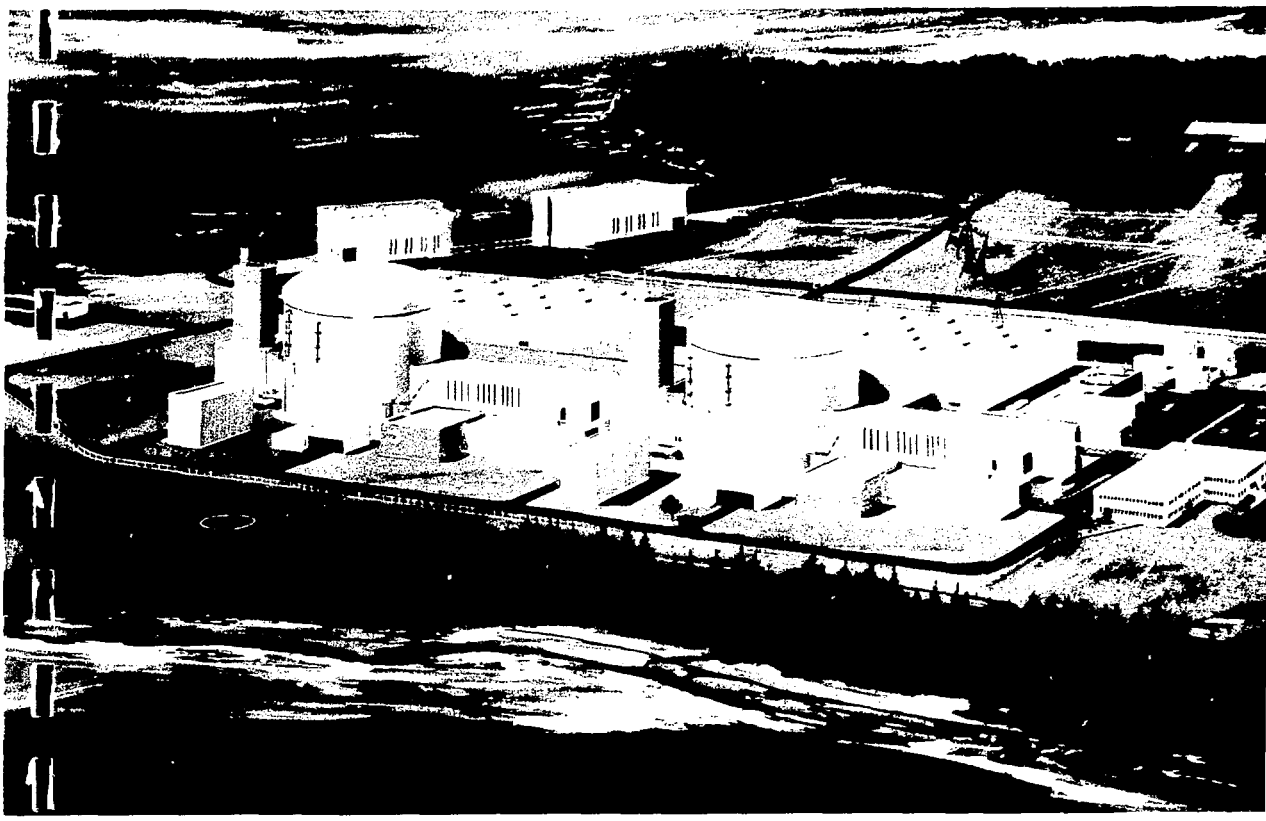
LEPREAU 2

Environmental Impact Statement
Supplemental Information



Prepared for

Maritime Nuclear

by

WASHBURN & GILLIS ASSOCIATES LTD.

in association with

SENES CONSULTANTS LIMITED

and

DPA CONSULTING LTD.

September, 1984

MARITIME NUCLEAR

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September 14, 1984

Dr. L. Desjardins
Mr. R.G. Connelly
Co-Chairmen
Lepreau 2 Environmental Assessment Panel
c/o Panel Secretariat
Environment New Brunswick
P.O. Box 6000
FREDERICTON, N.B.

Dear Sirs:

We are pleased to submit, for your consideration, supplemental information to the Lepreau 2 Environmental Impact Statement. This information is tendered in response to the list of questions attached to your letter of August 21, 1984. You will note that the supplemental information refers to a number of supporting documents which were instrumental in enabling us to respond to your request. These supporting documents are also tendered for your referral. As discussed with Mr. Monti of the Panel Secretariat, we have provided 35 copies of the supplemental information and ten copies of the supporting documents.

Please be assured that we have taken note of the additional comments and questions to which you made reference in your letter. As you have suggested, we will be in a position to respond to these at the public meetings.

We trust that we have now provided the Panel with sufficient information relative to the Guidelines to proceed to the public hearings process.

In closing, may I take this opportunity to commend the Panel and its Secretariat on the most timely response to our initial submission.

Very truly yours,

P.R. Cote

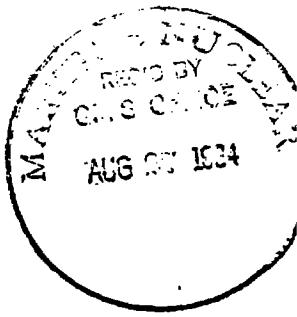
Enclosures

Environmental Assessment Panel — Lepreau II

Commission D'évaluation Environnementale — Lepreau II

Federal Environmental Assessment
Review Office
13th Floor, Fontaine Building
Hull, Québec K1A 0H3

August 21, 1984



Mr. R.P. Côté
General Manager
Maritime Nuclear
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Dear Mr. Côté:

The Lepreau II Environmental Assessment Panel has completed its review of the Environmental Impact Statement (EIS) and comments on it which have been made by 20 organizations and individuals as well as the Study Advisory Group. These comments are enclosed for your information.

As a result of our review we have identified a number of deficiencies (attached) which we feel should be addressed before public meetings are scheduled.

The review comments identified some additional questions which we have not listed, but answers to these questions should be available at or before the public meetings. In addition, the reviews addressed a number of general issues (e.g. monitoring, pollution control technology, decommissioning, emergency planning, transportation of workers) which we would like to discuss at our public meetings.

We look forward to receiving your response in order that we can continue the review process.

Yours sincerely,

Dr. L. Desjardins
Co-chairman

R.G. Connelly
Co-Chairman

Attach.

LIST OF DEFICIENCIES IN THE POINT LEPREAU II ENVIRONMENTAL IMPACT STATEMENT (EIS)

1. IMPACTS ON THE BIOLOGICAL ENVIRONMENT

RADIONUCLIDES

(1) The trajectory of dispersion of radioactive releases in water has not included information on currents and areas of deposition. Enough information should be provided to indicate the location of depositional areas for specific radionuclides over the long-term. The EIS also notes that dilution data were collected in the fall of 1983 and will be incorporated in a revision of the Derived Emission Limits (DELs). The dilution data should be provided.

(2) The Environment Canada brief (section 4.4) pointed out that meteorological information is outdated and not specific to the Point Lepreau site. The distribution of levels of radioactivity around the site should be presented using more recent and more site-specific meteorological data than that presented in the EIS. The assumption used for radionuclides emitted and the meteorological conditions should be stated.

(3) The expected persistence, accumulation and mobility of longer-lived radionuclides in plants, animals and sediments (e.g. carbon-14) has not been described, nor has any plan to monitor these been identified. This should be addressed.

(4) The EIS indicates the probability of an accident with a maximum frequency of a single failure once every 3 years and a dual failure once every 3000 years. What are the cumulative effects of such events on the natural environment over the lifetime of the plant based upon existing CANDU reactor experience?

(5) The levels of radioactivity that could lead to a closure of food harvesting in the area should be presented and the likelihood that such an event would occur should be predicted.

WASTEWATER DISCHARGE

(6) Effluent discharge from the inactive liquid waste treatment facility, contrary to the statement on Page 2-58 of the EIS, does not seem to be conforming to the New Brunswick Department of the Environment criteria

for suspended solids. Why is this occurring and what modifications will be made to meet the criteria both for the existing Lepreau I unit and for the proposed Lepreau II plant? Is seepage monitored and controlled?

(7) The EIS states that data on the sewage treatment plant effluent is not available but that effluent criteria are most likely being met. Data should be presented to substantiate this.

ENTRAINMENT

(8) Why haven't actual measurements of impingement/entrainment been made from Lepreau I experience to confirm the theoretical predictions?

THERMAL EFFLUENT

(9) Re-examine the suitability of the plume discharge model taking into account the comments made in the Department of Fisheries and Oceans review and with Ontario Hydro experience with sinking plumes in winter, and indicate whether predictions of effects made in the EIS would change.

2. IMPACTS OF RADIATION ON HUMANS

(10) The DELs were calculated for Lepreau I and do not seem to reflect current or emerging procedures. What is the status of the derivation of new DELs and is it likely that they will change significantly?

(11) Are the revised dose limits in the proposed Atomic Energy Control Board (AECB) Consultative Document C-78 likely to have an effect on the Lepreau II design and on monitoring operations?

(12) Indicate the distribution pattern of whole body doses under various meteorological conditions that would result from unusual releases of 1mGy/hr and 5mGy/hr. At releases of 1mGy/hr and 5mGy/hr evacuation would be initiated and prompt evacuation would be initiated respectively to prevent a 50mSv whole body exposure in one week. What is the predicted frequency of such releases over the lifetime of the plant? How would this affect health risk?

(13) The EIS on Page 5-18 states that it is unlikely that releases from Lepreau II will be detectable above background but this appears to be contradicted on Page 3-53. Present more recent data (particularly in summer) including any collected by other agencies to substantiate whether tritium levels are barely detectable above background. (see the comments by the Department of Fisheries and Oceans, the Atomic Energy Control Board, and the Department of National Health and Welfare).

(14) The EIS refers to an update of earthquake information and the Department of Energy, Mines and Resources comments mention a report prepared by the AECB that addresses seismic risk. Further information should be provided to determine whether recent earthquake activity would require new design criteria for Lepreau II from that used in Lepreau I.

3. IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

(15) A description of the "human systems" component of the proposed plant should be provided drawing upon data and experience from the construction and operation of Lepreau I. This should include:

(a) measures that would be taken for the construction of Lepreau II to minimize labour problems and their potential social impacts; the response should include information on the proponent's policy with regard to labour management and promoting labour harmony; and

(b) measures planned to ensure that system failure due to human error is minimized during operation of the facility.

(16) Is the housing vacancy rate high or low in the Saint John area at present? Can the projected population increase (400-585 during construction) be handled at present?

(17) Are some of the present social services (health care and hospitals, fire protection, police) over or under-utilized and hence could they accommodate the proposed increase in workers?

(18) How does the proposed facility conform with the New Brunswick government's plans and policies on employment, training and with its economic objectives?

4. MONITORING

(19) The nature and extent of the monitoring programs to be carried out by various government agencies (e.g. Environment Canada, the Department of Fisheries and Oceans, the Department of National Health and Welfare, the Atomic Energy Control Board, the New Brunswick Department of the Environment, and the New Brunswick Department of Health) studying and evaluating the environmental and health impacts of the proposed plant and the relationships of these programs to Maritime Nuclear's operations should be presented.

(20) The EIS does not indicate how monitoring results are evaluated to ensure that the program is optimal and how the results are related to emission monitoring and controls. This should be provided.

1. IMPACTS ON THE BIOLOGICAL ENVIRONMENT

Radionuclides

(1) The liquid effluent monitoring program will routinely monitor those radionuclides being discharged from the plant. (See Table 5.5 of the EIS for the results from Lepreau 1.) The only radionuclide which we would expect to be able to detect in the environment is tritium; all others will be in such infinitesimal quantities that they will be below the limits of detection.

With respect to tritium, this will occur as tritiated water which will be mixed with normal water and become diluted with distance from the plant. While tritiated water is marginally heavier than normal water, such factors as currents, tidal mixing, and temperature and salinity gradients are far more significant and will effectively prevent tritiated water from settling to the bottom. (In this regard it might be considered analagous to heavy water.) The tritium will not be deposited on bottom.

The prediction of dispersion trajectories in water can only be estimated with confidence by using tracer experiments. Such experiments provide practical difficulties, as indicated below.

The Bedford Institute of Oceanography, through its Point Lepreau Environmental Monitoring Program, has undertaken two dilution experiments using tritium as the "tracer" radionuclide. These experiments were timed to coincide with the pumping of the liquid radioactive waste storage tanks from the Lepreau 1 unit (see Section 2.7.3 of the EIS). This was done to provide the maximum possible "tracer"

effluent. N.B. Power has requested the data from these experiments, but has not received them to date. It is our understanding that the results of the first experiment were inconclusive, and that the results of the second experiment are still being analyzed. These data will be forwarded to the Panel when it becomes available.

With respect to radionuclides other than tritium, it would be necessary to conduct "tracer" experiments using measurable amounts of specific radionuclides in an attempt to determine deposition areas. N.B. Power does not have these radionuclides in sufficient quantities to allow such experiments to be performed. Further, it is unlikely that experiments of this nature could be conducted, since they would be inconsistent with the ALARA principle which governs the operation of Lepreau 1.

(2) The data presented in the EIS for levels of radioactivity around the site were reasonably current, and were representative of the situation both before (Section 3.3.2) and during (Section 5.6) operation of Lepreau 1. The most recent version of N.B. Power's "Environmental Radiation Monitoring Data for Point Lepreau Generating Station" is enclosed, as Supporting Document No. 1(2)a. It contains the complete spectrum of data upon which the synthesis in the EIS was based, as well as all other data collected in 1983. Also enclosed is a tabulation of our environmental radiation monitoring data collected to date in 1984 (Supporting Document No. 1(2)b.

The description of climate in the EIS was deliberately restricted to a rather general summary, reflecting earlier discussions we had held with Environment Canada regarding the utility of including a wide variety of data.

Nonetheless, we have prepared a more detailed historical account which is presented as Supporting Document No. 1(2)c.

The model used for the development of the DEL's is that formulated by Bryant (1), and we have already forwarded a copy of the paper describing this model to Environment Canada. For purposes of this model, N.B. Power assumed the conditions described in Figure 9 of Bryant's report, including a mean dilution factor of 2.2×10^{-7} secs/m^3 at a distance of 1 km from the stack. This was conventional practice in the Canadian nuclear industry at the time the DEL report was written.

We should emphasize here that it is N.B. Power's intention to measure the actual dilution factor by comparing the long term environmental tritium levels with measured stack releases. However, there are not high enough levels to do so at this time.

(3) The gaseous radioactive waste treatment facilities described in Section 2.7.4 of the EIS ensure that most radionuclides are removed from gaseous effluent. Only inert noble gases and tritium are released into the atmosphere where they are dispersed. The noble gases do not settle or react, and can be measured only as a component of general gamma radiation background. These are monitored using environmental TLDs, as described in Section 3.3.3 of the EIS. Also, noble gases are monitored in the stack, as described in Section 2.7.4.

(1) Bryant, P.M. "Methods of Estimation of the Dispersion of Windborne Materials, and Data to Assist in their Application." U.K.A.E.A. Report AHSB (RP) R42.1964

The tritium is also monitored in the environment and in the stack as described in the report and as further illustrated by the more recent data presented in support of question (2) above.

Tritium is also emitted in liquid effluent, but as there is no concentration mechanism at work in marine systems, we do not expect to see any accumulation of tritium in the marine ecosystem.

Table 5.5 of the EIS presents a monthly summary of the liquid effluent radionuclide releases from Lepreau 1. Similar data would be expected from the operation of Lepreau 2. The half-life of radionuclides is a measure of their persistance in the environment. Of the compounds found to date at Lepreau 1, only H-3 with a half-life of 12 years can be considered as relatively long-lived. Also, it is possible that detectable amounts of Cs-137 and Sr-90, with half-lives of 30 and 29 years respectively, may be emitted within the lifetime of the plant. Both of these radionuclides are already present in the environment as a result of fallout from nuclear bomb tests.

The study of mobility and accumulation of radionuclides in the marine environment near Point Lepreau is a research question requiring long term studies. In foreseeing this need, the Point Lepreau Environmental Monitoring Program operated by Bedford Institute of Oceanography has been designed to provide a broader understanding of the distribution and transport mechanism of radioactivity throughout the environment.

As the results of this program become available a clearer understanding of the mobility and accumulation of radionuclides from the Point Lepreau site should emerge.

N.B. Power will maintain their program which is aimed at monitoring radionuclides which could contribute to the radiation exposure of people.

We would like to address the example of C-14 which you proposed in your question. There are two sources of production of C-14 in CANDU units using N_2 as annulus gas, (n,p) reactions with N-14 in that gas, plus (n,) reactions with O-17 in the moderator. The decision was made to eliminate the former by changing the annulus gas to CO_2, thereby reducing the production rate to roughly half. However, C-14 produced in the moderator water is trapped in the IX resins of the moderator purification system. Data from Ontario Hydro indicate that units with CO_2 annulus gas have C-14 releases that are about 2-3% of those with N_2 annulus gas. Ontario Hydro does not monitor effluents for C-14 from CO_2 annulus gas units because the potential release rate is too small a fraction (0.1%) of the DEL to make it worthwhile. Maritime Nuclear has adopted the same approach. Nevertheless, we do operate an environmental monitoring station (at the lighthouse) with C-14 capability. To date no C-14 has been detected.

(4) Based on existing CANDU reactor experience, there are no cumulative effects of single and double failure accidents on the natural environment. Any single failure events which have occurred have not led to significant radiation leaks to the natural environment.

For water borne releases associated with a single failure event from a CANDU reactor, the maximum release has been seven percent of the monthly DEL which contributed less than 1% of the annual dose limit. For gaseous effluents the maximum release has been even smaller (less than 1% of the weekly DEL or a contribution of less than 0.02% of the annual dose limit.

(5) At present levels of radioactivity which could lead to a closure of food harvesting have not been established, either by the New Brunswick Emergency Measures Organization, the New Brunswick Department of Health, or the Federal Department of Health and Welfare. It would be the responsibility of the NB EMO to declare such levels. Discussions with Health and Welfare Canada have indicated that there are no published values for closures of food harvesting and that such closures have never occurred in Canada.

Theoretically such levels could be calculated based upon the annual dose limits. Too many assumptions enter into such a calculation for it to be worthwhile at this point. In practice, it would be more appropriate to make a decision at the time, when necessary information on the type and quantity of radionuclides, extent and variability of contamination, expected rate of decay, etc. are known from environmental measurements taken.

The order of magnitude levels which could lead to a closure could be reached only as a result of a major radioactive leak at the station. The contamination of seafood to those levels would take some time for the radioactivity to work its way through the appropriate food chain. Certainly there would be ample lead time to focus attention on such a potential problem, and to implement a directed monitoring program which would necessarily be more concentrated than those now in place.

We are confident that no event having a probability equal to or greater than a Dual Failure would lead to releases of the magnitude implied by the question. The prediction of radiation doses resulting from the accident scenarios we

analyse presupposes that individuals remain at the plant boundary, during and after the accident considered. Permitted releases are correspondingly low.

A Dual Failure is defined as a serious failure of process equipment (for example a pipe failure) coupled with a failure of any one of the Special Safety Systems, of which there are four:

Shutdown System 1 (SDS1)
Shutdown System 2 (SDS2)
Emergency Core Cooling (ECC)
Containment

We think it likely that, in order to generate the magnitude of the projected releases implied by a disruption to agriculture or the fisheries, it would be necessary to postulate the failure of not just one but two Special Safety Systems, following a serious process failure.

These remote possibilities are as follows:

(i) SDS1 and Containment fail
(ii) SDS2 and Containment fail
(iii) SDS1 and ECC fail
(iv) SDS2 and ECC fail
(v) ECC and Containment fail
(vi) SDS1 and SDS2 fail

The first four possibilities are covered routinely in Dual Failure analysis since the action of the more effective shutdown system is arbitrarily ignored so as to ensure both shutdown systems are capable of addressing the event under consideration. These four possibilities lead to releases within the Dual Failure guidelines and may be dismissed in this context.

Event combination (v), LOCA + Loss of ECC + Random Failure of Containment Isolation has a projected frequency of 10^{-7} per year (once in 10,000,000 years of reactor operation).

However, the postulated failure of both shutdown systems following a serious process failure, event combination (vi), is roughly equally probable and much more hazardous than the previous event sequence and so it probably provides a clearer definition of the frequency to which the question refers.

Analysis of the consequences of a serious process failure with failure to shut down would be purely speculative. It is recognized that the damage potential for the CANDU reactor core is self-limiting in that the unenriched fuel is already in the most reactive configuration during normal operation. Thus any displacement of core structures is likely to lead to the formation of an assembly which is no longer critical. Having said this we are not aware of any methodology which would lead to a confident prediction of the releases from containment after such an event. There is a possibility of closure of food harvesting at a projected frequency corresponding to the occurrence of any serious process failure coupled with a coincident failure of both shutdown systems. Such an event would be expected once in 3,000,000 years of reactor operation.

Wastewater Discharge

(6) An in-depth investigation of Lepreau 1's current operating problems vis-a-vis suspended solids was initiated by N.B. Power in June, 1984 and is expected to continue for the next 2-3 months.

The station's first priority was to substantiate that the data submitted to Environment New Brunswick over the past 3 years was indeed representative of system operation, and to that end the following actions were undertaken:

(1) the installation of an on-line sampling facility,

(2) implementation of a stepped-up monitoring program which included:

i) hourly recording of instantaneous flow rates into and out of the lagoons;

ii) once per shift recording of flow totalizer readings; and

iii) daily sampling and analysis for suspended solids (SS) into and out of the lagoons.

This investigation showed that SS were indeed consistently out of spec (an average of 37 mg/kg for 18 samples), in spite of the fact that typical flows were well below design (2-5 L/s as compared to 40 L/s). Equally important was the fact that both lagoons had been desludged on June 18, and data for the period June 20-29 showed an average SS concentration of 13 mg/kg. The obvious implication was that the effective settling volume of the lagoons had rapidly decreased. This led to a program aimed at characterizing the source and nature of the accumulated sludge.

It has been determined that clarifier blowdown is the cause of the present operating problems, a mass balance showing that it is generating 200-220 kg/day of very light floc. The resultant sludge, based on samples collected directly from the lagoons, contains only 5-10% solids and has a

density just marginally greater than 1.0. The current chemistry in the system would require that the lagoons be desludged every 2-3 weeks to maintain the 25 mg/kg criteria for SS. The cost of each clean-out is in the order of $5000-$6000, which clearly is unacceptable in the long term.

The immediate solution was the installation of an overflow weir in each lagoon, to act as a subsurface retaining wall to prevent the migration of sludge toward the lagoon discharge. One lagoon has already been retrofitted in this manner, and an evaluation of its effectiveness is now underway.

Should it be found that this relatively simple fix is inadequate, 4 alternatives are available to N.B. Power:

(1) alter the chemistry of the lagoons through the utilization of coagulant aids,

(2) develop a separate facility to handle clarifier blowdown,

(3) significantly increase the available settling volume in the system, e.g., through the addition of a third settling lagoon,

(4) install a clarifier in the vicinity of the existing lagoons with on-line desludging capability.

Alternative '1' is clearly the simplest solution from both a technical and implementation point of view. Moreover, N.B. Power's experience at the Dalhousie Generating Station, which operates on basically the same water chemistry, indicates that this approach will definitely work. However,

these benefits could be offset in the longer term by high O&M costs if, for example, desludging is still required every 2-4 weeks.

Thus, N.B. Power plans to proceed as follows:

(1) Implement a program of coagulant aid addition (our chemical consultant is already working on this) for a 3 month term with the primary objective of evaluating O&M costs. A report on this test program will be submitted to Environment New Brunswick in mid-November.

(2) If the program appears too costly, a design review and cost-benefit assessment of alternatives 2-4 will be initiated immediately. Upon completion of this review (mid-late February, 1985) appropriate funds would be allocated for the necessary remedial work, all of which would be completed by late-September, 1985.

(3) The chemical program will be continued throughout the duration of the design review (if in fact the latter is necessary).

To summarize, N.B. Power has now determined the cause of the suspended solids problem at Point Lepreau and is committed to its resolution in the immediate future. Environment New Brunswick has been and will continue to be routinely informed of our progress in this regard, and in fact has indicated its willingness to renew the Station's Operating Approval on the basis of the proposed plan of action.

The only possible source of seepage in the entire inactive drainage system would be the settling lagoons. Both lagoons are lined with an impervious rubber-like material called "hypalon" through which seepage is impossible. Therefore, seepage is totally controlled.

(7) Environment New Brunswick's current standard for BOD (biochemical oxygen demand) from sewage treatment plants is 20.0 mg/l. Tests conducted by plant personnel during the period November 9/83 - June 30/84 yielded the following results:

Sample	Date Collected	BOD (mg/l)
1	83/11/09	1.77
2	83/11/23	3.55
3	83/12/10	2.60
4	84/02/24	3.39
5	84/06/30	1.30

Entrainment

(8) The cooling water intake system of Lepreau 1 was designed to accommodate two 600 megawatt CANDU units using state-of-the-art techniques to prevent the entrainment of fish. The design was approved by the Federal Department of the Environment. In recent years, the system has been used by regulatory agencies as an example of offshore intake design.

The possibility of undertaking a monitoring program at the site for the purposes of the EIS was considered. The following discussion presents the rationale for the decision not to undertake such a program.

There have been a number of attempts at estimating the losses of fish stocks associated with entrainment and/or impingement of larval, juvenile or adult fish. These attempts have identified several requirements for an appropriate sampling program. First, the program must obtain estimates of the numbers of organisms entrained and/or impinged. These estimates are normally made on the basis of sampling programs conducted in the intake structure or forebay of the plant. Second, the estimate of the number of organisms entrained by the plant must be compared to an estimate of the abundance of these organisms in the environment outside the plant on a temporal and areal basis. To determine the potential magnitude of the effect of entrainment requires that an accurate estimate of size of the stock of organisms must be available and the area from which contributions to this stock can be drawn must be determined. This estimate is normally made on the basis of extensive sampling of fish populations within and around the project area (depending on the stock boundaries of the species of interest). Finally, an estimate must be made of the proportion of organisms which could be lost due to entrainment without harming the health of the stock. Several authors have attempted to establish allowable levels of removal of various ages of fish both with and without consideration of compensatory mechanisms (such as density dependence of juvenile mortalities). The goal of these attempts has been to determine the numbers of organisms which can be removed from the stock without harming the productive potential of the stock.

There were no measurements of numbers of entrained organisms made during the operation of Lepreau 1. The only information available on the mass of organisms entrained indicated that, during the period of operation, the amounts entrained posed no problem to the operation of the plant and

the materials impinged on the travelling screens could be readily removed with routine washings. Following the receipt of the guidelines for the conduct of the Lepreau 2 EIS, predictions were made of the level of entrainment and subsequent impingement due to the operation of the facility. These estimates were made on the basis of available information on fish stocks in the area particularly with reference to densities of larval fish established over several years of sampling by the Department of Fisheries and Oceans. The technique used to make the estimates was to determine the volume of water which was to be used (in the actual calculation, two cooling water flow rates were used), and then, based on the densities of organisms in the area susceptible to entrainment, to determine the numbers of organisms entrained. This estimate, as was reported in the Lepreau 2 EIS, was found to be well below any number which would be considered problematical to fish stocks in the area.

There were considered to be two primary sources of error in the estimates. First, if the estimates of the volumes of water used in the plant were in error or, second, if the densities of entrainable organisms in the vicinity were in gross error. The potential for volumes of cooling water used in the operation of Lepreau 2 to be increased over that used in the estimates is low given that the intake facilities were designed and approved for two units of operation during the construction of Lepreau 1. A major change in the volumes of water used in the plant would require design changes in the facility.

The other factor which could affect the level and subsequent effect of entrainment would be the density of susceptible organisms in the vicinity of the intake structure relative to the densities of such organisms in the Bay of Fundy (i.e., if such organisms were found to be concentrating in the vicinity of the intake structure). The densities used in the estimates of entrainment presented in the Lepreau 2 EIS were based on over one full year of sampling of the immediate area during the Lepreau 1 assessment as well as several years of sampling of the entire Bay of Fundy, including the Lepreau vicinity, by the Department of Fisheries and Oceans. Neither of these programs suggested that there is any concentration of organisms in the vicinity of Lepreau; indeed, the information from Fisheries and Oceans suggests that there are fewer larval fish near Lepreau than in other areas in the Bay.

The estimates of entrainment used for the Lepreau 2 EIS were finalized in early Spring 1984, between the onset of the study and the submission of the EIS. It was considered that a program undertaken between this time and the submission of the EIS to determine the actual numbers of organisms entrained in the existing Lepreau operation would not substantially add to the assessment of effects of entrainment due to Lepreau 2 for a number of reasons. First, the plant was shut down during portions of May and June which would have made sampling impossible during that time. Second, any program to assess entrainment should run for several years in order to compensate for the natural fluctuations in biological populations. Third, such a program must estimate densities of organisms entrained as well as densities of the same species and age of organisms in the stock from which the entrained organisms are to be drawn.

Estimates of densities of organisms entrained is difficult and entails much more than a simple sampling effort in the forebay. Protocols must be developed for the selection of appropriate sampling devices, sampling times (during the day or during the night?), duration of sampling and number of samples. The difficulties are compounded by the potential for predation on larval fish by organisms resident in the forebay or, in the case of bivalves, production of larvae. Estimates of the stock size from which the entrained organisms are drawn should be from a time period comparable to that used in estimating the numbers entrained. In the case of Lepreau, this may entail an estimate of the larval fish populations in the entire Bay of Fundy in order to determine effects of entrainment.

The level of risk which the proposed Lepreau 2 plant will place on the fish stocks in the Bay (on the basis of calculations presented in the Lepreau 2 EIS) did not appear to warrant such an extensive program. Also, the natural variation in populations would result in the confidence intervals associated with such a sampling program being very great. A lesser scale program such as sampling in the forebay for several years without attendant sampling in the bay at large would not provide a basis against which to assess the significance of the numbers of organisms entrained. A sampling program which would run for only a brief period would not allow confidence to be placed in the estimates of effects of entrainment which differ from that associated with the existing estimates of entrainment.

(9) We have carefully reviewed the comments of the Panel and the technical reviewers regarding the heat dissipation section of the EIS.

The predictions for the most critical conditions of a submerged plume are not based on a numerical model but on a extrapolation of data from field measurements with one reactor in April 1983 and a similitude model. The simulitude relation used for this extrapolation is theoretically based and its parameters are derived not only from the available measurements at Lepreau but also at other generating stations.

We would like to clarify that well-mixed conditions were considered in the previous study because at that time temperature criteria referred mainly to surface plume. For a single unit and well-mixed conditions the numerical model used in the previous study was found to be conservative when the results were compared to the September 1983 monitoring.

Additional information has been developed on the interpretation of field data and clarifies some apparent contradictions indicated by the reviewers including one caused by a typing error in the EIS. (The exponent r in the equation on page 6-10 of the EIS should have been set to -3/2 rather than 3/2.)

The experience of Ontario Hydro with sinking plumes was considered. Discussions with Ontario Hydro technical staff and review of several papers and reports indicate that conditions are different at Lepreau. The Ontario Hydro surface outlets are on the shore and fresh water has a critical density at 4°C. At Lepreau, the outlet is submerged and salinity effects, including eventual differences between the water body at intake and outfall, should be considered. For the range of observed winter temperatures at the outlet the plume may be submerged but it is very unlikely that it will sink below the higher salinity layer at the bottom.

In view of our re-examination of the thermal plume predictions we do not consider that the prediction of environmental effects will change.

The review was conducted on our behalf by Dr. Paul Wisner and Dr. John Edinger, both recognized experts in the highly specialized and extremely technical field of thermal plum modelling. Dr. Wisner's memorandum, attached as Supporting Document 1(9), contains details of the review, and provides copies of relevant reference material which provided background for the analysis.

IMPACTS OF RADIATION ON HUMANS

(10) The DELs calculated for Lepreau 1 and quoted in the EIS as applying to Lepreau 2 do reflect current Atomic Energy Control Board procedures. N.B. Power is awaiting the new Canadian Standards Association DEL document which is expected in 1985 and which will update procedures now in effect, and the new AECB regulations with revised dose limits, expectd by late 1985. New DELs will then be calculated for Lepreau 1 and for Lepreau 2.

The new DELs are not expected to change significantly.

(11) The revised dose limits as described in AECB Consulative Document C-78 will have no effect on the Lepreau 2 design and monitoring operations. The differences are not significant; whole body DLs are unchanged, although there are some modifications to single organ DLs. The new system follows the recommendations of the International Commission on Radiological Protection as expressed in ICRP Publication No. 26, and AECB Consultative Document C-78 explains how the philosophy of the ICRP is embodied in the proposed Canadian regulations.

(12) The values of 1 mGy/hr and 5 mGy/hr are not radioactivity release rates; rather, they are values of dose rates on the ground after a release of radioactivity from the stack. Therefore, prevailing meteorological conditions are not relevant because the effect which they would influence, namely dose rates on the ground, is already specified.

The predicted frequency of 1 mGy/hr and 5 mGy/hr is less than once in 3,000 years. If such dose rates were to occur, the health effects would be negligible, since evacuation would be complete within a few hours. The net doses could range from 1 to 10 mSv to individual members of the population, i.e. the same order of magnitude as the annual dose received from natural background radiation.

(13) The Panel is quite correct in pointing out an apparent discrepancy between pages 5-18 and 3-53. By way of clarification, we would like to point out that the statement in question on page 5-18 refers to concentrations in organisms rather than concentrations in aquatic or atmospheric media. Section 5.9 of the EIS, "Fate of Radionuclides in the Receiving Environment", from which this statement is an extract, deals with pathways of radionuclides in the marine, terrestrial and fresh water ecosystems. The closing paragraph of this section should be taken in that context. The original wording, however, is unclear, and we apologize for the misunderstanding this may have caused.

With respect to tritium, this radionuclide is, and will continue to be, released from Lepreau 1, and would also be released from Lepreau 2 in a similar fashion. N.B. Power data have been presented in the EIS, and in Supporting Document Nos. 1(2)a and 1(2)b. These releases will be detectable within a certain distance from the site.

However, data gathered to date relative to Lepreau 1 do support the contention that these detectable amounts are barely above background. Each sample is counted for 100 minutes in a conventional liquid scintillation counter to yield a lower limit of detection (LLD) of around 0.1 Bq/m^3. For the year 1984 (up to end of August) about one third of our samples were below the LLD. For the 1983 data (April to August) reported in the EIS, the LLD would be roughly the same, but obviously the levels would be lower, resulting in the majority of these results being below the LLD.

BIO has not published 1982 or 1983 data from its program, so we cannot comment on the capabilities of that organization with respect to LLD's. We have not received any data from BIO in advance of publication.

We have received some raw data from Health and Welfare Canada for samples taken during its tritium-in-air monitoring program during 1983. As per your request, this is enclosed in the form in which it was submitted to us. These data have not been published.

(14) We have reviewed the seismicity of the Point Lepreau area, particularly with regard to seismic activity in New Brunswick since the site was approved for Lepreau 1. We have considered as well the re-evaluation of some historical information in New Brunswick relating to seismic activity. The review report is appended as Supporting Document No. 2 (14).

It has been concluded that there are no reasons for major revisions to the assessment of seismicity contained in the Lepreau 1 Environmental Assessment Report. With respect to the January 9, 1982 earthquake in Central New Brunswick, the

large aftershocks provided the first accelograms for an earthquake in eastern North America. This information suggests that more emphasis should be placed on higher frequency motions in specifying design criteria in eastern North America. Such high frequency motions would not affect the integrity of the plant structures or their containment functions.

Maritime Nuclear has recently prepared a report entitled "Lepreau 2 Design Basis Ground Response Spectra" which has been submitted to the AECB for its consideration. This report deals in detail with the design criteria for Lepreau 2. However, it is in the review stage and has not yet been approved, and thus it is not possible to be more definite regarding design criteria.

The review on which this is based was undertaken for us by Dr. K. Burke, Professor of Geophysics at the University of New Brunswick. Dr. Burke is a reknowned expert in seismicity in Northeastern North America. He contributed as well to our report for the AECB.

3. IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

(15)(a) Labour relations during the construction of Lepreau 1 were less than satisfactory during a large part of the project. Unacceptably low productivity prevailed until an international union intervened by taking over direct jurisdiction on the project from its local union organization.

Project management of the Lepreau 2 project has appreciated the benefits of achieving labour harmony. At the outset of planning for Lepreau 2, it was clear that this project, with its massive financing

requirements, could not be undertaken without a firm commitment from organized labour to co-operate with management in the establishment of a production and cost effective relationship for the duration of the project. In addition, entry into the highly competitive market for the sale of electric power in the New England area requires guaranteed in-service dates and a reduction in fringe labour costs arising from non-wage items such as: premium pay, allowances, and overtime rules.

These labour pre-requisites were presented in general terms to a joint meeting of international and local union representatives and were accepted in principle. Detailed drafting and review of a proposed project agreement then took place and a continuing series of meetings were held with individual unions and with the group as a whole in order to gain labour acceptance.

This process, which commenced in 1982, is now drawing to a successful conclusion and management expects to consumate a collective agreement with the craft unions which will include the following major provisions:

(a) All parties to the agreement to be governed by common working conditions as defined in the master portion of the agreement. Specific items applicable to each trade will be defined in Trade Appendices of the agreement.

(b) The agreement to remain in effect for the duration of the project, thus eliminating the possibility of legal strikes.

(c) Wages and benefits to be adjusted semi-annually during the life of the agreement in accordance with the formula reflecting average changes in these items in nine major cities across Canada.

(d) Commitment by the parties to work together in the establishment of productivity improvement programs and foremen training.

(e) The establishment of joint labour - management committees with each craft union for the resolution of disputes and for an on-going examination of work experience on the project.

(f) Recognition of the management role and responsibilities of general foremen and foremen, and the exclusive rights of employers to select and appoint these supervisors.

(g) Provision for the establishment of continuous seven day operations on the project, with each employee working four days of ten hours followed by four days free from work.

(h) Establishment of competitive working conditions through reduction of non-wage labour costs and allowances.

It is our belief that in this way many of the problems encountered previously will be overcome, and the project can be built in an atmosphere of labour peace.

(15)(b) N.B. Power has a complex and demanding operator program to ensure that system failure due to human error is minimized during operation of the facility. This program will be applicable to Maritime Nuclear operations as well.

(1) Staff Selection

Point Lepreau salaries are considerably higher than those prevailing in the rest of the N.B. industry. As a result, we are able to select from the most competent individuals available within the Province, indeed from across the nation.

(2) Training

All staff are trained in-house by a comprehensive system of formal lectures, hands-on practical training, and field experience appropriate to the specific job requirements. All training is continuously being assessed and audited. Improvements are made on a continuous basis. All operating staff are retrained on a regular basis as well.

Senior operating staff (shift supervisors (SS) and senior power plant operators (SPPO)) are responsible for the day-to-day operation of the station. They obtain a vast amount of experience before they undertake to operate the plant; they are involved in conceptual and detailed design review, commissioning and preparation of design manuals, training manuals, operating manuals, flowsheets and reference documents. After several further years of operating experience at a less

senior level, they undertake an extensive full-time two-year training program to prepare them for the SS and SPPO positions. Their abilities are audited by the AECB through a comprehensive examination process before they obtain an operating license. This license can be rescinded by the AECB at any time.

(3) Operating Manuals (OM)

OM's are detailed operating procedures for every system and piece of equipment in the station. All normal operations must conform to the OM's, which have been reviewed and approved by the AECB. Also, abnormal conditions are generally addressed.

(4) Audit

The AECB has three resident engineers on site, whose function it is to continually monitor the performance of Point Lepreau and its staff. The AECB staff have access to all activities at the station.

In addition, there is an in-house Quality Assurance group whose mission is to ensure that all appropriate operating procedures are followed.

(5) Human Factors Design

As far as possible, layout of systems and controls has followed the guidelines of good human factors design to minimize the potential for "unforced errors".

(6) System Design

Systems are to be fail-safe with the "defence-in-depth" approach plus appropriate interlocks and alarms to inhibit or obviate incorrect operator action.

(7) Supervision

Performance of all staff is continuously reviewed on informal and formal basis. Staff not following the OM's could be subject to severe reprimands and/or dismissed.

(16) Apartments

The CMHC Apartment Vacancy Rate Survey, April, 1984 indicated the unofficial vacancy rate for Saint John to be 3.8%, 4.6% private and 1.6% public.

The detailed breakdown of vacant units by type is as follows:

Type	# Units Vacant
Bachelor	40
1 Bedroom	196
2 Bedroom	248
3 Bedroom	38

Source: CHMC, Apartment Vacancy Survey
April 1, 1984

Assuming a reasonable occupancy scale of one person - bachelor to 4 persons - 3 bedroom, the statistics indicate enough surplus capacity to accomodate 1,328 persons.

The above data do not include housing provided in the Market Square Complex or the 300-400 units presently under construction or in the process of being rented.

The Saint John Metropolitan Area historic vacancy rate in apartment structures of six units and over is shown below: (all figures month of April)

Year	Vacancy rate
1976	3.7
1977	9.2
1978	8.9
1979	2.7
1980	3.1
1981	3.4
1982	4.9
1983	4.0
1984	4.6

The vacancy rates have been consistently high (when compared with other Canadian centres) since 1981 and discussions with housing authorities indicate that there is no reason to believe this trend should change.

Single/Two Family Dwellings

Given that housing starts and completions have in recent years been substantially below historic levels, the housing market in the City of Saint John can be considered to be very tight, particularly in the market segment which would

appeal to the $30,000 income bracket. There are, however, building lots available (more so in the outlying areas of the Saint John CMA than the City proper) which would permit new construction should demand increase.

Conclusion

There is sufficient capacity in existing rental units to accommodate an influx to Saint John City of approximately 1,500 persons. The private housing market is somewhat restricted but could probably respond to an increased demand given approximately six months lead time.

(17) Health Care

In consideration of the existing number of hospital beds per thousand population, (the accepted health care service measure), the supply for the whole region (i.e. St. Stephen to Saint John Fundy Coastal Area) is currently adequate. Since the expected inflow of workers is not substantial, coupled with the fact that these workers will probably be young single males or young families, which traditionally are low consumers of health care services, they will be easily accommodated within the existing system.

The Province of New Brunswick's Health Region I, which covers approximately the same territory as the major impact region (Saint John CMA, Charlotte County), contains 976 beds approved for primary and secondary acute hospital services. The region is considered by the N.B. Department of Health as "over-bedded" relative to provincial standards, which indicate a theoretical requirement of 970 beds. By the Department's planning standards, an additional 600 individuals in the region (the majority of whom will be in the 15-44 age group, for whom the bed planning norm is

2.4 beds per 1,000 population) would increase the bed requirements for the region by a maximum of 2 beds. This small incremental requirement relative to the regional supply could readily be accommodated within the existing complement.

Police Protection

Police protection provided by municipal police forces is currently adequate and would not be affected by the projected increase in population provided it is evenly distributed through the region. The RCMP Lepreau sub-detachment staff level is higher than required from a population perspective because it must provide 24 hour service for the Lepreau 1 plant. Thus, RCMP protection can be considered to be more than adequate. In addition, the New Brunswick Highway Patrol is scheduled to assume Motor Vehicle Act enforcement and accident investigation in the area in 1985.

Fire Protection

Fire protection systems and services are regularly evaluated and upgraded within the constraints of Municipal and Local Service District budgets. Presently, all systems in the region are considered adequate and could service a greater amount of capital plant (i.e., homes, buildings) provided it is located within their present areas of jurisdiction. It is also assumed that the Lepreau 2 site fire truck will be available to respond to local fire calls.

Conclusion

There is sufficient excess capacity in government services within the region to accommodate the projected population increase, provided it is spread evenly through the region o concentrates in the Saint John CMA.

(18) The socio-economic benefits of the project have been detailed in Chapter 7.0 of the EIS, and need not be reiterated here. In summary, however, the project offers a stimulus to the construction industry in the Province of Ne Brunswick by creating a substantial number of construction jobs. The project also creates over 200 permanent jobs. Opportunities are offered in construction and operation for technologically advanced skills. Similarly, opportunities are offered for New Brunswick suppliers during both phases of the project. The product, electricity, is destined primarily for export to the north-eastern United States, fo some years at least, and then will enter the New Brunswick energy supply at very favourable prices.

These socio-economic impacts are in keeping with the economic objectives of the Government of New Brunswick, as articulated in its document entitled "Meeting the Challenge of the Eighties - An Economic Development Strategy for New Brunswick". That document confirms that the "main objectiv of economic development policy will continue to be to ensur that New Brunswick ... achieves a faster rate of growth of output" and ... "will continue to focus on:

- increasing the number of permanent jobs;
- increasing productivity; and
- encouraging the development of a skilled and versatile labour force."

It goes on to say that "development policy thrusts would continue", amongst others, "to increase value added in New Brunswick by increasing the level of processing in the Province, to diversify the economy into activities not based on natural resources, and to ensure that each region of the Province can develop, on the basis of its economic strengths, to its full potential and to ensure the development of viable diversified communities". An accompanying analysis of the international economic environment identifies opportunities for increasing exports to the Province's traditional north-eastern U.S. market. Clearly, this project satisfies those policy thrusts, and takes advantage of one such opportunity.

The document outlines a number of policy elements to the economic development strategy, all designed to create new employment opportunities. Prime amongst these is the development of human resources, with job creation the priority objective. Training, and retraining, and the match between employer requirements and skills available, are essential elements of the strategy. We have indicated in Section 7.6.1 of the EIS how some operational training requirements for Lepreau 1 have been co-ordinated with provincial institutions. To improve co-ordination between itself as a major employer and the two senior levels of government, N.B. Power has recently entered into a tripartite "Memorandum of Understanding" with the N.B. Department of Labour and Human Resources and the Canada Employment and Immigration Commission, in order to "develop and implement the measures required to overcome selected human resource imbalances and related problems presently being experienced or expected by the Commission". Maritime Nuclear, through N.B. Power, will benefit from the early identification of human resource needs and the consequent training resulting from this.

Another key element in the provincial strategy is diversification into new technology industries whose potential growth is higher than average. Nuclear powered generation is a new technology industry; also, the generation of electrical energy for export appears to offer a rapidly growing potential. In New Brunswick, electricity exports have grown from 1.4% of the total value of all exports in 1970 to 16% in 1983, with a total value in that year of $266 M. Indications are that export opportunities will continue to expand.

A final element in the strategy is the provincial energy policy, which seeks, in part, to displace foreign oil with generation of electricity from alternative Canadian sources. A second nuclear powered unit at Point Lepreau satisfies this policy.

Thus, there are a number of ways in which this project is consistent with New Brunswick's economic development objectives. The Premier of New Brunswick, the Honorable Richard Hatfield, expressed his government's support of the project on 17 February, 1983 when he pointed out that New Brunswick had the highest level of public support for the use of nuclear energy of any Province in Canada. He stated that " ... New Brunswickers support nuclear expansion as a means of provincial development and a high percentage of respondents (to a recent Gallup poll) would favor the initial export of nuclear generated electricity with eventual in-province use".

More recently, at the official opening of Lepreau 1 on 25 June, 1983, the Premier stated that he "will continue to fully support future nuclear developments" and that "there will be very real benefits from Lepreau 2 if it is developed".

The support of the provincial government was further demonstrated in the briefs read into the record by representatives of the New Brunswick Departments of Commerce and Development, and National Resources, at the Lepreau 2 Environmental Assessment Panel Scoping Workshops held in Saint John on December 9, 1983.

MONITORING

(19) The Federal Department of Fisheries and Oceans, Environment Canada, and the New Brunswick Department of Environment have collaborated to undertake a monitoring program known as the "Point Lepreau Environmental Monitoring Program", under the leadership of the Bedford Institute of Oceanography. This program, known as PLEMP, has been described in the EIS (Sections 3.3.2 and 3.3.3). The objective of the program was to investigate on a broad scale the movement and fate of radionuclides in the environment, rather than to focus on critical pathway monitoring as is carried out by N.B. Power at Lepreau 1. In this way, it is complementary to N.B. Power's program. Annual reports are issued by PLEMP, but they do not have a compliance or control function. This program has no relationship to the operation of Lepreau 1, except that N.B. Power co-operates with PLEMP in the provision of information and assistance if and when requested. It is not expected that this program will have any relationship with Maritime Nuclear's operations, if indeed it is still active at such time as Lepreau 2 becomes operational. We are not aware of plans by any of the three government departments involved in PLEMP to undertake other programs, either in concert or individually.

The Federal Department of Health and Welfare, together with the New Brunswick Department of Health, has undertaken a tritium-in-air monitoring program which is entirely separate from that carried out by N.B. Power. This program consists of monthly samples collected at each of five stations on the Lepreau Peninsula, and each of three remote stations (Fredericton Airport in New Brunswick, Digby and Greenwood in Nova Scotia). The results are published annually, and reports go to the Atomic Energy Control Board. There is no formal relationship between N.B. Power and the two participating departments with respect to this program, except that reports are exchanged as they become available. It is expected that a similar relationship would exist relative to Maritime Nuclear's Lepreau 2.

The Atomic Energy Control Board does not carry out any monitoring programs. Rather, it approves the program and reviews the results of the program conducted by the owner (i.e. N.B. Power in the case of Lepreau 1, Maritime Nuclear in the case of Lepreau 2). The AECB has a very real relationship with the owner's operations, in that it has absolute control over operating licenses and can suspend them should the monitoring program demonstrate that a unit is not in compliance.

In terms of non-radioactive wastes, the Lepreau 2 facility will be regulated by Environment New Brunswick through effluent discharge standards. Effluent discharge monitoring is undertaken by the Plant Operator (N.B. Power for Lepreau 1) and the results are made available to Environment New Brunswick. We refer the Panel to the response to Question #6 for a detailed discussion of the type of action taken when the effluent exceeds specifications, and the communications between the operator and Environment New Brunswick.

(20) The N.B. Power monitoring program for Lepreau 1 samples continuously for those radionuclides that could possibly be released in effluents, and monitors the levels in the environment on a regular basis. Effluent monitoring has two functions, one a control function, the other a compliance function. In the control function, the effluents are monitored prior to emission; should emissions exceed established levels, the plant automatically shuts down and the containment and isolation system is activated. The reactor building is completely sealed in this way. In the compliance function, emissions are monitored to ascertain that they are within regulated limits. The environmental monitoring program does not affect the emission monitoring program or its control function; however, it is possible that the emission control program could result in a revision to the environmental program.

N.B. Power's program at Lepreau 1 is formally reviewed on an annual basis; this review includes parameters sampled, sampling procedures, sampling locations, sample types, and sample frequency. Informally, there is continual assessment of the program as samples are analyzed. The program itself must be approved by the AECB, and any revisions suggested by N.B. Power must also be approved by that regulatory body. The AECB conducts its own systematic review of the program, and could request modifications at any time.

The PLEMP conducted by BIO is intended to continue for some five years of Lepreau 1 operation, according to our information, at which time it is anticipated that the entire program will be reviewed. It has been suggested to us that it might become more focused at that time, to concentrate upon features identified as a result of the earlier work. However, to our knowledge there is no commitment to extending the program at this time.

The tritium-in-air program conducted by the provincial and federal health departments is reviewed informally, and on a more formal basis it must be justified annually as a part of normal departmental program reviews. There is no rigorous review procedure in place at this time.

In all cases (N.B. Power, BIO, and H&WC/NBH) reports are exchanged as they are published, and in this way each program is subjected to review by the others, again informally.