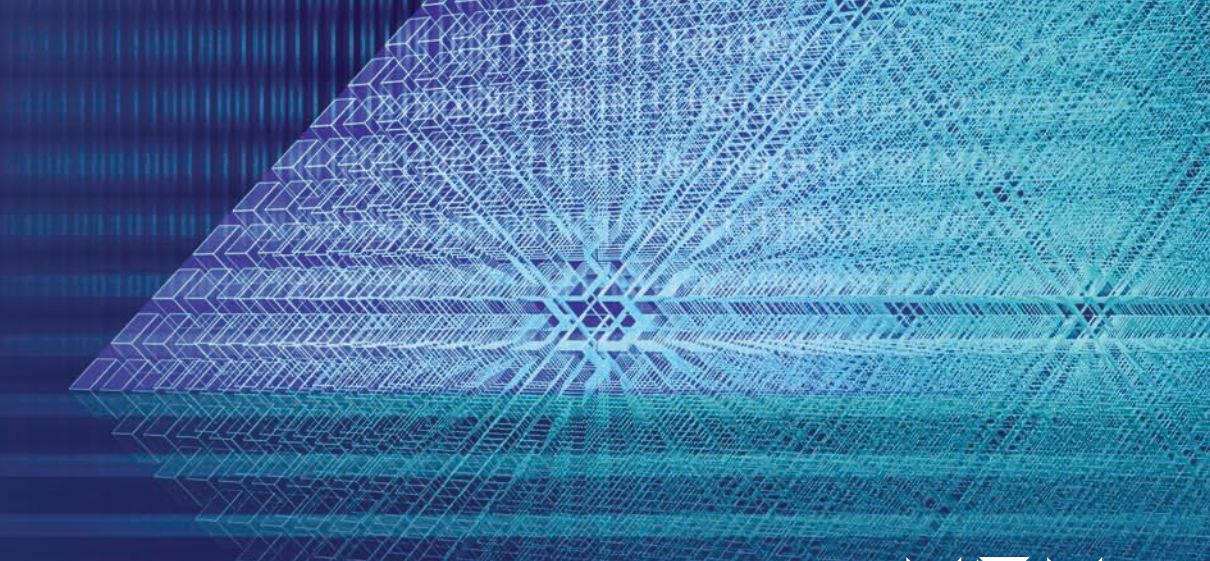

TECHNICAL REPORTS SERIES NO. 464

Managing the Socioeconomic Impact of the Decommissioning of Nuclear Facilities

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International Atomic Energy Agency

MANAGING
THE SOCIOECONOMIC IMPACT
OF THE DECOMMISSIONING
OF NUCLEAR FACILITIES

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TECHNICAL REPORTS SERIES No. 464

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INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2008

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FOREWORD

The aim of the IAEA programme on decommissioning is to provide Member States with comprehensive support in the planning and execution of the safe and effective decommissioning of their nuclear facilities. A considerable body of literature has been produced on the technological aspects of planning and implementation. In recent years, this has been supplemented with information on the organization and management of decommissioning. The present report is a further extension of this programme.

When nuclear facilities undergo large scale or total shutdown of their operations, there can be significant effects on staff made redundant and on the local community, especially for more remote locations where the site was a major source of local employment and revenue. Social and economic factors can have a significant influence on the success of late life operations and decommissioning. Facility owners or those implementing decommissioning programmes need to take account of these factors in their plans. The way in which these issues are managed will also be visible to and influence staff at other facilities owned by the same organization. In addition, the consequences for a community can be substantial, and appropriate government organizations also need to consider these effects.

This report focuses on the identification and management of the socioeconomic consequences of the final shutdown and decommissioning of a nuclear facility. The socioeconomic effects and potential consequences arising from decommissioning are identified, as well as the factors that affect the severity of the impact. The management of the potential consequences is discussed, together with illustrative international experience. This experience emphasizes the importance of planning, communications, consultation and investment. The value of good socioeconomic management can be seen in the performance of operating staff, in the vitality of the local community and in those at or near other operating facilities that have yet to declare a shutdown date. Although overall guidance is provided, it will be a matter for Member States to decide how best to manage the process in their own context.

The IAEA officers responsible for this publication were M. Laraia and P.J. McIntyre of the Division of Nuclear Fuel Cycle and Waste Technology.

EDITORIAL NOTE

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CONTENTS

SUMMARY

As nuclear facilities experience large scale or total shutdown of their operations, there can be significant effects on staff made redundant and on the local community, especially for more remote locations where the site was a major source of local employment and revenue. Social and economic factors can have a significant influence on the success of late life operations and decommissioning. Facility owners or decommissioning implementers need to take these factors into account in their plans. The way in which these issues are managed will also be visible to and influence staff at other facilities owned by the same organization. In addition, the consequences for a community can be substantial, and appropriate government organizations also need to consider these effects.

The eventual end of a plant's operating life is common to all industrial activities, and socioeconomic consequences are inevitable. Why do the socio-economic consequences of the decommissioning of nuclear facilities deserve special attention? Many nuclear sites are in relatively remote areas, as are many non-nuclear facilities located to take advantage of the presence of a natural resource. In fact, many non-nuclear facilities will have much faster staff rundown rates than nuclear sites, as they do not need the careful decommissioning that radioactive sites require. This is perhaps the key additional factor concerning nuclear facilities. It is important that the safety of late life operations and decommissioning is not threatened by loss of morale, uncontrolled staff changes or the other negative impacts of shutdown. Sensitive management of the impact of final shutdown on the workforce and the local community can ameliorate the threats to safety referred to above.

This report focuses on the identification and management of the socio-economic consequences of final shutdown and decommissioning of a nuclear facility. It is concerned with both on- and off-site implications. The social, economic or political aspects of radioactive waste management and disposal are not covered by this report, nor are such issues related to the uranium mining industry.

The approach in the report is to identify the socioeconomic effects and potential consequences arising from decommissioning, as they may affect the facility workforce as well as the local and wider communities. The magnitude of these consequences will be dependent on many factors and will vary from country to country and even from site to site. The factors that affect the severity of the impact are described in terms of variables such as facility type, location and the circumstances leading to final shutdown. The predicted effects at a particular facility provide a target for interventions to mitigate or prevent

negative consequences. Issues associated with such interventions are discussed, together with illustrative international experience.

A few key conclusions are drawn. These emphasize the importance of planning, communications, consultation and investment. The responsibilities for intervention need to be clear, and tend to lie with the facility operator and/or owner for the staff and with local and national governments for community actions, but team working will be essential. The value of good socioeconomic management can be seen in the performance of operating staff, in the vigour of the community and in those at or near other operating facilities for which a shutdown date has yet to be declared.

Implementation will be addressed differently in different countries. It will be for each Member State to decide how to approach implemention in their specific circumstances. In addition, the long term success of socioeconomic interventions is not guaranteed. An economy based on many smaller and diverse businesses may be more robust than one that is dependent on one or two large businesses.

The resources available to manage socioeconomic impacts will be limited whether these resources be financial, human or of other types. A key issue will probably be how to prioritize usage of available resources. Experience described in the literature often does not go into detail about the cost involved. Even where it does, translation of the scale of the investment from one economy to another is difficult. It is suggested that there is scope for further research in the area of prioritization and funding of socioeconomic interventions.

1. INTRODUCTION

1.1. BACKGROUND

By the 1980s organizations in a number of countries were planning, in increasing detail, for the decommissioning of those of their nuclear facilities that were approaching, or had reached, the end of their operating lives. The primary aims were to demonstrate the technical achievability of decommissioning and to provide data for better cost estimation to underpin the funding of decommissioning. Thus, the emphasis was on planning, formulating strategies and seeking technically viable and economic solutions to dismantling and management of waste.

There was limited explicit acknowledgement of the potential impacts of final shutdown of operations and decommissioning on the people whose livelihoods were in some way connected to the facility. Arguably, at that time, the socioeconomic impact was likely to be less pronounced either because the closed facility was one of several on a site or because there were new plants being built elsewhere to which staff could be redeployed.

As sites experienced large scale or total shutdown of their operations, the effects on redundant staff and on the local community became of greater concern, especially for more remote locations where the site was a major or the main source of local employment and revenue. Social and economic factors can have a significant influence on the success of late life operations and decommissioning. Facility owners or decommissioning implementers need to factor these into their plans. The way in which these issues are managed will also be visible to and influence staff at other facilities owned by the same organization. In addition, the consequences for a community can be substantial, and appropriate government organizations also need to consider these effects.

This report has been published by the IAEA in recognition of the growing awareness and experience of the socioeconomic issues arising from and related to nuclear decommissioning.

1.2. OBJECTIVE

The objective of this report is to assist Member States to manage final shutdown and decommissioning of nuclear facilities by:

(a) Raising awareness of the need to identify and address the social and economic consequences of nuclear decommissioning;
(b) Providing a record of relevant experience.

The audience is primarily anticipated to be facility owners, operators and decommissioning implementers, together with those responsible for community issues within local and national governments. These are the organizations that should have the motivation and the means to ensure that the wider impacts of facility shutdown are well managed. The report may also be of interest to other stakeholders in the decommissioning process.

1.3. SCOPE

This report focuses on the identification and management of the socio-economic consequences of final shutdown and decommissioning of a nuclear facility. It concerns itself with both on- and off-site implications. The social, economic or political aspects of radioactive waste management and disposal are not covered by this report, nor are such issues related to the uranium mining industry.

In this report, the term 'decommissioning' is often used as shorthand for the complete process of ending operations, dismantling plant, managing waste and remediating the site. When clarity is needed, the terms 'shutdown' or 'final shutdown' are also used where it is important to emphasize that many of the impacts on the workforce are felt most acutely before decommissioning itself commences.

1.4. STRUCTURE

The approach used in the report is to identify in Section 2 the socioeconomic effects and potential consequences arising from decommissioning, as they may affect the facility workforce, the local and the wider community. The magnitude of these consequences will be dependent on many factors and will vary from country to country and even from site to site. The factors that affect the severity of the impact are described in Section 3, including aspects such as facility type, location and the circumstances leading to final shutdown.

The discussions in Sections 2 and 3 allow a view to be taken on the predicted consequences at a particular facility. This then provides a basis for interventions to be made to mitigate or prevent negative consequences. The issues associated with such interventions are discussed in Section 4.

Illustrative international experience of the socioeconomic impacts of decommissioning and of the management of decommissioning is presented in Section 5. This section is supplemented by a further, more detailed, record of experience in the annexes.

Section 6 provides a few key conclusions.

2. SOCIOECONOMIC EFFECTS OF FINAL SHUTDOWN AND DECOMMISSIONING

This section identifies the socioeconomic effects that may arise following the announcement of the final shutdown of a facility. With the cessation of the primary function of the facility (e.g. electricity generation, nuclear research activities, fuel processing or defence activities), efforts turn to decommissioning and site remediation, which are likely to require significantly different skills and numbers of staff. In due course even these programmes will come to an end. What is then left on-site could range from a greenfield to safe enclosures, long term fuel or waste storage facilities, or previously used low level waste disposal areas. Some of these will require limited ongoing control and supervision. In due course even this legacy would itself be decommissioned, but until then it offers little more than would a greenfield site in terms of employment opportunities.

The eventual termination of a plant's operating life is common to all industrial activities, and socioeconomic consequences are inevitable. Why should the socioeconomic consequences of the decommissioning of nuclear facilities deserve special attention? Many nuclear sites are in relatively remote areas, but many non-nuclear facilities have been located in such areas to take advantage of the presence there of a natural resource. In fact, many non-nuclear facilities will have much faster staff rundown rates than nuclear sites as they do not need the careful decommissioning that radioactive sites require. This is the key additional factor concerning nuclear facilities. It is important that the safety of late life operations and decommissioning is not threatened by loss of morale, uncontrolled staff changes or the other negative impacts of shutdown. Sensitive management of the impact of final shutdown on the workforce and the local community can help to ameliorate the threats to safety referred to above.

In some situations there may be a change of ownership at the start of decommissioning. Some countries have established organizations to specialize

in the conduct of decommissioning (e.g. Empresa Nacional de Residuos Radiactivos (ENRESA) in Spain). Alternatively, a site may be operated for an owner under a contract, and the managing contractor may change following a competitive tender. Finally, in the normal course of business, ownership of assets changes from time to time, and this may also affect a nuclear facility. The issue here is that such a change of owner carries the risk of a discontinuity in commitment or support to the workforce or community around a nuclear facility facing decommissioning.

There may be substantial periods of time between the announcement of facility shutdown, the cessation of operation, the actual start of decommissioning and the final closure of a facility. Delays of up to ten years or more have been observed before any significant decommissioning activity started after shutdown. In such cases, it is likely to be difficult to retain essential staff if they have marketable skills. A long period of dislocation may be demotivating if appropriate support is not provided following announcements of impending shutdown. Morale will also be difficult to maintain if there is a sense of drift while waiting for decommissioning to take place. This may even affect management if the delays are caused by matters felt to be outside their control, for example, political, funding or licensing matters.

Not all impacts of shutdown are necessarily negative. In some cases, such as those for decommissioning contractors, other specialist suppliers or licensing personnel, the short term impact of decommissioning may be to provide an increase in workload and jobs, as well as skill development that can be utilized elsewhere. How much of the new work can be performed by existing staff is a key question.

The following sections give details of socioeconomic effects on three different groups: the workforce, the local community and the wider community. Not all will apply at a given facility or on every occasion, but their potential occurrence should be recognized in the plans of the owners, operators, decommissioning implementers and agencies responsible for community affairs.

2.1. IMPACTS ON THE WORKFORCE

The term ‘workforce’ primarily means those people who work at the facility at whatever level in the organizational hierarchy, the ‘staff’. Comments relating to the staff could also be applied to some other groups of people, the defining characteristic being that their income is completely derived from employment directly dependent on the operation of the facility. This would extend the workforce to include the staff of local contractors with long-standing

service contracts at a facility, for example, maintenance services, site transport services and franchised catering companies.

Decommissioning could also have effects on remotely based central organization personnel or employees of major suppliers to the facility. It could also affect the staff of organizations that may be largely dedicated to the facility, such as regulators. Although in these latter cases the effects on local communities are likely to be limited due to the relatively small number of people involved, the change for any individual person will remain a challenging one to deal with. In the discussion below the emphasis is on facility staff, but much will be implicitly relevant to these other groups.

Shutdown and decommissioning will inevitably lead to reduced numbers of personnel employed, and changes to the skill profile required. Decommissioning brings the prospect that workers with highly specialized work skills are no longer required. There will be a significant human resource planning task in reducing staff numbers, retraining for decommissioning and avoiding a loss of critical corporate memory. Staff directly employed in the operation of a nuclear facility are usually full time, long term employees whose career length expectations may exceed the remaining projected lifetime of the facility.

If shutdown announcements and human resource planning are not done well, then tensions may be generated potentially leading to labour relations or other staffing problems [1]. These have the potential to cause serious and costly consequences for the remaining operational lifetime of the nuclear facility. These possible consequences include a negative impact on safety culture, reduced operational performance or uncontrolled and unanticipated loss of critical numbers of key workers leaving for career opportunities elsewhere while they are still needed to support preparations for decommissioning.

Plant workers can be expected to suffer from significant increases in personal and family stress following a shutdown announcement. The resultant impact will continue until the causes are addressed to the satisfaction of the individuals involved – a subjective consideration. If those who are responsible for restructuring are not affected themselves, they may not foresee the impact of events on others.

Often the cause of stress is uncertainty about the future, and one potential coping mechanism is to take control of the situation by creating and taking an early opportunity to leave for other employment. From the perspective of the plant owner, there is a concern that those most able to move on may also be among the most valuable for the remaining period of operation and possibly for at least part of the decommissioning.

There are potentially conflicting drivers on the remaining duration of jobs at the facility. On the one hand, once productive activity is at an end, staff costs represent a significant outgoing that needs to be reduced as soon as possible.

On the other hand, it will be necessary to recruit key skills specific to decommissioning, and it would also be wise to retain selected experienced staff. Delays in starting decommissioning activities may damage morale due to the continued sense of uncertainty, even though the job lifetime may be effectively extended.

It is clear from the above discussion that there are many issues that may affect the workforce as a result of shutdown or impending shutdown, and many of these are listed below. They are grouped into three headings:

(1) Psychological issues;
(2) Personal and family income issues;
(3) Perceived management performance issues.

Issues are assumed to be negative in impact, but those that could be seen as positive are marked with an asterisk.

In detail, the issues that potentially affect the workforce of a decommissioning facility are as follows:

(1) Psychological issues:
- Shock if the shutdown of the facility is sudden and imposed from outside, for example, a political decision;
- Frustration, especially if there is no perceived technical reason for shutdown;
- Distraction from normal activities, with a potentially negative impact on morale, performance and safety;
- Delay of readjustment due to hope that the shutdown decision may be reversed;
- Feeling of having no influence on decisions made elsewhere yet having a major personal impact;
- Loss of the identity provided by work;
- Feeling unappreciated for dedication to the facility;
- Feeling that one's particular or special skills are not valued;
- Feeling devalued and lacking confidence to face the prospect of radical change and to find other employment;
- Confusion if decommissioning plans are not clearly understood;
- Fear of having to retrain for unfamiliar fields, possibly viewed as of lower status;
- Concern over the prospect of retiring at an earlier age than expected;
- Excitement over new opportunities and experiences*;
- Increased self-reliance*.

(2) Personal and family income issues:
- Concern about the effect of reduced income on family life;
- The prospect of having to live away from home or move to another location;
- Uncertain job and career prospects;
- Uncertainty about availability and adequacy of pension, social security and other benefits;
- Uncertainty about duration of job even if retrained for decommissioning;
- Absence of prospects for family members of employees;
- Prospect of multiple breadwinners in a family becoming redundant simultaneously;
- Opportunity to fulfil an ambition to build a new business using redundancy funds*.

(3) Management performance issues:
- Fall in confidence in management if decisions are not well communicated or if there are no clear plans;
- Risk of resignation of workers essential to supporting late operations and decommissioning;
- Visibly promoting the re-employment or training of staff for new facilities*;
- Reduction in safety culture, with an increased number of accidents or other unwanted events;
- Risk of increased staff absenteeism;
- Unrest if it is perceived that preferential treatment is given to some staff;
- Staff resentment of the use of outside contractors for some decommissioning tasks;
- Failure to manage public opinion, resulting in criticism as the facility receives more public exposure;
- Demonstration of common cause with staff as they and management face up to the same personal issues*;
- Increased credibility through making difficult decisions related to staff in a fair and transparent manner*.

The actions to mitigate the effects listed above are described in Section 4. The partitioning into three groups provides some insight into the nature of the mitigation required. Psychological impacts are internal to the person concerned, and mitigating measures will have to recognize the subjective nature of the issue. Personal and family income issues are more measurably felt within the family unit, and mitigating measures will inevitably have to include a financial component. Issues related to actual or perceived management performance represent a collective staff response to the management of the

facility. The challenge is to the facility management to anticipate and deal with these issues.

2.2. IMPACT ON THE LOCAL COMMUNITY

There is a significant variation in the nature of the local communities that supply the workforce to nuclear facilities. There are sites in, or close to, urban areas, and their facilities provide only a small contribution to the economic activity of their area. However, many nuclear industry sites are located in relatively remote areas for reasons of safety, security or the availability of resources.

Their local communities may be almost entirely dependent on the nuclear site for employment, as well as many services having been expanded or even established before or during construction of a facility. As nuclear facilities were constructed, the local community infrastructure (schools, hospitals, shops, businesses, etc.) developed along with the growing workforce. Shutdown of these nuclear facilities can have a significant effect on the local economy, having an impact on all who live there, not only those directly employed at the plant.

Thus, the impact of decommissioning on the local community will be significantly different depending on the economic context. There are a number of potential socioeconomic effects on local communities. They are grouped into four categories:

(1) Economic activity;
(2) Demographic changes;
(3) Services;
(4) Policy and funding requirements.

In detail, the issues that potentially affect the local community around a decommissioning facility are as follows (with an asterisk indicating a positive effect):

(1) Economic activity:
- If new jobs are created, but at remuneration levels lower than those in the nuclear industry, then the local economy will fall into decline.
- The availability of a skilled workforce may attract new investors*.
- There may be an increase in the number of retired persons on low incomes.

— An increase in economic activity might arise due to enhanced spending during the decommissioning project*.
— The influx of contractors may give a boost to local hotels and businesses*.
— Any previous subsidies, for example, in the price of electricity or district heat supplies, may be lost, resulting in higher costs for residents.
— A fall in spending may occur as residents react to the uncertainty caused by shutdown.
— Emigration of families from the area could yield a surplus of housing and a possible fall in property values.
— If the site is to be used for a replacement nuclear enterprise, then economic growth may be restored*, although there may be a significant time lag.
— A perception that the site is 'damaged' may have an impact on adjacent land values.
— If the site is restored and is marketable, then demand and prices for it and adjacent land may increase*.
— The removal of a nuclear facility may remove limitations on local development and population growth*.

(2) Demographic changes:
— Employment of breadwinners away from home;
— Lack of local employment prospects for young persons leading to departure of young persons to seek work elsewhere;
— Migration of whole families from the area;
— An increase in average age within the community;
— Possible difficulty in attracting new residents to the area if there are negative public perceptions about the site.

(3) Services:
— There may be a loss of essential services previously provided by the facility, for example, district heating.
— Financial support to other local amenities may be withdrawn by the facility.
— Reduced use of local transport infrastructure and social amenities may make them less viable.
— Once shutdown has been announced, some investors may be reluctant to invest in new or improved local services.
— Decommissioning activities may cause local disturbance or damage through increased road traffic, noise, etc.
— Opportunities may arise for local service providers to support the decommissioning project at the facility*.

(4) Policy and funding requirements:
- There may be uncertainty about which organization or agency will be responsible for funding the costs of measures to mitigate the effects of shutdown.
- There may be difficulty in providing the proposed support funds.
- An increase in the number of redundant or retired persons may require a change in the services provided locally, and funding would be needed for this purpose.
- If incomes fall, then local tax revenues are also likely to fall.
- The local taxes paid by the facility are likely to fall or cease altogether.

The effects of the shutdown of the facility on the local economy listed under (1) also tend to drive the various consequences listed in (2) and (3). However, it is noticeable that there are a number of potential positive effects under economic activity in particular, and capitalizing on these will be one of the most powerful means of mitigating the overall consequences.

2.3. IMPACT ON THE WIDER COMMUNITY

The loss of work and economic activity due to the shutdown of one or more nuclear facilities in a region or country will have effects on the regional or national economy proportional to the share of the relevant gross domestic product (GDP) that it represented. It is possible that the loss of employment opportunities in one region of a large country will be associated with a gain elsewhere. For example, the opening of a new power plant that causes an old nuclear power plant (NPP) to close elsewhere.

In addition, the question of funding decommissioning and waste management may be controversial when compared with other national priorities or if inadequate financial provisions have been made. There could be problems concerning ownership of liabilities associated with decommissioning shutdown facilities and site restoration, especially if there are long delays after shutdown before decommissioning commences.

There may be a need to develop new engineering and other technical competences to meet the requirements of decommissioning. Although decommissioning is cash negative, with the investment being made to restore the environment rather than to generate new incomes, the expertise developed could be marketable elsewhere. While this, at face value, can be viewed as positive, nuclear decommissioning must be carried out at the site, as the site cannot be brought to the contractor. As a result, new business obtained would inevitably result in the deployment of staff in other geographical areas, with

only the family members of the breadwinning employees remaining in the local community on a full time basis.

The only obvious exception to this is the small amount of business associated with nuclear submarine reactors which could, in theory, be moved to an area of nuclear decommissioning expertise.

The implications of decommissioning may also spread to the area of international relations. Aid may be needed to assist in funding decommissioning and waste management. The IAEA and the European Union (EU) have provided significant direct assistance to countries. In particular, there has been significant EU negotiation and support to accession countries concerning shutdown of nuclear facilities that are regarded as insufficiently safe or not in compliance with international standards.

The socioeconomic effects on the regional, national or international scale that are likely to be encountered are applicable in principle to most decommissioning situations. They are grouped into four categories (with an asterisk indicating a positive effect):

(1) The national economy;
(2) Financing of decommissioning;
(3) Infrastructure;
(4) Public relations.

In detail, the issues that could potentially affect the wider community are as follows:

(1) The national economy:
   — The loss of income from the sale of electricity or other products to neighbouring countries that occurs;
   — Possible requirement for imports of replacement products or services;
   — Impact on the viability of other indigenous industries due to the loss of locally produced outputs;
   — A demand on the economy for applicable resources to implement the selected decommissioning strategy*;
   — Possible benefits to society and the economy from the release of skilled workers from the shutdown facility, especially if the economy is growing*;
   — New skills developed for decommissioning may be marketable elsewhere*.
(2) Financing of decommissioning:
   — Adequate funds may not have been provided for decommissioning and site remediation.
   — Additional funds may be required to mitigate the socioeconomic impact of facility shutdown.

— The responsibility for funding may not be clear, or the relevant organization may not have sufficient powers to deal with any shortfall in funds.
— There may be competing priorities for funds.
— International financial and technical assistance may be available, but there may be a risk of some loss of control over policy.

(3) Infrastructure:
— Possible requirement for reconfiguration of essential national systems (e.g. the electricity grid or district heating if a major NPP has shut down) in the event of an unexpected shutdown;
— Loss of key capabilities at nuclear research or medical institutions;
— Loss of technical education supplied by the facility;
— Possible difficulty of funding research in the nuclear field without replacement facilities;
— Provision of facilities for the management of spent fuel, radioactive waste and other hazards that arise in decommissioning*;
— Provision of disposal facilities or routes to such facilities in other countries;
— Provision of effective arrangements to ensure uninterrupted safe management of the site if deferral of decommissioning is part of the strategy*.

(4) Public relations:
— Stakeholder interest may increase in comparison with the years the facility was in operation, particularly with respect to waste management.
— Speculation needs to be minimized by ensuring that accurate information is disseminated to satisfy public and stakeholder demands.
— Public debate may arise from proposed decommissioning, fuel storage and waste disposal strategies.
— The onset of decommissioning and waste management activities may raise wider issues of sustainability.
— Existing nuclear sites may be valuable for reuse for similar purposes*, but this may be controversial.
— There is a risk of envy of socioeconomic support measures from people in other areas of the country.
— Cross-border issues will need to be managed.

The topics listed above are similar in coverage to those presented in Section 2.2 for the local community, but the emphases are somewhat different. This reflects the smaller impact that will be felt by the community at large and the broader interests of national bodies. Issues beyond decommissioning may come to prominence, and there is a wider set of stakeholders to manage. There

are fewer potential positive factors than for the local community, but this reflects in part the smaller role played by the facility in the wider community.

The impact of the potential effects of final shutdown and decommissioning listed in Sections 2.1–2.3 will vary from facility to facility. The following section examines the factors that are likely to influence the scale of this impact. The size of the facility is likely to be important, but so too will be its location and socioeconomic context. Every case has to be treated on its own merits so that interventions to mitigate the effects of decommissioning are appropriate to the facility in question.

3. FACTORS THAT AFFECT THE SCALE OF SOCIOECONOMIC IMPACT

Section 2 described the potential socioeconomic effects of final plant shutdown and decommissioning. The scale of their impact will be dependent on a number of factors and will vary in detail from site to site and situation to situation. Nevertheless, there are features common to groups of facilities or situations that allow a degree of predictability in anticipating the relative scale of their impact; these factors are discussed below. They will often not be independent and the actual picture for specific sites will need to be determined on a case by case basis.

3.1. SIZE OF THE WORKFORCE

A small workforce (say of less than 50 people at a facility) will earn a relatively low total income and as such the loss of that income may not even have a measurable effect on the economic situation in the local community and certainly not in the wider community. However, the impact of the loss of that income, as well as job pride and status, will be potentially as great for the individuals concerned, and their families, as for an individual in a much larger workforce. As such, the impacts described in Section 2.1 are still to be expected. Their severity will be affected by the other factors mentioned below.

For a large workforce, the effects already described in Sections 2.1–2.3 could all potentially arise.

3.2. LOCATION

Coupled with the absolute value of the income generated will be the importance of that income relative to the overall income of an area. Many nuclear sites were situated in remote areas for reasons of safety or security. The more remote the site, the greater the proportion of economic activity in an area likely to be driven by incomes and expenditure from the site, and the greater the local community (and possibly the wider community) impacts of the final shutdown.

By contrast, in areas with a vibrant and varied local economy, the loss of nuclear facilities may have a very limited effect outside the site.

3.3. DECOMMISSIONING STRATEGY

The strategy to be adopted in the decommissioning of a nuclear facility could, in principle, be determined before the plant is constructed. This is not the case for most existing facilities, but a decision on strategy should be made before the decision is taken to shut the plant down for the last time in order to facilitate engineering and socioeconomic planning.

The issues determining whether to continue operation or to shut down are discussed in Ref. [1]. As part of the analysis, the socioeconomic impact may be considered along with other stakeholder related issues, but it is unlikely to be the determining factor for the date of shutdown. Whenever final shutdown should occur, the strategy that is selected for decommissioning can have a significant effect on the socioeconomic impact.

There are three basic decommissioning options to be considered: immediate dismantling, deferred dismantling and entombment [2]. The actual strategy at a particular facility may be a combination of these. For example, there may be a period of dismantling and waste recovery immediately following final shutdown, then a deferral period with little work before a final dismantling and waste removal phase. A period of inactivity may occur due to lack of funding and other resources, or to meet planning and authorization requirements.

The choice of decommissioning strategy will be dependent on many factors, and is likely to be a considered compromise between them. Deferral of part or most of the decommissioning work is likely to be driven by the unavailability of funds or of waste disposal facilities, or from seeking to take advantage of the benefits of radioactive decay. A disadvantage of deferral is the potential loss of knowledge of the facility's history as staff leave. Immediate dismantling will require the most human resources. A socioeconomic advantage of

immediate dismantling is that the high workload soon after the end of operation will mean retaining some staff for longer, especially if much of the work is done in-house, and provide an injection of investment into the local community.

Entombment and deferred dismantling (including creating a safe enclosure) have similarities and can be considered together in terms of the immediate socioeconomic impact. The amount of preparatory work to reduce the complexity of the site and establish a safe condition is similar for both options. This work can be quite extensive and can take up to five years or more, employing many of the remaining staff after shutdown. It may also require specialist contractors, but the presence of additional workers will also tend to stimulate the local economy. The establishment of arrangements for records retention over the deferral period could require employment of some administrative staff in compilation and management. Care and maintenance of a facility during the safe enclosure period will require some resources, but very few compared with those needed for operation and decommissioning activities.

Finally, there could also be additional employment associated with interim spent fuel and waste conditioning and storage facilities, in particular with the construction and operation of such facilities. These activities could be quite considerable, particularly if the site were to become an interim or final storage centre for radioactive waste from other sites.

3.4. TYPE OF SITE

To assist in the discussion, it is helpful to identify three basic groups of sites:

(1) Sites with a research reactor or other small facility;
(2) NPPs;
(3) Multifacility sites.

The last group often has its roots in defence activities and/or in management of the nuclear fuel cycle and may also contain facilities in groups (1) and (2).

Table 1 summarizes some of the general characteristics of these sites that are relevant to the prediction of the scale of socioeconomic impacts.

Each of these types of site is now discussed.

TABLE 1. CHARACTERISTICS OF NUCLEAR SITES RELEVANT TO SOCIOECONOMIC IMPACT

Characteristics typical of site	Research reactor, laboratory, etc.	NPPs	Multifacility
Facilities present at a typical site	Rarely more than a few small facilities, only one in some cases; many are now shut down	One to eight reactors; most still operate	Many facilities of various types, some operating, some shut down
Size of workforce in nuclear facilities on the site	Small (usually less than 50 staff)	300–3000	Up to around 10 000 on-site
Scale of shutdown	May be whole site	Likely to be a large part of the site if not all of it	Shutdown of individual facilities likely to be spread over a long period
Location	Many close to urban centres	Often remote	Usually remote
National economic development	Facility may have strategic role if unique in the country	Loss of electricity generation may have severe effect in small countries	Tend to be present only in developed nations
Scope for reuse	Small footprint, so reuse readily achievable, but on a small scale	May be attractive due to existing infrastructure such as electricity grid, cooling water and other services	Examples of use for business or science parks, but dependent on accessibility

3.4.1. Research reactors and other small sites

Research reactors are often associated with universities or research institutions, and other small nuclear facilities may have medical purposes. As a result, many will be sited in or near urban areas with some located at more remote locations but with reasonable access from the institution. Of about 830 research reactors constructed worldwide [3], about 520 are shut down and in various stages of decommissioning. The most significant social and economic impacts have probably already passed in cases where a research reactor has been shut down for many years, and adjustments in the staff and community have been made.

The impact of the shutdown of a research reactor or other small facility would not be expected to be as severe as that of a large facility, but there will be a local impact. There may be significant economic and other effects on the institution owning the facility due to the loss of a teaching aid, isotope production service or medical treatment capability, as well as the less tangible loss of prestige. At least for a time, decommissioning will generate new work and help to maintain the vigour of the facility and those associated with it. Limitations in the availability of funding or other resources may lead to delays, particularly as the costs of decommissioning may be large compared with the annual budget of a small facility.

A potentially difficult situation can arise in some countries when foreign support for nuclear research is lost. The remaining workforce is likely to be experienced in scientific fields but with limited engineering skills. There is also sometimes a problem with an ageing workforce and with experienced staff retired or soon to do so. Salaries for retained staff are usually maintained by the State, but these can be low and morale suffers in such an environment.

In countries where the research reactors or other small facilities are only a small part of a larger nuclear industry, the socioeconomic impact is likely to be limited given the opportunities to redeploy people elsewhere.

3.4.1.1. Electricity generating sites with single or multiple NPPs

Many NPPs were relatively remotely sited for reasons of safety, especially in terms of emergency evacuation. This may also have limited development near the plant. As NPPs also require connections to the electricity grid and access to services such as adequate cooling water supplies, there are usually advantages in having more than one reactor at a site. Where permanent shutdown of these reactors is spread over a period of years, the size of the socioeconomic impact at any particular time will be reduced.

The number of staff will be dependent on local policies but will be in the hundreds per unit. As a result, there will be a significant total loss of income to a community from job losses, the more so as NPP sites tend to be in the smaller communities typical of more remote locations.

In a small country, the shutdown of a large NPP may mean a major reduction in the national electricity supply capacity, leading to one or more of higher prices, lower exports or higher imports with consequent implications for the national economy. Such situations may increase the pressure to replace lost generation from a site by either nuclear or non-nuclear means. The existing infrastructure and workforce make this particularly attractive, and any such investment is likely to reduce the socioeconomic impact of shutdown.

The great majority of the world's NPPs remain in operation. Thus, there is considerable scope to ensure that the lessons learned from shutdown experiences on early plants are put into practice on later ones. In some countries, the number of shut down reactors is becoming significant. This is particularly the case with the United Kingdom (UK), where the fleet of 26 Magnox reactors on 11 sites will all be shut down by 2010. The implication of such a large programme of decommissioning, with the associated socioeconomic impacts, is partly behind the establishment of the Nuclear Decommissioning Authority (NDA) described further in Section 5.9. In addition to being responsible for the management of the decommissioning programme, the NDA has been charged by the UK Government with taking due account of the socioeconomic impact of its work.

3.4.2. Large research, fuel cycle and defence sites

There are large multifacility nuclear sites in a limited number of countries of varying economic strength. The land areas are often extensive, sometimes with levels of contamination that make the economics of reuse of reclaimed land challenging, if in fact practical at all. The legacy of unconditioned waste can be great, with significant public relations issues to deal with.

Some sites having multiple facilities (e.g. large United States Department of Energy (USDOE) establishments in the United States of America (USA), or nuclear fuel cycle facilities in the Russian Federation, the UK and France) may take decades for site restoration to be completed. At first sight, these prolonged periods provide an opportunity to manage the socioeconomic effects more successfully. However, there are also challenges in managing a site with both ongoing operations and shutdown or decommissioning facilities. Staff can see the operating plant as more attractive in terms of both job longevity and prestige, making the creation of a dynamic decommissioning project team with high morale more difficult. Operations may capture the attention of senior staff, while the management of decommissioning and its impacts may receive less attention than it requires. Separation of the management of operations and decommissioning can help to address this problem, but the site as a whole still requires integrated management.

As facilities shut down, the goals for a site are increasingly to decontaminate and dismantle redundant facilities and to condition waste for interim storage, subject to the availability of funds. The decommissioning strategy at the site may vary from facility to facility, in order to optimize the overall programme of work. These activities generate an extensive and long lasting work programme, which can occupy many employees and contractors. The cost of site decommissioning and waste management may run into billions of US dollars.

Similarly, new facilities may continue to be built on the site if it has a continuing role. Any such decommissioning or construction projects will limit the scale of the socioeconomic impact. At large sites dedicated primarily to research, there will be a gradual reduction in the number of jobs on the site as there is no real 'product' whose production is suddenly lost when operation ceases.

As many of these multifacility sites were based on sensitive defence related initiatives, they are particularly remote. Their remoteness coupled with their size means that they can have a dominating effect on the economy of the local area, with a high proportion of direct and indirect employment dependent on the site. As such, even a modest change in employment or investment levels at the site can be felt across the local community.

If the site is not in a remote area, the size can become an asset in the sense that it allows the release of parts of the site for alternative uses such as business or science parks. This provides a healthy diversification of the local economy, making it more sustainable and robust against changes in employment at the nuclear site itself.

This latter factor is the starting point for a discussion about the mitigation of the effects of shutdown of facilities that is taken forward further in Section 4, which considers the potential interventions that can be made to manage the socioeconomic impact of final facility shutdown.

4. MANAGING THE SOCIOECONOMIC IMPACT

The socioeconomic impact of shutdown and decommissioning is mainly negative for the workforce of the site and the local communities, involving as it does disruption, uncertainty and potential loss of income or services. As discussed in Section 3, the scale of the impact will depend on various factors including the nature of the facility, the proportion of the activities ceasing, the prevailing local circumstances and the swiftness of the changes. The worst situation is likely to be an unannounced or sudden shutdown of a large facility in a remote area that has a substantial economic dependency on the facility. As discussed in earlier sections, the effects on staff may include a reduction in plant safety and operational performance, and there may be unwanted effects on the community beyond. However, in any situation, the severity of the effects will be dependent on the actions taken to mitigate them. Active socioeconomic support may not be provided either because there is insufficient recognition of the issue or because priorities lie elsewhere.

Experience indicates that relatively positive outcomes are possible (see, e.g. Refs [4, 5]). However, there is likely to be tension between the desire to complete a decommissioning project in minimum time at minimum cost and the pressure for extension of employment and financial support to minimize the effects of final shutdown. There will be some situations where both aims can be in concert. For instance, attempting to reduce waste disposal by maximizing reuse of materials may lead to increased decontamination work on-site, but possibly lower costs overall.

The uniqueness of nuclear sites should not be overemphasized. Experience in managing similar changes in other industries could be potentially valuable for planning in the nuclear industry, for an example related to the UK coal and steel industries, see Ref [6]. Indeed, the lessons learned in a particular country may be more easily transferable to a nuclear site in that country than is nuclear specific experience from elsewhere.

The remainder of this section describes the interventions that can be made in order to either mitigate the negative socioeconomic impacts of decommissioning or promote the exploitation of positive impacts. These interventions are built around a planning process that is informed by appropriate consultation with those potentially affected. These plans will require an investment of time, finance and other resources. A realistic and constructive dialogue between plant owners and government agencies, and between these organizations and those affected, will be beneficial and will require an appropriate approach to communication.

4.1. PRINCIPLES OF INTERVENTION

Intended interventions need to reflect the nature of the socioeconomic effect being managed. For the workforce, those involved in support of the psychological impact need to recognize its subjective nature, whereas the implications of loss of income will be more effectively addressed by appropriate cushioning of the financial impact. Confidence in management will be dependent on the perception the workforce has of the response of the organization.

In contrast, the socioeconomic effects on the wider community have less direct immediate impact on the individual. Consequently, planning and investment will tend to concentrate on economic measures. When these fail to resolve issues, the social impacts will be felt and will need to be managed. The success of these plans will be dependent on an effective approach to communications.

TABLE 2. SUMMARY OF SOCIOECONOMIC IMPACTS VERSUS APPROPRIATE INTERVENTIONS

Group	Nature of impact	Intervention
Workforce	Psychological	Consultation, planning, communications and human resources support
	Personal and family income	Financial support within a human resources plan
	Management performance	Effective management via consultation, planning and communications
Local community	Economic activity	Consultation, planning, communications and financial investment in support of intervention
	Demographic changes	
	Services	
	Policy and funding requirements	
Wider community	National economy	Planning and investment
	Financing of decommissioning	
	Infrastructure	
	Public relations	Communications

The effects of facility shutdown were presented in Sections 2.1–2.3. The groupings of effects described there are presented in Table 2, along with associated intervention themes.

The process of decommissioning begins with a decision to shut down a facility at a particular time. There will be a need to communicate this decision and its implications to those affected or interested. Plans will need to be drawn up to manage the resulting effects, and those affected may be consulted on these plans, or even as part of the process of drawing them up. The longer the time that is available to manage the socioeconomic effects of decommissioning, the more likely that success can be achieved at reasonable cost. Where decommissioning began some time ago and decommissioning plans were prepared with little consideration of the socioeconomic aspects, then it may no longer be possible to achieve an optimum outcome, but some benefit may still be possible. The implementation of the plans will require investment and prioritization.

Responsibilities for planning and investment will need to be clear. The allocation of responsibilities may be different in different Member States, but

there will be common elements. Issues that have an impact on the workforce will be the responsibility of the plant management. They will also take the lead in the overall process as the initiators of the changes brought about by the decision to decommission. Management of the impact on the community will increasingly become the responsibility of the community representatives. It will be essential that good communications and cooperation exist between site management and community representatives.

Whereas implementation of the decommissioning project plans should result in the expected project outcome, the economic success or long term viability of a community cannot be guaranteed by even the best planned intervention process.

In order to facilitate further discussion, these issues are addressed in the following sections:

(a) Planning (Section 4.2);
(b) Communications and consultation (Sections 4.3.1 and 4.3.2);
(c) Investment (Section 4.3.3).

Given the interdependent and iterative nature of any intervention, this order implies neither importance nor the order in which interventions should be carried out.

4.2. SOCIOECONOMIC PLANNING

Early planning for shutdown and decommissioning is stressed as being essential in numerous publications by the IAEA and other bodies, as well as in papers given at international conferences. However, specific planning for socioeconomic impacts has not always been emphasized. In recent years, this has received more attention, especially the need for public and stakeholder consultation and involvement in planning and implementing decommissioning, and waste management and disposal activities, for example, in the OECD Nuclear Energy Agency and EU work [7–11]. Where decommissioning plans have not included explicit reference to socioeconomic aspects, the associated environmental impact assessments (EIAs) have often addressed some of these factors. Lack of planning and preparation for shutdown may exacerbate the socioeconomic impact and increase the risks of demotivating delays, loss of valuable staff and higher costs.

A simple approach to management of any change, including facility shutdown, consists of four basic steps:

(1) Identify the current situation;
(2) Define a vision of the preferred future position;
(3) Establish the enablers and barriers to achieving this vision;
(4) Determine the actions that will deliver this vision, recognizing the barriers and enablers.

A significant amount of work will be necessary to understand the potential consequences of shutdown on the workforce. An assessment of the dependence of the community on the facility will provide a baseline for future efforts. Without this provision of a baseline, inappropriate actions may be proposed, and the results may be insufficient or could even exacerbate problems.

The undertaking of preparatory planning measures can of themselves have a destabilizing effect on the workforce and perhaps even beyond, as it may lead to assumptions that a shutdown is imminent but simply has not yet been announced. Trust, built up through a history of good communications, will facilitate such a process.

A realistic vision for the site and the community will take time to develop. An analysis will be necessary to identify what can promote its achievement (enablers) and what may frustrate its achievement (barriers). Barriers could include statutory or regulatory requirements, local infrastructure limitations or the affordability of investment measures.

Enablers may include trade union support in responding to staff concerns or influence with government; assistance from organizations charged with regional development; or the availability of useful experience from earlier decommissioning projects. Actions should be identified to capitalize on the enablers and to show how the barriers will be overcome. Should they be insuperable, then the vision is not realistic and needs to be revisited.

If immediate dismantling is the selected decommissioning strategy, then detailed planning should start before shutdown, and this planning should include any public consultation and detailed attention to socioeconomic implications. Training programmes should be instituted early to equip otherwise experienced staff in new decommissioning skills. Although specialist contractors may be needed for particular activities, requirements can be placed on contractor organizations to use local labour where practical. Nevertheless, a large amount of dismantling work involving preparatory work and general site clearance could be performed by existing staff, following any necessary retraining. Such extended use of existing in-house resources would help to smooth the impact of shutdown across time. A balance must, however, be struck between the number of existing staff trained for decommissioning and the number brought in for the task. This recognizes the fact that the behaviours

and skills appropriate to the steady state operation of a facility are significantly different to those required to decommission the facility efficiently. This is as true for facility management where the cultural change from operations or research management to project management may be great.

As decommissioning progresses, activities normally undertaken by the staff will progressively cease to be required and the staff will no longer be able to be employed in their current roles. It is inevitable that eventually all of these roles will be lost, with the risk of loss of their knowledge and experience of the plant. This aspect needs to be considered in the human resources planning for the project.

The facility's human resources department, in conjunction with the decommissioning project managers, will need to consider the overall package of measures to support the workforce, the project and potential investors. This is likely to include the following measures:

(a) The preparation of a human resources management strategy;
(b) A human resources plan to identify the skills required at each phase of the project to ensure the process can be smoothed to a realistic profile;
(c) A plan to retain key staff when critical numbers leaving could disrupt plans for safe operation or preparation for decommissioning;
(d) The identification of new skills required at key transition stages;
(e) Career guidance and outplacement services for staff who become redundant;
(f) Compensation payments as a cushion for those staff.

A well thought out decommissioning plan will allocate a skills requirement to each project work area, as well as a financial requirement. Just as a profile of funds required over time can be produced, so too can the skills required and, therefore, when they can be released from the facility. Skills released will then be available to the community as local assets that can be used to attract new businesses. Before companies can conclude whether to invest in an area, they need to have good information on what skills will become available from the facility and at what time. These skills and their utilization will be major inputs to the plans to support the community.

The actions taken to aid the community need to be documented. This report will cover a broad range of issues, and will identify the baseline and vision for the community. It will provide a plan representing a realistic approach to achieving that vision. Importantly, it will identify the funding that would be required to be successful, and the potential sources for it. In the remainder of this report, the title 'Socioeconomic Development Plan' (SEDP) will be used to describe the report this paragraph refers to. This title is that in

use in the UK (see Annexes VII and VIII), but it represents only one possible model for such a report.

The preparation of an SEDP will require a multidisciplinary team including representatives from the site, the community (such as the local development agencies and politicians) and specialists from areas such as sociology, economics and business. As far as is possible, it should be the product of a process that includes consultation (Section 4.3), as there are advantages if the affected community is involved. These include specific input from those affected and the opportunity to manage their expectations. The SEDP would recognize the existing resources available to the community in the form of natural resources such as minerals and crops, the transport infrastructure or the skills available from the redundant workforce. To maximize the chances of success it will need to be subject to regular review, as indeed will the long term vision.

4.3. COMMUNICATIONS AND CONSULTATION

Many operating nuclear facilities will have mechanisms in place to allow a dialogue between the management of the facility and their stakeholders, be they staff, local community leaders or others. This experience should have built up trust and understanding between the parties and can be capitalized on in dealing with the issues arising from decommissioning. The nature of these interchanges will to an extent be a function of the broader culture in the organization and country within which the facility is found, and, therefore, prescriptive recommendations are not appropriate. Annexes I–VIII include some specific experiences where a high level of consultation was undertaken and where the results appear to have been positive.

Once the decision has been taken to permanently shut down a facility, it should be communicated to the staff and other interested parties. Such information tends to 'leak out' if not made public, and this can be a source of rumours and loss of trust in the facility management. The established communication routes can be used to present the decision, including a clear explanation of the need for shutdown and what will happen next, preferably with a timetable and clarification about the opportunity for involvement of stakeholders.

An effective communications strategy has to be designed and implemented alongside planning for decommissioning and for its socioeconomic impact. The shutdown of a nuclear facility will generate significant interest, and not just from those directly affected. Managing media and public interest might be approached on a purely reactive basis, and this may indeed be

sufficient in some situations. However, the issues arising from decommissioning include those that require a proactive communications approach to limit their negative impact, particularly where the workforce is concerned.

If, as part of the socioeconomic planning process, it is intended to consult the workforce or the local population, then this should be built into the communications plan. To achieve maximum effectiveness, the consultation process should start before final shutdown as concerns over the consequences of decommissioning will commence once shutdown has been announced, even if it is still some time off. The approaches to communications for the workforce and other parties will differ as described below.

4.3.1. Communication with the workforce

In the absence of accurate and trustworthy information, people tend to be more receptive to rumours, often of outcomes more unpleasant than reality. This is likely to cause increased stress, a negative attitude to management and a deterioration in operational performance reflected in measures such as accident statistics, output and operational reliability. Despite the clearest exposition of the issues about facility shutdown, there will still be uncertainties and general communication is not a panacea. Keeping the workforce informed will enable people to focus on important issues, but they will still require help in dealing with the effects at a personal level. Staff will require support, and it can be helpful to provide them with the opportunity to contribute ideas and to propose solutions.

Well designed human resources processes covering topics such as length of job, future opportunities and severance arrangements will also be of assistance. Making announcements alongside trade union representatives can be useful in order to assuage any workforce distrust in management after a surprise announcement.

Consultation can be undertaken to elicit personal preferences in terms of possible career development. This could cover retraining to become part of the decommissioning team, continued employment for a period followed by redundancy or transfer to another location. In order to have informed preferences the individual needs the communications process to have provided a clear understanding of the decommissioning programme, the skills requirements within it, the value of any financial cushioning available and the availability of roles elsewhere. The feedback from such consultation will help to inform the human resources planning for decommissioning.

4.3.2. Communication within the community

The vision for the community referred to in Section 4.2 must meet the following criteria:

(a) Be acceptable to the community;
(b) Be capable of being achieved on a timescale consistent with the decommissioning plan;
(c) Be consistent with the resources being released by the decommissioning process;
(d) Be sustainable;
(e) Be affordable.

Criterion (a) relies on consultation with the community, largely those close to the facility. The process of consultation involves identifying a proposal or options for proposals, and explaining the issues to the public and/or their representatives. Their views are sought as inputs to forming a plan or to obtaining endorsement for a specific plan. In the former case, the more precise and quantified the views, the easier to use them to select a future vision for the community and to build a realistic plan to achieve it.

The other criteria need to be considered when the options for the community are being developed. The community may have aspirations for a particular type of industry but, if this cannot be achieved on a timescale consistent with the decommissioning plan, then this needs to be made clear and alternatives sought.

A vision for the community that is acceptable, achievable and sustainable will still need to be turned into reality. This will require the production and implementation of an SEDP, as described in Section 4.2.

It will be important to demonstrate to the community that the SEDP is being achieved but, if not, to explain why and how it needs to be changed. If the confidence of the community is lost, it may lead, for example, to people with key skills or other assets choosing to leave the area, reducing further the chances of realizing the plan.

For the wider community, an awareness of activities at the site will again ensure that there is no information vacuum to be filled by rumour. In achieving this, some of the most effective ambassadors of the site are the workforce themselves. Key stakeholders need to be identified and plans made to maintain good communications with them throughout the decommissioning project.

4.3.3. Investment

In this context, investment could refer to the provision of any of a range of resources including: management time, human resources processes, socio-economic plans or counselling. However, it usually means the provision of some form of financial support.

Investment is usually made in the expectation of earning a return. In this sense, much of the financial support provided may not reasonably be regarded as investment. For example, payments made to compensate the people in the workforce for early loss of their jobs do not offer a direct return to the provider of support, but help former employees to cope until they find new employment. By contrast, money spent marketing the area or developing a business park at or near the affected site may lead to enhanced incomes for the area in future. Both types of financial support will be needed. The more successful the latter, true, investment, then the less need there will be for compensatory and other support payments.

The SEDP envisaged in Section 4.2 needs to be properly costed as it is almost certain that funds will be limited and that prioritization will be necessary. The funding of measures for staff will normally be provided by their employer. Where there is a fixed budget for decommissioning, any savings made by efficient late life operations or project delivery may release savings that could become available for use in the socioeconomic area. Although there may be some funds available for wider socioeconomic support from the facility owner, it is more likely that the major demands will fall on government controlled funds. This emphasizes the need for close cooperation between the facility owner, who is likely to initiate the socioeconomic plan, and the investment suppliers without whom it will not be delivered.

The uses to which funds will be applied will be varied in decommissioning [12]. In addition to financing the engineering aspects of decommissioning, there are also the financial implications of socioeconomic factors. These cover direct costs, including training provisions, funds to retain key employees, severance and job retraining expenditure. Furthermore, there is the financial impact related to the local community such as support for loss of local income, loss of tax revenue, relocation costs for families leaving the area, and the provision of new local facilities and amenities. The difficulty of estimating costs in advance and the problem of identifying those who will be responsible for part or all of the required funding must also be recognized.

When investing in a community, it is important to ensure that the associated vision and SEDP are sustainable. There are many definitions of sustainability, but a common and useful approach is to recognize that social, economic and environmental aspects should be considered:

(a) *Socially sustainable* — Will subsequent generations be able to continue in the area as a result of the measures to implement the vision?
(b) *Economically sustainable* — Will the proposed replacement businesses offer the same levels of employment and income, both direct and indirect, as the business being decommissioned and will the local economy be robust in that the loss of one element of the new economy will not result in the loss of the whole?
(c) *Environmentally sustainable* — Will the resources used by the incoming businesses be such that they will not foreclose on the ability of future generations to employ similar resources?

Employment and investment can be provided by the decommissioning project itself, from the construction of new nuclear facilities as part of reusing the site or from the introduction of new industries to the area utilizing resources available following the shutdown of the facility. The interests of existing local businesses need to be recognized as they may see potential newcomers as a threat. The long term profitability of existing companies is as important as the success of new ones, and care is needed to ensure that the introduction of new employers does not take place at the expense of existing ones since that may lead to no net gain to the community. A further important point for national authorities is that encouraging investment in the area close to a decommissioning nuclear facility could lead to a loss of jobs or reduced investment elsewhere. Care needs to be taken to understand the national impact of mitigation policies.

It will be important to encourage enterprises to come to the area to take advantage of the well trained and experienced staff members who will become available when a facility shuts down. The local availability of a sizeable contingent of qualified and skilled workers could represent a positive stimulus for investors to create new enterprises in the region. In addition, the relevant authorities need to promote the attractiveness of the area for investors in terms of its geographical location, favourable taxation climate, stability of regulations and the existence of necessary infrastructure. However, if a particular technology requires skills or resources that are not available in the local community and/or will not be released during decommissioning, then that technology may not be appropriate to replace the jobs related to the facility being decommissioned.

Decommissioning itself can provide an economic boost and stimulate local and national enterprises. Annex V describes the economic effect of the decommissioning project at Vandellòs, Spain. At Greifswald, in Germany, the chosen strategy of immediate dismantling was designed to provide worthwile short to medium term benefit of significant employment of existing staff when

they could be redeployed from operational activities (Section 5.4). This provided time to identify investments to create other employment opportunities for the longer term. Further discussion of industry experience is provided in the following section.

5. INDUSTRY EXPERIENCE OF THE MANAGEMENT OF SOCIOECONOMIC IMPACTS

There is a growing literature on assessing and managing the socioeconomic effects of final shutdown and decommissioning of nuclear facilities. Other publications of the IAEA refer to the socioeconomic aspects of decommissioning [1, 13, 14], and there have been increasing numbers of reports, publications and presentations at international seminars, workshops and conferences that discuss socioeconomic problems [1, 5, 11, 12, 15–21]. However, there are limitations to this literature. It is dominated by experience from relatively developed countries and particularly from large sites. It may be biased towards situations where interventions have been undertaken that have had some perceived benefits. Those situations where little was done to manage the impact are by definition unlikely to be recorded in the literature. Nevertheless, it is judged important to supplement the largely generic discussions of Sections 2–4 with specific experience of the management of the socioeconomic impact of decommissioning.

In order to achieve this aim, case experience has been drawn together in three ways in this report. A summary of lessons learned in several countries is presented below in alphabetical order. This is based partly on the quoted references and partly on material in Annexes I–VIII that contain specific and quite detailed experiences of particular socioeconomic situations related to decommissioning projects in seven countries (France, Germany, Lithuania, the Russian Federation, Spain, Sweden and the UK). No claim is made for how complete or representative these summaries are and, in such a relatively new field, new material and experience will be constantly emerging.

In addition, Annex IX provides shorter presentations of experience in a ‘lessons learned’ format. Many of these items include descriptions of a range of socioeconomic effects, factors that affected the scale of the impact or the mitigation techniques.

5.1. ARMENIA

The socioeconomic situation in Armenia, a small country with few resources, is potentially challenging [15]. Armenia's only two reactors at Metsamor were shut down in 1989 after an earthquake, causing severe energy shortages. There were acute social problems with environmental implications due to the urgent need for alternative energy sources, especially for the heating of homes. The NPP had employed the majority of residents in the local city of Metsamor, many of whom then became unemployed.

Unit 2 (440 MW) was restarted in 1996 after provision of Western financial assistance for safety upgrades and of subsidies from the Russian Federation for plant operation. The plant employs about 20% of the 10 000 population of Metsamor. This is a high level of staffing for a single 440 MW unit. The operation of the unit allows some hydroelectric generated power to be exported to neighbouring Georgia, which is also in need of energy.

The issues of nuclear safety, the benefits of electricity supply and how long the Metsamor plant should run will continue to be debated, with Unit 2 potentially operating until 2016 or beyond. Meanwhile, alternative sources of energy are being sought as the costs of shutdown and decommissioning are likely to be severe.

This is a case where the shutdown was unplanned, but the effects have been limited due to the partial restart. It emphasizes the need to plan during operation for contingencies such as unexpected events bringing forward final plant shutdown and decommissioning.

5.2. BULGARIA

The social consequences of the shutdown of Units 1 and 2 at Kozloduy NPP (KNPP) were presented at an IAEA workshop [20]. The anticipated reduction in personnel led to a related decline in motivation. To combat this, a wider remit was taken on by the plant training centre. The view was that training can play an important role in addressing the impact of shutdown, especially if it is part of the planning process. The training centre was involved in formulating a database of personnel information, as well as engaging in training and retention of personnel.

The loss of staff motivation at KNPP was attributed to uncertainties, frustration, fear of change and a loss of confidence in management. The consequences observed were more unwanted events, more absenteeism and an increase in stress. The demotivation was also due to a belief that there was no apparent technical reason for the shutdown, to uncertainties about the

decommissioning process itself, and to concern about redundancies and socio-economic decline in the region.

There was also an impact on the local region since KNPP was the major employer in this somewhat remote area. Decommissioning will provide some additional employment in the region but reduced business associated with electricity generation.

The experience gained from the shutdown of Units 1 and 2 is expected to be valuable in dealing with the socioeconomic impact of the eventual shutdown of Units 3 and 4.

This example shows that negative consequences of shutdown have been seen in operational performance and that there has been interest in the successful management of the socioeconomic impact. However, the number of staff at the site will continue to fall, so the effectiveness of mitigation measures is not yet evident.

5.3. FRANCE

France has had extensive defence and civil nuclear programmes. The scale of these does present the opportunity for redeployment of staff from decommissioning facilities. Annex I describes the situation following the final shutdown of the Superphénix NPP and the consequences of the mitigating steps that were taken.

5.4. GERMANY

There is substantial information on the socioeconomic impact of the decommissioning of the Würgassen and Greifswald NPPs in Germany. The Greifswald project is described in more detail in Annex II.

It was decided to shut down the 670 MW boiling water reactor unit at Würgassen near Hanover, Germany, in 1995 because of technical and economic considerations [4]. After examining technical, cost, human resources and political issues, it was decided to adopt a strategy of direct dismantling instead of safe enclosure. It was believed that this would have socioeconomic advantages by providing employment for many of the experienced staff as well as many more contractors over a ten year period, allowing the region to adapt more easily to the changed conditions and making the consequences of shutdown less severe. The plant is in a semi-rural area, and the project would provide a boost to the local economy by providing contracts to local companies. Extensive revenues would also arise from the accommodation needs of the

contractors. However, on a wider scale, there are adequate national resources and a surplus of electricity supply capacity.

In spite of the general public acceptance of the plant at Würgassen during the operating years, the shutdown caused a degree of local uncertainty. Various means of communication were used to provide information, consultation and an atmosphere of transparency. There is a visitor centre, and there were numerous mailing campaigns and contacts made with the local media. The only resistance came when fuel elements were removed, but this arose from outside the region and had no local support. It was expected that the structural changes made in the area would reduce the negative effects over the ten year dismantling period. Eventually the full impact would be felt, but only after this long period of readjustment.

The Greifswald decommissioning project is another example of how consideration of socioeconomic impacts influenced decommissioning strategy. A total of eight units of the Soviet designed WWER-440 were to have been located at the Greifswald site in the former German Democratic Republic. Soon after the reunification of Germany in 1989, a decision was taken to decommission all the operating units and to cease construction of the remainder. Annex II provides details of the circumstances at and around the site, the measures taken to manage the socioeconomic consequences and their outcome to date.

The site is located in a largely agricultural region without any major industries, which made redeployment very difficult. Greifswald management succeeded in keeping the site as an industrial and energy production site. More historical and quantitative details are given in Refs [22, 23].

The experience at Würgassen is an example where the socioeconomic impacts were to some extent predicted and were allowed to influence the decommissioning strategy. One of the main reasons for this was the need to retain, for as long as possible, the experienced staff from the site, who would be employed in the decommissioning programme.

Greifswald is also seen as a relative success story where the decommissioning strategy and, in particular, its timescale were adjusted in order to take account of socioeconomic impacts.

In both cases, the decommissioning strategy chosen and the support provided to the staff and the community have required significant injections of funds, with the use of measures such as retirement, new business startups and reuse of the site for a gas fired power plant able to minimize the impact.

5.5. LITHUANIA

The issues and plans surrounding the final shutdown of the Ignalina nuclear power plant (INPP) are described in Annex III. Unit 1 was shut down on 31st December 2004, and the shutdown of the other unit is planned for 2009. Preparations for decommissioning started in 2000. A number of measures have been taken or are planned to minimize the impact of shutdown [19, 24]. These include business support schemes, various programmes and special legislation on additional social guarantees [25].

The local community expressed the wish to restructure the region and regenerate it for new industries. This is currently being implemented via various Government programmes.

There have been intensive political discussions in Vilnius about the future of nuclear power and the possibility of building a new NPP [24, 26]. In the meantime, INPP has prepared a staff reduction plan to cover a period of at least ten years [27].

Funding has now been made available to directly finance the INPP decommissioning project. This funding has sufficient flexibility to include the involvement of more of the existing staff in decommissioning. This has a beneficial effect from an employment perspective, as finding alternative employment in the area is very difficult for the reasons explained above.

This is an example of a planned programme of socioeconomic development. A decision to decommission means that funds should be available to pursue a decommissioning strategy and other measures that will be aimed at minimizing the socioeconomic impact.

5.6. RUSSIAN FEDERATION

A discussion of socioeconomic issues in the Russian Federation is provided in Annex IV. The range of situations arising from the extensive defence and civil programmes of work means that the task of managing the consequences of shutdown remains challenging.

5.7. SPAIN

In Spain, the situation concerning socioeconomic impact of NPP shutdown was approached by initially determining the public reaction to the decommissioning of the country's eight nuclear facilities (seven NPPs and one waste site) [16].

The questions posed during the public consultation included whether respondents had noticed any changes in the municipality after shutdown of an NPP. As a result, three principles were suggested to gain public confidence:

(1) Safety is a non-negotiable concept.
(2) Public information and participation are necessary.
(3) There should be some economic development and guarantee for the future.

A survey was carried out to come up with ideas related to the influence of NPPs on economic development. The following points were noted:

— The economy of a local municipality depends mainly on its NPP.
— When an NPP closes down, the economy of the area will be weakened.
— NPPs have influenced the improvement of local services.
— NPPs are a handicap to the development of other economic activities.
— There are other very important economic sectors besides NPPs.
— Territories are ready with alternatives when an NPP closes down.
— NPPs have not been useful in developing other services.
— The wealth generated by NPPs is also positive for the future.

There are some apparent contradictions in these views. This is unsurprising as a range of views can be expected from polling the public.

The conclusion of the survey was that shutdown and decommissioning needed a public framework and local involvement in order to reach an appropriate agreement on implications and actions. Waste management and the future use of the site were the issues highlighted.

A supplementary publication on the situation in Spain [28] suggests that the impact of decommissioning be considered in three phases:

(1) Final shutdown;
(2) Decommissioning period;
(3) Post-closure.

The social impact is a demographic slump in the area and an associated indirect fall in employment. The economic impact is a reduction in economic activity, a reduction in revenue for local authorities and a blocking of the site for alternative activities.

When dismantling actually starts, there is a change in social impact with more public participation. There could be an upsurge in economic impact by creation of more employment. The specific experience from decommissioning

at Vandellòs 1 reinforced the above observations [18], and that experience is discussed further in Annex V.

In view of the experience gained during the dismantling of Vandellòs 1, ENRESA, as the implementer of decommissioning, developed a standardized series of strategic actions to be taken in the local area during the dismantling stage of a facility in order to promote participation of the local community and its administration, and to keep the population informed [17]. With regard to the economic aspects, the most important issue was to create or sustain local employment. About 65% of the labour used at Vandellòs was local. Another source of support for economic activity in the area is the financial contribution made to local administrations for licences and permits, compensation for the temporary storage of wastes, and agreements for the promotion of cultural activities for the urban area.

For the purpose of communication, ENRESA has developed an active and transparent policy based on dialogue and information transfer with political groups, the media and the scientific community. The general population living close to the installations at which ENRESA carries out its activities is a preferential target group as regards this policy. The mayor of the local community at Vandellòs has also confirmed the above situation from the local information committee that is involved [18]. These experiences provided valuable lessons for the shutdown of the next NPP, José Cabrera, in April 2006.

Union Fenosa has applied to build an 800 MW combined cycle gas turbine (CCGT) power plant at the site of José Cabrera nuclear power station, at Almonacid de Zorita, in central Spain, whose final shutdown was in 2006 [29]. According to the proposed CCGT schedule, building work would begin in the first quarter of 2009 and the plant would come on-line two years later, well before decommissioning of the nuclear plant is complete. The new CCGT units will be able to benefit from much of the necessary infrastructure already being present at the site. This investment, together with the dismantling project, will reduce the impact of the shutdown of the NPP.

5.8. SWEDEN

Relevant Swedish experience of the period at, and just after, final shutdown comes from Barsebäck NPP, where Unit 1 ceased operation in November 1999 and the other unit closed in May 2005. As described in Annex VI, rapid decision making was aimed at reducing uncertainty, while human resources initiatives (e.g. a training school and skill mentoring) were established to provide support to staff. Employment guarantees, five years for employees affected by Unit 1 shutdown, falling to three years when Unit 2

ceased operation, were used to reduce the immediate threat. These measures and close cooperation with the trade unions allowed the plant to operate safely in its final months and in principle have provided a good platform for employees to plan their futures.

In addition, following Barsebäck's acquisition by the owners of Ringhals NPP, it was agreed to make use in the Ringhals plant of some of the staff displaced from the units shut down at Barsebäck. This was an important and successful initiative, without which many staff would have had to seek new employment, probably outside the nuclear power industry.

The success of the Barsebäck approach can be judged by the fact that the best year of operation of the plant was in fact 2004, just before final shutdown, owing it is believed in part to the high morale of the staff during this period, as maintained by the effectiveness of the management programme for the employees.

This is a good example of proactive management of the effect of impending decommissioning on staff by utilizing the potential opportunities that were available. This led to a successful period of late life operation and minimized unwanted off-site consequences.

5.9. UKRAINE

The Chernobyl accident was severe not only at the plant but also on the community. Tremendous challenges have had to be faced in managing the socioeconomic consequences of this accident. Although they may have much in common with those encountered in the normal transition to decommissioning, they are at another level.

The last operating unit at Chernobyl was shut down in 2000, and the socioeconomic impact is being addressed [30]. The fact that the shutdown of the units was spread over the period from 1986 to 2000 has provided some delay in the full impact of shutdown. A programme of mitigation measures is reported in Ref. [31], including the creation of new jobs, payments to staff released as a result of shutdown, and the retention and development of the local town structure. A new industrial heating plant has also been completed [31]. Coupled to decommissioning projects on the site, there are also four other operating NPP sites in the Ukraine with multiple units, so there is some scope for redeployment of staff. Overall, the socioeconomic consequences of the accident and plant shutdown are still being felt 20 years later, with funding difficulties continuing [32].

5.10. UNITED KINGDOM

The UK has a large nuclear industry in both the civil and defence sectors. Some facilities are relatively close to areas of diversified economic activity, others are more remote. There is a significant decommissioning programme across the industry, and in 2005 the Government set up the Nuclear Decommissioning Authority (NDA) with the task of the safe cleanup of the UK's civil nuclear legacy.

The Energy Act 2004 [33], which established the NDA, sees that organization

> "as giving encouragement and other support to activities that benefit the social or economic life of communities living near designated installations, designated sites or designated facilities or that produce other environmental benefits for such communities."

In addition, it requires that "the NDA shall have the further duty to act in the manner that it considers most beneficial to the public."

Neither of these clauses requires the NDA to be responsible for the replacement of the jobs that will be lost when decommissioning of their 20 sites is complete. However, they do imply that the NDA should take an ethical socioeconomic stance in the management of the programme.

A discussion of how socioeconomic issues are now being addressed in the above context is provided in Annex VII for the case of Dounreay, a large former research site on the remote northern coast of Scotland.

Similar challenges to Dounreay are also encountered at the large nuclear multipurpose Sellafield site, again relatively remotely situated in north-west England. Sellafield is the largest economic enterprise in the area of West Cumbria, through both direct employment and the supply chain. Without new missions being assigned to Sellafield, the medium to long term plan [34] shows a gradual reduction in the scale of activity at the site, and there is currently no significant alternative that could generate equivalent wealth. The worst case scenario shows a regional economic slowdown, with a consequent impact on the major socioeconomic indicators.

Sellafield claims a track record of socioeconomic innovation that has delivered several major economic and infrastructure projects over the past 20 years, created thousands of jobs and received millions of pounds of EU finance. Stakeholder relationships built up over this period will be the foundation for the challenge that lies ahead. The local economy is arguably largely decoupled from national trends, in part through the influence of Sellafield. The result has been historically relatively low unemployment, but also relatively low growth. The fiscal certainties of the site have suppressed entrepreneurial activity,

except in a few notable cases, and have not prepared the area for industrial change. The region is fortunate that many parameters of the likely change are predictable for many years ahead, which gives it time to organize, to plan and to act in a coordinated way.

In the case of NPPs, by 2010 there will be 26 Magnox reactors being decommissioned on eleven sites, and a significant variation in the socioeconomic consequences can be expected dependent upon the local economic situation. On the one hand, Oldbury NPP is less than 20 km from the large conurbation of Bristol, an area of heavy investment and rapid growth. The release of personnel when Oldbury shuts down (planned for 2008) could help to meet the local economy's needs for skilled resources. On the other hand, there are two relatively remote Magnox NPP sites in north-west Wales, at Trawsfynydd and Wylfa, areas with limited local economies.

Trawsfynydd is a twin Magnox reactor NPP located within the Snowdonia national park. Some ten years before the unexpected announcement of cessation of generation in 1993, local councils were working to understand the likely effect of the eventual shutdown of the site. A significant impact was feared, particularly if the plant were not to be replaced. In the event, it was not replaced and the local community has been affected by some of the downturn in economic activity predicted. Decommissioning progressed slowly until a public inquiry in 2002 [35] endorsed the decommissioning plans.

Steps had been taken to cushion the impact of shutdown by retaining operating phase staff for decommissioning and encouraging contractors to hire locally. The socioeconomic impacts of shutdown have been ameliorated by the relatively protracted time taken to agree and implement decommissioning plans.

Wylfa NPP is situated on the island of Anglesey, off the north-west coast of Wales, in one of the most economically disadvantaged areas of the UK. The planned shutdown of Wylfa and the possible consequential closure of the nearby plant operated by Anglesey Aluminium Metal Ltd (AAM) will have a profoundly adverse and potentially long lasting impact on the economy of Anglesey. Wylfa and AAM have been cornerstones of the Anglesey economy for 30 years, providing just under 10% of jobs and an even higher proportion of local earnings. Both plants started operations in 1971, but Wylfa will cease operations and commence decommissioning in 2010. Anglesey Aluminium Metal Ltd is highly dependent on Wylfa for energy and has a direct feed into its site from the power station. The decommissioning of Wylfa is likely to lead to an increase in both the unit cost of electricity for AAM and the transmission user costs of taking energy from the national grid. Given that AAM's products are traded on the commodity markets, any increase in its cost base may make it uneconomic to continue producing aluminium on Anglesey once Wylfa enters its decommissioning phase.

Overall, job losses related to the closures of Wylfa and AAM are expected to have a very significant impact on unemployment rates across the region, reinforcing already high local unemployment rates. Studies into the impact and the likely effect of mitigation actions have identified a range of potential drivers of economic growth, including inward investment, development of indigenous small businesses, tourism, transport, the academic sector, new nuclear build and Government institutions. None of these is seen as a panacea and, in particular, the scope for inward investment of large scale manufacturing is seen as problematic due to competition from lower cost regions of the EU and beyond. The island faces a major challenge over the next ten years to adapt to the new economic realities.

This is an example of where it is possible, with the correct skills involved, to predict the main implications of decommissioning outside the site itself. The existence of the NDA and its mandate to consider the socioeconomic issues associated with decommissioning mean that such problems are being identified and solutions sought some three or four years before shutdown. Furthermore, by seeking a consistent approach to the management of such issues at all the sites it owns, the NDA can press for identification and adoption of good practices by its site management contractors.

5.11. UNITED STATES OF AMERICA

The USA has a very large civil and defence related nuclear industry. The literature on managing the socioeconomic impact of decommissioning is dominated by the defence sector, since its sites tend to have started earlier whereas most NPPs are still operating. Lessons have been learned on managing staff reductions and the impact on the local community.

Firstly, with respect to workforce reduction, the Rocky Flats Project is an example of successful accelerated cleanup that will thereby end cleanup jobs earlier than originally envisaged. As part of this project, there is a site transition and workforce transition programme in hand [36]. Regular communication with workers about the transition was found to help them by making the situation more predictable. This puts them in a position with more control over their futures, and their stress levels decreased.

At the time of writing [36], the workforce at Rocky Flats numbered roughly 1200, from a workforce of more than 5000 when the project began in 1995. In this period:

(a) Seventy-five per cent of workers who left the site successfully made the transition (finding a new job, starting a business or retiring).

(b) Nearly the entire site population attended a transition orientation presentation, familiarizing them with the benefits of the programme.
(c) More than 1700 employees had taken advantage of the one-on-one career counselling services available.
(d) More than 2000 employees had participated in career fairs organized by the site management contractor to bring local, regional and national employers to the workers.

Secondly, with respect to local communities, organizations such as the Energy Communities Alliance [37] and the US Department of Energy (USDOE) Office of Legacy Management [38] have concentrated on social and economic issues in the defence sector. The Community Assistance programme, operated by the USDOE Office of Legacy Management, sought to alleviate the negative impact of its changing mission on the workforce by ensuring the continuity of their pension and medical benefits.

The USDOE also initiated a community transition programme in 1993 to minimize the social and economic impacts of workforce restructuring on communities surrounding its facilities. This programme encouraged communities that are affected to chart their own future economic development through the creation of community reuse organizations (CROs). A CRO is an organization, recognized by the USDOE, which can receive grants for programmes that alleviate the impacts of workforce restructuring at USDOE facilities. Fifteen communities established CROs with Congress authorizing US $284 million in funding for community transition activities. With these funds, the CROs collectively created a total of 42 750 jobs in their communities at a cost of US $6040 per job. Funding, however, for community activities has declined sharply in recent years [39], presumably as the peak of concern has passed.

Another major initiative in the USA defence sector was the decision to close redundant defence facilities whilst minimizing the socioeconomic impact. In 1990 more than 200 military facilities were to be transferred to the private sector. A Defense Base Realignment and Closure Commission (BRAC) was set up in response [5]. In California alone, 29 defence bases were to be closed with direct or indirect losses of nearly 200 000 federal and civilian jobs. There were difficulties in gaining acceptance of the reuse of facilities that were once contaminated, with potentially about 77 000 acres (3.1×10^8 m^2) of land available. Reuse of potentially valuable land has been slower than hoped for due to issues or fears related to the liability associated with the former operations.

The benefits of early consultation to manage the impact of decommissioning were confirmed by the mayor of Idaho Falls [40] when making

reference to the shutdown of the Idaho National Engineering and Environment Laboratory (INEEL). He said that the shutdown of a facility should not come as a surprise to the local community. There should be communication long before a decision is taken. Locally elected and appointed officials are a direct route to local businesses and communities. Plans for possible reuse of a site should always involve the local community.

Fort St. Vrain NPP in Colorado was shut down in the early 1990s. As the plant had never performed satisfactorily, shutdown was not a great surprise. Nevertheless, an adverse social impact of shutdown was experienced as the site is in a somewhat remote area [41, 42]. It has more recently been rebuilt as a gas fired plant, which has ameliorated the situation [43].

Overall, the US experience is extensive. Significant resources have been applied to managing the socioeconomic impact of decommissioning and these have had some apparent success. However, reinvigorating an area by reuse, particularly with private sector involvement, requires that investors be confident in the condition of the assets that they acquire and the liabilities that may go with them. For example, at Hanford [44] there are doubts that the preferred strategy of reusing land for industry will be attractive to industry. The local community may prefer to see a more mixed use of land, but this could require costly additional cleanup, if it is feasible at all.

6. CONCLUSIONS

This report has drawn on the knowledge and experience of those associated with its preparation and on examples of experience found in the literature. Experience in a number of countries is now sufficient to be able to provide evidence supporting the assertion of some fundamentals likely to be applicable across a wide range of situations.

The following conclusions have emerged from the preparation of this report.

(a) The decommissioning planning of a nuclear facility is not complete until an SEDP and associated action plan have been prepared by site management and local community representatives.
(b) The SEDP and action plan should be agreed with relevant government and other authorities, and then implemented.

(c) Implementation will be addressed differently in different countries. It will be for each Member State to decide on the means of implementation in its own case.
(d) There will be an immediate impact on staff at the announcement of final shutdown, and this impact needs to be planned for.
(e) The value of good socioeconomic management can be seen in operating staff performance, community vigour and by those at or near other operating facilities yet to declare a shutdown date.
(f) The socioeconomic effects of a shutdown may extend beyond the local community. In addition, the investment drawn into an affected community may lead to a loss of opportunity or even jobs elsewhere. Account needs to be taken in planning of all the possible implications.
(g) The long term success of socioeconomic interventions is not guaranteed. An economy based on many diverse smaller businesses may be more robust than one dependent on one or two large businesses.

The resources available to manage socioeconomic impacts will be limited whether these resources be financial, human or of other types. A key issue is likely to be how to prioritize usage of available resources. Experiences in the literature often do not go into details on the funds applied. Even where they do, it is difficult to translate the scale of the investment from one economy to another. It is suggested that there is scope for further research in the area of prioritization and funding of socioeconomic interventions.

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Annexes

NATIONAL AND PROJECT EXPERIENCE

The examples provided in these annexes describe practical experience of policies and programmes for the management of socioeconomic impacts of decommissioning in various Member States. The examples given are not necessarily best practices; rather they reflect a variety of situations that have been met. Although the information presented is not intended to be exhaustive, readers are encouraged to evaluate its applicability to their own situation.[1]

[1] National annexes reflect the experience and views of their contributors and, although generally consistent with the guidance given in the main text, are not intended for specific guidance.

Annex I

CREYS-MALVILLE, FRANCE: SOCIOECONOMIC IMPACT OF DECOMMISSIONING

The final shutdown of Superphénix is the first example of the decommissioning of a large NPP in France. The socioeconomic impact on the workforce and the community, as well as the management of human resources, is likely to be quite representative of the decommissioning of a plant in the Électricité de France (EDF) group. However, there are also some unique aspects of this case, mainly due to specific technical aspects and the unanticipated shutdown decision.

I–1. CONTEXT AND PLANT SPECIFICS

Located on the site of Creys-Malville, in the Isère department, Superphénix is a 1200 MW(e) sodium cooled fast reactor. Its size is of the same order as those in the pressurized water reactor (PWR) fleet operated by EDF (900–1450 MW(e) units). In operation, the on-site organization and workforce were more similar to those of a twin unit 900 MW(e) PWR site. Twelve hundred people worked on-site at the time the plant was shut down.

I–1.1. The shutdown decision

The decision to abandon Superphénix was taken by the French prime minister in June 1997, and officially confirmed by the Government in February 1998. This decision was taken mainly for political reasons, and came very suddenly.

Usually, the final shutdown of an NPP is planned several years ahead, allowing enough time to prepare the technical side of the decommissioning, and to organize the redeployment of plant personnel.

The consequences of this sudden shutdown decision were as follows:

(a) Several years were required to perform the decommissioning studies and to obtain the dismantling decree (e.g. the turbine hall was dismantled in 2003–2004, but the construction of the sodium treatment units only began in late 2005).
(b) From the social point of view, acceptance of the decision was very difficult. Numerous demonstrations (around one hundred) were staged

by site personnel and members of surrounding communities in a vain attempt to seek the resumption of plant operation.

(c) No human resources management plan was available, as it had still to be devised.

I–1.2. Technical aspects

Superphénix is a sodium cooled reactor, creating some specific challenges for the dismantling process and, as a consequence, for the workforce requirements:

(a) To treat the sodium coolant, a specific treatment unit is under construction on-site, and will be operated for about four years. The dismantling of the reactor block cannot proceed until all its sodium has been drained and removed.

(b) The fuel assemblies will remain on-site for at least 30 years, in the APEC storage pool, another basic nuclear facility, distinct from the reactor to be dismantled.

A large quantity of equipment is still being operated and maintained. Thus, the activities on-site are varied: operation and monitoring, maintenance, modifications, final disabling of redundant systems, dismantling and even building of new installations (e.g. for sodium treatment).

To perform these tasks, the number of workers on-site still includes 100 EDF staff and 300 employees of subcontracting firms. These figures should remain stable, or possibly decrease slightly, for several years to come.

I–1.3. An EDF Group power plant

The Creys-Malville site is now an EDF site. During its design and building phases, Superphénix was originally held by NERSA, a European consortium (EDF: 51%; Enel: 33%; SBK: 16%). In operation, the plant was mainly staffed by EDF personnel (650) with an additional 85 German and Italian employees.

Following the shutdown decision, an agreement was reached between the NERSA partners that left EDF in sole charge of Superphénix decommissioning.

Superphénix is included in the general EDF dismantling policy for its first generation reactors. The EDF Group has a global approach to nuclear energy and intends to prove its expertise in mastering the decommissioning as well as the operation of its NPPs. For this purpose, the Centre d'Ingénierie, Déconstruction et Environnement (CIDEN), a specialized engineering unit and part of the EDF engineering branch, was created in 2001. This unit, based

in Lyons, is in charge of decommissioning studies and dismantling activities for nine reactors (six gas cooled reactors (GCRs), one PWR, one heavy water reactor (HWR) and one fast breeder reactor (FBR) (Superphénix)).

I–2. SOCIOECONOMIC IMPACT (CONTRACTORS AND COMMUNITIES)

In support of its final shutdown decision, the French Government decided to implement an economic programme.

A dedicated employment organization was set up to help redundant employees of subcontractors find work or gain additional training. One hundred and five applicants were included and 54 of these found employment quickly.

A 'social and economic development fund' was established to support the development of activities creating or maintaining jobs in the area, with 11 million euros being loaned by the Government and EDF over a five year period.

The success of the programme was helped by several factors:

(a) The positive context of the local and regional economies at the time;
(b) Loans granted at a zero rate, if the proposed project was reasonable;
(c) Creation of a loan approval commission chaired by a representative of the regional prefect.

As such, 1100 jobs were created between 1998 and 2005.

When in operation, 1200 people worked on the plant site, while an additional 550 indirect jobs were generated to support the on-site workers and their families. It was estimated that locally 5300 people had a link with the plant activity (workers and their families).

At the time of the shutdown decision, it was feared that the social consequences would be severe for the above mentioned persons and for the local economy. Fortunately, the social and economic measures implemented, together with the good health of the economy in the region at that time, helped mitigate the consequences.

I–3. ÉLECTRICITÉ DE FRANCE STAFF

As the Creys-Malville plant operation was the responsibility of EDF, and most of the site staff belonged to EDF, solutions were found within the EDF Group which included (figures are approximate):

(a) Relocating to other EDF units (400);
(b) Early or normal retirement (200);
(c) Remaining on-site for decommissioning activities (100).

From 1998 to 2002, the main goal of the site management board was to reduce the number of staff on-site, while fine-tuning the management of human resources.

A social agreement was made with the union's local representatives, defining several accompanying measures to facilitate the relocations stemming from plant decommissioning:

(a) The usual EDF relocation administrative measures were reinforced: compensation of possible loss of income over a longer period, help in job hunting for spouses and assistance with the sale of property (where applicable).
(b) Each EDF employee was helped to define their professional project.

At the beginning, the relocation process progressed quite easily (200 in 1998), but it became more difficult with each passing year. A strong involvement of all senior managers was also necessary, as well as the help of other social partners such as unions, the plant doctor and social workers.

In 2003, a view was developed of prospective on-site activities up to 2008. An estimate was made of the number of staff and the skills required to carry out these activities, as well as the associated site organization. This rather detailed view of the future allowed the definition of those who could remain (skills necessary to the site) and those who had to leave.

This last period of staff reduction (2003–2004) was a difficult one:

(a) Most people did not want to relocate.
(b) Lack of motivation among personnel was high, but there were differences among the various teams. For example, operating teams had difficulties because many operators had to be relocated, whereas the motivation of the teams in charge of decommissioning work was better because their jobs and futures were clearer.
(c) It was still too early to recruit new (and young) people.

During the whole period of staff redeployment, a steadfast commitment was shown at the managerial level of the EDF Group regarding the relocation of the Creys-Malville staff. The personnel relocated mostly to other NPPs (in that respect, the help of Bugey NPP, a nearby PWR site, was important), but also to other units within the EDF Group.

In addition to this human resources management policy, the standardization prevailing within the EDF power generation fleet made it easier to relocate staff, as the staff from Creys-Malville applied the same technical methods, followed the same operating and maintenance rules, and used the same software tools as those in all other EDF plants.

In 2005–2006, the site, previously a unit of the EDF operating division, was integrated into CIDEN, which then took sole responsibility as both dismantling project manager and nuclear operator. This decision allowed a clarification of responsibilities, and a stronger synergy between design studies and on-site implementation teams.

With staff redeployment coming to an end, everyone on-site is at present (2007) involved with the dismantling project. The technical activities on-site are now well organized, and the project has fully entered its realization phase. As a result, motivation is improving, but the complexity of the plant and its future evolution require that reinforcement of the competence and expertise of the teams on-site remains a priority.

Annex II

SOCIAL ASPECTS OF NUCLEAR POWER PLANT DECOMMISSIONING AT THE GREIFSWALD SITE IN GERMANY

II–1. THE GENERAL SITUATION OF NPP DECOMMISSIONING IN GERMANY

The normal situation in Germany is that private electricity companies, such as E.ON, RWE, Bayernwerke and EnBW, are responsible for the costs and implementation of decommissioning of the NPPs that they own. The private companies have their own decommissioning approach and financing tools. This situation applies, for example, to the Würgassen plant, which has been discussed in Section 3.1.

In addition, there are some Government owned organizations that are responsible for nuclear decommissioning sites. The largest one is Energiewerke Nord (EWN), which covers the large Greifswald site, the AVR research reactor and, since February 2006, the reprocessing plant (WAK) at the Karlsruhe site.

EWN is owned by the Federal Republic of Germany (Ministry of Finance). The Federal Ministry of Finance provides EWN with the funds necessary to deliver the decommissioning programme and the tasks in that programme.

The shareholder structure of EWN can be seen in Fig. II–1 (drawn prior to the takeover of WAK).

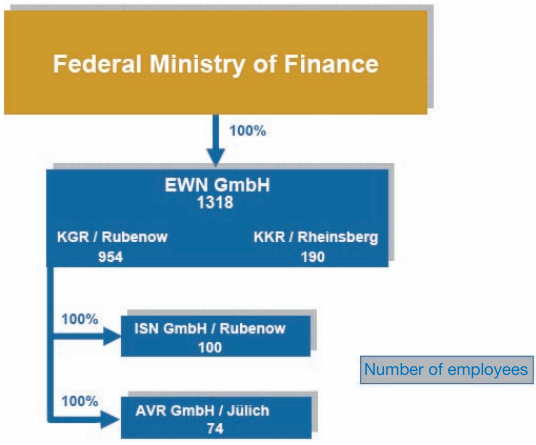

FIG. II–1. The shareholder structure of EWN.

The German Federal Ministry of the Environment is in charge of all licensing aspects, to ensure realization of the decommissioning in a safe and secure way. The responsible authorities are the Ministries of Environment in the 16 German states. In the case of EWN, this is Mecklenburg/Western-Pommerania.

In the context of EWN's special licensing approach, as described in the next section, there is a close and practical cooperation between EWN as decommissioning operator and the above mentioned authorities. In this context, EWN sought to establish a decommissioning strategy that recognized the socioeconomic effects of plant shutdown and make decommissioning friendly as described in the next section.

II–2. THE STRATEGY OF EWN TO MITIGATE THE NEGATIVE SOCIOECONOMIC IMPACTS OF DECOMMISSIONING

German reunification had an enormous economic and social impact on the former GDR. After reunification, a political decision was taken to cease operation immediately of all five 440 MW(e) units and all construction works on the Greifswald site.

Thus, the initial conditions of the decommissioning position on the Greifswald site were severe. There was a large workforce, an unexpected and immediate shutdown decision and no fully worked out plans to help EWN, who faced a complicated multifaceted situation. At that time, there was no vision of the socioeconomic future of the site and its associated communities, and clearly no plans for the future.

It was therefore necessary for EWN to develop a strategy covering the following key areas:

— Decommissioning;
— Establishment of an appropriate new project management structure;
— Dismantling plans;
— Licensing procedures;
— Waste management.

A framework was developed covering the above mentioned largely technical issues, but taking into account at all times the social aspects of all measures, see Fig. II–2.

The socioeconomic situation in the north-east German region was very difficult after German reunification. The unemployment rate was high, 25–30%.

FIG. II–2. Layered approach to managing decommissioning issues.

Recognizing these traumatic circumstances, EWN had to develop a complex personnel development strategy (PDS) and in this context also a site reuse strategy for industrial purposes, to attempt to mitigate the negative socio-economic impacts on the staff and the local communities.

The overall PDS included the following:

(a) A personnel reduction plan;
(b) A personnel development plan, including how to transfer know-how, effectively to ensure that essential knowledge gained is not lost, but is available for use elsewhere;
(c) A site development plan.

II–2.1. Personnel reduction plan

The actual and planned personnel reduction plan as in 2001 is shown in Fig. II–3. In practice, the approximately 6000 employees in 1990 were down to about 1000 employees in 2006.

For comparison, Fig. II–4 shows the actual fall in the number of residents in the Greifswald area over the same period. It is apparent that the overall shape is similar. Some Greifswald residents, especially the younger ones, have gone to the western part of Germany to find work there.

II–2.2. Personnel development plan

A key early strategic decision was to perform as much as possible of all the decommissioning activities with the site's own personnel. This decision set

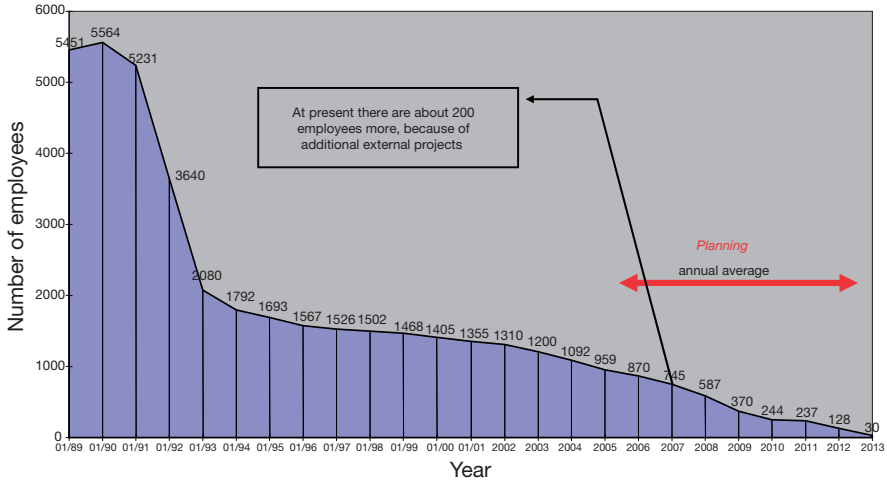

FIG. II–3. Number of employees over the decommissioning period.

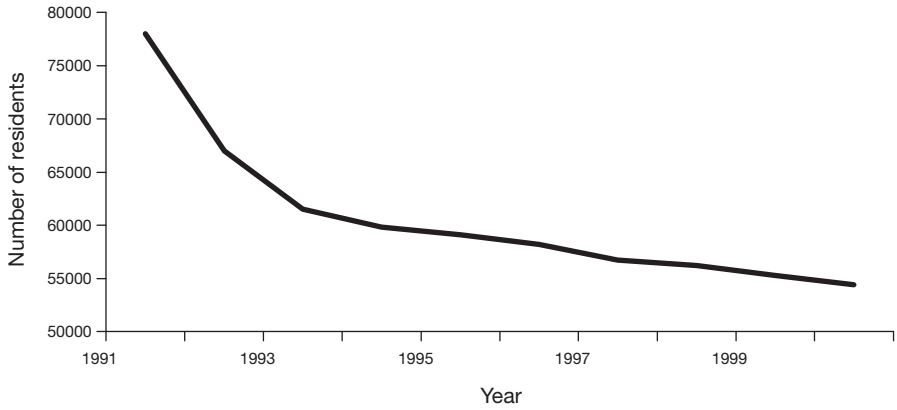

FIG. II–4. Number of residents in the Greifswald area.

the boundary conditions for the personnel development plan and the related know-how transfer concept. In this context, the following cornerstones were fixed for the decommissioning strategy:

(a) Complete direct dismantling of the facilities on-site (i.e. no safe enclosure period).
(b) Immediate introduction of a decommissioning project management structure.
(c) Rapid establishment of an overall decommissioning technical concept as a basis for accelerating the licensing process.

(d) Speedy transfer from an operating licence to a decommissioning licence, including development of a special licensing procedure having one umbrella licence with additional part licences. This made it possible to produce a reliable full workload over the project lifetime.
(e) Construction of an integrated interim storage facility for waste and fuel on-site, to be independent and to ensure a smoothly running decommissioning (dismantling) process at all times.
(f) Pursuit of site reuse as early as possible in order to create new employment.

The know-how transfer concept was aimed at using EWN's experience for work at other German decommissioning projects such as the AVR reactor at the Jülich site and the WAK reprocessing plant at the Karlsruhe site. It was intended to further extend this to decommissioning projects in other countries.

To deal with international projects, a new division was founded in EWN. This has been a successful policy, with EWN involved in international decommissioning projects such as:

(a) Decommissioning of submarines of the Russian Federation Northern Fleet at Saida Bay;
(b) The Chernobyl Waste Projects Coordination Unit (CWPCU) in the Ukraine;
(c) Bohunice in Slovakia (Development of V1 NPP decommissioning documentation: the conceptual decommissioning plan (CDP) for the first stage);
(d) Project development of a decommissioning plan for the Kozloduy plant in Bulgaria;
(e) Project development for the overall radiation investigation at Units 1 and 2 of the Kozloduy NPP;
(f) The EIA report for the decommissioning of the V1 NPP at Bohunice in Slovakia;
(g) The Tacis project (R2.04/03) in the Russian Federation: Support for the decommissioning phase of NPP units, covering scientific, technical and economic issues (preparation for pilot decommissioning projects at Novovoronesh and Beloyarsk).

As a result of this initiative to involve EWN employees by matrix working across several projects, some 200 jobs have been saved.

II–2.3. Site development plan

The aim of the site development plan was to seek to secure future industrial use of the site. A critical requirement was the early and continued involvement of all stakeholders, including the following activities:

(a) Establishing together with the local community a vision for the site and initiating development of a strategy for implementation;
(b) Engaging with the trade unions involved to gain support for implementation of the strategy;
(c) Working with a joint body representing the local communities and set up as a co-initiator of strategy, to support the implementation of decisions taken by the Government and regulators;
(d) Interfacing with the Government and regulators over decision making;
(e) Communicating with the public to gain an understanding and acceptance of the strategy adopted.

On the latter, a key point was an open and easily understandable consultation process. This was supported by clear public information on all decommissioning activities and other important items regarding the activities on-site as well as comprehensive information about all site development activities. In this context, very close cooperation with the local media was also necessary. Close cooperation with the local communities is a precondition to realize an optimal site development for future industrial use.

A joint body represents the local communities of Rubenow, Kröslin and Lubmin (Fig. II–5).

II–3. THE FUTURE INDUSTRIAL PROSPECTS FOR THE EWN GREIFSWALD SITE

The work that has been done has opened up the following future uses for the Greifswald site (Fig. II–6):

— To deliver, consume and distribute natural gas;
— To process renewable raw material for the production of synthetic fuel (approximately 1 Mm^3/a);
— To produce large components for shipbuilding.

FIG. II–5. Communities in the area around Greifswald.

Preconditions:

- Industrial area
- Energy production at the site
- **Industrial harbour with 7 m draught**
- Rail system
- Highly qualified personnel

Production and Handling of:

GAS
Delivery / Consumption / Distribution

Processing of renewable raw material for the production of synthetic fuel
appr. 1 Mm³/a

Production of large components for shipbuilding

FIG. II–6. Industrial developments in the Greifswald area.

FIG. II–7. The new harbour at Greifswald.

The basis for such huge projects is to prepare the infrastructure for an industrial area, for example, an existing rail system for long freight trains (up to 300 m), a heating system, water supply, electricity generation and supply, and, last but not least, highly qualified personnel on-site. Additionally, owing to the site location close to the Baltic Sea, EWN constructed, as a major advantage for future industrial development, a harbour with a draught of 7 m (Fig. II–7).

The goal of these site development activities is to create an attractive context for the establishment of companies or subsidiaries leading to more than 400 new jobs by 2010.

Annex III

DECOMMISSIONING IN LITHUANIA

III–1. IGNALINA NUCLEAR POWER PLANT: DECOMMISSIONING AND NEW PERSPECTIVES

Lithuania has no primary energy sources of its own. From the late 1980s, the Ignalina NPP (INPP) produced a large percentage of Lithuania's electricity. The Lithuanian electricity and gas networks are closely interrelated to the north-west power sectors of the Russian Federation (Fig. III–1).

The plant, when originally constructed, was intended to supply the north-west region of the former Soviet Union rather than Lithuania alone. The first unit of INPP was commissioned in 1983 and the second unit in 1987. Since Lithuania became independent in 1990, INPP has typically contributed around 80% of national power supply. The plant is located in the north-eastern corner of Lithuania, close to the borders with Belarus and Latvia — 130 km from Vilnius, on the shore of lake Druksiai (Fig. III–2).

Lithuania gained its independence from the former Soviet Union in 1990, and from then on took full responsibility for the safe operation of INPP. The plant, with two Soviet designed RBMK-1500 reactor units, is the only NPP of its type in the EU.

The G7 high level meeting in Munich in 1992 was crucial to Lithuania and operation at INPP. The political decision was made that these RBMK reactors should be closed, as the reactors were judged incapable of being upgraded to Western safety levels.

The first step in the preparations to close INPP was the International Donors Conference in the year 2000 in Vilnius. Shortly afterwards, the Ignalina International Decommissioning Support Fund (IIDSF) operated by the European Bank for Reconstruction and Development (EBRD) has been established. The initial contributions to the fund were made by a number of European countries and by the EU. Since that time, only the EU has continued to contribute to the IIDSF, its contributions now totalling 389.5 million euros, equivalent to 93% of the fund.

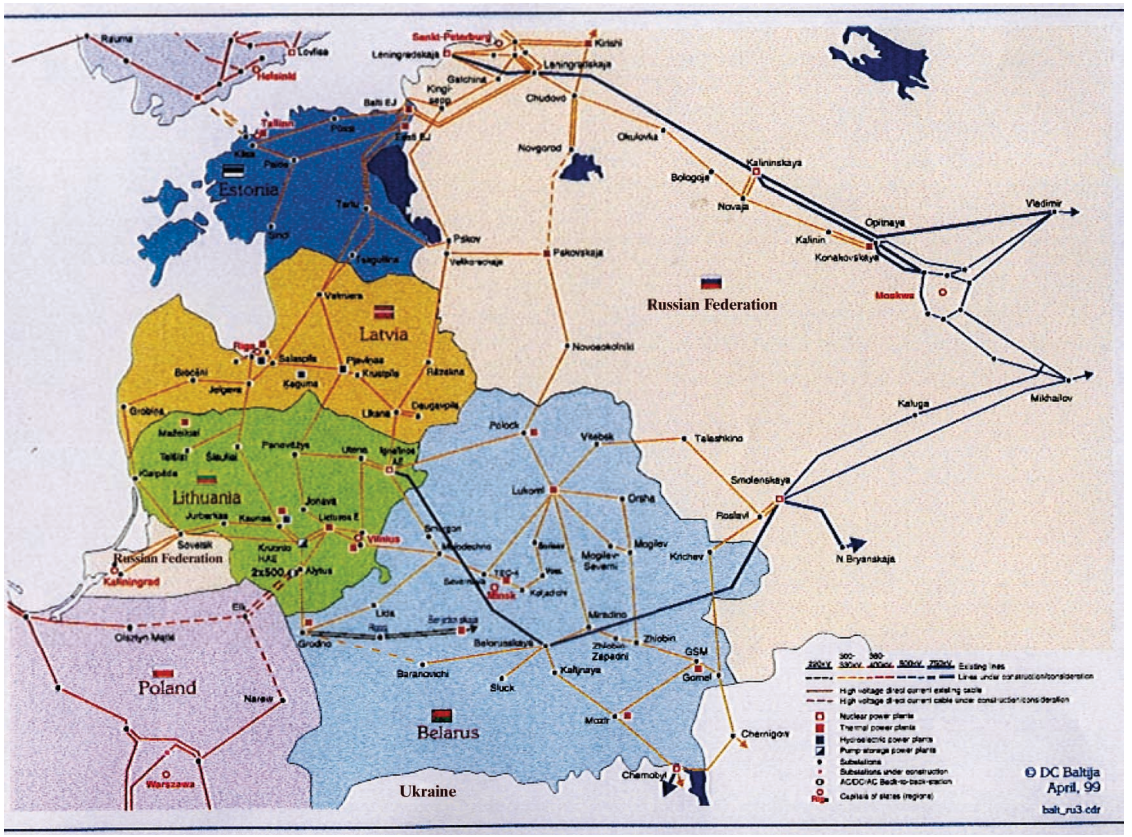

FIG. III–1. The Lithuanian electricity network.

FIG. III–2. View over Ignalina NPP.

III–2. IGNALINA NUCLEAR POWER PLANT PREPARATION FOR NEW PERSPECTIVES

Ignalina nuclear power plant is a relatively new NPP. Given the prolongation of the life of NPPs to up to 60 years, 20 years of operation represents only the first third of its potential life. Many safety improvements have been made to INPP, and there have been no serious accidents. The employees of INPP find it difficult to understand the political decision to close it and difficult to prepare themselves to the new perspectives. The operational staff is not familiar with decommissioning issues. A decommissioning unit was established at INPP in 2000. A consortium of consultants was invited to join the decommissioning department to assist in the preparation of planning documents for decommissioning such as the final decommissioning plan, the decommissioning project for the first phase up to the year 2010 and licensing documents.

The first significant action under the IIDSF, in 2001, was to issue a contract for an internationally staffed decommissioning project management unit (DPMU) based at the plant. The DPMU continues to assist the plant's own

decommissioning service in planning the overall decommissioning process, preparing technical specifications and putting out tenders for pre-dismantling contracts, including spent fuel storage and a radioactive waste handling and storage facility. The DPMU is also intended to train INPP personnel and to transfer their knowledge of decommissioning management issues.

Recognizing that INPP's main experience was in operating an NPP, a plan has been developed that sets out the main steps that need to be taken to transform the INPP Decommissioning Service (INPP-DS) into an effective decommissioning organization. The development and application of these steps is an ongoing process and addresses areas such as:

— A stakeholder review;
— Organizational structure and processes;
— Mission statement and values;
— Strategic goals and performance indicators;
— Resource management and the development of personnel;
— The safety culture.

All of these are issues concerning human factors and are therefore strongly influenced by the way people think and react. The size of the task cannot be underestimated. The process should start when closure of the facility is first being contemplated, and remain under constant development and review. These issues are only now being understood at INPP, and action is being taken by the senior management to determine how they should be addressed throughout the INPP organization.

One of the most effective tools used in the transformation of INPP-DS was a survey of organizational culture and effectiveness. This has provided a benchmark against best practice in other organizations, and has clearly indicated what needs to be done to improve INPP-DS.

Throughout all aspects of decommissioning, it is important to focus on the establishment of strong working relationships and team building.

In 2006, the decommissioning department was comprised of 90 staff members.

III–3. DECOMMISSIONING PLANNING

There have been no strict legal requirements for the preparation of a final decommissioning plan (FDP) and other planning documents. It is now clear that planning should start from selection of decommissioning strategy, which is closely related to economic development aspects for the region and the whole

country. The strategy is the main foundation for establishing the national decommissioning programme as well as regional development priorities and plans.

The first decommissioning programme has been adopted by the Lithuanian Government as a requirement of the Law on Decommissioning of Unit 1 of INPP. One of the measures in the programme implementation plan was a selection of decommissioning strategy.

Together with consultants, INPP began the preparation of the FDP in early 2002. Two strategies were investigated: deferred dismantling with a cooling period of 35 years, and immediate dismantling. Calculations have been performed on the main issues: workforce, finance and radioactive decay characteristics. The main findings on workforce requirements are shown in Fig. III–3.

The first plan was based on deferred dismantling since this had benefits from the safety, cost and waste management viewpoints. It was rejected by the Lithuanian authorities because of the social consequences for the region. It is considered [III–1] that the availability of a suitable workforce is the main risk factor in decommissioning projects. Lithuania has neither other nuclear facilities nor specialist preparation institutions, factors that could cause huge problems with availability of specialists after 35 years of storage. In financial terms, the deferred dismantling option has no advantages compared with the immediate dismantling option. In choosing the immediate dismantling strategy, personnel could be retrained from operation to decommissioning, so as to keep

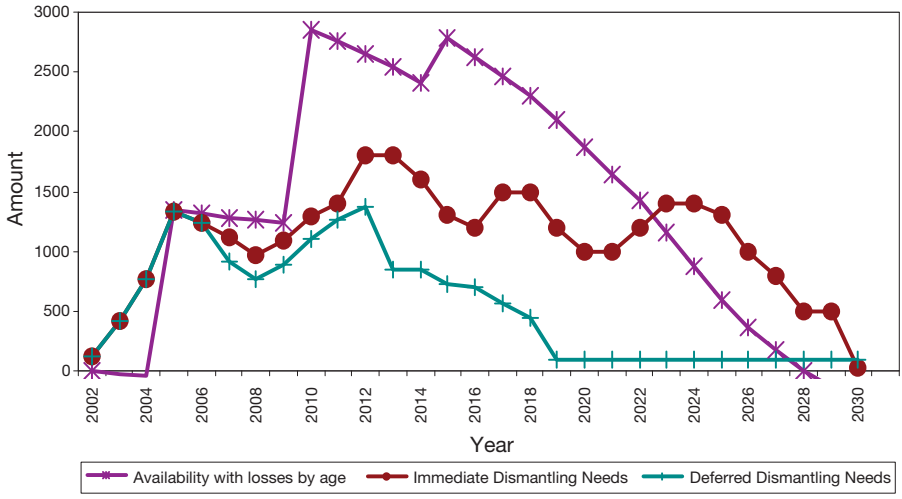

FIG. III–3. Needs and personnel availability with losses by age.

work inside the plant. These people could implement decommissioning projects more effectively and cheaply than outside companies, while many social problems could be solved more smoothly.

III–4. ADDITIONAL SOCIAL GUARANTEES

The Law on Additional Employment and Social Guarantees for the Employees of the State Enterprise Ignalina nuclear power plant, adopted in April 2003, establishes additional employment and social guarantees for the employees of INPP, who will be or have been dismissed from work as a result of decommissioning of Units 1 and 2 of INPP, as well as for their family members. This law seeks to mitigate the negative social consequences and to ensure the safe and uninterrupted functioning of INPP pending the end of operation.

On the basis of Articles 3 and 4 of this law, the employees of INPP who face unemployment will be provided with additional employment guarantees. These shall take the form of direct and indirect support to their employment. Indirect support will include target programmes on employment, INPP regional development, use of human resources and business promotion, as well as measures approved by the Government with a view to safeguarding the employment guarantees for employees who will be or have been made redundant.

Direct support for employment of employees who will be or have been made redundant will include drawing up and implementation of individual plans providing for employment measures (and social guarantees). These measures may include guarantees referred to in the Law on Support of the Unemployed, Article 7 (2) (2-7). These are applicable to the unemployed, who are eligible for additional support on the labour market (guarantees are also provided to family members), vocational training, retraining and in-service training for the performance of INPP decommissioning work. The latter includes granting of educational leave, when employees shall be paid their average salaries, and reimbursement of travelling expenses to the educational institution. Furthermore, there will be compensatory job creation (compensation of a minimum of 24 months income for each job) and the possibility to study the Lithuanian language if relevant.

The employees of INPP who face unemployment will also be provided with additional social guarantees on the basis of Chapter 3 of the above law. Upon approval of the technical decommissioning plans of INPP, the INPP administration shall annually announce to INPP employees the list of employee positions and professions that may be made redundant within the

next 12 months. Employees who are being made redundant shall be given ten months' written notice.

The social guarantees include life insurance to the employees of the INPP, whose qualification and work is of special importance for ensuring safe operation of the INPP, granting supplementary severance pay (in addition to severance pay under the labour code), granting and payment of pre-retirement unemployment allowance, and provision of relocation allowance. The latter applies to those who, following their being made redundant at INPP, decide to move their permanent residence to another locality in Lithuania or to move abroad. These persons shall be reimbursed with their actual relocation expenses, but not in excess of three months' salary per family member).

Article 5 of the Law on Support of the Unemployed stipulates that additional employment guarantees will also be provided to unemployed family members of employees, who are being or have been made redundant, provided they have registered at the territorial labour exchange. Employment guarantees will include grants and compensation for employers to create new jobs.

The Lithuanian Labour Exchange under the Ministry of Social Security and Labour is in charge of organizing the implementation of additional employment and social guarantees for the employees of INPP who are being made redundant and for their family members.

The redundancy statistics for INPP show the following characteristics (Fig. III–4). The first years have been very frightening for INPP employees. Most of them leave the plant because they do not agree to take another position. The year 2003 was a time of restructuring of INPP as an entity. Four new companies have been separated from INPP, and new state owned companies have been created: Visagino energija, Visagino statybininkai, Visagino transporto centras and Visagino energetikos remontas. All these entities were previously separate undertakings within INPP. The first redundancies arising from decommissioning of Unit 1 have been started only in the year 2005 after the final shutdown of Ignalina Unit 1. The first 106 employees took advantage of the law on additional social guarantees. The formal shutdown has not changed the situation very much because of the technological characteristics of the reactor. The RBMK reactor is a channel type reactor, and its full defuelling will take about a year. The process suffered some delays because there were no spare places in the cooling pools and the new spent nuclear fuel facility was not yet in place. These delays make the decommissioning process more expensive but less painful for the workforce.

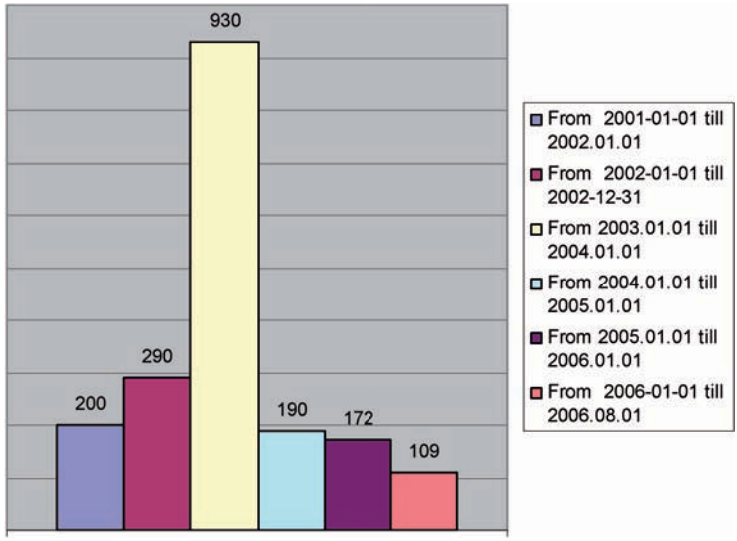

FIG. III–4. Changes in workforce numbers at Ignalina NPP over the years from 2000 to 2006.

III–5. SOCIAL CONSEQUENCES FOR THE REGION

The town of Visaginas (population approximately 30 000) was purpose-built to serve the NPP, and INPP remains by far the largest employer. Although there are pockets of Russian language speakers in communities throughout Lithuania, Visaginas is the only example on the scale of a whole town.

The town of Visaginas has an urban type labour force, with a young age structure (residents under 41 years of age account for 67% of the population), well educated people and a considerable variety of professional occupations. Ignalina and Zarasai districts have a rural type labour force: an older age structure, lower education level and a narrow variety of professional occupations.

In order to expand the supported industrial area in territories adjacent to INPP, the INPP region was created by a decision of the Government taken in 2002. It consists of three municipalities: Visaginas, Ignalina and Zarasai. There are approximately 72 000 inhabitants in this region. Having started the decommissioning process, the number of workers in the plant fell from about 5000 in 2000 to 3394 on 1 December 2005. It is scheduled that after the shutdown of the second unit at the end of 2009 the plant will have only 1500 workers. This may have a marked negative influence on the economic development of the

regional municipalities and cause social tension. There are 980 employers in the region (including public institutions), about 700 of whom are small to medium sized enterprises (SMEs) who have no more than 250 workers [III–2].

The Regional Development Council and Regional Development Agency started functioning in 2003. The first strategic programming document, the regional development plan (strategy), has been prepared. The main aim of the regional development was identified: to regenerate the region from the social and economic points of view and to ensure the creation of new jobs in a balanced development. Later, on the basis of the development plan, an SME development programme, an infrastructure development plan and a social support development programme were prepared.

In 2003, a business grant scheme was implemented. It granted irrevocable subsidies of up to 100 000 Lithuanian litas to SMEs for implementing business development projects. By applying the measures of direct support for business, 320 new jobs had already been created in the region during 2003–2005 and 68 enterprises have been supported. Another 54 jobs have been created in the first six months of 2006. A transparent granting mechanism and typical grant contracts will enable beneficiaries to ensure current control of projects and the legitimacy and efficiency of asset utilization. The agency finances 50% of appropriate expenses.

Local initiatives and youth programmes of the region have also been prepared and administered. The non-governmental organization sector is being supported in these programmes, ensuring that the whole community would be able to develop by making use of the full available potential. The best projects are supported as judged in a contest.

The INPP Region Business Incubator was established in Visaginas (Fig. III–5). It provides information/consulting services for businessmen as well as leasing premises on easy terms for the newly established enterprises. The effectiveness of business support institutions in the region (Zarasai and Ignalina business information centres) should be stressed.

Lithuania joined the EU in 2004, and the private and public sectors now have opportunities to receive the support of EU structural funds. An industrial park has been established in the territory of the industrial zone in Visaginas. In 2006, the furniture factory Visagino linija started functioning, creating 250 new jobs during the first stage (up to 700 later).

A potentially important investment decision for the INPP region was made by the Lithuanian Parliament (Seimas) in December 2006 by adopting the new National Energy Strategy. The main issue in this strategy is a proposal to construct a new NPP in the period 2013–2020. It would provide a great opportunity for the Ignalina region of Lithuania to secure its prosperity.

FIG. III–5. The Ignalina NPP Region Business Incubator in Visaginas.

REFERENCES TO ANNEX III

[III–1] MELLOR, R.A., SAWYER, T.M., SZALINSKI, S.J., "Workforce transition of the WVDP from operations to decommissioning", paper presented at Conf. on Decommissioning, Decontamination and Reutilization, Denver, CO, 2005.

[III–2] ABRAMAVIČIUS, A., Possibilities and Perspectives of INPP Region (2006), http://www.inppregion.lt/index.php?cid=6435

Annex IV

SOCIOECONOMIC ASPECTS OF DECOMMISSIONING PROJECTS IN THE RUSSIAN FEDERATION

IV–1. INTRODUCTION

The Russian Federation is now fully engaged in decommissioning, with the list of affected facilities reaching several hundred. Shutdown and the necessity for proper management of various nuclear installations have required a broad spectrum of regulatory, financial, organizational and technical activities. Noticeable progress has already been achieved, although a significant number of issues still require realistic and carefully considered solutions. As domestic and foreign experience shows, socioeconomic aspects may become crucial in influencing the success of both the decommissioning project itself and the post-decommissioning fortune of the locality or region. In the delicate sphere of human relations and social interactions, it would be folly to rely upon finding solutions to the problems that may arise without thorough preparation and detailed examination of all the likely variants of events that may develop. This requires time as well as purposeful and closely coordinated efforts of both local and federal authorities.

In this annex, an attempt is made to highlight the topicality of socioeconomic issues, with the emphasis on country-specific realities.

IV–2. EXPERIENCE TO DATE

The Russian Federation has already faced serious socioeconomic problems occasioned by the shutdown of numerous nuclear facilities. This occurred in the 1990s, mostly as a result of nuclear disarmament within the framework of the Strategic Arms Limitation Treaty. At that time, a few scores of nuclear submarines, the majority of the industrial uranium–graphite reactors (10 out of 13) and related defence works for production of nuclear weapons were almost simultaneously removed from service. This was accompanied by dramatic staff reductions, resulting in mass transfer of naval officers to other

places of service or to the reserve, and in compulsory redundancy for many highly qualified specialist personnel from the defence nuclear enterprises[1].

It can be stated that such changes are more or less regular for service personnel; however, for civilians, the unforeseen (sudden and imposed from outside) loss of jobs is bad news, even in a favourable economic environment. In the so-called Closed Administrative–Territorial Formations (CATFs) (relatively small towns located in the restricted territories of large nuclear establishments), where practically everyone is critically dependent on the continuing operation of multiple nuclear facilities, such an unexpected reduction in production capacity may acquire the character of a social catastrophe.

Unfortunately, there is limited available reporting of events during those years in CATFs, either in the press or in the more specialized literature. The Ministry for Atomic Energy and the administrations of CATFs made efforts to mitigate the social consequences of forced decommissioning of nuclear facilities by the 'conversion' of defence facilities into civilian ones. For these purposes, some factories were created for the production of consumer goods, and the production of radioisotopes for various applications in industry and medicine was expanded and diversified. However, because of the lack of verified information, it is difficult to confirm how successful these and other actions were, and how seriously the population and economies of CATFs were affected by the shutdown of nuclear facilities. One might suppose that the socioeconomic situation was difficult, and that this factor, apart from anything else, would have negatively influenced the psychological climate in CATFs.

Nevertheless, these events generally took place almost unnoticed by the wider public and the professional community. That happened partly because of the traditional atmosphere of secrecy around the defence establishments but mostly because early closure of nuclear facilities took place against the backdrop of difficulties in the overall economic position in the country. Suffice to say that in five years (1991–1995) GDP fell by a factor of as much as 2.5 times, national revenue by 3.6 times and investment by 3.8 times [IV–1].

The above experience supports the following generalization: The socio-economic aspects of nuclear facility decommissioning may, under certain conditions, turn out to be a crucial factor, influencing many aspects of the decommissioning process itself and the post-decommissioning fortunes of a locality or even region.

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[1] Owing to the decommissioning of nuclear facilities and for a number of other important reasons, the number of employees in the Minatom system has been reduced by a factor of five, to about 300 000 people, over the last 15 years.

It appears that the experience of the 1990s was not adequately recorded and/or promulgated in order to ensure that lessons could be learned[2]. In any event, socioeconomic aspects of decommissioning seem to have had limited consideration as a topical issue of sustainable development of the nuclear sector. Much practical experience of the recent past has probably been effectively lost, with information scattered through documents of limited distribution.

Meanwhile, the country remains involved in large scale decommissioning programmes[3]. The scope and the rate of this activity will increase, and timely solution of socioeconomic issues is undoubtedly a task of great importance.

During preparations for decommissioning, the experience in this field worldwide must be carefully investigated and then used in national practice to the extent that is applicable to actual conditions. However, country and/or region specific features can play an important and often decisive role in the search for effective solutions, in the Russian Federation or elsewhere.

IV–3. CURRENT SITUATION

To maintain a balanced view, it should be noted that:

(a) Activities in the decommissioning of nuclear submarines have now entered a phase of stable and balanced realization.
(b) Ten NPP sites are operating in a steady regime and, in accordance with the resolution of the Government, all the existing reactor units are planned for continued operation (plant life extension for five to ten years).
(c) The Federal Atomic Energy Agency may revive the strategy for nuclear power development and expand international cooperation in the field of nuclear fuel cycle technology.

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[2] The problem is not limited to the nuclear sector. As a result of early closures (military bases, machine building plants, collective farms, peat cutting, etc.), scores of economically depressed areas and settlements with degraded social infrastructure came into being in the 1990s.

[3] At present, more than 200 nuclear submarines with about 450 nuclear reactors, a few tens of auxiliary vessels, ten industrial reactors, open radioactive waste storage ponds with a total capacity of about 4×10^8 m^3, 30 research reactors, four NPP units, more than 100 radioisotope thermoelectric generators and the 'Radon' establishment in the Murmansk region are all at various stages of decommissioning.

(d) It is planned to construct a large plant for the production of mixed oxide fuel.
(e) There is some hope for the development of additional reprocessing capacity on the basis of expected orders for storage and/or treatment of spent nuclear fuel from abroad.

Therefore, for the time being, the situation in the nuclear sector of the economy seems to be stable, and perhaps quite good. However, that in no way reduces the level of urgency of decommissioning related issues.

To illustrate the potential socioeconomic consequences of how events could unfold, it is useful to consider an extreme hypothetical scenario — the sudden and simultaneous shutdown of all NPP units. Considering the Leningrad NPP (LNPP), situated at Sosnovy Bor, eighty kilometres from St. Petersburg, such a scenario would immediately result in the following:

(a) A 50% shortage of electricity in the St. Petersburg region;
(b) The loss of jobs for 23% of the able-bodied population of Sosnovy Bor;
(c) The suspension of additional payments to the State pension of NPP retirees;
(d) The loss of the district heating capacity;
(e) A fall in the gross economic output of the town by a factor of 3.3 and a cut in municipal revenue by 2.5;
(f) An economic shock (if not collapse) for more than 200 outside companies contracted with LNPP.

In a sense, this is not even the most disastrous situation for towns adjoining NPPs, because in Sosnovy Bor, in addition to the NPP, there are a number of other large organizations and enterprises, such as the A.P. Alexandrov Research Institute of Technology, the Leningrad special enterprise 'Radon', the Joint-Stock Company Ecomet-S and a branch of the Central Design Bureau of Machine Building. In the majority of other towns, for example Desnogorsk (Smolensk NPP), Polyarnye Zori (Kola NPP) and Kurchatov (Kursk NPP), NPPs are probably the only significant employer and the absolutely dominant source of municipal budgets. In Polyarnye Zori, for example, the NPP provides 93% of industrial output.

Although it appears that this extreme scenario will not occur under any reasonable circumstances, the real economic conditions in the towns adjoining NPPs are such that even a limited change in nuclear related activities could significantly affect many people with consequences that are difficult to predict.

IV–4. THE EFFECTIVENESS OF SOLUTIONS IN PRACTICE

Theoretically, approaches to solve the socioeconomic problems are quite well known. These are:

(a) *Prepare for change*: Planned activities to support staff morale and prepare them psychologically for the decommissioning of the facility and the coming changes in their lives. Help needs to be provided in order to motivate people in the timely search for suitable occupations and to seek sources of extra earnings to supplement their pensions. The overall aim is to address the phenomenon known, since the Chernobyl accident, as the 'victim' syndrome, which creates an atmosphere of mistrust, desperation and apathy in both family and social life. Frequently, this can influence human health and the vitality of society even more strongly than temporary unemployment and lack of a livelihood.
(b) *New nuclear build*: Timely commissioning of substitute nuclear generating capacity, if planned and economically promising.
(c) *New investment*: In advance of need, to allow diversification of the economy.
(d) *Redeployment*: Creation of new places for work, taking into account, as far as possible, the specializations and/or qualifications of NPP personnel.
(e) *Retraining*: Specific retraining of staff. This is justified and worthwhile when there is a clear requirement for certain professions in the locality or region.
(f) *Resettlement support*: Payment of reasonable resettlement allowances, i.e. determined on the basis of a reasonable compromise between social expectations and the actual capability of the State[4].
(g) *Information on opportunities*: Dissemination of information about employment opportunities outside the locality/region limits.

The fact that practically every item of the above list has some preconditions and provisos primarily reflects the inherent complexity of choosing the optimal strategy. What is applicable in one country or region can be unacceptable in another. What is desirable for regional administrations can be completely unattractive for investors. Objectively justified and necessary

[4] All the NPPs in the Russian Federation are State owned. The State, and not the market, determines tariffs and controls the financial resources of NPPs. This is why the State must bear the responsibility for the future of staff, in particular in the case of early closure of an NPP.

actions can be hampered by the lack of resources or even the inability of decision makers to recognize the need. The needs and initiatives of the regions can be at variance with the urgent tasks of the Federal Government. It would be short-sighted, and to a certain extent risky, to give NPP staff everything necessary for life at the expense of aggravating the conditions of other members of the community. To determine an optimal socioeconomic approach requires considerable time, close coordination of all the parties that must be involved, and careful examination of all the details and limitations.

IV–5. LIMITATIONS ON SOCIOECONOMIC SOLUTIONS

In the Russian Federation, as in similar situations elsewhere, one key limitation can be the low mobility of the workforce. Reasons for this include existing expectations of security of job location and the challenge of finding affordable alternative accommodation following a move.

For example, according to a survey of NPP employees, one of the most important issues was neither employment security nor career development but the possibility of purchasing their homes.

Such limitations on workforce mobility can be an important factor in economic development in general and provision of employment for discharged NPP staff in particular. However, from the standpoint of an NPP town's survival, this factor should not necessarily be considered as purely negative.

As a rule, in the settlements adjoining NPPs, 10–20% of the population work at the NPP, providing 60–90% of municipal revenue. Thus, in order to maintain the same level of activity and social security after the closure of a nuclear facility, it is extremely desirable to create in the locality another efficient and profitable enterprise. In that case, the availability of a sufficient contingent of qualified workers can provide advantages to the NPP town compared with other potential candidates.

Certainly, creating new enterprises cannot be recommended in such a situation as the only way forward. However, under certain conditions, for example, attractiveness of the site for investors due to its geographical position, favourable taxation regime, stability of regulation, existence of necessary infrastructure, opportunities for development and, above all, with the timely and committed efforts of decision makers, it can be an apt solution.

Housing is not the only issue potentially influencing the decision making process. Other challenges might include linguistic barriers, a high average age amongst the nuclear facility's employees, matching new jobs to the qualifications of discharged employees and the number of dependants in an average family.

Thus, comprehensive analysis of various non-technical factors should be considered as an indispensable precondition for the successful delivery of any decommissioning project. In this connection, the following important questions arise:

(a) Who should initiate and organize the necessary preparatory activities and how should they proceed?
(b) Who should be responsible for implementing and funding socioeconomic programmes?
(c) Which indicators and criteria could be used for the assessment of the socioeconomic consequences of decommissioning projects?

IV–6. MEETING FUTURE CHALLENGES

Some impressive examples of workforce transition programmes exist, as has been discussed in the main text of this report. However, in most other cases, such activity has an episodic and reactive character. If the way a problem is posed focuses only on formal assistance to staff discharged from the nuclear facility in their search for new work, it is difficult to achieve good results.

Ideally, the emphasis should be on the maximum use of human potential for further development of the local or regional economy. In that case, the initial conditions of the mission are changed in a radical way. The release of the qualified workforce becomes a planned and expected event. The workers are helped to take ownership of the situation and there is more predictability in their lives, thereby ensuring social stability for the rest of the community.

Such a scenario is ideal where there is timely replacement of shut down reactors by new nuclear facilities. In the Russian Federation, decisions concerning the construction of new nuclear power units are the exclusive prerogative of the Government. The management of the NPP and the local administration have little influence. The role of the regional administration is also rather limited, either welcoming the initiative of the Government or raising objections. Indeed, the federal authorities do not bear the formal responsibility for local or regional difficulties arising as a result of a nuclear facility shutdown.

When it is a matter of private investment in non-nuclear high-tech enterprises, regional and local administrations have, in principle, more freedom over decision making. The question is: What can encourage a large investor to come to a given locality or region? Availability of qualified workforce is a positive factor, but it is not the only consideration influencing the decisions of investors.

These, and a number of other issues associated with the coming shutdown of nuclear facilities, require recognition and due attention from those with the power to influence events. It is necessary to understand that, at present, foreign donors will not support discharged employees of NPPs and nuclear fuel cycle facilities in order to prevent dissemination of nuclear know-how, as was done during the first wave of staff reductions through, for instance, the projects of the International Science and Technology Centre.

Having acknowledged the problem, it would be reasonable to:

(a) Conduct a comprehensive analysis of the situation and probable scenarios of how it may develop;
(b) Establish indicators for comparative assessment of the productivity of relevant activities;
(c) Determine the resources that will be necessary;
(d) Adapt the legislative base (if necessary);
(e) Create specific State programmes with clearly defined responsibilities and plenary powers, involving all relevant parties, and with viable mechanisms of control, encouragement and compulsion.

It is understandable that such an algorithm can only be successful if the socioeconomic aspect of nuclear facility decommissioning is considered as crucial to sustainable development of the national economy. In order to arrive at such conclusions or to reject them, it is necessary to conduct an open and constructive discussion about the subject.

REFERENCES TO ANNEX IV

[IV–1] CENTRE FOR COMPLEX ECONOMIC PROGRAMMES, Modernization, CCEP (1995).

Annex V

SOCIOECONOMIC IMPACT OF THE DISMANTLING OF VANDELLÒS I NUCLEAR POWER PLANT, SPAIN

V–1. INTRODUCTION

The Vandellòs I nuclear power plant was connected to the grid for the first time in March 1972. It ceased to operate in October 1989 owing to a fire that damaged the conventional facilities of the plant. Nevertheless, this did not have any radiological consequences. This event marked the beginning of the dismantling process of the nuclear plant, the first to be undertaken in Spain and one of the few commercial power reactors to be dismantled anywhere in the world. As from 1998, ownership of the plant was transferred to ENRESA for the latter to proceed with the dismantling.

As with any investment project, the dismantling of a nuclear facility causes an influx of economic resources that benefit local agents, companies and the overall economic prosperity of a given area. This boost of resources positively affects the economic activity in the region, translating into job creation, increased demand for local services, the possible creation of new companies and a general increase in local production. Other types of investments also have positive consequences for the local economy, for example, subsidies to improve local infrastructures and more funding to provide better social services.

Although there have been several studies on the economic impact of building nuclear facilities, studies dedicated to their dismantling are practically non-existent. This research project aims precisely at determining the economic impact associated with the dismantling process of the Vandellòs I NPP in terms of the overall revenues that closure of the facility generated in the area.

V–2. COLLABORATING COMPANIES

V–2.1. Investment made

We begin by studying the direct impact of dismantling of the plant on its different areas and spheres of influence. The area of influence of the plant refers to different zones, areas or districts, including different municipal areas, on the basis of their distance from the NPP. Specifically, and in accordance with data provided by ENRESA, a classification was designed as presented in Table V–1.

TABLE V–1. CLASSIFICATION OF THE AREA OF INFLUENCE OF VANDELLÒS I NUCLEAR POWER PLANT

Zone	Area of influence	Affected populations
1	Municipal	Vandellòs i l'Hospitalet de l'Infant
		L'Ametlla de Mar
		Mont-roig del Camp
		Pratdip
		Tivissa
2	Regional	Baix Camp
3	Provincial	Province of Tarragona
4	National	Other areas

TABLE V–2. INVESTMENT (IN EUROS) MADE IN THE DISMANTLING PROCESS

Year	Zone 1	Zone 2	Zone 3	Zone 4	Total
1998	8 320 564	407 449	477 449	6 294 839	15 500 301
1999	7 551 787	380 937	548 774	11 184 687	19 666 185
2000	7 768 051	360 711	609 586	13 266 875	22 005 223
2001	7 583 342	752 738	1 044 987	12 735 700	22 116 767
2002	5 816 147	1 433 507	2 615 793	11 009 819	20 875 266
2003	1 341 975	767 788	1 553 230	3 966 026	7 629 019
Total	38 381 866	4 103 130	6 849 819	58 457 946	107 792 761

Table V–2 shows that most of the investment has been made in the areas designated as Zones 1 and 4. Regarding the total direct investment, 54% of this amount has gone to Zone 4, while Zones 1 and 2 (areas closer to the facility) received around 40% of this investment. Within the municipal category, distribution of this amount (40%) is quite unbalanced. The adjacent towns directly surrounding the NPP (Zone 1) received most of this investment (specifically 36% of the total), while the remaining municipalities within the Baix Camp area received only 4%.

The economic impact of permanent shutdown is closely linked to the social impact. Loss of income (due to both direct and indirect effects) has a significant effect on the area influenced by the installation. This is for the following reasons:

(a) A reduction in economic activity in the municipal areas affected that is caused by the disappearance or reduction in activities formerly carried out during the operation of the facility — services (maintenance, cleaning and subcontracting), refuelling outages and indirect activities (commercial and services).
(b) A reduction in revenues (taxes, rates and economic compensation) for municipal administrations, causing in turn a reduction in the activity of these administrations and, therefore, lower investments and reduced activity.
(c) Blocking of the site for other uses, thereby preventing the development of alternative activities.

The negative impact of decommissioning makes it necessary for the time lag between permanent shutdown and decommissioning to be as short as possible, as this is a period of uncertainty and economic slowdown in the area.

The direct loss of employment from the end of operations at the Vandellòs NPP was almost 300 jobs in a community of some 4000 inhabitants.

The loss of indirect employment affected not only support to the NPP but also community commerce and services.

V–2.2. Companies participating in the dismantling process

A similar analysis may also be performed in reference to the average number of companies that participated directly in the Vandellòs I NPP dismantling process. In this case, it may be observed that, unlike what occurred with the levels of investment, Zones 3 and 4 were those that on average provided the largest number of companies in the dismantling process (Table V–3) followed by Zone 1 and, finally, Zone 2.

In absolute values, Zone 1 provided 46 companies from the total, while Zone 2 provided 11, and Zones 3 and 4 provided 70 and 80, respectively.

In relative terms, 38% of the companies that have on average participated directly in the process of dismantling the Vandellòs I NPP come from the area we have classified as Zone 4, while 34% correspond to Zone 3 and the remaining 27% relate to the municipal areas closest to the plant. As in the previous case, the distribution among the adjacent areas is unequal, since Zone 1 corresponds to 22% of the total number of companies, while the rest of the municipal areas in the Baix Camp (Zone 2) include only 5% of these companies.

Excluding 2003, which corresponds to the final phase of the dismantling process, when business activity was already clearly declining and the number of

TABLE V–3. AVERAGE NUMBER OF COLLABORATING COMPANIES

Year	Zone 1	Zone 2	Zone 3	Zone 4	Total
1998	50	9	62	116	237
1999	57	11	65	71	204
2000	56	11	62	95	224
2001	43	14	61	91	209
2002	42	11	112	47	212
2003	29	10	60	62	161
Average	46	11	70	80	208

companies required was appreciably lower, a trend over time of the number of collaborating companies is observed. Both generally and when considering Zones 1 and 2 (the municipal and district levels) individually, the average number of collaborating companies remained more or less constant throughout the time period considered (1998–2002). The provincial zone (Zone 3) also shows stable behaviour throughout the period considered, except for 2002 when it peaked at 112 collaborating companies.

V–2.3. Analysis of workers

We shall begin by studying the number of workers and the days they have worked on the basis of the sector of activity associated with the companies that hired them and the zone in which these employees live. Table V–4 specifically shows this relationship.

It should be pointed out that we have divided the sectors to which the different collaborating companies belong into three categories: industry, construction and service. The agriculture sector has not been included for obvious reasons. Another factor worth considering is that workers hired as interns have also been accounted for as part of this study. Interns do not belong to any specific company but also form part of the dismantling process, as a result of which they have been included in the analysis of workers belonging to collaborating companies.

Table V–4 and Fig. V–1 illustrate how the construction sector has absorbed the largest number of workers (62.4%), followed by the service sector (25%) and the industrial sector (12.6%). However, when the number of days worked is observed, the proportions change substantially. Thus, over 43% of the days worked correspond to companies that operate in the construction sector, followed by 33% that relate to industry and approximately 23%

TABLE V–4. NUMBER OF WORKERS AND DAYS WORKED BY SECTOR OF ACTIVITY AND ZONE

	Sector			
	Industry	Construction	Service	Total
Number of workers				
Zone 1	93	174	155	422
Zone 2	7	60	19	86
Zone 3	12	139	30	181
Zone 4	2	189	21	212
Total	114	562	225	901
Days worked				
Zone 1	119 218	195 966	76 895	392 079
Zone 2	9 939	75 738	6 790	92 467
Zone 3	17 480	16 873	12 159	46 512
Zone 4	2 699	44 258	10 132	57 089
Total	149 336	332 835	105 976	588 147

referring to services (Fig. V–1). These results are coherent since the construction sector is much more labour intensive than the other two sectors and, therefore, corresponds to a greater proportion of days worked per worker.

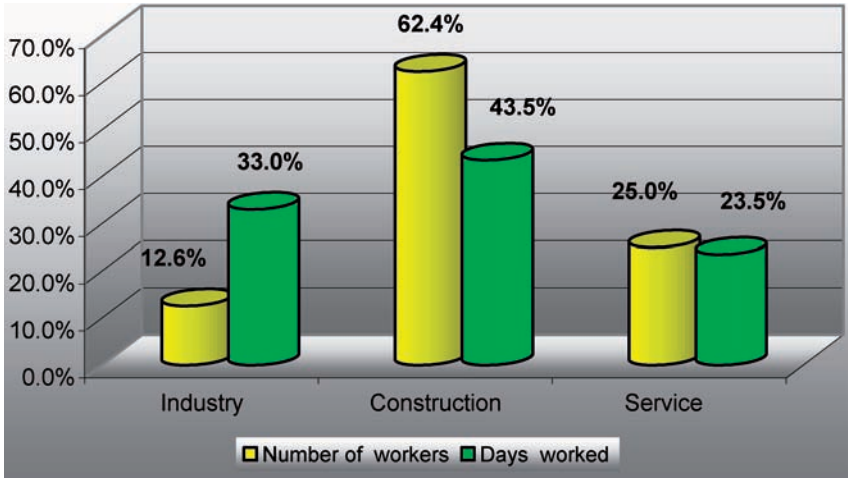

FIG. V–1. Number of workers and days worked by activity sector.

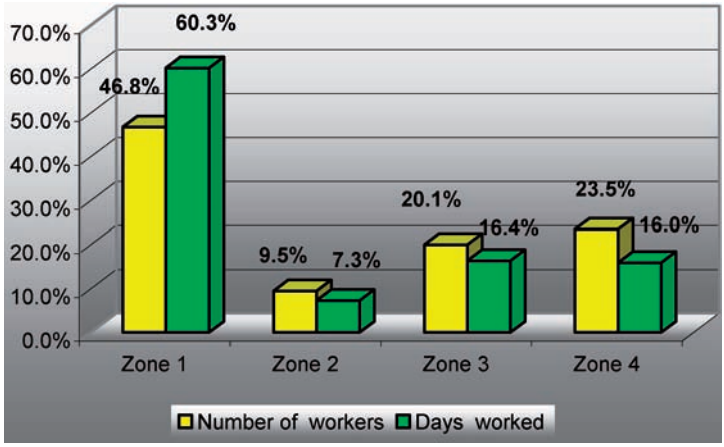

FIG. V–2. Number of workers and days worked based on origin.

We may also deduce from Table V–4 that most of the workers, as well as the days worked, correspond to the municipal and regional areas within Zone 1, which refer to municipal areas close to the NPP. This result may also be observed in Fig. V–2. Thus, 56.3% of the total number of workers resided in the municipal or regional areas (Zones 1 and 2), while 23.5% lived in Zone 4 and almost 20% resided in the provincial area (Zone 3). As occurred previously, the distribution between Zones 1 and 2 is quite unequal and clearly favours the municipal area. On the other hand, this difference becomes even further accentuated when considering the days worked: 60.3% correspond to Zone 1 residents, while 7.3% refer to Zone 2 inhabitants. The other two zones present similar percentages.

Finally, Table V–5 shows the distribution of the number of workers based on the sector to which their companies belong and their origin. It may be observed that Zone 1 contains the most workers. Almost 82% of industry workers originate from this zone, while close to 69% of its residents work in the service sector and 31% are employed in construction. More balanced percentages among the different zones are shown specifically in construction. While 31% of all employees in this sector are from Zone 1, special mention should be made of the fact that 33.6% reside in Zone 4 and 24.7% come from Zone 3.

On the other hand, Table V–6 indicates how workers are distributed on the basis of their professional category within the same zone. Of the total number of workers residing in Zone 1, 10.4% are interns (students) (INs), 77.3% are auxiliaries (AUs), 2.1% are foremen (FMs), 6.6% are intermediate technicians (ITs) and 3.6% are certified technicians (CTs).

TABLE V–5. DISTRIBUTION OF NUMBER OF WORKERS (%) BASED ON SECTOR OF ACTIVITY

	Industry	Construction	Service
Zone 1	81.6	31.0	68.9
Zone 2	6.1	10.7	8.4
Zone 3	10.5	24.7	13.3
Zone 4	1.8	33.6	9.3

TABLE V–6. WORKER DISTRIBUTION (%) BY ZONE AND PROFESSIONAL CATEGORY

	IN	AU	FM	IT	CT
Zone 1	10.4	77.3	2.1	6.6	3.6
Zone 2	7.0	77.9	1.2	9.3	4.7
Zone 3	5.6	89.4	0.6	2.2	2.2
Zone 4	1.4	79.3	5.2	8.0	6.1

Zone 2 (other municipal areas within the Baix Camp) also presents a similar distribution, since most of the workers residing in the area are auxiliaries (77.9%). Unlike Zone 1, 9.3% of the workers are intermediate technicians, followed by interns (7%), certified technicians (4.7%) and foremen (1.2%).

V–2.4. Collaborating companies: municipal analysis

To conclude this analysis, we have pinpointed several municipal areas or cities that might be significant in each zone for this study. We have selected all the municipalities found within Zone 1. Cambrils and Reus have been selected from Zone 2, while Tarragona and Tortosa are the chosen cities from Zone 3. Barcelona and Madrid have been selected for Zone 4. We have sought the number of workers per professional category from each of these municipal areas or cities. The results of this search are shown in Table V–7. Most of the workers from Zone 1, in all the professional categories considered in this table, come from the town of Vandellòs i l'Hospitalet. Mont-roig del Camp is at a distant second location. Three other municipalities appear with much lower numbers. The number of workers that come from Pratdip and Tivissa

TABLE V–7. NUMBER OF WORKERS BY TOWN OF RESIDENCE AND PROFESSIONAL CATEGORY

		IN	FM	AU	IT	CT
Zone 1						
	L'Ametlla de Mar	1	0	14	0	0
	Mont-roig del Camp	5	1	60	2	6
	Pratdip	0	0	4	0	0
	Tivissa	0	0	12	1	0
	Vandellòs i l'Hospitalet de l'Infant	38	8	236	25	9
	Total for Zone 1	44	9	326	28	15
Zone 2						
	Cambrils	3	1	28	6	1
	Reus	1	0	32	2	2
	Total for Zone 2	6	1	67	8	4
Zone 3						
	Tarragona	3	2	49	2	3
	Tortosa	1	0	4	0	1
	Total for Zone 3	10	2	161	4	4
Zone 4			0	0	0	0
	Barcelona	0	0	12	0	1
	Madrid	0	2	16	8	6
	Total for Zone 4	3	10	169	17	13
	Grand total	63	22	723	57	36

corresponds to the sizes of these towns. However, the same does not hold true in the case of L'Ametlla de Mar. In view of its size, a larger number of workers from this town should have participated in the NPP dismantling process.

Workers residing in Cambrils and Reus represent approximately 90% of all the employees from Baix Camp (Zone 2). Both cities show similar numbers, except for intermediate technicians, where the greatest concentration corresponds to Cambrils.

When analysing the remainder of the province (Zone 3), Tarragona is seen to be home to 33% of all the workers from this area. As in the case of Baix Camp, 56% of intermediate and certified technicians come from this city.

As regards the auxiliaries from Zone 4, Barcelona and Madrid show similar values. Nevertheless, special mention should be made of the fact that, in view of the wide range of the study, there is a strong dispersion of workers

throughout the entire country. Madrid does stand out in terms of qualified personnel, intermediate technicians and certified technicians, since 30% of these reside in the Spanish capital.

V–3. ECONOMIC EFFECTS ASSOCIATED WITH DISMANTLING

V–3.1. Effects on income

The construction of Vandellòs NPP led to an increase in the local population (at that time, Hospitalet de l'Infant was not a municipality but a quarter of the Vandellòs municipality), a change in economic activity and an increase in employment. In addition, the start of operations produced an increase in municipal incomes, but the end of construction contracts and related employment.

Any investment project brings a boost in income for the receiving economy. This increase causes additional effects on financial institutions and economic agents, whereby the initial improvement ends up being multiplied. Figure V–3 illustrates the sequence of effects on production income, which may be classified in the following manner:

(a) *Direct effect*: This effect relates to the initial injection of income on production activities. Consequently, the direct effect includes the impact of product purchases resulting from the investment on the different sectors of the reference economy.

(b) *Indirect effect*: The sectors receiving the direct demand will in turn require inputs and raw materials from other industries, and this will cause a corresponding boost in the production of these sectors. This indirect effect captures the impacts on production caused by chain reactions in investment and initial spending, as a result of the dependencies that exist among the production activities.

(c) *Induced effect*: The direct and indirect effects trigger increases in the production sectors, as a result of which the productive sectors will increase labour contracting in order to satisfy this production growth. Higher employment will result in higher salaries and boost consumer income. This in turn will increase consumption, which will generate new production increases. In short, the induced effect measures the feedback triggered on production activities as a result of an outside shock in demand that increases production and, therefore, raises salaries, generating an increase in consumption and a further impact on production.

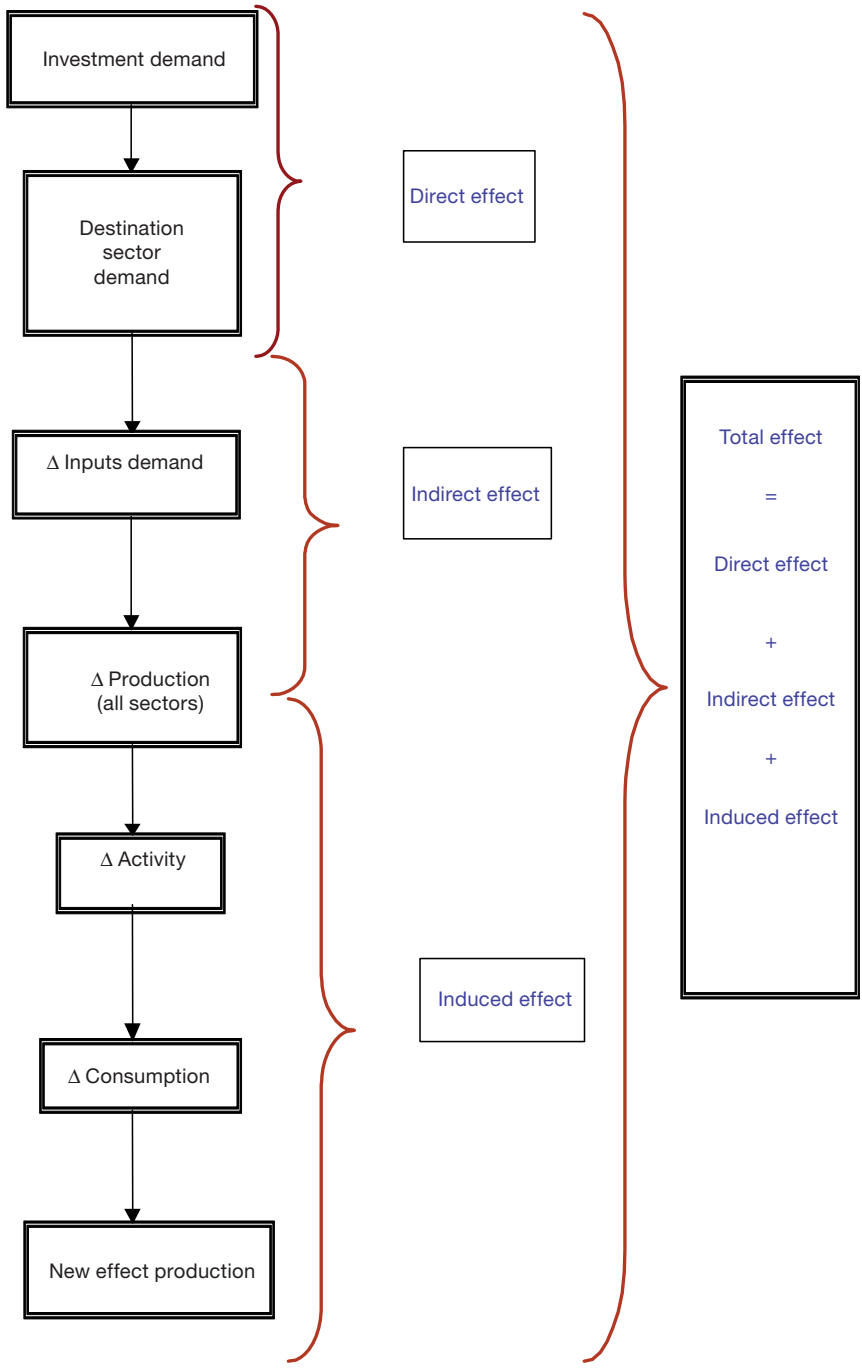

FIG. V–3. Effects on productive income. Here Δ means 'change in'.

V–3.2. Effects on employment

Quite apart from the aforementioned effects on the income of the production sectors, investments generate impacts that materialize in relation to other economic variables. The creation of employment in the local economy takes special prominence among them.

Considering that any investment causes an increase in production activity, the sectors affected need more workers to satisfy this production growth. This increased demand for labour constitutes a positive effect on employment in the area that receives this investment, known as the occupation effect.

V–3.3. Effects on the creation of companies

Investment triggers all kinds of new relationships with the local production structure, materializing in a demand for service providers and the contracting of activities with local agents and companies. As a result of this, the new demand may be associated with a process of creation of companies at local level to satisfy the services required by the investment project.

It should be pointed out that the effect on company creation is difficult to quantify beforehand, i.e. before the investment process has reached its culmination and before it is possible to establish all its consequences. Occasionally, it may also be difficult to establish a cause–effect relationship between the setting up of companies and investment decisions, i.e. it may be difficult to be entirely sure that the setting up of a company is due solely to a specific investment project. All of these difficulties explain the fact that impacts on the creation of companies generally fall outside the margin of analysis.

V–4. ECONOMIC IMPACT OF DISMANTLING

The economic impact is calculated using the input–output method, which broadly speaking consists of defining a group of relationships that reflect the connections within the production framework. The logic of the input–output model is based on the idea that, in response to an increase (reduction) in the final demand of a sector, this sector should produce more (less) to satisfy the new demand. This should in turn lead the sector to demand more (less) intermediate consumption from the remaining sectors that, in addition, should produce more (less) and use more (less) intermediate inputs, and so on. In brief, therefore, the increase (reduction) in final demand in a given sector multiplies throughout the entire economy, in keeping with the relationships of interdependence that exist between all productive activities.

The, at that time, latest input–output table available for Catalonia, referring to the year 1987, was used as a starting point. By means of statistical techniques of adjustment, a double forecast was made from this table: a timeline forecast (from 1987 to 2001) and a territorial forecast (from Catalonia to the province of Tarragona, the Baix Camp region and, finally, all five municipalities adjacent to Vandellòs I NPP).

The study of the economic impact of the effects of dismantling Vandellòs I NPP was addressed taking three different territorial areas as a reference:

(1) Firstly, the effects on the creation of activity and employment in the province of Tarragona were evaluated.
(2) Secondly, the creation of activity and employment in the region surrounding the NPP (Baix Camp) was assessed.
(3) Finally, the creation of economic activity and employment in the five municipal areas surrounding the Vandellòs I NPP (Vandellòs i l'Hospitalet de l'Infant, L'Ametlla de Mar, Mont-roig del Camp, Tivissa and Pratdip) was estimated.

V–4.1. Investment effect, consumption effect and total effect

The amount of direct spending caused by the closing of the NPP took into account all the categories of demand associated with such closure and the sectors towards which they were directed (Table V–8). Given that assessment of the economic impact required that all the associated expenses were exhaustively taken into account, we consider not only the investment necessary to complete the closure of the facility but also the demand arising from the consumption by the workers directly linked to the dismantling process.

Most of the economic impact is explained by the investment in dismantling, while the consumption of dismantling workers makes a lesser contribution.

TABLE V–8. INVESTMENT EFFECT AND CONSUMPTION (EUROS 2001)

	Investment effect	Consumption effect	Total effect
Tarragona	393 538 532	17 886 897 (4.35%)	411 425 429
Baix Camp	185 059 887	14 492 491 (7.26%)	199 552 378
Municipalities	186 409 077	11 410 080 (5.77%)	197 819 157

V–4.2. Direct, indirect and induced effects

The division of the overall effects on income into direct, indirect and induced effects is shown in Table V–9. In this table, it may be observed how the overall effect significantly amplifies the direct demand caused by the dismantling process.

TABLE V–9. DIRECT, INDIRECT AND INDUCED EFFECTS

	Direct effect	Indirect effect	Induced effect	Total effect
Tarragona	103 222 287	76 687 463	229 515 678	409 425 428
Baix Camp	48 843 425	42 399 521	108 309 432	199 552 378
Municipalities	46 449 997	43 323 604	108 045 557	197 819 158

V–4.3. Effects on employment

The employment effect is shown in Table V–10, where a distinction is made between the impact on occupation caused by the dismantling and the impact on occupation caused by worker consumption.

Again, most of the economic impact is explained by the investment in dismantling, while the consumption of dismantling workers makes a lesser contribution.

TABLE V–10. OCCUPATION EFFECT (NUMBER OF JOBS)

	Investment effect	Consumption effect	Total effect
Tarragona	5687	235 (3.97%)	5922
Baix Camp	2911	200 (6.43%)	3111
Municipalities	2175	121 (5.27%)	2296

V–4.4. Multiplier effects

Table V–11 shows the multiplier effects on production income in each of the territories analysed in the study on the economic impact of the dismantling of the Vandellòs I NPP.

TABLE V–11. COMPARISON OF MULTIPLIER EFFECTS

	Direct effect	Indirect effect	Induced effect	Total effect
Tarragona	1	0.76	2.22	3.98
Baix Camp	1	0.87	2.22	4.09
Municipalities	1	0.93	2.32	4.25

The multiplier effect on income is quantified at 3.98, 4.09 and 4.25 euros, for Tarragona, Baix Camp and the municipalities, respectively. Viewing these values indicates that each monetary unit affected by the dismantling of Vandellòs I NPP generated between 3.98 and 4.25 euros, depending on the territory considered.

V–5. CONCLUSION

The main objective of this work was to determine the economic impact of the Vandellòs I NPP decommissioning process.

The cessation of any economic activity implies a negative economic impact within the area where that activity was established, as was the case with Vandellòs I. Nevertheless, that negative impact has been mitigated by the creation of the new economic activity associated with the decommissioning process. The dismantling project has generated an important positive economic effect, mainly on municipal zone 1 (the area closest to the facility). Moreover, it has allowed the creation of new companies in the locality, specialized in decommissioning. These companies can play an important role in future decommissioning projects to be carried out in Spain.

The dismantling period lasted from 1998 to 2003. During this period, 34% of total direct investments were in the municipalities (Zone 1). Moreover, 22% of the companies that have participated directly in the dismantling process also came from this area.

The best indicator that shows the importance of the dismantling in the influencing area has been the large proportion of workers coming from the local municipalities (Zone 1): 46.8% contributing more than 60% of total working hours; nearly 50% of all professional categories also came from this area.

Without doubt, direct investment has had a positive effect on the municipalities where the facility is located, particularly the adjoining ones. This

positive effect can be observed in the investment generated, as well as in the creation of businesses and the number of workers employed.

The global economic impact has also been evaluated using the input–output methodology. It was used to assess the creation of revenues and employment in the provincial area (Zone 3, Tarragona), corresponding to the global effect of the dismantling. In addition, the revenue and employment creation in the regional area (Zone 2, Baix Camp) and in the five municipalities adjoining the NPP (Zone 1) were also assessed.

The total effect on the provincial economy highlights a multiplier effect from the investment for dismantling. The indirect effect on the production sector multiplies the direct effect (initial investment) by 0.76; and, furthermore, the increased activity produces higher incomes and consumption, which leads to further production increases; when this effect (the induced effect) is included, the rate is about 3.98.

The main contribution on the global economic impact from the above effects is from the induced effect (56%), while the direct and indirect effects represent lower contributions (25 and 19%, respectively).

The private services sector and the construction industry obtained the greater part of the income injected. Overall, dismantling created 5922 jobs in Tarragona, 3111 in the Baix Camp and 2296 in the municipalities.

During the decommissioning and dismantling project of Vandellòs I NPP, several of the activities and projects developed were of lasting social value. These included, among others, a theatre, sports facilities and an industrial area, but the most important was the creation of the Mestral technological centre, located on the site. The main components of this centre are the surveillance programme of the nuclear installation during the dormancy period, a training school on decommissioning and dismantling, and the development of decommissioning and remediation projects for the final dismantling stage of Vandellòs I NPP and for other future decommissioning and dismantling projects.

Annex VI

BARSEBÄCK NUCLEAR POWER PLANT IN SWEDEN: TRANSITION TO DECOMMISSIONING

VI–1. INTRODUCTION

VI–1.1. Description of the installation

Barsebäck is an NPP located in southern Sweden on the west coast of Skåne. Barsebäck NPP is owned by E.ON Kärnkraft Sverige AB (EKS), a subsidiary of E.ON Sverige AB.

The details of Barsebäck 1 and 2 are as follows:

Type:	Boiling water reactor
Capacity:	1800 MW(th)/615 MW(e)
Startup:	1975 and 1977, respectively
Contractor:	ASEA Atom (Westinghouse Electric Sweden)
Owner:	E.ON Kärnkraft Sverige AB, EKS
Operated by:	Barsebäck Kraft AB, Vattenfall
Production:	Barsebäck 1: total 93.4 TW(th) net (30 November 1999)
	Barsebäck 2: total 108 TW(th) net (31 May 2005)
Status:	Barsebäck 1: permanently shut down since 30 November 1999.
	Barsebäck 2: permanently shut down since 31 May 2005.

Barsebäck 1 and Barsebäck 2 are two adjacent installations structurally linked via electric plants, control rooms and personnel buildings (Fig. VI–1). A number of process systems are also integrated between the units.

VI–1.2. History

In 1997, the Swedish Parliament passed a law on the phasing out of nuclear power. The law entitles the Government to decide whether the right to operate an NPP should cease.

On 5 February 1998, the Government decided, on the basis of the 1997 law, that Barsebäck 1 should close in June 1998. An appeal to the Supreme Administrative Court meant that the closure was temporarily postponed. After the Court declared that the Government's decision should stand, Barsebäck 1 was closed permanently on 30 November 1999.

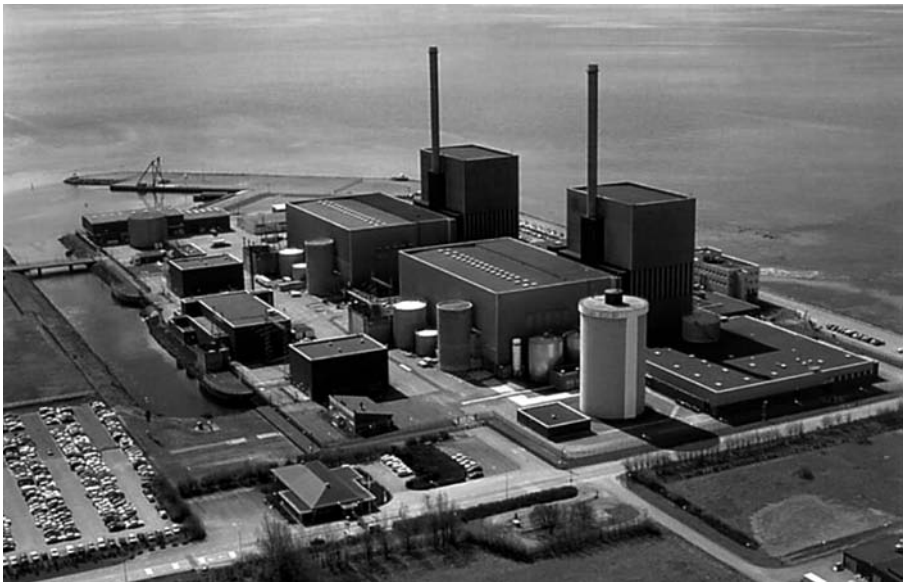

FIG. VI–1. Barsebäck NPP in Sweden.

When the final political decision was taken that Barsebäck 1 would close down, the management of the company, together with the trade unions, set up a project called Framtidsfabriken/Nya Fabriken (The Future Factory/The New Factory) with the aim of carrying out a broad preliminary study of possible future scenarios and of describing these from the corporate and individual points of view. The employees of Barsebäck Kraft AB (BKAB) had a high degree of participation in this work.

On 16 December 2004, the Government decided, again on the basis of the 1997 law, that Barsebäck 2 should close down on 31 May 2005.

VI–1.3. State of ownership

The owner of Barsebäck NPP, EKS, is responsible for decommissioning and dismantling of the Barsebäck plant. E.ON Kärnkraft Sverige AB plans to minimize the life cycle cost and dose load for its total decommissioning undertaking for the Barsebäck plant, while taking into consideration the interests of future generations. This work has been commissioned from BKAB by EKS. BKAB is a part of the Ringhals group, owned by Ringhals AB (70.44%) and EKS (29.56%).

VI–2. ORGANIZATION

On 1 April 2002, a new, integrated organization was formed, consisting of the two companies Ringhals AB and Barsebäck Kraft AB(BKAB), which together made up the Ringhals group, with about 1500 employees. The two companies will continue to operate as separate legal entities.

On 1 July 2006, as a result of the closure of the Barsebäck 2 plant, BKAB was reorganized to adapt the organization to the prevailing operating mode (Fig. VI–2). The organization at Barsebäck Kraft AB has gone down from 450 during the operation of units 1 and 2 to 68 employees (February 2007) during the service operation of both units. Service operation begins when all the fuel has been transported away from the installation and other adaptations have been made. It lasts until dismantling operations begin.

The plan is to reach 44 employees after the electrical system has been rebuilt and the decontamination project will be completed by 2008.

VI–3. STATUTORY REQUIREMENTS

According to Section 10 of the Act on Nuclear Activities (1984:3), the licencees of nuclear installations in Sweden are responsible for:

(a) Maintaining safety with regard to the nature of the activity and the conditions under which it is carried out;
(b) Safe handling and final storage of the nuclear waste produced in the activity or of any nuclear material arising from it that is not reused;
(c) Safely decommissioning and dismantling the installations in which the activity is no longer to be carried out.

The Swedish Radiation Protection Authority (SSI) requires that when a nuclear installation is built there should be a preliminary plan for future decommissioning. This was a later requirement, which did not exist when the Barsebäck plant was constructed. Not later than one year after the installation has been finally shut down, SSI requires the licencee broadly to state and justify goals, measures and a timetable for the decommissioning. Nine months before dismantling begins, a detailed dismantling plan must be submitted to SSI.

The Swedish Nuclear Power Inspectorate (SKI) requires that, before an installation can be built, a preliminary plan for future decommissioning must have been drawn up. This plan must be kept up to date for as long as the installation is in operation. Before dismantling and demolition of the installation can begin, the decommissioning plan must be updated and incorporated in the

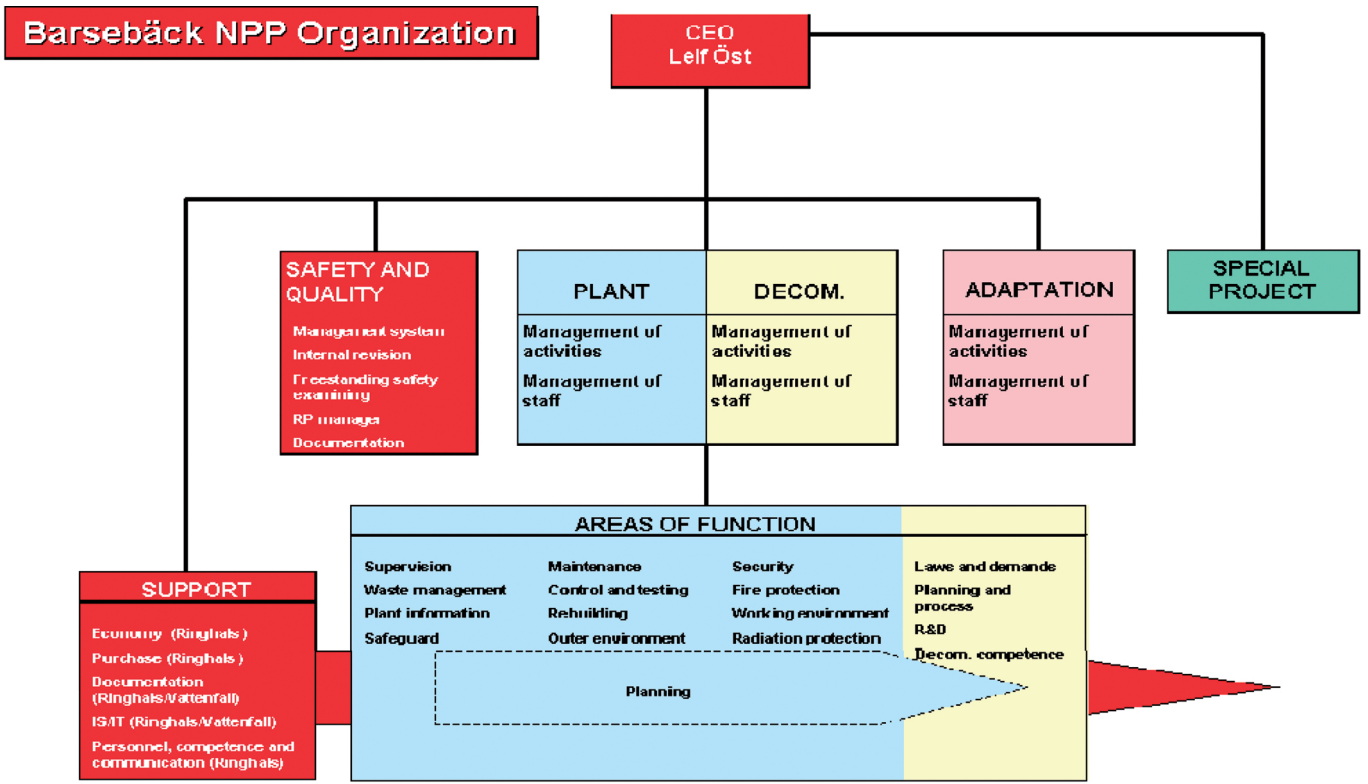

FIG. VI–2. The organization at Barsebäck NPP from 1 January 2007.

safety analysis report of the installation, as well as having undergone safety checking and approval by SKI.

In 1999, new environmental legislation, an Environmental Code, was introduced in Sweden. The Environmental Code (Miljöbalken) gathers all the legislation in the environmental area in one place. At the same time, the scope of the legislation has been made broader and deeper. One new feature is that the operation of existing NPPs must also be subjected to environmental testing. It is a requirement of the Environmental Code SFS (1998:808) that an EIA should be included in an application for an environmental licence to build, operate an NPP or change an activity. An application for an environmental licence and an updated EIA must be sent to the Environmental Court before an NPP is finally shut down.

VI–4. STRATEGY

Investigations have led to the following strategies being developed for shutdown and service operation of the Barsebäck plant:

(a) Service operation must be simple, safe and with costs optimized. This means placing the plant in the lowest energy mode, reducing the need for monitoring, minimizing residual safety risk, and optimizing the costs of service operation and future dismantling.
(b) Dismantling of Barsebäck 1 and Barsebäck 2 will probably be carried out in a joint project.
(c) Ultimate storage for the short lived low and medium activity dismantling waste (SFR-3) must be ready before the dismantling begins. According to the present plan from SKB, SFR-3 will not be operational until 2020 at the earliest. Intermediate storage must be avoided for reasons of cost and radiological considerations.

This leads to the present plan, which means that dismantling of Barsebäck will not start before 2020 (Fig. VI–3).

Given the time horizon of 2020 at the earliest, there is no point in starting comprehensive or detailed planning of the actual dismantling phase yet. In the short term, it is more urgent to carry out a number of studies and produce the installation documentation that will be needed when procuring and implementing the dismantling work and, at the same time, to build up general expertise concerning the dismantling process.

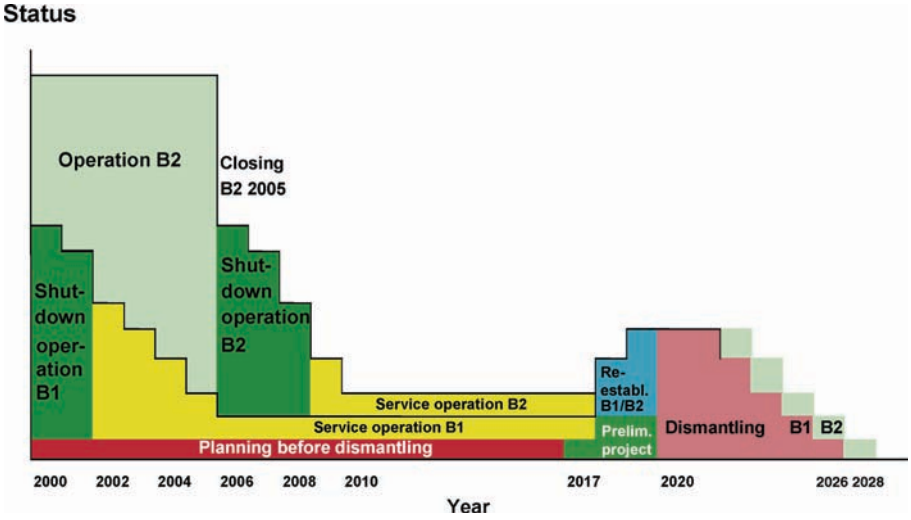

FIG. VI–3. Scenario for decommissioning of Barsebäck 1 and 2.

The pre-project, including project structure, environmental consequence assessment, safety report and obtaining licences for the final dismantling phase should, as far as can be judged at present, be initiated three to five years before the period when dismantling would actually be carried out.

The ultimate aim of the decommissioning of the Barsebäck plant is that the remaining buildings of the installation, including the equipment, should be declared free for release or be dismantled. The ground must be reinstated and declared radiologically free for release, and the environmental requirements must be met in accordance with current official requirements.

It would then be for the plant owner (EKS) to decide what is to be done with buildings and the land as a whole.

VI–5. PLANT ACTIVITIES

VI–5.1. Activities undertaken to 2007

The following main activities have been carried out since the closure of Barsebäck 1 and Barsebäck 2:

(a) A decommissioning plan has been presented and accepted by the owner and the authorities.

(b) The nuclear fuel has been transported away for interim storage at CLAB in Oskarshamn. Service operation is maintained using the following: a closed building, controlled ventilation, irradiated components covered by water in ponds, and fire monitoring/fire fighting and radioactivity metering equipment.
(c) A number of systems and components not needed for further operations have been conserved.
(d) Measures have been undertaken to reduce the total environmental impact and fire risk at the Barsebäck plant. Among other factors, this involves transporting away flammable materials such as turbine oil and chemicals.
(e) A preliminary study into reducing the temperature and ventilation flow in the reactor and turbine building has been completed. The measures proposed have been assessed, and parts of the proposal were introduced during 2004.
(f) A radioactivity survey of Barsebäck NPP has been carried out. A complete record has been compiled of events that may have generated radioactive spillage in the installations of the Barsebäck plant. Personnel interviews and meetings were undertaken with experienced employees.
(g) Preventive maintenance has been optimized for a shut down installation, the intention being to switch to remedial maintenance to a greater extent.
(h) An inventory of existing documentation has been made and continues.
(i) Barsebäck 1 has been made available for two research projects, CONMOD (for resistance of concrete to ageing) and the materials testing project.
(j) Several contacts have been established, and visits have taken place to European plants being dismantled. There has been participation in the work of a number of national and international organizations on decommissioning issues. Cooperation with EKS/BKAB began in 2003. A number of areas for exchange of experience were defined.
(k) A new management system for the service operation has been created.
(l) A new safety analysis report (SAR) and new safety technical regulations for service operation have been sent to the authorities.
(m) Rebuilding of the electricity system and of the operation system was completed during 2007.
(n) A cost calculation of the future dismantling of Barsebäck NPP, including dose estimation in the first half of 2007.

VI–5.2. Main activities for the future

The following are the main activities that will be carried out at Barsebäck NPP:

(a) A full system decontamination of Barsebäck 1 and 2 during 2007–2008.
(b) Supervision of service operation to reduce the total operating and maintenance costs of the Barsebäck plant. This requires an analysis of the costs of preservation of systems and components, maintenance and new purchases in the context of a long period of service operation followed by dismantling operations.
(c) Disposal of operational waste stored on-site. For example, consumed components such as the core grid, moderator tank lid and ion exchanger masses produced during cleaning and filtering of process water.
(d) Lowering of the temperature and reduction of the ventilation flow in the turbine and reactor building at Barsebäck 2, thereby cutting costs by saving energy and adapting to the needs of the prevailing operating mode.
(e) Lighting and other electrical consumption is being continuously reduced at Barsebäck 1 and this will also be done at Barsebäck 2.
(f) Planning of decommissioning, drawing up plans for the eventual dismantling of the Barsebäck plant. These plans will be completed in more detail during the dismantling pre-project phase.
(g) Continued work on archives and documentation systems.
(h) Continued building up of knowledge through cooperation with national and international organizations working in the field of decommissioning. An example is the involvement of the SKB Demolition Group with the IAEA, the World Association of Nuclear Operators (WANO) and the World Nuclear Association (WNA). Visits to European plants being dismantled will continue.
(i) Exchange of experience between E.ON Hannover, EKS and BKAB will continue within selected strategic topic areas.
(j) The Barsebäck plant will be used for special projects such as equipment testing and personnel training before overhaul work on other installations. All such work at Barsebäck will be assessed, prioritized and directed to achieve the correct quality assurance. The purpose is to meet the as low as reasonably achievable (ALARA) principle by avoiding the mistakes made in other installations and to reduce the total collective dose to personnel working there.

VI–6. PERSONNEL DEVELOPMENT AND STAFF REDUCTION

The signals from the Swedish authorities during 1997, that Barsebäck NPP was to be the first NPP in Sweden to close down for political reasons, started a long process of change in the organization for the future situation.

The strategy before closing Unit 1 on 30 November 1999 was 'business as usual':

— We are not the ones closing Unit 1.
— Operation and maintenance of Units 1 and 2 continued.
— Further modernization, development and investments took place.
— New staff continued to be recruited.
— Communication ensured awareness and participation.

When the time came for Unit 2 to close down on 31 May 2005, the strategy was:

— We are not the ones closing Unit 2.
— The focus and priority of Unit 2 was operation, safety, maintenance and competence.
— Cooperation with Ringhals NPP increased.
— A good working atmosphere, including awareness, motivation and belief in the future, was created.
— A high safety culture was maintained.
— Knowledge about decommissioning was developed.
— Swedish energy politics was followed and the consequences for Unit 2 analysed.

The following activities were important to achieving a feeling of security for the personnel:

— A five year employment guarantee from 1998 gave the staff confidence and security.
— The 'Compass' has allowed individual supportive discussions.
— Seminars for managers were held about facing the future.
— The human resources (HR) department has provided general support.
— An internal support group was established.
— Additional support was provided by other individuals and groups (friends, health care organizations and churches).

During the years from 1997, there have been many projects in which the staff have been fully involved:

(a) The Future Factory (1997) — this project analysed the possibilities for the company and staff before the closure of Unit 1. What will happen and what can we do?
(b) The New Factory (December 1999) — this project was established to prepare, plan and start activities as a result of the closure of Unit 1.
(c) The OBS project — this project was started to cope with the political threat to Unit 2 from 2002 to 2005.

The closure of Barsebäck 1 and the uncertainty concerning the whole of BKAB's future have weighed heavily on many of the employees. Views have been aired and discussed, but the decisive and most important item on the agenda has been to maintain employees' motivation and professionalism in their work.

By taking decisions relatively quickly, before the definitive closure of Barsebäck 1, the company management, together with the trade union organizations concerned, attempted to predict the problems that could arise and to deal with them in a realistic manner.

The organizational structure was changed to match the needs of the prevailing plant status, to provide security for employees through employment guarantees and thereby to increase the potential for securing human resources. A mentoring system was developed with regard to skills and experience feedback. A design school was established where some of the employees have had the opportunity to be retrained for other duties and to widen their choice of other duties.

Further steps were, for example, to give high priority to proposals that are positive in terms of the company and employees. This encouraged creativity in the individual.

The results of the above measures were the following:

(a) A good dialogue with the authorities, who expressed a positive attitude to the decommissioning work at Barsebäck 1;
(b) An open and positive dialogue with staff;
(c) A greater feeling of security and choice for the individual when facing the future.

The company was sure about being able to maintain the skills necessary to continue to operate one unit and to start a decommissioning process on the

unit shut down. This has now been further reinforced through the robust organizational structure of Ringhals and Barsebäck.

Following the political decision about the final shutdown of Barsebäck 2, the management of BKAB, in consultation with the trade unions, concluded a contract defining the rules of the process for moving the employees into alternative occupations. This includes a three year employment guarantee that began on 31 May 2005 when Barsebäck 2 permanently shut down. Each employee has the responsibility to analyse their own situation and to draw up their own development plan with the following possible options:

(a) Continued work at Barsebäck NPP;
(b) Work at Ringhals AB, Vattenfall AB, E.ON Sweden or another company on the external market;
(c) Development of competences for use in another field of work;
(d) Retirement at the age of 60 during the period of the employment guarantee.

Among those 352 individuals who were employed at Barsebäck NPP when Barsebäck 2 shut down permanently on 31 May 2005, the situation is as follows (1 Febraury 2008):

— BKAB (66);
— Retirement at the age of 60 (78);
— Employed at Ringhals AB (72);
— Return to studies (21);
— Form own company (15);
— Leave of absence for new employment (11);
— Left employment (50);
— BO adaptation group (32);
— Remainder (7).

The resulting figures for plant operation demonstrated that BKAB's management, acting in dialogue with the trade unions concerned and in face of the threat from the final shutdown of Barsebäck NPP, achieved excellent safety and operational performance of the NPP up to and after the final shutdown. This also created good conditions for employees to be able to find new occupations.

VI–7. RESULTS OF THE TRANSITION DURING 1997–2006

VI–7.1. Proactive management ideas and performance

Under this heading come the following:

— A five year employment guarantee, later changed to three years;
— A long term strategy for creating social security (support to staff);
— Activities and actions introduced in due time, but not too early;
— Business as usual (operation, maintenance and investment for Units 1 and 2);
— A high degree of involvement of staff in future development;
— Open, reliable and fast release of information;
— Maintenance of a strong safety culture;
— As simple as possible, but not oversimplified;
— Analysis of mood and/or motivation, tracking of safety, personnel leaving and absence due to illness;
— Benefit from the cooperation with Ringhals;
— Gathering of knowledge about decommissioning;
— Simple, safe and optimized care and maintenance;
— Planning in advance for different future scenarios;
— Identification of key resources and securing necessary competences for the company.

The results were:

(a) The plant was closed with professionalism and dignity.
(b) Safety and production were at an all time high in 2004.

VI–7.2. New possibilities and challenges for employees arising from staff reduction

Under this heading come the following:

— A reduction in number of staff from 450 during operation to 40 during service operation (care and maintenance);
— Creation of conditions for each employee to see future opportunities;
— Formation of internal and external support groups as well as a special crisis unit;
— Individual development plans;
— Own personnel replacing external resources in several areas.

The possibilities were:

— Continued employment at Barsebäck;
— New employment at Ringhals or elsewhere;
— Setting up their own businesses;
— Early retirement.

The end result was an increase in motivation and commitment.

VI–7.3. Interested parties — supportive stakeholders

It is important to:

— Earn the respect of stakeholders and build confidence;
— Have strong and supportive owners;
— Maintain an open dialogue with the authorities during their process of making new regulations;
— Take the leading position on decommissioning;
— Have good relations with press and media;
— Undertake public relations activities in the local community, for example: a Barsebäck NPP newsletter, a calendar and different kinds of events;
— Organize public hearings during the EIA.

The result is an increase in confidence and trust.

VI–7.4. Critical success factors

Such factors include the following:

— Always being open and providing reliable information;
— Being supportive to staff: coming up with solutions and expressing ideas;
— Through influence and participation, creating commitment and a belief in the future, together with social security;
— Reducing uncertainty by communication, dialogue and provision of information;
— Providing support to managers, both generally and individually;
— Looking out for mood changes;
— Cooperating with the unions;
— Leaders always being visible and accessible.

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ANNEX VII

SOCIOECONOMIC POSITION IN THE UNITED KINGDOM AND THE DOUNREAY PROJECT

VII–1. BACKGROUND

In the UK, the Energy Act 2004 established the Nuclear Decommissioning Authority (NDA). This Government organization has responsibility for the decommissioning of the 20 legacy nuclear sites in the UK. The current budget for this work is approximately £70 billion (US $140 billion) and will take several decades.

The philosophy that will be adopted by the NDA will be to put the contracts for management and operation (M&O) of the sites out to competitive tender. It is expected that this competition will reduce both the costs and the duration of decommissioning.

In addition to the responsibilities of the NDA for decommissioning, the Energy Act envisages the NDA as:

> "giving encouragement and other support to activities that benefit the social or economic life of communities living near designated installations, designated sites or designated facilities or that produce other environmental benefits for such communities."

Furthermore, it requires that "the NDA shall have the further duty to act in the manner that it considers most beneficial to the public."

In response to these obligations, the NDA has required the current M&O contractors to prepare annual socioeconomic development plans (SEDPs) for their sites (Annex VIII). These are intended to show how the site operators will deploy financial resources, saved in the decommissioning projects, to support the economies of the communities around the sites. This is a particularly important issue in the UK as most of the nuclear sites are in relatively remote areas and some are in very remote locations.

An important feature of the NDA approach is that it has not allocated any of its annual budget of approximately £2 billion (US $3.9 billion) to this topic. It expects that the M&O contractors will make savings that will enable funds to be allocated to projects for the benefit of the community.

Within the UK, the Government is committed to a policy of sustainability. This policy is embodied in the report 'Securing the Future' [VII–1]. This sets out the UK Government's commitment to sustainable communities and a

sustainable environment, and provides guidance on sustainability criteria for new developments. As a result, any industries intending to replace the employment of staff displaced from nuclear decommissioning sites must meet the sustainability criteria contained in this national policy.

The socioeconomic impact of decommissioning varies across the UK sites. In the south-east of England, for example, there is ample employment and land availability is at a premium. The United Kingdom Atomic Energy Authority (UKAEA), the operator of the Harwell site, owns a great deal of land and, when decommissioning of an area has been completed, it has been successful in making land available and selling it for the construction of very successful science parks.

However, of the 20 sites, Dounreay in the far north of Scotland and Sellafield in the north-west of England have the highest staff numbers and, as both are in remote areas with little alternative employment, they are seen as priorities by the NDA.

In addition, the two facilities in Wales are a source of concern. While they employ fewer people than the two sites referred to above, the potential for alternative employment in the area is extremely low. One of the sites in Wales, the former nuclear power station at Trawsfynydd, is in a national park, and planning restrictions there make new development even more difficult.

The first SEDPs were submitted by the sites to the NDA in March 2005. There was, at the time, little guidance as to what they should contain and, in consequence, their content and quality varied considerably.

Although the problem to be addressed by the NDA is nationwide, the remainder of this annex concentrates on the plans for the area around the Dounreay site in the north of Scotland. This site has examples of most or all of the problems encountered at other sites.

VII–2. INITIAL SOCIOECONOMIC PLANNING AT DOUNREAY

The former fast reactor development site at Dounreay in the north of Scotland is extremely remote, and the area has almost no alternative employment. The facility directly employs some 19% of the local employable population, either as employees or as contractors working on the site [VII–2].

The decommissioning plan for the site shows that the current number of employees will fall progressively from 1250 at present to zero by the year 2036. The impact of the loss will be extreme, because the current population grew from a relatively small number of people employed in the farming and fishing industries when Dounreay was constructed in the 1950s, so that now the

community is heavily dependent upon Dounreay jobs for its continued existence. The Dounreay community has its own web site [VII–3].

This is not a sustainable model for the community and is compounded by the fact that the current jobs tend to be at the high-tech end of the market such that the average salaries at Dounreay in 2002 were 48% higher than for the local area as a whole and 30% above the average for Scotland. Replacing this large number of well paid high-tech jobs in such a remote area makes the challenge even greater.

In preparing the initial SEDP, the UKAEA was immediately faced with the problem of determining the current baseline position and then having some vision of what the community might look like when decommissioning is complete.

A socioeconomic baseline report [VII–2] had been commissioned by the UKAEA as part of the site-wide environmental impact statement. This was not ideally suited to the task as set by the NDA but was felt to represent the best data available. It was therefore used as the reference document in the first plan, noting that it needed to be improved as part of the future plan preparation.

In the absence of a vision for the future of the community, the UKAEA concentrated on the issues over which it had some measure of influence. These are in the main contained in the overall decommissioning plan for the site: the LifeCycle BaseLine (LCBL). This document shows all of the activities to be undertaken until 2036 and, in addition, assigns costs and resources to each.

From the standpoint of resources, each of the staff members at the site is allocated to one of several skill types. These are then collected on an annual basis, with the bar chart shown in Fig. VII–1 being produced.

While the total numbers of staff fall in a reasonably well ordered fashion, the variances from year to year for individual sets of skills often swing wildly, requiring the recruitment of many staff one year, only to be discharged the following year and then recruited again the year after.

A typical bar chart for a skill set is shown in Fig. VII–2.

This was the first time that this kind of analysis had been performed, and it showed the benefit of the planning process undertaken. It also provided a useful tool by which the staffing consequences of the decommissioning plan could be observed and, if appropriate, fed back into the plan to establish what changes would be required to the plan to manage the availability of the staff.

One of the decisions taken by the UKAEA was to seek, where possible, to re-deploy, to alternative work, those staff whose jobs would be lost. While this constitutes good management, it will never result in zero job losses as all employment must cease by 2036. Nonetheless, it did give the staff the opportunity to identify when their own job might be at risk and to investigate what replacement jobs they might wish to be trained for.

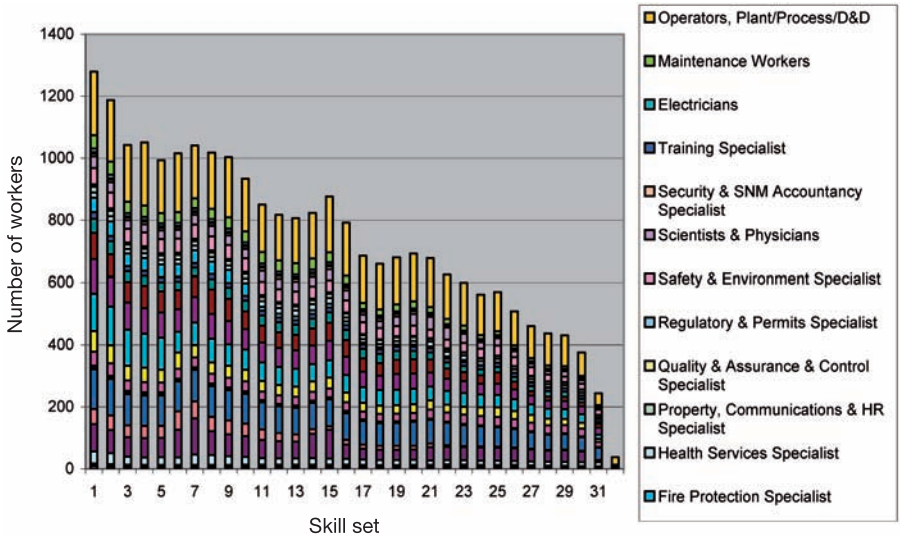

FIG. VII–1. A sample of some of the 28 skill sets.

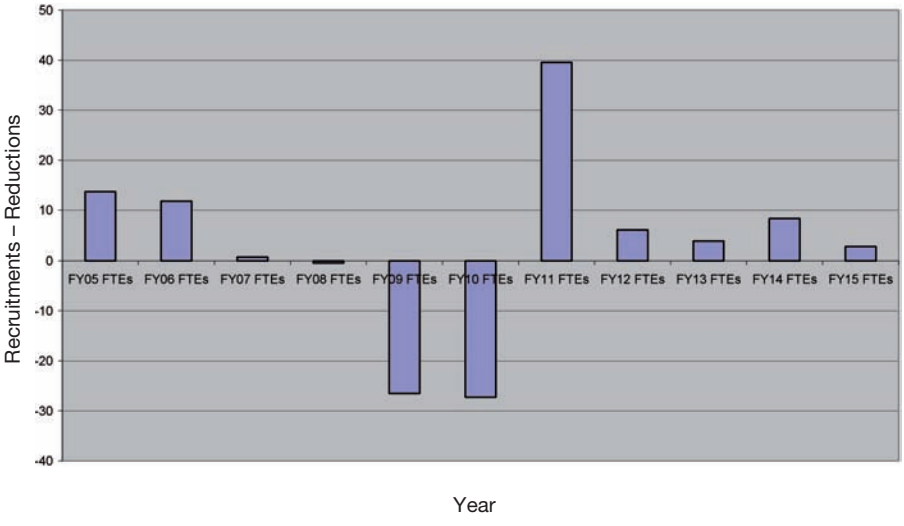

FIG. VII–2. Variation in annual demand for a typical skill set.

To provide guidance on the subject, a redeployment matrix was produced, as is shown in Fig. VII–3. This was not intended to be definitive, but provided guidance to staff as to the jobs they might reasonably be expected to move to when their own ceased to exist. It was hoped that this would give early

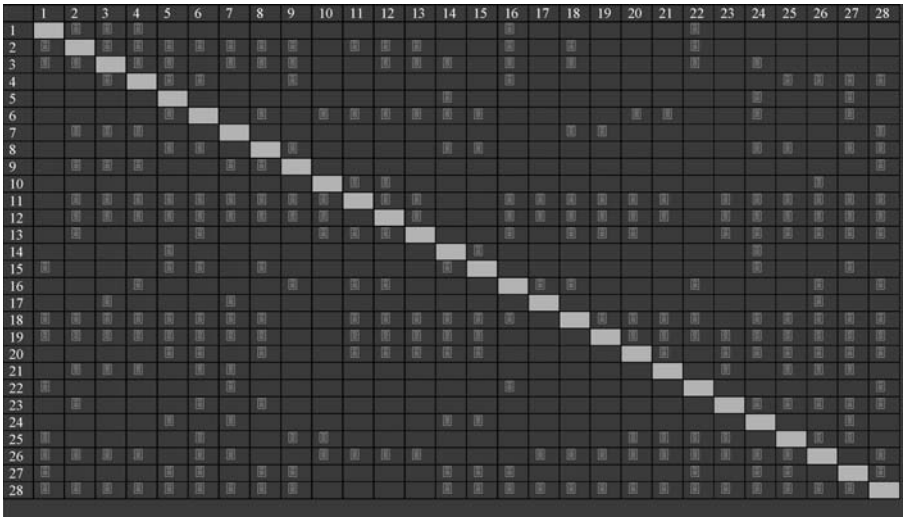

FIG. VII–3. Example of a redeployment matrix.

indications of training needs that could be implemented before the transfer date.

The matrix illustrated in Fig. VII–3 shows each of 28 skill sets along both the vertical and horizontal axes. To use it, a member of staff with skill set 17 can look down the vertical column at skill set 17 and note that there is a possibility for retraining to carry out the role of skill sets 11, 12, 16, 26 and 28.

Eventually, however, all of the jobs would come to an end, and a useful output from this process would be the release rate per skill set. It was intended to pass this on to the local enterprise company so that it would know what skills would be released, in what numbers and at what dates. This might then guide its search for new companies to come to the area, as availability of trained staff and low overhead costs could be attractive to them.

Tackling the absence of a vision for the future has proved to be a very difficult challenge. Many questions require to be addressed, not least, 'Who decides what the community of 2036 will look like?' Although the local council publishes a plan for the next five years, this tends to concentrate on the infrastructure of the area, its development and maintenance, against a stable economic backdrop.

It is clear that any vision of the future would require the acceptance of the local population and, ideally, would have been prepared by them. Experience has, however, shown that the preference of the general public is for someone else to do the thinking and to provide them with a number of options that they can then comment on. It was felt that the preparation of such options should be

the subject of a socioeconomic development strategy that could then be implemented by a number of organizations, with coordination by a central body.

The regional enterprise company (Highlands and Islands Enterprise) was asked to set up a working group to address this issue. A meeting was called with representatives from the companies and organizations given in Table VII–1.

This meeting voted that the local Member of Parliament (MP) should chair the group. Its terms of reference were to consider the imminent impact of the loss of the Dounreay plant and to prepare a strategy for the preparation of a vision for a regenerated local community in a manner that would be consistent with the rundown of the number of staff at the Dounreay site.

A copy of the executive summary of the strategy was delivered to every home in the Dounreay area, and the complete strategy document was published on the Internet.

Comments and views from the local community were invited, with the intention of publishing a strategy for the community that takes account of as many different views as possible.

The strategy can then be used by all who have a role in the development of new business for the community, to guide them towards a sustainable future business base for the community.

It is tempting to believe that all initiatives for new development in the community will enjoy universal acceptance. This is not the case. As an example,

TABLE VII–1. ORGANIZATIONS REPRESENTED ON THE SOCIOECONOMIC WORKING GROUP

J. Thurso MP (Chair)
Lord McLennan of Rogart
J. Stone MSP
Caithness & Sutherland Enterprise
North Highland College
The Highland Council
Highlands and Islands Enterprise
The Nuclear Decommissioning Authority
UKAEA
Dounreay Stakeholder Group
Local trades unions
Local community councils

when the main road connecting the area with the city of Inverness was upgraded and a series of bridges built, this reduced the travelling time from the Dounreay area to Inverness by some 90 minutes.

An unexpected impact was that residents of the local towns could now easily make day trips to Inverness and, as a result, they reduced their dependence on local shops, particularly those selling clothes and 'white goods', as they could have greater choice and lower prices by travelling. Any further improvements in the transportation infrastructure are therefore likely to be unpopular with those local retailers who are most likely to be adversely affected.

To summarize, the approach taken to the preparation of the 2005 plan was to identify a baseline, to provide a mechanism for the preparation of a strategy and to create a tool that would provide the necessary data on staff numbers to enable staff to have some control over their futures. The plan would also provide the local enterprise company with an indication of which skills would be available and when, in an effort to match these to potential inward investments in the area.

VII–3. EXPERIENCE WITH THE FIRST PLAN

As indicated in Section VII–2 above, the initial starting point for the plan was the existing socioeconomic baseline study. This was used at the outset to seek to establish the extent to which the community is dependent upon the expenditure and jobs at Dounreay. While the study does provide useful data, it was not accurate enough nor was the geographical breakdown adequate to enable its use as a base for the future development plan.

An estimate was obtained from a company of economic consultants, and a contract was awarded to carry out a socioeconomic study of the Dounreay area (funded by the NDA and managed by the local enterprise company — Caithness & Sutherland Enterprise (CASE)). This would be specifically tailored to the needs of those considering how to redevelop the area following the decommissioning of Dounreay [VII–4].

The variations in the numbers of staff in each skill set over the course of the programme were such that it was felt that it was premature to provide these data to staff who might be using them to determine their future careers. It was decided to await the production of the next version of the site plan and seek to smooth the skills profiles before releasing the tool to staff. The tool itself would, however, be used during the preparation of the next plan to try to smooth the skills profile at the same time as similar tools would be used to seek to maintain the project programme within the funding limits available.

The next plan was submitted to the NDA in March 2006. The 28 skill sets used in the preparation of the first plan were used again for the second; however, experience showed that, while these skill sets were acceptable for programme planning purposes, they were not appropriate to allocate to individual members of staff. As a result, it is now planned that the skill sets be reviewed to enable them to be used for both programme management and resource management purposes.

It was also found that to be of use in the manner expected, it would be necessary for the number of workers with some skills to be on the increase at the time when staff with other skills would be released. If this were not the case, then there would be no potential for staff released from a skill set for which the need is on the decline to one for which the need is increasing.

Despite the swings referred to earlier, the inevitable result of the decommissioning process is that, in general, the numbers of all skills fall over time, and the more effort that is applied to removing the swings referred to above, the more each skill set will exhibit a monotonic downward trend. As a result, opportunities for redeployment are significantly reduced, except where the effects of retirement result in a redeployment opportunity. At present, within the UK, retirement rules are under review, and it is therefore not possible to say with confidence that an individual will retire at his or her 'nominal' retirement date.

The impact of these issues is that the value of the tool for management of redeployment may, in the longer term, be reduced to a point where it is not useful; however, its value in skills planning remains.

The last element of the 2005 plan was associated with the provision of a vision for the future. The strategy by which the vision will be prepared is described above and in Ref. [VII–5].

The NDA has established a set of site stakeholder groups, one for each of its 20 sites. These meet quarterly, and one of their main interests is the socioeconomic impact of decommissioning activities.

These groups hold their meetings in public and the press are also in attendance. The issue of socioeconomic development has therefore been given a much higher profile than ever before and, as a result, it is hoped that the increased awareness of these issues will result in improved responses to the strategy document.

VII–4. OTHER EFFORTS AND INITIATIVES

The remit given to the NDA under the Energy Act does not require it to find replacement jobs for all of those lost as a result of the decommissioning

activity. Nonetheless, the NDA is acting in a responsible way in an effort to provide monetary support to measures that improve the economics of the local area and it is very active in supporting potential new businesses in the area.

The 'Mey' initiative is one such project supported by the NDA. The late Queen Elizabeth the Queen Mother's former castle near the village of Mey, some 30 miles from the Dounreay site, was opened to the public in 2002. The castle attracts many visitors each year, and its name is closely associated with the UK royal family.

The opportunity was taken, with support from the Prince of Wales Trust, to establish a quality brand under the banner of the North Highland Initiative. This sets out criteria by which specific products and services, available from and within the community, are labelled. The result is a series of products of exceptionally high quality that command higher prices than more standard products. The initiative has been successful, and demand far outweighs supply at present.

The community around the Dounreay site has many assets. These include the highly skilled professional and craft staff members who have been responsible for the design, construction, operation and maintenance of the facility for 50 years.

In addition, the area has very strong winds, large waves and very high tidal ranges. It is therefore probable that the area has some of the best opportunities for the development of renewable energy in the UK and possibly Europe. Individual companies and the local educational establishment are seeking to attract investors to a new form of tidal power development. A prototype could be tested in the area, and then production units constructed, installed and operated.

The emerging hydrogen technology could easily be accommodated in the area, as many of the intellectual and engineering resources needed to make it a reality are located there as a result of the Dounreay site being there.

The area also has a great many trees, and an investment company has been identified with links to technologies to produce power and heat by pelleting and burning trees. Other initiatives being considered by this company are the production of ethanol from wood and the generation of power from solid municipal waste. This would offset a growing problem in the UK because of landfill sites filling up. The Renewable Energy Park project could, when complete, employ approximately 100 people in a sustainable business.

VII–5. CONCLUSIONS AND LEARNING POINTS

The principal conclusions of the Dounreay project to date are:

(a) The first SEDP for the Dounreay site, while innovative, had a number of deficiencies that have now been identified.
(b) The newly completed socioeconomic baseline will be used in the formation of future plans.
(c) Valuable experience has been gained in skills management, and the tools developed will find application in the skills planning area, although possibly not in redeployment management.
(d) The Socioeconomic Working Group, chaired by the local MP, is an effective vehicle for the development of a strategy for the regeneration of the area in parallel with the decommissioning of the site, and various options have been issued for public consultation.
(e) A number of initiatives began in 2006. More will follow in the future, and these will be directed towards the provision of a sustainable community in line with Government policy.

The principal lessons learned from the 2005–2006 SEDP are:

(a) Detailed planning of the decommissioning programme for the site is essential to provide the information on which the SEDP is prepared. The results of this must be fed back into the plan to control the resource profiles. It must, however, be realized that redeployment of existing resources to other jobs within a decommissioning site provides at best a temporary respite. Inevitably, all employment will cease by the time decommissioning is complete.
(b) Preparing an SEDP is not possible without a vision of how the community will look at the end of the decommissioning period.
(c) Plan preparation needs to take account of the current position, requiring the preparation of a socioeconomic baseline.
(d) Most communities do not have organizations responsible for eliciting a vision of the future of the community. As a result, a competent organization, which has the trust of the community, needs to be established. This organization should, ideally, also be responsible for the creation of the plan and for its implementation.
(e) Projects that would, on first consideration, seem likely to have universal approval within the community may not have such approval as a result of changes brought about by changes to the local business profile or improvements in infrastructure.

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ANNEX VIII

PRODUCING A SOCIOECONOMIC DEVELOPMENT PLAN IN THE UNITED KINGDOM

VIII–1. BACKGROUND

In most countries where nuclear research was conducted in the late 1940s and 1950s, the sites where the research was carried out were located in remote areas due to concerns about safety and security. As these facilities grew, they attracted large numbers of highly qualified staff who established their families in the areas, and the local communities grew, mainly in support of the nuclear research facility.

In some extreme cases, particularly in the former Soviet Union, the locations were chosen such that the only prime employer was in fact the nuclear facility, and all other employment in the area supported its operation. It, therefore, follows that, when these facilities are decommissioned, there will be no opportunity for the staff to remain in the local community, as there will be little prospect of employment.

Two options are available. Either the community is allowed to decline until there is no one left or, if the community wishes to continue, there will be a need to attract new industry to the area so that employment levels can be maintained.

This annex deals with the preparation of plans to address the second scenario, where it is intended that replacement employment should be attracted to the area.

VIII–2. WHAT IS A SOCIOECONOMIC DEVELOPMENT PLAN?

The underlying problem being addressed when community regeneration is being considered is sustainability.

There are three ‘pillars’ of sustainability:

(1) Environmental sustainability;
(2) Social sustainability;
(3) Economic sustainability.

A sustainable community is one where the activities undertaken by the current generation do not foreclose on subsequent generations being able to exist.

On this basis, it is clear that the decision to locate large nuclear facilities in remote areas was a non-sustainable policy. This is due to the fact that, when a single large employer ceases to exist, the community that has grown around it will fail. By contrast, a sustainable community will have a larger number of small and medium scale enterprises (SMEs). These will be technologically diverse so that the failure of one company or the demise of a single technology will not create the severe problems being faced at many of the former nuclear research and development sites.

An SEDP should therefore be directed towards the conversion of the community from its current socioeconomic status to a more sustainable one with many diverse businesses.

VIII–3. PREPARING THE PLAN

If one accepts the definition of the plan in Section VIII–2 above, then it is necessary to identify the current status of the community, define the intended status and then decide how to convert from one to the other.

This seems deceptively simple; however, there are usually two items missing from this process, namely:

(1) Firstly, a detailed knowledge of the current socioeconomic baseline for the area;
(2) Secondly, an idea of how the community wishes to develop as the reliance on the nuclear facility diminishes.

VIII–3.1. The socioeconomic baseline

This is an essential piece of work, which is necessary in the preparation of an SEDP. The baseline must include an accurate picture of the community as it currently is and also of the direction in which it is moving. This means there should be an understanding of the demographics, the economy, businesses and the asset base.

In considering the demographics of the area, it is necessary not only to produce an up to date ‘snapshot’ of the position, but also to obtain information about trends. It is not sufficient to state that at present there are, for example, 10 000 people in the immediate area. If the numbers are falling by 2000 per annum, then this paints a different picture than if the numbers are static or are

even increasing. For this reason, the socioeconomic baseline can be seen as a starting point but must be kept constantly under review, to ensure that the information about trends is as up to date as possible.

The economy of the area will be directly influenced by the amount of money being injected into the community by all of the businesses in the area and, also, by external factors such as national fiscal policy, international trends (such as the price of oil) and technology.

As a working assumption, it is reasonable to suppose that those who wish to live in the community will want to ensure that the local gross domestic product be at least maintained and ideally be raised. If the nature of the work in the facility has been dominated by well paid scientific and technical staff, then the community will have benefitted from their high disposable incomes. In seeking to replace these jobs, there is limited benefit in bringing in companies who specialize in mass production and have low wages. Although they may create many jobs, the disposable incomes from these would be very much lower.

The business profile of the community is also important and must be captured in the baseline. With the exception of those few sites where there was nothing in existence before the nuclear facility arrived, there will have been some indigenous industries such as farming, mining and fishing. These may need to be revitalized, adapted or, in some cases, wound down in order to ensure that more sustainable incoming industries can be successful.

Knowledge about the business base of the community will be essential to marketing the area, when it will be necessary to find new businesses from other regional, national or international locations.

VIII–3.2. The 'vision' for the community

Unlike the preparation of the current socioeconomic baseline, the vision for the community after the completion of decommissioning of the nuclear facility is much more difficult to prepare.

In the case of the current baseline, this is simply a case of identifying the current situation and recording it. The current position represents reality and the accuracy with which it is captured can usually be proved.

A vision of the community in the future will be very subjective. The types of new industry for the area that would appeal to some people will not appeal to others. In the case of nuclear related activities, there will also be those who have a view and yet who do not live in the immediate area.

Constructing this vision therefore requires a great deal of patience, local knowledge and time. It is a process that requires consultation: ways must be found to invite the local community to give its views about the vision for the

future. In cases where the local community has become too dependent upon the nuclear facility, the idea of the community without the plant may be abhorrent to local people, and they may simply not be able to imagine the community without the plant or, at least, their ideas for replacement employment may be very limited.

It is therefore important that, in the preparation of the baseline described above, the asset base of the community be clearly identified. Some ideas about the types of replacement employment for which the workforce is skilled may need to be suggested to the community. The community can then decide from a list of practical suggestions, rather then attempting to generate new ideas.

The vision, in much the same way as the baseline, needs to be kept up to date. Business opportunities change to reflect trends in, for instance, preferences, technologies and legal requirements.

VIII–3.3. The plan

Once the baseline has been established, it will be possible to assess how and when to encourage new industries to invest in the area. A detailed decommissioning plan for the site will be available that identifies the activities to be undertaken during the decommissioning period and that enables the skills, numbers and timings of released staff to be predicted.

These skill profiles can then be used to establish when a particular employer might be encouraged to invest in the area, using the availability of the skill base as an encouragement.

This approach not only matches available skills to incoming commercial opportunities but also has the potential to minimize the potential conflict that might arise if an incoming company requires skills that are also needed by the decommissioning company.

In such cases, there will be a detrimental effect on the decommissioning programme, which will require staff to be brought in from outside the local community. Every such job must be viewed as a loss of potential revenue to the community and should be avoided where practical.

Unlike the decommissioning plan for the site, a regeneration plan cannot be considered to be absolute. If it is necessary to demolish a building, plans can be made with a great probability of success that, by hiring the correct contractor with the correct equipment, the building will be successfully demolished.

There is, by contrast, no method of guaranteeing, simply because the required skills are available, that a new company will invest in the area and open up a business. However, there are some steps that can be taken to maximize the possibility that a successful business can be created.

These include support from local and central Government, as well as application of sustainable procurement methods. Within the UK, sustainable procurement is becoming extremely important. This involves Government in considering the whole life cost of procurement when seeking a supplier. The EU Procurement Directive prohibits unfair competition; however, by assessing the whole life implications of procuring goods and services, it is often possible to see a benefit from structuring procurement in a particular way that at least enables smaller local companies to compete.

VIII–4. SUMMARY

The procedure for the preparation of an SEDP has been described. This, in general, consists of three main elements:

(1) Preparation of a socioeconomic baseline;
(2) Creation of an agreed vision for the community after the facility has gone;
(3) Preparation of a plan by which the existing asset base can be redeployed in a way that achieves the vision.

The vision is one of the most difficult components to obtain as it is highly subjective, and it will not, in general, be possible to achieve 100% agreement among the local population. This needs to be made clear from the outset.

Preparation and successful implementation of the plan is not a definitive process. It is possible to influence companies towards moving to the area, but there can never be certainty that they will in fact come nor can it be assumed that their businesses will be successful. It will always, therefore, be necessary to have contingency plans which can be implemented in the event that a new company fails. The concept of sustainability described above suggests that in a sustainable community, with a large number of SME organizations, the impact of such failures on the local community will be minimized.

Although not really an aspect of the preparation of an SEDP, one other essential element is necessary if a plan, once it has been prepared, is to be successfully implemented. This is the identification of the person or organization charged with the responsibility to drive the process through. An accountability process is also necessary as the person or organization needs to be accountable to the local community, although this may not be an easily defined concept.

The role of local Government representatives in this accountability process is very important, as is a clear communications strategy by which the

activities of those responsible for the implementation of the plan can be observed and understood by the community.

The accountability process will also require those who implement the plan to review it at regular intervals in order to ensure that the aspirations of the community have not changed and to alert the community to any new technology or other business opportunity of which they were previously unaware.

Annex IX

LESSONS LEARNED AND CASE STUDIES

IX–1. CHANGES IN POLICIES OR REGULATIONS ON THE US NATIONAL LEVEL

IX–1.1. Problem encountered

The reindustrialization programme at Oak Ridge was affected by a major change at the national level due to the results of a top-to-bottom review, initiated when the George W. Bush administration took office. This documented the fact that the liabilities for the USDOE were not being reduced in a timely manner and that significant environmental management resources were being directed at efforts less related to cleanup than to economic development. As a result, the focus of cleanup at the East Tennessee Technology Park (ETTP), Oak Ridge, shifted from support of reindustrialization to an accelerated shutdown project, with reindustrialization a much reduced priority.

The possibility had been foreseen that cleanup might interfere with the ongoing use of leased facilities, and the lease agreements between private industries and the Community Reuse Organization of East Tennessee (CROET) included appropriate clauses. However, it had not been anticipated that the entire programme would be disrupted, with all ageing and potentially contaminated facilities intended for demolition. This would put several companies out of business due to their dependence on specialized equipment that is integral with their leased facilities. Furthermore, in fiscal year 2004, the USDOE eliminated funding for community reuse organizations, putting further pressure on CROET, which was also facing loss of its lease revenue streams.

IX–1.2. Analysis

After the change in environmental management policy, uncontaminated buildings, for the most part office buildings, were designated for direct transfer to CROET. This helped preserve income for CROET. However, the tenants were contractors to the USDOE as opposed to the new industries that reindustrialization was designed to attract in order to replace jobs dependent on the Federal Government. There are plans at CROET to build new facilities on uncontaminated sites in order to relocate some of its industrial tenants, but this action is being delayed, due in part to lack of capital for construction purposes.

Further details can be found in Ref. [IX–1].

IX–1.3. Lessons learned

Abrupt changes in policy due to fundamental leadership changes in Government can be highly disruptive of innovative programmes such as reindustrialization, as demonstrated at Oak Ridge. Both new businesses and the community were adversely affected by significant changes in policy and priorities emanating from USDOE headquarters. Local programmes need to be carefully evaluated by the communities they are designed to benefit as to their economic viability in the absence of Federal funding and their ability to be self-sustaining in the long term.

IX–2. WORKFORCE RESTRUCTURING, OAK RIDGE SITE, TENNESSEE

IX–2.1. Problem encountered

The Davis–Bacon Act in the USA requires that, other than for small values, each Government contract for the construction, alteration or repair of public buildings or public works contains a clause setting out the minimum wages to be paid to various classes of labourers and mechanics employed under the contract and which have to be no less than the locally prevailing wages and fringe benefits paid on projects of a similar character.

In undertaking the Powerhouse Demolition Project, USDOE Oak Ridge Operations decided that the project would be implanted under a service contract and not a construction contract. This distinction meant that the project did not fall under the requirements of the Davis–Bacon Act. The work was put out to tender to specialist demolition contractors and won by a non-union demolition contractor. Despite discussions, an agreement could not be reached with the Knoxville Building Trades Council about how many craft workers would be hired, the type of craft labour to be used, the project duration and the project work rules. The local unions responded to the failure to reach agreement by setting up an informational picket at the entry that had been planned for use by Powerhouse Demolition Project personnel. In order to proceed with minimal impact on the project, an alternative portal entry was set up. Union representatives did not establish pickets at this second portal, and the work continued to completion. Additional costs were incurred to cover the costs associated with providing another portal entrance.

IX–2.2. Analysis

An essential strategic issue faced by the USDOE is how to ensure the availability of qualified trained staff to carry out environmental restoration work successfully, while being under pressure to downsize its staff and reduce costs. Human resource requirements shift dramatically as sites change in status from operations oriented to shutdown and decommissioning. In many of these transitional facilities, the workforce that was responsible for operations activities is still present and concerned about preserving their jobs. However, the workers formerly required to maintain these facilities may not have the appropriate mix of knowledge and skills needed to successfully decommission those same facilities. An argument has been made that specialist contractors may be able to perform decommissioning activities faster and at lower cost, because their workforce is trained and experienced in performing specialist decommissioning work. However, bringing in outside contractors and their workers may upset the economic base of the community with undesirable consequences.

IX–2.3. Lessons learned

The workforce strategy to be used needs to have been finalized before procurement activities begin. The outcome will need to include policy on 'make or buy' decisions in achieving safe, economic and timely project completion, scope for utilizing existing staff, need for renegotiation of existing agreements designed for the operating phase, level of encouragement to contractors to recruit locally, etc. If these issues are not addressed in a timely manner, future debate and conflict are likely, with the potential to harm both the project and the parties involved.

Further details can be found in Ref. [IX–2].

IX–3. CREATING NEW SKILLS, HINKLEY POINT A NUCLEAR POWER PLANT, UNITED KINGDOM

IX–3.1. Problem encountered

The workforce of an NPP after 35 years of electricity generation is likely to be of high average age and not necessarily have the skills required for a long decommissioning project.

IX–3.2. Analysis

British Nuclear Group is decommissioning Hinkley Point A, an NPP that shut down in 2000. As of 2006, the number of staff working on Hinkley A had risen to 600, with more than 70 jobs created in the previous year. After a long pause, new apprenticeships will offer craft training, including electrical and mechanical aspects, and will focus on the skills needed to safely dismantle the plant. They will be offered to candidates aged between 16 and 18, and the first three started in August 2006. Site manager M. Lesinski said: "This will provide an excellent stepping stone for young people to enter a rapidly growing decommissioning and cleanup industry." The site will also be looking to take on young people aged between 18 and 25, to be trained as decommissioning technicians in conjunction with Bridgwater College. It is already interviewing to fill 12 graduate roles, from business skills to health physics and engineering. Mr Lesinski added: "The number of people employed on the site is significantly more than when Hinkley Point A was generating."

IX–3.3. Lesson learned

The length of many decommissioning projects is such that the training of young new staff can make a strong contribution to the project and to the community, as well as providing the persons involved with valuable skills for the future.

IX–4. SUPPORTING CRITICAL COMMUNITY INFRASTRUCTURE, NUCLEAR DECOMMISSIONING AUTHORITY, UNITED KINGDOM

IX–4.1. Problem encountered

Key community services can be placed under threat by the reduction in usage due to a reduction in economic activity in an area. In West Cumbria, UK, there are several legacy nuclear sites owned by the NDA, who also wish to ensure that sufficient services are available for the community to support its waste and decommissioning responsibilities. Local hospitals were under threat because of funding difficulties.

IX–4.2. Analysis

A National Health Service review casts doubt over community hospitals at Brampton, Keswick, Millom, Maryport, Cockermouth and Alston. Campaigners and local MPs called for urgent cash help to retain the sites. The NDA has stated that it will provide a total of £18 million over three years, obtained from savings made in Sellafield decommissioning [IX–3]. The NDA also stated that it was providing the funds because it had responsibility under the Energy Act to "help with the economic and social development of the area". The organization was approached by the area's MPs and council leaders, who said the hospitals should remain open while plans for a new acute hospital in Copeland were being developed.

I. Roxburgh, chief executive of the NDA, has stated that:

> "The NDA has a vital role to play in assisting West Cumbria to maintain a strong and sustainable community. An essential element in the emerging plans is the hoped for development of a new acute hospital to replace the existing West Cumberland Acute Hospital. The early plans for the new hospital envisage it integrating fully with the existing community hospitals to provide a joined-up service. Clearly, if the community hospitals were to close during the two year or so planning period, then this widely supported new model for providing care would be lost."

IX–4.3. Lesson learned

The investment required to support local services may be high but, if savings can be made in implementing decommissioning, then some of this should be considered for support of local communities.

IX–5. UTILIZING LOCAL SKILLS FOR NEW ESTABLISHMENTS, NUCLEAR DECOMMISSIONING AUTHORITY, UNITED KINGDOM

IX–5.1. Problem encountered

The decommissioning of nuclear facilities in remote areas can lead to a loss of expertise from an area and a loss of local markets to specialist suppliers.

IX–5.2. Analysis

From 2006 to 2008, the NDA will contribute over £20 million to the funding of three new initiatives to be based in West Cumbria, UK: a Nuclear Institute, a National Nuclear Skills Academy and a new academic position of chair of epidemiology [IV–4, IV–5]. The aim is that these initiatives will begin to equip both the present workforce in the nuclear industry and the generations to follow with the correct mix of skills to grow and sustain an industrial base capable of being a world leader in the field of nuclear decommissioning at home and abroad. The NDA is also bringing forward plans to support skills development in other areas of the UK affected by nuclear decommissioning such as the north of Scotland, north Wales and the south-west of England.

IX–5.3. Lesson learned

Investments made that utilize the specialist expertise present in an area are more likely to maximize the continued value of those specialist individuals and suppliers.

IX–6. EARNING PEOPLE'S TRUST: DISMANTLING AND DECOMMISSIONING NUCLEAR POWER PLANTS, SPAIN

IX–6.1. Problem encountered

The completion of decommissioning means the end of most of the related employment activity. All of the incentives arising from having hosted a nuclear installation disappear, and new economic alternatives are needed for the area to survive.

IX–6.2. Analysis

In Spain, the situation concerning the socioeconomic impact of NPP shutdown was approached by initially determining public reaction to the decommissioning of the country's eight nuclear facilities (seven NPPs and one waste site).

As a result, three principles were suggested to gain public confidence:

(1) Safety is a non-negotiable concept.
(2) Participation and ready availability of information are a necessary part of policy.
(3) There must be guarantees about economic development for the future.

Planning for the future must be based on the training of people and on the promotion of companies and entrepreneurs in the area.

As regards training, advantage should be taken of the available resources to prepare the people participating in dismantling for their return to the job market, aiming for positions similar to those they have been occupying. Likewise, advantage should be taken of training courses for the participation of other people in the area who are not employed or who wish to improve their knowledge.

There are three areas of training management:

(1) Local administrations, through agreements with other administrations (for training fund management) and with the companies responsible for dismantling (for the management of local employment), may generate job profiles that serve not only to provide work during the dismantling phase but also to offer alternatives in other sectors during and subsequent to dismantling, predominantly in construction and services.
(2) Universities, taking advantage of their collaboration in dismantling, may create a specialization for both teachers and students in areas with a high level of technology, and thereby provide for the future in areas such as the management of conventional and non-conventional wastes or of the environment.
(3) Companies, through their own needs for the training of personnel working in dismantling, may promote the creation of groups of experts in an innovative field such as dismantling, thus allowing the creation of stable jobs. Furthermore, offering internships and scholarships to students allows for professional development of the best trained individuals in the area.

As regards the promotion of companies and entrepreneurs in the area, advantage should be taken of the economic resources contributed locally by dismantling in order to promote economic activities, through either the strengthening of existing sectors (services, light industry, tourism, farming, etc.) or the creation of new activities relating to the environment or to dismantling itself.

Finally, the release of the site at the completion of dismantling allows the resulting space to be reused for new activities. The released site may house a wide variety of companies requiring space and services, since advantage may be taken of the existing infrastructure: electricity lines, water supplies, cooling systems, etc.

IX–6.3. Lesson learned

The main actions at different levels that need to be carried out in order to gain people's confidence include the following:

(a) In the institutional framework, to carry out public information, social and economic impact assessment, and EIA of the decommissioning and dismantling project.
(b) To create a follow-up commission, composed of the local administration, state representative, regional government, nuclear companies, ENRESA, and social and economic representatives. The objectives of this commission are the knowledge and monitoring of the evolution of the decommissioning and dismantling project, the creation of an alternative economy and institutional coordination.
(c) To plan sustainable development in several areas such as communications and infrastructures, technical training, and encouragement of private initiatives in all economic sectors as well as of public investment.

The lessons that have been learned from the experience at Vandellòs will be taken into account in the decommissioning and dismantling of José Cabrera NPP.

REFERENCES TO ANNEX IX

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This report discusses the identification and management of the socioeconomic consequences of the final shutdown and decommissioning of a nuclear facility as they may affect the facility workforce and the local and wider communities. Factors that affect the severity of the impact are described in terms of influences such as facility type, location and the circumstances leading to final shutdown. International experience is presented to illustrate the advice offered. This report will be of interest to facility owners, operators and decommissioning implementers, together with those responsible for community issues within local and national governments.

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