Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

CNSC Staff

Annual Report for 2002 on the Canadian Nuclear Power Industry

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CNSC STAFF
ANNUAL REPORT FOR 2002 ON THE CANADIAN NUCLEAR POWER INDUSTRY

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SUMMARY

This report reflects the Canadian Nuclear Safety Commission (CNSC) staff's assessment of the Canadian nuclear power industry's safety performance in 2002.

CNSC staff assesses the programs and performance of each licensee in nine safety areas using five categories – "Exceeds requirements", "Meets requirements", "Below requirements", "Significantly below requirements" or "Unacceptable" (results for 2002 are shown in Figure 1).

In 2002, there were no *serious process failures* at any plant, no worker or member of the public received a radiation dose in excess of the regulatory limits and emissions from all plants were below regulatory limits.

Industry performed strongly in the safety areas of:

- Operating Performance;
- Design Adequacy;
- Equipment Fitness for Service;
- Emergency Preparedness;
- Environmental Performance;
- Radiation Protection;
- Nuclear Security; and
- Safeguards.

However, CNSC staff reviews found limited improvement in the safety area of:

- Performance Assurance.

In particular, industry is being directed by the CNSC to address the slow rate of progress in improving the Quality Assurance, Human Factors or Training aspects of the Performance Assurance program.

Figure 1: CNSC Staff Annual Report Card of Nuclear Power Plant Performance in 2002

	Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
	Program	Implementation	Program	Implementation	Program	Implementation	Program	Implementation	Program	Implementation	Program	Implementation	Program	Implementation
Operating Performance	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Performance Assurance	**B**	**C**	**B**	**C**	**B**	**C**	**B**	**B**	**B**	**C**	**C**	**C**	**C**	**C**
Design Adequacy	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Equipment Fitness for Service	**B**	**C**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Emergency Preparedness	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**C**
Environmental Performance	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Radiation Protection	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**C**	**A**	**B**
Nuclear Security	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
Safeguards	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Legend:

A	**= Exceeds requirements**	**B**	**= Meets requirements**	**C**	**= Below requirements**	**D**	**= Significantly below requirements**	**E**	**= Unacceptable**

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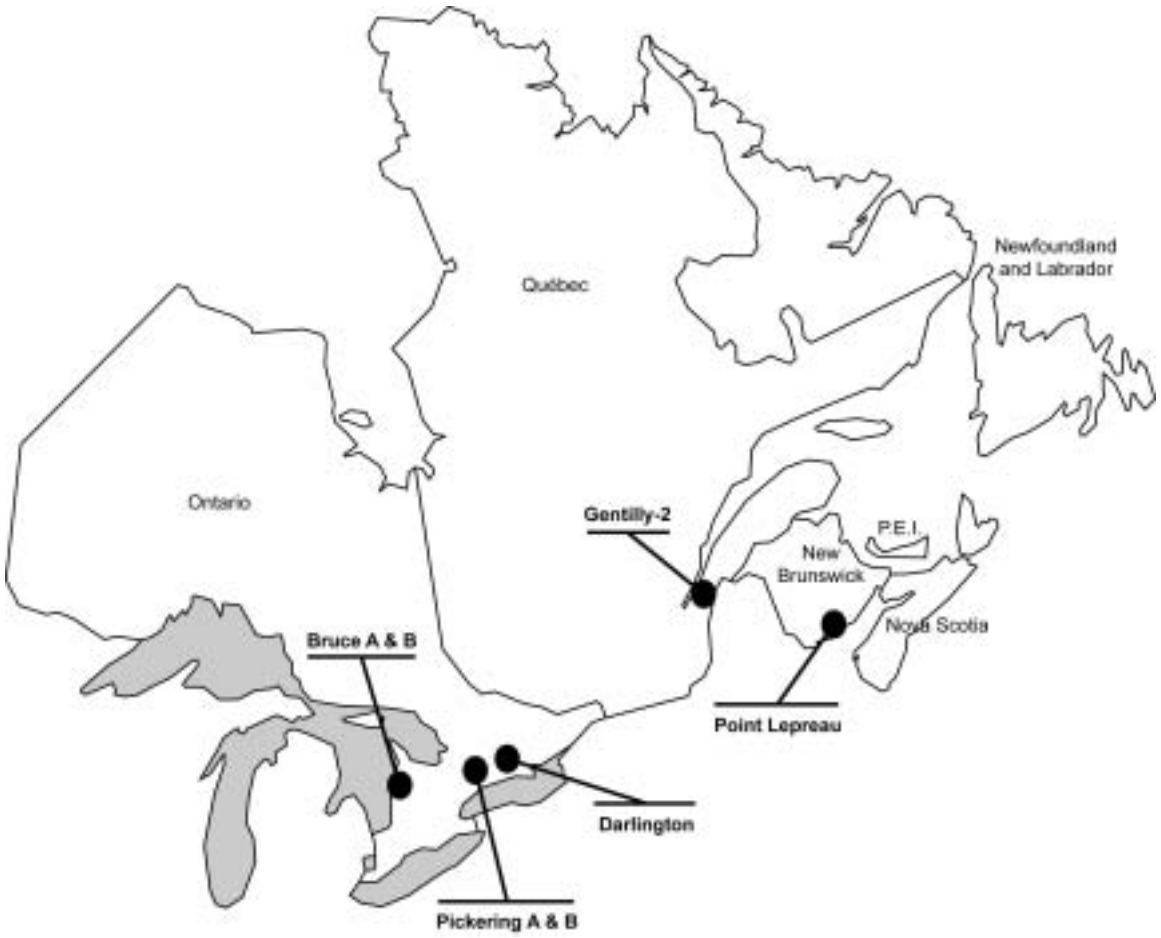
INTRODUCTION

This report summarizes the Canadian Nuclear Safety Commission (CNSC) staff's assessment of the Canadian nuclear power industry's performance in 2002. The report covers licensee programs and performance in nine safety areas, and makes comparisons where possible, shows trends and highlights significant issues that pertain to the industry at large. Conclusions are supported by information gathered by CNSC staff inspections, document reviews and studies of events and performance indicators. Through these activities, CNSC staff identifies strengths and weaknesses in licensees' programs and their implementation and raises issues requiring corrective action. More detailed information on issues requiring corrective action can be found in the licensing *Commission Member Documents (CMDs)* for each facility.

Of the 22 CANDU reactors that have been issued operating licences by the *Commission*, eight have not produced power since 1998. The Bruce A reactor units 3 and 4 and all four Pickering A reactor units are undergoing preparatory work for restart. Bruce A units 1 and 2 are defuelled and in a *lay-up state*. CNSC staff is evaluating activities related to the restart of Bruce A and Pickering A and have used Bruce Power's and Ontario Power Generation's past performance of programs which are generic to the A and B sites to assess Bruce A and Pickering A operational programs for this report. The Bruce B and Darlington reactors are limited to operating at or below 90% and 98% of full power, respectively. The Pickering B, Gentilly-2 and Point Lepreau reactors are operating at full power. Figure 2 shows the location of each site, the number and generating capacity of the reactors, and the initial start-up date, licence holders and expiry date of current licences.

To meet the legal requirements of the *Nuclear Safety and Control Act and Regulations*, licensees must implement programs which provide adequate provisions for the protection of the environment, the health and safety of persons, the maintenance of national security and the measures required to implement Canada's international obligations. CNSC staff assesses every plant's performance against legal requirements, including the conditions of operating licences and applicable standards. About 130 CNSC staff members are authorized as *inspectors* of the Canadian nuclear power industry.

Figure 2: Location of Nuclear Power Plants in Canada



PLANT DATA

Plant	Bruce A	Bruce B	Darlington	Pickering A	Pickering B	Gentilly- 2	Point Lepreau
Licensee	Bruce Power	Bruce Power	Ontario Power Generation	Ontario Power Generation	Ontario Power Generation	Hydro-Québec	New Brunswick Power
Reactor Units	4	4	4	4	4	1	1
Gross Electrical Capacity per Reactor (Megawatts)	904	915	935	542	540	675	680
Start-Up	1976	1984	1989	1971	1982	1982	1982
Licence Expiry	2003/10/31	2003/10/31	2008/02/29	2003/06/30	2003/06/30	2006/12/31	2005/12/31

CNSC staff rates licensee programs (P) and their implementation (I) separately, according to the five categories shown in Figure 3. The results of the 2002 assessment are shown in Figure 1 and at the beginning of each section in this report. A glossary of technical terms used, italicised on first reference, is provided in the Annex.

Figure 3: CNSC Program and Implementation Assessment Categories

A - Exceeds requirements Assessment topics or programs meet and consistently exceed applicable CNSC requirements and performance expectations. Performance is stable or improving. Any problems or issues that arise are promptly addressed, such that they do not pose an unreasonable risk to the maintenance of health, safety, security, environmental protection, or conformance with international obligations to which Canada has agreed.
B - Meets requirements Assessment topics or programs meet the intent or objectives of CNSC requirements and performance expectations. There is only minor deviation from requirements or the expectations for the design and/or execution of the programs, but these deviations do not represent an unreasonable risk to the maintenance of health, safety, security, environmental protection, or conformance with international obligations to which Canada has agreed. That is, there is some slippage with respect to the requirements and expectations for program design and execution. However those issues are considered to pose a low risk to the achievement of regulatory performance requirements and expectations of the CNSC.
C – Below requirements Performance deteriorates and falls below expectations, or assessment topics or programs deviate from the intent or objectives of CNSC requirements, to the extent that there is a moderate risk that the programs will ultimately fail to achieve expectations for the maintenance of health, safety, security, environmental protection, or conformance with international obligations to which Canada has agreed. Although the risk of failing to meet regulatory requirements in the short term remains low, improvements in performance or programs are required to address identified weaknesses. The licensee or applicant has taken, or is taking appropriate action.
D – Significantly below requirements Assessment topics or programs are significantly below requirements, or there is evidence of continued poor performance, to the extent that whole programs are undermined. This area is compromised. Without corrective action, there is a high probability that the deficiencies will lead to an unreasonable risk to the maintenance of health, safety, security, environmental protection, or conformance with international obligations to which Canada has agreed. Issues are not being addressed effectively by the licensee or applicant. The licensee or applicant has neither taken appropriate compensating measures nor provided an alternative plan of action.
E – Unacceptable Evidence of either an absence, total inadequacy, breakdown, or loss of control of an assessment topic or a program. There is a very high probability of an unreasonable risk to the maintenance of health, safety, security, environmental protection, or conformance with international obligations to which Canada has agreed. An appropriate regulatory response, such as an order or restrictive licensing action has been or is being implemented to rectify the situation.

OPERATING PERFORMANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Operating performance includes the overall review of plant operation that covers licensees' program integration, plant management, plant status and material condition. Also included are the review of licensee programs related to conduct of operations, technical surveillance, compliance to reporting requirements, outage management and non-radiological health and safety.

In 2002, CNSC staff reviews concluded that licensees have appropriate organizations in place to safely operate their plants. Apart from some weaknesses in the area of implementation of outage management at Pickering B, Gentilly-2 and Point Lepreau, all licensees' programs and implementation met CNSC requirements.

OVERALL REVIEW OF PLANT OPERATION

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

In 2002, there were 14 licensed reactors providing power to the electrical grid. Six other reactors were undergoing rehabilitation work (Pickering A units 1 to 4 and Bruce A units 3 and 4) and two reactors remain in the lay-up state (Bruce A units 1 and 2). The 14 operational reactors were critical approximately 86% of the time and were in, or being placed in, a *guaranteed shutdown state* the remaining 14% of the time.

There were no serious process failures at any plant, no worker or member of the public received a radiation dose in excess of the regulatory limits. Emissions from all plants were below regulatory limits. This continues to be an industry strength.

The results of the CNSC performance indicator on the "Number of Unplanned Reactor Power Transients" are shown in Table 1. This indicator shows the number of manual or automatic power reductions from actuation of either the shutdown, the *stepback* or *setback* systems. Unexpected power reductions may be indicative of problems within the plant and place unnecessary strain on systems. However, it should be noted that setbacks typically pose little risk to plant operations. Table 2 provides the Canadian industry results for this indicator since 1999. The Canadian industry average over the last four years has been one transient (reactor trip, stepback or setback) for every 6,735 hours of criticality and one trip or stepback for every 13,700 hours of criticality. For comparison, the international performance target is one reactor trip per 7,000 hours of reactor operation.

Table 1: Number of Unplanned Transients in 2002

	Approximate Reactor Critical Hours for 2002	Reactor Trip	Reactor Stepback	Reactor Setback
Multi-Unit Plants				
Bruce B	27,780	1	0	4
Darlington	33,150	0	0	1
Pickering B	29,630	0	0	6
Single-Unit Plants				
Point Lepreau	6,850	1	0	1
Gentilly-2	7,380	0	1	1

Table 2: Number of Unplanned Transients, 1999-2002

Year	Approximate Reactor Critical Hours	Reactor Trip	Reactor Stepback	Reactor Setback
1999	103,000	2	4	5
2000	99,000	5	4	2
2001	104,000	7	5	11
2002	104,800	2	1	13

CONDUCT OF OPERATIONS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Conduct of operations covers licensees' programs for reactor start-up, operational inspections, procedural adherence, communications, approvals, change control and maintenance of procedures. To verify these programs, CNSC staff routinely carries out document reviews and field inspections of systems and operational practices. In 2002, CNSC site staff completed approximately 570 inspections and operating practice assessments. The majority of these assessments did not identify any remedial action to be taken by licensees. CNSC staff also reviewed 690 licensees' requests for approval. In general, licensee submissions contained the necessary information for CNSC staff to conduct reviews and approvals.

TECHNICAL SURVEILLANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

CNSC staff requires licensees to monitor and report on plant system performance. CNSC staff expects that maintenance and testing practices be adjusted to keep pace with industry advances or

in response to declining system performance. For this reason, CNSC staff requires all licensees to have in place a technical surveillance program that helps detect system and component problems. This ensures optimum system reliability and availability.

In 2002, CNSC staff was satisfied with licensees' system performance monitoring and the feedback to the work-planning process. CNSC staff found that licensees' efforts in this area have resulted in a general improvement to the condition of plant systems.

REPORTING REQUIREMENTS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Events such as process failures, unplanned reactor shutdowns and licence non-compliances are an important source of information. The power reactor operating licences require all licensees to report events according to *regulatory policy statement* R-99 so that lessons can be learned to improve safety and prevent these events from re-occurring. CNSC staff monitors licensees to ensure that events are promptly detected, analyzed and that required information is reported. CNSC staff reviews each event and investigates any that may be significant.

In addition to this reporting requirement, an *action item* program is used by CNSC staff to bring other issues to the attention of licensees and to require corrective action to be taken in a timely manner.

In 2002, CNSC staff opened 109 and closed 121 action items. CNSC staff was satisfied with licensees' action-item management, event reporting, analysis and follow up. In addition, CNSC staff continues to observe a low self-reporting threshold, indicative of a positive questioning attitude of licensee staff.

OUTAGE MANAGEMENT

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
-	-	B	B	B	B	-	-	B	C	B	C	B	C

As systems and equipment are taken out of service during a maintenance outage, the plant must remain in a safe state. Therefore, CNSC staff monitors outages to ensure reactor safety principles are maintained. As well, CNSC staff verifies that licensee programs such as maintenance, radiation protection and dose control are effectively implemented throughout the outage. For safety-significant work, CNSC staff reviews the licensees' outage planning and organization. As the outage nears completion, CNSC staff reviews the start-up and return-to-service of the reactors.

In 2002, nine of the 14 operating reactors were shutdown for routine outages for a total of 731 days. The shortest outage was 36 days (Darlington unit 1) while the longest was 176 days (Bruce unit 6). CNSC staff reviews of these outages showed that progress has been made in the area of planning. Execution remains a concern at Gentilly-2 and Pickering B, where CNSC staff has notified these licensees of the need for improvements to radiological and conventional safety during outages. At Point Lepreau, CNSC staff also requires stricter adherence by New Brunswick Power staff to their outage-planning process in dealing with forced shutdowns.

NON-RADIOLOGICAL HEALTH AND SAFETY

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	C	B	B

Licensees must follow accepted safety practices to minimize risk to workers. To verify this, CNSC staff monitors a performance indicator called "Accident Severity Rate". This indicator measures the total number of days lost to injury for every 200,000 person hours worked at a site (2002 results are shown in Table 3). CNSC staff's review of these events showed that licensees have adequate safety programs. However, at Gentilly-2, CNSC staff requires improvement in some of Hydro-Québec's staff work practices related to conventional safety.

Table 3: Accident Severity Rate for 2002

Site	Days Lost	Person Hours Worked	Accident Severity Rate
Point Lepreau	0	1,443,950	0
Bruce A and B	148	6,211,300	5
Pickering A and B	36	5,272,430	1
Darlington	0	3,285,460	0
Gentilly-2	159	1,316,720	24

The industry results for this indicator since 1999 are shown in Table 4.

Table 4: Accident Severity Rate, 1999-2002

Year	Days Lost	Person Hours Worked	Accident Severity Rate
1999	1,329	18,536,000	14
2000	462	19,510,380	5
2001	469	19,654,200	5
2002	343	17,529,860	4

PERFORMANCE ASSURANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	C	B	C	B	C	B	B	B	C	C	C	C	C

Performance assurance includes those management programs that enable effective human and organizational performance. CNSC staff rates this safety area through the assessment of the development, implementation and continuous improvement of policies, standards and procedures required to manage licensee programs. Performance assurance groups the programs of quality assurance, human factors and training, because performance in these areas affects performance in all plant programs. Weak performance in these cross-cutting programs reduces effectiveness of the overall plant-management processes.

During 2002, quality assurance of the licensees' pressure boundary programs was below requirements. Human factors and training experienced limited improvements in various programs. However, weaknesses still exist in the implementation of these programs.

QUALITY ASSURANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	C	B	C	B	C	C	C	C	C

An operational quality assurance program is the integrated series of processes, documented in manuals, policies, standards and procedures, necessary for the safe operation and maintenance of the plant. A licence condition for all plants specifies the Canadian Standards Association (CSA) N286 series of standards as the regulatory requirement for power reactor quality assurance programs.

In 2002, the industry had some successes in quality assurance but lack of progress and deterioration of specific programs caused CNSC staff to reduce the implementation rating at Ontario Power Generation (OPG), while Hydro-Québec and New Brunswick Power's program and implementation remain below requirements. For example, OPG continued to refine its governance documentation but failed to obtain a certificate of authorization for their pressure boundary program. Hydro-Québec continued to develop a new quality assurance program document structure, but still had problems implementing corrective measures identified by previous CNSC audits. In addition, CNSC staff rejected Hydro-Québec's initial pressure boundary quality assurance program. New Brunswick Power's progress has been slow in completing its new plant quality-management project.

Implementation of a quality assurance program for pressure boundary work remains a particular concern to CNSC staff. To mitigate this shortcoming until licensees obtain certification, CNSC staff has limited some licensees' authorization to perform pressure boundary work and/or

required them to subcontract fabrication work to certified companies.

HUMAN FACTORS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	C	B	B	B	B	C	C	C	C

The objective of the human factors program is to ensure that licensees minimize the potential for human error by adequately addressing factors that may affect human performance. These include:

- human performance in operating experience and *root-cause analysis*;
- work organization and job design (e.g., staffing levels, hours of work);
- human reliability and usability aspects of procedures and job aids; and
- human factors in design.

In 2002, CNSC staff noted improvements in the incorporation of human factors into licensees' design-change processes. OPG's and Hydro-Québec's human performance programs were broader in scope than before. Human factors engineering program plans were used to guide human factors work for the Pickering A and Bruce A restart projects. Also New Brunswick Power is improving its process of incorporating human factors into design changes. However, the below-requirements ratings given to Point Lepreau and Gentilly-2 are the result of weaknesses that still existed in their design change processes, and to Darlington because improvements are required to the implementation of the human factors component of their engineering change-control program and root-cause analysis for event investigations.

TRAINING, EXAMINATION AND CERTIFICATION

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
C	C	B	C	B	C	B	B	B	C	B	C	B	C

Licensees must ensure that there is an adequate number of qualified workers available to safely carry out the licensed activity. To meet this requirement, CNSC staff expects licensees to establish and implement adequate training programs, including testing methods, which provide licensee staff from all relevant job families with the knowledge and skills necessary to safely carry out their duties. CNSC staff evaluates the licensee training programs using criteria based on the methodology called *systematic approach to training*.

For a number of safety-critical positions, CNSC staff assesses the competence of licensee staff through the conduct of knowledge-based and performance-based examinations. In 2002, the success rate on CNSC examinations for shift supervisor and control room operator candidates was 96% (108 of 112 candidates were successful). This represents an increase from the 2001

success rate of 78% (90 of 115 candidates were successful) and the average historical success rate of 86%.

Throughout 2002, the transfer of responsibilities to conduct examinations for certified positions from the CNSC to the licensees continued. Also, CNSC staff is working with licensees on a requalification standard which will be used to retest certified staff. At Bruce A, CNSC staff is concerned with the lack of preparation of the training programs given the schedule for the restart of units 3 and 4. At Point Lepreau, CNSC staff found deficiencies in the training for emergency response personnel.

Although all licensees have developed training programs, only Pickering A has implemented the program to CNSC requirements. All other licensees need to improve implementation of adequate training for non-certified operations and maintenance staff.

DESIGN ADEQUACY

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Design adequacy refers to the ability of systems in a nuclear plant to meet their design intent, given new information resulting from operating experience, safety analysis or review of safety issues. When necessary, CNSC staff raises an action with the licensee if a new failure or degradation mechanism has been uncovered. The licensee is then required to take interim compensatory measures to ensure that adequate safety margins of reactor operation are maintained. The issue is then monitored until it has been satisfactorily and permanently resolved.

In recent years, CNSC staff has increased regulatory monitoring in the area of research and development to counterbalance a decrease in industry funding. CNSC staff has consulted with industry representatives and is evaluating a proposal for routine reporting of research results that should address concerns about the future of the program. In 2002, CNSC staff reviews of design adequacy showed that all licensees continue to provide acceptable analysis and response to new safety issues.

SAFETY ANALYSIS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Safety analysis is performed by licensees to confirm that safety systems met requirements to

reduce the probability and consequences of a range of accidents to acceptable levels. Analysis results also define safe operational limits for reactor parameters.

In recent years, CNSC staff has instructed licensees to improve quality-assurance programs for safety analysis, with the goal of clearly identifying responsibilities for reporting, performing audits and keeping records. Safety analysis must be performed by qualified analysts, according to the highest technical standards, and demonstrate that regulatory requirements such as dose limits will be met. Safety analysis must also be updated to cover changes in reactor systems and to make use of new research findings, analytical tools and knowledge gained from operation.

In 2002, CNSC staff reviews confirmed that licensees performed adequate safety analyses, with notable progress in safety analysis quality assurance and the use of appropriate methodology to justify safety cases. In addition, all licensees submitted, as required, updates to their safety reports.

SAFETY ISSUES

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	C

Safety issues arise from research work, incorporation of new knowledge, hazard analysis for events such as fire and other accident-mitigation strategies. CNSC staff uses the generic action item program to define problem statements and document resolution criteria for these safety issues.

At the end of 2002, there were 17 generic action items open. During the year, no new generic action items were created and three were closed. CNSC staff is satisfied that adequate progress has been made on the remaining safety issues by all licensees except New Brunswick Power which is falling behind on the required work schedules.

PLANT DESIGN

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

CNSC staff reviews plant design to ensure licensees maintain a documented description of equipment, including equipment qualification and classification requirements. CNSC staff reviews the licensees' design-change and safety-enhancement programs as well as programs that impact on the overall safe operation of the plant such as fire protection and chemistry control.

Plant systems and processes occasionally require changes to align with modern standards, best industry practice or to correct past deficiencies. For example, CNSC staff and industry have

recently agreed to an alternative approach for calculating chemistry-related plant performance, which licensees will report as part of the CNSC performance indicator program.

In 2002, CNSC staff continued to be satisfied with industry's progress on physical changes made to the plants to resolve identified problems. Noteworthy are the improvements to the fire-protection provisions, *environmental qualification* upgrades and the extensive work that has been carried out in preparation for the restarts of the Pickering A and Bruce A units.

EQUIPMENT FITNESS FOR SERVICE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	C	B	B	B	B	B	B	B	B	B	B	B	B

Equipment fitness for service includes those programs that impact on the physical condition of the various systems and components in the plant. To ensure that structures, systems and components important to safety in nuclear power plants remain effective as the plant ages, licensees must integrate the results of inspection and reliability programs into their plant-maintenance activities.

In 2002, CNSC staff reviews of equipment fitness for service found that, with the exception of the implementation at Bruce A, all licensees' met requirements. Bruce A staff has to address weaknesses in their periodic inspection program prior to the restart of units 3 and 4.

MAINTENANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Licensees are required to maintain their plant systems in a state that conforms to the current design requirements and analysis results and implement a maintenance program that includes adequate organization, tools and procedures. Licensees must also demonstrate that related programs involving reliability, environmental qualification, training, technical surveillance, procurement and planning, effectively support this maintenance program.

In 2002, CNSC staff reviews of maintenance programs showed that licensees met requirements and continued to make improvements in the management of work. Licensees are setting aggressive targets and reducing corrective and preventative maintenance backlogs. As well, equipment degradation is being adequately controlled through effective aging and equipment life-cycle programs.

STRUCTURAL INTEGRITY

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
C	C	B	B	B	B	B	B	B	B	B	B	B	B

Licensees carry out periodic inspections to confirm that major components important to safety remain fit for service. As inspections uncover degradations, CNSC staff requires that licensees establish strategies for mitigating or fixing the problems or, if appropriate, replacing the component. The emphasis of these inspections is on *steam generator* tubes*, pressure tubes* and *feeder* piping, as almost all other high-pressure nuclear components have exhibited few signs of degradation.

In 2002, CNSC staff reviews found that licensees implemented adequate measures and appropriately adjusted their inspection programs to deal with new findings and inspection results. CNSC staff judge that licensees' equipment at all sites continues to be fit for service. In addition, CNSC staff is encouraged with OPG's development, with input from CNSC staff, of a new pressure tube sampling tool. The new tool will reduce the likelihood of radiation exposure and leave the pressure tube in better condition after sampling compared to the previous technique. However, at Bruce A, CNSC staff has directed Bruce Power to update their periodic inspection program to current standards and to complete the required inspections prior to the restart of units 3 and 4.

RELIABILITY

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Licensees are required to ensure that systems whose failure impacts on the risk of a release of radioactive material be part of a reliability program. Licensees must establish a program that includes setting of reliability targets, performing reliability assessments, testing and monitoring, and reporting the results of these activities. CNSC staff reviews of licensees' reliability programs mainly cover:

- reliability model and data verification;
- safety system availability;
- testing program; and
- reporting.

In 2002, some special safety systems did not meet their regulatory targets for availability. However, reviews by CNSC staff determined this had negligible impact on the safe operation of the affected plants. In addition, safety support systems performed well and there were no system

failures that significantly increased the risk of the release of radioactive material. In 2002, all licensees completed their annual reliability reports and continued to follow mandatory testing programs. Table 5 shows the CNSC performance indicator for the "Number of Missed Mandatory Safety System Tests". This data shows the ability of licensees to successfully complete routine tests on systems related to safety. About 64,000 of these tests were performed throughout the industry in 2002. CNSC staff reviewed each test missed and found that none significantly impacted on safety.

Table 5: Number of Missed Mandatory Safety System Tests in 2002

Plant	Special Safety Systems	Standby Safety Systems	Safety Related Process Systems
Bruce B	0	0	0
Darlington	0	0	0
Pickering A	0	0	0
Pickering B	1	0	0
Gentilly-2	1	0	0
Point Lepreau	1	1	0

EMERGENCY PREPAREDNESS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
A	A	A	A	A	A	A	A	A	A	A	A	A	C

To respond effectively to an emergency, licensees must establish a consolidated emergency plan, an emergency preparedness program, and must ensure the response capability of their staff through simulated emergencies. To evaluate the emergency preparedness of a licensee, CNSC staff assesses the emergency plan and preparedness program as well as the results of simulated emergency exercises. The assessment of the emergency plan provides an indication of the effectiveness of the emergency response strategy. The review of the emergency preparedness program verifies that all components of the emergency response plan are in place and maintained in a state of readiness. Finally, the evaluation of facility staff during a simulated exercise provides an assessment of the emergency response capability.

In 2002, CNSC staff evaluated a full-scale emergency exercise at Bruce B and the emergency preparedness program at Darlington. Emergency exercises of limited scope were also evaluated at Point Lepreau and Gentilly-2. The evaluations at Darlington, Bruce B and Gentilly-2 showed that these licensees exceeded CNSC requirements. However, the evaluation at Point Lepreau found some deficiencies in training for emergency response personnel and outdated emergency procedures. Despite these findings, CNSC staff judge that emergency preparedness is overall an industry strength.

ENVIRONMENTAL PERFORMANCE

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

CNSC regulations require that each licensee take all reasonable precautions to protect the environment and control the release of radioactive and hazardous substances. CNSC staff verifies that licensees have programs in place to identify, control and monitor all releases of nuclear and hazardous substances from their plants. CNSC staff reviews of environmental performance include:

- public dose;
- emission data;
- effluent and environmental monitoring;
- nuclear and conventional waste management;
- unplanned releases;
- assessment of environmental protection systems; and
- compliance with provincial environmental regulations.

In 2002, data on airborne emissions and liquid releases of radioactive substances for all plants showed releases to the environment were consistently below the *derived release limits*. Doses to the most exposed members of the public were below regulatory limits. As in previous years, these results continue a strong trend throughout the industry. Furthermore, licensees met all applicable CNSC requirements in controlling radioactive effluent releases and exposure to members of the public.

Finally, the implementation ratings of all licensees was reduced from an "A" (exceeds requirements) in 2001 to a "B" (meets requirements) in 2002. This change reflects an expanded environmental protection mandate under the *Nuclear Safety and Control Act* and not a deterioration of licensee performance.

REVIEW OF UNPLANNED RELEASES

Licensees are required to report to the CNSC any unplanned releases of radioactive material or other controlled substances to the environment. There were no reported unplanned releases from a nuclear site in 2002.

RADIATION PROTECTION

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
A	B	A	B	A	B	A	B	A	B	A	C	A	B

The radiation protection program ensures the protection of persons inside a nuclear facility from unnecessary exposure to radiation. The *Radiation Protection Regulations* prescribe dose limits for workers who may be exposed to radioactive material, and require that exposures to radiation be kept as low as reasonably achievable (ALARA).

In 2002, no worker received a radiation dose in excess of the regulatory limits. CNSC staff reviews of radiation protection programs found that, in general, all licensees continue to adequately manage radiation doses. However, at Gentilly-2, CNSC staff noted several instances where radiation safety procedures did not adequately follow the ALARA principle, resulting in doses to Hydro Québec's staff that could have been lower.

NUCLEAR SECURITY

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
B	B	B	B	B	B	B	B	B	B	B	B	B	B

Licensees are required to follow the security requirements for their sites as stipulated in the *Nuclear Security Regulations*. To obtain assurance of compliance with these requirements, CNSC staff assesses licensees':

- security guard service, including duties, responsibilities and training;
- protection arrangements with local response forces and testing of response plans;
- procedures to assess and respond to potential breaches of security; and
- security monitoring/assessment systems and communications equipment.

Licensees are required to have a sufficient number of trained and properly-equipped security staff available at all times. Their sites must be continuously monitored and licensees must take appropriate action in the event of a security breach. In addition, while not directly specified by the Regulations, CNSC staff expects all licensees to conduct joint security exercises with their respective off-site response forces.

In 2002, CNSC staff conducted several site inspections and reviewed site-security reports. The results of these evaluations indicated that licensees were in compliance with applicable

Regulations and that all sites remain on heightened alert following the events of September 11, 2001. In addition, CNSC staff assessed and approved approximately 190 applications for import, export and transport of nuclear materials, all of which had security implications and proceeded without incident.

SAFEGUARDS

Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P	I	P	I	P	I	P	I	P	I	P	I	P	I
A	A	A	A	A	A	A	A	A	A	A	A	A	A

The CNSC regulatory mandate includes ensuring conformity with measures required to implement Canada's international obligations under the Treaty on the Non-Proliferation of Nuclear Weapons. Pursuant to the Treaty, Canada has entered into a safeguards agreement with the *International Atomic Energy Agency (IAEA)*. This agreement provides the IAEA with the right and the responsibility to verify that Canada is fulfilling its commitment not to use nuclear material from its peaceful program to make nuclear weapons or nuclear explosive devices.

The CNSC provides the mechanism, through the *Nuclear Safety and Control Act and Regulations* as well as licence conditions, for the IAEA to implement the safeguards agreement. Conditions for the application of IAEA safeguards are contained in power reactor operating licences and compliance includes the timely provision of reports on the movement and location of all nuclear materials and measures for the application of IAEA safeguards.

In 2002, CNSC staff assessed all licensees as exceeding safeguards requirements. All reports required by the IAEA were provided in a timely manner. All licensees cooperated with the IAEA to successfully accomplish routine inspection activities, including design information verification and annual simultaneous physical inventory verification. All licensees promptly addressed any problems or issues that arose.

ANNEX

Action Item
A numbered tracking system used by CNSC staff to control issues requiring licensee attention.

Commission
A corporate body of not more than seven members, established under the Nuclear Safety and Control Act and appointed by Governor in Council, to:

- regulate the development, production and use of nuclear energy, the production, possession, use and transport of nuclear substances:
- regulate the production, possession and use of prescribed equipment and prescribed information;
- implement measures respecting international control of the development, production, transport and use of nuclear energy and nuclear substances, including those respecting the non-proliferation of nuclear weapons and nuclear explosive devices; and
- disseminate scientific, technical and regulatory information concerning the activities of the CNSC and the effects on the environment and on the health and safety of persons, of the development, production, possession, transport and uses referred to above.

Commission Member Documents (CMDs)
Documents prepared for Commission hearings and meetings, by CNSC staff, proponents and intervenors. Each CMD is assigned a specific identification number.

Derived Release Limit (DRL)
A limit imposed by the CNSC on the release of a radioactive substance from a licensed nuclear facility such that compliance with the DRL gives reasonable assurance that the regulatory dose limit is not exceeded.

Environmental qualification
A program that establishes an integrated and comprehensive set of requirements that provide assurance that essential equipment can perform as required if exposed to harsh conditions and that this capability is maintained over the life of the plant.

Feeder
There are several hundred channels in the reactor that contain fuel. The feeders are pipes attached to each end of the channels and are used to circulate heavy water coolant from the fuel channels to the steam generators.

Guaranteed shutdown state
A method for ensuring that the reactor is shut down. It includes adding a substance to the reactor moderator which absorbs neutrons and removes them from the fission chain reaction, or draining the moderator from the reactor.

Inspector
A qualified person the Commission designates as an inspector for the purposes of the *Nuclear Safety and Control Act and Regulations*.

International Atomic Energy Agency (IAEA)
A United Nations' agency, which, inter alia, establishes and administers safeguards to ensure that States are complying with their commitments to utilize nuclear energy for peaceful purposes. The IAEA also provides an international forum for scientific and technical cooperation in the field of nuclear safety.

Lay-up state
A special configuration into which a plant is placed to prevent system and component degradation during extended periods of shutdown.

Pressure tubes
Tubes that pass through the calandria and contain 12 or 13 fuel bundles. Pressurized heavy water flows through the tubes, cooling the fuel.

Regulatory policy statements
CNSC documents that stipulate requirements and guidelines for regulatory compliance.

Root-cause analysis
An objective, structured, systematic and comprehensive analysis that is designed to determine the underlying reason(s) for a situation or event, and that is conducted with a level of effort that is consistent with the safety significance of the event.

Safeguards
A set of activities/measures by which the IAEA seeks to verify that a State is living up to its international undertakings not to use nuclear programmes for nuclear weapons purposes. The safeguards system is based on an assessment of the correctness and completeness of the States's declarations to the IAEA concerning nuclear material and nuclear-related activities.

Serious process failures
A failure of a process system, a component or a structure:
(a) that leads to a systematic fuel failure or a significant release from the nuclear power plant, or
(b) that could have lead to a systematic fuel failure or a significant release in the absence of action by any special safety system.

Setback
A system designed to automatically reduce reactor power, at a slow rate, if a problem occurs. The setback system is part of the reactor-regulating system.

Steam generator
A heat exchanger that transfers heat from the heavy water coolant to ordinary water. The ordinary water boils, producing steam to drive the turbine. The steam generator tubes separate the reactor coolant from the rest of the power-generating system.

Stepback
A system designed to automatically reduce reactor power, at a fast rate, if a problem occurs. The stepback system is part of the reactor-regulating system.

Systematic approach to training
A logical progression from the identification of training needs and competencies required to perform a job, to the development and implementation of training to achieve these competencies and to the subsequent evaluation of this training.