

## Regulatory Considerations For Lay-Up of Power Reactors

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### Introduction

The intent of this paper is to discuss, from a regulatory perspective, the acceptability and requirements for the lay up of nuclear power reactors. The focus will be on the Bruce A nuclear generating station as Atomic Energy Control Board (AECB) staff prepare to make a recommendation on the operating licence in the year 2000. This paper does not discuss Bruce A restart issues.

In Canada, nuclear facilities are regulated by the AECB, an agency of the Federal Government. Its mission is to ensure that the use of nuclear energy in Canada does not pose undue risk to health, safety, security and the environment.

In the province of Ontario there are twenty CANDU power reactors owned by the electrical utility, Ontario Power Generation Inc. (formally OntarioHydro). They are located at three different sites: four 900 MWe reactors at Darlington, eight 500 MWe at Pickering and eight 800 MWe at Bruce. At Pickering and Bruce, the units are in two sets of four, designated Pickering A, Pickering B and Bruce A, Bruce B. The reactors range in age from about five years to twenty-five years of service.

Ontario Power Generation has struggled to turn recent poor performance around with a myriad of organizational and program changes. In December of 1996, Ontario Hydro's then Chief Executive Officer, Dr. Allan Kupcis hired Mr. G. Carl Andognini as Executive Vice President and Chief Nuclear Officer. Dr. Kupcis immediately directed Mr. Andognini to conduct the type of "brutally honest" assessment of Ontario Hydro Nuclear conducted by the American nuclear industry. In January, 1997, Mr. Andognini chartered the Nuclear Performance Advisory Group to perform an Independent, Integrated Performance Assessment (IIPA) of Ontario Hydro Nuclear. The IIPA team ranked all of the operating stations as minimally acceptable. This rank was stated to be consistent with the lower ranks that the Institute of Nuclear Power Operators (INPO) would issue and still permit the plants to operate if in the USA. It also was also stated that it indicates that immediate attention is required to improve performance or even maintain current performance.

In response to the IIPA, Ontario Hydro produced the Nuclear Asset Optimization Plan (NAOP). NAOP is a major recovery plan designed to implement the recommendations in the IIPA. It calls for a phased recovery of the performance of Darlington, Pickering B and Bruce B over an initial four year period and Pickering A followed by Bruce A over the subsequent years. The "A" units would be laid up in order to allow release of resources to improve the performance of the newer stations. Restart of the "A" units would be conditional on an approved business case on a unit by

unit basis. Discussions between Ontario Power Generation and AECB staff regarding restarting the first Pickering A unit next year have already begun. Before Bruce A is restarted, it would have to undergo some major rehabilitation which would include new boilers and pressure tubes.

### What is Lay Up?

It is important to understand exactly what is meant by “lay up” because a rigorous definition of the term will help determine its requirements. Lay up is the **time limited shutdown**, and **preservation**, of a nuclear facility in conjunction with the **suspension** of the activities/issues associated with that facility.

In Canada, we have had experience with extended outages (i.e. years) required for the replacement of pressure tubes however there is a fundamental difference between a lay up and an extended maintenance outage. The objective of the lay up is to reduce expenditures and activities in order to reduce or free-up resources. Staff is reduced, as many systems as possible are taken out of service, and costs are minimized. This is in contrast to a maintenance shutdown (or presumably decommissioning) where activity and resource expenditure remains high. Staffing, for example, during a maintenance outage will often increase.

### Other Regulatory Agency Positions on Reactor Lay Up

Some other regulatory agencies were contacted to learn about their experience and position with respect to lay up. Those contacted were: the International Atomic Energy Association (IAEA), the Swedish Nuclear Power Inspectorate (SKI), Britains Nuclear Installations Inspectorate (NII), the Swiss Federal Nuclear Safety Inspectorate (HSK) and the US Nuclear Regulatory Commission (NRC).

None of those contacted had any sort of formal recognition of a state of lay up. States that are recognized are construction, operating and decommissioning.

IAEA Project A.2.05 currently underway on Management of Delayed Nuclear Power Projects is meant for projects delayed during construction however it covers some of the same issue faced for lay up. These include human factors, maintenance requirements, upgrade requirements etc. At the time of writing the project has produced two working documents: one on the preservation and maintenance of site installations, structures and equipment and one on the retention of human resources and preservation of construction data.

NUREG/CR-6451, “A Safety and Regulatory Assessment of Generic BWR and PWR Permanently Shutdown Nuclear Power Plants” provides a rationale for licence exemptions based on the status of the fuel. That is, more exemptions are allowed as the fuel is moved from the reactor, cools in storage on site and finally, is move off site. The approach seems reasonable.

Also available from the US are many guides with respect to the management of shutdowns. NRC Inspection Manual Chapter (IMC) 0350, "Staff Guidelines For Restart Approval" could be very useful for regulatory site inspection staff in assessing licensee readiness to restart.

Finally, the Electric Power Research Institute (EPRI) has published EPRI NP-5106: "Sourcebook for Plant Lay Up and Equipment Preservation".

### Browns Ferry Unit 1

In terms of actual lay-up experience, the best found was Tennessee Valley Authorities' (TVA) Browns Ferry Unit 1 which has been shut down since March, 1985. All three units at Browns Ferry were shut down at that time due to a failure to maintain a documented design basis and to control the plant's configuration in accordance with that basis. Unit 2 returned to service in May 1991 and Unit 3 subsequently resumed operation in early 1996.

TVA continues to preserve the option of restarting Unit 1 and is retaining its operating licence. Time on the licence, however, is running out and with only 14 years left, the economics of restarting the unit without some kind of licence extension are becoming poor. The NRC position is that as long as TVA continues to meet regulatory requirements, the unit can remain licenced as an operating unit. The US Technical Specifications are broad enough to allow suspension of testing etc. while a unit is shut down.

In April, 1998 the Union of Concerned Scientists submitted a petition to the NRC pursuant to 10 CFR 2.206 requesting that the operating licence for Browns Ferry Unit 1 be revoked. The issues raised in the petition bear scrutiny and will perhaps become more compelling for Bruce A as time goes on. The main thrust of their argument is summarized in the following points:

- For Browns Ferry Unit 1, TVA has not addressed any of the approximately 39 bulletins, 141 generic letters and 1,047 information notices issued by the NRC to its licensees during the time Unit 1 has been shut down. TVA's response has been that these will be taken into account prior to returning the unit to service.
- The material condition and configuration management problems can only have gotten worse since the unit was shut down for these very reasons.
- It is unlikely that the plant will be restarted. No US commercial nuclear power plant has ever returned to service after an outage lasting over 12 years.
- Granting the petition would move Browns Ferry Unit 1 out of "administrative hold", a non-defined regulatory state, into a condition governed by applicable regulations [i.e. those for decommissioning].

- If TVA elects to restart the unit, the regulatory process for granting a new licence would be better and safer in this case rather than following the administrative process for restarting a problem plant.

The NRC concluded that “the petition raised novel issues with respect to maintaining an operating license for a facility for which there are no plans for future operation...” and they accepted the petitioner request for a public hearing. The hearing was held on October 26, 1998 at Browns Ferry.

On March 29, 1999 the NRC Director’s Decision concerning the petition was published. It is available at the US Federal Register internet site ([www.nara.gov/fedreg](http://www.nara.gov/fedreg)). The Petitioner’s requests for the NRC to revoke the Browns Ferry Unit 1 operating licence and to require TVA to submit a decommissioning plan or a lay-up plan for Unit 1, and for the NRC to conduct inspections against the decommissioning plan were denied. Part of the reason for the denial, was the demonstrated success of NRC experience using the above mentioned NRC IMC 0350. There was no “demonstrated basis for the assertion that facility restart based upon IMC 0350 is a less reliable process for resolving the safety concerns of a problem plant than the relicensing process”. The decision will now undergo review by the Commission.

#### AECB Staff Position

It is AECB staff position that lay-up of power reactors is acceptable subject to some criteria. Lay up should not be used or cause an unwarranted delay or avoidance of decommissioning. It should not be a form of abandonment. It should not be used to prolong the operational period of a design that would not otherwise meet new requirements. There must be a reasonable probability that the unit will be restarted.

As a minimum, the following should be (and were) provided to the AECB when a decision has been made to lay up one or more reactors:

- a statement of intent to lay up
- the reason for the lay up
- the planned time period for the lay up
- a commitment to continued safety and security

This will allow for an assessment of the reasonableness of the request to determine that it does not fall into one of the negative categories mentioned above.

It is an interesting exercise to review the steps in the initial licensing process to see how far back in the process the facility is placed by lay up. In Canada, the major steps to achieving an operating licence are:



- Letter of Application Sent
- Submission of Final Safety Report
- Submission of Commissioning Programs
- Submission of OP&Ps, Radiation Protection and Emergency Procedures
- Safeguards and Security in place
- Submission of Construction Completion Assurances
- Authorization of Staff
- Approval to Load Heavy Water and Fuel
- Provisional Licence Granted (for start up and post criticality testing)
- Operating Licence Granted

At Bruce A, the reactors have been officially defuelled since October 1, 1998. Second, and perhaps the most important, backwards step on the list is the loss of authorized staff. AECB authorizing of staff lasts "...as long as they are employed as such..." and with time no Bruce A staff will be able to claim that they are continuing the role for which they were authorized. Ontario Hydro can mitigate against many of the other items in the list by doing a good job of maintaining the systems and configuration control. If it chooses not to do this, then one can see that over time we would slide back to the start of the operating licence process. Thus the likelihood that AECB staff would make continued positive recommendations for licence renewal for a laid up station is small. The AECB does not have the equivalent of the NRC IMC 0350 so redoing the process for obtaining the original operating licence may be most appropriate. Whatever process is used, the public will be given the opportunity to express their views and/or appear before the Board.

#### Current Status of the Licence

In Canada, the operating licences for power reactors are renewed on a periodic basis, typically every two years. The operating licence for Bruce A expired on August 31, 1998. Ontario Hydro applied for a two year renewal.

As part of the licence renewal process, interested groups or members of the public can make submissions expressing their views to the Atomic Energy Control Board. Some questioned whether an operating licence would be appropriate for a station that would not be operated at power during the licence period. AECB staff considered this also. In making the recommendation to the Board that an operating licence was appropriate the Board staff considered the following:

- There would still be fuel left in one or two of the reactors at the time the licence expired. Therefore they would still have to be operated and maintained to control reactivity and provide cooling, i.e. the fundamental safety objectives of operation would still be present.
- If the units are to be restarted in future, they will have to be maintained in the interim. Such maintenance can be viewed as a mode of operation of the facility.

- Ontario Hydro stated that a decision to restart Bruce A units is scheduled to be made prior to the end of 1999. A licence period to the end of August 2000 will allow time for the AECB to consider the results of this decision, whichever direction it takes.

Another point that was expressed in submissions to the Board was that Ontario Hydro be required to establish a fund for the decommissioning of Bruce A reactors. The Nuclear Safety and Control Act, which is scheduled to come into effect in the summer of 1999, will allow financial guarantees to be one of the conditions of the licence and this may well be pursued.

At the August 13, 1998 Board meeting, the Board renewed the Bruce A operating licence for a period of two years. A new condition of the operating licence states that all the units will remain in an approved shutdown state. Note also that not all of the justification presented above for a renewed operating licence would apply to a further renewal.

#### Licence Exemptions

The shutdown and defuelling of the reactors allowed for exemptions to the licence. The most common of these was a series of revisions to the Station Policy on required staff complement. Approval at AECB Director level was necessary for each revision. The new (current) licence incorporates requirements for staffing up to and including the completely defuelled state. The key points from Section A.A.3 iii) of the current licence are:

when any reactor unit contains fuel:

- there shall be in the nuclear facility at all times at least one Authorized Nuclear Operator for each reactor unit containing fuel, one Unit 0 Supervising Nuclear Operator and two Shift Supervisors, one of whom may be a Shift Operating Supervisor
- there shall be in the station main control room at all times a minimum of one Major Panel Operator qualified to operate the Unit 0 control room panels, and either two Authorized Nuclear Operators when three or four reactor units contain fuel, or one Authorized Nuclear Operator when only one or two reactor units contain fuel.

When all reactor units are in a guaranteed defuelled state:

- there shall be in the nuclear facility at all times, at least one Authorized Nuclear Operator, one Supervising Nuclear Operator and one Shift Supervisor
- there shall be in the station main control room at all times a minimum of one Operator qualified to operate the reactor panels and the Unit 0 control room panels.

After all the units were defuelled, Ontario Hydro requested approval to allow a Shift Operation Supervisor to act in the place of the Shift Supervisor. We agreed to this request with constraints that requirements of the OP&Ps still be met, e.g. that jumpers receive Shift Supervisor approval. Thus far, Ontario Hydro has retained Shift Supervisors on shift but that may change soon.

Also as the units were shut down and defuelled, testing and maintenance requirements changed. Many tests no longer made any sense on a defuelled reactor. This was dealt with by a new revision to the Operating Policies and Principles (OP&Ps) (Revision 13) which formally recognize the Defuelled Guaranteed Shutdown State (DGSS.). Several sections in Revision 13 of the Bruce A OP&Ps end with a statement that "these policies do not apply to reactor units in the defuelled guaranteed shutdown state". Example sections include those on:

- the control of core reactivity
- moderator level and purification requirements
- alternate heat sinks requirements and heat transport inventory monitoring
- special safety system and reactor regulating system maintenance requirements
- boiler safety valve capacity and testing requirements
- trip set points
- absorber operation

Ontario Hydro was also granted relief on requirements of the Periodic Inspection Program and leakage testing of the negative pressure containment system.

The Operating Licence also makes requirements for reporting in accordance with Regulatory Document R-99, "Reporting Requirements for Operating Nuclear Power Facilities". Ontario Power Generation may seek exemptions from parts of this, for example, the requirements to produce an annual Reliability Report and Quarterly Technical Reports.

#### Outstanding Commitments to the AECB

After the decision was made to lay up Bruce A, Ontario Hydro conducted a review of outstanding commitments made to the AECB. A total of 278 commitments were divided into three categories: those which could be closed, those which would be continued and those which would be suspended. The rationale for placing a commitment in a particular category was provided by Ontario Hydro. AECB staff then reviewed the resulting data base and was in agreement with all but a few of the categorizations.

Commitments which could be closed had all actions complete and required nothing more than an agreement to close. Continued items are typically those which were far along the path to resolution or were ongoing commitments to follow certain procedures still necessary at the time of the review. Suspended commitments were those for which all work was stopped.

The careful recording and storing of suspended commitments is an important process for a licensee that wants to restart reactors in future. Such commitments will have to be revived and, in fact, resolution of some will be a prerequisite to restart. Thus it is important to document not just a description and current status of the commitment, but also the anticipated effort required to complete and the appropriate trigger for its reactivation. The suspended Bruce A Risk Assessment, for example, is an important commitment which will require a lot of lead time and should be revived immediately after a decision to refurbish and restart the units.

The fields in Ontario Hydro's regulatory commitment database include:

- Reference Number
- Title
- Description of Issue
- Current Commitment/Deliverable
- Recommendation [to continue, close or suspend]
- Basis for Recommendation

and in the case of suspended items, there are the additional fields:

- Re-start Milestone
- Lead Time for Completion

#### Ongoing Requirements

There are ongoing radiation protection requirements. A major decontamination program is not required but we would expect that the number of rubber areas would be diminished. Fixed area monitors need to remain in service and routine surveys completed. While containment may not be necessary, it is probably prudent to maintain airlocks so that "containment" is at least "confinement".

The licensee must also be diligent about configuration management. The lay up process would likely involve the physical removal and storage of equipment. Licensees such as Ontario Hydro with more than one station may be tempted to use this equipment at other locations. AECB staff accept that this can be managed with an established temporary change control process but it must not be allowed to degrade.

To their credit, Ontario Hydro is being strict on the use of parts from Bruce A. To do so requires the approval of the Site Vice President and to date, only two items of USI equipment have been taken to Bruce B: Unit 3 pressurizer heater 6 and emergency core injection heat exchanger plates. Also, there is a policy of ordering replacements for any parts taken.

Emergency plans must remain in effect to address the limited number of still credible emergencies at the station. The most important of these are fires and tritiated water spills. Degassing of the generators should be a high priority to remove one of the larger fire hazard.

Compliance with the Physical Security Regulations and fulfilling obligations to the International Atomic Energy Agency with respect to safeguards remain a requirement.

### AECEB Monitoring

AECEB staff will continue to monitor Bruce A as part of its compliance verification function. For the 1999 fiscal year, there have been 69 Project Officer days scheduled for Bruce A compliance verification (about half of that scheduled for Bruce B). This information will be an input to the recommendation on Bruce A licence renewal the following summer.

There are five types of compliance activities comprising the verification program:

- 1) Field Inspections: inspections of selected **areas** within the station. Over the course of the year, most areas will have been inspected
- 2) Operating Practice Evaluations: evaluations of specific activities such as a start-up. None of these have been scheduled for Bruce A.
- 3) System Inspections: inspections of specific systems. Six systems are scheduled:
  - Liquid Effluent Monitors
  - Fixed Gaseous effluent Monitors
  - Primary Spent Fuel Bay
  - Freezing Protection System
  - Humidity Control
  - Low Pressure Service Water
- 4) Observations: Observations of emergency drills: Will be done ad-hoc as they occur.
- 5) Audits: Two planned, one on Security and one on Operating Experience.

During our field inspections, we expect to find that housekeeping will be maintained to minimize the possibility of contamination spread and fire hazards. We expect leaks to be fixed. We expect radiation hazard signs to be filled in and up to date.

The systems chosen for inspection are those that are still required to operate during the lay-up. Later, the emphasis will switch to system condition with respect to the impact of being laid up. Signs of equipment degradation will be recorded as possible impediments to restart.

### Summary

Lay up has been defined as the time limited shutdown and preservation of a facility in conjunction

with the suspension of activity associated with that facility. It is an approach being used by Ontario Hydro to free resources which can then be applied to improve performance at other locations. The lay up state has not been formally recognized in the world community. It is our view that lay up is acceptable from a regulatory perspective if the time period is defined and reasonable, there is a commitment to continued safety and security, and it is apparent that the restart of the reactors remains viable.

In August of 1998, the AECB accepted that an operating licence was appropriate for the following two years of Bruce A operation. AECB staff will consider the issues discussed in this paper in making a recommendation one way or the other for licence renewal in the summer of 2000.