



Point Lepreau Refurbishment Review

Dr. Robin Jeffrey

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Point Lepreau Refurbishment Review

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The Honourable Bruce Fitch
Minister of Energy
520 King Street
Fredericton, New Brunswick
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Dear Minister:

In accordance with the terms of reference set out in December 2003, I am pleased to present to you the report on the Point Lepreau Refurbishment Review.

I would like to express appreciation to the participants who contributed to the review and to acknowledge the valuable assistance by officials from New Brunswick Power.

Finally, I wish to thank the staff from the Ministry of Energy for the very great assistance provided.

Respectfully submitted,



Dr. Robin Jeffrey, FREng

POINT LEPREAU REFURBISHMENT REVIEW

The purpose of the review

In 2002, the New Brunswick Board of Commissioners of Public Utilities (PUB) considered the proposal from New Brunswick Power (NB Power) that the Point Lepreau Nuclear Generating Station should be refurbished at an estimated cost of around \$1.14 billion to cover all the project, financing and replacement electricity charges. Refurbished in this way, Point Lepreau would then be capable of continuing to supply around 30% of the province's electricity needs for the next 25 years but without refurbishment, the station would only remain operational till around 2010 when it would have to be shut down permanently.

The PUB hearing process was detailed and thorough. In addition to questioning the NB Power witnesses to clarify their submissions, the Commissioners heard evidence from a wide range of interveners. Finally, at the end of this process, the decision of the PUB was that there was no economic case for the proposed refurbishment as filed but noted that there could be non-economic issues outside the scope of the PUB remit that only government could evaluate. Here is what the PUB concluded:

The Board is an economic regulator and has conducted its review from that perspective. In the absence of a clear mandate, it is the opinion of the Board that any assessments, other than economic, must be conducted by government. The Board, in assessing the evidence, has applied the standard of public interest.

The Board, as a result of its review of the evidence in relation to the capacity factor and the cost of capital, finds that there is no significant economic advantage to the proposed refurbishment project. In addition, the Board considers that there are other significant aspects of the refurbishment option for which the economic impact is uncertain. These aspects create additional economic risk which leads the Board to conclude that the refurbishment of Point Lepreau, as outlined in the evidence, is not in the public interest. The Board, therefore, will recommend to the Board of Directors of NB Power that it not proceed with the refurbishment of Point Lepreau.

Since the PUB decision, work has continued on the project but limited to the activities necessary to keeping open the option of completing refurbishment by 2009 compared with a date of 2007 at the time of the PUB hearings. In addition, over the past two years, a number of factors have emerged that now need to be considered in deciding whether or not Point Lepreau should be refurbished including:

- ◆ The most recent forecast of the electricity needs of the province shows the demand continuing to grow and that were Point Lepreau to be permanently closed then alternative arrangements would be needed to provide the shortfall.
- ◆ Although the projects are significantly different, concern has been expressed on the potential implications of the recent adverse experience in Ontario where restarting Pickering Unit 4 had a cost over-run from \$450 million to \$1.25 billion and a schedule slip of more than two years.
- ◆ Finally, whether or not to refurbish impacts on the generation mix within the province and whatever decision is taken needs to be based on minimizing the cost and risk to the taxpayers and the ratepayers.

To assist in deciding whether or not to refurbish Point Lepreau, the Provincial Government commissioned this review.

How the review process was conducted

All documents considered to be relevant were reviewed including:

- ◆ The PUB filings and decision.
- ◆ The NB Power board papers and minutes.
- ◆ The plant condition assessment report commissioned by NB Power to determine the scope of the project.
- ◆ The various Atomic Energy Canada Limited (AECL) contracts, agreements and related documents.
- ◆ The minutes of the NB Power refurbishment advisory committee.
- ◆ Various NB Power project reports and other documents.
- ◆ Responses by NB Power and others to specific queries raised through the review process.

A “top to basement” walk down was made of the Point Lepreau plant supplemented by presentations from site management on a wide variety of topics. A comprehensive series of meetings was held with NB Power officials to collect data and to clarify issues. In addition, meetings were held with the following:

- ◆ The independent members of the NB Power board.

- ◆ The chairman and other members of the PUB.
- ◆ Selected PUB interveners.
- ◆ The Canadian Nuclear Safety Commission (CNSC).
- ◆ The union representing the staff of NB Power Nuclear, the IBEW.
- ◆ Legal counsel experienced in contract law.
- ◆ Senior officials of Ontario Power Generation (OPG) who had been involved in the Pickering restart project.
- ◆ The federally owned engineering contractor AECL, who is the original designer of Point Lepreau and the proposed contractor for the refurbishment project.

Throughout the review, valuable assistance was forthcoming from the staff of NB Power and the Department of Energy.

Findings from the review

Terminology; in what follows, there will be discussion of the “refurbishment contract” and the “retubing contract”; for both of these, it is intended that AECL will be the contractor. The first of these contracts covers work outside the reactor and the second, work internal to the reactor. The total scope of the work to be done in refurbishing Point Lepreau is these two contracts plus NB Power’s own effort including the work to be done by its own project team and related station activities. This total scope is referred to as the “refurbishment project” or more simply, “the project.”

1. Point Lepreau refurbishment and Pickering restart sound similar but are really quite different

A meeting was facilitated between some of the key OPG officials responsible for the Pickering restart project and their counterparts at NB Power. This produced an open and frank exchange about the differences in approach and content of the two projects. There was also a separate, in-depth presentation by AECL officials who had been deeply involved in both the Pickering and Point Lepreau projects.

All of the participants in the above were strongly of the view that the Point Lepreau project was much less complex than the Pickering restart. In part this is because Point Lepreau is a more modern plant with a simpler design; for example, there are only four heat transfer pumps at Point Lepreau compared with 16 at Pickering. As a

consequence of this and the different approach to ongoing investment, there is a substantially smaller scope of work at Point Lepreau with only 32 design changes being required compared with 810 at Pickering.

Also, at Point Lepreau, a full environmental impact assessment was completed as part of the process of finalizing the project scope and it is intended all the engineering and procurement activities will be done well in advance of the plant being shut down rather than being carried out in parallel with construction work. Some \$40 million has already been spent on the early work including a detailed condition assessment evaluation, feasibility work on retubing and other activities to define the project content.

At Point Lepreau, a risk mitigation strategy has been implemented based on firm contract prices, selection of an experienced general contractor, an integrated project schedule and a detailed project implementation plan. In addition, the fuel will be removed from the core prior to any work being done on the reactor, a major simplification.

The review concluded the following:

- a) Compared with Pickering, the Point Lepreau project has a much smaller extent of work and the project start-up activities have been organised on good project management principles.
- b) The approach of using a single general contractor to be responsible for all engineering, scheduling, procurement and site construction supervision should avoid many of the problems that plagued Pickering.
- c) A thorough process has been used to determine the scope of the Point Lepreau project.
- d) There are sound arrangements to review project risk on a regular basis and also a good progress reporting process.
- e) CNSC has been kept fully apprised of the project strategy and content and all regulatory matters are being progressed to plan and in good time.
- f) The NB Power board has been kept properly advised on the key issues.
- g) On the basis of the above, there are sound reasons to believe that the Point Lepreau refurbishment project can be done without the massive over-runs experienced at Pickering.

2. There are pros and cons to the AECL contracts

Point Lepreau consists of a single reactor. On account of its relatively small size, NB Power has a limited design/safety/engineering in-house capability. Accordingly, NB Power's strategy for the refurbishment project and for the subsequent overlife operation was to enter into a partnering type of arrangement with AECL in order to secure their worldwide knowledge of CANDU technology and their project management expertise not just for the duration of the project but for an extended period thereafter.

The intent is to have four contracts with AECL; the refurbishment contract, the retubing contract, the plant performance contract and the CANDU operations support services (COSS) contract.

The retubing contract covers the replacement of all the reactor calandria tubes, all the pressure tubes and an "at-risk" length of all the feeder supply pipes; this is the first time such an operation has been done on a reactor that has been in service. However, AECL is the design authority for these components and so is uniquely qualified to carry out all the safety and engineering activities required. AECL has also been responsible for installing these components as part of the construction of new reactors. Regarding reactors that have been in service, AECL has managed the replacement of total sets of pressure tubes and has had experience of replacing a small number of calandria tubes and feeder pipes.

Deciding on the contractor for the refurbishment contract is not so clear-cut. AECL has been outstandingly successful in being the lead contractor on new build overseas. However in recent years, AECL has done no significant "general contractor" work on Canadian CANDU plants.

The present estimated value of the refurbishment and retubing contracts is \$554 million of which some \$37 million is work completed on determining project scope, \$479 million is covered by a firm price and \$38 million relates to identified work still to be priced. A high percentage of these amounts relate to AECL own costs; these were negotiated and not subject to competition. The review was concerned that NB Power's perceived "need" for AECL created a negotiation approach less determined than would be usual between a purchaser and a potential contractor.

The contracts are on a "firm price" basis rather than a "fixed price", the difference being that the former is subject to escalation through agreed price indices. The effect of this is that NB Power takes the risk that, over the period of the contracts, inflation will increase more than is currently assumed.

These retubing and refurbishment contracts were negotiated in a non-competitive environment. Legal counsel advised that the values of the commercial penalties (e.g. liquidated damages) that can be applied in the event of poor performance by AECL are low; in counsel's opinion, *liquidated damages caps in construction projects are*

commonly set at 25% to 50% of the contract price or designed to remove the profit component plus some percentage of overheads (i.e. so that the contractor is out of pocket).

In the contracts negotiated with AECL, the values of the liquidated damages are only \$5 million for the refurbishment contract and \$10 for the retubing contract whereas the yardstick of 25%-50% would result in a range of \$35 million-\$70 million on the refurbishment contract and double those amounts on the retubing contract.

Similarly, the schedule delay penalties are limited to \$250,000 per day for the retubing contract and are capped at the level of the liquidated damage sums (i.e. \$10 million maximum) corresponding to only 40 days. However, over a 40-day period NB Power will incur interest charges and replacement energy costs amounting to some \$30 million.

Clearly there is a serious imbalance between the risks NB Power is exposed to and the penalties of the AECL contracts.

The plant performance contract is an arrangement, over the planned extended plant life period of 25 years, whereby NB Power will pay AECL a bonus when the plant performs above an available capacity of 80% (i.e. lower than has been achieved historically) and conversely AECL will make penalty payments below this figure. (Note; the 80% figure is for the first 15 years only; thereafter it reduces to 75% for penalty payments).

Given the plant has achieved a capacity factor of 83% for the past 20 years and the massive investment being proposed to improve the plant, it is inappropriate that bonus payments to AECL should begin at a capacity factor of 80% particularly as NB Power considers the economic case for the refurbishment investment should be based on a 25-year future performance level of 89%.

All three of the above contracts are signed and prior to signature, all the appropriate NB Power Board and Lieutenant Governor in Council approvals were received. Advice from legal counsel has indicated that these contracts should be capable of being terminated without financial penalty.

The fourth contract, COSS, is presently only an outline covered by a memorandum of understanding. This proposes that NB Power will transfer to AECL certain business activities along with the NB Power staff who currently carry out this work.

The review concluded the following:

- a) The selection of AECL as the retubing contractor is appropriate.

- b) The logic of having a single general contractor on both the retubing and refurbishment contracts is compelling and the selection of AECL in this role is endorsed.
- c) The commercial terms for these two contracts are too biased in favour of AECL with the contract pricing having been set by negotiation and not by competition.
- d) The terms of the plant performance contract are also too biased in favour of AECL.
- e) The business case for the proposed COSS contract seems ill thought out.
- f) The contracts provide that, under defined circumstances, the government can terminate all three contracts without penalty.

Recommendation 1:

The basis of the AECL retubing and refurbishment contracts should be renegotiated in respect of pricing and commercial terms.

Recommendation 2:

These contracts should be put onto a 'fixed price' basis so that AECL takes the escalation risk.

Recommendation 3:

Either the terms of the AECL plant performance contract should be revised so that there is an equitable proportioning of risk and reward or the contract should be terminated.

Recommendation 4:

The negotiations on the CANDU operational support services contract should be terminated.

3. How realistic is the estimate of the final cost?

NB Power provided the following information on their current cost estimate:

Table 1: NB Power estimate of refurbishment project cost as at Jan.10, 2004

| Item | \$m |
|--|------------|
| Item1. Costs expended on determining the scope of the project | 37 |
| Item 2. AECL contracts | |
| • Retube contract; firm price | 338 |
| • Refurbishment contract; firm price | 141 |
| • Refurbishment contract; non-firm price | 38 |
| Item 3. NB Power project team and station costs | 77 |
| Item 4. Generation revenue during commissioning | (6) |
| Item 5. Contingency | 36 |
| Item 6. Estimated escalation on items 1 - 5 above | 101 |
| Item 7. Interest during construction | 173 |
| Total | 935 |
| <u>Notes:</u> Total costs expended to March 31, 2004 includes Item 1 plus elements of Items 2, 3, 6 and 7 for a total of \$70 million. Numbers in brackets are a credit to the project. In its filing to the PUB, NB Power used a figure of \$845 million for the value of the project compared with the \$935 million above. The increase of \$90 million is mainly due to increases in items 6 and 7 caused by the decision to delay the project by two years plus the decision to increase the scope of the retubing contract. | |

The review concluded the following:

- a) Items 1 and 2; as discussed in earlier sections of the report.
- b) Item 3; NB Power will have to be disciplined regarding its own in-house project costs, as this will be even more prone to scope creep.

- c) Item 5; Within the AECL contracts (Table 1, Item 2), there is a substantial contingency that is quite separate from the project contingency (Item 5). Provided NB Power exercises effective project management control and come down hard on the tendency of nuclear projects to exhibit “scope creep”, the combined level of AECL and NB Power contingency is appropriate for Item 2 activities but is considered inadequate overall, see below.
- d) Item 6; escalation is calculated using appropriate indices.
- e) Item 7, “interest during construction (IDC)” is outside project control. Issues influencing this will be bank rate and the capital structure of NB Power post-restructuring.

The above addresses the “refurbishment project” cost. However, when analysing the project economics, NB Power also includes the estimated cost of providing the replacement electricity during the 18-month period when Point Lepreau will be shut down for refurbishment. In calculating this it is assumed that there will be a surplus of NB Power generation capacity available (coal, orimulsion or oil) with the cost of replacement generation being based on using the differential between orimulsion and nuclear fuel cycle costs.

In its evidence to the PUB, NB Power estimated the cost of replacement power to be \$300 million at 2006/7 price levels.

The “all-up” cost of the project is therefore the sum of the refurbishment project cost plus the replacement electricity cost. At the time of the PUB hearing, this was therefore:

- ◆ Refurbishment project cost, \$845 million
- ◆ Replacement electricity cost, \$300 million
- ◆ All-up PUB hearing project cost, \$1.14 billion.

Based on the information presented to the review, an amended estimate of cost to completion is set out below:

Table 2: Amended all-up estimate of final cost

| Item | \$m |
|---|----------------------|
| Total from Table 1 above | 935 |
| Item 8. Purchase of electricity equivalent to Point Lepreau’s output during the 18-months when the plant is shut down for refurbishment during 2008/9 | 280 |
| Item 9. Avoidable cost items and capital work to be done, post refurbishment, that should be brought forward to the refurbishment period | 80 |
| Item 10. Further contingency | 60 |
| Total | \$1.4 billion |
| <p><u>Notes:</u></p> <p>Item 9; NB Power presented details of its projected capital expenditure plan for the next ten years or so. Some of this would be avoided were the decision taken not to proceed with the project and close the plant in 2010. These “avoidable” costs should properly be included in the all-up cost estimate. Other items, such as the proposal to replace the plant process computers in 2012, could with advantage be brought forward and done during the refurbishment period since this eliminates the need for a further extended outage at some later date.</p> <p>Item 10; An additional contingency provision is considered necessary.</p> | |

Regarding the above, the review concluded the following:

- a) The Point Lepreau refurbishment project is complex and will require tough, experienced and committed project management to achieve a successful outcome.
- b) With this qualification, the revised cost and schedule estimates for the Point Lepreau refurbishment project are considered to be realistic.

- c) However, as the PUB noted, there are several low risk, high cost items that, were they to arise, could result in massive extra costs; for example, steam generator replacement or a major turbine rebuild. The decision that these were low risk was taken on the basis of a thorough, professional evaluation (the condition assessment study). Nonetheless, “low risk” is not “zero probability”.

Recommendation 5:

The recently appointed NB Power chief executive should review the project management arrangements and ensure that; a) within the NB Power team, there are the necessary skills, experience and leadership, and b) that the interface with AECL provides the framework for a successful project.

Recommendation 6:

NB Power should develop arrangements for purchasing replacement power aimed at reducing cost and risk.

Recommendation 7:

Rather than delay significant capital work till after the refurbishment outage, this should be done as part of the project.

4. Project economics alone cannot drive the decision

For purposes of the Review, NB Power ran a revised version of the business model based on the new company organisation that will come into effect following restructuring using a discount rate of 10.2% and a capacity factor of 80%. The results from this are set out below:

Table 3: Business modelling results expressed as net present value of the time-based expenditures (November, 2004 money values)

| | |
|---|--|
| Point Lepreau refurbishment versus a new gas-fired plant. | Point Lepreau has an economic advantage of \$118m (6%) over gas. |
| <p>Adjustments 1</p> <p>A. Remove benefit of selling 35MW outside the province. B. Reduce by 50% the allowance for extra O&M costs. C. Remove benefit of CO₂ credits. D. Increase the capacity factor from 80% to 85%.</p> | <p>On the basis of the sum of items A - D, Point Lepreau has an economic advantage of \$20m (1%) over gas.</p> |
| <p>Adjustments 2</p> <p>E. Assume a 50% cost over-run on the refurbishment contract. F. Assume a 6-month overrun on the refurbishment schedule.</p> | <p>On the basis of the sum of items A - F, gas has an economic advantage of \$150m (8%) over Point Lepreau.</p> |
| <p>Adjustment 3</p> <p>G. Assume gas price rises by 20%. H. Assume CO₂ credits.</p> | <p>On the basis of the sum of items A - H, PL has an economic advantage of \$32m (2%) over gas.</p> |
| <p><u>Notes:</u></p> <p>In the above, the gas plant option includes a sum of \$85 million to make good the underfunding of the Point Lepreau decommissioning provision should the plant close at 2010. Without this penalty, the fossil case would have an improved economic advantage.</p> <p>It is also assumed that orimulsion will be available to provide the replacement electricity for refurbishment. Were oil to be burnt instead, this would penalise refurbishment by some \$83 million.</p> | |

The review concluded the following;

- a) Economic modelling of the refurbishment project compared with the construction of a new fossil plant shows a wide range of outcomes depending on the assumptions.
- b) Refurbishment has no clear economic advantage over the construction of a new fossil plant of equivalent capacity.
- c) The rationale for the PUB decision in 2002 is as relevant today as it was then.

5. Does the operation performance of Point Lepreau justify this level of expenditure?

Nuclear plants are expensive to build and to refurbish. However, nuclear fuel is cheap and so investment in a nuclear plant can be economically competitive provided the plant operates reliably. One of the measures to judge the latter is termed the 'capacity factor'; that is the electricity actually produced expressed as a percentage of what would have been produced had the plant operated continuously at full output.

To illustrate this, the table below shows the capacity factor from the 100-plus commercial reactors in the USA:

Table 4: USA capacity factors (CF)

| Year | CF,% | Year | CF,% |
|------|------|------|------|
| 1991 | 71 | 1997 | 74 |
| 1992 | 71 | 1998 | 78 |
| 1993 | 73 | 1999 | 86 |
| 1994 | 75 | 2000 | 88 |
| 1995 | 79 | 2001 | 90 |
| 1996 | 77 | 2002 | 91 |

This demonstrates the steady improvement in performance that has been achieved as a consequence of a determined effort by USA utilities focussed on the methodology of the Institute of Nuclear Power Operations, INPO (which in a Canadian context is the related organisation, the World Association of Nuclear Operators, WANO). As a consequence, in the USA, it is highly likely that the majority of utilities will decide to apply for license extension from the present 40 years by a further 20 years on the basis that the investment of funds to do this will benefit shareholders. Well run USA nuclear utilities have a track record of excellence in nuclear performance and this spins off into a high capacity factor and a low unit generation cost.

The equivalent Point Lepreau capacity factor data are:

Table 5: Point Lepreau capacity factors (CF)

| Years | CF,% | Years | CF,% |
|---------------|------|---------------|------|
| 1983/4 - 84/5 | 92 | 1995/6 - 96/7 | 46 |
| 1985/6 - 86/7 | 96 | 1997/8 - 98/9 | 75 |
| 1987/8 - 88/9 | 94 | 1999/00-00/1 | 64 |
| 1989/90-90/1 | 96 | 2001/2 - 02/3 | 77 |
| 1991/2 - 92/3 | 94 | 2003/4 | 86 |
| 1993/4 - 94/5 | 95 | | |

The Point Lepreau performance divides into three time periods:

- ◆ The first ten years when Point Lepreau was a world leader with capacity factors consistently above 90%.
- ◆ The mid-to-late 90s with poor performance attributable to poor maintenance and low investment.
- ◆ The last three years when performance has improved but is still significantly below the USA average.

Point Lepreau management is confident that with refurbishment, capacity factors of 89% can be achieved consistently in the future.

The review concluded the following:

- a) In the USA, there has been a steady improvement in performance as a consequence of a determined effort by USA utilities focussed on the methodology of the Institute of Nuclear Power Operations, INPO (which in a Canadian context is the related organisation, the World Association of Nuclear Operators, WANO).
- b) NB Power needs to continue a dedicated focus on nuclear and operational performance.
- c) There is a lack of nuclear experience at NB Power board level.

- d) The experience of the USA goes much wider than the discussion on nuclear performance outlined above. Since 1998, there has been a pattern of consolidation within the nuclear industry. Owners of single nuclear plants have concluded that they should either shut down their plant or sell out to multi-plant owners with the resource and the economies of scale necessary to implement the program of excellence required to achieve world class operational performance.

Recommendation 8:

NB Power needs to reinforce its focus on achieving the INPO/WANO objectives.

Recommendation 9:

An NB Power board nuclear committee should be created. The chairman of this committee should be a board member and have independent, nuclear plant expertise.

Recommendation 10:

The provincial government should review what options for alternative ownership structures of Point Lepreau may be possible including lease or partnership.

6. What non-financial considerations might be relevant to the decision?

NB Power provided the following information:

- a) Point Lepreau delivers 635 MW of electricity into the New Brunswick system. Were the plant not to be refurbished, the replacement of nuclear by fossil based generation would have a significant adverse impact on New Brunswick's effort to meet its commitments to greenhouse gas reduction; i.e. replacement by coal would contribute around 4 million tonnes of CO₂ and similarly replacement by natural gas would add 2 million tonnes of CO₂.
- b) The station employs 600-700 highly skilled employees. Point Lepreau contributes some \$70 million annually into the local economy. The present value of this sum over the 25 years of the proposed extended operation is estimated at \$1 billion.
- c) AECL estimate that up to \$50 million could be expended in New Brunswick as a result of the refurbishment work. In support of this initiative, Business New Brunswick has been involved in the promotion and identification of qualified New Brunswick companies.

- d) In the execution of the refurbishment and retube work, it is estimated that 450 person-years of labour will be required. The vast majority of trade labour will be supplied from New Brunswick residents.
- e) Point Lepreau is the centre of a high technology industry and this has a favourable impact on local schools, universities and community colleges.
- f) Uranium fuel is sourced from Canada. It is plentiful and provides a diverse and secure fuel source. Market price fluctuations have little effect on nuclear plant economics unlike fossil fuel prices that have a major impact on fossil generation costs.
- g) The table below shows the installed capacity of NB Power plant and also the quantity of electricity produced:

Table 6: Fuel sourcing (data from NB Power annual report 2002-3)

| Fuel type | Installed capacity, MW | Installed capacity, % | Energy produced, TWh | Energy produced, % |
|--|------------------------|-----------------------|----------------------|--------------------|
| Nuclear | 635 | 17 | 4.6 | 25 |
| Hydro | 884 | 23 | 5.1 | 27 |
| Thermal | 1923 | 51 | 8.7 | 47 |
| Combustion turbine | 327 | 9 | negligible | negligible |
| Total | 3769 | 100 | 18.5 | 100 |
| <u>Note:</u> Were nuclear to be replaced by fossil, there would be a significant reduction in fuel diversity within the province. | | | | |

- h) Regarding the gas alternative, since the time of the PUB hearings, gas has increased in price, in price volatility and there are now increasing concerns on the lack of supply. The Sable Island gas volumes have depleted rapidly, new offshore supply is uncertain and liquefied natural gas, which could fill the supply void, is still subject to supply risk due to siting, shipping and storage concerns.

The review concluded the following:

- a) Security and diversity need a high weighting when considering the decision on whether to refurbish or to build a new fossil plant.
- b) The positive attributes of the nuclear fuel cycle are also important. However, there are other issues such as the additional costs that might sometime in the future be added to nuclear generation similar to the cost consequences of the events of 9/11. There is also uncertainty in nuclear decommissioning and waste management costs until a site is selected for the final repository.
- c) Issues such as jobs in New Brunswick are important but it would be inappropriate to overemphasise this to the detriment of the ratepayer and the taxpayer.

Recommendation 11:

The New Brunswick government should review the non-economic benefits of the refurbishment project and determine what weighting should be attached to these.

Summary of main conclusions

The following are the main conclusions:

- a) Compared with Pickering, the Point Lepreau project has a much smaller extent of work and the project start-up activities have been organised on good project management principles.
- b) The approach of using a single general contractor to be responsible for all engineering, scheduling, procurement and site construction supervision should avoid many of the problems that plagued Pickering.
- c) AECL, from a technical viewpoint, is the correct choice of contractor.
- d) The commercial terms for these two contracts are too biased in favour of AECL with the contract pricing having been set by negotiation and not by competition.
- e) The terms of the plant performance contract are also too biased in favour of the AECL.

- f) The business case for the proposed COSS contract seems ill thought out.
- g) The contracts provide that, under defined circumstances, the government can terminate all three contracts without penalty.
- h) The Point Lepreau refurbishment project is complex and will require tough, experienced and committed project management to achieve a successful outcome.
- i) With this qualification, the revised cost and schedule estimates for the Point Lepreau refurbishment project are considered to be realistic.
- j) Economic modelling of the refurbishment project compared with the construction of a new fossil plant shows a wide range of outcomes depending on the assumptions.
- k) Refurbishment has no clear economic advantage over the construction of a new fossil plant of equivalent capacity.
- l) The rationale for the PUB decision in 2002 is as relevant today as it was then.
- m) In the USA, there has been a steady improvement in performance as a consequence of a determined effort by USA utilities focussed on the methodology of the Institute of Nuclear Power Operations, INPO (which in a Canadian context is the related organisation, the World Association of Nuclear Operators, WANO).
- n) NB Power needs to continue a dedicated focus on nuclear and operational performance.
- o) There is a lack of nuclear experience at NB Power board level.
- p) Security and diversity need a high weighting when considering the decision on whether to refurbish or to build a new fossil plant.
- q) Issues such as jobs in New Brunswick are important but it would be inappropriate to overemphasise this to the overall detriment of the ratepayer and the taxpayer.

The way forward

There are three factors that make it difficult to arrive at a clear recommendation on the way forward at this time. These are:

- a) First, the uncompetitive nature of the AECL contracts and the concern that they may be overpriced and unduly expose NB Power (and thereby the province) to financial risk.
- b) Secondly, the information on the fossil alternatives are based on business planning information and not on contractually binding, competitive tenders.
- c) Finally, the significance to be attributed to the non-economic issues.

Clearly there is a need for a decision-making process that is open, accurate and auditable. What is proposed is the following:

Recommendation 12:

To facilitate a decision-making process that is open, based on fact and auditable it is proposed that, in parallel:

- a) ***NB Power invites competitive bids for 635 MW of new capacity backed by a long-term fuel supply contract.***
- b) ***NB Power renegotiates the AECL contracts to achieve more competitive prices and commercial terms.***
- c) ***The government solicits expressions of interest by nuclear utilities for their interest, in whole or in part, to lease or partner Point Lepreau either pre or post refurbishment.***
- d) ***There needs to be a clarification on a number of issues including; a review of electricity requirements within the province, the appropriateness of charging the refurbishment project with replacement power costs and the importance to be attributed to the non-economic issues especially those of security and diversity of electricity supply.***

The intent is that all of the above will be completed by the fall of 2004 and so form the basis for a factually based decision on the future structure of electricity generation in the province.

Recommendations

Set out below are the recommendations from the various sections of the review:

1. *The basis of the AECL retubing and refurbishment contracts should be renegotiated in respect of pricing and commercial terms.*
2. *These contracts should be put onto a 'fixed price" basis so that AECL takes the escalation risk.*
3. *Either the terms of the AECL plant performance contract should be revised so that there is an equitable proportioning of risk and reward or the contract should be terminated.*
4. *The negotiations on the CANDU operational support services contract should be terminated.*
5. *The recently appointed NB Power chief executive should review the project management arrangements and ensure that; a) within the NB Power team, there are the necessary skills, experience and leadership, and b) that the interface with AECL provides the framework for a successful project.*
6. *NB Power should develop arrangements for purchasing replacement power aimed at reducing cost and risk.*
7. *Rather than delay significant capital work till after the refurbishment outage, this should be done as part of the project.*
8. *NB Power needs to reinforce its focus on achieving the INPO/WANO objectives.*
9. *An NB Power board nuclear committee should be created. The chairman of this committee should be a board member and have independent, nuclear plant expertise.*
10. *The provincial government should review what options for alternative ownership structures of Point Lepreau may be possible such as sale, lease or partnership.*
11. *The New Brunswick government need to review the non-economic benefits of the refurbishment project and determine what weighting should be attached to these.*

12. *To facilitate a decision-making process that is open, based on fact and auditable it is proposed that, in parallel:*
- a) *NB Power invites competitive bids for 635 MW of new capacity backed by a long-term fuel supply contract.*
 - b) *NB Power renegotiates the AECL contracts to achieve more competitive prices and commercial terms.*
 - c) *The government solicits expressions of interest by nuclear utilities for their interest, in whole or in part, to lease or partner Point Lepreau either pre or post refurbishment.*
 - d) *There needs to be a clarification on a number of issues including; a review of electricity requirements within the province, the appropriateness of charging the refurbishment project with replacement power costs and the importance to be attributed to the non-economic issues especially those of security and diversity of electricity supply.*

The intent is that all of the above will be completed by the fall of 2004 and so form the basis for a factually based decision on the future structure of electricity generation in the province.