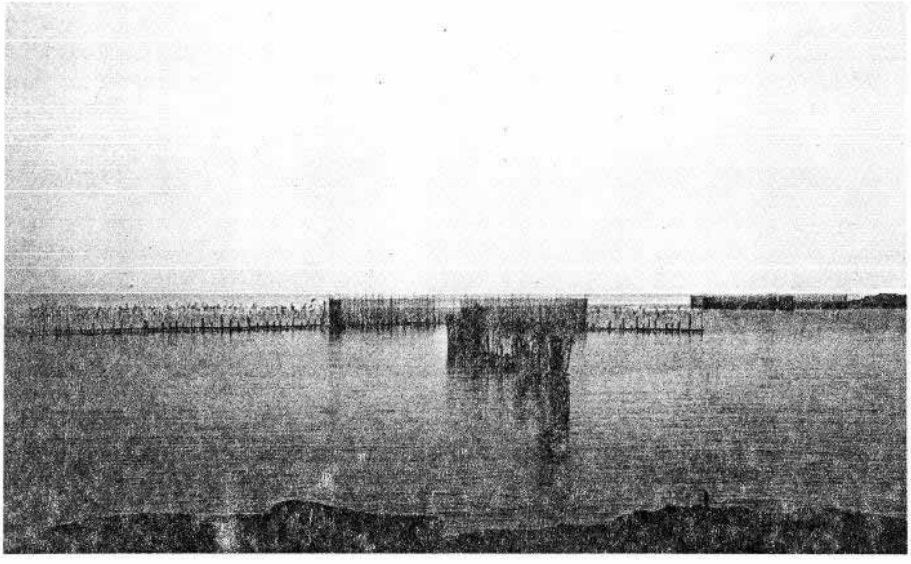
Second Nuclear Reactor
Point Lepreau, New-Brunswick

Report of the Environmental Assessment Panel



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Environmental Assessment Panel — Lepreau II

Commission D'évaluation Environnementale — Lepreau II

The Honourable Suzanne Blais-Grenier
Minister of the Environment
Ottawa, Ontario

The Honourable C.W. Harmer
Minister of the Environment
Fredericton, New Brunswick

Dear Ministers:

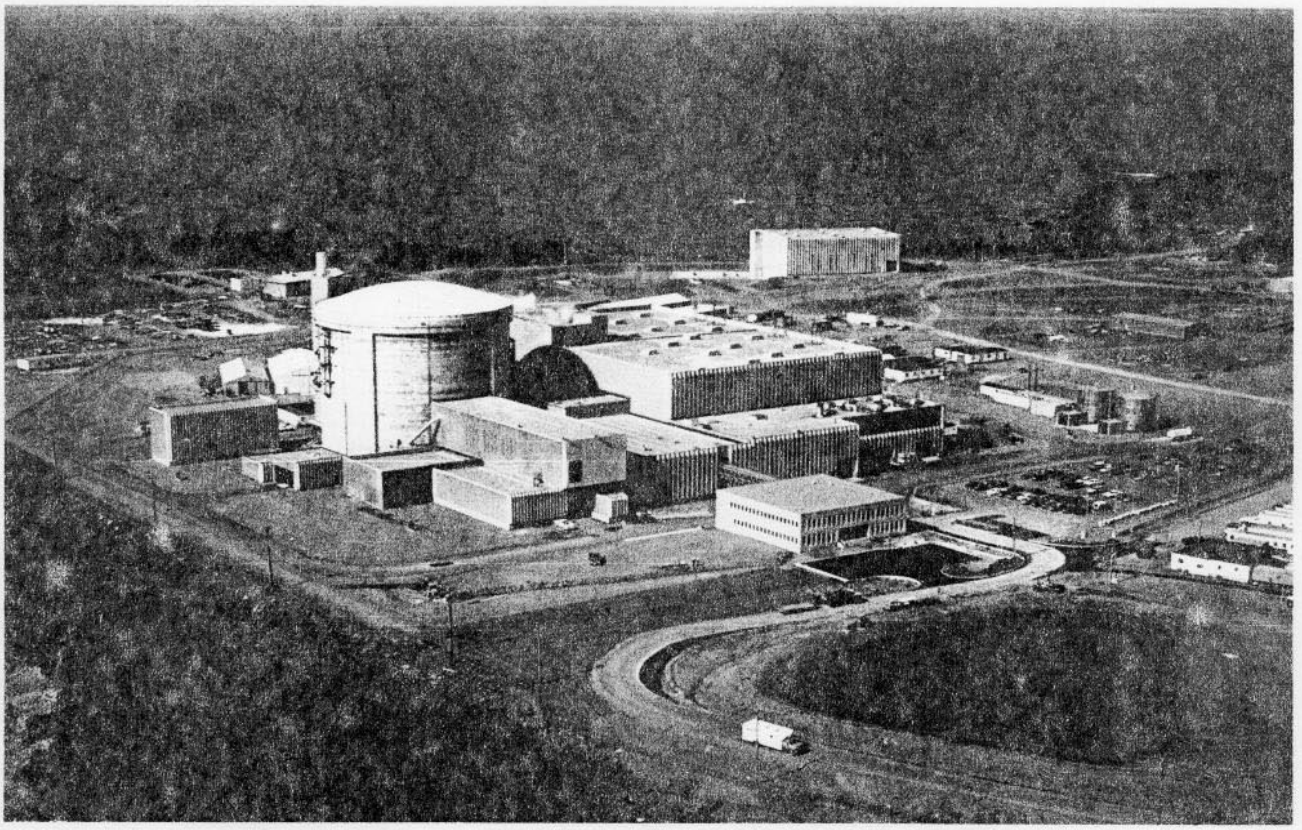
In accordance with the terms of reference issued on September 28, 1983, we have reviewed the environmental and related social impacts of the proposal to construct a second nuclear unit at Point Lepreau, New Brunswick. We are pleased to submit for your consideration the report of the Environmental Assessment Panel appointed to review the proposal.

We have concluded that the project can proceed without significant adverse effects provided certain recommendations are followed. In order to understand the impacts of Lepreau II, it was necessary to review, to the extent possible, the actual effects of Lepreau I before estimating the incremental effects of Lepreau II. In so doing, we made a number of recommendations that should be implemented now. The information gathered and experience gained can be applied to Lepreau II to ensure that potential impacts are reduced to a minimum and existing concerns associated with Lepreau I can be corrected.

Sincerely yours,

Robert Connelly
Co-chairman

Léandre Desjardins
Co-chairman



Point Lepreau Nuclear Generating Station New Brunswick

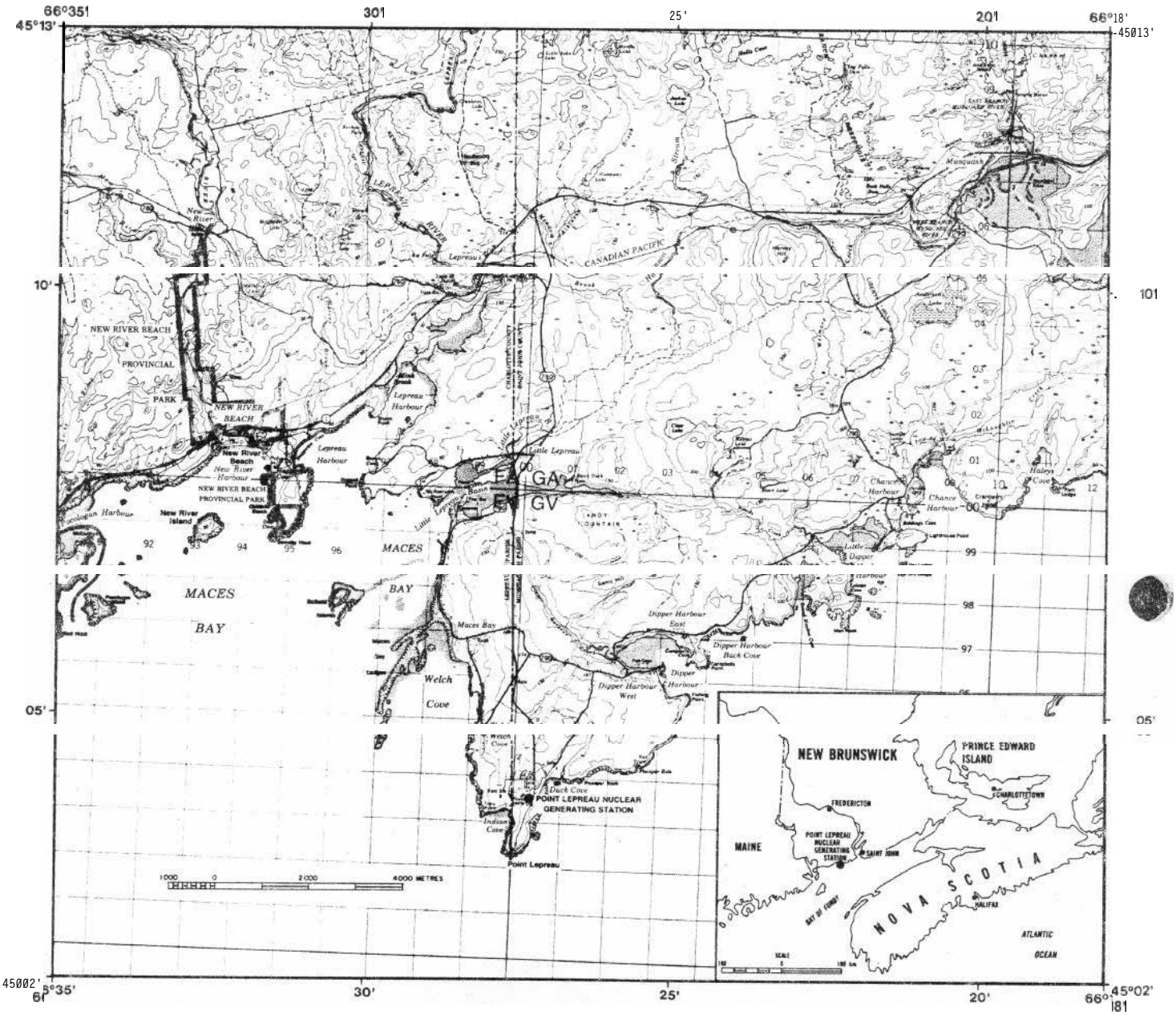


Figure 1: Study Area

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1.0 EXECUTIVE SUMMARY

This is a report of the findings, conclusions and recommendations of the Environmental Assessment Panel appointed by the Ministers of Environment of New Brunswick and Canada to review the proposal to build a second nuclear unit at Point Lepreau, New Brunswick.

The Panel's mandate was to assess the environmental and related social impacts of the proposal. Issues related to the export of Lepreau II power and the role of nuclear energy within the National Energy Policy were excluded from the mandate.

The Panel concludes that the project can proceed without significant adverse effects provided certain recommendations are followed. In order to understand the impacts of Lepreau II, it was necessary to review, to the extent possible, the actual effects of Lepreau I before estimating the incremental effects of Lepreau II. In so doing, the Panel made a number of recommendations that should be implemented now. The information gathered and experience gained can be applied to Lepreau II to ensure that potential impacts are reduced to a minimum and existing concerns associated with Lepreau I can be corrected.

A number of these concerns arise from the lack of monitoring data on the impact of Lepreau I on the marine environment in particular. In predicting impacts of Lepreau II, the Panel, in some cases, had to rely on professional judgment rather than empirical data. Consequently, it is important to maintain and coordinate existing monitoring programs and develop new ones. Specifically, the Point Lepreau Environmental Monitoring Program carried out by the Bedford Institute of Oceanography should continue until its objectives have been fully achieved. A non-radiological monitoring program should be established by the Proponent to permit a more accurate determination of the actual non-radiological impacts on the marine environment. In addition, a coordinating committee should be formed involving all agencies monitoring the effects of Lepreau I to coordinate and report on the monitoring programs. The Panel also believes that further research is needed on the impact of radioactive releases on components of the environment other than humans. The Point Lepreau Generating Station provides a good opportunity to further this research because it is the only Canadian nuclear station situated in a coastal environment.

In considering issues associated with the effect of radioactivity on humans, the Panel recommends that monitoring agencies besides the Atomic Energy Control Board be notified when target emissions are exceeded. Derived Emission Limits should be updated and applied as soon as the necessary information and new standards become available. In addition, the Proponent should update information on the distribution of radioactive releases under various weather conditions as a result of postulated upset conditions. Provision should be made in the plant design to allow for a tritium removal system to be installed in the future. Carbon-14 should be monitored in the stack and removal equipment installed if emission levels approach 1/100 of the Derived Emission Limit. The regulatory limit for the discharge of radionuclides to the ocean should be made more stringent. Control technologies such as evaporator systems can be installed if necessary to reduce liquid radiation releases to meet new standards.

Recommendations dealing with emergency planning include the discontinuation of the siren warning system, improvements to the existing telephone system and regular testing of the telephone link between the plant and the New Brunswick Emergency Measures Organization. The Panel also recommends that the wardens, who would notify residents in an emergency, be better informed of the emergency procedures and of the operating characteristics of the plant. The New Brunswick Department of Health which distributes potassium iodide pills should review this program periodically to ensure that the pills are available in local homes and are adequately safeguarded. In addition, the New Brunswick Emergency Measures Organization should simplify mock exercises in the future and ensure that the public is well informed on the best procedures to follow.

The Panel considered non-radiological environmental impacts and concludes that the Proponent did not adequately deal with the potential impact of the cooling water system on the marine environment. It recommends that impingement and entrainment data for Lepreau I be collected for at least two years. This data should be reviewed by Fisheries and Oceans and if required, appropriate mitigation measures implemented. In addition, more data should be collected to determine the size, configuration and temperature differentials of the thermal plume. Biological data should also be collected and reviewed to determine the effects of the thermal plume on the biota and the need for mitigation measures. The Panel recommends that non-radioactive liquid discharges from the plant be closely monitored, and that appropriate mitigation measures be applied if necessary.

In considering social and economic issues, the Panel believes it is important to make every effort to promote the well-being of people actively involved in the construction of Lepreau II as well as that of the people affected by the two units. Recommendations are made to train and upgrade local tradesmen and to encourage hiring of local workers to the extent possible. In addition, to improve communication and reduce possible conflicts, the Proponent should document and distribute information to people associated with the project on its approach to labour-management relations, personnel management and training policies, and planned mechanisms for conflict resolution.

A community advisory committee should be formed as soon as possible to provide a forum for exchange of information and problem-solving within the community context. Also, the New Brunswick Department of Municipal Affairs should re-examine the possibility of establishing a Local Service District Advisory Committee to serve local citizens who do not benefit from this type of representation. There are a number of recommendations aimed at improving local schooling, fire protection and transportation. The Proponent is urged to actively support community demands for the improvement of these services.

The Panel concludes that the Proponent's predictions of indirect economic benefits arising from construction of

Lepreau II are too optimistic, although benefits arising from plant operations appear more realistic. it was noted that the stimulative effect of Lepreau I in the development of high technology in New Brunswick was minor. Nevertheless, hepreau II would have an important economic effect in the Saint John area. The Panel recommends that the New Brunswick Department of Commerce and 'Development study and identify high technology engineering and technical opportunities for New Brunswick firms associated with Lepreau II and the potential for growth of these firms, It also recommends that the Proponent and appropriate government agencies examine further and encourage the development of the use of waste heat from both reactors for commercial purposes.

In considering the Proponent's plans for decommissioning the facility and transporting and disposing of the used fuel, the Panel recommends that the annual decommissioning levy be scaled so that contributions are higher during the first years of operation. The levy should also be adjusted according to new knowledge on decommissioning and transportation technology. In addition the Proponent should review periodically the amount of the Used Fuel Fund in tight of any new technical or financial information or any significant change in research and development costs to the utilities in the future.

The Panel also directs certain recommendations to federal and provincial administrators of environmental impact assessment review processes as a result of its experience in reviewing Lepreau II. They are encouraged to provide funding assistance to public groups' in highly technical reviews, to continue to examine ways to improve the scientific basis for environmental impact assessment, to develop principles to establish what constitutes an adequate baseline for environmental impact analysis and to consider greater interchange among technical experts in future reviews. The Panel also believes there is a desire for a public review of broad issues associated with the nuclear industry and recommends that the federal government consider undertaking a public review of the nuclear energy option within Canada's National Energy Policy.

2.0 THE PROJECT AND ITS REVIEW

2.1 project Description

Maritime Nuclear, a consortium of Atomic Energy of Canada Limited and the New Brunswick Electric Power Commission (N.B. Power), plans to construct a second Candu 630 megawatt nuclear-powered generating unit at the site of the existing Point Lepreau Generating Station. Lepreau I is owned and operated by N.B. Power. The second unit would be built adjacent to the existing Lepreau I unit, which is now in operation and was the subject of an environmental assessment review in 1974-75. It is intended to export the power produced at Lepreau II, at least in the first years of production.

2.1.1 Regional Setting and Site Description

The Point Lepreau site (see figure 1) is located on the Bay of Fundy, approximately 80 km from the Maine-New Brunswick border and 42 km west of the City of Saint John (population 80,500 in 1981). There are no incorporated communities in the immediate area. The 1981 census identified 12 settlements located in the parishes of Musquash and Lepreau: Chance Harbour, Dipper Harbour, Gilmore Subdivision, Lepreau, Little Lepreau, Maces Bay, Musquash, New River Beach, Pocologan, Prince of Wales, Thompson Subdivision, and Welch Cove. The combined population of Musquash and Lepreau Parishes in 1984 was 2,338. Fishing, fish processing and forestry-related industries have historically been the main sources of employment in the area.

The existing plant lies on a peninsula consisting of a low, rolling plateau with rock cliffs which drop sharply to the Bay of Fundy. Before the site was cleared for Lepreau I, it consisted of bog, either open or tree covered, or shallow soil with many rock outcroppings.

The area of the peninsula cleared and grubbed for construction of Lepreau I was 50 hectares (125 acres). For construction and operation of Lepreau II an additional 10 hectares (25 acres) of clearing and grubbing would be required, the majority of which would take place to the east of the existing station.

2.1.2 Plant Process

In Candu reactors, heat is produced by the fission of natural uranium fuel. Heavy water (deuterium oxide) under pressure carries the heat to the steam generators, and is then pumped back to the reactor core. In the steam generators the heat is transferred to ordinary light water, which is turned into steam. The steam drives turbines, which in turn drive electrical generators.

At Lepreau I, water used to cool the reactor and condense the steam is taken from the Bay of Fundy on the west side of Point I-epreau, passed through the plant, and returned to the Bay of Fundy on the east side of the point. The system was designed to accommodate two units.

Electrical power to run the generating station is taken from the generator output, or from the utility grid. Auxiliary power sources are provided to ensure the reactor can be safely shutdown if the main power source is interrupted.

Since failure of components within the nuclear system could result in the release of radioactivity, the reactor is housed in a containment building. It is designed to withstand accidents and to minimize the release of radioactive contamination during normal operations and upset conditions.

Used fuel would be stored in used fuel storage bays adjacent to the reactor building. Eventually when a facility is available in Canada for the disposal of high-level radioactive wastes, the spent fuel would be transferred to it. The low-level radioactive solid waste would be stored on-site in the solid radioactive waste management facility, which was constructed for Lepreau I and designed for both units.

2.2 The Review process

The Lepreau II Environmental Assessment Review was a joint federal-provincial undertaking to assess the environmental and directly related social impacts of a second nuclear unit at the Point Lepreau Generating Station. On September 28, 1983, the federal and New Brunswick Ministers of the Environment announced the review and issued terms of reference (see Appendix A) outlining its scope. On November 23, 1983, the Ministers appointed Dr. Leandre Desjardins (co-chairman), Dr. John Foster, Robert Connelly (co-chairman) and Dr. Adrian Booth to serve on the Panel. Biographies are contained

in Appendix B. The Panel was assisted by a secretariat consisting of Gerry Hill and Paul Monti from the New Brunswick Department of the Environment and Carol Martin from the Federal Environmental Assessment Review Office.

2.2.1 Scope of the Review

The terms of reference requested the Panel to review the proposed project and make recommendations to both governments on its acceptability in regard to environmental and directly related social impacts, The mandate pointed out that the National Energy Board would be examining the question of power export from Lepreau II and that the Panel should not address this matter. It also stated that Canada's

National Energy Policy and the role of nuclear energy within that policy were not issues within the Panel's mandate.

The terms of reference issued by the Ministers specified that several innovative features would be incorporated in the review. These included a public scoping exercise conducted by the Panel to identify priority issues and concerns and the establishment of a Study Advisory Group (terms of reference and membership listed in Appendix C) to provide advice to the Proponent on the scientific design of the Environmental Impact Statement.

2.2.2 **The Public Review**

The review process initially focussed on the production and content of an Environmental Impact Statement which the Proponent was required to submit to the Panel. The first step was completion of a public scoping exercise to assist in the development of guidelines for the Environmental Impact Statement. The Panel's secretariat held informal open house sessions on November 28, 29 and 30, 1983, in Dipper Harbour, Maces Bay and Saint John. Approximately 60 persons attended the sessions. In addition, the Panel convened scoping workshops on December 9 and 10, in Saint John. Approximately 80 participants from various government agencies, construction unions, trade associations, universities, the Proponent and the general public took part. Both the open house sessions and the workshops provided an opportunity for participants to learn about the review process and to identify priority issues and concerns.

On January 31, 1984, the Panel issued guidelines to Maritime Nuclear for the preparation of the Environmental Impact Statement. During formulation of the guidelines, the Panel considered input received from the open house sessions, the scoping workshops and written submissions. Issues identified were the impact of the proposal on the biological and socio-economic environments, impacts of radiation on human health, emergency planning, decommissioning, and monitoring. Certain issues identified by participants were considered to be outside the mandate and hence not included in the guidelines.

The Environmental Impact Statement was submitted to the Panel on June 6, 1984 by Maritime Nuclear. It was distributed by the Panel secretariat to review participants, including government agencies, interest groups and individuals, and placed in various public locations in southern New Brunswick. A 60-day review period was announced to receive written comments on the Environmental Impact Statement. The Panel received 20 submissions; 10 from government agencies, 7 from non-government organizations and 3 from individuals. These were issued in a compendium in early August, 1984.

On August 2 1, 1984, following its review of the Environmental Impact Statement and the comments received, the Panel requested more information from the Proponent regarding impacts on the biological environment, impacts of radiation on humans, impacts on the socio-economic environment, and monitortng. Maritime Nuclear's response to the Panel's list of deficiencies was distributed on October 3 to review participants.

After reviewing the response, the Panel determined that the information was sufficient to proceed to public meetings. The dates and locations of the meetings were announced on October 12, 1984, together with topics to be discussed (Appendix D) and meeting procedures. It also announce:! that six independent experts had been engaged to assist in the review and discussion of thermal pollution, discharge of radionuclides and their effects in the marine environment, pollution abatement technologies, risk assessment, emergency planning and economic impacts. The experts prepared a written report on their area of expertise, participated in the public meetings, and were available as resource people to participants in the review who wished to seek their advice.

The public meetings were held from November 21 to December 1, 1984 in Saint John, Fredericton and Pennfield. The meetings were advertised in local newspapers, posters were placed in central locations, and notices were sent to those on a mailing list established for the review. Considerable media coverage was received prior to and during the meetings. Apart from representatives of the Proponent and various government agencies, approximately 75 people attended the sessions.

All documents issued or received by the Panel throughout the review are available from the secretariat. These include verbatim transcripts from the scoping workshops and the public meetings, as well as the compendium of written comments received on the Environmental Impact Statement. The main documents associated with the review are listed in Appendix E. A list of participants is included in Appendix F.

2.2.3 Public Participation

2.2.3.1 **Nature of the Public Input**

The Panel facilitated public involvement in the public meetings in a number of ways. The meetings were divided into general sessions and special sessions devoted to specific topics. Sessions with general or non-technical subjects on the agenda were scheduled at convenient times (i.e. evenings and Saturdays). A free bus service was provided to transport local people in the Lepreau, Maces Bay and Dipper Harbour area to and from the sessions in Pennfield and Saint John that dealt with general and socio-economic topics. Technical experts engaged by the Panel were available for consultation upon request.

There was active participation by provincial and federal government agencies, various economic development associations, academic institutions and other groups. However, only a few local residents from the Point Lepreau and Saint John area took part. Those who did participate contributed much to the Panel's understanding of local concerns.

During the scoping workshops and the public meetings, the Panel observed that participants associated with economic development associations and union groups saw the project as an opportunity to reduce the high unemployment in the area and hence improve the local economy. They were also concerned that labour strife which affected construction at Lepreau I might be repeated and felt that local people and New Brunswickers should be hired first. Representatives of academic institutions outlined the professional and technical

skills available in New Brunswick to fill new jobs associated with the design, construction and operation of Lepreau II, and encouraged Maritime Nuclear to use their facilities to train New Brunswickers.

Local people who participated actively in the review were generally supportive of the project, while offering suggestions on how to improve local community services and emergency planning. Those who were opposed to the project cited some of the negative socio-economic effects of Lepreau I, were opposed to nuclear power, questioned the economic viability of the project, or were concerned with safety. Some were local residents disturbed by losing the quality of life which they enjoyed previously in an isolated and remote corner of New Brunswick. They also saw short-term construction work or other unskilled jobs as inappropriate approaches to job creation for local people.

2.2.3.2 **Factors Affecting Public Participation**

The reason for the comparatively low public input at the public meetings was difficult to determine and, in the Panel's view, probably resulted from a number of factors. The proposed project is essentially a twinning of an existing facility with certain infrastructure already in place for two units. Since it is not a new intrusion into a predominantly fishing and rural area, it is less likely to prompt wide public interest and comment unless major concerns exist among local people about the operation of the existing plant.

Some seemed to have been skeptical about the value of the review process since they believed that a decision had already been made to proceed with the project, and their participation would only legitimize that decision. The public review of Lepreau I in 1974-75 was one of the first such reviews conducted in Canada, and was held after decisions had apparently been taken to proceed with the project. This perception created a certain amount of skepticism towards the review of Lepreau II, although both the Proponent and the governments involved indicated that no decision to proceed had been taken.

The question of economic viability of the project was of concern to some people who had observed the high cost overruns of Lepreau I. This concern was also expressed by those who would have preferred to discuss alternatives to Lepreau II and the economic need for the second reactor. However, questions of the economic need or alternatives to Lepreau II were outside the Panel's mandate and hence rhose interested in such issues were aware that they could not be addressed in the environmental assessment review.

Another explanation for the low participation was offered by one local resident who said that people in the communities near Lepreau I feel they are "in a fish bowl" (i.e. subjected to many studies). Also some suggested that nuclear industry issues are TOO complex for local people to overcome their reluctance to speak at a public meeting.

Several groups boycotted the Panel's public meetings in November, 1984, although they participated in the scoping workshops of December, 1983. They indicated they would only participate in the public meetings if the Panel's mandate was expanded to include a review of the project economics, alternatives to a second nuclear reactor, the desirability of exporting nuclear power, and broad issues associated with the nuclear industry as a whole. Although the Panel did not prevent individuals from presenting views on such issues during the meetings, it pointed out that it would not be able to deal with these concerns in the context of its review.

These groups also argued that they did not have adequate resources to carry out a technical review of the Environmental Impact Statement which they considered necessary in order to participate in the public meetings. They had been unsuccessful in obtaining financial support from the governments for this purpose and claimed they were at a disadvantage in presenting their opinions while the Proponent had access to considerable resources and expertise to present its position on all aspects of the proposal.

These groups made an important contribution during the scoping workshops and, in the Panel's opinion, could have made a positive contribution during the public meetings had they chosen to participate. Nevertheless, the issues of concern to these groups which were within the Panel's mandate were raised by others, and hence the Panel had an opportunity to consider them.

Having outlined a number of factors which seemed to have affected public participation in the review, the Panel wishes to emphasize that care should be taken in attempting to link the low participation to a specific attitude toward the project. Moreover, comments made by residents who did participate should not be dismissed as being unrepresentative, simply because their numbers were low.

2.2.3.3 **Facilitating Public Input**

The Panel believes that two of the factors outlined above can be acted upon by governments in similar reviews of complex issues. First, there is a desire by the public for a public review of broad issues associated with the nuclear industry. There has never been a national forum in Canada to discuss these broad issues and consequently those who wish to discuss these issues attempt to do so in the review of a specific project. Therefore, the Panel recommends that:

1 **the federal government consider undertaking a public review of the nuclear energy option within Canada's National Energy Policy.**

Secondly, certain groups and individuals felt that they did not have the necessary resources to make a complete review of the Environmental Impact Statement and to make a presentation at a level of detail similar to other reviewers. The Panel believes that funding public groups in reviews of highly complex issues would aid them in understanding the complexity of issues and allow them to participate better in discussions of these issues. The Panel recommends that:

2 **government8 consider providing funding assistance to public groups to assist them in participating in highly technical reviews; criteria should be developed which, among other rhings, are sensitlve to the interests of local citizens who live near the site of a proposed project, and to those organizations that have the ability to provide an**

Independent examination of the Proponent'8 propoaai and can contribute to a discussion of alternative points of view.

2.2.4 Consideration of Technical Issues in Environmental Impact Assessment

A Study Advisory Group was formed by the federal and provincial environmental impact assessment administrators to advise the Proponent on the scientific design of the Environmental Impact Statement and hence improve its overall scientific quality. This approach, which has not been used prior to this review, is based on the premise that improved scientific quality in an Environmental Impact Statement should lead to improved project decisions.

Environmental impacts can be predicted by the collection and analysis of empirical data, examination of data from similar projects in similar environments, modelling exercises, and professional judgment. The accuracy of prediction is strongly influenced by the quality of the scientific studies conducted. Well designed studies are also essential for environmental protection.

The Panel guidelines requested that an ecological approach be used in study design and encouraged the collection of data based on the Lepreau I experience. In spite of this and the effort of the Study Advisory Group to improve the scientific basis of the Environmental Impact Statement, the judgments were not based on the collection and analysis of comprehensive data in many areas. Specific areas of concern in this regard are identified later in this report in the consideration of each of the various issues. Overall, the scientific quality of the Environmental Impact Statement was lower than the Panel had expected.

Long-term monitoring of the distribution and transport of radionuclides is being conducted by Fisheries and Oceans in its Point Lepreau Environmental Monitoring Program and by N.B. Power. However, other long-term environmental studies of the potential effects of Lepreau I on the marine environment have not been undertaken by N.B. Power in spite of the Lepreau I Environmental Assessment Panel recommendation that a cooperative federal government/N.B. Power program be initiated to determine the environmental effects caused by the operation of the station.

In contrast to the situation in Ontario and the United States, where long-term impact studies are required by government regulations, no such requirement was imposed in New Brunswick either by Fisheries and Oceans or the New Brunswick Department of the Environment. Hence when a decision to seek approval for Lepreau II was taken, data on non-radiological effects on the marine environment had not been collected.

In many respects, the Lepreau II Environmental Impact Statement contained little new information beyond that provided in the Lepreau I statement. The Panel had expected a more thorough, up-to-date presentation of baseline data specific to the Lepreau II project. However, there was a reluctance on the part of N.B. Power and Maritime Nuclear to carry out environmental studies or monitoring other than that imposed by government regulations. The Proponent assumed that the collection of such data was time consuming and not cost effective. In their view, collection of baseline data in the marine environment would have limited value and it would be difficult to establish a cause and effect relationship.

This placed the Panel in the situation where it had to rely on professional judgment in predicting impacts rather than basing predictions on empirical data. Most reviewers considered that impacts would be minimal. However, some felt that impacts may have been understated and most agreed that predictions of impacts were based on inadequate data. The Panel concludes that not enough empirical data has been used or collected on actual impacts from Lepreau I and consequently the Environmental Impact Statement is not of good scientific quality. Therefore, the Panel recommends that:

3(a) Environmental impact assessment administrators continue to examine wayr to improve the scientific basis for environmental impact assessment; and

(b) the principles of what constitutes an adequate baseline for environmental impact analyses be established by the reviewing agencies so that future Proponents know well in advance what will be expected.

The review process would have been improved by the provision of greater interchanges among technical experts (Scientific Advisory Group and independent experts), the Panel and the Proponent in a more informal setting to allow discussion of complex technical issues. The Panel believes that such exchanges would improve the preparation of guidelines and subsequent studies. This would equally facilitate a multidisciplinary discussion of the interrelationship of issues. The Panel recommends that:

4 there be a greater interchange among technical experts, the Panel and the Proponent in an informal setting in future reviews.

3.0 ISSUES ASSOCIATED WITH RADIOACTIVITY

3.1 Introduction

Small amounts of radionuclides are emitted from Candu reactors into the environment from a number of sources. Gaseous releases, primarily consisting of tritium, with much smaller amounts of noble gases (argon, xenon and krypton), iodine-131, and particulates (cobalt-60, strontium-89, rubidium-106, cesium-134, cesium-137), are monitored continuously. Further, there are at least twenty radionuclides present in liquid radioactive releases coming from a number of sources. These are stored and monitored to ensure compliance with radiation limits, before being discharged into the cooling water flow.

The environmental and health concerns over radiation from the Lepreau II reactor are common to all Canadian reactors of the Candu type. Because Candu reactors are largely standardized, there is an extensive background of experience to draw on in assessing their behaviour. Experience at the Douglas Point, Bruce and Pickering sites in Ontario is highly relevant, as is that of the Lepreau I reactor.

This experience has been generally reassuring. No radioactive pollution of any health significance has been observed around any Candu site. From time to time releases have been reported and traces of radioactivity found in the environment but, to date, these have remained very much below the regulatory limit. These limits are established by the Atomic Energy Control Board which has prime responsibility for regulating the nuclear industry in Canada. Assistance in the area of environmental health is provided to the Atomic Energy Control Board by Health and Welfare Canada and the provincial departments of health.

Certain emission standards for radiation exposure are applied to ensure the protection of human health. These standards are known as Derived Emission Limits. The Derived Emission Limit for any radionuclide isotope is the maximum amount of radiation which, if released, would cause the individual exposure limit to be exceeded and hence pose a health risk. Appropriate Derived Emission Limits are not established through direct measurements of levels in environmental media (air, water, soil) but rather involve making assumptions and modelling predictions about the movement of radionuclides through various environmental media and the food chain. These assumptions are used to relate the global distribution of radioactivity to the dose received by humans.

3.2 Predicted Radiation Exposures

The Panel guidelines specified that the Lepreau II Environmental Impact Statement should base any predictions on the Lepreau I record, since the operation of this plant would provide the most relevant experience. The Proponent stipulated that Lepreau I environmental radiation is currently about 0.3 micro-sieverts* whole body exposure per year (0.2 from gaseous sources and 0.1 from water) at the plant boundary, which is about 1 km from the plant.

Assuming normal (accident free) operations, this level could increase during the life of the reactor about 20-fold, due to a build-up of radioactivity in the reactor itself. If Lepreau II adds an equal amount, the total environmental radiation around the site from both reactors could increase by about 12 micro-sieverts per year in the course of time. This is a 1 per cent increase over the normal background radiation level. It is not a substantial increase since natural background radiation levels in specific locations across Canada can fluctuate up to 30 per cent from the national average.

3.3 Radiation Health Risk

The health risk associated with any increase in ambient radiation around a nuclear site may be expressed as the risk that an individual living at the site boundary might have of getting a radiation-induced cancer, and the genetic risk to a child born to the exposed individual. This health risk may also be expressed as a presumed statistical increase in the incidence of cancer (and genetic defects) in the population living in neighboring communities.

The cancer and genetic risks are about the same order of magnitude. They are generally estimated to be about 1 per cent per sievert of radiation exposure (i.e. a person's chances of getting cancer are increased by 1 per cent as a result of an exposure of 1 sievert). This conversion of radiation exposure levels to a quantitative health risk is internationally accepted and is used by ail Canadian agencies. While it must be applied with some discretion, because of the 10-20 year cancer induction period and other complicating factors, it is nevertheless a useful rule-of-thumb.

The projected environmental radiation resulting from both Lepreau reactors, operating under normal conditions (i.e. giving 12 micro-sieverts per year radiation exposurej would carry a cancer risk of about 1 in 8 million annually. This would correspond to a risk of 1 in 100,000 for a lifetime exposure. The current average cancer risk is about 1 in 5 (20 per cent) on a lifetime basis.

Expressed in population terms, the same 12 micro-sieverts per year exposure could be said to produce a minuscule increase in the cancer death rate of the exposed population. In Canada the annual rate is currently about 1.7 cancer deaths per thousand people. The 52 micro-sieverts per year exposure would hypothetically raise this rate to 1.70012 deaths per thousand. Applied to the population of the villages in the Point Lepreau area this exposure rate would produce less than one additional cancer death in 4,000 years.

* A micro-sievert is a unit used to measure radiation Radiation from natural radioactive elements in the environment is typically about 1,000 micro-steverts or 00 1 sieverts per year

3.4 Radiation Exposure Standards for Humans

Although predicted radiation levels pose no health hazard, there must be assurance that levels will not gradually creep upward over the years even in normal (accident free) conditions. This depends on the regulatory control exercised by government agencies such as the Atomic Energy Control Board, which licenses the construction and operation of the reactor.

Under the Atomic Energy Control Board regulations, the exposure of an individual living beyond the plant boundary is limited to 5,000 micro-sieverts per year. This is more than 400 times greater than the predicted level of 12 micro-sieverts referred to earlier. In terms of the individual cancer (and genetic) risk, the 5,000 micro-sievert annual exposure would carry a risk of about 1 in 250 for a lifetime exposure. The Panel believes that every effort should be made to keep radiation levels much below this regulatory standard.

Fortunately, both the Proponent and the Atomic Energy Control Board favor the application of the so-called ALARA principle; (i.e. that exposures should be kept "as low as reasonably achievable, social and economic factors being taken into account"). While this is a principle, not a regulation, it is applied by the Atomic Energy Control Board in licensing requirements on an ad hoc basis.

During the Panel's public meetings, the Proponent stipulated the application of an emission limit corresponding to 1/100 of the regulatory limit for operational control purposes. The Panel was also assured that the Atomic Energy Control Board would be notified of any incidents in which such target emission limits are exceeded.

N.B. Power presently informs the public of incidents in which target emission limits are exceeded. The Panel endorses this procedure. However, monitoring agencies (other than the Atomic Energy Control Board) generally have not been alerted in the past and it is particularly important that they be notified because of the time lag between any release and the identification of the radioactive nuclides in the environment. The Panel recommends that:

5 monitoring agencies in addition to the Atomic Energy Control Board be notified when incidents occur in which target emission limits are exceeded.

3.5 Impacts on the Non-Human Environment

Radiation protection programs carried out by the Proponent, and health protection and regulatory agencies assume that if humans are protected, no harm to the non-human environment will occur. However, there is evidence that radionuclides are accumulating in pathways that do not lead to humans. Therefore, the Panel believes that it is important to consider the movement of radionuclides in the biophysical environment and, in particular, the marine environment.

The Panel requested an analysis of impacts on marine and terrestrial organisms (other than humans) resulting from radioactivity from Lepreau I. Data provided by the Proponent on the sources, types and levels of radioactivity released indicated very low emissions and little concern for environmental effects.

However, it is difficult to evaluate with confidence the impacts that would result from these levels of emissions. The almost exclusive reliance on Derived Emission Limits to ascertain the dose to humans has resulted in a focus on only those organisms which constitute a portion of the pathway to humans. Hence the general knowledge of impacts on non-human organisms and pathways to specific organisms is very limited. It is crucial that these biological pathways be well understood and that appropriate data be used in evaluating them.

Further research, as recommended in Section 6.5, is required to improve knowledge of the impact of radionuclides on the non-human environment.

3.6 Radiation Pollution Controls

The application of environmental radiation controls does not usually involve direct measurement of levels in the environment. Instead, emissions are controlled according to the Derived Emission Limit.

The current Derived Emission Limit is based on the regulatory limit for an individual (non-occupational) exposure. which is 5,000 micro-sieverts per year. However, as stated earlier, the Proponent indicated an intention to apply pollution controls based on 1/100 of the Derived Emission Limit' in conformity with the ALARA principle. In addition, the reactor licensing procedure of the Atomic Energy Control Board will require the Proponent to show that the plant has been designed with the intention of achieving such reductions. The Panel strongly endorses this procedure to ensure that environmental levels are kept as low as reasonably achievable.

The Derived Emission Limits were calculated for Lepreau I and appear to be outdated. The Proponent indicated that new Derived Ernission Limits will be calculated for Lepreau I and Lepreau II, based on a new Canadian Standards Association Derived Emission Limit document, expected in 1985, and on new Atomic Energy Control Board regulations with revised dose limits, expected by late 1985. In the Panel's opinion these new calculations for Lepreau I and II ought to reflect the latest information available on the trajectory and dispersion of radionuclides in the aquatic and terrestrial environment. The Panel recommends that:

6 Derived Emission Limits for Lepreau I and II be updated and applied, taking into account new environmental information, 8% soon 8s the Canadian Standards Association document on Derived Emission Limits and the Atomic Energy Control Board revised dose limits become available.

It was suggested that, instead of controlling to an "allowable" emission limit, the best practical technology for pollution control should be installed because any level of radiation, however small, **may** be presumed to degrade the environment. It was pointed out that practical technology exists which could reduce the amount of certain volatile radionuclides in the stack gas to a level much below the Derived Emission Limit. Liquid radioactive effluents could be nearly eliminated by use of

evaporators. It was also mentioned that pollution control technology is expected to improve with time.

The Panel heard representations and technical opinions on these issues. The available technology for removing radioactivity from gaseous and liquid wastes was discussed. The following sections deal separately with the most significant items discussed.

3.6.1 Tritium

Tritium is radioactive hydrogen which forms in the heavy water used in the reactor. It is the major volatile emission (as water vapor) from Candu reactors and the chief source of internal radiation exposure. It can enter the human body (like any other form of water) through the lung, skin or digestive system. Its radioactive half-life is 12 years but its retention in the body after inhalation or ingestion is only a few days or a few weeks.

Atmospheric monitoring around Lepreau I indicates that tritium emissions have been low. However the amount of tritium in the heavy water inventory will increase substantially during the next few years of operation, due to radiation reactions. At some point the heavy water may need to be reprocessed to remove this tritium, perhaps to protect the reactor workers from excessive exposures.

Control options suggested include the installation of a tritium removal system or alternatively transporting heavy water to the Ontario Hydro tritium removai plant now being built at Darlington. The technology for tritium removal is relatively new and its capital cost is estimated to be $70 million. The plant being built at Darlington will be the first in Canada and is being constructed to minimize exposure levels for worker protection purposes. Tritium will be recovered and sold for fusion program research to provide revenue. Although the Panel does not believe that a tritium removal system should be installed initially at Lepreau II, it recommends that:

7(a) provision be made in the Lepreau II design to allow for a tritlum removal system to be installed at some point in the future; and

(b) tritiated heavy water be shipped to Darlington to be reprocessed, if levels reach the point where worker exposure requires lowering tritium levels.

3.6.2 Carbon-14

Carbon-14 {radioactive carbon) has a half-life of 5,000 years and is environmentally important because carbon is the primary building block of life. At Lepreau I this nuclide is monitored at the lighthouse near the property boundary. Preliminary information shows levels to be less than 0.1 per cent of the Derived Emission Limit. The Proponent plans to install a carbon-14 monitor in the stack for more direct assessment of this nuclide.

The Panel was informed that a special scrubbing device could be installed to remove carbon dioxide from the stack gases and the capital cost would be about $250,000. The Panel believes that the installation of such equipment should not be a pre-condition for environmental approval. However, the Panel recommends that:

8(a) N.B. Power proceed to monitor carbon-14 in the stack as planned; and

(b) the results of the carbon-14 monitoring program be evaluated periodically by the Atomic Energy Control Board and if emission levels approach 1/100 of the Derived Emission Limit, removal equipment be installed by the Proponent.

3.6.3 Noble Gases

The radioactive nuclides of the noble gases are of minimal health concern because they are not assimilated into the human body when inhaled, and their short half-life makes them relatively innocuous. However, they are not removed by stack filters and are therefore a major component of the volatile radioactivity release. They could be removed by means of a large "delay" tank designed to provide time for radioactive decay, since all of these nuclides (except krypton-85j are short lived.

It was noted that during start-up of operations at Lepreau I, noble gases were detected for 7 weeks out of 25 early in 1983. Under normal operations, emissions of noble gases have been virtually non-detectable. If needed in the future, the appropriate control technology would involve a delay tank system at a cost estimated at $8 million. The Panel concludes that the installation of a delay tank system is not warranted at this time given the small releases and their negligible effect.

However, krypton-85 is a special case, since it has a lo-year half-life. Unlike the other noble gas isotopes, it tends to build up in the global atmosphere. Individually any one reactor makes a negligible contribution to global atmospheric accumulation but with thousands of reactors operating it could conceivably cause an environmental problem in the next century. Should evidence indicate that this is becoming a problem in the future, then the appropriate pollution control technology should be installed.

3.6.4 Radioactive Wastewater

The Proponent plans to install an evaporator system during the decommissioning phases of the station to ensure zero discharge of radionuclides. The system could be installed when Lepreau II is constructed and used during plant operation. It has an estimated capital cost of $5 million and an annual operational cost of $1 million. The Proponent argued that evaporators have significant maintenance problems and costs, and that it would be more sensible to wait 30 years and buy a more technologically advanced evaporator. The discharge of radionuclides has so far been only a very small fraction of the permitted Derived Emission Limit with the average being .0024 per cent of the limit. Based on the existing Derived Emission Limit, Lepreau I has a satisfactory record in terms of liquid radioactive releases and it appears that an evaporator system may not be necessary for Lepreau II at present.

However, the Panel is concerned that there is no regulatory assurance that very much larger amounts would not be released into the sea. This possibility arises because the Derived Emission Limit for seawater is permissive, since it is calculated on the presumed health effect. Thus the large

dilution factor involved, together with the fact that sea water is not used for drinking water, combine to minimize potential human intakes. The Derived Emission Limits for releases to sea water at Lepreau are, in fact, based on the presumed intake of dulce and clams by local residents.

The Panel believes that some special consideration, other than the immediate effect on human health should apply to the ocean waters. Canada and many other countries have deplored the practice of ocean dumping of radioactive wastes. Sea disposal of radioactive wastes from universities, hospitals or industry is not permitted in Canada. The Panel recommends that:

9 **the regulatory limit** for **the discharge of radionuclides to the oceans be reviewed by the Atomic Energy Control Board to make it more stringent and hence provide greater assurance that only minimal amounts of radiation would be discharged to the oceans; reductions in radiation levels discharged could be achieved through the use of control technology such as ovaporator systems.**

3.7 Accidents and Upsets

An evaluation of the accident potential of the Lepreau II reactor is essential in assessing environmental impacts. This is a highly technical problem which is dealt with in detail primarily through the licensing procedures of the Atomic Energy Control Board.

A set of detailed criteria has been developed for judging the accident potential of reactor systems. The Atomic Energy Control Board guidelines are intended to assure that postulated accidents (of a given severity) occur at less than a given frequency. The severity is defined in terms of the radiation exposure of the population and the frequency in terms of hypothetical failure-rates for reactor components.

In the guidelines a "single failure" accident (complete failure of a process system alone) producing a 100 person-sievert * exposure of the population should not occur more frequently than once in 3 years. A "dual failure" accident (failure of a safety system in addition to a process system) producing a 10,000 person-sievert exposure should not occur more frequently than once in 3,000 years.

These standards (or guidelines) are not regarded as predictions but as reactor design criteria. They enable engineers to develop safety systems that can be shown to meet the Atomic Energy Control Board requirements. Meaningful accident rates are virtually impossible to predict accurately when dealing with such low probability events.

However, the regulatory criteria do provide a quantitative basis for assessing environmental impacts. In the "single failure" case the resulting exposure would correspond to one additional cancer in the population; i.e., a cancer ?hat would not otherwise have occurred. For the "dual failure" case the consequence would be 100 additional cancers. The genetic consequence would be of the same order.

The Proponent did not estimate an accident rate but, based on the above regulatory criteria, contends that it would be acceptably low. The Panel accepts this as a reasonable conclusion. It heard expert opinion that the analysis was consistent with the current state of the art for predicting the frequency of accidents. In addition, the Panel considers operating experience at other Candu reactors to be reassuring.

However, in turning to the question of the magnitude of the impact of such accidents (or upset conditions) the Panel found some cause for concern. It could not assess the environmental impact of any specifically postulated accident because no determinations had been made of the distribution of radioactive releases under various site-specific meteorological conditions. Instead, environmental levels had been calculated from a simple formula, using an assumed atmospheric dilution factor designed to demonstrate compliance with regulatory standards.

While the Panel does not challenge the validity of the formula when used for this purpose, it regards as unsatisfactory the fact that the Lepreau II Environmental Impact Statement should be without a specific analysis of the distribution of radioactivity in surrounding areas under various weather and oceanographic conditions. This may be of particular importance in considering pollution levels which, although below the regulatory limit, do not conform to the ALARA principle. it also is important in determining the persistence, accumulation, mobility and ultimate fate of radionuclides in the terrestrial and marine environment. Such information is currently lacking.

The Panel believes that the use of more recent formulas and better modelling techniques would result in a more accurate prediction of the distribution of radioactive releases under various site-specific meteorological conditions. Hence if there was an accident with a sudden release of radiation, precalculated distribution patterns would assist in rapidly determining the area that could be contaminated and thus assist in implementing emergency plans. The Panel recommends that:

10(a) the Proponent prepare updated Information on the distribution of radioactivity In the rurroundlng area under various weather condltlonr as a result of postulated releases under accident or upset condltlonr; and

(b) the dhtrlbution patterns be Included in the Emergency Plan documents or added as an Appendix.

* a person-siever! is the number of persons exposed to a certain radiation dose multiplied by the dose each received (e.g 100 person-sieverts is equivalent to 100 persons being exposed to 1 sievert).

4.0 EMERGENCY PLANNING

4.1 Introduction

Emergency plans are prepared in order to facilitate a quick and orderly response to emergencies that may arise from events such as industrial or transportation accidents or natural events such as floods or earthquakes. In the case of Lepreau I, the Atomic Energy Control Board has established criteria for on-site contingency plans and the New Brunswick Emergency Measures Organization has formulated an off-site plan. Similar plans exist at all Canadian nuclear power stations and to date the evacuation of people living near the stations has not been required.

The on-site plan requires certain actions to be initiated at specific radioactive release levels. The objective of the plan is to control and ameliorate contingency events inside the site in order to protect the public, persons at the plant and the plant itself. The present on-site plan outlines the responses which would be made to potential on-site contingencies, and the facilities, responsibilities, agreements, and training required to respond to contingencies. Evacuation would be planned if air releases from the stack reached a level resulting in a dose rate of 1 milli-gray* per hour at 1 km from the station and for a dose rate of 5 milli-gray per hour, evacuation would be implemented. Given that evacuation would likely occur a few hours after a release, the net doses could range from 1,000 to 10,000 micro-sieverts to individual members of the population. Annual dose received from natural background radiation is approximately 1,000 micro-sieverts.

The off-site plan, administered by the New Brunswick Emergency Measures Organization, would be activated following notification of an emergency by the plant shift supervisor. The interface between the two plans is evaluated periodically.

The existing emergency on-site and off-site plans for Lepreau I would require some minor modifications if a second nuclear unit is installed. They would have to take into account the large work force that would be on-site during construction of Lepreau II. In the following section the Panel makes a number of recommendations dealing with the existing emergency plan. These recommendations should be implemented as soon as possible to ensure that the improvements are introduced prior to the construction of Lepreau II.

4.2 Communications Network

Initial action during an emergency would be taken by the plant shift supervisor. The link between the on-site plan and the off-site plan would occur if the shift supervisor determines that radiation levels have exceeded a pre-determined level. If so, the supervisor would notify the N.B. Power dispatch center in Marysville, which in turn would contact the New Brunswick Emergency Measures Organization Office in Fredericton.

The New Brunswick Emergency Measures Organization would decide whether to declare an emergency and the action required to protect the public. It could, if required, request federal government assistance from the Radiation Protection Bureau of the Department of National Health and Welfare. If it became necessary for the public to be alerted, sirens placed in six locations throughout the area would be sounded, police cars would be sent through the area using their sirens and public address systems and wardens would be directed to contact residents in their areas. The New Brunswick Emergency Measures Organization would move individuals requiring assistance if evacuation became necessary.

4.2.1 Sirens

If the New Brunswick Emergency Measures Organization considered it necessary to sound the sirens it would direct the shift supervisor at the plant to do so. The six civil defence sirens in the Point Lepreau area are owned and maintained by the Department of National Defence.

During the operation of Lepreau I, problems have occurred with the sirens sounding for no reason or failing to sound during tests. As a result, the credibility of the warning system has suffered. The false alarms seem to have caused anxiety among some of the local residents and they tend to ignore the warning system. The Panel notes that in theory a siren warning system could be effective in a relatively sparsely populated area such as the one at Lepreau. However, due to the history of malfunctioning sirens at Lepreau and the resultant loss of credibility, the Panel recommends that:

11 the siren warning system be discontinued and not implemented for Lepreau II.

The Panel believes that other existing means of notifying people can, with some minor improvements, be more effective than the sirens. These are discussed in the following sections.

* A gray (Gy) is a unit of radiation absorbed dose. In the present context it can be taken as numerically equal to 1 sievert of exposure dose.

4.2.2 Telephones

if it is necessary to alert the public, the New Brunswick Emergency Measures Organization would use the telephone system to establish and maintain contact with the 82 wardens in the area. Concerns were expressed during the review that the present telephone system, which has a switching capability of 75 lines, would be overloaded and fail in an emergency situation. The Panel considers the telephone to be a key communications link and its improvement to be a high priority. Suggestions were made at the hearings for the installation of a line load control system — a management device in which pre-identified telephone numbers are maintained on a priority basis.

In addition, the Panel suggests that the New Brunswick Emergency Measures Organization investigate the installation of a telephone warning system that in an emergency could cause the telephones of local residents to ring for a 20 second period. This would signal the residents to turn on their radios for intormation.

The Panel believes that improvements can be made to the telephone system at reasonable cost and recommends that:

12 the New Brunswick Emergency Measures Organization arrange with N.B. Telephone to:

(a) expand the existing telephone system in the Point Lepreau area to a switching capability of 100 lines so that wardens could be contacted quickly in an emergency;

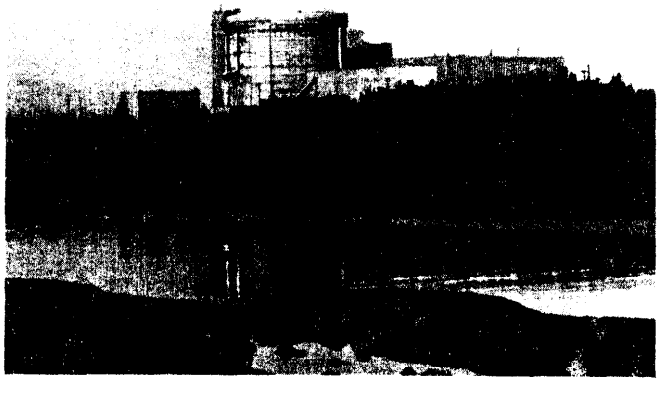
(b) inrtaii a line load control system into the existing telephone system; and

(c) investigate the installation of a telephone warning system that in an emergency could cause the telephones of local residents to ring for a 20 second period.

During the review of the emergency olans, it was observed that calls from the shift supervisor to the dispatch center were not tested and were without back-up measures to ensure that the New Brunswick Emergency Measures Organization was in turn notified. At the public meetings, Maritime Nuclear indicated that they had noted this concern and had aiready taken measures to ensure that the link between the shift supervisor and the dispatch center would be tested and used. Furthermore, if the shift supervisor has not heard from the New Brunswick Emergency Measures Organization duty officer within ten minutes of notifying the dispatch center, he would call or radio the Organization directly. The Panel supports these efforts and recommends that:

13(a) the telephone link between the ahift supervisor, the dispatch center and the New Brunswick Emergency Measures Organization be tested periodically to ensure that it functions properly; and

(b) more frequent use of thie telephone link be incorporated into operational procedure8 at the plant to allow personnel to become accustomed to reporting to the dispatch center.



4.2.3 Wardens

In the event of an emergency, local volunteer wardens would contact residents in a designated area, thus providing door to door notification. A survey conducted in 1980 showed that local people preferred the use of wardens as a means of alerting people. Wardens are aware of residents with mobility problems or disabilities, and are responsible for ensuring that residents know that an incident has occurred and advising them to listen to their radios for information and instructions.

The Panel believes that the warden system is a positive development, but heard concerns at the public meetings that suggest several possible improvements. The Panel recommends that:

14(a) wardens be better identified so that people in the area would know who the wardens are and would be able to identify their vehicles;

(b) the New Brunswick Emergency Measures Organization hold more regular meetings with the wardens to review and update as necessary the off-site emergency plan;

(c) the New Brunswick Emergency Measures Organitation, with the assistance of N.B. Power, assist the wardens to become more familiar with the general operating characteristics of the plant; and

(d) when selecting future wardens, there be greater use of people who are more frequently in the community (e.g. housewives, retired people).

4.3 Use of Potassium Iodide Pills

To protect local residents in the event of an accidental release of radioactive iodine, the New Brunswick Department of Health has distributed potassium iodide pills to local residents within 20 km of the plant. These pills saturate the thyroid gland with potassium iodide and block the absorption of radioactive iodine which would be inhaled and otherwise transmitted through the bloodstream to the thyroid glands. The pills are accompanied with instructions for their use in an emergency situation, and are replaced every three years.

The rationale for the pre-distribution program is that the pills are most effective if taken before exposure, and that timely distribution after an event would likely be difficult since residences are scattered ttiroughout the area. This pre-distribution program, which is unique in Canada, has been met with mixed reactions. Some people have applauded the foresightedness of the approach, while others have expressed concern over the potential for pill misuse. It was also noted that the pre-distribution creates a public perception that the risk of an accident is higher than it actually is.

The Panel believes that since the program is already in place for Lepreau I, it ought to be continued for Lepreau II. However, the Panel notes that the program is innovative, and therefore recommends that:

15 the program involving the pre-dlstribution of potassium iodide pills be periodically reviewed by the New Brunswick Dapartment of Health to ensure that the pills are available in local homes and adequately safeguarded, and that the program is acceptable to the residents.

4.4 Testing the Emergency Plan

It was noted by several participants at the public meetings that the public awareness of the emergency plan in the Lepreau area is very high. Despite this awareness, recent mock drills simulating an emergency situation coupled with events such as terrorist attacks, and trucks catching fire seemed to cause considerable confusion and a loss in confidence among the population. This in turn appears to have created anxiety among local people who may now imagine that the likelihood of an evacuation is high, coupled with a lack of confidence that the evacuation would be well conducted. It appears, in hindsight, that the mock drills were overly complex and hence were not realistic. However, it was noted that the mock drills were learning exercises designed to identify problems so that solutions could be found.

In the Panel's view, efforts should be made to correct the misunderstandings particularly since the mock drills together with the frequent siren malfunctions seem to have caused some concern among local people. The Panel recommends that:

16(a) the New Brunswick Emergency Measures Organization keep the public better informed on procedures to follow during any future mock emergencies and on any new developments regarding emergency procedures in general; and

(b) future mock exercises be less complex and more realistic to maintain the high level of public awareness in the area and minimize skepticism and anxiety.

5.0 NON-RADIOLOGICAL ENVIRONMENTAL IMPACTS

5.1 Cooling Water System

Lepreau I and II would share the same once-through cooling water system. Bay of Fundy water enters the intake located in Indian Cove, passes through screens located in an onshore forebay, then passes through turbine steam condensers and service water heat exchangers in the power house, before discharging into the Bay of Fundy at Duck Cove. The system is designed for a two-unit operation, but with minor modifications has been used in Lepreau I operations only.

The total capacity of water through this system is approximately 63.4 cubic meters per second (m^3/s) (Lepreau I and II requiring 31.7 m^3/s each), although flows are halved in winter. The design temperature rise for each unit is 13.3°C above ambient, although the temperature rise in winter may be as much as 23°C above ambient. The total heat discharged into the environment is approximately 3,200 megawatt thermal or 1,600 per unit.

The intake and outfall structures were designed to minimize environmental impacts by excluding fish from the intake and minimizing thermal effects. Although the design was based on the best technology available during the late 60's and early 70's there was little quantitative evidence presented to evaluate the effectiveness of the design. New designs now incorporate improved features to further minimize environmental impacts.

There was an opportunity to base predictions of environmental effects of Lepreau II on concrete empirical data collected during the operation of Lepreau I. In spite of the guideline requirements of the Panel and the advice of the reviewing scientists, the opportunity to analyze environmental effects based on Lepreau I experience was ignored by the Proponent. Maritime Nuclear indicated during the public meetings that data could have been collected to verify predicted effects but they decided early in planning due to the tight project schedule, not to undertake field programs to measure actual effects of Lepreau I. Thus while there was a great deal of expert opinion provided to the Panel from a number of sources, there was no evidence presented based on adequate scientific studies or conclusions supported by sufficient data for the Panel to use in evaluating the characteristics of the cooling water system and effects caused by impingement, entrainment and thermal pollution.

5.1.1 Impingement

In the existing cooling water system, travelling screens strain most organisms larger than one centimeter from the cooling water flow. Organisms impinged on this type of screen are invariably killed. Impingement may not only have an adverse environmental effect, but impingement of large numbers of organisms have forced the emergency shutdown of other generating stations due to the restriction of cooling water flow.

Both the Lepreau I and Lepreau II Environmental Impact Statements concluded that it was not possible to make predictions of impingement rates. While this was acceptable at the time of the Lepreau I Environmental Impact Statement, the Panel finds it unacceptable for Lepreau II. Direct measurements of impingement could have and should have been made using the travelling screens of Lepreau I, thus enabling the Proponent to support statements to the effect that impingement would not result in significant environmental effects. The Panel therefore recommends that:

17(a) data for Lepreau I be collected over at least a two year period to determine if fish and Invertebrate mortality due to impingement is signlficant; and

(b) these data be reviewed by Fisheries and Oceans to determine the extent to which fish and invertebrate mortality Is occurring; if the mortality is significant or is likely to be significant for two units, then mitlgation measures be Implemented.

5.1.2 Entrainment

Once-through cooling water systems, similar to that which exists at Lepreau I, capture or entrain organisms smaller than one centimeter in the cooling water flow before discharging them back into the ocean. A variable proportion of these plants and animals are killed by temperature stress or mechanical damage.

The Proponent predicted the effects of entrainment based on plankton data presented in the Lepreau I Environmental Impact Statement and Fisheries and Oceans herring surveys. The authors of the Lepreau I Environmental Impact Statement considered their data unsuited for making entrainment predictions and did not do so. The Fisheries and Oceans data were collected for other purposes and seem similarly unsuited for predicting entrainment. The most accurate way of predicting entrainment for Lepreau II would be to measure entrainment at Lepreau I and extrapolate appropriately to a two-unit operation. While this was the approach requested by the Panel, the Proponent felt that direct measurements of entrainment could not be made because of time constraints. The Panel recommends that:

18(a) entrainment data for Lepreau I be collected for at least a two year period to determine the extent of the impact of Lepreau I; and

(b) these data be reviewed by Fisheries and Oceans and If impacts are found to be significant or are likely to be signlflcant for two units, then mitigation measures be implemented.

5.1.3 Thermal Effects

The accepted procedure for examining thermal effects is first to characterize the nature and extent of the cooling water plume, then examine its effects on the bio?a within its confines, before relating these effects to the viability of discrete stocks or populations within some defined receiving body. The Proponent had the opportunity to base the characterization of

the plume and predictions of its effects on data collected during the operation of Lepreau I.

This opportunity having been ignored, much of the discussion in the Environmental Impact Statement and at the public meetings on this subject revolved around the hydrological thermal plume model developed for the Lepreau I environmental impact assessment. There was disagreement among experts about the appropriateness of the plume model used and the actual size, configuration and temperature differentials of the thermal plume. With only two incomplete data sets available there was agreement among the Panel and the various experts that if more data had been collected, then the size, configuration and temperature differentials of the thermal plume could have been accurately determined for Lepreau I and scaled up to Lepreau II.

While the original design goals were based on sound scientific principles, virtually no data were collected to determine if these design goals were being met or if they were appropriate for this particular site. It was apparent that the design criteria of a maximum of 5°C temperature differential for the surface plume and the plume model had failed to take into account the thermal stratification due to salinity stratification observed in one of the two data sets collected.

Detrimental thermal effects (including premature spawning and hatching, interference with migratory patterns, thermal stress and death) have been observed at both coastal and inland power stations. Thus, it is necessary to examine the area influenced by the thermal plume from Lepreau I, to see what impacts, if any, are occurring. However, Maritime Nuclear made no measurements of thermal effects.

The consensus among the Panel, reviewers, and experts retained by the Panel to examine the issue was that the thermal plume was expected to be small and have limited negative impacts. However, the Panel feels that sound scientific data should be collected to ensure adequate environmental protection. The Panel recommends that:

19(a) more data be collected to accurately determine the size, configuration, and temperature differentials of the thermal plume;

(b) biological data be collected to determine if there are detrimental effects due to residence in the thermal plume or impingement of the thermal plume on marine biota; and

(c) results be revlewed by Fisheries and Oceans to determine if mitigation measures are necessary at preaent or are likely to be required wlth the addition of Lepreau II.

5.2 Liquid Discharges

5.2.1 Sewage

The extended aeration sewage treatment plant installed for Lepreau I was designed to handle wastes from *two* units. Data presented by Maritime Nuclear indicated that the plant was complying with provincial effluent standards. This was confirmed by the New Brunswick Department of the Environment.

Although a chlorinator was installed with the plant to disinfect the treated effluent, it is not operating. Normally, chlorination is required to prevent bacterial contamination of shellfish or swimming areas. Since the shellfish beds in the Pocologan and Little Lepreau area were closed before Lepreau I was built and since there is no swimming in the immediate area, the New Brunswick Department of the Environment did not require chlorination.

There are several sources of bacterial contamination in the area therefore chlorination of Lepreau wastes may not remove the cause of the closures. Further, shellfish beds may be closed because of paralytic shellfish poisoning. However, the Panel recommends that:

20 the chlorinator be operated until Maritime Nuclear is able to demonstrate that treated wwage from Lepreau I as well as the predicted loading from Lepreau I and II would have no effect on the shellfish beds.

5.2.2 Oily Waste

Wastes from oil handling areas would be removed from the plant by direct removal of oil from a closed sump system to an appropriate site, or by an oil separation and sedimentation system as part of the inactive liquid waste treatment facility (described below). These systems are already in operation at the Lepreau I facility, and no problems have been identified.

The Panel concluded that the wastes would be effectively controlled by the proposed system, and no environmental damage would result provided that the existing provincial standards are followed and the wastes are disposed of at a facility designed for such purposes.

5.2.3 Discharges from the Inactive Liquid Waste Treatment Facility

A facility was installed for Lepreau I and designed to accommodate a number of liquid waste streams for two units. The treatment system consists of two lined lagoons equipped with oil retention weirs. It receives wastewater from the water treatment plant, floor and equipment drains, auxiliary boiler blowdown and ion exchange regeneration waste from the steam condensate polisher.

These wastes are neutralized prior to discharge to the lagoons. Turbine oil area drains are discharged to an oil removal facility and then to the lagoons as well. Effluent tram the lagoons is discharged into the Bay of Fundy via the cooling water outfall. Sludge is removed to separate on-site sludge disposal ponds.

During the Panel review, it became apparent that the facility was not meeting the New Brunswick Department of the Environment effluent standards for suspended solids. Maritime Nuclear indicated tha: the problem was associated with changes in the water treatment process which led to a greater amount of suspended matter being discharged to the lagoons. This in turn rapidly decreased the effective settling volume of the lagoons and resulted in higher suspended solids being discharged to the Bay of Fundy.

At the time of the public meetings, the problem had not been completely resolved, although N.B. Power's plan to correct the problem was considered acceptable by the New Brunswick Department of the Environment, The Panel believes that the appropriate measures 'are now being taken to correct the existing suspended solids problem in the near future. However, the Panel recommends that:

21 **Maritime Nuclear re-examine the adequacy of the existing inactive liquid waste treatment facility to handle additional wastewater from Lepreau II In light of the meaaurea that may have to be taken to resolve the present auapended solids problem.**

5.2.4 Sludge

Sludge from the inactive liquid waste treatment facility and the domestic sewage treatment plant is periodically removed and trucked to nearby earthen sludge disposal ponds with impervious liners. Sludge from the sewage treatment plant consists primarily of partially biodegraded solids and non-biodegradable solids. Sludge from the inactive waste treatment facility contains coagulants and chemicals used to precipitate solids which have been removed from raw water by the water treatment plant. It was noted that the overflow from the ponds, although it would be intermittent, is currently not being monitored. The Panel therefore recommends that:

22 N.B. **Power and the New Brunswick Department of the Environment periodically monitor suspended solids In the effluent of the sludge disposal ponds to ensure that established provincial standards are met.**

5.2.5 Discharges from Anti-Biofouling Operations

Chemicals (principally chlorine) are used where necessary to control biofouling in the cooling water system. Operational experience with bepreau I has shown that biofouling has not been a significant problem, warranting chemical control. To date, biofouling has been managed effectively through physical cleaning. The Panel recommends that:

23 if **chemical control la required to *control* biofoulIng In the cooling water system, required chlorine dosage rates be determined baaed upon discussions wlth Fisheries and Oceans to establish effective control and safe environmental levels.**

5.2.6 Boiler Blowdown Discharge

Impurities in the boiler water are continuously removed through boiler blowdown, and discharged to the Bay of Fundy via the cooling water system. Flows from this system would be diluted by an estimated 8,500 to 1 ratio before reaching the bay. Chemical constituents of the boiler blowdown discharge typically consist of hydrazine, phosphate and suspended solids (primarily rust).

The Panel does not feel that the chemicals would be discharged in concentrations or forms which would cause an environmental problem.

5.2.7 Heavy Metal Discharges due to Cathodic Protection

Cathodic protection is installed to protect cooling water condensers and lubrication oil coolers from corrosion. Zinc anodes are sacrificed in the process, giving rise to the release of about 0.9 kilograms per year from one unit (1.8 kg/year for a two unit operation). The concentration of zinc in the cooling water effluent is estimated by the Proponent to be approximately one part per trillion.

The average zinc level in the waters off Point Lepreau prior to the construction of Lepreau I was 70 parts per billion which is higher than the mean concentration of this metal in the marine waters of the North Atlantic Region. However, the concentrations of all heavy metal ions in the Point Lepreau region are higher than the waters of the western North Atlantic.

The Panel concludes that zinc, the only heavy metal to be released from Point Lepreau, would not be present in concentrations which would pose any environmental problems.

6.0 MONITORING OF THE BIOPHYSICAL ENVIRONMENT

6.1 Introduction

A well designed and comprehensive monitoring program is essential for environmental protection. Monitoring is important because it allows for an evaluation of the validity and accuracy of predicted impacts, is essential to the identification of operations-related environmental problems and is a means of defining a suitable baseline against which future impacts can be assessed. Furthermore, it is also a means of reassuring the public of the environmental safety of the operation.

6.2 Radiological Monitoring

Extensive radiological monitoring programs are a regulatory requirement common to all nuclear power reactors. The result is that these programs are usually well designed and administered, with equivalent efforts being expended by operators to ensure compliance with licensing conditions.

Radiation levels in the environment around Lepreau I were determined in a pre-operational program from 1976 to 1982. Since start-up, regular environmental monitoring programs have been conducted. The advent of Lepreau II can be regarded as simply an additional source at the same site, needing only an extension of the present monitoring effort.

There are three separate radiation monitoring programs associated with the Lepreau site:

1. The Operational Environmental Radiation Monitoring Program collects and analyses samples of air, well water, sea water, milk and sea food on a monthly basis. This program is a regulatory requirement of the Atomic Energy Control Board, and results are published annually.

2. The Point Lepreau Environmental Monitoring Program began in 1980 and is carried out by the Bedford Institute of Oceanography, Fisheries and Oceans, in association with other agencies. Its objective is to study the distribution and transport of radioactive nuclides in the environment, with the ultimate goal of providing an improved basis to assess the environmental implications of the operation of nuclear reactors in coastal environments.

3. The Health Department Program, which is carried out by the federal and provincial departments of health consists largely of tritium analyses in air and water samples as the most sensitive measurement of potential emissions of health significance.

Total radioactivity and a number of especially important radionuclides are measured in these programs. However, the levels found are low and (wi?h one exception) are entirely attributable to fallout from nuclear weapons tests or to natural radioactive elements. The radioactivity emitted from Lepreau I is undoubtedly present in the samples but cannot be distinguished against the much stronger "background" radioactivity. The one exception is tritium. It is thought that some of the tritium found by analysis of water vapour in the air can be attributed to reactor emissions. However, the arnounts found are near the lower limit of detection and confirmation is uncertain.

These programs have been set up to correspond to the mandates and goals of the participating agencies. There is some cooperation between the programs and information is exchanged on an informal basis.

The Operational Environmental Radiation Monitoring Program and the Health Department Program are long-term in nature. However, the Point Lepreau Environmental Monitoring Program, which is primarily a research program, may only continue for another five years. The Panel was impressed with the quality of this program and strongly supports its continuation. It is not only gathering information which will be of use in assessing the operation of nuclear reactors in coastal environments but also by virtue of its independence provides further assurance that any environmental effects will be detected. The Panel recommends that:

24 **The** Point **Lepreau Environmental** Monitoring Program continue until its **objectives** have **been fully achieved.**

6.3 Non-Radiological Monitoring

In contrast to the radiological monitoring programs, monitoring of non-radiological impacts of nuclear power reactors vary widely, depending on the corporate philosophy of the utility and government requirements. At Lepreau I very little non-radiological monitoring is being done in contrast to other locations such as in Ontario or Maine. Virtually all of the limited non-radiological data arises from the Point Lepreau Environmental Monitoring Program and is consequently collected by government rather than the utility.

It is in the best interest of the industry, concerned government agencies and the public that data be collected to evaluate the impact of plant operations. One conclusion frequently reached in environmental impact studies of megaprojects is the inability of scientists to accurately predict impacts. In fact, each new project can be viewed as an experiment, and data simply must be collected during the operational phase to determine the degree of impact. Thus the process of environmental impact analysis cannot end with the production of an Environmental Impact Statement.

Therefore it is incumbent on the operators of nuclear power stations and the appropriate government agencies to conduct site-specific studies in order to ensure that if detrimental environmental effects occur, mitigating measures are developed and implemented. Such studies also provide new information on the effectiveness of innovative designs for future incorporation into similar projects. However, in the case of the existing plant, such studies have not been done to determine actual non-radiological impacts.

In the absence of scientific studies aimed at predicting impacts, monitoring information from similar projects can provide a basis for a case study approach to anticipating

environmental impacts, The lack of reference to similar projects in the Lepreau I! Environmental impact Statement indicates that there is apparentiy little information on the environmental impacts of thermal generating stations in the Canadian coastal marine environment. Such information could have aided the Lepreau !! environmental impact studies and would be useful in future studies of similar projects in coastal marine environments.

In the Panel's opinion, a non-radiological monitoring program should be established by the Proponent to permit a more accurate determination of the actual non-radiological impacts on the marine environment. Specific recommendations listed in section 5 include monitoring the effects of non-radioactive effluents and the effects of the existing cooling water system. This monitoring program should be established now.

6.4 Coordination of Monitoring Activities

The Panel has examined the programs and responsibilities of the various agencies involved in the operational monitoring of Lepreau I. Various government agencies have responsibility for carrying out certain aspects of Lepreau I monitoring. There is some coordination of efforts owing to a mix of voluntary cooperation and regulatory requirements.

However, during the public meetings it became obvious that the needs of all parties involved were not being met. For example, there seemed to be a weak link between those responsible for compliance monitoring and public health officials, with the result being an inability of the iatter to respond to public requests for information regarding the health risks related to publicized incidents.

The Panel concludes that more formalized coordination of existing and recommended monitoring programs would result in more efficient and productive use of agency efforts in this area.

The Panel believes that a coordinating committee should be formed with the following objectives:

a) to prepare an integrated monitoring plan that would enable coordinated and timely data to be collected in an efficient, cost-effective manner;

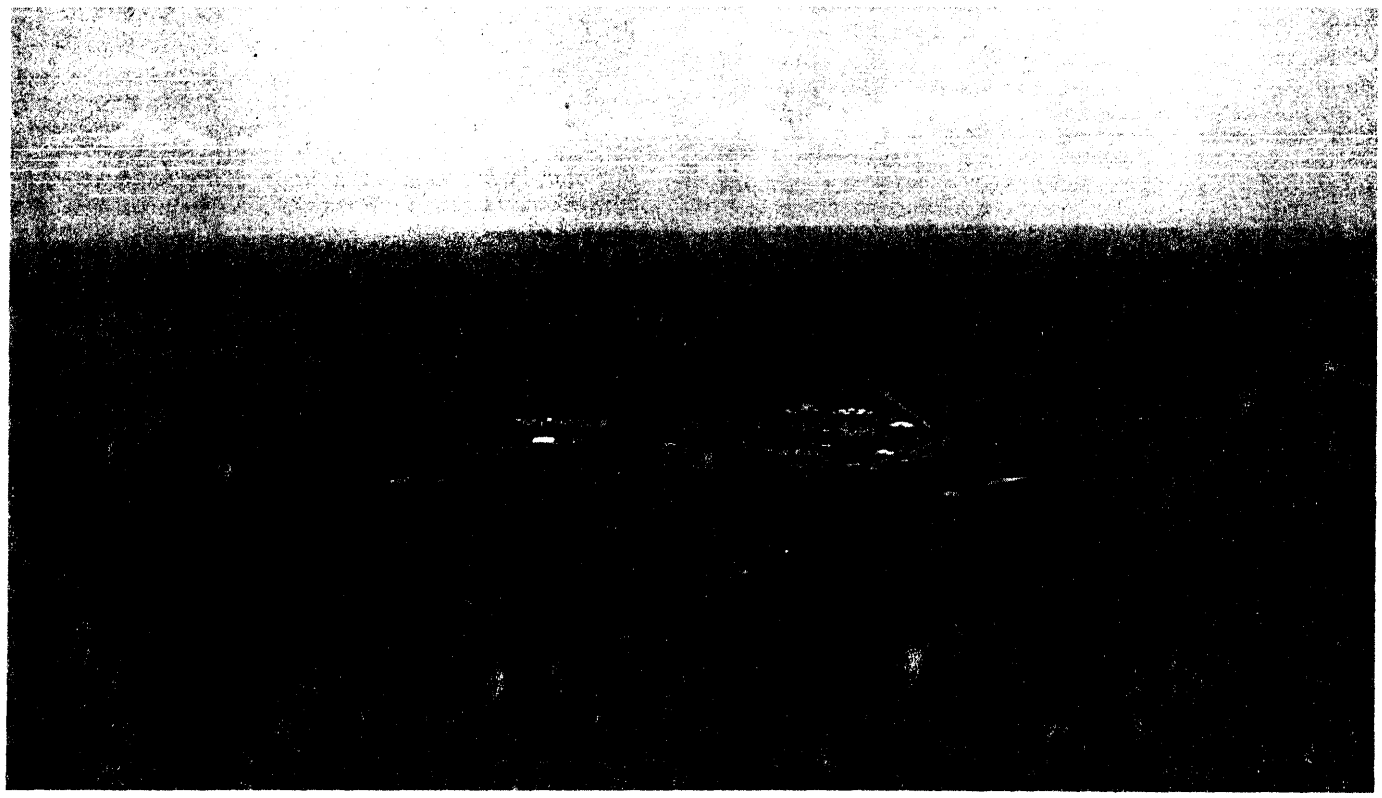
b) to review data and trends from the various monitoring programs sponsored by member agencies and organizations;

c) to modify monitoring programs as appropriate to reduce any duplication or to fill any information gaps, recognizing that each program has been established for a specific purpose;

d) to prepare an annual report of the data and analysis, trends and future directions of existing monitorrng programs; and

e) to prepare a summary of its annual report in non-technical terms for the Ministers of the Environment and the community advisory committee as recommended in section 7.2.6.

Membership should include the following: the Atomic Energy Control Board, New Brunswick Department of the Environ-



nent, Environment Canada, New Brunswick Department of Health, Health and Welfare Canada, Fisheries and Oceans, Maritime Nuclear and N.B. Power.

There are alternative administrative mechanisms that could be considered for the coordinating committee. These are the expansion of the Point Lepreau Environmental Monitoring Program steering committee or the creation of a new body. The steering committee consists of most of the agencies mentioned above (except the Atomic Energy Control Board, N.B. Power and Maritime Nuclear) and could be expanded. However, as the Panel noted earlier, the program is functioning well and there could be problems if it is burdened with an expanded coordinating function for all programs.

The other alternative is the creation of a new body consisting of all the agencies mentioned above. One agency would have to assume a lead role in calling meetings and producing the annual report. The Panel does not believe that such a task would be a burden for any of the agencies. However, the lead role could be rotated among the various government agencies and the Proponent if this was considered desirable by those involved. The Panel recommends that:

25(a) a coordinating committee be formed consisting of the Proponent and all government agencies involved in monitoring Lepreau I to coordinate the various monitoring programs and report annually on their findings; and

(b) the coordination role be assumed either by the expansion of the present steering committee of the Point Lepreau Environmental Monitoring Program or by the creation of a new committee where the lead role or chairmanship would rotate among the various agencies involved.

6.5 Long-Term Research

Lepreau I is the only nuclear generating station in the Canadian coastal marine environment. Thus, it provides a unique opportunity for the study of radionuclide effects.

Derived Emission Limits have beer; established based on limited food chain models (dulse and clams). Furthermore, the environmental pathways underlying these models do not appear to be well understood. The Environmental Assessment Panel which reviewed the Lepreau I project recognized this problem and recommended that a research program be undertaken by the federal government on the short and long-term effects of radioactive emissions on representative organisms. This has not been undertaken, although the Point Lepreau Environmental Monitoring Program has attempted to carry out some radionuclide research on an opportunistic basis.

More recently, the National Research Council in a 1983 publication entitled "Radioactivity in the Canadian Aquatic Environment" (NRCC No. 19250) recommended that:

a) research be conducted on the radionuclide releases, and subsequent transport, distribution, and behaviour in the aquatic and marine environment;

b) research be conducted on the various mechanisms of radionuclide uptake, metabolism, retention and excretion by biological organisms/populations so that better models of radionuclide movement through the food chain can be developed; and

c) research be conducted on the long-term effects of chronic, low level radiation on aquatic and marine organisms and populations under natural conditions.

Furthermore, the international Atomic Energy Agency in a document entitled "Control of Radioactive Waste Disposal into the Marine Environment" states that "one area of research that should be continued is the study of radiation exposure of marine resources to determine the validity of the prevailing philosophy that if man is protected by applying the dose limits of the International Committee on Radiation Protection, no unacceptable harm to marine resources will occur. While this is the general opinion according to work promoted by the International Atomic Energy Agency, continuing attention to this subject is both desirable and appropriate since it might result in factors other than the dose consequences for man to become significant in the control and authorization of waste disposal operations". The Panel supports these recommendations made by others and recommends that:

26 **the federal government undertake further research on the impact of radioactive releases on component& of the environment other than humane.**

7.0 SOCIAL AND ECONOMIC ISSUES

7.1 Economic Impacts

Economic impacts discussed in this section include the issues of job creation and indirect economic benefits accruing from the construction and operation of the plant. Several macroeconomic issues are identified which, although part of the economic impact of the project, are not within the mandate of the Panel.

Public input throughout the review showed that Lepreau II is primarily seen as an economic venture. Depending on the individual's perspective, the project was seen to be a job creation project, a boost to technological advances in New Brunswick, or an energy export development which would support Canada's nuclear industry. The public also pointed out that the megaproject nature of the proposal has important economic and social ramifications.

7.1.1 Macroeconomic Considerations

The Panel was conscious of the limited opportunity for macroeconomic analysis in this review. Various government agencies concerned with reviewing Lepreau II examine the project within their respective jurisdictions and distinct areas of interest. However, from the public's perspective, the division of the subject into sub-components to allow each agency to respect its regulatory and technical perspective does not always provide enough flexibility to present and discuss holistic views on a project. Some of the concerns brought to the Panel's attention by the public are described in this section.

Concern was expressed about alternatives and the fact that economic impacts were only evaluated as direct and indirect outcomes of one option, rather than by cost-benefit analyses of several options. Equally important was the concern about the high costs associated with the creation of jobs in the nuclear industry.

The Panel has accepted the Proponent's estimated construction cost of $1.05 billion (1983) as a basis for its review of economic impacts. At the same time, it was pointed out that actual costs for megaprojects have generally been well above original estimates in recent years. In addition, several cost factors are involved in the generation of electricity from a Candu station which are not addressed in the context of this review. These include the cost of ongoing government operations such as Atomic Energy of Canada Limited and the Atomic Energy Control Board, and any costs associated with damage to public property in excess of $75 million.

Some participants considered macroeconomic issues to be important in any discussion of the project. Some macroeconomic issues are likely to be considered by the National Energy Board in its review of the Proponent's application to export power to the United States. However, others might be more appropriately considered in discussions concerning alternative energy scenarios and future energy planning in Canada. The Panel has recommended in section 2.2.3.3 that the federal government consider undertaking such a review,

7.1.2 Employment

The Proponent estimated that 7,800 person-years would be required during the five year construction period at the project site. In addition, approximately 2,100 person-years would be required in the Fredericton corporate office to design and purchase materials during this period. Plant operation would require 220 people at Lepreau and 50 in the Fredericton office.

In addition to direct employment, the proposed project would create indirect or spin-off employment. The Proponent used a Statistics Canada 1974 Inter-Regional Input/Output Model to estimate that construction would create an additional 7,500 indirect person-years of employment in New Brunswick and 15,200 elsewhere in Canada. According to the estimates, a total of 285 person-years would also be created as a result of the indirect employment effects of plant operation.

The independent economist engaged by the Panel reviewed the estimated indirect employment effects using the latest Statistics Canada input/output tables of 1979 for New Brunswick, and took issue with the Proponent's conclusion. It was noted that no data had been presented by the Proponent to show the actual indirect employment created as a result of the construction and operation of Lepreau I. Instead, figures were provided on estimated labour income without reference to wage levels and types of employment. The Panel concludes that realistic predictions of indirect employment effects during construction of Lepreau II would most probably be substantially lower than those suggested in the Environmental Impact Statement, on the basis of the 1974 model.

The Proponent estimated that most jobs directly related to the project would be filled by New Brunswickers (i.e. less than 10 per cent of construction, 7 per cent for the corporate office and 15 per cent of operations would be imported from outside New Brunswick). The experience of Lepreau I suggests that New Brunswickers did not benefit fully from associated job creation, due in part to lack of job training prior to and during construction. However, a decade has passed and it would appear that resources are now available through the New Brunswick Community College to partially address this need. Union records and statistics can also help forecast which trades would be in demand and the availability of skilled New Brunswickers to fill job openings.

The Panel believes that the Proponent should complement this effort in cooperation with governments, by developing job training programs, where appropriate, to assist presently unemployed area residents to upgrade their skills in advance of project implementation. The objective would be to maximize local employment during construction of Lepreau II, as well as opening up operational jobs for local people when the construction phase is complete. in developing these programs, the Proponent should be able to obtain assistance from the New Brunswick Community College.

At the same time, it should be recognized that a preferential hiring policy for New Brunswickers may prove difficult to

implement in some instances because of established trade union practices. With unemployment at high levels throughout the country, and unions protecting their members on the basis of seniority, often on a national rather than provincial scale, the Proponent may be constrained in implementing this objective.

Thus, it is possible that labour strife, similar to that experienced during construction of Lepreau I, could reoccur. Local tradesmen were frustrated by the hiring of incoming senior union members from other provinces. This resulted in labour management disputes and subsequent project delays and cost overruns. To encourage local employment on the development of a second unit, the Panel recommends that the Proponent should:

27(a) reach timely agreement with the New Brunswick Community College, Saint John Campus, to establish, in cooperation with governments, tralning and upgrading program8 for tradesmen; and

(b) attempt to resolve, through discussions with the relevant trade unions, the difficulties identified during the construction of Lepreau I with respect to the employment of local workers.

7.1.3 Economic Effects

The Proponent estimated that Lepreau II would cost $1.05 billion (1983) to construct. A Statistics Canada model was applied over the 1985-1989 period and the estimated total direct and indirect effects were $2.4 billion for New Brunswick and $4.2 billion for Canada. The total effects (value of shipments) on New Brunswick would be approximately 57 per cent of the Canadian total. The major Impacts outside New Brunswick would be in Quebec and Ontario where the majority of materials would be purchased.

During operations, $64 million in materials and services would be purchased annually and $17 million would be paid in wages and salaries, Approximately 42 per cent of the direct expenditures would be in New Brunswick with most of these benefiting the Saint John area. The total indirect and induced effects due to these operating expenditures were estimated to be approximately $45 million for New Brunswick.

The Proponent's predictions on indirect economic effects relied primarily on econometric modelling, rather than actual data or practical experience available from various sources regarding Lepreau I. Based on comments from the independent economist engaged by the Panel and input from other reviewers, the Panel concludes that the estimated indirect effects in New Brunswick due to construction are too optimistic while those related to operations appear to be more realistic. Nevertheless, the project would have an important economic effect in the Saint John area.

Suggestions were made during the scoping workshops that waste heat in the cooling water discharge was an economic resource that should be used for aquaculture, agriculture or other inaustrial purposes. Maritime Nuclear indicated that it supported in principle the concept of using waste heat and would make provision in the design to allow recovery. However, it would not incur any costs associated with delivery of the cooling water off-site nor assume liability in the case of interruption.

There are apparently no government assistance programs specifically targeted for the development of waste heat recovery for commercial purposes. The Panel believes that there is a potential for beneficial use of waste heat should Lepreau II be constructed. The Panel recommends that:

28 the Proponent and appropriate government agencies examine further and encourage the development of the use of wrote heat from both Lepreau reactors for commercial purposes.

Suggestions were also made that the project would stimulate the development of high technology industries in New Brunswick. Specialization in the nuclear industry is demanding, and very few companies in New Brunswick have developed a capability in this area. An exception to this is Combustion Engineering Ltd. in Moncton which manufactures nuclear fuel bundles for Candu reactors.

Some participants suggested that N.B. Power's basic approach to contracting services during Lepreau I did not produce sufficient stimulation for private companies and firms in New Brunswick to upgrade or expand their capabilities to obtain work at Lepreau II. Although frustration was expressed, few concrete proposals were presented to overcome such problems in the future. Other participants expressed increased optimism regarding improvements in technical capability which had taken place in the province following Lepreau I. The Panel recognizes that government has a role in encouraging the development of engineering and technical expertise and recommends that:

29 **the New Brunswick Department of Commerce and Development study and identify high technology engineering and technical opportunities for New Brunswick firms associated with Lepreau II and the potential for growth of these firms.**

7.2 Social Impacts

Social impacts include all effects of projects on people and communities, whether biophysically, demographically or economically induced. Without an evaluation of social impacts, an environmental assessment review would be seriously incomplete. Included in these effects are broad areas of concern such as the megaproject or "boom and bust" experience which influence the choice of directions for future community development.

In discussing issues involving impacts at the community or regional level, matters of government policy often become difficult to separate from site and project-specific issues. In the course of this review, those who criticized megaprojects and the social disruptions attributed to the "boom and bust" experience were also critical of the political decisions that brought them about. The New Brunswick population appears to be divided between those who continue to favor growth and economic development through the promotion of megaprojects, and those who promote alternative economic plans to produce greater stability in social structures and less disruption in the existing social fabric.

Given the size of the Lepreau II project, the Panel believes that the Proponent and both governments involved should recognize that the project does have the potential to be disruptive, not only to the local communities but to the larger economic context in which it is placed. Consequently, the Proponent and governments should proceed with caution and be committed to public consultation and involvement in impact management to maximize benefits and protect against negative socio-economic impacts.

This would help decision-makers relate their choice of mitigating measures to the interests of the population. In a situation where local residents are concerned about a variety of issues (provision of community services, job opportunities for local people, emergency planning etc.), the overall impact of a megaproject should be well understood by decision-makers. In this sense, overall integrated impacts may have greater significance than can be demonstrated in a fragmented analysis of individual effects.

7.2.1 Human Systems

The construction of a large project such as Lepreau II should be considered as a human system, comprised of groups of people working toward a variety of related objectives, rather than simply a collection of machinery and concrete. Local communities affected by construction and operation of the plant in their neighborhood are also included as part of the human system. Experience with ?he construction of Lepreau I demonstrated that problems with the human system could easily overshadow the technical and physical complexities of the project.

Little written information was provided by the Proponent on the various groups of people involved in the construction and operation of Lepreau II, labour management relations, and the interrelationship between plant personnel and local communities. Although several important issues were clarified during tho public meetings, the Panel believes that should Lepreau II proceed, the Proponent and all employees involved in the project would benefit from further written clarification. The Panel recommends that:

30 the **Proponent distribute to people associated with the project, detailed information on its approach to personnel management and training policies, labour-management relations, and planned mechanism8 for conflict resolution throughout the different phases of the project.**

7.2.2 Community-Based Structures and Land-Use

Lepreau I has had an impact on a large land area in Saint John and Charlotte Counties, although the actual development site is located in Saint John County. It appears that some residents of Charlotte County have been under the impression that while they share the risks of Lepreau I equally, they do not share the tax revenues from the plant. The Panel was satisfied to learn during the public meetings that all tax revenues generated by Lepreau I are collected by the province, and redistributed according to formulas aimed at responding to needs in each area.

The construction of Lepreau I also stimulated some interest on the part cf land developers in the local communities. Faced with the possibility of uncontrolled growth, a citizens group from the area asked the New Brunswick Department of Municipal Affairs for assistance in establishing zoning regulations. More recently, some of the communities involved in the original citizens group took the necessary steps to create a Local Service District Advisory Committee. Upon receipt of a petition from local citizens, the Department will conduct a public hearing to determine the degree of support which exists for the establishment of such a Committee. The Local Service District, which replaced the earlier system of county government in the 1960's, is the formal system for local representation in unincorporated areas of New Brunswick.

The Musquash Local Service District now includes the communities of Dipper Harbour, Chance Harbour, Musquash and Prince of Wales. However, the communities of Maces Bay. Little Lepreau, New River Beach, Lepreau Settlement and Pocologan are not represented by a Local Service District Advisory Committee. Some of the cornunities were involved in the original citizens group and all are located in Charlotte County.

Apparently there are some residual concerns on the part of local citizens which resulted from the creation of one formal Advisory Committee following the construction of Lepreau I, the zoning issue which dates back to the earlier citizens group, and the historical significance of county line boundaries. The Panel believes that the Proponent and the Department of Municipal Affairs should continue to work closely in collaboration with local residents to reduce these apparent concerns. Given the size of the Point Lepreau development and the special character of the surrounding communities, the Panel recommends that:

31 **the New Brunswick Department of Municipal Affairs re-examine the possibility of establishing a Local Service District Advirory Committee to serve local citizens In the Point Lepreau area who do not presently benefit from this type of representation.**

7.2.3 Social Networks and Lifestyles

In small communities such as those surrounding the Lepreau site, the influx of large numbers of workers can disrupt traditional lifestyles and existing social networks. This may be either positive or negative depending on the individual's perspective. An increase in housing development, the construction of a new road in the area, and the existence of a large exclusion area around the plant close to their communities are among a wide range of impacts connected with Lepreau I which have affected local residents.

These local issues may not change substantially should Lepreau II go ahead. Alternatively, new or related aspects or concerns could take on major importance with the second Plant, or entirely new issues could emerge. The Panel believes that the Proponent should address such issues if they occur.

Lifestyle and social network issues are affected by coincidence as well as individual choice, and perceptions as well as realities. Although it is difficult to separate the role of a Proponent from that of communities in regard to social change, shared responsibilities are imperative. Since the first plant is functioning within the local communities, and another

major project may be introduced, it seems only natural for the Proponent to deal with local issues as part of its ongoing relationship with people in the area. The Panel has noted the interest expressed by the Proponent in more active community liaison and strongly supports this direction. The Panel recommends that:

32 **the Proponent eupport the local residents in resolving concerns they have with school services, fire protection and roads.**

7.2.4 Community Services and Infrastructure

The Panel notes that the positive benefits of large projects are generally widespread whereas any negative effects are generally very localized. Consequently, local people need the support of the Proponent in their effort to mitigate these adverse effects.

During the public meetings, concerns were expressed regarding fire protection services, the need for a new school in the area and twinning of Highway 1. The construction of Lepreau I led to an increase in population in the local area and has resulted in some increased demands being placed on the level of services provided by the provincial government.

There has been an increase in the number of school children which has overloaded the existing elementary school. Temporary classrooms have been added. Discussion on the need for a new school has continued for a number of years with little result. This residual effect of Lepreau I should be corrected as soon as possible before Lepreau II is constructed. The Panel recommends that:

33 a new elementary school be constructed in the Lepreau area as soon as possible to accommodate existing demand and the demand that would result from Lepreau II.

Fire protection service in the local communities is provided from St. George, approximately 50 km from the plant site. During the construction of Lepreau I, a fire truck was provided by N.B. Power on-site and was also made available to the local communities. This equipment was transferred outside the area after construction. The Proponent has indicated that should Lepreau II proceed, fire protection equipment would again be provided during project construction. In the opinion of the Panel, there is a clear need for such protection in the surrounding communities. The Panel recommends that:

34 the Proponent provide fire protection to the surrounding communities during construction of Lepreeu II and transfer the equlpment to local reeidente when construction is complete.

During the public meetings concerns were expressed as to the adequacy of Highway 1 to support increased traffic during construction of Lepreau II. It was confirmed that although twinning of the existing highway between the Musquash and Lepreau interchanges would be required eventually whether or not the project proceeds, a decision to construct Lepreau II would advance the time frame for this upgrading by at least four years. The Panel recommends that:

35(a) the New Brunswick Department of Transportation review traffic projections to determine whether Highway 1 expansion is required if a decision is made to proceed with Lepreau II; and

(b) alternative8 to highway twinning (e.g. bueing conetructlon workers) be examined, and if it is determined that twinning is required earlier to accommodate Lepreau II workers, the Proponent ehould provide financial assistance to the Department of Transportation for the construction costs involved.

7.2.5 Reallocation of Social Assistance Financing

The construction phase of Lepreau II would have a noted impact on employment in the greater Saint John area. The severity of unemployment and the number of families now being supported by welfare in that area should diminish during the construction period. Welfare and unemployment Insurance payments should also be lower. However, during the same period increasing demands on certain social service delivery systems could be expected which would result from the social impact of project construction. Corresponding budget increases in social assistance payments could be required for services such as police, counselling services and alcoholism treatment services in both Saint John and the communities adjacent to the plant site. The Panel recommends that:

36 social services agencies review their programs and resources in the project area and ensure there is sufficient flexibility to adapt them if necessary to meet changing needs.

7.2.6 Community Advisory Committee

Requests from various local and regional organizations that they be consulted in project planning and construction were made to the Panel during its review. The Panel believes that effective consultation and input by these organizalions would assist in ensuring that benefits to the local area would be maximized and disruptions minimized.

The Proponent stated that a public liaison office would be established and suggested the formation of a community advisory committee. The Panel believes such a committee would be effective in resolving potential social impact issues and would complement the monitoring coordinating committee recommended in section 6.4.

The Panel believes the community advisory committee is needed to provide a forum for exchange of information and problem-solving within the community context. For such a committee to be effective, it would require significant input from citizens, as well as relevant agencies of the provincial government and the Proponent. During the construction phase, representatives from business, community and labour groups in Saint John could provide valuable input in conjunction with people from the adjacent communities. Outside the construction phase, the committee's interest would most probably be centered on more locally-oriented concerns.

Representatives from various provincial and federal agencies could relay the results of monitoring programs to the community advisory committee, although they would not be expected to sit as full-time members of the committee. Exchange of information between the community advisory committee and

the coordinating committee on monitoring would be useful in resolving public concerns.

The community advisory committee should be aimed at actively seeking and maintaining broad representation from concerned citizens. St should also play a major role in ensuring effective information flow between the public, the Proponent and relevant government agencies. The Panel recommends that:

37 **the New Brunswick Government and the Proponent establish a community advisory committee as soon as possible and provide it with the necessary administrative support.**

8.0 DECOMMISSIONING, USED FUEL TRANSPORT AND DISPOSAL

8.1 Decommissioning

The design life of the Candu 600 reactor is a minimum of 30 years, but due to a variety of factors impacting on plant capacity and economics, Maritime Nuclear stated that the actual life of Lepreau II is expected to be in excess of 40 years. Decommissioning for the Lepreau II unit would likely start no sooner than the year 2030 and perhaps even further in the future since no decision has been taken concerning the project construction schedule.

The decommissioning scenario presented appears to be reasonable in terms of both technical viability and social acceptability. The scenario consists of three options which are different stages in a continuum of events. Stage 1 involves the removal of nuclear fuel and heat transport fluids, and the partial decontamination cf systems; stage 2 involves the decontamination of some parts of the facility, the sealing and surveillance of remaining contaminated areas, and the release of some portions of the site to other uses; and stage 3 is the extension of the preceding states, and results in a state of "unrestricted site use".

Decisions regarding the choice of method involve considerations of safety, economic and land-use requirements. Environmental safeguards and financial provisions must be built into the planning process.

8.1.1 Health and Safety Considerations

Some years ago it was widely questioned whether complete decommissioning (restoring the site to unrestricted re-use status) was physically possible without grave health and safety risks. Recent experience in Canada, the United States and Europe has largely dispelled this fear.

Generally, health and safety problems can be minimized if a passive approach is taken. This would involve removing only the fuel and other high activity components, then securing and safeguarding the site for a lengthy period — possibly as long as 80-120 years. After such a period, radiation levels would be lowered substantially and the structures could be removed more economically and with less health risk to workers. The site would then be available for unrestricted use. A more aggressive approach would aim at restoring the site to full accessibility as soon as possible by demolishing the buildings and removing equipment and materials to an approved disposal area.

Both these procedures (and possibly others) are feasible and there is no clear choice at present. Given the information currently available and that submitted by Maritime Nuclear, the Panel considers that such an operation could be undertaken with minimal risk to the human and biological environment. However, it is important to plan for decommissioning from the outset. Inherent in such planning is the need to keep records of the type and amount of wastes, how they were treated, and when and where they have been stored, in order that the organizatrons and persons eventually involved in decommissioning would understand the full nature of the facility and its accumulated waste material.

8.1.2 Financial Considerations

Provision would be made for a special fund to decommission the facility. A $1.83 million annual charge would be collected over a 40 year period as a component of the contracted price to customers. In this way, the burden of the cost is to be borne equally by customers who would use the power.

There was some discussion at the public meetings on the adequacy of these financial provisions. It appeared that the special fund would not be sufficient to cover the cost of decommissioning the facility. There are unforeseeable circumstances such as the actual operational life of the reactor which could be less than the anticipated 40 years. In addition there could be unexpected increases in transportation and decommissioning costs. These factors could have significant effects on the cost of the operation.

The Panel recognizes that predicting the actual costs of decommissioning is difficult given the many unknowns associated with the timing and technology. The Panel notes that the Proponent intends to provide all of the necessary funds and to periodically adjust the annual amount collected as more knowledge is gained about decommissioning operations. To ensure that sufficient funds are available, the Panel recommends that:

38(a) the annual decommissioning levy be scaled so that contributions are higher during the first years of operation; and

(b) the levy be adjusted according to new knowledge on decommissioning end transportation technology.

8.1.3 Role of the Atomic Energy Control Board

The decommissioning of nuclear facilities such as Lepreau II is regulated by the Atomic Energy Control Board. The regulations require the operator to obtain a license or instruction when decommissioning a nuclear facility. Revised regulations currently being drafted will specify some of the detailed information which will be required in order to obtain decommissioning approval. The objective is to ensure that a reactor is retired from service in a manner that is safe and environmentally acceptable. The "secure storage" method is likely to be allowed in many cases provided that there is reasonable justification for it, that it is safe, that continuing responsibility of the facility operator can be assumed, and that eventual dismantlement is feasible and safe.

8.2 Transport and Disposal of Used Fuel

8.2.1 Transport of Used Fuel

Used fuel would be stored in fuel storage bays adjacent to the reactor building. At or before the end of the life of the plant,

the fuel would be transferred from the bays to another storage location for reprocessing or permanent disposal.

Disposal off-site requires transport of the used fuel rods by rail or road transport. Current practice in Canada is to place the fuel in flasks made of either laminated steel or a combination of lead and steel. The flasks weigh approximately 15,000 kg and have walls at least 25 cm thick. Once the flasks have been loaded with the spent fuel, they would be taken to the ultimate disposal site or reprocessing facility. Some shipments are already being made from Ontario to the United States without any safety problems. The packaging and transport is under close regulatory control by the Atomic Energy Control Board and Transport Canada. The shipping flasks and other hardware meet standards set by international agencies. In the case of Point Lepreau it was estimated that each year of operation would generate approximately 20 shipments of used fuel per reactor. The Panel considers that transportation of used fuel is unlikely to pose a serious safety problem.

8.2.2 Disposal of Used Fuel

At present, used fuel from Point Lepreau and other nuclear power generating stations in Canada is stored on-site in water-filled fuel bays. This is a temporary measure, since there is no facility in Canada for the long-term disposal of the used fuel. In recognition, of this, Canada has initiated a national plan and associated research and development program for safe disposal of used fuel and other high level radioactive wastes.

In 1981, the federal government announced its intention to assess the concept of placing high-level radioactive waste in stable granite rock formations. Funding of $30 million/year for 10 years has been committed. Atomic Energy of Canada Limited is developing an underground research laboratory to study the concept of hard rock disposal. It is undertaking long-term research studies to examine among other things the concern about possible slow leakage of nuclides into the ground water. Once the concept has been considered acceptable, then the process of site selection and development would begin. It is estimated that a facility could be available by 2010.

The Proponent has identified a "Used Fuel Fund" to pay for the cost of placing the used fuel in a national disposal facility. If the national facility is not available when needed for Lepreau II fuel, the Proponent stated that there would be sufficient money in the Used Fuel Fund to store and maintain the fuel on-site. This would be done by constructing an additional used fuel bay and safeguarding the facility for the required period of time.

Funding for research and development appears to be adequate at present. However, should additional funds be required then those utilities with nuclear power generation facilities (e.g. N.B. Power) which have not contributed to research and development should be approached to contribute according to their waste generation. As in the case of decommissioning, the Panel supports the concept that the present consumer should pay for these future costs.

The Panel believes that the research and development programs being conducted are likely to lead to a technical solution for the transportation and disposal of high-level radioactive wastes. The Panel recommends that:

39 the Proponent review **periodically** the amount of the **Used** Fuel Fund In light of any new technical or financial **information** or any **significant change** In **research** and development costs to the **utilities.**

9.0 LIST OF RECOMMENDATIONS

The Panel has concluded that the project can proceed without significant adverse effects provided certain recommendations are followed. The Panel has made 39 recommendations which are reproduced in this section according to each issue area.

In the first area dealing with the review process the Panel has directed recommendations to federal and provincial administrators of environmental impact assessment review processes rather than to the Proponent.

Most of the recommendations dealing with issues associated with radioactivity, emergency planning, non-radiological environmental impacts, monitoring of the biophysical environment, and social and economic issues are directed to Maritime Nuclear or N.B. Power. However, some are also directed to federal and provincial government agencies. To understand the impacts of Lepreau II, the Panel reviewed, to the extent possible, the actual effects of Lepreau I before estimating the incremental effects of Lepreau II. in so doing, the Panel made a number of recommendations that relate to Lepreau I operations in these issue areas. These recommendations should be implemented now so that information gathered and experience gained can be applied to Lepreau II to ensure that impacts are reduced to a minimum and so that existing concerns identified can be corrected. These recommendations are identified with an asterisk (*) in the following list.

In the last section dealing with decommissioning, used fuel transport and disposal, recommendations are directed to Maritime Nuclear. The Panel recommendations are that:

The Review Process

1 The federal government consider undertaking a public review of the nuclear energy option within Canada'6 National Energy Policy.

2 Government6 consider providlng fundlng assistance to public groups to assist them in participating In highly technical reviews; criteria should be developed which, among other things, are sensitive to the interests of local citizens who live near the site of a proposed project, and to those organizations that have the ability to provide an independent examination of the Proponent'8 proposal and can contribute to a discussion of alternative point6 of view.

3 (a) Environmental impact assessment administrators continue to examine way8 to improve the scientific basis for environmental impact assessment; and

(b) The principles of what constitutes an adequate baseline for environmental impact analyses be established by the reviewing agencies so that future Proponent6 know well in advance what will be expected.

4 There be a greater Interchange among technical experts, the Panel and the Proponent In an Informal setting in future reviews.

Issues Associated with Radioactivity

• 5 Monitoring agencies in addition to the Atomic Energy Control Board be notlfied when incidents occur in which target emission limits are exceeded.

• 6 Derived Emission Limits for Lepreau I and II be updated and applied, taking into account new environmental information, a6 soon as the Canadian Standard6 Association document on Derived Emission Limits and the Atomic Energy Control Board revised doae limits become available.

7 (a) Provision be made In the Lepreau II deaign to allow for a tritium removal • yatem to be installed at some point in the future; and

(b) Tritiated heavy water be • hlpped to Darlington to be reproceaaed, if levels reach the point where worker exposure require6 lowering tritium levels.

• 8 (a) N.B. Power proceed to monitor carbon-14 in the stack a6 pianned; and

(b) The results of the carbon- 14 monitoring program be evaluated periodically by the Atomic Energy Controi Board and if emission levels approach 1 / 100 of the Derived Emission Limit, removal equipment be inatailed by the Proponent.

*9 The regulatory limit for the discharge of radionuclides to the ocean8 be reviewed by the Atomic Energy Control Board to make it more stringent and hence provide greater assurance that only minimal amount6 of radiation would be discharged to the oceans; reduction8 in radiation levels dlacharged could ba achieved through the use of control technology such as evaporator systems.

• 10 (a) The Proponent prepare updated information on the distribution of radioactivity In the surrounding area under various weather conditions as a result of postuiated releases under accident or upaet conditions; and

(b) Tha distribution pattern6 be Included in the Emergency Plan documenta or added as an Appendlx.

Emergency Planning

*11 The siren warning system be discontinued and not implemented for Lepreau il.

*12 The New Brunswick Emergency Measures Organization arrange with N.B. Telephone to:

(a) expand the existing telephone system in the Point Lepreau area to a awitching capabillty of 100 lines ao that warden6 could be contacted quickly In an emergency;

(b) Inatali a line load control system Into the existing telephone system; and

(c) Investigate the Inatailation of a telephone warning system that in an emergency could cause the telephone8 of local residents to ring for a 20 second period.

* 13 (a) The telephone link between the shift supervisor, the dispatch center and the New Brunswick Emergency Measures Organlzation be tested periodically to ensure that it function6 properly; and

(b) More frequent use of this telephone link be incorporated into oparationai procedure6 et the plant to allow personnel to become accustomed to reporting to the dispatch center.

• 14 (a) Warden8 be better identified so that people in the area would know who the wardens are and would be able to identify their vehicles;

(b) The New Brunswick Emergency Measurer Organization hold more regular meeting6 with the warden8 to review and update as necessary the off-site emergency plan;

(c) The New Brunswick Emergency Meaeuree Organization, with the assistance of N.B. Power, assist the warden8 to become more familiar with the general operating characterietice of the plant; and

(d) When selecting future wardens, there ba greater use of people who are more frequently in the community (e.g. housewives, retired people).

*15 The program involving the predietrlbution of potassium iodide pills be periodically reviewed by the New Brunswick Department of Health to ensure that the pills are available In local homer and adequately safeguarded, and that the program is acceptable to the residents.

• 16 (a) The New Brunswick Emergency Measurer Organization keep the public better informed on procedures to follow during any future mock emergencies and on any *new* developments regarding emergency procedures in general; and

(b) Future mock exercises be lees complex and more realistic to maintain the high level of public awareness in the area and minimize ekepticiem and anxiety.

Non-Radiological Environmental Impacts

• 17 (a) Data for Lepreau I be collected over at least a two year period to determine if fish and invertebrate mortality due to impingement is elgnificant; and

(b) These data be reviewed by Fisheries and Oceans to determine the extent to which fish and invertebrate mortality is occurring; if the mortality is significant or is likely to be significant for two units, then mitigation measures be implemented.

• 18 (a) Entrainment data for Lepreau I be collected for at least a two year period to determine the extent of the impact of Lepreau I; and

(b) These data be reviewed by Fisheries and Ocean6 and if impacts are found to be significant or are likely to be significant for two units, then mitigation measures be implemented.

*19 (a) More data be collected to accurately determine the sire, configuratlon, and temperature differential8 of the thermal plume;

(b) Biological data be collected to determine if there are detrimental effects due to residence in the thermal plume or impingement of the thermal plume on marine biota; and

(c) Results be reviewed by Fieheriee and Oceans to determine if mitigation measures are necessary at present or are likely to be required with the addition of Lepreau II.

• 20 The chlorinator be operated until Maritime Nuclear is able to demonstrate that treated sewage from Lepreau I ae well as the predicted loading from Lepreau I and II would have no affect on the shellfish beds.

21 Maritime Nuclear re-examine the adequacy of the existing inactive liquid waete treatment facility to handle additional wastewater from Lepreau Ii in light of the measures that may have to be taken to resolve the present suspended solids problem.

*22 N.B. Power and the New Brunswick Department of the Environment periodically monitor suspended solids in the effluent of the sludge disposal ponds to ensure that established provincial etandarde are met.

• 23 If chemical control is required to control biofouling in the cooling water system, required chlorine dosage rates be determined based upon discussions with Fisheries and Oceans to establish effective control and safe environmental levels.

Monitoring of the Biophysical Environment

• 24 The Point Lepreau Environmental Monitoring Program continue until it6 objectives have been fully achieved.

*25 (a) A coordinating committee be formed consisting of the Proponent and all government agencies involved in monitoring Lepreau I to coordinate the various monitoring programs and report annually on their findings; and

(b) The coordination role be assumed either by the expansion of the present steering committee of the Point Lepreau Environmental Monitoring Program or by the creation of a new committee where the lead role or chairmanship would rotate among the various agencies involved.

• 26 The federal government undertake further research on the impact of radioactive releases on components of the environment other than humane.

Social and Economic Issues

27 (a) The Proponent reach timely agreement with the New Brunswick Community College, Saint John Campus, to establish, in cooperation with governments, training and upgrading programs for tradesmen; and

(b) Attempt ta resolve, through discussions with the relevant trade unions, the difficulties identified during the construction of Lepreau I with respect to the employment of local workers.

28 The Proponent and appropriate government agencies examine further and encourage the development of the use of waste heat from both Lepreau reactors for commercial purposes.

29 The New Brunswick Department of Commerce and Development study and identify high technology engineering and technical opportunities for New Brunswick firms associated with Lepreau II and the potential for growth of these firms.

30 The Proponent distribute to people associated with the project, detailed information on its approach to personnel management and training policies, labour-management relations, and planned mechanisms for conflict resolution throughout the different phases of the project.

'31 The New Brunswick Department of Municipal Affairs re-examine the possibility of establishing a Local Service District Advieory Committee to serve local citizens in the

Point Lepreau area who do not presently benefit from this type of representation.

32 The Proponont support the local residents in resolving concern6 they have wlth school services, fire protection and roads.

*33 A new elementary school be constructed In the Lepreau area as soon as possible to accommodate existing demand and the demand that would result from Lepreau II.

34 The Proponent provide fire protection to the surrounding communities during construction of Lepreau II and transfer the equlpment to local resident6 when construction Is complete.

35 (a) The New Brunswick Department of Transportation review traffic projection6 to determine whether Highway 1 expansion is required if a decision is made to proceed with Lepreau II; and

(b) Alternatives to highway twinning (e.g. busing construction workers) be examined, and if it is determined that twinning is required earlier to accommodate Lepreau II workers, the Proponent should provide financial assistance to the Department of Transportation for the construction costs Involved.

36 Social services agencies review their programs and resources In the project area and ensure there is sufficient flexibility to adapt them if necessary to meet changing needs.

*37 The New Brunswick Government and the Proponent establish a community advisory committee as soon as possible and provide it with the necessary admInistrative support.

Decommissioning, Used Fuel Transport and Disposal

38 (a) The annual decommissioning levy be scaled so that contributions are higher durlng the ffrst years of operation; and

(b) The levy be adjusted according to new knowledge on decommissioning and transportation technology.

39 The Proponent review periodically the amount of the Used Fuel Fund In light of any new technical or financial information or any significant change in research and development costs to the utilities.

LEPREAU 2

ENVIRONMENTAL ASSESSMENT PANEL

Robert G. Connelly
(Co-Chairman)

Léandre Desjardins
(Co-Chairman)

John Foster

Adrian Booth

APPENDIX A

TERMS OF REFERENCE FOR THE POINT LEPREAU II ENVIRONMENTAL ASSESSMENT PANEL

Introduction

This Panel has been established by the Ministers of the Environment of Canada and New Brunswick to undertake a review of the proposal to construct a second nuclear unit at Point Lepreau. The first unit, now in operation at the site, was the subject of a Panel report in 1975. Because incremental impacts are anticipated a further review has been requested.

Mandate and Related Responsibilities

The mandate of the Panel is to assess the environmental and related social impacts of a second nuclear unit at the Point Lepreau Generating Station in New Brunswick and report its findings to the Ministers of the Environment.

The objective of this report will be to make recommendations to both governments on the acceptability of the proposed project in regard to both environmental and directly related social impacts.

Since the question of construction of the second unit at Point Lepreau for the purpose of exporting power will be considered by the National Energy Board, the Panel will not be required to address this matter. Similarly, Canada's National Energy Policy, and the role of nuclear energy within that policy, are not issues which fall within the mandate of the Panel.

It is also noted that the Atomic Energy Control Board would have the responsibility of regulating the design and operation of the plant.
The Government of Canada and New Brunswick will be responsible for deciding whether or not to proceed with the project and, if so, under what conditions.

Scope of the Review

The review should include matters related to the nature and levels of potential pollutants which may be released or stored as wastes and the effects of these materials on the environment. Construction, normal and upset operating conditions, as well as decommissioning of the facility should be addressed.

The social impacts should include any effects directly related to a change in the natural environment as well as those impacts on local communities affected by the plant construction and operation. Such impacts could include, for example, demographic changes associated with manpower migration, competing demands on available labour, stress on community facilities and infra-structure during the high-empioyment construction period, as well as the relationship of the project to local and regional land-use plans.

Project Description

The proposed Point Lepreau II project consists of a 630 megawatt Candu nuclear reactor to be built adjacent to the existing Lepreau I unit, which is already in operation. It would be similar to the Lepreau I design with modifications to take into account any updated codes and standards. It is proposed that certain common facilities already in place for Lepreau I would be used. These would include the intake and outfall tunnels for the cooling water system, the fresh water supply and some waste management systems. The new unit would occupy approximately 11 hectares (27 acres) of the total of 525 hectares (1295 acres) owned by New Brunswick Power at Point Lepreau. The proposed nuclear plant is initially expected to produce electricity for export rather than for domestic purposes.

Review Process

The review process would include the following:

1. A public scoping exercise conducted by the Panel to identify the priority issues and concerns to be addressed in the review followed by the issuance of guidelines for the preparation by the Proponent of an Environmental Impact Statement (EIS);

2. The establishment by the secretariat of an advisory group of experts to assist in the scientific design of the EIS;

3. Distribution of the EIS information by the Panel to the public and government agencies for review and comment:

4. A request by the Panel to the Proponent for more information, if necessary, following review of the EIS;

5. Public meetings held by the Panel; public comment on matters relevant to the Panel's mandate will be solicited in response to the EIS;

6. Preparation of a report by the Panel to the Ministers of the Environment.

APPENDIX B

PANEL MEMBER BIOGRAPHIES

DR. L&ANDRE DESJARDINS

Dr. Leandre Desjardins is Dean of Social Sciences at the University of Moncton. He has published extensively and is active as a consultant in the area of psychology and community mental health programming. The human impact of unemployment as well as science and technology on modern lifestyles and community-based social services has been a particular focus of his recent work.

Dr. Desjardins holds a doctorate in social personality psychology from the University of Colorado, and a masters degree in clinical psychology from the University of Moncton. He is a former president of the N.B. Association of Psychologists and the New Brunswick Division of the Canadian Mental Health Association.

DR. JOHN FOSTER

Dr. John Foster is Assistant Director of the Huntsman Marine Laboratory in St. Andrews, New Brunswick and Assistant Professor of Zoology at the University of Toronto. He has both a doctorate and a masters degree in behavioral ecology from University of Toronto. His undergraduate studies in Zoology were completed at the University of Maryland.

Dr. Foster has an extensive background in fisheries biology, and has authored research papers in a wide variety of scientific journals. One major emphasis of his research activity has been centered on entrapment, impingement and entrainment of aquatic organisms in cooling water intake systems of thermal generating stations, as well as the impact of nuclear and thermal plants on the aquatic environment.

MR. ROBERT G. CONNELLV

Mr. Connelly is Director of the Central Region with the Federal Environmental Assessment Review Office in Ottawa. He graduated from the University of Waterloo in Civil Engineering and was first employed with the Proctor and Redfern Group, consulting engineers in Ontario. In late 1930 he joined Environment Canada in Winnipeg and was involved in environmental monitoring and pollution control programs in Manitoba.

From 1975 to 1978, Mr. Connelly worked for the United Nations Economic Commission for Europe in Geneva where he was a member of the U.N. secretariat to International meetings on environmental matters.

DR. ADRIAN BOOTH

Dr. Adrian Booth (retired) was, for many years, Director of the Radiation Protection Bureau, Health and Welfare Canada. More recently, he served as Special Advisor to the Department's Environmental Health Directorate and as Science Advisor to the Office of Energy Research and Development in the Federal Department of Energy, Mines and Resources. He has an extensive background in research on health aspects of nuclear programs and investigation of health standards for workers in environments where radiation is a concern.

Dr. Booth holds a doctorate in physics from the Univesity of Manchester and a masters degree in science from the University of Manitoba. He has been engaged in scientific research into nuclear physics and radiation for over 30 years and has authored numerous publications on health and safety issues related to nuclear energy.

APPENDIX C

TERMS OF REFERENCE AND MEMBERSHIP OF THE STUDY ADVISORY GROUP

Objective

The Group is to provide advice to the Proponent, Maritime Nuclear, on the scientific aspect of the design of studies Involved in the Environmental Impact Statement (EIS). The objective, in providing such advice, is to have an EIS prepared by the Proponent, which will be of high quality. Aspects of the Environmental Impact Assessment would include baseline studies through to monitoring requirements.

Methods of Work

The Group will provide advice to the Proponent on acceptable study designs and scientific methodologies which effectively address the issues the Panel considers important to be examined in the EIS. The Panel will identify these issues and incorporate them in guidelines it will prepare after conducting workshops to receive public and government agency views on. issues and concerns of importance.

The Group may call upon additional outside expertise as it deems necessary.

Although the Group will advise on scientific aspects of study design, its role is not to evaluate the conclusions reached by the Proponent as a result of conducting the various studies. During the formal EIS review, individual members of the Group may be asked by the Panel to interpret study results. Participation in this regard would be on the basis of the individual's own personal and professional capacity and not as a member of the Group.

Following completion of the EIS by the Proponent, the Group will report to the Panel on the adequacy of the studies undertaken in support of the EIS.

Membership and Reporting Relationship

The Group will consist of experts appointed because of their knowledge in subject areas considered to be important in the review of the Lepreau II proposal. Individuals are appointed by the Executive Chairman of FEAR0 and the New Brunswick Deputy Minister of the Environment to serve in their own capacity and not as representatives of any organization.

The membership of the Group is as follows:

Dr. Gordon Beanlands (Chairman)
Federal Environmental Assessment Review Office, Halifax

Dr. Gordon Butler
Division of Biological Sciences
National Research Council, Ottawa

Dr. Martin Thomas
Biology Department
University of New Brunswick, Saint John

Dr. Alan Miller
Psychology Department
University of New Brunswick, Fredericton

Paul Monti (Secretary)
New Brunswick Department of the Environment, Fredericton

APPENDIX D

PROGRAM FOR THE POINT LEPREAU II PUBLIC MEETINGS

St. Mark's United Church, 50 Dexter Drive, Saint John

Wednesday, November 21:	7:00 p.m.	General Session
Thursday, November 22:	1:30 p.m.	Pollution Control Technologies
	7:00 p.m.	Impacts of Radiation on Humans
Friday, November 23:	9:00 a.m.	Impacts on the Biological Environment
	1:30 p.m.	Monitoring
Saturday, November 24:	9:00 a.m.	Emergency Planning
	1:30 p.m.	General Session

Howard Johnsons Motor Lodge — Fredericton, Salons A, B, and C

Wednesday, November 28:	1:30 p.m.	Impacts on the Socio-Economic Environment
	7:00 p.m.	General Session

St. Mark's United Church, 50 Dexter Drive, Saint John

Thursday, November 29:	7:00 p.m.	Impacts on the Socio-Economic Environment

Eastern Charlotte County Lions Club Hall — Pennfield

Friday, November 30:	1:30 p.m.	Decommissioning, Spent Fuel Transport and Disposal
Saturday, December 1:	9:00 a.m.	General Session
	1:30 p.m.	General Session

APPENDIX E

MAIN DOCUMENTS USED BY THE PANEL DURING THE PUBLIC REVIEW

Pre-Operational Environmental Monitoring Report for the Point Lepreau, N.B., Nuclear Generating Station — 1981, December 1982, Bedford Institute of Oceanography.

Radiological Monitoring Annual Report — Environmental Radioactivity in Canada, 1982, published by authority of the Minister of National Health and Welfare.

Consultative Document C-78, Limitation of Exposure to Ionizing Radiation — Explanatory Notes Relating to a Proposed Amendment of the Atomic Energy Control Regulations, November, 1983, Atomic Energy Control Board.

Transcripts of Scoping Workshops held in Saint John, New Brunswick, December 9 and 10, 1983.

Guidelines for the Preparation of an Environmental Impact Statement for the Proposed Second Reactor at the Point Lepreau Nuclear Generating Station, January, 1984, issued by the Lepreau II Environmental Assessment Panel.

Lepreau II Environmental Impact Statement, May, 1984, submitted to the Lepreau II Environmental Assessment Panel by Maritime Nuclear.

EIS Supporting Documents:

- No. 1(2)a — Environmental Radiation Monitoring Data, January 1, 1983 to December 31, 1983
- No. 1(2)b — Environmental Radiation Monitoring Program, January 1, 1984 to August 23, 1984
- No. 1(2)c — Climate of the Point Lepreau Area, New Brunswick Electric Power Commission, September, 1984
- No. 1(9) -- Memorandum on Thermal Plume from Dr. Paul Wisner
- No. 2(13) — Tritium in Air Monitoring Data, 1983, Health and Welfare Canada
- No. 2(14) — Seismicity of the Point Lepreau Area
- On-Site Contingency Plan — General Plan
  - Appendix 1 — Radiation Contingency Plan
  - Appendix 2 — Fire Contingency Plan
  - Appendix 3 — Medical Contingency Plan
  - Appendix 4 — Chemical Contingency Plan
  - Appendix 8 — Off-Site Emergency Centre
  - Appendix 9 — Call-Up Charts for Alerts and Emergencies
- Off-Site Emergency Plan — Volume One
- Off-Site Emergency Plan — Volume Two
- Emergency Response Package for Residents
- information Services Digest
- Administrative Directive Manual — Public Reporting Policy

Compendium of Comments received on the Lepreau II EIS, August, 1984, issued by the Lepreau II Environmental Assessment Panel.

Panel letter to Maritime Nuclear, dated August 21, 1984, requesting additional information.

Lepreau II Environmental Impact Statement Supplemental Information, September, 1984, submitted to the Lepreau II Environmental Assessment Panel, by Maritime Nuclear.

Compendium of Comments received on the Lepreau II EIS from Technical Experts to the Panel, October, 1984, issued by the Lepreau II Environmental Assessment Panel.

Transcripts of public meetings held in Saint John, November 21 to 24, 1984, Fredericton, November 28, Saint John, November 29, and Pennfield, November 30 and December 1.

Technical Response to comments on Decommissioning submitted to the Lepreau II Environmental Assessment Panel, November, 1984, by Maritime Nuclear.

Compendium of Briefs presented at the public meetings.

APPENDIX F

PARTICIPANTS IN THE PUBLIC REVIEW

Scoping Workshops

Mr. R. Albright — Environment Canada
Mr. J. Beddell — local resident
Mrs. K. Beddell — local resident
Mr. D. Besner — New Brunswick Department of the Environment
Mrs. J. Brown — Conservation Council of New Brunswick
Mr. H. Bryan — local resident
Mr. R. Carr — Saint John Building Trades
Mr. G. Comeau — N.B. Power
Mr. P. Darrah — Saint John Construction Association
Mr. W. Denny — New Brunswick Department of Natural Resources
Mr. L. Fraser — Association of Professional Engineers of New Brunswick
Mr. S. Friedman — local resident
Mr. K. Gordon — New Brunswick Department of the Environment
Reverend Canon W. Hart — local resident
Ms. C. Hooper — local resident
Mr. V. Ireton — local resident
Mr. J. Law — Saint John Board of Trade
Mr. R. Lyon — Atomic Energy of Canada Limited
Mr. L. McClare — New Brunswick Department of Commerce and Development
Mr. F. Meth — N.B. Power
Mr. J. Paciga — N.B. Power
Mrs. Parfett — local resident
Mr. B. Patterson — local resident
Dr. D. Scarrett — Fisheries and Oceans
Dr. J. Smith — Fisheries and Oceans
Mr. J. Sommerville — N.B. Power
Mr. G. St. Onge — local resident
Mr. D. Thompson — Maritime Energy Coalition
Dr. P. Tippett — local resident
Mr. R. Wilson — Environment Canada

Public Meetings

Dr. J. Adams — Energy, Mines and Resources
Mr. S. Alikan — N.B. Power
Dr. M. Bewers — Fisheries and Oceans
Dr. C. Boyd — technical expert to the Panel
Mr. J. Burnham — Maritime Nuclear
Dr. R. Burridge — Association of Professional Engineers of New Brunswick
Dr. G. Butler — Scientific Advisory Group
Ms. A. Caverhill — New Brunswick Department of Social Services
Mr. G. Chalder — Combustion Engineering — Superheater Ltd.
Mr. B. Chan — Environment Canada
Mr. J. Cole — International Brotherhood of Electrical Workers
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APPENDIX G

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