Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

CNSC Staff Annual Report for 2001 on the Canadian Nuclear Power Industry

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Figure 1: CNSC Staff Report Card of Nuclear Power Station Performance in 2001

Safety Area	Bruce A		Bruce B		Darlington		Pickering A		Pickering B		Gentilly-2		Point Lepreau	
P = Program I = Implementation	P	I	P	I	P	I	P	I	P	I	P	I	P	I
Operating performance	–	–	B	B	B	C	–	–	B	C	B	B	B	B
Performance assurance	–	–	B	C	B	B	–	–	B	B	C	C	C	C
Design adequacy	–	–	B	B	B	B	B	B	B	B	B	B	B	B
Equipment fitness for service	–	–	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	B	B
Environmental performance	B	A	B	A	C	A	B	A	B	A	C	A	C	A
Radiation protection	A	B	A	B	A	B	A	B	A	B	A	C	A	B
Nuclear safety	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; – = Not assessed

SUMMARY

This report is the Canadian Nuclear Safety Commission (CNSC) staff assessments of the Canadian nuclear power industry's operational safety in 2001.

CNSC staff assesses the programs and performance of each licensee in nine licensing and safety areas according to five categories: "exceeds requirements", "meets requirements", "below requirements", "significantly below requirement" or "unacceptable" (this year's results are shown in Figure 1).

In 2001, there were no serious process failures at any station, no worker or member of the public received a dose in excess of the regulatory limits and emissions from all stations were well below regulatory limits. The industry continues its strong performance in the safety areas of:

- design adequacy;
- equipment fitness for service;
- emergency preparedness;
- environmental performance;
- radiation protection, and
- nuclear security and safeguards.

On a negative note, CNSC staff's reviews have found the industry's performance assurance to be below requirements. CNSC staff's reviews have found weaknesses in quality assurance, human factors and training programs, which make up this safety area. CNSC staff assesses that corporate oversight and the degree of implementation of performance assurance programs throughout the industry requires improvement. This weakness with respect to human and organizational performance issues is having a negative impact on overall station operation, such that at some stations, these weaknesses are contributing to unnecessary plant transients.

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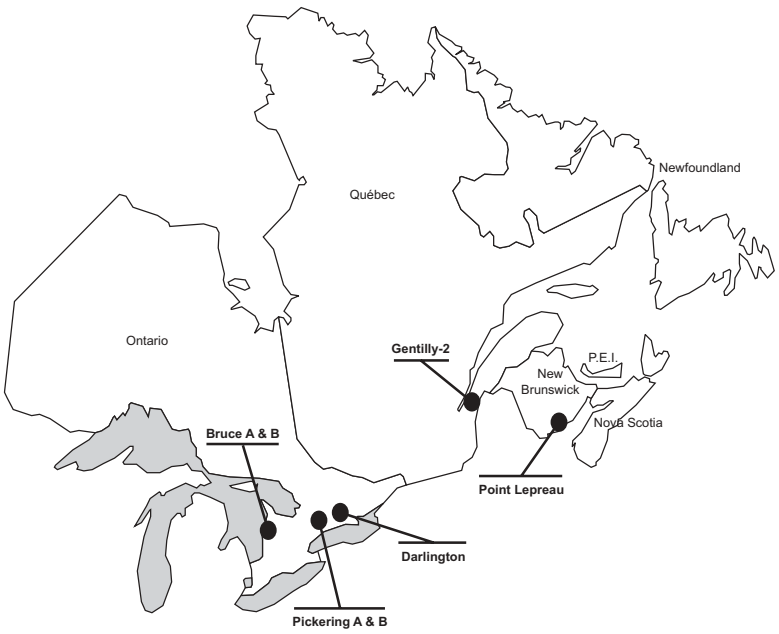
INTRODUCTION

This report summarizes the Canadian Nuclear Safety Commission (CNSC) staff assessments of the Canadian nuclear power industry's operational performance in 2001. The report presents the CNSC staff score card of licensee programs and performance in nine safety areas. In addition, the report makes comparisons where possible, shows trends and highlights significant issues that pertain to the industry at large. More detailed information on issues can be found in the licensing *Commission Member Documents* (CMD) for each facility. The report's conclusions are supported by information gathered by CNSC staff inspections and document reviews, event reviews and studies of performance indicators. Through these activities, CNSC staff identifies strengths and weaknesses in licensees' performance and raise issues requiring attention or corrective action.

Of the 22 CANDU reactors that have been issued operating licences by the CNSC, eight have produced no electric power since 1998. The Bruce A reactors are defuelled and in a *layed-up state*. The Pickering A reactors are fuelled, but remain in a drained *guaranteed shutdown state*. The Bruce B reactors are currently limited to operating at or below 90% of full power. The Darlington reactors are limited to 98% of full power. The remaining reactors are nominally 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 licence expiry date (at the time of the production of the report).

To meet the legal requirements of the Nuclear Safety and Control Act and Regulations licensees must implement programs which ensure that station operation has adequate provisions for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed. CNSC staff assesses every stations' 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: Locations of nuclear power station sites in Canada



Station data

	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 in 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	2003-02-28	2003-06-30	2003-06-30	2002-12-31	2002-10-31

In early 2002, CNSC staff introduced a new approach and terminology to rate licensee programs. CNSC staff now assesses licensee programs and their implementation separately, according to the five categories shown in Figure 3. The results of this years' assessment are shown in Figure 1 and are repeated for the licensing and safety areas (as well as sub-areas) at the beginning of each section in the report.

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.

In May 2001, Ontario Power Generation (OPG) leased Bruce A and B facilities to Bruce Power Incorporated. Bruce Power is a company owned by British Energy, with minority interest held by Cameco, the Power Workers Union and the Society of Energy Professionals. To a large extent, Bruce Power has retained the OPG staffing levels, programs, policies and procedures that existed at the Bruce facilities when the lease came into effect. The ratings CNSC staff has given to Bruce Power take this history into account.

A glossary of technical terms used in this report is provided in the Annex. Terms are *italicised* on first reference.

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	C	–	–	B	C	B	B	B	B

Operating performance includes the overall review of station operation that covers licensee's program integration, plant management, plant status and material condition. Also included in this licensing and safety area are the review of licensee's conduct of operations, technical surveillance, compliance to requirements for reportable events, outage management and non-radiological health and safety.

In 2001, CNSC staff's reviews of this licensing and safety area showed that Darlington, and Pickering B require improvement in overall review of station operation and the conduct of operations. Furthermore, Pickering B and Gentilly-2, require improvement in the safety area of outage management.

OVERALL REVIEW OF STATION 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	C	–	–	B	C	B	B	B	B

This year, the fourteen reactors available to provide electrical power operated approximately 85% of the time; the reactors were in, or being placed in, a guaranteed shutdown state the remaining 15% of the time. All reactors at Pickering A are undergoing restoration work in preparation for start up. Reactor units 3 and 4 at Bruce A are undergoing some preparatory work for re-start, while reactor units 1 and 2 remain in a layed-up state.

There were no *serious process failures* at any station. This continues to be an industry strength.

Table 1 gives the results of the CNSC performance indicator on the "Number of unplanned reactor power transients". 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. Table 2 gives the industry results for this indicator since 1999. The international benchmark of acceptable performance is about one reactor trip per 7000 hours of reactor operation. The Canadian industry average over the last three years has been one transient (reactor trip, stepback and setbacks) for every 6,650 hours of operation.

Table 1: Number of unplanned transients in 2001

	Approximate reactor operating hours for 2001	Reactor trip	Reactor stepback	Reactor setback
Multi-Unit stations				
Bruce B	30,500	1	1	2
Darlington	32,000	1	3	2
Pickering B	26,250	4	1	6
Single-Unit stations				
Point Lepreau	7,900	1	0	0
Gentilly-2	7,500	0	0	1
Industry – Total	**104,000**	**7**	**5**	**11**

Table 2: Number of unplanned transients, Canadian industry historical

Year	Approximate reactor operating 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

CNSC staff's reviews of these transients have identified concerns of the causal factors involved and, as appropriate, have requested licensees to initiate corrective measures. In particular, two events that occurred at Darlington prompted an independent CNSC review. These and other event reviews showed that weaknesses in several program areas are contributing to an increase in plant transients. At Pickering, CNSC staff is concerned with events caused by failure to implement recommendations from previous similar events, non conservative decision making or supervisory deficiencies.

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	C	–	–	B	C	B	B	B	B

Conduct of operations covers the licensee 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 practicese:. For example, in 2001, CNSC site staff completed approximately 500 field and system inspections or operating practice assessments. In addition, the licensee is required to obtain CNSC approval, in writing, to make changes to certain documents, components or systems. CNSC staff requires all approval requests to contain accurate and sufficient information to be able to make an informed decision. Once submitted, CNSC staff reviews these approval requests and responds accordingly. This year, licensees submitted approximately 960 requests for approval.

In 2001, most licensees met CNSC requirements in the area of conduct of operations. However, there have been inconsistencies in the performance of the Darlington and Pickering B stations, programs where improvement is required are procedural compliance 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

CNSC staff requires licensees to monitor and report on plant system performance. CNSC staff expects that maintenance and testing practices be adjusted in accordance with industry advances or in response to declining system performance. Therefore, CNSC staff requires all licensees to have a technical surveillance program which helps to detect system problems in order to ensure optimum system reliability and availability.

In 2001, CNSC staff reviews found that licensee's staff emphasized continuous monitoring, assessment, and accountability for the condition of their 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

As the facility operates through its life, events such as process failures, unplanned reactor shutdowns, licence non-compliances, are an important source of information. The power reactor operating licences requires all licensees to report events according to Regulatory Document R-99 so that lessons can be learned to improve safety and to prevent these events from recurring. CNSC staff monitors licensees to ensure that events are promptly detected, analysed and that the required information is reported. CNSC staff reviews each event and follows up on 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 the licensee and to solicit corrective action in a timely manner, (there are approximately 300 open action items across the industry).

In 2001, CNSC staff reviews have found that all licensees met requirements for reporting, root cause analysis and follow-up.

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	B

During a maintenance outage, the plant must remain in a safe state. Therefore, CNSC staff monitors licensee 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 licensee's outage planning and organization. Finally, as the outage nears completion, CNSC staff reviews the start-up and return-to-service of the reactors.

In 2001, eleven of the fourteen operating reactors were shutdown for routine outages. CNSC staff's review of these outages showed that Pickering B and Gentilly-2 require improvement in one or more of the following areas:

- planning and preparatory work;
- implementation of the ALARA principle for outage doses;
- adhering to accepted safety practices, and
- self-checking.

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	B	B	B

Licensees must follow accepted safety practices to keep the number of injuries to workers as low as possible. In order 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 (2001 results are shown in Table 3). CNSC staff's review of these events showed that no accident demonstrated unsafe licensee behaviour.

Table 3: Accident severity rate for 2001

Site	Days lost	Hours worked	Accident severity rate
Point Lepreau	58	1,358,000	9
Bruce (A and B)	257	5,312,000	10
Pickering (A and B)	24	7,316,700	1
Darlington	15	4,388,400	1
Gentilly-2	115	1,279,100	18
Industry – Total	**469**	**19,654,200**	**5**

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

Table 4: Accident severity rate historical trend

Year	Days lost	Hours worked	Accident severity rate
1999	1,329	18,536,000	14
2000	462	19,510,380	5
2001	469	19,654,200	5

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	C	C	C	C

The safety area of performance assurance covers those activities that enable effective human and organizational performance through the development and implementation of management programs, standards, processes and procedures. Specifically, CNSC staff reviews the human performance aspects of a nuclear facility, such as the licensee's quality assurance, human factors and training programs.

In 2001, CNSC staff continues to assess that the extent of corporate oversight and the degree of implementation of performance assurance programs throughout the industry must improve. Furthermore, CNSC staff finds that the lack of consideration of human performance issues is having a negative impact on the overall station operation, such that at some stations, these weaknesses are contributing to unnecessary plant transients.

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	B	C	C	C	C

A quality assurance program is an umbrella program which requires that programs, standards, policies and procedures necessary for the safe operation of the station exist, and are implemented in accordance with documented requirements. Shortcomings in this area has led CNSC staff to include a licence condition for all stations specifying the Canadian Standards Association (CSA) series of standards as the regulatory requirement for quality assurance programs. These standards require that licensees

establish and implement a quality assurance program for the products and services they are supplying. CNSC staff reviews concentrate on the licensee's ability to demonstrate:

- consistent definition of roles and responsibilities;
- effective implementation of station programs;
- adequate control of changes and program interactions; and
- timely and effective self-assessment and corrective action.

CNSC staff considers that weak performance in quality assurance is reflected in the reduced effectiveness of certain station operational and management processes.

In 2001, the industry continued to make improvements in' quality assurance in both program definition and implementation. CNSC staff reviews have found improved field practices, self-assessments and ownership of station programs related to quality assurance. However, at OPG sites, the licensee has yet to complete the required governing documentation and to resolve identified procedural deficiencies. At Point Lepreau, progress has been slow as New Brunswick Power has yet to complete their new station management system project. At Gentilly, CNSC staff reviews found significant deficiencies in the structure and content of the quality assurance program and are concerned that the licensee has not implemented corrective measures from previous audits.

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	C	B	C	–	–	B	C	C	C	C	C

The objective of the human factors program is to ensure that the potential for human error is minimised by adequately addressing factors known to affect human performance, such as:

- organization and management structures;
- policies, processes and job design;
- human machine interfaces, procedures and job aids, and
- physical work environments.

CNSC staff has developed a method of evaluating aspects of a nuclear facility organization from empirical studies. These studies show that there are common techniques used by high reliability organizations to manage safety performance. Although there are areas that require improvement, CNSC staff's reviews have found that all licensees exhibit these high reliability organization characteristics,

however, only Bruce Power and OPG plants have formal programs. Furthermore, CNSC staff's reviews for all licensees found significant deficiencies with the implementation of human factors programs.

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
–	–	B	C	B	C	B	C	B	C	B	C	B	C

Licensees must ensure there are a sufficient number of qualified workers available to safely carry out the licensed activity. To meet this requirement, CNSC staff expects the 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*.

In 2001, CNSC staff reviews have found for all licensees that implementation of training programs are below requirements. In particular, CNSC staff reviews found shortcomings throughout the industry in training for maintenance staff and for some certified staff. Despite this, licensees made progress towards establishing satisfactory training programs, as OPG and Bruce Power upgraded their training information management systems and revised some of their training programs for certified staff. This led CNSC staff to re-instate the supplementary examinations for shift supervisor candidates at these facilities. In addition, all utilities have progressed in developing the necessary training material for maintenance staff as well as completing an acceptable standard on requalification testing of certified staff.

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 2001, the success rate on CNSC examinations for shift supervisor and control room operator candidates was 78% (90 of 115 candidates were successful). This represents a decrease from the 2,000 success rate of 91% (59 of 65 candidates were successful) and the average historical success rate of 86%.

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

Design adequacy refers to the ability of systems in a nuclear plant to meet their design intent given new information arising from operating experience, safety analysis or the 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 the safety margins of reactor operation are maintained. The issue is then monitored until it has been satisfactorily resolved.

In 2001, CNSC staff reviews of design adequacy showed that the industry continues to provide acceptable safety analysis, respond to any new issues and make the required physical changes to plant equipment or operating procedures.

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

Safety analysis is performed by licensees to confirm that reactor safety systems meet their 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.

CNSC staff requires safety analysis to be performed by qualified analysts, according to the highest technical standards, and to demonstrate that regulatory requirements such as dose limits are met. Safety analysis must also be updated to account for changes in reactor systems, and to make use of new research findings, analytical tools and knowledge gained from operation.

CNSC staff requires all licensees to develop quality assurance programs that satisfy regulatory requirements. These programs identify responsibilities for reporting, performing audits and keeping records. CNSC staff is satisfied with the progress of all licensee's safety analysis quality assurance programs. Licensees also submitted the required safety report updates for 2001.

CNSC staff has requested that the licensees re-examine the large break loss of coolant accident to see if engineering improvements can be made to provide better safety margins for this design basis event. In 2001, OPG and Bruce Power started this work and to date, CNSC staff is encouraged with the results.

In addition, CNSC staff is monitoring an industry initiative to improve the link between the operational limits and safety analysis. This industry work has identified some inconsistencies and omissions for key reactor systems that have been corrected.

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

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 2001, there were 17 generic action items open. During the year, all licensees made progress as five safety issues were resolved and another five are close to resolution.

A safety issue that CNSC staff has emphasized in recent years is fire protection. CNSC staff has included a standard clause in all licences that require compliance with the Canadian Fire and Building Codes and the CANDU fire protection standards. This year, CNSC staff reviews have found that licensees continue to make improvements in their fire protection provisions. In addition, fire hazard assessments were completed by all licensees.

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

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.

In 2001, CNSC staff did not raise any new design adequacy issues. In addition, CNSC staff is satisfied with the industry progress on physical changes made to the plant to resolve problems in programs such as *environmental qualification* and fire protection.

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	B	B	B	B	B	B	B	B	B	B	B

Equipment fitness for service includes those programs which impact on the physical condition of the various systems and components in the plant. Structures, systems and components important to safety in nuclear power plants must remain effective as the plant ages. For this purpose, licensees must integrate the results of inspection and reliability programs into the plant maintenance activities.

In 2001, CNSC staff reviews of equipment fitness for service have found that all licensees' programs and performance met requirements.

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

CNSC staff requires licensees to be able to maintain their plant systems in a state that conforms to the current design requirements and analysis results. Licensees are required to implement a maintenance program which includes adequate organization, tools and procedures. In addition, licensees must demonstrate that other related programs, such as, reliability, environmental qualification, training, technical surveillance, procurement and planning, effectively support this maintenance program.

In 2001, all licensees had maintenance improvement projects underway at their facilities. These range from a maintenance optimization project at Bruce Power to a management of ageing program across the industry. CNSC staff's reviews have found that all licensees have established satisfactory maintenance programs and have improved the standard of maintenance of their plant equipment.

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
–	–	B	B	B	B	B	B	B	B	B	B	B	B

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

In 2001, CNSC staff reviews have found that all licensees' inspection programs were adjusted to take into account new findings and inspection results. For example, during the year, Point Lepreau experienced a feeder crack which led to a plant shutdown. CNSC staff's reviews of this issue found that New Brunswick Power and all other licensees implemented adequate measures and adjusted their inspection programs to deal with this degradation mechanism.

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

CNSC staff requires 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's reviews of licensee's reliability programs mainly covers:

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

In 2001, at all plants, all special safety systems met their regulatory targets for availability. As well, the performance of safety support systems was good and there were no system failures that contributed significantly to an increase in risk of the release of radioactive material from the plants. In addition, all licensees completed their annual reliability report on time and CNSC staff's reviews have found that all licensees adhered to their mandatory testing programs.

Table 5 shows the CNSC performance indicator for the "Number of missed mandatory safety system tests". This indicator measures the ability of licensees to successfully complete all required routine tests on systems related to safety. There are about 45,000 of these tests performed annually throughout the industry. CNSC staff reviews each test missed and the licensee is required to provide an event report. This year, CNSC staff's reviews have found that none of the missed tests significantly impacted on safety system availability.

Table 5: Number of missed mandatory safety system tests in 2001

Station	Special safety systems	Standby safety systems	Safety related process systems
Bruce B	0	0	0
Darlington	3	0	1
Pickering B	0	0	2
Gentilly-2	0	0	0
Point Lepreau	0	0	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	B	B

To be able to respond effectively to an emergency, licensees must establish a consolidated emergency plan, an emergency preparedness program under the plan, 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 review of the facility's staff during a simulated nuclear accident provides an assessment of the emergency response capability.

In 2001, CNSC staff evaluated a full scale emergency exercise at Darlington and the emergency preparedness program at Point Lepreau. Both evaluations, as well as ongoing compliance activities at other sites, have found that licensees programs and performance meet or exceed CNSC requirements. Consequently, CNSC staff judges that emergency preparedness continues to be 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	A	B	A	C	A	B	A	B	A	C	A	C	A

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 requires licensees to have programs in place to identify, control and monitor all releases of radioactive and hazardous substances from their plants. CNSC staff's reviews of environmental performance include:

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

In 2001, data on airborne emissions and liquid releases of radioactive substances for all stations showed releases to the environment were consistently well below the *derived release limits* (DRL). As well, doses to the most exposed members of the public were well below the regulatory limits. As in previous years, these results continue a strong trend throughout the industry. Furthermore, licensees consistently exceed all applicable CNSC requirements in controlling radioactive effluent releases and dose to members of the public.

In response to previous CNSC evaluations, Darlington, Point Lepreau and Gentilly-2 are improving their environmental programs. In the case of Gentilly-2, CNSC staff is concerned with some delays in implementing corrective actions. However, staff is satisfied that the environmental programs will meet requirements when licensees complete their current improvements plans.

REVIEW OF UNPLANNED RELEASES

CNSC staff has a requirement for licensees to report any unplanned releases of radioactive material or other controlled substance to the environment.

In May 2001, an unplanned liquid release of tritium occurred at the Darlington site. OPG initiated an analysis of this event, identified the root causes and implemented procedural and engineering changes to reduce the risk of a recurrence. There were no other unplanned releases from any site.

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

Radiation protection is the program that 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.

During the past year, CNSC staff's reviews have found that licensees continue to adequately manage radiation doses, as no worker received a radiation dose in excess of the regulatory limits. However, at Gentilly-2, a CNSC staff audit revealed weaknesses in adherence to radiation protection procedures for working with tritiated heavy water.

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 the licensee's:

- 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 communication equipment.

Licensees are required to have a sufficient number of trained and properly equipped security staff available at all times. Also their sites must be continuously monitored and they must take appropriate action for any security breaches. 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 2001, the results of CNSC staff security evaluations indicate that licensees were in compliance with the Nuclear Security Regulations and, as required, undertook the necessary improvements to resolve any security deficiency.

Following the terrorists events of September 11, 2001, and based on new information received from Canadian and international security agencies, CNSC staff conducted detailed reviews of the security status of all facilities subject to the Nuclear Security Regulations. Subsequent to these reviews and other independent threat/vulnerability studies, the CNSC issued and Order pursuant to the Nuclear Safety and Control Act. The Order requires licensees to implement augmented physical protection measures to deal with the increased security threat and to conduct further vulnerability assessments. CNSC staff's assessments have found that all licensees are progressing satisfactorily in implementing the requirements of the Order and making the necessary changes to their security measures.

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, Regulations and 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. The latter includes providing access and assistance to IAEA inspectors for verification purposes as well as for the installation and maintenance of IAEA equipment.

In 2001, CNSC staff has assessed all licensees as meeting the requirements with respect to safeguards. All reports required by the IAEA were provided. All licensees cooperated with the IAEA to successfully accomplish routine inspection activities, including design information verification and the annual simultaneous physical inventory verification.

GLOSSARY

Commission member documents (CMD)
A CMD is a document that the Commission refers to in making its licensing decisions. Based on the CNSC staff recommendations presented in the CMD, together with information supplied by the licence applicant and by interest groups or members of the public, the Commission is required to make a decision on whether to approve or reject a licence application.

derived release limits (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 fuel channels in the reactor. The feeders are pipes attached to each end of the fuel 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 moderator which absorbs neutrons and hence, removes them from the fission chain reaction, or draining the moderator from the reactor.

International Atomic Energy Agency (IAEA)
A United Nations agency, it provides a system of safeguards to make sure that states do not divert nuclear materials to non-peaceful activities. It also provides an international forum for nuclear safety.

layed-up state
The station is placed in a special configuration which prevents 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 statement
These CNSC documents contain requirements and guidelines for compliance. However, the CNSC may allow variations, or consider alternative means of attaining the same objectives where a satisfactory case is made.

safeguards
An international program of monitoring and inspection carried out by staff of the International Atomic Energy Agency. Safeguards ensure that nuclear materials in the station are not diverted for non-peaceful uses.

serious process failures
A failure in the stations= components or systems, which is sufficiently serious that one or more of the special safety systems must operate to prevent reactor damage.

setback
A system designed to automatically reduce reactor power 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 if a problem occurs. The stepack system is part of the reactor regulating system.

systematic approach to training
A logical progression from the identification of training needs and of the 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.