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Limitation of the EIA Process for the Assessment of Nuclear Fuel Waste Disposal in Canada

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1. Introduction

The Canadian environmental impact assessment process for the Nuclear Fuel Waste Management and Disposal Concept was completed in 1994. Almost four years later, in February 1998, the Review Panel released its report. The viewpoints of those who participated in the assessment process is archived in the thousands of pages of hearing testimony, meeting transcripts and written briefs. One of the most contentious issues raised, and one that continues to plague management in Canada, is the debate surrounding how the problem of NFW waste management should be defined. The purpose of this paper is to critically assess the problem frame of the Canadian NFW management disposal concept EIS. This will be accomplished through an analysis of stakeholder participation and views, and through an evaluation of the range and nature of the information considered legitimate or constrained in the Canadian process.

1.2 The Canadian Context

For the last thirty years, Canadian nuclear utilities have managed a fuel waste volume of about 16 000 tons through wet and dry interim storage methods [1]. In the long-term, the mandated management option involves deep geologic disposal. To meet engineering requirements, a disposal facility must be sited in igneous rock on the Canadian Shield. The Shield is located in the northern portions of several provinces including Ontario.

The federal government is currently reviewing the feasibility of the geologic option under federal environmental assessment legislation. The environmental impact assessment (EIA) of the NFW facility consists of two distinct stages: 1) a generic appraisal of the construction and closure technology, and 2) detailed site selection and facility construction. The EIA process is administered by the Canadian Environmental Assessment Agency (CEAA).

In 1988 the Minister of Environment established the terms of reference for the environmental impact assessment. Atomic Energy of Canada Limited (AECL) and Ontario Hydro (both Crown corporations) submitted an environmental impact statement on the pre- and post-closure disposal technology in September 1994. The final recommendations of the Canadian Environmental Assessment Panel were

2.4 Loss of Amenity

The potential loss of amenity as a result of the presence of a facility for long-term storage or disposal of radioactive waste should be considered in the environmental assessment. *Inter alia* the assessment should consider:

- effects on the human environment, including effects on community structure and the built environment, and on tourism and employment;
- implications for utilisation of natural resources, including the landscape, soil and bedrock, surface water and groundwater; and
- impact on the local economy including tourism and employment.

2.5 Mitigation of Environmental Impacts

A central element of the assessment will be the development of proposals to avoid or minimise the impacts on the environment and Article 5(3) of the Directive makes it obligatory for information to be provided concerning “the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects”. In the specific context of radiological protection Council Directive 96/29/Euratom of 13 May 1996 requires Member States “to ensure that ... in the context of optimisation all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account” (Article 6(3)(a)). In effect this means that measures should continue to be taken to reduce exposure until the benefit gained becomes disproportionate to the cost of the measures involved.

A standard approach to addressing the above requirements is to develop an environmental action plan. This would document the key environmental impacts identified by the assessment, the proposed actions to address the identified impacts, the implementation schedule and an estimate of the associated costs. The plan would document regulatory requirements including those relating to compliance and identify any specific regulatory consents needed. It would distinguish between issues to be addressed on a short timescale and those requiring a long-term approach. It is suggested that the EIA Report for a geological facility should contain details of the environmental action plan, in sufficient detail for the competent authority to be able to form a view on the adequacy of the measures being proposed. A more detailed plan should be prepared before the construction of the facility begins.

3. A Model EIA Process for Geological Repositories

3.1 The Role of EIA in the Development Process

The process of developing a repository will necessarily include a number of discrete steps, with formal consents normally being required from national authorities before moving from one major phase to the next. In this context the major phases are site selection, construction of the facility, commencement of waste emplacement, closure of the facility and termination of institutional control of the site. An assessment of the likely performance of the facility, at an appropriate level of detail considering the stage of development, will be an important input to the decision process at each of these consent points.

Development consent, as discussed in the Directive, implies the granting of permission to proceed with that part of the project involving “interventions in the natural surroundings and landscape” including “the execution of construction works or of other installations of schemes” (Article 1). The Directive requirements therefore relate largely to the site selection phase, though it is implicit that national authorities should take measures to ensure that the measures proposed to address environmental impacts are implemented in practice.

Under Article 8 of the Directive the body responsible for deciding whether development consent is granted for a project coming within the scope of the Directive (the competent authority) must take account of:

- the information supplied in the EIA Report; and
- the results of the necessary consultations with the public and other relevant authorities (including in other Member States where appropriate).

Although the environmental assessment process is linked to the consent process there are no strict requirements as to the extent to which these two activities are integrated. The EIA Report could be regarded as one of many submissions from the proponent to the competent authority, or it could be used to draw together all the main arguments being advanced by the proponent for seeking to proceed with a particular project. The remainder of this section argues in favour of the latter approach, and it is suggested that the extent to which the public is likely to participate fully in the EIA process will be determined to a significant extent by the extent to which the latter is perceived to influence decisions about the project itself. (See section 4.)

It is important to note that the assessment should include:

“... an outline of the main alternatives studied by the developer and an indication of the main reasons for his choice, taking account of the environmental effects”. (Article 5(3))

The practical effect of this requirement is to make it obligatory (for installations for which an environmental assessment is required) for a developer to study alternative options to that being proposed in any application for development consent, unless there clearly are no real alternatives. Therefore, although there is no explicit requirement for the EIA process to be integrated closely into the process of site selection and project development the requirements of Article 5(3) make this unavoidable. Further, as discussed in section 2, the EIA Report should incorporate information on the assessed performance of the preferred site for development together with comparative information for alternative sites.

In principle the requirement on a developer to give details about the main alternatives studied applies both to the waste management process being advanced as well to the choice of a particular site for development of a disposal facility. Consideration of alternative waste management options could take place in connection with an application for development consent at a specific site, or this could be addressed in advance of site selection through a strategic environmental assessment of waste management options.

Although such a process of early strategic evaluations is outside the scope of the Directive (being the subject of a draft Directive concerned with strategic environmental assessment of 'plans and programmes' [1]), it does provide a convenient mechanism for discussion of issues of principle in advance of considerations about a specific project. Nonetheless, in some countries (notably France) development work relating to a range of waste management options is taken forward in parallel, with a decision on which option to pursue to completion being taken at a relatively late stage. Such an approach ensures that decision-makers have a large quantity of information on which to make their evaluation, though at the expense of a significant increase in cost for the project as a whole. The model process described below assumes that the former approach is taken.

3.2 Model EIA Process

In principle, the process of selecting a site for a facility for disposal of radioactive waste could follow an approach based on screening of potential sites on the basis of pre-established technical and other criteria, or an approach based on volunteerism by local communities, or on some combination of these two approaches. Regardless of the precise method for site selection adopted, the siting process will generally be organised in the following four stages, as set out by the IAEA [2]:

- concept and planning;
- national and area survey;
- site characterisation; and
- site confirmation.

The model process outlined below, as summarised on Figure 2, is based around these stages. The major decision milestone in this process is the point at which consent is sought from the competent authority to proceed with development of the facility. The options concerning when this application should be made, and other decision points in the site selection process are discussed below. Public participation considerations are highlighted in the figure: these are discussed in greater detail in section 4 of the paper.

Pre-EIA Process

The search for suitable facilities for the disposal of radioactive waste has now been underway in various countries for several years. Although many countries are at different stages of a site selection process the world's only operating facility for disposal of long-lived radioactive waste is the Waste Isolation Pilot Plant (WIPP) near Carlsbad in New Mexico. The process of selecting a site for the long-term management of radioactive waste involves considerations of benefit and detriment at local and national level and considerations of sustainability and equity between current-day and future populations. The process has always been controversial.

Taken together the above issues make it inevitable that the Government, representing the national interest, plays an important role in determining the overall strategy for long-term waste management of radioactive waste. A necessary precursor to any site selection exercise will therefore be the establishment of a national policy for waste management by Government [3]. Government will need also to establish mechanisms (e.g. a regular review process) for ensuring that the policy is being implemented adequately by the various national organisations with waste management responsibilities.

The process of establishing Government policy will generally require a national debate on the policy options [3]: such a debate will only be possible where there is a minimum level of awareness of relevant issues. It has been suggested [4] that, for such a debate to be meaningful, 80% of the national population should be aware of these issues.

Concept and Planning Stage

The concept and planning stage of a site selection process is concerned with establishing the ground rules for the subsequent phases (i.e. the social and technical criteria for choosing a particular site) as part of a plan for the siting process. Such criteria can only be developed in the context of an assumed disposal concept, which in turn will be associated with broad categories of hydrogeological setting.

The long-term performance of a disposal facility will be determined by the performance of man-made (engineered) barriers, such as the waste container and the material emplaced around it, in combination with the performance of the natural barriers, the rock and the biosphere (which will disperse and retain the radionuclides).

Stages of Site Selection	Pre-EIA process	Concept and Planning	National and Area Survey	Site Characterisation	Site Confirmation
Main Activities	Establish Government Policy	<ul style="list-style-type: none"> Generic disposal / storage concept Plan for siting process 	<ul style="list-style-type: none"> Identification of : <ol style="list-style-type: none"> areas for potential sites; potential sites 	<ul style="list-style-type: none"> Surface-based investigations at potential sites Determination of application by competent authority 	<ul style="list-style-type: none"> Underground investigations
EIA Process		Development and strategic appraisal of: <ul style="list-style-type: none"> Generic disposal / storage concept Plan for siting process Screening guidelines Site evaluation strategy 	<ul style="list-style-type: none"> Assessment of potential locations against technical and social siting criteria EIA process in relation to drilling of boreholes at the identified potential sites (where applicable) 	<ul style="list-style-type: none"> Site specific and design specific environmental and social assessments Evaluation of alternatives and selection of preferred site for development 	<ul style="list-style-type: none"> Preparation of detailed performance assessment Monitoring of compliance with conditions of development consent
Public Participation	<ul style="list-style-type: none"> Consultation by Government on radioactive waste management policy Develop public education programme (where appropriate) 	<ul style="list-style-type: none"> Undertake social profile and stakeholder analysis Develop public involvement programme Measure public support for specific proposals 	<ul style="list-style-type: none"> Prepare area and community social profiles Develop mechanisms for interaction with interested communities Implement public involvement programme (at regional and local levels) 	Ongoing implementation of public involvement programme, including: <ul style="list-style-type: none"> Consultation on programme for EIA process ('scoping') Evaluation of environmental and social impacts Consultation on EIA report 	<ul style="list-style-type: none"> Continuing interaction with local community about development of final design and mitigation of environmental impacts Feedback results of ongoing investigations to local community and to interested groups at regional and national level
Formal Decision Points		Endorsement of plan for siting process by competent authority	Development consent for boreholes by competent authority	Development consent for project by competent authority	Consent for construction by regulatory authorities

Figure 2. The Process of Environmental Impact Assessment for a Geological Repository

A search for a site which provides optimal hydrogeological performance, whilst ignoring social impact considerations, is unlikely to be successful, as is shown by recent experience in Canada [5]. Also, because ultimate performance of a repository depends on the combination of the different barrier systems, a key consideration in choosing a site is to find a hydrogeological setting that can be modelled adequately, rather than one for which the ultimate performance will be more uncertain.

It is suggested that guidelines for site selection should therefore be of a qualitative rather than quantitative nature. Their development should be integral with considerations of the disposal concept or concepts, including the relative contributions of the engineered and natural barriers. The siting plan should recognise that social impact considerations are no less important than technical considerations and should recognise the importance of local community involvement in the project activity.

National and Area Survey Stage

This stage of site selection is concerned with the identification of a small number of potential locations, at which detailed investigations would subsequently be undertaken, following the siting plan developed during the concept and planning stage.

The EIA process during this phase is concerned with preliminary evaluations of potential locations against the established siting criteria, from desk-based studies of existing information. In the event that a site is selected for detailed investigations using deep boreholes, development consent (and an associated EIA Report) may be required, subject to the discretion of individual Member States. Although such an assessment would be focused primarily on the immediate potential impacts from the drilling of boreholes, it must take account also of the potential wider impacts in the event that a repository were located at that location.

The extent to which such wider impacts need to be considered will depend on the level of confidence that the site under consideration might ultimately prove to be a suitable location for a repository. For example, where there is already a high level of confidence from desk and remote sensing studies that the site would prove to be a suitable location, then it would be appropriate to give more detailed consideration of wider impact than if the application for borehole consents was more speculative.

Site Characterisation Stage

This phase of site selection is distinguished by the collection of site-specific geological, hydrogeological and other environmental data, as well as on the results of research work on the performance of the engineered elements of a repository at that location. Because this phase involves site-specific geological investigations it is envisaged that only a small number of potential sites would be characterised in detail.

The availability of site-specific data will enable preliminary assessments of the performance of potential sites, including environmental impact, to be made, taking

account of properties of the waste to be emplaced in the repository and the proposed disposal method for that particular environment. It is suggested that these assessments should address both radiological and non-radiological impacts, including an analysis of social and economic factors.

It is during the selection of a preferred site or sites for development that the EIA requirements as outlined in the Directive have most relevance. The environmental assessment process provides a framework for comparison of the sites being investigated against attributes such as:

- radiological and non-radiological impact on human beings and the natural environment (including the robustness of predicted impacts);
- social and economic considerations;
- costs of developing a facility at each of the potential locations; and
- implications for the future availability of natural resources in the vicinity of the facility.

It will generally be appropriate to make an application for development consent at the point at which a preferred site or sites have been chosen, even though final decisions about proceeding to construct the facility are unlikely to be taken until a phase of underground investigations (the site confirmation phase) has occurred.

Site Confirmation Phase

Data obtained during site confirmation activities will enable a more comprehensive assessment of the potential environmental impact from a facility to be undertaken, and will provide further confirmation that the assumptions made in assessing the potential impacts are likely to be valid.

The legal systems in many Member States are such that consent under nuclear safety legislation will be required before proceeding with construction of a repository, with a further consent being required before the start of waste emplacement. Consent for construction under nuclear safety legislation would normally be sought at the end of the site confirmation phase. In the event that development consent was being sought at the same time, the consent regimes would need to operate in parallel, with the EIA Report (setting out the basis for seeking to proceed at the selected site) being augmented by documentation addressing the basis for the assessed safety performance in greater detail.

The above approach suffers from a number of disadvantages, including:

- the outcome of the site selection process may not be considered formally by the competent authority until after a significant level of expenditure had been incurred by the developer and by other interested parties, including the regulatory authorities; and
- the ability of the competent authority to influence the choice of measures to avoid, reduce and mitigate significant adverse effects may be

diminished in a situation where their formal involvement begins at a late stage of the project.

4. Public Involvement in the EIA Process

4.1 Introduction

Article 9 of the Directive states that the competent authority is required to make the following information available to the public following a decision on whether to grant or refuse planning consent:

- *the content of the decision and any conditions attached thereto;*
- *the main reasons and considerations on which the decision is based;*
- *a description, where necessary, of the main measures to avoid, reduce and, if possible, offset the major adverse effects.”*
(Article 9(1))”

The Directive allows Member States wide discretion as regards public participation in the assessment process, including determining which ‘publics’ are concerned with a particular proposal. Nonetheless, such participation is a fundamental component of the EIA process and it is suggested that the assessment must take account of social values as well as scientific issues if the consequences of any development are to be properly evaluated. It is worth noting also that open discussions on the environmental and social effects of a project can help to allay fears and promote increased acceptance of the project in general. The ‘public’, therefore, needs to be broadly defined, incorporating any individuals or groups that have an interest in the project, and accepting that the interest does not need to be demonstrable.

There is a range of possible approaches to public involvement in an EIA process, from an information-giving approach (with or without consultation of the information provided) to a process of ‘mutual education’ (involving two-way information flow and interactive participation between proponents and the interested public). The Directive requirements are framed in terms of ‘consultation’, based around documentation supplied by the project proponent to the relevant authorities as part either of the application for development consent or related to an application for advice on what information should be contained in the assessment report. Such a consultative process would normally involve the public being informed, through local media, of the existence of such documentation, with comments being sought within a certain time frame. Prior to a decision about development consent being taken a public hearing would normally take place at which the public would have a further opportunity to express its views.

4.2 Approaches to Public Involvement

The nature of public involvement in decision-making relating to the development of a geological repository will differ according to the different stages of the project itself. In the early phases of a project, before potential repository sites are identified, decisions are required at national level relating to strategic issues (such as the overall waste management strategy), as discussed earlier. During the siting process the focus of involvement will move towards those regions that appear to meet the basic siting criteria, and finally to local communities as specific potential sites are identified.

Although the type of public involvement changes as the project progresses, it is possible to identify overarching principles that apply at all stages of the process. A basic objective for any public participation activity is to achieve a certain level of public awareness: the level of existing awareness must therefore be determined at the outset by market research techniques. Ultimately the objective should be to develop a waste management strategy that is both technically sound and has broad public understanding and support.

Any attempt to involve the public in an effective way should adhere to the following principles. Participation should be:

- started early and occur throughout the process (with defined cycles of activity);
- interactive - a two-way process including feedback; and
- inclusive, transparent and honest.

A key requirement will be the development at the outset of a public involvement programme that defines the overall objectives and outlines a series of public activities connected with the various phases of the assessment process. The programme will need to provide for easy access by any interested individuals and must be seen as being fair, i.e. the public must be able to contribute to defining the scope and nature of the programme itself. Experience from Canada [4] suggests an approach based on the following elements:

Social Profile – a compilation of the key social characteristics of the community concerned (which may be at national, regional or local level)

Responsive Publication – circulation of documentation outlining key proposals in an easily understandable format and inviting the public to express their interest and to make comment.

Open Houses – a staffed display at convenient locations, which the public is invited to visit, to discuss the proposals and to provide verbal and written comments.

Planning Workshops – meetings between proponents and community and NGO representatives, with a neutral facilitator, at which views are discussed and

strategies developed for the resolution of points of disagreement. Minutes of these workshops should be distributed amongst the wider community.

Various models for public participation may be used to support the above approaches, such as :

Community Advisory Committees – groups of people formed to represent the community and their interests in dealings with the developer. These will be less appropriate in situations with a strong tradition of representative local democracy.

Citizens' Juries and Consensus Conferences – a process in which a small representative panel of people is chosen to reflect the views of a community and are given the opportunity to develop their understanding of relevant issues through dialogue with experts chosen by the panel. The findings of the panel are publicised. The same general approach is adopted for both methods, though Consensus Conferences are less formal than the former. Both processes are costly and are limited in their usefulness by the fact that only a small group of people can be involved.

Participative Social Impact Assessment and Management – a process using a combination of advertisements in local news media and open houses, in which the public is encouraged to indicate views on specific questions relating to the assessment and management of social impacts of a proposal.

The above processes should be iterative, and the degree of ongoing involvement by the public will depend on the extent to which it believes that it is able to influence the decision-making process. In this context it will be important that mechanisms are put in place which ensure that queries raised by members of the public are considered by proponents, with visibility of how the query is addressed, e.g. by providing access to correspondence dealing with that issue.

5. Conclusions

In the European Union Directive 85/337/EEC establishes basic assessment principles and procedural requirements allowing Member States considerable discretion in the details of implementation into domestic legislation, particularly as regards the specific impacts to be addressed and nature of public involvement in the assessment process. The Directive requirement to provide information on the alternatives studied by a developer makes it inevitable that the environmental assessment process has an integral role in the process of selecting a preferred site for development.

Although the Directive requires an assessment of the direct and indirect effects of a project on human beings, as well as on the natural environment, is not specific as to the particular environmental impacts that should be addressed. Recent history shows that the issue of the long-term management of radioactive waste requires consideration of social, ethical and economic issues as well as technical considerations. It is suggested that the environmental assessment process provides

a suitable mechanism for consideration of these issues in a single overall framework.

Any proposal to develop a geological repository can only be expected to receive development consent where there the project commands a broad level of public understanding and support. The development of effective mechanisms for involving the public in the environmental assessment process is therefore a fundamental requirement. Public involvement needs to be an ongoing two-way process, with easy access to information and visibility of how issues raised by the public are addressed in the ongoing project development process.

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1.2 The Canadian Context

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In 1988 the Minister of Environment established the terms of reference for the environmental impact assessment. Atomic Energy of Canada Limited (AECL) and Ontario Hydro (both Crown corporations) submitted an environmental impact statement on the pre- and post-closure disposal technology in September 1994. The final recommendations of the Canadian Environmental Assessment Panel were

released in February 1998 [2]. Ultimately, it will be up to the Minister of Natural Resources to decide whether or not to proceed with the concept and to initiate the next stage of the process. It is at this point that actual site selection will begin.

1.3 Theoretical Approach

In environmental impact assessment, defining the management problem and the study parameters has traditionally consisted of the delineation of an explicit set of purportedly neutral guidelines called the terms of reference. These guidelines delineate the topics and the spatial and temporal scale that are considered part of the undertaking. For most environmental analyses, the terms of reference are set unilaterally by a regulatory agency such as the CEAA; this step is not considered to be an integral part of the assessment process [3].

Analysis of the Concept EIS and its associated documentation suggests that the definition of the Canadian NFW management problem is comprised of more than just the non-partisan guide set out in the terms of reference. First, the analysis indicates that the articulated terms are a political product rather a neutral set of guidelines. Second, also important in framing the management problem is the host of other regulations and policies that impinge on the project. Third, problem definition is delineated by the underlying core perspectives of those who have decision making power.

The consideration of problem definition is of particular importance in complex technologic undertakings where assessments are required to extrapolate short-term trends to timelines of thousands of years. Under these conditions uncertainty becomes a central characteristic of the available information [4]. On the one hand, Eden maintains that a necessary strategy for the management of uncertainty involves the consideration of multiple problem frames [5]. If only a single approach is utilized, the available knowledge and possible solutions will be limited [6]. On the other hand, when the traditional scientific paradigm is unseated as the standard against which projects are measured, judgments must still be made among competing definitions of the problem. Shrader-Frechette suggests that a policy should be judged to be more objective and rational than its competitors if it best survives critical evaluation by differing stakeholder groups each of whom utilizes their own particular problem definition [7].

2. Articulated Terms of Reference

The first aspect of problem definition involves the articulated terms of reference. The terms of reference for the EIS of the NFW disposal concept provided the explicit mandate for the Review Panel. No formal process of public input was undertaken nor is there any accessible public record regarding the establishment of these terms. Several stakeholder groups decried this opaqueness and lack of public input. From the outset of the EIS this initial discord set an adversarial tone within the EIA process [8].

The terms of reference can be divided into four components. First, aspects of the overarching focus included the review and evaluation of the safety and acceptability of the nuclear fuel waste disposal concept and a range of other nuclear fuel waste management issues. A second component required that the Canadian disposal concept be compared to other long-term management options and to the management of hazardous waste. Third, the terms of reference limited the scientific review group to biological and physical scientists and engineers; other specialists were not represented on the scientific review panel. Fourth, the Review Panel was explicitly instructed to refrain from discussing Canadian energy policy and the construction and operation of nuclear power plants.

Litmanen maintains that a salient consideration in the analysis of a problem frame involves the ascertainment of which definitions have a dominant status [9]. The terms of reference for the NFW management EIS established an overarching focus to review the safety and acceptability of the nuclear fuel waste disposal concept while concurrently denying the discussion of issues related to the construction and management of nuclear power facilities. For several groups, particularly non-government organizations (NGO), women's and Aboriginal associations, proponent credibility regarding future projects was intimately bound with the safety and management record of current operations. The consideration and legitimacy of this concern was denied through the limitations imposed in the terms of reference.

An issue considered under the second component of the terms of reference involved the storage of NFW waste rather than disposal. There was widespread consensus among NGO, women's and Aboriginal groups that a walk-away repository was not acceptable. Instead, many advocated for a monitored retrievable storage facility. They suggested that alternatives to disposal were only considered in a cursory fashion and that AECL had not explicitly compared the storage and disposal options in order to provide justification for their choice of facility. Among others, Environment Canada and the Review Panel noted that both the terms of reference and the regulatory agency, the Atomic Energy Control Board (AECB) mandated the focus on deep geologic disposal. Yet, for Canadians, judging the acceptability and safety of the disposal concept is likely to hinge on whether or not people consider it to be the most appropriate management option [10].

A limitation stipulated in the terms of reference related to the establishment of the scientific review group (SRG). The SRG was struck explicitly to provide the Review Panel with an independent source of information and an additional review of the concept EIS. Since membership was restricted to engineers, biological and physical scientists, the Review Panel was denied a full evaluation of social issues. The Review Panel asserted in its Final Report that a peer review by social scientists and ethicists is needed to provide information regarding the social acceptability and safety of the concept [11]. Ten years earlier this same idea had been recommended by the Standing Committee on Environment and Forestry in their 1988 report to the House of Commons regarding NFW management in Canada [12].

Similarly, issues that the terms of reference deemed beyond the Review Panel's mandate also caused considerable controversy. For instance, Canadian policy in general, and hazardous waste management in particular, emphasizes the importance of source waste reduction as part of a '4R' management strategy (reduce, re-use,

recycle and reclaim) [13]. Conversely, although seven reactors in Ontario have been shut down since 1996, Canadian energy policies continue to support the production of nuclear waste. The debate about these policies was deemed outside the terms of reference. A substantial number of participants and the members of the Review Panel itself found this particularly troublesome. Initially, the Canadian government justified the exclusion of energy policy by promising that the energy review would be undertaken in a separate forum. However, as of 1999 the review of energy policy has yet to be undertaken.

3. Societal Rules: Regulations and Policies

A second aspect of problem definition involves the implicit societal regulations and policies that impinge on assessment. Two examples are provided. The first relates to the public participation policies within the EIA process itself. The second involves regulations established outside the EIA that guide the assessment of risk.

3.1 The Public Participation Process

Over the course of seven years the opportunities for stakeholder participation in the NFW concept EIS included numerous open houses, scoping meetings, hearings, written briefs and round table sessions. Public participation occurred throughout the five provinces of Saskatchewan, Manitoba, Ontario, Quebec and New Brunswick. Participants included invited speakers, both pro and anti-nuclear environmental professionals, engineers, Aboriginal groups, professional associations, industrial and technical specialists, government ministries, social and biophysical scientists women's groups and private citizens.

Within the context of environmental impact assessment, none of this information regarding public participation should seem even remotely surprising. With only minor variations, the standard protocol for a normal EIA was followed. However, this tends to beg the questions: Who sets the standards and who benefits from this normalized process? Fiorino contends that the participation forums deemed acceptable in EIA process are a politically established set of arbitrary mechanisms [14].

Based on Brenneis and M'Gonigle's adaptation of Arnstein's ladder of participation, the forums utilized in the Canadian NFW concept EIS established an advisory or consultative role for participants, but did not provide real power in the decision-making process [15]. Following standard protocol, the final decision regarding the concept remains the responsibility of the Minister of Natural Resources. The extension of power in decision-making to interests beyond the responsible ministry would require a devolvement of control from the central authority to those who are potentially affected by the project.

In the Canadian process, the decentralization of decision-making was of particular concern to First Nations. These groups suggested that as Canada's original inhabitants any development on traditional land ought to require explicit Aboriginal approval. Since the disposal facility will probably be sited on land claimed by First

Nations as their traditional territory, Aboriginal territorial rights will ultimately play a fundamental role in whether or not a facility can ever be sited. In contrast, the AECL states that the consideration of Aboriginal governance concerns is beyond their mandate. As standard EIS forums do not provide participants with a legitimate place at the decision-making table, the influence of Aboriginal opinion, or that of any other public participant, is entirely dependent on the will of those with political authority. The utilization of standard participation forums provides a mechanism to preclude the discussion of issues considered extraneous to the proponent but central to other organizations.

3.2 The Regulatory Framework

In an extension of the more limited consideration of the actual EIA participation process, the concept EIS demonstrated that NFW management is embedded in a larger regulatory environment that also works to constrain problem definition in subtle ways. One example of this broader regulatory framework involves risk assessment.

In the concept EIS the technical definition of acceptable risk from radionuclide exposure was one fatality or serious genetic effect in one million per annum. Several stakeholders challenged this definition. First, they took exception to the limitation of risk to exclusively fatal cancers and serious genetic effects. Despite the broader definition of risk from the World Health Organization, Health Canada, and the Review Panel, the EIS did not consider the risk of non-fatal cancers or non-genetic health effects such as reproduction dysfunction, immune suppression, physical pain, psychological distress or stress-related community dysfunction. Second, stakeholders were particularly appalled at the use of a 'reference man' in the risk assessment. The central individual for whom risk was assessed was 170 cm tall, weighed 70 kg, was between the ages of twenty and thirty, in good health and neither male or female. Based on outdated 1975 International Commission on Radiological Protection guidelines, this automatically discounted the risks to smaller, older or weaker individuals as well as the risk of gender related effects. It was also biased towards Euro-Canadian individuals and patterns since it did not adequately account for the subsistence hunting and fishing patterns of Aboriginal peoples. The only other individual considered was a one year old baby; not unborn children nor a baby at its peak newborn growth rate.

4. Core Values and Perspectives

In the management of Canadian NFW, underlying values form the third aspect of problem definition. Vaughan and Seifert assert that the most fundamental aspect of risk evaluation concerns how the risk is initially conceptualized and framed [16]. Several initial perspectives are possible including technical and social justice frames [17]. A technical frame usually invokes scientific or economic arguments and utilizes risk assessment methodology. Conditions of uncertainty are often marginalized and assumed to require further study and quantification [18]. A social justice frame is inclined to balance social equity and environmental factors and is concerned with the societal distribution of risks and benefits. The tenets of technologic risk assessment are frequently questioned.

The range of views that the Review Panel attempted to balance represents a continuum from total endorsement of the concept to complete rejection. On the one end of the spectrum were members of the nuclear industrial community who adopted a technologic frame. They confidently endorsed AECL's long-term modeling and safety predictions. They declared that future research at the implementation stage would resolve any residual questions or uncertainties. Members of this community urged the government to proceed without delay.

At the opposite end of the spectrum were the Aboriginal, women's and non-government organizations who espoused a social justice frame. They contended that the existence of irreducible uncertainty in such areas as modeling and long-term predictions requires the availability of an inclusive political arena in which to assess, debate and resolve the issues. They expressed their complete dissatisfaction with the concept EIS and urged the Review Panel to reject it.

Between these two extremes lay a range of perspectives representing government agencies and professional organizations. Members of this group shared at least some of the same reservations about the EIS as those who had adopted the more extreme ends of the spectrum. Some of these groups, such as AECL's research and development advisory panel, were more closely aligned with the nuclear industry and expressed confidence in AECL and its ability to address remaining details at the implementation stage. Cautious endorsement of the EIS in its unaltered form was granted. A slightly more critical position was adopted by others, such as the AECB, who contended that the EIS alone was not an adequate demonstration of the deep geologic concept. However, when the EIS is viewed in the context of AECL's other work and international research, these organizations had confidence that the concept was safe and acceptable and that implementation should begin. Environment Canada and others were still somewhat more cautious than AECB and declared that AECL should provide additional information through a deficiency statement before proceeding.

The link between underlying core values and the level of support proffered the concept EIS is clear. As suggested by the literature and noted by the Review Panel, predictably, those who express vocal opposition to nuclear power technology also tend to reject deep geologic disposal. Those who firmly support nuclear technology tend to believe that the disposable concept is viable. Less predictable are the stakeholder groups that espoused cautious support of the NFW concept EIS while simultaneously sharing many of the same misgivings of those who felt that the EIS should be rejected. One possible explanation for this apparent contradiction could be that for some organizations the flaws within the actual NFW concept EIS did not weaken their underlying belief that a disposal facility was the viable and preferable method to manage nuclear fuel waste.

5. Altered Problem Definition

The final section of the paper constructs an alternative definition of the nuclear fuel waste problem and postulates the probable effects that this would have on the

process. Only two significant changes are made in order to more easily trace their effects. These changes are assumed to reflect an altered terms of reference set after due consultation with stakeholders. If the final terms reflect stakeholder input, this in itself should reduce conflict and animosity. First, the overarching focus is changed from a review of the nuclear fuel waste disposal concept to a review of nuclear waste management options. As a result of the change in focus, limits on the mandate are relaxed. In this broader context, options to geologic disposal, Canadian energy policy and nuclear power plant operation also become integral elements of the evaluation.

Second, the composition of the Scientific Review Group is altered to include a range of biological, physical, and social scientists as well as ethicists and specialists in indigenous knowledge. This change lends credence to a range of social perspectives while not discounting the technical community. Knowledge that the scientific review is to be more broadly focused, would potentially encourage the proponents to move beyond their technologic mindset. It would also ensure a more careful evaluation of the types of information that are important to a more encompassing range of viewpoints.

These two changes can then be followed through to the second level of problem definition, societal rules and regulations. Within the terms of reference, modification of the focus phrase and of the Scientific Review Group would affect the context of both the EIA process and other regulations. Broadening the scope and shifting the focus towards a balance among several perspectives would probably result in the analysis of information discounted by the current process. Technical risk assessment, modeling and long-term predictions would be re-appraised and the needs and concerns of First Nations would be more adequately considered.

At the third level of problem definition, although neither of the suggested changes would transform core values, the opinion of the EIS would most likely be adjusted. Since the revised EIS would continue to support vigorous scientific analysis, it is quite possible that those of a technocratic bent would continue to find it adequate. At a minimum, approval of the process by other organizations such as First Nations, women's and NGO's would likely increase. The two adjustments to the terms of reference would also address many of the concerns of those who gave the current EIS guarded support. Thus, it seems plausible that the overall support for this new EIS would surpass previous levels. If this were to occur, Schrader-Frechette's criterion for judging policy rationality under conditions of uncertainty would be achieved.

Certainly under the altered conditions, the Review Panel would be less hamstrung in their evaluation of the issues that are salient to many Canadians and there would be a better availability of pertinent information. It would provide a forum in which to debate the merits of alternative problem frames and policy outcomes. It would increase the possibility that any assessments of safety and acceptability would not be hindered by a lack of knowledge or a discredited process. Finally, a rational evaluation of a range of options would result in an appropriate and defensible nuclear waste management strategy for Canada.

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