Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

REGULATORY STANDARD

Reliability Programs for Nuclear Power Plants

S-98

December 2001

Canada

REGULATORY DOCUMENTS

The Canadian Nuclear Safety Commission (CNSC) operates within a legal framework that includes law and supporting regulatory documents. Law includes such legally enforceable instruments as acts, regulations, licences and orders. Regulatory documents such as policies, standards, guides, notices, procedures and information documents support and provide further information on these legally enforceable instruments. Together, law and regulatory documents form the framework for the regulatory activities of the CNSC.

The main classes of regulatory documents developed by the CNSC are:

Regulatory policy: a document that describes the philosophy, principles and fundamental factors used by the CNSC in its regulatory program.

Regulatory standard: a document that is suitable for use in compliance assessment and describes rules, characteristics or practices which the CNSC accepts as meeting the regulatory requirements.

Regulatory guide: a document that provides guidance or describes characteristics or practices that the CNSC recommends for meeting regulatory requirements or improving administrative effectiveness.

Regulatory notice: a document that provides case-specific guidance or information to alert licensees and others about significant health, safety or compliance issues that should be acted upon in a timely manner.

Regulatory procedure: a document that describes work processes that the CNSC follows to administer the regulatory requirements for which it is responsible.

Document types such as regulatory policies, standards, guides, notices and procedures do not create legally enforceable requirements. They support regulatory requirements found in regulations, licences and other legally enforceable instruments. However, where appropriate, a regulatory document may be made into a legally enforceable requirement by incorporation in a CNSC regulation, a licence or other legally enforceable instrument made pursuant to the *Nuclear Safety and Control Act*.

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Published by the
Canadian Nuclear Safety Commission
December 2001

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Catalogue number CC173-3/3-98E
ISBN 0-662-29396-7

Ce document est également disponible en français.

Document availability

This document can be viewed on the CNSC website (www.nuclearsafety.gc.ca). To order a print copy of the document in English or French, please contact:

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RELIABILITY PROGRAMS FOR NUCLEAR POWER PLANTS

1.0 PURPOSE

The purposes of this regulatory standard are:

- To help an applicant for a nuclear power plant construction or operating licence develop a reliability program that assures that the "risk-significant systems" of the plant can and will meet their defined design and performance specifications at acceptable levels of reliability;
- To describe the reliability program for risk-significant systems that the licensee shall develop, submit or implement when required to do so by a condition of a licence to construct or operate a nuclear power plant; and
- To help the Canadian Nuclear Safety Commission (CNSC) evaluate the adequacy of reliability programs for risk-significant systems of nuclear power plants.

2.0 SCOPE

This regulatory standard describes the reliability program that the CNSC may require in connection with a licence to construct or operate a nuclear power plant.

When appropriately incorporated into an operating licence for a nuclear power plant, this standard and its contents are mandatory. In other situations, the standard and its contents constitute guidance to interested persons, such as to licence applicants, licensees and CNSC staff, on what reliability programs for nuclear power plants should typically entail.

3.0 DEFINITIONS

Within this regulatory standard:

- A **nuclear power plant** (NPP) is any fission-reactor installation that has been constructed to generate electricity on a commercial scale. A nuclear power plant is a Class IA nuclear facility, as defined in the *Class I Nuclear Facilities Regulations*.
- A **reliability program** for a NPP is a formal program to ensure that the risk-significant systems of the plant can and do function safely, reliably, and effectively, in accordance with any design and performance criteria set out in a relevant safety target or a CNSC licence.
- A **risk-significant system** of a NPP is any system of the plant that, if it fails to meet its design and performance specifications, could result in unreasonable risk to the health and safety of persons, to national security or to the environment.

4.0 BACKGROUND

4.1 Regulatory framework

The CNSC is the federal agency that regulates the use of nuclear energy and materials to protect health, safety, security and the environment, and to respect Canada's international commitments on the peaceful use of nuclear energy.

The *Nuclear Safety and Control Act* ("*NSC Act*", or "Act") requires persons or organizations to be licensed by the CNSC for carrying out the activities referred to in section 26 of the Act, unless otherwise exempted. The associated regulations stipulate prerequisites for CNSC licensing, and the obligations of licensees and workers.

4.2 CNSC licensing process

The CNSC typically applies a phased process to its licensing of nuclear facilities and activities. For major facilities, this process begins with a consideration of the environmental impacts of the proposed project, and proceeds progressively through site preparation, construction, operation, decommissioning and abandonment phases.

The *NSC Act* and regulations require licence applicants to provide certain information at each licensing stage. The type and level of detail of this information will vary to accommodate the licensing stage and specific circumstances.

At all licensing stages, applications may incorporate (directly or by reference) new or previously submitted information, in accordance with legislated requirements and the best judgement of the applicant. An application that is submitted at one licensing stage can become a building block for the next stage.

Upon receipt of an application that is complete, the CNSC reviews it to determine whether the applicant is qualified to carry on the proposed activity, and has made adequate provision 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. If satisfied, the CNSC may issue, renew, amend or replace a licence that contains relevant conditions. Typically, this licence will incorporate the applicant's undertakings and will contain other conditions that the CNSC considers necessary, including those that reference or incorporate a CNSC regulatory standard.

4.3 Relevant legislation and justification

The *NSC Act* and its regulations do not contain express references to reliability programs at NPPs. However:

- The stated purpose of the *NSC Act* includes providing for "the limitation, to a reasonable level and in a manner that is consistent with Canada's international obligations, of the risks to national security, the health and safety of persons and the environment that are associated with the development, production and use of nuclear energy and the production, possession and use of nuclear substances, prescribed equipment and prescribed information".
- Accordingly, if the risks from the operation of a NPP are to be limited to a reasonable level, the plant must operate within some requisite bounds of overall safety. This overall safety can only be assured when the risk-significant systems of the NPP are (a) capable of adequately performing their purposes, and (b) available to do so. Thus, the risk-significant systems of the plant must function at a certain level of "reliability" if the associated risks to the health and safety of persons and the environment are to be limited to a reasonable level, in accordance with the purpose of the *NSC Act*.
- Under subsection 24(5) of the *NSC Act*, a licence that is issued by the Commission may contain any term that the Commission considers necessary for the purpose of the Act.

Thus, the dependency of the safety of a NPP on the reliability of its risk-sigificant systems, and the authority of subsection 24(5) of the *NSC Act,* are the justifications for this standard and its intended application.

5.0 RELIABILITY PROGRAM

5.1 Program objective

The objective of the reliability program described in this standard is to ensure that the risk-significant systems of the NPP can and do function reliably, in accordance with the relevant design, performance, and safety criteria, including the safety targets of the plant and CNSC licence requirements.

5.2 Program requirements

A reliability program for a NPP shall:

(a) identify the risk-significant systems of the NPP;
(b) rank the risk-significant systems of the NPP on the basis of their relative risks to health, safety, national security and the environment;

(c) specify reliability targets for the risk-significant systems of the NPP;
(d) identify and describe the potential failure modes of the risk-significant systems of the NPP;
(e) specify the minimum capabilities and performance levels that the risk-significant systems of the NPP must attain to achieve reliabilities that are consistent with the safety targets of the NPP and the regulatory requirements;
(f) include provisions for maintaining the effectiveness of the risk-significant systems of the NPP;
(g) provide for inspections, tests, modelling, monitoring or other measures to effectively assess the reliability of the risk-significant systems of the NPP;
(h) include provisions to assure, verify and demonstrate that the program is implemented effectively, in accordance with the safety objective described in subsection 5.1 of this standard;
(i) include provisions for recording and reporting the results of program activities, including assessments, inspections, tests, or monitoring of the reliability of the risk-significant systems of the NPP; and
(j) document, clearly and comprehensively, the activities, attributes, elements, results and administration of the program, including:
- the activities that make up the program;
- the procedures and schedules for conducting the program activities;
- the licensee's organization for managing and implementing the program, including the specific positions, roles, and responsibilities of the persons involved;
- the risk-significant systems of the NPP and their relative risks to health, safety, national security and the environment;
- the potential failure modes of the risk-significant systems of the NPP;
- the methods used to determine the potential failure modes of the risk-significant systems of the NPP;
- the assessment, inspection, monitoring, testing, verification, recording and reporting activities that the licensee will carry out to assure, verify, demonstrate or document that the reliability program is implemented correctly and effectively in accordance with regulatory requirements; and
- the results of the assessment, inspection, monitoring, testing, verification, and reporting activities carried out as part of the reliability program.