Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Regulatory Guide

G–323

Ensuring the Presence of Sufficient Qualified Staff at Class I Nuclear Facilities – Minimum Staff Complement

July 2007

Canada

TYPES OF REGULATORY DOCUMENTS

Regulatory documents support the Canadian Nuclear Safety Commission (CNSC) regulatory framework. By expanding on expectations set out in general terms in the *Nuclear Safety and Control Act* and associated regulations, regulatory documents provide one of the core management tools upon which the CNSC relies to fulfill its legislated obligations.

The regulatory documents most commonly published by the CNSC are *regulatory policies*, *regulatory standards*, and *regulatory guides*. At the highest level, regulatory policies provide the direction for regulatory standards and guides, which serve as the policy "instruments." A fourth type of regulatory document, the *regulatory notice*, is issued when warranted. Because the information in a *regulatory notice* must be conveyed with relative urgency, the development process is faster than that applied to the other documents.

Regulatory Policy (P): The regulatory policy describes the philosophy, principles or fundamental factors on which the regulatory activities associated with a particular topic or area of concern are based. It describes why a regulatory activity is warranted, and therefore promotes consistency in the interpretation of regulatory requirements.

Regulatory Standard (S): The regulatory standard clarifies CNSC expectations of what the licensee should do, and becomes a legal requirement when it is referenced in a licence or other legally enforceable instrument. The regulatory standard provides detailed explanation of the outcomes the CNSC expects the licensee to achieve.

Regulatory Guide (G): The regulatory guide informs licensees about how they can meet CNSC expectations and requirements. It provides licensees with a recommended approach for meeting particular aspects of the requirements and expectations associated with their respective licensed activities.

Regulatory Notice (N): The regulatory notice notifies licensees and other stakeholders about significant matters that warrant timely action.

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Document availability

The document can be viewed on the CNSC web site at www.nuclearsafety.gc.ca. Copies may be ordered in English or French using the contact information below:

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ENSURING THE PRESENCE OF SUFFICIENT QUALIFIED STAFF AT CLASS I NUCLEAR FACILITIES – MINIMUM STAFF COMPLEMENT

1.0 PURPOSE

The purpose of this regulatory guide is to assist Class I nuclear facility licensees and applicants for a Class I nuclear facility licence to demonstrate to the CNSC that they will ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the *Nuclear Safety and Control Act* (NSCA, the Act), the regulations made under the NSCA, and their license.

2.0 SCOPE

This regulatory guide sets out information related to the staffing of a Class I nuclear facility that should typically be included in an application for the issuance, renewal, amendment, or replacement of a licence to operate a facility. The guide sets out the key factors that CNSC staff will take into account when assessing whether the licensee has made or the applicant will make adequate provision for ensuring the presence of a sufficient number of qualified staff. This guide addresses staffing levels required to respond to the most resource-intensive conditions under all operating states, including normal operations, anticipated operational occurrences, design basis accidents, and emergencies.

Expectations for use of this guide will vary with the complexity of facility operations and the consequences of potential events on the environment, health and safety of persons, and maintenance of national security and measures required to implement international obligations.

3.0 RELEVANT LEGISLATION

The sections of the NSCA and the regulations made under the NSCA relevant to this regulatory guide are as follows:

1. Paragraph 24(4)(*a*) of the NSCA states that "No licence may be issued, renewed, amended or replaced unless, in the opinion of the Commission, the applicant is qualified to carry on the activity that the licence will authorize the licensee to carry on;"
2. Subsection 24(5) of the NSCA authorizes the CNSC to include terms or conditions in licences that it considers necessary;

3. Paragraph 12(1)(*a*) of the *General Nuclear Safety and Control Regulations* requires every licensee to "ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the NSCA, the regulations made under the NSCA, and the licence;"

4. Paragraph 3(1)(*n*) of the *General Nuclear Safety and Control Regulations* stipulates that an application for a licence shall contain "at the request of the Commission, any other information that is necessary to enable the Commission to determine whether the applicant (*i*) is qualified to carry on the activity to be licensed, or (*ii*) will, in carrying on that activity, make 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;"

5. Section 5 of the *General Nuclear Safety and Control Regulations* specifies that an application for the renewal of a licence shall contain "the information required to be contained in an application for that licence by the applicable regulations made under the Act," as well as "a statement identifying the changes in the information that was previously submitted;"

6. Paragraph 3(1)(*k*) of the *General Nuclear Safety and Control Regulations* specifies that an application for a licence shall contain the "applicant's organizational management structure insofar as it may bear on the applicant's compliance with the Act and the regulations made under the Act, including the internal allocation of functions, responsibilities and authority;"

7. Section 6(a) of the *General Nuclear Safety and Control Regulations* requires that an application for the amendment, revocation or replacement of a licence shall contain "a description of the amendment, revocation, or replacement and of the measures that will be taken and the methods and procedures that will be used to implement it;"

8. Section 6(b) of the *General Nuclear Safety and Control Regulations* requires that an application for the amendment, revocation or replacement of a licence shall contain "a statement identifying the changes in the information contained in the most recent application for the licence;"

9. Paragraph 6(d) of the *Class I Nuclear Facilities Regulations* specifies that an application for a licence to operate a Class I nuclear facility shall contain "the proposed measures, policies, methods and procedures for operating and maintaining the nuclear facility;"

10. Paragraph 6(m) of the *Class I Nuclear Facilities Regulations* specifies that an application for a licence to operate a Class I nuclear facility shall contain "the proposed responsibilities of and qualification requirements and training program for workers, including the procedures for the requalification of workers;"

11. Paragraph 6(n) of the *Class I Nuclear Facilities Regulations* specifies that an application for a licence to operate a Class I nuclear facility shall contain "the results that have been achieved in implementing the program for recruiting, training and qualifying workers in respect of the operation and maintenance of the nuclear facility;" and
12. Subsection 9(2) of the *Class I Nuclear Facilities Regulations* specifies that the Commission or a designated officer is authorized under paragraph 37(2)(*b*) of the NSCA to certify a person referred to in paragraph 44(1)(*k*) of the NSCA.

4.0 BACKGROUND

All Class I nuclear facility licensees are required to ensure the presence of a sufficient number of qualified workers to carry on the licensed activity safely and in accordance with the NSCA, the regulations made under the NSCA, and the facility licence. One aspect of ensuring the presence of a sufficient number of qualified workers is defining the minimum number of workers with specific qualifications who will be available to the nuclear facility at all times, known as the minimum staff complement. The number and qualifications of workers in the minimum staff complement should be adequate to successfully respond to all credible events, including the most resource-intensive conditions for any facility state.

5.0 EXPECTATIONS

5.1 Basis for Minimum Staff Complement of Qualified Workers

5.1.1 Use of a Systematic Analysis

It is expected that the minimum staff complement is determined by the licensee through a systematic analysis. An analysis of tasks should be performed to determine the minimum staff complement requirements for personnel available to the nuclear facility. The analysis should include those tasks carried out in the main control room (MCR) and in secondary control areas, where they exist. For Class I nuclear facilities that modify their minimum staff complement for different operational states, the most resource-intensive conditions for each operational state should be analyzed.

The analysis to determine the minimum staff complement requirements should consider the following:

1. The actions required in the facility and their timing for the full range of the most resource-intensive conditions under all operating states, including normal operations, anticipated operational occurrences, design basis accidents, and/or emergencies.
2. The most resource-intensive initiating events and credible failures considered in the Safety Analysis Report and the Probabilistic Safety Assessment;

3. The operating strategies that define how the nuclear facility personnel respond to anticipated operational occurrences, design basis accidents, and emergencies;
4. The required interactions among facility personnel for the purpose of diagnosing, planning, communicating, coordinating and controlling anticipated operational occurrences, design basis accidents, and emergencies;
5. The staffing demands required for the possible concurrent use of procedures related to anticipated operational occurrences, design basis accidents, and emergencies;
6. The staffing demands required to monitor indicators, displays and alarms and to promptly and effectively operate the facility's equipment controls using procedures related to anticipated operational occurrences, design basis accidents, and emergencies;
7. The staffing demands required to perform tasks in field locations using procedures related to anticipated operational occurrences, design basis accidents, and emergencies;
8. The staffing demands required for the successful completion of any safety-critical human actions using procedures related to anticipated operational occurrences, design basis accidents, and emergencies;
9. The additional staffing demands when independent verification of task completion is specified in procedures related to anticipated operational occurrences, design basis accidents, and emergencies;
10. The staffing strategy to provide for qualified staff for unplanned situations under anticipated operational occurrences, design basis accidents, and emergencies;
11. The staffing strategy to ensure the provision of qualified relief for workers; and
12. The restrictions on the location of workers within the nuclear facility.

5.1.2 Validation of Minimum Staff Complement Requirements

It is expected that the minimum staff complement requirements are validated by the licensee to provide assurance that there is, at all times, a sufficient number of qualified workers available to operate the facility safely and to respond to the most resource-intensive conditions under all operating states, including normal operations, anticipated operational occurrences, design basis accidents, and/or emergencies.

When designing the method of validation, licensees should meet the expectations found in the CNSC's regulatory guide on *Human Factors Verification and Validation Plans* and international standards on human performance evaluation techniques, such as the Institute of Electrical and Electronics Engineers' *IEEE Guide for the Evaluation of Human-System Performance in Nuclear Power Generating Stations*, as referenced in the "Associated Documents" section of this regulatory guide.

5.1.2.1 Range of Validation Scenarios

Validation scenarios should include the most resource-intensive credible events, including those that involve coincident anticipated operational occurrences, design basis accidents and emergencies.

For Class I nuclear facilities that modify their minimum staff complement for different operational states, the most resource-intensive scenarios for each operational state should be validated.

For multi-unit nuclear power plants, validation scenarios should include the most resource-intensive events that could affect more than one unit, such as, but not limited to, seismic events, loss of off-site power and steam line or feedwater line breaks.

5.1.2.2 Objectives of Validation Exercises

The validation exercises should demonstrate that the following can be achieved by the minimum staff complement for all validation scenarios:

1. The relevant procedures can be effectively implemented in a timely manner;
2. There is an effective and timely response to anticipated operational occurrences, design basis accidents, and emergencies;
3. The facility can be effectively monitored, controlled and stabilized;
4. There is effective communication and coordination of required actions;
5. Workers are able to maintain awareness of facility conditions;
6. The physical and mental workload of minimum staff complement is achievable; and
7. All safety-critical human actions are achievable.

5.1.3 Systematic Approach to Training

It is expected that the principles of a systematic approach to training are applied to all positions included in the minimum staff complement.

5.1.4 Minimum Staff Complement for Nuclear Power Plants

In addition to certified operations personnel, it is expected that the minimum staff complement at nuclear power plants will include a number of workers with specialized qualifications, such as:

1. Fuel handling operators when fuelling;
2. Chemical, mechanical, and electrical maintainers;
3. Emergency response personnel; and

4. Stores personnel.

A decision not to include any of these positions should be justified by the licensee.

5.2 Implementation of the Minimum Staff Complement

5.2.1 Documentation

The method followed to determine the minimum staff complement requirements and the results obtained from the analysis should be documented.

5.2.2 Minimum Staffing Procedures

Minimum staffing requirements should be formalized by the licensee in a procedure. This minimum staff complement procedure should include the following:

1. The specific number of staff to be present on-site, in the facility, and in the MCR (if one exists), and the composition of the minimum staff complement with reference to specific positions or qualifications;
2. For nuclear facilities that modify their minimum staff complement for different operational states, the specific number and composition of the minimum staff complement with reference to specific positions or qualifications for each operational state;
3. Consistent terminology when referring to specific positions or staff qualifications;
4. The specific restrictions on the location of individuals in the facility (for example, it may be necessary to limit the location of certain workers within the facility if they must be able to return to the MCR within a specified time limit);
5. A description of the measures in place to monitor compliance with the minimum staff complement and to prevent non-compliance with the minimum staff complement; and
6. Specific actions to be taken to reduce the risk to the facility in the event of non-compliance with the minimum staff complement.

5.2.3 Design Basis Accident Procedures

There should be a documented basis for staffing requirements for each design basis accident procedure that is based on an analysis using sections 5.1.1 and 5.1.2 of this regulatory guide.

The number of qualified workers required in the MCR (if one exists) and in the remainder of the nuclear facility should be clearly stated on the coversheet of the design basis accident procedure. Where there are separate procedures for field actions, the number of qualified workers required to successfully complete these actions should be clearly stated in each procedure.

5.3 Compliance with the Minimum Staff Complement

Compliance with the minimum staff complement should be ensured by the following:

1. Licensees should have a process for shift scheduling and accounting that ensures that each minimum staff complement position is filled at all times;
2. The shift scheduling process should ensure that planned and unplanned absences do not lead to non-compliance with the minimum staff complement;
3. The shift turnover process should ensure that minimum staff complement positions are filled at all times;
4. Licensees should have in place a documented fitness-for-duty program that provides confirmation that any person filling a minimum staff complement position does not have a physical or mental limitation that would make the person incapable of performing the duties of the applicable position; and
5. Licensees should have adequate plans in place for addressing short-term (e.g., severe weather) and long-term (e.g., pandemic) threats to the minimum staff complement.

5.4 Periodic Review of the Minimum Staff Complement

The adequacy of the minimum staff complement should be reviewed periodically for the following:

1. There should be methods for ongoing testing of the adequacy of the minimum staff complement. For example, emergency drills and exercises should be carried out regularly using only minimum complement personnel;
2. Internal and external operating experience that identifies performance deficiencies, coordination problems, communications problems, or inadequacies in the availability of workers with the necessary skills should be considered; and
3. Relevant international standards and guidelines should be considered.

5.5 Changes to Minimum Staff Complement

When a change in the minimum staff complement is required, an implementation plan should be developed that demonstrates that the potential for adverse effects on facility operations is minimized.

The plan for implementing changes to the minimum staff complement should consider the following:

1. The basis for the modified staffing levels is analyzed, as described in Section 5.1 of this regulatory guide;
2. The transition from existing to new requirements is effectively managed;

3. Any changes to documentation, staff qualifications, and training programs are effectively implemented in a timely manner;
4. There is an appropriate allocation of time for regulatory review and approval of the proposed changes; and
5. There is an application of lessons learned from the implementation of previous changes.

GLOSSARY

Anticipated operational occurrence (also known as a transient)
An operational process deviating from normal operation which is expected to occur at least once during the operating lifetime of a facility but which, in view of appropriate design provisions, does not cause any significant damage to items important to safety nor lead to accident conditions.

Design basis accident (DBA)
Accident conditions against which a facility is designed according to established design criteria, and for which the damage to the fuel and the release of radioactive material are kept within authorized limits.

Emergency
An abnormal situation that may increase the risk of harm to the health and safety of persons, the environment, or national security, and that requires the immediate attention of the licensee. This would include, but not be limited to, medical events, fires, toxic gas releases, or radioactive releases.

Main control room (MCR)
A room where facility systems can be centrally monitored and controlled by operations personnel.

Minimum staff complement
The minimum number of qualified workers who must be present at all times to ensure the safe operation of the nuclear facility and to ensure adequate emergency response capability.

Normal operation
The operation of the facility within specified operational limits and conditions under all operating states.

Nuclear facility
A facility included in the definition “nuclear facility” set out in Section 2 of the *Nuclear Safety and Control Act* (NSCA, the Act).

Nuclear power plant (NPP)
A fission reactor installation constructed to generate electricity on a commercial scale. This is a Class IA nuclear facility, as defined in the *Class I Nuclear Facilities Regulations*. Where a facility licence is issued for multiple reactors, NPP means all the reactors identified in the licence.

Operating states
States defined under normal operation and anticipated operational occurrences. Normal operating states include starting, power operation, shutting down, shutdown, maintenance, testing, and refueling. Anticipated operational occurrences include loss of normal electrical power and faults such as a turbine trip, malfunction of individual items of a normally running plant, failure to function of individual items of control equipment, and loss of power to the main coolant pump.

Systematic approach to training (SAT)
A phased approach to training consisting of:

1. An analysis phase, which is the identification of the competencies in terms of knowledge and skills required by a position;

2. A design phase, which is the conversion of competency requirements into training objectives and the production of a training plan;

3. A development phase, which is the preparation of the training material to meet the training objectives;

4. An implementation phase, which is conducting the training using the material developed; and

5. An evaluation phase, which is the collection and review of data obtained during each of the phases of the SAT to be followed by appropriate actions to improve training effectiveness.

ASSOCIATED DOCUMENTS

Additional information about legislation, regulations, and topics associated with minimum staff complements may be found in the following documents:

1. Nuclear Safety and Control Act, S.C. 1997, c. 9.

2. General Nuclear Safety and Control Regulations, SOR/2000-202.

3. Class I Nuclear Facilities Regulations, SOR/2000-204.

4. CNSC G-278, Human Factors Verification and Validation Plans (2003).

5. IEEE Standard 845-1999, IEEE Guide for the Evaluation of Human-System Performance in Nuclear Power Generating Stations.

6. Entec UK Ltd. for the Health and Safety Executive (2001). Assessing the Safety of Staffing Arrangements for Process Operations in the Chemical and Allied Industries, Contract Research Report 348/2001.

7. IP and Health and Safety Executive (2004). Safe Staffing Arrangements – User Guide for CRR348/2001 Methodology.

8. Hallbert, B., Sebok, A. and Morisseau, D. (2000). A Study of Control Room Staffing Levels for Advanced Reactors, NUREG/IA-0137.

9. United States Nuclear Regulatory Commission (2004). Technical Basis for Regulatory Guidance for Assessing Exemption Requests from the Nuclear Power Plant Licensed Operator Staffing Requirements Specified in 10 CFR 50.54(m), NUREG/CR-6838.

10. United States Nuclear Regulatory Commission (2002). Human Factors Engineering Program Review Model, NUREG-0711, Rev. 1.

11. United States Nuclear Regulatory Commission (1995). Results of Shift Staffing Study, Information Notice 95-48.

12. United States Nuclear Regulatory Commission (1997). Integrated System Validation: Methodology, and Review Criteria, NUREG/CR-6393.