



Reactor Facilities **Licence Application Guide: Licence to Construct a Reactor Facility**

REGDOC-1.1.2, Version 2

September 2020

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Licence Application Guide: Licence to Construct a Reactor Facility

Regulatory document REGDOC-1.1.2

© Canadian Nuclear Safety Commission (CNSC) 20XX

Cat. No. NNNNN

ISBN NNNNN

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Également publié en français sous le titre : Guide de présentation d'une demande de permis : Permis de construction d'une installation dotée de réacteurs

Document availability

This document can be viewed on the [CNSC website](#). To request a copy of the document in English or French, please contact:

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Twitter: [@CNSC_CCSN](https://twitter.com/CNSC_CCSN)

LinkedIn: linkedin.com/company/cnscccsn

Publishing history

August 2011 RD/GD-369, *Licence Application Guide: Licence to Construct a Nuclear Power Plant*

August 2019 REGDOC-1.1.2, *Licence Application Guide: Licence to Construct a Nuclear Power Plant*

[month year] REGDOC-1.1.2, *Licence Application Guide: Licence to Construct a Reactor Facility*,
Version 2

Preface

This regulatory document is part of the CNSC's reactor facilities series of regulatory documents, which also covers site suitability and licence application guides for other lifecycle stages for reactor facilities. The full list of regulatory document series is included at the end of this document and can also be found on the [CNSC's website](#).

Regulatory document REGDOC-1.1.2, *Licence Application Guide: Licence to Construct a Nuclear Reactor Facility* sets out requirements and guidance on submitting an application to the CNSC to obtain a licence to construct a reactor facility in Canada, and identifies the information that should be included in the application.

This document is the second version, and supersedes REGDOC-1.1.2, *Licence Application Guide: Licence to Construct a Nuclear Power Plant*, published in August 2019. It will be used to assess licence applications for proposed new reactor facilities. Once the Commission has granted a licence, the safety and control measures described in the licence application and the documents needed to support the application will form part of the licensing basis.

The licence application and the documents needed to support it become the reference safety case for the reactor facility. The information provided with the licence application, including the documents to which the application makes reference, constitutes the construction safety case.

The information that will be required for the operating licence application will be added to the construction safety case. The operating licence application needs to update or make reference to documents previously provided in the preceding construction licence application. This information will constitute the reference safety case for the facility. The reference safety case is then kept up to date over the reactor facility's lifecycle to reflect its current state and condition.

For information on the implementation of regulatory documents and on the graded approach, see REGDOC-3.5.3, *Regulatory Fundamentals*.

The words "shall" and "must" are used to express requirements to be satisfied by the licensee or licence applicant. "Should" is used to express guidance or that which is advised. "May" is used to express an option or that which is advised or permissible within the limits of this regulatory document. "Can" is used to express possibility or capability.

Nothing contained in this document is to be construed as relieving any licensee from any other pertinent requirements. It is the licensee's responsibility to identify and comply with all applicable regulations and licence conditions.

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Licence Application Guide: Licence to Construct a Reactor Facility

1. Introduction

1.1 Purpose

This licence application guide identifies the information to be provided in support of an application for a licence to construct a reactor facility. It sets out requirements and guidance on submitting an application to the Canadian Nuclear Safety Commission (CNSC) to obtain a licence.

By following the information in this regulatory document, applicants will submit the appropriate information to demonstrate that they are qualified and will 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.

1.2 Scope

This document will be used:

- by applicants to prepare a licence application for a licence to construct a proposed new reactor facility at a new or existing site
- by CNSC staff to assess the licence application

Where appropriate, this document may be used in conjunction with REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents* [1].

Note: This application guide covers facility design, construction and fuel-out commissioning. It also provides information that should be considered in planning for operation.

1.3 Relevant legislation

The following provisions of the *Nuclear Safety and Control Act* (NSCA, the Act) and the regulations made under it are relevant to this document:

- NSCA, subsection 24(4) and paragraphs 26(a) and (e)
- *General Nuclear Safety and Control Regulations* (GNSCR), subsection 3(1.1)

Other relevant sections of the regulations made under the NSCA are included in the content of this document. Appendix A maps a list of relevant clauses from the NSCA and the regulations made under the NSCA to the related sections of this licence application guide.

The applicant must also comply with all applicable laws and regulations at all jurisdictional levels.

Note: This regulatory document includes select requirements that are based on the NSCA and the regulations made under the NSCA. While each section of the regulatory document addresses select requirements related to the safety and control area (SCA) or other topic of regulatory interest being discussed, applicants are responsible for ensuring that all requirements under the NSCA and regulations for the proposed activities are addressed in an application.

1.4 National and international standards

Key principles and elements used in developing this document are consistent with national and international standards.

1.5 CNSC contact information

A single point of contact from the CNSC is assigned to work with every licensee or applicant. This point of contact can provide the licensee or applicant with additional information or explanation of the information contained within this document.

The applicant should contact the CNSC early in the licence application process, and request the name and contact information of the single point of contact assigned to the licence application.

To contact the CNSC, refer to the [CNSC's website](#).

2. Licensing Basis, Process and Submission

This section provides information on the licensing basis and application process, including completing and submitting the licence application.

The licence application and the documents needed to support it become the reference safety case for the reactor facility, and form part of the licensing basis at the construction licence stage. The information provided with the licence application, including the documents to which the application makes reference, constitutes the construction safety case.

The information that will be required for the operating licence application will be added to the construction safety case. The operating licence application needs to update or make reference to documents previously provided in the preceding construction licence application. This information will constitute the reference safety case for the facility. The reference safety case is then kept up to date over the reactor facility's lifecycle to reflect its current state and condition.

2.1 Background

Under the *Nuclear Safety and Control Act* (NSCA), the CNSC does not certify a reactor design. The following activities may be licensed:

- site preparation for the purpose of constructing or operating a reactor facility
- construction of a reactor facility
- operation of a reactor facility
- decommissioning of a reactor facility
- abandonment of a reactor facility

Licenses can be combined to permit multiple activities. The applicant shall address all regulatory requirements pertaining to each stage of the reactor facility's lifecycle in the licence application.

In most cases, policies, programs, processes, procedures and other safety and control measures developed at the lifecycle phase of site preparation will continue to be used, and will be adapted to support construction and commissioning activities and future facility operation.

2.2 Licensing basis

The licensing basis sets the boundary conditions for a regulated activity, and establishes the basis for the CNSC's compliance program for that regulated activity. The concept of the licensing basis is explained in REGDOC-3.5.3, *Regulatory Fundamentals* [2].

The applicant shall notify CNSC staff of any conflicts between elements of the licensing basis for the proposed licence (for example, conflicts between provincial and federal legislation).

CNSC staff will review both the application and the supporting documentation, and assess whether the information is acceptable. If the Commission issues a licence, the information describing the safety and control measures will form part of the licensing basis.

2.3 Licensing process

REGDOC 3.5.1, *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills* [3], clarifies the licensing process in the context of the NSCA.

In addition to the information provided in this licence application guide (REGDOC-1.1.2), the CNSC may request additional information by sending supplemental, facility-specific guidance to the applicant prior to the beginning of the licensing process.

The licensing process is initiated when the applicant submits a licence application. The CNSC may request additional information from the applicant, even if the application generally conforms to the guidelines provided in this document. Applicants should ensure they have included sufficiently detailed information to allow the licensing process to proceed efficiently; early engagement with CNSC staff is encouraged.

Note: The information provided in this document does not prevent applicants from proposing alternative ways to meet a requirement. However, any proposed alternative should appropriately reflect the complexities and hazards of the proposed activities, and must be demonstrated by supporting information.

2.4 Structuring the licence application

The application may be completed in either of Canada's official languages (English or French).

This licence application guide describes the expected safety and control measures, organized by the CNSC's safety and control area (SCA) framework. The CNSC uses SCAs as the technical topics to assess, review, verify and report on regulatory requirements and performance across all regulated facilities and activities, as follows (see appendix B):

- management system
- human performance management
- operating performance
- safety analysis
- physical design
- fitness for service
- radiation protection
- conventional health and safety
- environmental protection
- emergency management and fire protection
- waste management
- security
- safeguards and non-proliferation
- packaging and transport

Each of the 14 SCAs is further divided into specific areas that cover topics addressed in a complete assessment and review.

The applicant may choose to organize the information in any structure. However, the applicant is encouraged to organize the licence application according to the CNSC's SCA framework so as to facilitate the CNSC's review. If the application does not follow the order and organization of SCAs as shown above, the applicant should map the application to the CNSC's SCA framework. References to more detailed supporting documentation may be included in the application.

Appendix C provides the review objectives for an application for a licence to construct a reactor facility. These objectives assist in integrating individual reviews into an overall assessment of the adequacy of a licence application.

2.5 Completing the licence application

The applicant is responsible for ensuring that the licence application contains sufficient information to meet regulatory requirements and to demonstrate that the applicant is qualified to carry on the licensed activity and will make adequate provision to protect the health, safety and security of persons and the environment. The applicant may provide cross-references to detailed information in other sections as appropriate.

The application should cite CNSC regulatory documents, and other codes and standards that will govern program objectives that demonstrate the applicant's ability to implement the safety and control measures.

Early in the licensing process, the CNSC will provide the applicant with the appropriate version (publication date and revision number) of each document to be cited through supplemental guidance. The supplemental guidance may also indicate additional documents that the applicant should consider and address in the application.

The applicant may provide references to documents that were previously provided in a pre-licensing vendor design review (VDR) submission. For a design that has undergone the VDR process, relevant supporting information would be considered in the context of the application for a licence to construct. An application for a licence to construct a reactor facility should provide a list of the application's supporting documents and clearly identify which information has already been submitted to the CNSC (for example, as part of a previous licence application or for another purpose). The supporting documents describe the safety policies, programs, processes, procedures, and other safety and control measures. Appendix C provides a sample format for applicants to map their supporting documents to the SCA framework. **Note:** If the document version in the supporting information has changed, the applicant must provide the CNSC with the new version number and a revised copy of the document.

The application should indicate the relevant sections of each supporting document.

In the case of a licence renewal:

- The applicant shall submit improvement plans and significant activities to be carried out during the proposed licence period. These improvements include activities such as programmatic changes and major hardware modifications, replacements or repairs. Where changes are planned for the purposes of meeting new standards or practices, the applicant shall identify the standard to be met and provide an implementation plan that includes target dates for implementation.
- The applicant shall provide a statement of performance assessment that includes significant findings and lessons learned over the previous licence period. This statement should describe, at a minimum:
 - industrial safety performance history
 - past performance under each SCA
 - significant findings that affect or have previously affected the conduct of licensed activities

- significant lessons learned from operating experience (OPEX)
- results from major self-assessments
- how the applicant:
 - has addressed any follow up actions from any environmental reviews conducted during the current licensing period
 - will address any ongoing or outstanding follow up actions
- The applicant should describe any additional planned changes that may affect the applicant's ability to carry on the licensed activities (for example, significant organizational or management changes).

2.6 Submitting the licence application

The applicant should ensure that the application is complete, dated and signed by the appropriate authority, and that all supporting documents are clearly identified and cross-referenced. All information submitted is subject to the *Access to Information Act* and the *Privacy Act*. It is the responsibility of the applicant to identify and justify any material that is not suitable for disclosure (that is, subject to confidentiality requirements). Submitted information may be presented to the Commission to support the licensing decision. Any such information is also made available to the public on request, subject to confidentiality requirements.

If the licence application is subject to the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*, the applicant should ensure that payment is enclosed. For further details, contact the CNSC Cost Recovery Advisory Group at 613-995-5894 or toll-free at 1-888-229-2672, or through the [CNSC's website](#).

Applicants are strongly encouraged to submit the documents in electronic format (for example, on secure memory devices).

The applicant may choose instead to submit the licence application in printed (hard-copy) format; in this case, the applicant should submit two printed copies of the application (signed and dated) to the Commission at:

Commission Secretary
Canadian Nuclear Safety Commission
P.O. Box 1046, Station B
280 Slater Street
Ottawa, ON K1P 5S9

As required by section 27 of the *General Nuclear Safety and Control Regulations*, the applicant or licensee shall keep a record of all information relating to the licence that is submitted by the applicant or licensee to the Commission.

Note that prescribed information, such as details of the security program, may be transmitted only by secure means, such as letter mail or encrypted secure memory devices. It is prohibited to submit prescribed information via unencrypted email. Guidance for the protection and transmission of prescribed information can be found in REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material* [4] and the Treasury Board of Canada Secretariat *Policy on Government Security* [5].

3. Applicant's General Information

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(a), (b), (c), (d) and (k), and section 15
- *Class I Nuclear Facilities Regulations*, paragraphs 3(a), (b), (c), (e) and (i)
- *Nuclear Security Regulations*, paragraph 3(b) and section 16

The licence application shall include the following general information to satisfy the regulations, and should also include some additional general information, as listed below. The applicant may identify appropriate information and documents as being subject to confidentiality requirements.

3.1 Identification and contact information

3.1.1 Applicant's name and business address

The applicant shall provide the applicant's name and business address.

The name should be that of the person or organization applying for the licence, as it appears on the proof of legal status documentation (such as the proof of incorporation or sole proprietorship). The applicant should name an individual only if that person is a sole proprietor or will be solely responsible for the licence.

The business address should be the legal, physical address of the applicant's head office, including the complete street name and number, rural route number if appropriate, city, province or territory, and postal code. A post office box number is not acceptable for a head office address.

The applicant should notify the Commission within 15 days of any changes to this information.

3.1.2 Mailing address

If the mailing address is different from the head office address, the applicant should provide the mailing address, including the complete street name and number, rural route number if appropriate, city, province or territory, and postal code.

If no address is provided here, the licence issued in response to the application will be mailed to the head office address. A post office box number is acceptable as a mailing address.

The applicant should notify the Commission within 15 days of any changes to this information.

3.1.3 All persons who have authority to interact for the applicant with the CNSC

The applicant shall notify the Commission of the persons who have authority to act for them in their dealings with the Commission. Also, the applicant shall notify the Commission of any change in the information, within 15 days after the change occurs.

The applicant should provide a list of names, positions and contact information of all persons who are authorized by the applicant to interact with the CNSC. **Note:** The applicant may request that, for security reasons, this information be subject to confidentiality requirements.

3.1.4 Proof of legal status

Applicants should provide proof of legal status by appending proof of incorporation, corporation number or charter. When submitting an application to renew a licence, a revised proof of legal status should be provided if the applicant's original organization name has changed.

If the applicant is a corporation, the application should include the following information:

- corporation's legal name
- corporation number
- date of incorporation
- registered office address (if different from the head office address)

3.1.5 Evidence that the applicant is the owner of the site or has authority from the owner of the site to carry on the activity to be licensed

The applicant shall provide evidence that the applicant is the owner of the site or has authority from the owner of the site to carry on the activity to be licensed.

3.1.6 Identification of persons responsible for management and control of the licensed activity

The application shall contain the applicant's organizational management structure insofar as it may bear on the applicant's compliance with the NSCA and the regulations made under it, including the internal allocation of functions, responsibilities and authority.

The applicant shall notify the Commission of the names and position titles of the persons who are responsible for the management and control of the licensed activity and the nuclear substance, nuclear facility, prescribed equipment or prescribed information encompassed by the licence. The applicant shall notify the Commission of any change in this information within 15 days after the change occurs.

To satisfy these requirements, the applicant should provide a summary list of all persons responsible for management and control of the licensed activity, including:

- names
- positions (job titles)
- contact information (email, telephone, facsimile)
- mailing addresses (if different from the business mailing address); include the complete street name and number, rural route number if appropriate, city, province or territory, and postal code

3.1.7 Billing contact person

The applicant should provide the following information for the person responsible for licence fee payments:

- name
- position
- contact information (email, telephone, facsimile)
- mailing address (if different from the business mailing address); include the complete street name and number, rural route number if appropriate, city, province or territory, and postal code

3.1.8 Legal signing authority

The applicant should provide the name, title and contact information (address, email address and telephone number) of the individual who is signing the application as the applicant authority.

By signing, the applicant authority is indicating that they understand that all statements and representations made in the application and on supplementary pages are binding on the applicant.

3.2 Facility and activities to be licensed

3.2.1 Licence period

The applicant should state the requested licence period (years or months).

The CNSC uses flexible licence periods, which enable it to regulate reactor facilities in a risk-informed manner by adjusting the licence period in consideration of the licensee's previous performance and findings of its compliance verification activities.

3.2.2 Statement of the main purpose

The applicant shall provide:

- information about the activity to be licensed and its purpose
- a description of any nuclear facility, prescribed equipment or prescribed information to be encompassed by the licence

The application should include a general summary description of the reactor facility, the practices and safety concepts, and a comparison of the reactor facility's design and construction with prevailing modern standards and international practices. The description should provide an overall understanding of the reactor facility, without the need to refer to other sections in the licence application.

This information may be provided in summary format; for example, by listing the facilities, equipment or information.

3.2.3 Description of site

The application shall contain:

- a description of the site of the activity to be licensed, including the location of any exclusion zone and any structures within that zone
- plans showing the location, perimeter, areas, structures and systems of the nuclear facility
- a site plan that indicates the location and includes a description of the following, if applicable:
 - the perimeter of the lands on which a high-security site is located
 - the barrier enclosing every protected area
 - the protected areas
 - the unobstructed areas that meet the requirements set out in section 10 [of the *Nuclear Security Regulations*]
 - the structure or barrier enclosing every inner area
 - the inner areas
 - the vital areas

3.2.4 Description of the facility's existing licensing status, if any

If a facility on the site is currently licensed by the CNSC, or a previous licence application is pending, the applicant should provide a description of the licensing status.

3.2.5 Nuclear and hazardous substances

The applicant shall provide:

- the name, maximum quantity and form of any nuclear substance to be encompassed by the licence
- the name, form, characteristics and quantity of any hazardous substances that may be on the site while the activity to be licensed is carried on

The applicant should provide the scientific name of each nuclear and hazardous substance.

This information may be provided in summary format; for example, by providing a table of the nuclear and hazardous substances and the information required for each substance.

3.3 Other relevant information

3.3.1 Certificates and other licences

The applicant should describe the relationship of this application to any previous licences (for example, site preparation) issued by the CNSC for this facility, including any changes to the safety case that was included in any previous licences.

The applicant should reference any other CNSC licences that control other nuclear substances or activities at the reactor facility; for example, licences for nuclear substances and radiation devices, dosimetry service, and import/export of nuclear substances.

3.3.2 Similar facilities

The applicant should provide a list of any similar facilities owned or operated by the applicant that have been assessed and licensed by either the CNSC or any foreign national regulatory body, and a description of the main differences or design improvements made since that earlier licence was granted. The list should include the following information:

- facility name
- location
- description of the facility

3.3.3 Supporting information

Supporting information includes:

- the results of experimental programs, tests or analyses (for example, results of manufacturers' material tests and qualification data, and results of fuel behaviour experimental programs)
- those that have been submitted to, received from, or published by a foreign national regulatory body
- information published by a national agency or an international nuclear agency such as the International Atomic Energy Agency (IAEA) or the International Commission on Radiological Protection (ICRP)

4. Safety Policies, Programs, Processes, Procedures and Other Safety and Control Measures

The applicant's safety policies, programs, processes, procedures and other safety and control measures shall address all relevant sections in the NSCA and the regulations made under the NSCA (see appendix A), and shall also address the CNSC's safety and control areas (SCAs).

The applicant's policies, programs, processes and procedures shall also address other matters of regulatory interest, such as public information and disclosure programs, financial guarantees and Indigenous engagement.

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4.1 Management system

The management system SCA covers the framework that establishes the processes and programs required to ensure an organization achieves its safety objectives, continuously monitors its performance against these objectives, and fosters a healthy safety culture.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(k), 12(1)(a), and 17(c) and (e), and sections 15, 27 and 28
- *Class I Nuclear Facilities Regulations*, paragraphs 3(d) and (f) and 5(g) and (i), , and subsections 14(1), (4) and (5)
- *Nuclear Security Regulations*, subsections 37(1), (2) and (3), and section 38
- *Nuclear Substances and Radiation Devices Regulations*, subsection 36(1)

4.1.1 General considerations

The application should describe the management system programs, processes and procedures that have been or will be put in place to protect health, safety and the environment, and a description of the organizational management structure.

The application should also describe the safety policies, the roles of external safety assessment organizations, and the advisory committees that will advise the management of the organization that will carry out the licensed activities.

4.1.2 Management system

The application should describe how the main features of the applicant's management system are compliant with the relevant requirements of REGDOC-2.1.1, *Management System* [6] and CSA N286, *Management system requirements for nuclear facilities* [7], and how the management system will be implemented.

The application should set out the process for establishing, implementing, assessing and continually improving the management system in line with the twelve management system principles set out in CSA N286 [7], with sufficient detail to ensure that safety is properly considered. The application should describe how the system will address internal and external factors while ensuring that safety is maintained.

The application should demonstrate that:

- the structure of the management system is clear, and it reflects a logical hierarchy of processes and procedures aligned and integrated to the applicant's business purpose and safety culture
- the requisite processes are defined, and the inputs and outputs to each process are clear
Note: Processes may be categorized as:
 - key processes – those providing the main products or services
 - management processes – those setting direction and applying management controls
 - enabling processes – those providing common support and essential services
- process owners have been appointed, and they understand and are fulfilling their roles
- processes and procedures are clear and concise, and where applicable, they are being satisfactorily implemented and complied with

4.1.3 Organization

The application should describe:

- the applicant’s organizational structure and resources, including:
 - verification that adequate organizational structures and resources will be in place to meet the nuclear safety management needs of the licensed facility or activity
 - top-level organizational charts with references to the full organizational charts (including the staffing levels)
- the relationship between the applicant and any other organization with which significant interactions will occur (such as partners or contractors), including:
 - information on how potential effects on nuclear safety management from each relationship will be recognized and addressed
 - confirmation that the applicant is in control of the licensed facility and activities and will not be subject to undue influence by any other organization
- the design principles used to develop the organizational structure; some examples of design principles are:
 - number of layers of hierarchy
 - length of decision-making chains
 - scope of managerial control
 - policy for the use of contracted resources to supplement in-house capability
- the approach taken to ensure the applicant has all the capabilities necessary to provide nuclear safety and ensure the integrity of the safety case, including how the applicant will retain sufficient in-house core capability to:
 - manage the licensed facility and activities
 - prevent degradation of the in-house core capability through over-reliance on contractors
 - maintain technical subject matter expertise for all topics necessary for nuclear safety, including “intelligent customer” roles where expertise is contracted out
 - be an “intelligent customer” for items or services procured from the supply chain
- how the organization will ensure it has sufficient numbers of qualified workers, using the organizational charts:
 - as a vehicle to identify the nuclear safety related positions and underpinning role
 - as a reference to arrangements to control organizational changes and maintain the organizational charts as evergreen documents
 - to set out the resource strategy to:
 - ensure the right resources are available at the right time with the right skills and experience to meet the core capabilities of the organization at all stages of the reactor facility’s lifecycle
 - describe arrangements to review its implementation and ongoing review
 - to describe how aspects of the organization that may lead to vulnerabilities (such as reliance on scarce or singular areas of expertise) are identified and mitigated

The application should describe the resource strategy, indicating the quantity of resources and the mix of disciplines and skills required as construction progresses through the various phases of the project (that is, design, pre-construction, construction, commissioning and operation).

Where project work is being implemented, the application should show how the applicant's resource strategy will be proactively managed to ensure that resource profiles and organizational arrangements remain fit for purpose.

In most cases, the applicant is also the responsible organization that will later operate the reactor facility. Where this is not the case, the responsibility for the reactor facility and its safety continues to reside with the applicant, who must supervise the construction and commissioning activities.

For more information on organizational responsibilities, see appendix E of REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8].

Oversight of contracted work

The applicant shall ensure that, as a contractual obligation:

- the applicant and the CNSC will have right of access to the premises of any supplier to the construction program (including off-site testing)
- all sub-suppliers will provide right of access to their premises by those clients who are suppliers to the construction program (including off-site testing)

The application should describe how the applicant will ensure contracted work (design, procurement and manufacturing, construction and commissioning) is carried out to the required level of safety and quality. Some considerations are:

- establishing an effective commercial or supply chain strategy to enable delivery of safety case requirements
- maintaining an “intelligent customer” capability for all work that may affect nuclear safety that is carried out on its behalf by any of the Tier 1 (main) contractors and suppliers (that is, engineering, procurement and construction (EPC); engineering, procurement and construction management (EPCM); and project management consultants and contractors (PMC+C))
- ensuring the EPC, EPCM or PMC+C contractor maintains an “intelligent customer” capability for all work carried out by the contractor's supply chain that may affect nuclear safety; for example, where a Tier 2 contractor (subcontractor) may use its own supply chain to meet the needs of its Tier 1 customer, and will need to procure items or services appropriately
- issuing specifications that adequately describe the items or services, meet the safety case requirements and identify the required level of quality assurance; some examples are:
 - procurement specification
 - commissioning specification
 - design clarification
 - codes and standards requirements
 - description of any operational constraints
 - review of the specifications and the results of the commissioning activities
 - disposition and resolution of any design-related performance issues with the structures, systems and components (SSCs), in accordance with a formal design change process
- for work with nuclear safety significance, and before placing any contract, evaluating and confirming that EPC, EPCM or PMC+C contractors and suppliers have the organizational, technical and project management capability, capacity and culture to deliver items or services to the specification

- ensuring suppliers have quality management arrangements that are appropriate and consistent with the safety significance of the procured items or services
- ensuring suppliers identify and categorize any deviations from specified requirements, and refer the deviations to the design authority and the authority having jurisdiction for assessment
- ensuring suitable arrangements to mitigate the risk of counterfeit, fraudulent and suspect items (CFSI) entering the supply chain
- ensuring arrangements are in place to capture and act on operational experience feedback from the safety case and supply chain management activities, sharing learning as appropriate within the organization and wider industry
- conducting effective oversight and assurance of the supply chain, including the acceptance of items or services for work with nuclear safety significance

For more information on design and engineering activities, see section 5.1 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. In addition to describing how the expectations in that regulatory document will be met, this application should describe the following elements of the design authority:

- design authority for each lifecycle phase up to and including commercial operation
- other organizations with responsibility for the design of specific parts of the nuclear facility
- the relationship, including authorities, accountabilities, roles and responsibilities between the design authority and the:
 - applicant
 - major technical support organizations
 - prime contractor and sub-contractors
 - procurement organizations
 - commissioning and operations organizations
- prerequisites for transferring the design authority to the operating organization, to ensure the recipient of the design authority has the requisite knowledge, expertise and resources to assume this responsibility

For more information on procurement, manufacturing, construction and commissioning, see REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8].

Readiness for operation

The application should describe the applicant's management system and organizational arrangements for the transition from construction to commissioning to operation. This transition plan should:

- include provisions for recruiting, training, assigning and retaining the required numbers of workers for optimal staffing levels, in a manner consistent with schedules for implementation and workloads
- describe the policies, programs and processes to manage the key functions important to safety, with the timeline and milestones for their development and implementation; some examples of key functions are operations, maintenance and engineering
- describe the arrangements for managing the information, such as an electronic document management system or a paper document management system

- describe the arrangements for the transition or transfer where a contractor's construction and commissioning management system is to be adopted, in whole or in part
- identify the beginning of applicability and the point at which full implementation and control will occur, in line with the transition or transfer of SSCs
- include measures for assessing the suitability and effectiveness of the elements of the transition plan during all stages of the transition

Detailed information on programs pertaining to operation is not needed for a licence to construct; however, the applicant must provide sufficient information to show that adequate provisions have been made in the design to address readiness for operation. This level of detail is intended to facilitate commissioning before fuel load, and to prepare the applicant for the transition to fuel-in commissioning and operation upon receipt of a licence to operate.

4.1.4 Performance assessment, improvement and management review

The applicant should describe the programs covering performance assessment, improvement and management review.

The application should describe the provisions made for an independent and ongoing safety review, including an objective internal self-evaluation program supported by periodic external reviews and taking into account national and international experience and feedback from the nuclear industry.

The application should describe how organizational effectiveness and safety performance are measured, including the use of performance indicators to detect any shortcomings and deteriorations in safety.

The application should describe how organizational changes are managed to prevent degradation of safety performance.

The applicant should demonstrate that the analysis of the causes of significant events will consider technical, organizational and human factors aspects, and that the necessary arrangements have been made to report and analyze near-miss events.

The application should clearly state how the applicant intends to present, promote and assess the key characteristics of good safety performance by all workers at the reactor facility, including contractors and sub-contractors. The application should provide a proposed timeline and milestones for completion of specific detailed safety performance documentation that will be developed later.

4.1.5 Operating experience

The application should describe how the program for feedback of operating experience has been implemented during site evaluation and design activities, and how it will continue during the construction, commissioning and operating phases of the reactor facility's lifecycle. The description should explain how the program addresses how events are identified, recorded, investigated, and reported (both internally and to the CNSC), as well as how findings from these events will be used as an input to promote enhanced safety performance of the workers and to support ongoing demonstrations of the high quality of the construction and commissioning activities for the reactor facility.

The applicant should demonstrate that the program covers feedback of relevant operational experience from other reactor facilities, including the identification of generic problems and the implementation of measures for improvements as required. The applicant should also explain how feedback from non-event-related operational feedback (for example, observation of good practices, lessons learned from post-job briefings) will be collected, analyzed and disseminated.

The operating organization is responsible for problem identification, resolution and continual improvement during construction and commissioning. For more information, see REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8].

The application should provide a proposed timeline and milestones for completion of specific detailed operational experience documentation that will be developed later.

4.1.6 Configuration management and change control

The application should describe the provisions to establish and maintain configuration from initial conception until end of operating life, including:

- demonstrating adherence to:
 - section 7 of REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]
 - CSA N286.10, *Configuration management for high energy reactor facilities* [10]
- ensuring compatible information management technologies between participating organizations for transferring, sharing and storing configuration information
- ensuring interface arrangements between participating organizations for reviews, approvals, releases, design changes, engineering field changes and non-conformances
- notifying the CNSC in cases where configuration changes affect or will affect the submitted design and the licensing basis
- where necessary, obtaining approvals from the authority having jurisdiction

4.1.7 Safety culture

The application should demonstrate that the applicant's approach to foster a healthy safety culture is in accordance with:

- REGDOC-2.1.2, *Safety Culture* [11]
- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]

4.1.8 Records management

The application should describe the provisions for maintaining all required documents and records, including the processes for identifying and categorizing controlled documents. If specific detailed documents and records-related documentation are to be developed later, the application should provide a proposed timeline and milestones for the work.

The application should describe elements of record management control, such as retention periods, methods for indexing and placing records in proper locations, and provisions for security and access.

4.1.9 Business continuity

The application should include a business continuity plan. This plan should provide procedures and information that guide the applicant to respond, recover, resume and restore to a predefined level following disruption. Some examples of disruptions are:

- natural disasters (such as hurricanes, floods, blizzards, earthquakes and fire)
- accidents
- sabotage, including cyber attacks and hacker activity
- labour actions
- loss of a key contractor
- power and energy disruptions
- communication, transport, safety and service sector failure
- pandemic
- environmental events (such as pollution and hazardous materials spills)

For more information, see ISO 22301, *Societal security – Business continuity management systems – Requirements* [12].

4.2 Human performance management

The human performance management SCA covers activities that enable effective human performance through the development and implementation of processes that ensure that a sufficient number of licensee personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(k), and 12(1)(a), (b), (e) and (j), and section 17
- *Class I Nuclear Facilities Regulations*, paragraphs 3(f) and 5(i), (l) and (m), and sections 9, 10, 11 and 12
- *Nuclear Security Regulations*, section 38 (all requirements related to security training)

4.2.1 General considerations

The application should describe the qualifications, adequate numbers, skills and competencies required by workers at the facility.

The description should include the measures to ensure a sufficient number of workers in all job areas, and that workers have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

The application should describe the measures to promote and support human performance at all levels in the organization. The application should demonstrate how the applicant's programs and processes interface to support continuous enhancement of human performance. The application should demonstrate various measures to identify and monitor human performance weaknesses and to correct any organizational deficiencies to minimize human error.

The application should describe the workforce planning process - including measures for knowledge transfer - to ensure that workers are recruited and trained to fill each key role within the organization.

The application should also provide information on the plans to transfer procedures for commissioning to allow an efficient transfer of knowledge to the operating organization.

4.2.2 Human performance program

The application should describe how the human performance program addresses and integrates the range of human factors that influence human performance, including but not limited to:

- the provision of qualified workers
- the reduction of human error
- organizational support for safe work activities
- the continuous improvement of human performance
- monitoring hours of work

The applicant should describe the programs that aim to continuously improve human performance, to take steps to identify human performance weaknesses and to remove human performance-related root causes of events. The application should include plans for developing and updating these programs.

4.2.3 Personnel training

The application shall describe a training system that is in accordance with REGDOC-2.2.2, *Personnel Training* [13].

The applicant shall submit a description of any proposed full-scope training simulator used for the reactor facility and the manner in which the simulator will be used to support commissioning. The application should include information showing how the simulator meets the expectations of section 15 of REGDOC-2.2.3, Volume III, *Certification of Persons Working at Nuclear Power Plants* [14].

The applicant should describe the qualification and training requirements for personnel engaged in the design activities, and the proposed program and schedule for recruiting, training and qualifying workers for work relating to construction, commissioning, operation and maintenance.

The applicant should ensure that personnel engaged in construction and commissioning activities have the appropriate training, qualifications and competence to perform their assigned tasks effectively and safely. For more information, see sections 3.3.3 and 8.2 of REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8].

For certified positions, the training program should be in accordance with REGDOC-2.2.3, Volume III, *Certification of Persons Working at Nuclear Power Plants* [14].

4.2.4 Personnel certification

For positions requiring certification as set out in REGDOC-2.2.3, Volume III, *Certification of Persons Working at Nuclear Power Plants* [14], the application shall include details on the program that will be implemented to achieve the specified requirements for certification training and testing.

The application should describe the program and schedule established for the certification of personnel for work relating to fuel-in commissioning and operation of the reactor facility.

The certification program should include roles and responsibilities of certified positions to support the training programs for certified workers at the reactor facility.

The application should describe how the certification training will be linked to, or build upon, the training programs that are common to other workers.

The application should include any proposed alternate approaches that will be implemented to achieve certification and information on how the training and testing positions for the certification program will be staffed. The application should include information on the qualifications of the examiners and training personnel required to conduct certification-related training and testing on the full-scope training simulator.

The applicant should demonstrate that the training and testing of certified personnel ensure that they have the skills and knowledge necessary to perform the duties required to oversee and supervise fuel-in commissioning activities. The applicant should submit the certification exam results or provide references where appropriate.

For applicants who plan to use previously certified or experienced staff for certified positions, the applicant should show that a gap analysis of their competencies will be done and that the required supplementary training programs will be developed and conducted.

The applicant should demonstrate that the programs ensure that only personnel who hold a CNSC certification for a position are assigned to that position (these positions are directly related to the safe operation of the reactor facility; for example, responsible health physicist, shift manager, authorized nuclear operator).

Where detailed specific certification documentation is to be developed later on, the applicant should provide a proposed timeline and milestones for completion of this work.

4.2.5 Initial certification examinations and requalification tests

The application shall describe an examination program to support workers certification in accordance with REGDOC-2.2.3, Volume III, *Certification of Persons Working at Nuclear Power Plants* [14].

The application shall address the CNSC examination guides EG1, *Requirements and Guidelines for Written and Oral Certification Examinations for Shift Personnel* and EG2, *Requirements and Guidance for Simulator-based Certification Examinations for Shift Personnel at NPPs*, and the document *Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants*, revision 2.

The two examination guides and the document *Requirements for the Requalification Testing of Certified Shift Personnel at Nuclear Power Plants*, revision 2, are available from the CNSC (through the single point of contact between the applicant and the CNSC).

4.2.6 Work organization and job design

The applicant should demonstrate that the staffing levels supporting the safe construction and commissioning of the reactor facility have been determined through a systematic analysis.

In view of readiness for operation, the application should describe the minimum number of workers with specific qualifications required for normal operations and accident conditions, including the minimum number and position of certified personnel at all times in the nuclear facility and in the main control room (minimum shift complement).

The application should describe the measures that will be in place to mitigate the effect of any violations of the minimum shift complement until minimum complement is restored. The application should demonstrate that each shift's minimum shift complement will be monitored and recorded.

The application should identify the staff positions planned to cover all plant states, along with the proposed occupational groupings for workers at the reactor facility. It should explain in general terms how the analysis connecting the two has been performed, as well as how the individual personnel will be recruited, their skills assessed and the ensuring performance gaps identified to determine the required level of training programs.

The application should outline the qualification and skill requirements that have been set for contracting organizations and their personnel who perform activities that could affect safety for the reactor facility.

Where detailed specific qualification and training documentation is to be developed later on, the applicant should provide a proposed timeline and milestones for completion of this work.

The application should demonstrate how staffing levels will be in accordance with REGDOC-2.2.5, *Minimum Staff Complement* [15].

For more information, refer to –REGDOC-2.2.5, *Minimum Staff Complement* [15] and REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

4.2.7 Fitness for duty

For construction and fuel-out commissioning activities, the application shall describe how the requirements for fitness for duty will be implemented in accordance with:

- for all workers:
 - REGDOC-2.2.4, *Managing Worker Fatigue* [16]
 - REGDOC-2.2.4, Volume II, *Managing Alcohol and Drug Use* [17]
- for security personnel:
 - REGDOC-2.2.4, Volume III: *Nuclear Security Officer Medical, Physical, and Psychological Fitness* [18]
 - REGDOC-2.12.1, *High-Security Facilities, Volume I: Nuclear Response Force* [19]

For readiness for operation, the application shall describe how the requirements for fitness for duty will be implemented in accordance with REGDOC-2.2.3, Volume III, *Certification of Persons Working at Nuclear Power Plants* [14] and:

- for all workers:
 - REGDOC-2.2.4, *Managing Worker Fatigue* [16]
 - REGDOC-2.2.4, Volume II, *Managing Alcohol and Drug Use* [17]
- for security personnel:
 - REGDOC-2.2.4, Volume III: *Nuclear Security Officer Medical, Physical, and Psychological Fitness* [18]
 - REGDOC-2.12.1, *High-Security Facilities, Volume I: Nuclear Response Force* [19]

The application should identify the oversight requirements for supervisors of certified and security personnel from the perspective of fitness for duty.

4.3 Operating performance

The operating performance SCA includes an overall review of the conduct of the licensed activities and the activities that enable effective performance.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(k) and 12(1)(c), (e) and (f), and sections 17, 29, 30, 31 and 32
- *Class I Nuclear Facilities Regulations*, paragraphs 5(c) and (i)
- *Radiation Protection Regulations*

4.3.1 General considerations

The application shall include information on how the nuclear facility will adhere to any applicable provincial legislation or other applicable codes and standards.

The application shall describe the programs and their proposed measures, policies, methods and procedures for constructing and commissioning the nuclear facility.

For activities conducted under the licence to construct, the applicant shall characterize the risks to health, safety and the environment that may be encountered by workers and the public. The applicant shall outline the strategy that the applicant will take (including development of mitigation measures) upon discovery of additional risks to the health and safety of the public that were not anticipated during the licence application process. These risks are generally similar to those encountered during construction activities at a conventional large-scale construction project. Some examples are:

- noise hazards, primarily from blasting activities and operation of heavy machinery
- dust from overburden and rock removal and movement
- chemical hazards from fuel spills, and conventional chemicals used during the construction of the structure
- mechanical hazards from excavation, earth movement, road building, and so on
- ground vibration and flying rock hazards from blasting activities
- electrical hazards from establishing construction electrical infrastructure
- transportation of building materials for construction and associated installation of internal components

The application should include information (such as timelines and milestones) regarding the development, verification, validation and implementation of programs and procedures related to commissioning, reliability testing, maintenance and operation.

The application should describe the processes used to ensure that the performance of the SSCs has been assured from construction to operation and when (in the future) major modifications are made to the facility. Communication between the authority having jurisdiction, the applicant's organization, construction organizations and other involved parties is a fundamental aspect of the construction and commissioning programs. The provisions for communication that link all these parties must be established and implemented early in the project. The application should document the appropriate tools when conflict resolution is needed.

For more information on how the applicant can demonstrate how they will exercise overall responsibility for construction and commission of the reactor facility, see REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]:

- section 3.1 for information about the licensee's responsibilities related to the construction of the reactor facility
- section 8.1 for information on organizational responsibilities during commissioning under the overall direction of the licensee

4.3.2 Procedures

The application should describe the provisions that will be implemented for the construction and commissioning of the reactor facility in accordance with REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]. This description should include the arrangements made to facilitate regulatory oversight of specified construction and commissioning stages, tests and hold points for specified licence activities.

The application should also describe the programs and process in place to manage the key functions important to safety. Many of these programs and processes will begin during the construction and commissioning of the reactor facility and will be completely implemented when normal operation commences. The beginning of applicability and the point at which full implementation will occur should be indicated in the description of each process. If the applicant expects to implement a program later in support of normal operation, they should supply sufficient information to demonstrate how the program's development and implementation is planned, including the timelines and milestones that will apply.

Construction program

The application shall:

- include information on how the applicant will exercise overall responsibility for the conduct of construction activities
- describe the construction program to be implemented

The construction program should be well planned, controlled, and properly documented, and it should cover:

- procurement, construction, fabrication, certification, identification, transportation and storage
- design and engineering, or testing of SSCs, either at the construction site or at fabrication locations remote from the site
- activities to be performed (described in manageable units)

The application should describe the processes and procedures that will be used to confirm that the reactor facility's SSCs are constructed according to their design specifications and applicable regulatory requirements, codes and standards. A list of the construction functional tests and commissioning tests that are planned for the different construction stages should also be included.

Construction of concrete structures

The application should describe the overall process to be followed to satisfactorily complete the concrete work during the construction phase. The application should provide sufficient information to permit a clear understanding of how the concrete construction will proceed, how the quality will be controlled and assured, and what objective evidence will be collected

to demonstrate that the design performance specifications for the buildings and structures will be verified.

Some examples of considerations are:

- material certification, identification and control, batching, mixing of concrete constituents, curing of concrete, and construction joint preparation
- measures to control the quality of the construction, including inspections and required tests
- processes for grouting work
- control of forms in final structures, arrangements for their bracing to ensure conformance of structures with design drawings
- control of concrete temperatures and, when required, the specification of pre-heating or pre-cooling of the concrete constituents, and prevention of thermal shock
- fabrication and placing requirements for reinforcing systems of concrete containments and confinements to comply with the relevant design, and construction drawings
- installation procedure for the tendons

For more information, see:

- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]
- CSA A23.1:19/CSA A23.2:19, *Concrete materials and methods of concrete construction / Test methods and standard practices for concrete* [20]

Construction and installation of metallic components

The application should describe the measures taken to control the quality of the construction and installation of the reactor facility's metallic components, including the inspections and tests to which they will be subjected.

The application should also provide the codes, standards and technical specifications for metallic components used during construction and the installation process. The materials used for welding, manufacturing, construction and installation should be identified and certified as per their applicable codes and standards.

The application should identify the processes and certifications for examination, shop inspection, field inspection and testing.

Commissioning program

The application should describe how the commissioning program will confirm that equipment, SSCs, and the reactor facility as an integrated unit will perform and function in accordance with the design specifications and regulatory requirements.

The application should describe, in general terms, the program established for the implementation of commissioning activities up to, but not including, the first loading of fuel into the reactor. This program should confirm that the reactor facility's SSCs have been properly installed and will perform within their design specifications, and that the integrated reactor facility will perform all the necessary safety functions in accordance with design requirements. This program is particularly important for those design features that are new or first of a kind.

The application should also describe the commissioning plans, processes, procedures and documents proposed for commissioning following fuel loading, and the approach to commercial operation. The application should include the timeline and milestones for preparation and completion of the commissioning plans, processes, procedures and documents.

For each system, the application should provide a cross-reference to a commissioning specification document that defines the design and analysis requirements that must be met during physical commissioning checks and tests.

The commissioning program should indicate the proposed hold points and identify the hold points that require regulatory approvals. For each hold point, the program should define the applicable prerequisites and should demonstrate how, using documented evidence, they will be adequately completed.

The application should include the timelines and milestones for the detailed development of the rest of the commissioning program, and hold points for the first fuel loading and beyond.

The applicant should ensure that commissioning tests are performed in a systematic sequence from pre-operational tests on each SSC to integrated reactor facility performance tests. There should be allowance for regulatory witnesses of specified tests and hold points for specified licensing phases in the commissioning program.

Readiness for operation

The application should describe the timelines and milestones for the development, verification, validation and implementation of operating procedures covering normal, abnormal, unplanned and emergency conditions (including beyond-design-basis accidents and severe accidents). The application should include information on how the applicant will ensure that the normal operating procedures are conducted safely in all normal operational configurations (including startup, power operation, shutting down, shutdown, cooldown, load changes, power transients and fuel handling), and that operation will be consistent with the safe operating envelope for the reactor facility.

The application should include sufficient information to demonstrate that the operator actions required to diagnose and respond to anticipated and unanticipated events are covered appropriately and use symptom-based and event-based procedures. The application should also describe the manner in which principles and processes related to human factors will be considered in the development and validation of the appropriate administrative, maintenance and operating procedures.

The application should describe how all normal, abnormal, unplanned and emergency operating procedures will be validated.

For more information, see REGDOC-2.5.1, *General Design Considerations: Human Factors* [21].

4.3.3 Safe operating envelope

The applicant should provide information related to the reactor facility's proposed safe operating envelope. The application should include a description of how the corresponding requirements for surveillance, maintenance and repair are specified, to ensure that these parameters remain within

acceptable limits and that systems and components are operable. Where appropriate, this information should be supported by means of a deterministic safety analysis and a probabilistic safety assessment.

The application should state the safe operating limits and conditions pertaining to reactor core, channel and fuel bundle powers. The information submitted should describe how the applicant will comply with limits imposed by the design and safety analysis assumptions – for example, the total power generated in any one fuel bundle, the total power generated in any fuel channel, and the total thermal power from the reactor fuel. The application should clearly describe the actions to be taken if the limits and conditions are not met.

The information available on the set of limits and conditions and the accompanying design information for the reactor facility should be sufficient to support the training, qualification and certification of the workers.

4.3.4 Outage management performance

The application should describe the approach and relevant arrangements that are proposed for conducting maintenance outages, as required by the operating cycle and other factors. The information submitted should demonstrate that an outage management program exists for the management of planned outages, including a review to ensure proper scoping, planning and execution of safety-related commitments (such as for heat sinks and dose control).

The application should describe the timeline and milestones for the development, validation and implementation of the outage management program.

The outage management program should describe the designated criteria that the licensee will follow to confirm that planned and discovery work has been satisfactorily completed. For more information on specific reporting requirements for outages, refer to REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* [22].

4.3.5 Accident and severe accident management and recovery

The application should describe the approach that will be followed to develop the emergency operating procedures (EOPs) for accident management, and the guidelines for a severe accident management (SAM) program in accordance with REGDOC-2.3.2, *Accident Management* [23]. In addition to these expectations, the application should:

- demonstrate that these procedures and guidelines support the operator when responding to anticipated and unanticipated events
- describe the systematic approach, and the principles and data used to develop the EOPs and SAM guidelines in accordance with sections 7.3, 7.9.3, and 8.5 to 8.10 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]
- describe the timeline and milestones for the development, validation and implementation of all EOPs and SAMs for accident management

4.4 Safety analysis

The safety analysis SCA covers maintenance of the safety analysis that supports the overall safety case for the facility. Safety analysis is a systematic evaluation of the potential hazards associated with the conduct of a proposed activity or facility and considers the effectiveness of preventive measures and strategies in reducing the effects of such hazards.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(d), (e) and (i), and 12(1)(c) and (f)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(b) and (d), and 5(f)
- *Radiation Protection Regulations* (all requirements related to dose)

4.4.1 General considerations

The application shall include a preliminary safety analysis report (PSAR) for the reactor facility. The PSAR includes a deterministic safety analysis, a probabilistic safety assessment (PSA) and a hazards analysis. The application should demonstrate that all levels of defence in depth are addressed, and should confirm that the facility's design is capable of meeting the applicable dose acceptance criteria and safety goals.

Whenever operator action is taken into account, the application should demonstrate that the operators will have reliable information, sufficient time to perform the required actions, documented procedures to follow, and will have been trained.

The safety analyses included in the PSAR should proceed in parallel with the design process, with iteration taking place between the two activities. The applicant should outline the methodology used to advance the detailed design and the safety analyses. The scope and level of detail of the analyses should increase as the design is developed, so that the final safety analyses reflect the finished reactor facility design. The application should demonstrate that the design, procurement, manufacture, equipment qualification, construction, installation and commissioning processes are taken into account in the safety analyses to ensure that the design intent will be achieved in the “as built” reactor facility.

The applicant should also describe the programs and oversight in place to ensure that the safety analysis is carried out by technically qualified and appropriately trained staff, and is in accordance with the management system program supporting safety analysis and in accordance with “intelligent customer” principles. The information should demonstrate that all contractors and subcontractors involved in the safety analysis are qualified to carry out their respective activities.

4.4.2 Postulated initiating events

The safety analysis shall identify postulated initiating events (PIEs) using a systematic methodology (for example, failure modes and effects analysis). The scope and classification of PIEs in the application shall meet the requirements specified in:

- REGDOC-2.4.1, *Deterministic Safety Analysis* [24]
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants* [25]
- REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

For more information on external events, see REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26].

The information provided should demonstrate that all foreseeable events with the potential for serious consequences or with a significant frequency of occurrence are anticipated and considered.

For a site with multiple units, the application should describe how the design and safety analyses have taken into account the potential for specific hazards simultaneously affecting several units on the site.

4.4.3 Deterministic safety analysis

The application shall include a deterministic safety analysis to evaluate and justify safety at the reactor facility, conducted in accordance with REGDOC-2.4.1, *Deterministic Safety Analysis* [24]. The level of conservatism of each deterministic safety analysis should be appropriate for the class of event analyzed and the analysis objectives.

The application should provide the dose acceptance criteria.

The application should also describe the trip coverage and trip setpoints.

The deterministic safety analysis should demonstrate that applicable dose limits under design-basis accidents (DBAs) are met.

For DBAs, the application should demonstrate that there is a high confidence that qualified systems (as identified in REGDOC-2.4.1 [24]) acting alone can mitigate the event.

4.4.4 Hazard analysis

The applicant shall provide a hazard analysis that has been performed in accordance with the requirements of:

- REGDOC-2.4.1, *Deterministic Safety Analysis* [24]
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants* [25]
- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26]

The application should describe the analysis of all potential hazards (internal and external), both natural and human-induced. Some examples are:

- for natural external hazards: earthquakes, droughts, floods, high winds, tornadoes, abnormal surges in water level and extreme meteorological conditions
- for human-induced external hazards: those that are identified in the site evaluation, such as airplane crashes and ship collisions
- for internal hazards: internal fires, internal floods, turbine missiles, onsite transportation accidents and releases of hazardous substances from onsite storage facilities

The application should describe the analysis of any potential combinations of the external hazards. It should also consider the potential interaction of external and internal hazards, such as external events that initiate internal fires or floods, or interactions that may lead to missile generation.

For a site with multiple units, the application should describe how the potential for specific hazards simultaneously affecting several units has been taken into account.

4.4.5 Probabilistic safety assessment

The application shall include a probabilistic safety assessment (PSA) conducted in accordance with the requirements specified in REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants* [25].

The application should describe how the results of the PSA have been used to identify any reactor facility vulnerabilities. With support from the PSA, the application should also:

- provide information that verifies the emergency operating procedures will be adequate during commissioning and future operation
- describe how the results of the PSA provide insights into the severe accident management program, and how these results meet the safety goals
- describe how the PSA could be used, during commissioning and future operation, to identify any systems for which design improvements or modifications to operational procedures could reduce the probabilities of severe accidents or mitigate the consequences

4.4.6 Severe accident analysis

The applicant shall demonstrate that a severe accident analysis has been performed in accordance with the requirements of:

- REGDOC-2.3.2, *Accident Management* [23]
- REGDOC-2.4.1, *Deterministic Safety Analysis* [24]
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Nuclear Power Plants* [25]

The format and content of the beyond-design-basis accident (BDBA) analyses should be consistent with the presentation of the analyses for anticipated operational occurrences and design-basis events. In addition, the application should:

- state the objective and/or the specific acceptance criteria for the BDBA analysis
- include a discussion of the additional postulated failures in the accident scenario, including the reasons for their selection
- summarize the key results of the analyses with specific acceptance criteria, and state how the acceptance criteria are met

The application should provide detailed information concerning the analysis to identify accidents that can lead to significant core damage, and/or offsite releases of radioactive material (severe accidents). In addition, the information submitted should describe the evaluation that has been carried out on the capability of complementary reactor facility design features to meet the design criteria, in accordance with REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should demonstrate the capability of the design to mitigate certain BDBAs. The applicant should explain the choice of the BDBAs to be analyzed and justified, indicating whether the choice was made on the basis of a PSA or according to another fault analysis that identifies potential vulnerabilities of the reactor facility. Additionally, the applicant should describe, explain and justify the approach taken.

BDBA events are typically sequences involving more than one failure (unless they are taken into account in the DBAs at the design stage), such as reactor facility blackout, design-basis events with degraded performance of a safety system, and sequences that lead to containment bypass and/or confinement bypass. The application should describe how the analysis:

- uses best-estimate models and assumptions
- takes credit for realistic system action and performance beyond original intended functions, including systems not important to safety
- takes credit for realistic operator actions

Where this is not possible, reasonably conservative assumptions should be made. These assumptions should consider uncertainties in the understanding of the physical processes being modelled.

The application should include an explanation of the analysis performed for severe accident sequences, including (as applicable) hydrogen fire, steam explosion and molten fuel/coolant interaction, and a description of the results of the most relevant severe accident analyses used in the development of the accident management programs and emergency preparedness planning for the reactor facility.

4.4.7 Summary of analysis

The application should include information concerning the integrated review of the reactor facility design and operational safety, carried out to complement the results of the deterministic analyses already performed and to give an indication of the success of the design in achieving the design objectives.

4.4.8 Event mitigation

The application shall provide the results of a review of event mitigation measures in accordance with the requirements of REGDOC-2.3.2, *Accident Management* [23].

4.5 Physical design

The physical design SCA relates to activities that affect the ability of SSCs to meet and maintain their design basis, given new information arising over time and taking changes in the external environment into account.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(d), (e), (g), (h), (i) and (j), and 12(1)(c) and (f)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(a), (b), (d) and (i), and 5(a), (b), (d), and (e)
- *Radiation Protection Regulations*
- *Nuclear Security Regulations*

4.5.1 General considerations

The application should include a general description of the overall conceptual physical design of the reactor facility, the design practices and the safety concepts. The application should also describe the approach followed for the general design of the SSCs. The design should be provided in sufficient detail that independent reviews can be performed as described in section 5.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should include a comparison of the reactor facility's design, construction, commissioning and operation with prevailing modern standards and international practices.

For all reactor technologies, the application should address the information in this section to the extent practicable. Any alternative approaches selected or mitigating measures applied should be identified.

The application may refer to information that was submitted previously (for example, in the application for a licence to prepare site). The set of documents that address the requirements in this section should be submitted only once (for the initial application), with few subsequent revisions.

The application should demonstrate that normal operations can be carried out safely such that radiation doses to workers and members of the public, and any planned discharges or releases of nuclear and hazardous substances from the reactor facility, will be within authorized limits.

In addition, the application should demonstrate that the radiation dose limits, release limits of pollutants and safety goals are met.

The application should also describe the programs and oversight in place to ensure that the design is carried out by technically qualified and appropriately trained staff, and is in accordance with the management system program supporting design and in accordance with "intelligent customer" principles. The information should demonstrate that all contractors and subcontractors involved in the design are qualified to carry out their respective activities.

The application should provide information on the support programs that demonstrate the design:

- conforms to high standards
- behaves as predicted for novel aspects of the design, materials and use of equipment
- incorporates the latest developments in knowledge and technology

- maintains its characteristics during its lifecycle within the bounds accounted for in the design and safety analysis
- is resistant to the effects of common-cause events and, to the extent practicable, to severe accidents
- ensures the reactor facility will remain reliable and robust
- facilitates effective maintenance, operation and decommissioning

Description of structures, systems and components

For each SSC, the application should describe in detail the characteristics, major components and design basis requirements (such as the functional and performance requirements associated with the definition of design basis), including the following information:

- objective of the system and how it relates to the entire reactor facility
- design description of the system and its main components with their configuration and their modes of operation, including:
 - functional requirements (for example, postulated demands and required performance for all plant states)
 - the design-basis events that contribute to the determination of the system design requirements, and which design limits are determined by which events
 - interfaces with other systems
 - measures taken to minimize the generation of nuclear and hazardous waste through design
 - any other specific requirements imposed by applicable regulations, codes and standards
- supporting design documentation and any related documents, such as design requirements of the system
- cross-cutting programs, such as:
 - safety and pressure boundary code classifications
 - quality assurance
 - seismic and equipment requirements
 - human factors requirements
 - requirements developed to ensure consistency with other systems and the safety analysis
 - the design reliability targets for systems and main components
 - any requirements resulting from operational feedback
- detailed elements of system design, including, as appropriate:
 - design flowsheets for fluid systems
 - single line diagrams for electrical, and instrumentation and control systems
 - functional block diagrams for logic systems
 - physical location and isometric drawings
 - system boundaries as a function of mode of operation
 - containment boundaries including isolation requirements
 - code classification and classification boundaries for pressure-retaining systems and components
 - seismic categories and seismic boundaries and their interfaces with support systems providing services, such as electric, pneumatic or hydraulic power, cooling, lubrication and sampling systems
 - chemical control specifications

- operational aspects, such as:
 - operation of the system and its expected performance (including under beyond-design conditions, if important)
 - interdependence with the operation of other systems
 - requirements for technical specifications regarding system operability
 - system testing for availability, reliability and capability, including online health monitoring, reporting and trending
- maintenance aspects, including:
 - surveillance
 - condition-based preventive maintenance
 - periodic maintenance and overhauls to ensure continued safety performance and to meet design reliability targets throughout the system's qualified life
- in service inspection specifications, including visual, surface and/or volumetric non-destructive examination for SSCs to confirm that the actual condition of the SSC complies with design assumptions
- commissioning testing requirements to:
 - demonstrate to the extent practicable that the SSCs meet their performance requirements in all operational states and accident conditions credited in the safety analysis (particularly important for those design features which are new or first of a kind)
 - verify that the SSCs have been correctly installed/constructed

The application should describe any design features necessary to support commissioning tests.

The design information should reflect all design modifications and changes made during previous licensing periods or phases.

4.5.2 Site characterization

The application should refer to, or summarize, the information previously submitted in any relevant environmental review or licensing documentation, such as impact assessments and any previous licence application (such as licence to prepare site).

The results of site characterization are used in facility design and supporting safety analysis. The application should focus on confirmation of the site characteristics (especially external events) and on assessing the effects of any updated information.

The applicant should describe the site evaluation process and procedures used during the design phase and design assessment stage, including:

- site-specific hazard evaluation for external events (of human or natural origin)
- design assumptions or values in terms of recurrence probability of external events
- definition of the design basis for external events
- collection of site reference data for the facility design (geotechnical, seismological, hydrological, hydrogeological and meteorological)
- arrangements for the monitoring of site-related parameters throughout the lifecycle of the reactor facility

- site plan and description, and site reference data
- exclusion zone authority and control

For additional information on site characterization, see:

- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26]
- sections 4.1, 4.2.2 and 6.4 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

For additional information on exclusion zone authority and control, see:

- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26]
- sections 6.5 and 6.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

4.5.3 Design principles and requirements

The application should describe the design principles and requirements that cover the processes for the overall design of the facility, and the operation and interaction of all of the SSCs to be addressed. To ensure that the reactor facility will be reliable, robust and maintainable, the applicant should ensure that the design:

- conforms to high quality levels
- is informed by recent developments in knowledge and technology
- is resistant to the effects of common-cause events and, to the extent practicable, to severe accidents

When aspects of the design are based on conservative deterministic principles, such as those outlined in international codes and standards or in regulatory documents, the application should describe the use of such principles. If the design of the reactor facility does not fully comply with a specific deterministic principle in a regulatory document, the applicant should demonstrate that the overall level of safety is not impaired.

The application should identify the criteria used for determining the level of acceptable risk, and should show that the criteria meet general safety objectives and concepts in accordance with section 4 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should describe the decision-making methodology (for example, cost/benefit, best available technology, and so on) that was used to select the design option.

Safety objectives and goals

The safety objectives and goals are described in detail in REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should describe how the safety objectives and goals have been met in the design of SSCs, and should demonstrate that these objectives and goals are in accordance with sections 4.1 and 4.3.3 of REGDOC-2.5.2 [9].

Where there is some duplication of information requested in various sections, the application may include cross-references to detailed information in other sections as appropriate.

Safety objectives include general nuclear safety objectives, radiation protection objectives, technical safety objectives and environmental protection objectives. Safety goals include qualitative and quantitative safety goals, core damage frequency, and small and large release frequencies.

Design authority

The application should demonstrate that the design authority is established in accordance with section 5.1 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should identify the design authority responsible for the overall design. If the design authority has been transferred from another organization, the applicant should provide the formal relationships (including roles and responsibilities) and the prerequisites that had to be met prior to the transfer.

Applicable regulations, codes and standards

The application should demonstrate that the design envelope of the reactor facility is established in accordance with section 7.2 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should include declarations of the design's compliance with the codes and standards used. The applicant should evaluate these documents for their applicability, sufficiency and adequacy, and provide the results in the application. If necessary, the standards used should be supplemented with additional requirements that should also be identified in the application.

The applicant should provide an assessment, such as a gap analysis, if the codes and standards differ from those used in Canada. The application should include information pertaining to cases where requirements contained in any of the applicable regulations or codes and standards are not met.

The application should include an assessment of the safety significance of any deviations from applicable codes and standards. Where necessary, a separate and complete justification should be provided for each deviation. This justification should include all information necessary to assure the CNSC that any deviations will not negatively affect the facility's overall level of safety. This justification should be included wherever applicable in the licence application or in documents referenced in the licence application.

Safety assessment and engineering evaluation

The applicant should demonstrate that a systematic process has been applied throughout the design activities to ensure that the design meets all relevant safety requirements, and that the design process of the reactor facility has followed proven engineering practices. For systems important to safety, this includes:

- failure modes and effects analysis
- assessment of vulnerability to single failures, crosslinks, common cause and common mode failures
- assessment of system reliability and equipment function in the anticipated environment
- as applicable, assessment of seismic events

The applicant should ensure that the reactor facility design meets all other applicable safety and regulatory requirements.

The application should summarize compliance with applicable design requirements (with reference to the original reports), including technical information on:

- material strength
- overpressure protection
- corrosion resistance
- environmental qualification
- reliability assessment
- resistance to electromagnetic and radiofrequency interference
- verification and validation of software

This section should provide the following information for each system that is credited, or that supports a credited system, in the safety analysis:

- an assessment of the functional capability of the system that is directly credited in the safety analysis, including but not limited to:
 - timing of system operation
 - minimum system performance envelope to meet safety analysis assumptions
 - ability of the system to perform over the lifetime of the reactor facility
 - ability of the system to perform in any abnormal environmental conditions in accident scenarios for which the system is credited
- a demonstration that the physical separation, the electrical and/or fluid isolation devices and the environmental qualification requirements (or any other special protective measures) provide sufficient capacity to deliver the credited functions reliably

Identification of plant states and operational configurations

The application should identify all plant states and operational configurations in accordance with:

- REGDOC-2.4.1, *Deterministic Safety Analysis* [24]
- section 7.3 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

For operational states (normal operation and anticipated operational occurrences (AOOs)), the information should cover configurations such as start-up, normal power operation, shutting down, shutdown, refuelling and any other normal operating configuration. The application should identify the key parameters and unique characteristics of each operational configuration, including the specific design provision for maintaining the configuration. The application should also provide the permissible periods of operation at different conditions (for example, power level) in the event of a deviation from normal operating conditions.

Design envelope

The application should include a cross-reference to the design envelope for the reactor facility, which includes all plant states and configurations. The applicant should demonstrate that the design authority has established the design envelope.

Defence in depth

The applicant should describe the approach taken to incorporate the defence-in-depth concept into the design of the reactor facility. The design approach adopted should ensure that multiple and (to the extent practicable) independent levels and barriers for defence are present in order to provide protection against AOOs and accidents including DBA and severe accidents. For more information, see sections 4.3.1 and 6.1 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should describe the selection of the main barriers, with particular emphasis placed on SSCs important to safety. The application should describe any proposed operator actions to mitigate the consequences of events and to assist in the performance of important safety functions.

Safety functions

The application should describe how the fundamental safety functions have been incorporated into the design of the reactor facility, in accordance with section 6.2 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. The application should provide information on the SSCs used to perform necessary safety functions at various time intervals following a PIE.

The application should also identify and provide a description of any additional safety functions; for example, heat removal from irradiated fuel in fuel handling and storage systems.

Safety classification of structures, systems and components

The application should describe the approach adopted in the design for the safety classification of the SSCs. The approach should be in accordance with section 7.1 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. It should include criteria for deciding on the appropriate design requirements for each class, such as:

- appropriate codes and standards to be used in the design, manufacturing, construction, testing and inspection of individual SSCs
- in accordance with the appropriate sections of REGDOC-2.5.2 [9]:
 - system-related characteristics, such as the degree of redundancy, diversity, separation, and reliability (section 7.6)
 - environmental qualification (section 7.8)
 - seismic qualification (section 7.13)
- availability requirements for particular SSCs for on demand duty and for reliability for the prescribed mission time
- quality assurance requirements

Design for reliability

The application shall include the basis for reliability targets that meet the requirements in section 7.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9] and REGDOC-2.6.1, *Reliability Programs for Nuclear Power Plants* [27].

The description of the reliability program should include the following:

- methods used for reliability assessment
- how aging-related considerations are taken into account
- selection criteria for the reliability assessment input data and subsequent updates, based on testing, surveillance and other experience

The applicant should demonstrate that all SSCs important to safety have been designed with sufficient quality and reliability to meet the design limits. The applicant should provide a reliability analysis for each of these SSCs. In accordance with the appropriate sections of REGDOC-2.5.2 [9], the application should include considerations of:

- common-cause failures (section 7.6.1)
- single-failure criterion (section 7.6.2)
- fail-safe design (section 7.6.3)
- allowance for equipment outages (section 7.6.4)
- shared systems (section 7.6.5)

Human factors

The application should describe how the facility design takes into account human factors. It should describe the systematic process that has been followed, for all systems, to incorporate considerations of human factors into the specification, definition and analysis of requirements; design activities; and verification and validation activities.

The application should describe the interfaces of human factors in design with other areas (for example, as inputs to the development of operating and other procedures and training). The application should also describe the considerations of human factors that apply to the design of specific SSCs, including:

- human-machine interfaces for all plant states
- instrumentation, displays and alarms provided to monitor system operations
- physical location, accessibility and usability of equipment that is operated, tested, maintained or monitored
- physical interlocks, and indication of bypassed or inoperable status

The application should include a list of human factors analyses and activities that were used in developing the design. The applicant should demonstrate that human factors engineering and human-machine interface considerations have been applied to all operational states and accident conditions, and for all locations within the reactor facility where such interactions are anticipated.

The applicant should also provide a human factors engineering program plan.

For additional information on human factors design requirements, refer to:

- REGDOC-2.5.1, *General Design Considerations: Human Factors* [21]
- CSA N290.12-14, *Human factors in design for nuclear power plants* [28]
- section 7.21 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

Radiation protection

The application shall include a description of the design approach adopted that demonstrates the facility design meets the requirements of the *Radiation Protection Regulations* and the radiation

protection objectives and dose acceptance criteria in accordance with sections 4.1.1 and 4.2.1 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The information submitted shall demonstrate that, over the lifecycle of the nuclear facility and in all operational states, radiation doses within the reactor facility or any planned release of radioactive material are kept below regulatory limits and are as low as reasonably achievable (ALARA).

Robustness against malevolent acts

The information submitted should demonstrate that the design includes considerations of both physical protection concerns and transportation routes, in accordance with the requirements of:

- the *Nuclear Security Regulations*
- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26]
- section 7.22 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

The application should describe both the general design approach and the approach and provisions followed to ensure the physical protection of the reactor facility (including control areas) against internal and external sabotage. These measures should take into account the selection of specific materials, the physical separation of redundant systems, the performance requirements of the equipment, and the use of barriers to segregate redundant safety trains.

The description of the design approach should include:

- rules followed to establish the scope of threats
- justification for the specification of vital areas and the anticipated loads (for example., impact forces, blast pressure waves, internal induced vibrations, fires and missiles) on SSCs and buildings
- methodology used for assessing the vulnerability of the reactor facility, along with the measures selected to address these vulnerabilities and their consequences

The application should also describe the provisions for protecting the capability of:

- monitoring and control of reactor facility parameters
- emergency management and response
- mitigation and recovery measures to ensure the safety of workers and the public

Note: Applicant submission and resultant review correspondence related to this topic is considered to be prescribed information under the NSCA and must be submitted in a secure manner. Refer to REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material* [4] and the Treasury Board of Canada Secretariat *Policy on Government Security* [5] for further details on handling, submitting and transmitting assets considered security-sensitive.

Safeguards in the design and design process

With respect to the design and design process, the information submitted should demonstrate that the design and design process comply with the obligations arising from the safeguards agreement between Canada and the International Atomic Energy Agency (IAEA). For additional information on safeguards, see section 4.13.

Design changes

The application should describe the provisions being established for control and implementation of design modifications such that the reactor facility is maintained and modified within the limits prescribed by the design, analysis and (once established) licensing basis.

The application should also describe the processes for maintaining the design basis, taking into account new information, operating experience, safety analyses, resolution of safety issues or correction of deficiencies.

The application should describe how design changes are assessed, addressed and accurately reflected in the safety analyses or analysis of record prior to implementation.

Feedback into the design and design process from operating experience and safety research

The application should describe how lessons learned from the operation of other facilities or results of new research have been incorporated into the submitted reactor facility design in accordance with section 5.5 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

With respect to the design and design process, the application should describe how feedback from operating experience (OPEX) and safety research takes into account:

- changes in design due to recent advances in material properties
- improved methods of construction and fabrication
- considerations related to improvement in reliability and in the operability and maintainability of the reactor facility
- considerations on the current safety approach
- the understanding of important phenomena governing behaviour of the reactor facility
- methods and tools used in design and analysis

Operability and maintainability

The application should describe how, in general, the design process and its outputs support the design for system and equipment operability and maintainability in accordance with sections 7.3.1 and 7.14 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

Control of foreign material

The application should demonstrate that the design provides for the detection, exclusion and removal of all foreign material and corrosion products that may have an effect on safety.

Other safety functions

The application should specify, describe and explain the appropriateness of any other safety requirements or criteria that have been respected in the design to reduce the effect of failures and enhance the safety of the design. The description should include, but not be limited to:

- adequate safety margins
- simplified design
- passive safety features
- gradually responding systems

- fault-tolerant reactor facility and systems
- operator-friendly systems
- leak-before-break concepts
- fail-safe design

Decommissioning

The application shall describe considerations and design provisions that will facilitate future reactor facility decommissioning and dismantling activities.

The application should also describe considerations and provisions for storage of radioactive waste after the end of commercial operation.

4.5.4 Facility design

The application shall describe the processes that pertain to the overall adequacy of the facility design, including layout of the facility itself.

Basic technical characteristics

The application should include a description (in a table, if appropriate) of the principal features and specifications of the reactor facility, including (but not limited to):

- number of reactor units
- type of reactor facility and its main features and characteristics
- safety systems
- type of nuclear steam supply system
- type of containment structure
- thermal power levels to be reached in the core
- corresponding net electrical power output for each thermal power level
- any other characteristics necessary for understanding the main technological processes of the design

In cases where the reactor facility design is similar to earlier designs licensed by the CNSC, the applicant should provide a comparison that identifies and justifies the main modifications and improvements that have been incorporated into the submitted design.

Layout of main systems and equipment in the facility

The application should include basic technical and schematic drawings of the main facility SSCs, including:

- details of the physical and geographical location of the reactor facility
- connections with the electrical grid
- means of access to the site by rail, road and water

This information should be sufficient for the CNSC to verify that:

- the facility design is in accordance with sections 6.5 and 6.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]
- the reactor facility design includes adequate provision for an appropriate exclusion zone

The information submitted should demonstrate that:

- the facility layout takes into account PIEs to enhance the protection of SSCs important to safety
- in accordance with section 8.13 of REGDOC-2.5.2 [9], suitable provision has been made in the design and layout of the reactor facility to reduce doses and radioactive releases from all sources

The application should also include general layout drawings of the entire reactor facility, accompanied by a brief description of the main systems and equipment, and their individual purposes and interactions. Information on reactor facility layout that contains security-related information should be submitted in a secure manner.

The application should include references to other sections that provide more detailed descriptions of SSCs. The application should describe the main interfaces and boundaries between onsite equipment and systems provided by different design organizations, including the interfaces with equipment and systems external to the reactor facility (for example, the electrical grid). The description should provide sufficient detail to reveal how the reactor facility operation will be coordinated.

The application should refer to the confidential information on the provision made for the physical protection of the reactor facility.

4.5.5 Structure design

The application shall present relevant information on the design of the site layout and on civil engineering works and structures associated with the nuclear facility, with sufficient detail for CNSC staff to verify that the design is in accordance with sections 7.15 and 8.6.2 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. The application should describe the design and analysis procedures, the assumed boundary conditions and the computer codes used in the analysis. Site and reactor facility layout information should include the main building and structures (including the foundation), sources of cooling water, grid connection, and access to all essential services required for both normal and emergency operation.

The application should describe the design principles, design basis requirements and criteria, and applicable codes and standards used in the design. The application should demonstrate that the safety margins are sufficient for the buildings and structures important to safety (for example, seismic design and robustness against internal and external events). The application should clearly state and justify any deviation from applicable codes and standards or from other design requirements.

The application should describe the safety classification for each building containing equipment or used for operations important to safety. The classification should be commensurate with the classification of the systems and equipment that it contains or the operations it is used for.

The application should include the seismic classification for each structure and building. The descriptions provided here should include the extent to which various load combinations have been considered in order to confirm the building's ability to meet its safety functions. If a structure performs a function other than structural support (for example, radiation shielding, separation barrier, and confinement or containment), the application should specify the additional requirements for this function and should reference them in other relevant sections of the application.

The application should describe the range of anticipated structural loadings and performance requirements, including design consideration for specific hazards during operation, and for any design considerations or mitigation measures in place to deal with beyond-design-basis accidents.

The description of structures that house nuclear material (such as new and spent fuel or tritiated light or heavy water) should include the design considerations (for example, applied loads, codes and standards, analytical tools and material properties), the structural stability, the relative displacements, and the means of protection against internal and external events that were considered.

The application should address the safety requirements for the containment building or system, including, for example, its structural strength, leak tightness, and resistance to steady-state and transient loads (such as those arising from pressure, temperature, radiation and mechanical effects that could be caused by postulated internal and external events). The application should also include the main design features of the structures provided to comply with these safety requirements.

The application should provide details on the safety requirements and design features for all structures that support confinement and containment functions, such as reactor vault structures, shielding doors, airlocks and access control and facilities, in accordance with section 8.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. The application should include the coupling between the internal structures and the main confinement or containment structure that affects the transmission of loads from external events to the internal structures.

The description of design provision should also cover details such as:

- identification of the applicable design guides and design requirements
- descriptions of structures, including:
 - base slab and sub-base
 - containment wall design
 - containment wall openings and penetrations
 - pre-stressing system
 - containment liner and its attachment method

The application should describe the confinement, including the analytical models and methods used and the results of the design evaluation of the containment's ultimate pressure capacity with the corresponding acceptance criteria. For designs incorporating a liner plate, the application should provide the analysis and design procedures for the liner plate and its anchorage.

4.5.6 System design

The applicant should present relevant information for the system description, pressure-retaining SSCs, equipment environmental qualification, electromagnetic interference, seismic qualification, and fire safety/fire protection.

System description

The applicant should provide, in detail, the characteristics and major components of the system and its design basis requirements (for example, the functional and performance requirements associated with the definition of design basis).

Pressure- or fluid-retaining structures, systems and components

The application should describe the basis for the design of the pressure- or fluid-retaining SSCs and their supports, in accordance with section 7.7 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. The application should also describe the pressure boundary standards and codes (and their editions / effective dates). It should also describe the overall pressure boundary program, including its implementation processes and procedures. In addition, the application should describe the service agreement with a recognized authorized inspection agency and the related pressure boundary quality assurance program.

Equipment qualification

The applicant should provide detailed processes and specifications for an equipment qualification program. The program should identify equipment service conditions. The application should demonstrate that equipment can perform its intended safety functions under the environmental conditions defined for all plant states in which it is credited.

The application should include the designated functional requirements, the definition of the applicable environmental parameters, and the documentation of the qualification process used to demonstrate that the required equipment is capable of meeting the requirements in accordance with sections 5.7, 7.3, 7.5, 7.8 and 7.14 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

For SSCs important to safety, the application should include a description of how aging effects due to service life are taken into account.

Electromagnetic interference

The applicant should demonstrate that instrumentation and electrical equipment of SSCs important to safety are protected from electromagnetic interference (EMI)-induced faults for all plant states in which they are credited.

The information submitted should meet the requirements in accordance with section 7.9 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9] and also demonstrate the capability, as specified in the design, of instrumentation and electrical equipment to function within the applied electromagnetic environment of the reactor facility in different plant states, and without introducing significant electromagnetic disturbances to other equipment within the reactor facility.

The application should include the layout strategies for grounding and shielding, and should also provide EMI-qualified device handling and storage requirements.

Seismic qualification

The application should describe how the reactor facility design protects SSCs (including building structures) from earthquake damage, and how the approach is in accordance with section 7.13 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]. The applicant should ensure there is instrumentation available to monitor seismic activity at the site for the lifecycle of the reactor facility.

SSCs important to safety should be designed to withstand a design-basis earthquake (DBE) event. For a beyond-design-basis earthquake, the applicant should demonstrate that there is a high confidence of low probability of failure of the SSCs that are credited to function during and after the event.

4.5.7 Fire safety and fire protection system

The application should describe how the reactor facility's design provisions will address prevention of, protection from, control of, mitigation of, response to, and recovery from fires (including explosions) in order to protect the SSCs, persons and the environment.

The application should include an independent third-party review of the design, assessing compliance against the applicable fire codes and standards used in the design for protection from fires and explosions.

4.5.8 Reactor and reactor coolant system

The application should demonstrate that the reactor and reactor coolant system meet the requirements in sections 8.1, 8.2 and 8.4 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The applicant should provide relevant information concerning the reactor, including a summary description of:

- mechanical, nuclear, thermal and hydraulic behaviour of the designs of the various reactor components
- fuel, reactor internals, and reactivity control systems
- related instrumentation and control systems in place to demonstrate the capability of the reactor to perform its design safety functions in all operational states throughout its design life

The applicant should ensure that the nuclear criticality safety program meets the requirements in REGDOC-2.4.3, *Nuclear Criticality Safety* [29] and section 8.12 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

Design of fuel system

The applicant should provide the following information concerning the thermal, mechanical, thermal-hydraulic and material design of all fuel systems and components, including a description of the fuel manufacturing and a summary of the in-core fuel management:

- the design documents of all fuel systems to be used, including the fuel design drawings
- the fuel design basis requirements
- evaluations of the fuel design
- a description of the methods and computer codes used to assess the fuel behaviour under normal and accident conditions
- testing, inspection and surveillance plans
- the manufacturing process

Design of the reactor internals

The application should describe the design of the reactor internals and their design basis requirements, specifically:

- structures into which the fuel has been assembled (for example, the fuel assembly or fuel bundle)
- related components required for fuel positioning
- all supporting elements internal to the reactor, including any separate provisions for moderation and fuel location

The information provided should link to and complement other sections that cover related aspects of the reactor fuel and its handling and storage, such as:

- physical and chemical properties of the fuel components including:
 - thermalhydraulic, structural and mechanical aspects
 - the expected response to static and dynamic mechanical loads and their behaviour
 - a description of the effects of irradiation on the ability of the reactor internals to perform their safety functions adequately over the design life of the reactor facility
- any significant sub-system components, including any separate provisions for moderation and fuel location (corresponding design drawings should be provided)
- consideration of service effects on the performance of safety functions, including surveillance and/or inspection programs for reactor internals to monitor the effects of irradiation and aging on them
- program to monitor the behaviour and performance of the core, which should include provisions to monitor the neutronics, dimensions, and temperatures of the core

Nuclear design and core nuclear performance

The application should describe how the design meets the design basis requirements for:

- nuclear design of the fuel
- reactivity control systems (including nuclear and reactivity control limits such as excess reactivity, fuel burn-up, reactivity feedbacks)
- core design lifetime
- fuel replacement strategies
- reactivity coefficients
- stability criteria
- maximum controlled reactivity insertion and removal rates
- control of power distributions
- shutdown margins
- rod speeds and stuck rod criteria
- chemical and mechanical shim control
- neutron poison requirements
- all shutdown provisions

The description should also include any of the following areas of the design if applicable:

- fuel enrichment distributions
- burnable poison distributions
- physical features of the lattice or assemblies relevant to nuclear design parameters

- delayed neutron fractions and neutron lifetimes
- core lifetime and burn-up
- plutonium build-up
- soluble poison insertion rates
- xenon burnout or any other transient requirements

Further detailed information should be provided on the following topics, as appropriate:

- power distributions
- reactivity coefficients
- reactivity control requirements
- reactivity devices
- criticality during refuelling
- reactor core stability, irradiation issues
- analytical methods used (with verification and validation information and uncertainties)
- testing and inspection plans
- operational limits and conditions

Core thermalhydraulic design

The applicant should provide information concerning the reactor and reactor coolant system thermalhydraulic design, including:

- design basis requirements, the thermal and hydraulic design for the reactor core and attendant structures, and the interface requirements for the thermal and hydraulic design of the reactor coolant system
- analytical tools, methods and computer codes (with codes for verification, and validation information and uncertainties) used to calculate thermal and hydraulic parameters
- flow, pressure, void and temperature distributions, and the specification of their limiting values and a comparison with design limits
- justification for the thermalhydraulic stability of the core; for example, stability in forced or natural circulation flow against:
 - neutronic/thermalhydraulic feedback
 - flow oscillations
 - parallel channel instabilities

Reactivity control systems

The design of the reactivity control systems should provide the means for detecting levels and distributions of neutron flux. Information provided on the reactivity control systems should include, but not be limited to:

- design basis requirements for the systems
- demonstration that the reactivity control systems, including any essential ancillary equipment, are designed to provide the required functional performance and are properly isolated from other equipment
- description of the qualification and commissioning tests that have been carried out, in order to ensure that the equipment and system performance comply with the design requirements and meet the claims for their performance made in the safety analysis

- description on how separation and diversity have been achieved
- description of the rate of reactivity insertion and the depth of each reactivity control system in accordance with section 8.4 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

Taken together, the SSCs important to safety instrumentation and control systems and the reactivity control systems should meet the expectations for shutdown means, in accordance with section 8.4 of REGDOC-2.5.2 [9].

Reactor materials

The application should describe the materials used for the components of the reactor (including the materials for the reactor coolant system pressure boundary, the materials for the core support function and the materials for in-core components such as control rods and instrumentation). The application should include information on the material specifications, including:

- chemical, physical and mechanical properties
- resistance to corrosion
- dimensional stability, strength, toughness, hardness and crack tolerance
- where important, microstructure and material fabrication details

The application should describe the properties and required performance of seals, gaskets and fasteners in the primary pressure boundary.

The application should describe a material surveillance program that will address potential material degradation for all components, particularly for components operated in high radiation fields, in order to determine the metallurgical or other degradation effects of factors such as irradiation, stress corrosion cracking, flow-accelerated corrosion, thermal embrittlement, vibration fatigue, and other aging mechanisms.

The application should describe how neutronic properties of control rod materials are addressed in the nuclear design and core nuclear performance section.

Design of the reactor coolant system and reactor auxiliary system

The application should provide the design basis requirements for the reactor coolant system and its major components. The application should describe the system design performance and features to ensure that its various components and its interfacing subsystems meet the safety requirements for design.

The application should demonstrate that the reactor coolant SSCs are designed, manufactured and installed in a manner to allow periodic inspections and tests during their operating lifetime.

Where applicable, the information provided should cover:

- reactor coolant pumps
- steam generators or boilers
- depressurization system
- reactor coolant system piping
- main steamline isolation system
- isolation cooling system for the reactor core

- main steamline and feedwater piping
- pressurizer
- pressure-relief discharge system
- provisions for main and emergency cooling
- residual heat removal system and its components, such as pumps and valves
- supports for piping, vessels and components

The application should indicate the location of specified inspection information in the design documentation, including the volumetric or visual examination and testing.

The application should describe any additional systems associated with the reactor that are not described elsewhere in the application. For example, for CANDU reactors, such information would include the moderator system and its auxiliaries, the end shield cooling system and the annulus gas system. For light water reactors, an example would be the primary leak detection system.

Integrity of the reactor coolant system pressure or fluid boundary

The application should include the results of the detailed analytical and numerical stress evaluations, and of the engineering mechanics and fracture mechanics studies for all components comprising the reactor coolant system pressure or fluid boundary.

The application should take into account the entire range of operating and postulated accident conditions in all operating and shutdown states. The description should directly refer to the detailed stress analyses for each of the major components, to permit further evaluations to be made, if necessary.

The information should be detailed enough to demonstrate that the materials, fabrication methods, inspection techniques, loading conditions and load combinations used conform to all applicable regulations, codes and standards. The pressure or fluid boundary materials, the pressure-temperature or fluid-temperature limits and the integrity of the reactor pressure or fluid boundary – including embrittlement considerations – should all be taken into account in this information.

4.5.9 Safety systems and safety support systems

The information submitted in the application should demonstrate that the safety systems (as defined in REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]) ensure the safe shutdown of the reactor or the residual heat removal from the core, or limit the consequences of AOOs and DBAs. The application should describe how the safety support system supports the operation of one or more safety systems.

Means of shutdown

The application should describe the means of reactor shutdown, reducing reactor power to a low value, and maintaining that power for the required duration, when the reactor power control system and the inherent characteristics are insufficient or incapable of maintaining reactor power within the requirements of the SOE.

Systems and components supporting emergency core cooling functions

The application should describe the systems and components that support the emergency core cooling functions. Systems that supply electrical power or cooling water to equipment used in the operation of emergency core cooling should be considered as a safety support system.

The applicant should ensure that, if injection of emergency coolant is required, an operator cannot easily prevent the injection from taking place.

The application should demonstrate that reactor facility safety would not be affected even if all or part of emergency core cooling was operated inadvertently.

Systems and components supporting emergency heat removal functions

The application should describe the systems and components that support the emergency heat removal functions, which provide for removal of residual heat in order to meet fuel design limits and reactor coolant boundary condition limits in accordance with section 8.8 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

If emergency heat removal is required to mitigate the consequences of a DBA, then the emergency heat removal functions should be designed as a safety system.

The applicant should demonstrate that, during DEC, the emergency heat removal systems and components will function as required.

Systems and components supporting confinement and containment functions

The application should describe the systems and components supporting confinement and containment functions in place to minimize the release of radioactive materials to the environment during operational states and DBAs. The confinement and containment functions should also assist in mitigating the consequences of design-extension conditions (DECs). Confinement or containment functions should be part of the safety system and may include complementary design features. The application should cover the full spectrum of operational states and accident conditions and should include applicable codes and standards, in accordance with section 8.6 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The description should describe, as appropriate, the following information about the systems and components supporting confinement and containment functions:

- heat removal systems
- functional design of the secondary containment
- isolation system
- ventilation system
- penetrations
- protection against overpressure and under-pressure
- control of combustible gas
- venting provisions
- spray system
- leakage testing system

The application should address the design basis requirements for each of the systems identified above. It should also include a schematic presentation of the containment envelope showing the containment boundary for each operational state.

Safety support system

The information submitted should demonstrate that the safety support systems ensure the fundamental safety functions are available in operational states, DBAs and DECAs. The design should include emergency safety support systems to cope with the possibility of loss of normal service and, where applicable, concurrent loss of backup systems.

4.5.10 Electrical power systems

In accordance with sections 7.10 and 8.9 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9], the application should specify the required functions and performance characteristics of each electrical power system that provides normal, standby, emergency and alternate power supplies to ensure:

- sufficient capacity to support the safety functions of the connected loads in operational states, DBAs and DECAs
- availability and reliability is commensurate with the safety significance of the connected loads

4.5.11 Instrumentation and control

The application should describe the instrumentation and control (I&C) systems used to support the safety case of the facility. The applicant should include provision of instrumentation to monitor and control reactor facility variables and systems over the respective ranges for operational states, DBAs and DECAs, in order to ensure reactor facility safety and to make sure that adequate information can be obtained on reactor facility status.

For more information, see the following sections of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]:

- section 7.9 for general requirements and guidance
- section 7.6 for requirements and guidance related to reliability and sharing
- section 7.21 for requirements and guidance on human factors

4.5.12 Control facilities

The application should describe the control facilities, including the main control room, secondary control room and emergency support facilities. It should demonstrate that the control facilities are in accordance with sections 7.21 and 8.10 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9] with an emphasis on human/machine interfaces and the safety grouping concept.

The application should provide the following specific information (noting that some information will be preliminary):

- safety class of each information system important to safety
- list of the measured parameters
- physical locations of the sensors

- equipment qualification envelope (defined by the most limiting conditions in operational states or accident conditions)
- duration of the time period for which the reliable operations of the sensors is required

If the measured parameters are processed by a computer, the application should describe:

- characteristics of any computer software (for example, scan frequency, parameter validation, and cross-channel sensor checking) used for filtering, trending or to generate alarms
- longterm storage of data and displays, and how that information will be made available to the operators in the control room and the secondary control room
- implications of the failure of the reactor facility computers and the mitigating strategies developed to provide operators with essential information
- means of achieving the synchronization of the different computer systems if data processing and storage are performed by multiple computers

The description should cover the habitability systems, equipment, supplies and procedures that are in place to ensure that essential workers, including those in the main and secondary control rooms, can remain at their posts and operate the reactor facility safely in all operational states, or to maintain the reactor facility in a safe condition under all accident conditions considered in the safety case.

The application should include considerations of escape routes and means of communication. The documentation should explain how workers will relocate from the main control room to the secondary control room when the circumstances demand it, and should demonstrate that the route is properly qualified to ensure safe passage in these circumstances. In addition to the habitability systems for the control rooms, this section should cover:

- shielding
- air purification systems
- systems for the control of climatic conditions
- storage capacity for food and water, as required

4.5.13 Steam supply system

As applicable to the proposed reactor facility, the applicant should provide design information related to the steam supply system, including the steam lines, steam and feedwater system piping and vessels and turbine generators. The applicant should ensure there is sufficient margin in the design such that pressure boundary limits are not exceeded in operational states and DBAs.

The application should demonstrate that piping and vessels are separated from electrical and control systems to the extent practicable.

The application should demonstrate that turbine generators have protection systems in place to minimize the potential for any missiles from a turbine break up striking SSCs important to safety.

4.5.14 Auxiliary systems

The application should describe the auxiliary systems, including their design basis requirements. It should also describe any other auxiliary system whose operation may influence safety, but has not been covered elsewhere in the application (for example, communication and lighting systems).

Those systems that support SSCs important to safety or safety functions should meet the expectations of the safety support system.

Water systems

As applicable to the proposed reactor facility, the applicant should provide information concerning the water systems associated with the reactor facility, including the station service water systems, the cooling system for reactor auxiliaries, the makeup system for demineralized water, the condenser cooling water system, the fire protection water supply systems, the ultimate heat sink, and the condensate storage facilities.

The application should describe the safety significance and reliability requirements of each of the water systems, taking into account any claims made in the safety case for their availability to provide cooling.

Heat transfer to an ultimate heat sink

The application should describe the systems for transferring residual heat from SSCs important to safety to an ultimate heat sink. This overall function should be subject to very high levels of reliability during operational states, DBAs and DECAs.

Process auxiliaries

The application should describe the auxiliary systems associated with the reactor process system, including but not limited to the following:

- compressed-air systems
- process and post-accident sampling systems
- equipment drainage and floor drainage systems
- chemical control systems and volume control systems
- purification system

The application should also define the guaranteed shutdown state (GSS) that will support safe maintenance activities of the reactor facility. If soluble poisons are used to provide a GSS, the application should be in accordance with section 7.11 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

Heating, ventilation and air conditioning systems

The application should describe the reactor facility's heating, ventilation, and air conditioning (HVAC) systems. The description should include areas such as control facilities, the spent fuel pool area, the auxiliary and radioactive waste area, the turbine building (in boiling water reactors), and the ventilation systems for safety systems.

The safety significance of any HVAC system credited in the reactor facility safety analysis should be clearly stated, including all common safety-related functionality dependencies such as the air-conditioning system for an equipment room that may contain multiple divisions or groupings of support systems.

4.5.15 Fuel handling and storage

The application should include a description of the fuel handling and storage systems in accordance with section 8.12 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9], including details for:

- monitoring and alarming
- criticality prevention
- shielding, handling, storage, cooling, transfer and transport of non-irradiated and irradiated fuel (**note:** human/machine interface aspects of fuel handling should be in accordance with section 7.21 of REGDOC-2.5.2 [9])

The application should also include a description of methods for detection of failed fuel in the reactor, in accordance with section 8.12.3 of REGDOC-2.5.2 [9].

4.5.16 Waste treatment and control

The application should:

- describe how the generation of radioactive and hazardous wastes is minimized
- how the wastes are characterized, controlled, handled, conditioned and disposed of,
- indicate which systems are or will be in-service before initial fuel load
- provide a schedule for completing the development and implementation of the remaining systems

This information should be in accordance with the following sections of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]:

- section 8.11 for the design of waste treatment and control systems
- sections 7.9 and 8.11 for the safe handling of waste of all types that is produced at any stage of the reactor facility's lifecycle, from construction to commissioning
- section 7.21 for human factors considerations

The application should also describe how releases within the reactor facility and to the environment will be monitored and controlled such that they remain within prescribed limits.

4.5.17 Laboratories and Class II nuclear facilities

The applicant should provide information on the design of laboratories and Class II nuclear facilities within the reactor facility and whether the applicant proposes for this activity to be included as a licensed activity under the Class I licence. The design of laboratories and Class II nuclear facilities should meet the requirements of the *Class II Nuclear Facilities and Prescribed Equipment Regulations* and the *Nuclear Substances and Radiation Devices Regulations*, as applicable.

The applicant should provide information on the provisions for storage of items such as, but not limited to, contaminated tooling and radiation sources.

For more information, refer to GD-52, *Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms* [30].

4.6 Fitness for service

The fitness for service SCA covers activities that affect the physical condition of SSCs to ensure that they remain effective over time. This area includes programs that ensure all equipment is available to perform its intended design function when called upon to do so.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(d), (e), (i) and (j), and 12(1)(c) and (f)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(f) and 5(d), (e), (f) and (m)
- *Radiation Protection Regulations*

4.6.1 General considerations

The application shall describe the proposed measures, policies, methods and procedures to ensure all SSCs important to safety are available to perform their intended design function when called upon to do so. The application should identify all SSCs important to safety.

4.6.2 Reliability program

The reliability program shall meet the requirements of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should provide a description of the reliability program that meets the general approach of REGDOC-2.6.1, *Reliability Programs for Nuclear Power Plants* [27] for systems in the facility whose failure affects the risk of a release of radioactive or hazardous material.

Examples of topics include:

- setting reliability targets
- performing reliability assessments
- testing and monitoring
- regulatory reporting

4.6.3 Maintenance program

Maintenance activities include monitoring, inspecting, testing, assessing, calibrating, servicing, overhauling, repairing and replacing parts.

The maintenance program shall meet the requirements of REGDOC-2.6.2, *Maintenance Programs for Nuclear Power Plants* [31].

The application should include a clearly defined maintenance program containing the proposed measures, policies, methods and procedures that provide direction for maintaining SSCs so that they remain capable of maintaining their functions, as described in design documents and safety analyses that are included in the reactor facility licensing basis.

The application should describe the processes for planning, monitoring, scheduling and executing work activities so that SSCs continue to perform the design intent and remain fit for service in the presence of degradation mechanisms.

The application should describe:

- preventive maintenance activities
- maintenance processes and record retention requirements
- corrective maintenance
- calibration of measuring and monitoring devices
- SSC monitoring, activity optimization
- outage management, work assessment
- work planning and scheduling
- work execution
- maintenance procedures
- post-maintenance verification and testing
- maintenance program assessment

Tasks relating to maintenance, surveillance, inspection and testing take place primarily during the operating phase of the reactor facility's lifecycle. However, for the construction phase, the application should describe what will be done during construction and commissioning to ensure that those tasks can be carried out effectively when the reactor facility is in the operating phase.

The description of the surveillance program should adequately cover all aspects of the operational limits and conditions (OLCs). The frequency of surveillance should be based on a reliability analysis, a probabilistic safety assessment, and previous operational experience (OPEX). This description should show the viability of inspection techniques to meet performance requirements, taking ALARA into account.

The application should describe the approach to be taken for developing acceptance criteria in the SSC inspection program. The application should consider defects such as crack-like flaws and metal loss. When establishing the acceptance criteria, the application should consider the worst combination of design loading conditions and the potential for propagation of a flaw if subjected to system transients or adverse environmental conditions.

The application should describe the program planned to cover the testing for all SSC that can affect the safety functions of the reactor facility, to confirm the continuing performance effectiveness for each SSC. The program should emphasize inspection of the primary and secondary coolant systems, given their integrity to reactor facility safety, and the severity of the possible consequences of their failure.

The information about the surveillance program, the inspection program and the testing program should include a timeline for each of these activities, with milestones for the development and implementation of each program and the processes to be followed. It should include a description of the program to ensure that each activity is carried out within the planned timelines, and that the results obtained in each activity are reviewed against the applicable acceptance criteria. Each program should include periodic reviews to ensure that it continues to meet its objectives.

4.6.4 Aging management program

The application shall describe the integrated aging management program that meets the requirements of:

- REGDOC-2.6.3, *Aging Management* [32]
- section 7.17 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]

The application should include the aging management processes that ensure reliability and availability of required safety functions of SSCs throughout the service life of the reactor facility.

The application should include the following elements of an aging management program:

- organizational arrangements
- data collection and record keeping
- screening and selection process for aging management
- evaluations for aging management
- condition assessments
- SSC-specific aging management plans
- management of obsolescence
- interfaces with other supporting programs
- implementation of SSC-specific aging management plans
- review and improvement process for aging management programs

The application should include SSC-specific aging management plans (also called lifecycle management plans (LCMPs)) for major components in accordance with the overall integrated aging management program framework. Examples of major components that may require LCMPs are fuel channels, feeder piping, steam generators and reactor components, and structures. The application should include SSC-specific aging management plans (or LCMPs) that are structured and have forward-looking inspection and maintenance schedules, requirements to monitor and trend aging effects, and any preventive actions to minimize and control aging degradation of the SSCs.

Periodic inspection or in service inspection programs may be incorporated directly into aging management programs or LCMPs, or may be treated as stand-alone programs. When such programs are treated as stand-alone programs, their role in the aging management framework should be described in the application.

4.6.5 Chemistry control program

The application should include a clearly defined chemistry control program that states the goals and objectives of the program. The program should:

- preserve the integrity of SSCs important to safety
- manage the harmful effects of chemical impurities and corrosion on SSCs
- implement the ALARA principle to manage the buildup of radioactive material and occupational radiation exposure
- limit the release of chemicals and radioactive material to the environment

The applicant should describe the approach, based on industry research- and operating experience, that will be used for the chemical control of reactor facility fluid systems important to safety during construction and commissioning, and at a programmatic level for operational states.

The application should include sufficient information and provide references to detailed documents to demonstrate how chemistry program objectives will be achieved during

construction and commissioning activities and operation. Some examples that the information should address are:

- policy that states the goals and objectives of the chemistry program
- chemistry procedures, specifications and methods of control, and how they will be monitored through the use of adequate performance indicators (for more information on chemistry control performance indicators, see REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* [22])
- methods of data management, including adequate trending, evaluation and reporting of analysis results and investigations
- administrative controls to ensure compliance with industry practices for controlling products in the workplace
- a training program that is sufficient to determine the content, periodic review of needs, assessment of final competencies, and evaluation of the training efficiency

The applicant should demonstrate that the chemistry control program establishes processes and overall requirements for effective control during commissioning and operation and under lay-up conditions to ensure critical equipment performs safely and reliably over the requested licensing period. The application should include a set of technical basis documents establishing the design basis for chemistry control.

The applicant should demonstrate that a chemistry surveillance program is established and implemented to verify the effectiveness of chemistry control in all systems. The surveillance program should be used to detect trends in parameters and to discover and eliminate undesirable effects and consequences of out of range chemistry parameters.

The applicant should demonstrate that consideration is given to the use of online monitoring of control parameters as the preferable monitoring method for evaluating chemistry conditions in all systems. The applicant should demonstrate that a calibration and maintenance program is established and applied to all online and laboratory monitoring instrumentation. The applicant should demonstrate that redundancy or equivalency of laboratory facilities is provided to ensure analytical services at all times.

The applicant should demonstrate that the chemistry control program includes defined chemistry specifications for systems; procedures for chemistry parameter monitoring, trending and monitoring activities; and procedures for the storage and handling of chemicals.

The application should describe provisions for a post-accident sampling system or other adequate sampling facility. If one does not exist, the applicant should describe the other approaches that have been adopted for core damage evaluation and for estimation of the inventory of fission products released into containment.

The applicant should demonstrate that the operating organization has procedures for chemicals and for controlling their required quality. The application should include lists of approved chemicals.

The applicant should demonstrate that the chemistry control program includes procedures for selection, monitoring and analysis of chemistry regime, instructions for operations involving chemistry processes and evaluation of operating results, the operation and reference limits for chemistry parameters and action levels, and possible remedial actions, including ensuring that the chemicals and their quantities used are correct.

The application should include a timeline and milestones for the development and implementation of the remaining matters related to chemistry control.

4.6.6 Periodic and in service inspection and testing programs

The application should include periodic and in service inspection and testing programs for the following SSCs:

- nuclear pressure boundary components
- containment components
- containment structures
- safety-related structures
- balance-of-plant pressure boundary components important to nuclear safety

Periodic and in service inspection and testing programs require physical inspection and testing of SSCs to confirm that service-induced degradation has not increased the likelihood of a failure of a barrier against the release of radioactive substances in accordance with section 7.14 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should state the codes and standards that the applicant intends to use as the basis of the design, inspection and testing programs. Regulatory acceptance of the proposed codes and standards will be considered as part of the application review process.

The application should include inspection programs for balance-of-plant pressure boundary components based upon the aging management program requirements.

Program documents should describe baseline inspection activities implemented to establish the condition of an SSC at the time it was placed into service and describe periodic inspection activities spanning the intended operating life of the reactor facility.

It is acceptable to divide inspection programs by component type or other relevant criteria and to submit separate inspection program documents.

4.7 Radiation protection

The radiation protection SCA covers the implementation of a radiation protection program in accordance with the *Radiation Protection Regulations*. This program must ensure that contamination levels and radiation doses received by individuals are monitored, controlled and maintained as low as reasonably achievable (ALARA).

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(e), (f) and (i), and 12(1)(a), (b), (c), (d), (e) and (f); and sections 17 and 29
- *Class I Nuclear Facilities Regulations*, paragraphs 5(i), (j), (k), (l) and (m), and section 14
- *Radiation Protection Regulations*
- *Nuclear Substances and Radiation Devices Regulations*, sections 5, 8, 20 and 23

The application should describe how the design of the radiation protection program is commensurate with the radiological hazards associated with the licensed activities, based on a thorough analysis of radiological hazards, radiation exposure and dose assessments, and an optimization of doses to conform to the ALARA principle.

4.7.1 Radiological hazard identification and assessment

The application should provide the radiological evaluation and safety assessment performed in the development of the radiation protection program. Information provided should include the potential sources of radiation and the analysis of exposure pathways. The applicant should take into account contained and immobile sources, potential out-of-core criticality (resulting from mishandling of enriched fuel), and potential sources of airborne radioactive material. The application shall describe a nuclear criticality safety program that meets the requirements in REGDOC-2.4.3, *Nuclear Criticality Safety* [29].

Estimated annual collective, individual effective and individual equivalent radiation doses for individuals selected for monitoring should be provided, including methods for estimating the doses.

Where detailed specific radiation protection provisions are to be developed later on, the applicant should provide a proposed timeline and milestones for completion of this work.

4.7.2 Application of ALARA

The applicant should provide the policy that documents the application of the ALARA principle. The application should describe how the policy is integrated within the radiation protection program to ensure that radiation exposures and doses conform to the ALARA principle. The information submitted should demonstrate that there is sufficient management commitment in establishing this policy. The application should demonstrate that, beginning with reactor facility design, the policy is in accordance with:

- sections 4.1.1 and 8.13 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]
- REGDOC-2.7.1, *Radiation Protection* [33]

For additional information, refer to REGDOC-2.7.1, *Radiation Protection* [33].

4.7.3 Elements of the radiation protection program

The applicant should demonstrate that the radiation protection program includes the following elements:

- organization and administration for radiation protection
- radiation protection training and qualification
- classification of areas and local rules
- radiation exposure and dose control
- radiation protection equipment and instrumentation
- radiation monitoring and dose assessment
- contamination control
- planning for unusual situations
- radiation protection program oversight

The information submitted should demonstrate that the radiation protection program is based on an assessment that takes into account the location, magnitude and form (solid, liquid or gas) of all radiological hazards.

Design features for radiation protection

The application should describe the features in the design of the equipment and the reactor facility that ensure radiation protection from sources of radiation. The application should demonstrate, in accordance with section 8.13 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9], that suitable provisions have been made in the design and layout of the reactor facility to reduce doses and radioactive releases from all sources.

The application should also state radiation dose targets in the reactor facility design specification, including those that relate to the dose levels expected for workers and members of the public resulting from operation of the reactor facility throughout its lifecycle.

Organization and administration for radiation protection

The applicant should provide the organizational structure related to the radiation protection program, including the roles and responsibilities of each position and their experience, training and qualification requirements.

The applicant should provide the policies and procedures that will ensure sufficient management control over work practices.

Radiation protection training and qualification

The application should describe the radiation protection training program, including methods for training, retraining and indoctrination training, and for maintenance of radiation protection instruction manuals.

The application should identify the knowledge, skills and awareness required for all employees, including radiation protection personnel, health physics staff, contractors and visitors.

Classification of radiation zones and local rules

The applicant should provide the classification of radiation zones within the reactor facility. The applicant should also provide the criteria and rationale for radiation zone designations, including zone boundaries during normal, refuelling and accident conditions. The application should describe how the zones are based on predicted dose rates, contamination levels, concentration of airborne radionuclides, access requirements, and specific requirements such as the need to separate safety trains. The application should describe how the rationale for zoning includes control of radiation exposures to conform to the ALARA principle, to prevent spread of contamination and to prevent or limit potential radiation exposures.

The information submitted should demonstrate that local rules for the zones have been established and described.

Radiation exposure and dose control

The application should describe the methods for radiation exposure and dose control, including policies and procedures that provide the basis for work instructions with the intent of ensuring radiation exposures and doses conform to the ALARA principle.

The applicant should provide the policy and procedures for radiation work planning and radiation work protection. The application should demonstrate that anticipated radiological hazards are also considered in the establishment of operating and maintenance procedures.

The applicant should provide the policies for radiation personal protective equipment (RPPE) and respiratory protection, which includes selection, use and maintenance.

The applicant should identify the equipment for radiation exposure and dose control.

The applicant should provide the action levels and their bases.

Radiation protection equipment and instrumentation

The description of the radiation protection program should include the criteria for selecting fixed, portable and laboratory technical equipment and instrumentation for:

- performing radiation and contamination surveys
- airborne radioactivity monitoring and sampling within the reactor facility
- area radiation monitoring
- monitoring of workers for normal operation, AOOs and accident conditions

The application should describe how the program will provide adequate quantities and types of equipment for anticipated needs in normal operations and emergencies, taking into consideration unavailability during calibration, maintenance and repair.

The application should describe the provisions for instrument storage, calibration and maintenance facilities. The application should include details on the frequency of calibration, the maintenance programs and the traceability of the instrumentation's usage. The application should also describe the calibration services for instrumentation, including how the service ensures traceability to a national standards laboratory.

Radiation monitoring and dose assessment

In the radiation protection program, the application should include the policy for a radiation monitoring and survey program with provisions for:

- routine monitoring, which is conducted to demonstrate that the working environment is satisfactory for continued operations and that no change has taken place that would call for a reassessment of operational procedures
- task-related monitoring, which supplies information about a particular task or operation and to provide, if necessary, a basis for immediate decisions on the execution of the task
- special monitoring, such as during the commissioning stage for new facilities, following major modifications to either facilities or procedures, or when operations are being carried out under abnormal circumstances such as those following an incident or an accident

The application should describe the methods for monitoring and performing surveys, as well as the frequency, types and locations of the measurements to be performed.

The applicant should provide the policy for radiation monitoring and dose assessments for workers. The information should include details on monitoring procedures for workers, bioassays, and recording and reporting doses for workers.

Contamination control

The application should describe the contamination control program and its provisions for monitoring and decontaminating objects and persons in controlled areas, including storage areas for contaminated tools and other items.

Planning for unusual situations

The application should include the policy describing provisions for radiation protection during AOOs, DBAs and BDBAs/severe accidents. The application should include information on access controls, properly designed habitability controls, communications systems, adequate radiation monitoring capabilities, portable emergency response radiation protection equipment and instrumentation, and radiation personal protective equipment (RPPE), instrumentation and equipment.

Radiation protection program oversight

The applicant should provide a policy for oversight of the radiation protection program, including, but not limited to, considerations of:

- management commitment
- assignment of responsibilities for quality assurance and oversight of the radiation protection program
- corrective action feedback into the radiation protection program

The applicant should provide a policy for conducting regular reviews of the radiation protection program. The application should include details on the frequency of, and the process for, conducting the review. The application should describe how procedures, equipment and facilities are improved when warranted.

The applicant should provide the policy for developing performance indicators (such as goals, objectives and guiding principles for their development).

The applicant should also provide details on which records are generated and the retention periods for those records.

4.7.4 Dose to the public

All applicants should submit the technical basis for calculating the dose to the public from licensed activities.

This information may be submitted as part of the information addressing environmental protection.

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4.8 Conventional health and safety

The conventional health and safety SCA covers the implementation of a program to manage workplace safety hazards and to protect workers.

This section addresses the requirements of paragraph 21(1)(a) of the NSCA and of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, subsection 12(1), section 17, and paragraphs 29(1)(d), (h) and (i)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(e), (f) and (h)

It also addresses the requirements of the *Canada Labour Code Part II*, and the *Canada Occupational Health and Safety Regulations* or the applicable provincial occupational health and safety legislation.

4.8.1 General considerations

The application should describe the program and implementation of policies to minimize risk to the health and safety of workers posed by conventional (non-radiological) hazards in the workplace, including the management of workplace safety hazards and the protection of personnel and equipment.

The applicant should demonstrate that the occupational health and safety (OHS) program meets the requirements set out in all applicable provincial and federal legislation. The application should demonstrate how it ensures that all workers, including contractors, comply with the applicant's health and safety policies and procedures.

The application should demonstrate that the applicant has policies in place to:

- adequately execute the worker health and safety policies and procedures
- make adequate provision for the protection of the health and safety of persons, including provisions to:
 - demonstrate adequate oversight of the site OHS program
 - ensure compliance with applicable OHS regulations and requirements
 - ensure adequate OHS training of persons involved in OHS activities
 - have the capabilities for reporting, investigating and identifying root causes of incidents and significant events
- implement corrective actions to eliminate the identified root causes and verify completion to prevent recurrence

The application should demonstrate how it identifies potential OHS hazards, assesses the associated risks, and puts in place the necessary materials, equipment, programs and measures to effectively manage, control and minimize those risks. The applicant should demonstrate that the handling and storing of hazardous materials complies with the Workplace Hazardous Materials Information System (WHMIS) program.

The application's description of the health and safety program should address periodic inspections, safety meetings, OHS committees and continuous improvement.

The application should describe the measures for monitoring accident severity rate, accident frequency, lost-time injuries, medically treated injuries and disabling injuries.

For more information, see REGDOC-2.8.1, *Conventional Health and Safety* [34].

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4.9 Environmental protection

The environmental protection SCA covers programs that identify, control and monitor all releases of radioactive and hazardous substances and effects on the environment from facilities or as the result of licensed activities.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(c), (e) and (i), 12(1)(c) and (f), and 17(a), (b), (c) and (e)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(e), (g), and (h), and 5(b), (i), (j) and (k); and subsection 14(1)
- *Radiation Protection Regulations*

4.9.1 General considerations

The application shall include a comprehensive set of environmental protection measures that meet the requirements of REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures* [35]. The application should include detailed information related to the potential environmental effects resulting from the conduct of construction and commissioning activities.

Because construction includes fuel-out (or phase A) commissioning, the application shall address control and monitoring of hazardous substances.

The application shall provide proposed timelines and milestones for development of provisions for environmental protection during fuel-in commissioning and reactor facility operation.

The application should identify and describe all standards, guidelines or criteria that have been applied with respect to preventive and control measures for environmental protection from discharges from the reactor facility, including:

- preventive and control measures pertaining to environmental protection, including their expected performance
- a list of SSCs that are important for preventive and control measures; for example, active liquid waste and stack monitoring equipment
- the maintenance program established to ensure the sustained operational performance of preventive and control measures
- alarm systems to be installed to respond to failure of preventive and control measures
- identification of the measures that will be taken to make appropriate data available to the authorities and the public

4.9.2 Effluent and emissions control (releases)

The application should describe the effluent monitoring program that will be the primary indicator of reactor facility performance in terms of releases to air, surface waters, groundwater and soils, from both operation and waste management activities. For more information, see CSA N288.5, *Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills* [36].

The applicant should demonstrate that the program encompasses all measures to be carried out related to monitoring releases of radioactive and hazardous substances with potential

environmental effects. The application should describe how the program integrates all site routines that will sample, measure and analyze radiological and hazardous substances and physical parameters.

The application should include detailed information on:

- criteria established to identify the radioactive and hazardous substances that will be monitored, and the detection limits that will be set to verify the performance of the preventive and control measures taken to manage releases
- inventory of potential radionuclides and physio-chemical elements that could be released and affect the environment
- identification of the authorized limits (for example, dose to the public, derived release limits, action levels and discharge limits) and operational targets for releases and the mitigation of physical effects
- alarm systems provided to respond to unplanned releases
- availability targets for the various monitoring devices, and a maintenance program to assure sustained performance of monitoring equipment at their availability targets
- documentation on worker qualifications and the training program for specialist staff and contractors participating in the implementation of this effluent monitoring program
- documentation on quality assurance and quality control to be followed when undertaking specific monitoring tasks
- documentation on procedures for sampling, analytical methods, calibration of equipment and data management
- documentation outlining the audit and review process for each of the elements of the effluent monitoring program

The applicant should identify derived release limits (DRLs) for radionuclides such as tritium, iodine, carbon-14, noble gases and particulates. The applicant should demonstrate how these DRLs were derived using mathematical equations that describe the transfer of radioactive materials through the environment to humans. For more information, see CSA N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities* [37].

The information submitted should demonstrate how the radiological emissions will be monitored and controlled to conform to the ALARA principle.

The applicant should identify environmental action levels (EALs) for nuclear and hazardous substances released via airborne, waterborne or sewage discharge pathways. For more information, see CSA N288.8, [*Establishing and implementing action levels for releases to the environment from nuclear facilities*](#) [38].

The application should describe non-radiological aspects of site activity that could have environmental effects, including exposure to members of the public. The application should include detailed information on:

- identification of the chemical and physical nature of the releases and the potential chemical and physical effects
- identification of the authorized limits and operational targets for releases and the measures taken to comply with such limits

- the offsite monitoring regime for hazardous substances and the physical effects they cause
- the alarm systems for responding to unplanned releases
- identification of the measures that will be taken to make appropriate data available to the authorities and the public

The application should include an explanation of the measures that will be taken to identify potential or expected releases of hazardous substances to the environment and to identify any physical effects to biota, such as impingement and entrainment or habitat loss.

Where applicable, the applicant should provide information on the monitoring of routine discharges of radioactive effluents and hazardous substances (such as SO₂, NO₂, CO₂, ammonia, hydrazine, chlorine, morpholine and ozone-depleting substances).

4.9.3 Environmental management system

The application should describe the environmental management system established to ensure protection of the environment throughout operation. For more information, see:

- REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* [35]
- CAN/CSA-ISO 14001, *Environmental management systems – Requirements with guidance for use* [39]

The description of the environmental management system should include information on:

- emissions management
- spills management
- land assessment and remediation management
- waste management
- management of polychlorinated bi-phenyls (PCBs)
- management of ozone-depleting substances
- management of environmental impacts
- radiological emission limits and action levels
- monitoring of radioactivity in effluents
- management of the offsite radiological environmental monitoring program
- management of adverse effects on fish population (fish impingement and entrainment, and thermal effects)

4.9.4 Assessment and monitoring

The application should describe the monitoring system established to cover all environmental monitoring measures on the site during operation.

The application should describe all important pathways, contaminants and parameters, and their relevance to the protection of the environment and human and non-human biota. The description of the system should include the following:

- a design document that describes the structural framework, environmental monitoring components and associated rationale for the environmental monitoring program, including:
 - description of objectives and monitoring rationale
 - methodology and criteria to identify radiological and hazardous substances and physical and biological parameters that require monitoring

- sampling and analytical frequency
- sampling locations
- environmental media to be sampled
- analytical detection limits
- performance indicators, targets and action levels
- corrective action plan to be implemented if the levels or performance targets are exceeded
- documentation on worker qualifications and the training program required by staff and contractors
- information on sampling, analytical methods, calibration of equipment and data management
- documentation outlining the audit and review process for each of the elements of the environmental monitoring program

The application should:

- describe how the radiological conditions in the environment of the reactor facility site and the radiological effects of any neighbouring reactor facilities and other external sources are taken into account
- provide an understanding of the prevailing radiological conditions at the site
- be detailed enough to serve as an initial reference point of the prevailing radiological conditions

The application should also describe the provisions for monitoring the site-related parameters affected by:

- seismic events, atmospheric events, and water- and groundwater-related events
- demographic, industrial and transport-related developments

This description should be sufficiently detailed to provide the information necessary to support emergency actions in response to external events, to support a periodic review of safety at the site, and to develop dispersion modeling for radioactive material. The description should also serve as confirmation of the completeness of the set of site-specific hazards that have been taken into account.

4.9.5 Protection of the public

The application should identify and describe all the radiological and non-radiological aspects of site activities that could have environmental effects, including exposure to members of the public during operation.

The application should address the measures taken to identify releases of solid, liquid and gaseous radioactive effluents into the environment. It should indicate how the effluents will be managed to conform to the ALARA principle, and should include information on:

- identification of the authorized limits and operational targets for solid, liquid and gaseous effluent releases and the measures taken to comply with such limits
- the offsite monitoring regime for contamination levels and radiation levels in the various components of the surrounding environment, and the methods to be followed to estimate radiation doses to members of the public

- the methods to be used to prepare, store and retain records of the radioactive releases that will be made routinely from the site
- the dedicated release monitoring programs and alarm systems that are required to respond to unplanned radioactive releases and the automatic devices to be provided to interrupt such releases, if applicable
- identification of the measures that will be taken to make appropriate data available to the authorities and the public

4.9.6 Environmental risk assessment

The application shall include an environmental risk assessment (ERA).

The applicant should review the ERA that was developed under their application for a licence to prepare the site, and update the information as necessary to reflect any changes to the site or the situation.

For more information, see REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* [35].

4.10 Emergency management and fire protection

The emergency management and fire protection SCA covers emergency plans and emergency preparedness programs that exist for emergencies and for non-routine conditions. This area also includes any results of participation in exercises.

Note: This SCA includes conventional emergency and fire response. Fire protection operations, design and analysis are discussed in the appropriate SCA of operating performance, safety analysis or physical design.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(d) and (i) and 12(1)(a), (b), (c), (d), (e), (f), (g) and (h)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(a) and (f), and 5(i) and (k)

4.10.1 General considerations

The application shall describe an emergency preparedness program that meets the requirements of:

- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]
- REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response* [40]

The application's emergency preparedness and fire protection provisions shall take into account the location of the facility (greenfield, or on an existing nuclear reactor facility site).

The application shall provide proposed timelines and milestones for development of provisions for emergency preparedness and fire protection during fuel-in commissioning and reactor facility operation.

An effective emergency preparedness program is based on the following components:

- planning basis
- program management
- response plan and procedures
- preparedness

The application should describe the preparations that have been made to ensure that onsite and offsite emergencies and severe accidents will be dealt with safely and effectively. The application should reference population studies and emergency planning considerations related to the site.

4.10.2 Nuclear emergency preparedness and response

The application should describe how the nuclear emergency program encompasses both emergency preparedness and emergency response measures. The description should:

- address emergency situations that could endanger the safety of onsite workers, the environment and the public
- include information outlining the interfaces with the provincial nuclear emergency response plans and coordination with the municipalities and foreign states in the surrounding region when implementing the emergency plan and related protective actions
- provide information on the proximity to the reactor facility of airports, railways, roads and emergency services

The application should describe how the applicant intends to conduct emergency exercises and drills as outlined in their nuclear emergency plan.

The application should describe any natural or artificial events within and beyond the design basis that would affect emergency management requirements (for example, forest fires, earthquakes, extreme weather conditions, toxic fume clouds, explosions and airplane crashes).

The description of the emergency plan should include:

- a basis for emergency planning
- selection and qualification of workers
- emergency preparedness and response organizations
- staffing levels
- emergency training, drills and exercises
- emergency procedures
- assessment of emergency response capability
- assessment of accidents
- activation and termination of emergency responses
- protection of facility workers and equipment
- interface with offsite organizations
- a recovery program
- a public education program

4.10.3 Conventional emergency preparedness and response

The application should describe all non-radiological, non-routine conditions at the facility for which the emergency preparedness program has been established. The description should include details about which provisions exist on site and which provisions involve off site response support.

4.10.4 Fire emergency preparedness and response

The applicant should describe a comprehensive fire protection program that ensures the licensed activities do not result in unreasonable risk to the health and safety of persons and the environment due to fire.

4.11 Waste management

The waste management SCA covers internal waste-related programs that form part of the facility's operations up to the point where the waste is removed from the facility to a separate waste management facility. This area also covers the planning for decommissioning.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(c), (d), (e), (i) and (j), and 12(1)(c)
- *Class I Nuclear Facilities Regulations*, paragraphs 3(e), (f) and (k); 5(i), (j) and (k); and subsection 14(2)
- *Radiation Protection Regulations*

4.11.1 General considerations

Because construction includes fuel-out (or phase A) commissioning, the application's waste management provisions shall address management of hazardous substance wastes.

The application shall provide proposed timelines and milestones for development of provisions for waste management during fuel-in commissioning and reactor facility operation.

In addition, the application should describe the overall waste program to address waste generated during day-to-day operations of the reactor facility, during planned or unplanned outages, and its transfer to the waste storage facility or an authorized facility.

The description of the waste management program should address both conventional and radioactive waste, and should include information on:

- controls for handling
- storage
- disposal
- characterization
- classification
- minimization
- segregation
- clearance
- exemption
- processing
- packaging
- training
- auditing
- transportation

For more information, see:

- REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* [41]
- REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste* [42]
- REGDOC-2.11.2, *Decommissioning* [43]

4.11.2 Waste management practices

The application should identify the main sources of solid, liquid and gaseous radioactive and hazardous waste within the facility. The measures taken for the safe management and disposal of these wastes throughout operation should be described.

The application should describe the types, quantities and volumes of radioactive and hazardous waste that will be accumulated, and how waste will be categorized and separated within the storage areas.

The application should describe the provisions for safe handling of radioactive and hazardous waste of all types produced during operation.

Where the application includes the consolidation of the waste management facility into an operating licence, the application should describe the process for handling (including receipt, transfer and loading of waste), storage and disposal of the solid radioactive waste and the management of spent fuel from the spent fuel bay to the dry storage facility.

The application should describe the potential need for specialized systems to deal with issues of storage in both the near and longer term (for example, cooling, containment, volatility, chemical stability, reactivity, retrievability and criticality), in accordance with sections 8.11 and 10 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9] and with REGDOC-2.11, *Framework for Radioactive Waste Management and Decommissioning in Canada* [41]. Any system already in place should be described.

The application should describe how common safety considerations for waste storage are addressed, including:

- immobility and energy state of the radioactive material
- stability and resistance to degradation of the waste form and container
- multi-barrier containment approach
- waste package life and retrievability
- facility resistant to hazards, with minimized need for monitoring and maintenance
- appropriate robustness for the storage period, prior to disposal activities

The application should describe how the program takes into account the possible need to retrieve waste at some point in the future, including during the decommissioning stage.

With respect to the storage and management of spent nuclear fuel, the application should describe how the program reflects the fundamental safety concerns related to criticality, exposure, heat control, containment and retrievability.

If waste will be transported to another specified location for long-term storage, the application should describe provisions for ensuring safe transport.

4.11.3 Waste characterization

The applicant should demonstrate that the waste management program includes the measures taken to categorize and separate waste (for example, physical, chemical and radiological waste).

The application should also describe the measures taken to condition the waste produced during operation, and describe the procedures for processing the waste.

4.11.4 Waste minimization

The application should describe the measures taken to minimize the accumulation of waste produced during operation. The application should include provisions to reduce the waste to a level that is as low as practicable.

The application should describe methods to minimize radioactive waste generation at the source, such as:

- design measures
- operating procedures
- product changes
- source control
- technology

The application should show that both the volume and the activity of the waste are minimized, and that the volume and the activity of the waste meet any specific requirements that may be posed by the design of the waste storage facility.

4.11.5 Decommissioning practices

The application shall include a preliminary decommissioning plan for the work required to decommission the reactor facility, in accordance with REGDOC-2.11.2, *Decommissioning* [43]. This plan also forms the basis for establishing a financial guarantee sufficient for decommissioning the reactor facility.

The application should describe provisions for periodic updates to include additional details and to reflect recent developments in the decommissioning plan.

The application should include a strategy for the management of waste and spent fuel when the reactor and waste storage facility are decommissioned, in accordance with section 7.24 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

For further guidance on decommissioning, refer to REGDOC-2.11.2, *Decommissioning* [43], and REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities* [44].

4.12 Security

The security SCA covers the programs required to implement and support the security requirements stipulated in the regulations, the licence, orders, or expectations for the facility or activity.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(d), (e), (g), (h) and (i), 12(1)(c), (g), (h) and (j), and 17(c) and (e); sections 21, 22, and 23; subsection 28(1); and sections 29 and 30
- *Class I Nuclear Facilities Regulations*, paragraphs 3(a), (b) and (i), and 5(h) and (i)
- *Nuclear Security Regulations*
- *Nuclear Substances and Radiation Devices Regulations*, paragraphs 36(1)(a) and (d)

4.12.1 General considerations

The application shall describe a security program that meets the requirements of:

- REGDOC-2.12.1, *High-Security Facilities, Volume I: Nuclear Response Force* [19]
- REGDOC-2.12.1, *High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices* [45]
- REGDOC-2.12.2, *Site Access Security Clearance* [46]
- REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material* [4]
- REGDOC-2.2.4, *Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness* [18]

Note: Any information considered classified, protected, proprietary or personal should be submitted in accordance with the CNSC's *Guidance Document on Confidential Filings* [47].

Because construction includes fuel-out (or phase A) commissioning, the application's security provisions shall address the measures necessary to protect the reactor facility throughout construction and fuel-out commissioning. For more information on protecting SSCs under construction and on methods to detect and deter conditions that may affect site security, see REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8].

The application shall provide proposed timelines and milestones for development of provisions for security during fuel-in commissioning and reactor facility operation.

The application should describe the security program and plan that will encompass all licensed activities, including a description of:

- the threat risk assessment (TRA) process and results
- the cyber security program
- response arrangements
- security practices
- the security training and qualification program

The applicant should provide information related to:

- site access control and measures to prevent loss or illegal use, illegal possession or illegal removal of the nuclear substance

- prescribed assets (equipment or prescribed information)
- the proposed measures to prevent acts of sabotage or attempted sabotage at the nuclear facility
- specific information related to meeting the requirements for high-security sites and the transportation of Category I, II or III nuclear material

The application should include a complete TRA to evaluate any threats, risks or vulnerabilities to the facility. The application should describe how vital areas within the nuclear facility are protected against design-basis threats and any other credible threats identified in the TRA. The application should describe how the security program is based on credible risks and vulnerabilities, and should contain a site plan that conforms to the *Nuclear Security Regulations*.

REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material* [4] provides information on preparing and submitting a written transportation security plan and on what information should be included with a licence application (specific topics include, for example, how security information should be organized and the administrative procedures to be followed when providing the security program description).

4.12.2 Facilities and equipment

The application should describe how the security program ensures that:

- security systems, devices and equipment provide deterrence, detection, assessment and delay functions
- operational readiness is maintained

The applicant should describe the engineered safety barriers that protect against malevolent acts and how these provisions are documented as part of a managed program or process within the management system. The application should describe the process to report on changes in design, analysis or operational procedures that are credited for the protection against malevolent acts, in accordance with the *Nuclear Security Regulations*.

The application should describe the access control of workers and vehicles to vital areas. The application should also describe the control mechanisms, which may include access control devices, identification badges, escorted access, and detection and assessment systems.

4.12.3 Response arrangements

The application should describe how the security program ensures that onsite and offsite response arrangements provide effective response to unauthorized removal of nuclear or radioactive material or to the sabotage of nuclear facilities.

The applicant should provide a tactical deployment plan that describes protection arrangements with an offsite response force.

When applicable, the applicant should demonstrate how the program ensures that a nuclear response force is in place and authorized to prevent and detect unauthorized entry into a protected area or inner area, including unauthorized entry of weapons and explosive substances.

The application should demonstrate that the communications systems are implemented commensurate to the threats, risks and vulnerabilities.

4.12.4 Security practices

The application should describe the measures in the security program that ensure administrative and technical measures are implemented, maintained and documented in a security program.

The applicant should describe how access to prescribed equipment and information is limited to those workers having the appropriate security clearance and a valid need-to-know basis.

4.12.5 Security training and qualification

The application shall describe measures in place to ensure response workers are trained and capable of performing the duties described in section 30 of the *Nuclear Security Regulations* and in accordance with training requirements specified in REGDOC-2.12.2, *High-Security Facilities, Volume I: Nuclear Response Force* [19]. The application should describe realistic drills and exercises to test the performance of security systems, processes, procedures and workers.

The application should describe the duties of the security officers. The applicant should demonstrate that the security officers are adequately equipped to perform their assigned duties and tasks.

The application should describe the process that ensures that the required documentation and necessary medical, physical and psychological certification of a person is obtained before that person can be authorized to act as a nuclear security officer.

4.12.6 Cyber security

The application should describe a cyber security program that ensures cyber assets that are subject to cyber security requirements are protected from cyber attacks. The application should address internal and external cyber threats.

The application should describe how the cyber security program is designed, implemented and maintained as an effective program. The application should provide information on the following program elements, including but not limited to:

- defensive strategy and security architecture
- policies and procedures
- asset identification and classification
- roles and responsibilities of the involved parties
- security controls
- awareness and training
- configuration management
- coordination with other programs
- incident response, reporting and recovery plan
- program review and maintenance
- lifecycle approach to cyber assets

4.13 Safeguards and non-proliferation

The safeguards and non-proliferation SCA covers the programs and activities required for the successful implementation of the obligations arising from the Canada/International Atomic Energy Agency (IAEA) safeguards agreements as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons* (IAEA INFCIRC/140) [48].

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, subsection 3(2), paragraphs 3(1)(g) and (h), 10(b) and 12(1)(i); paragraphs 20(d) and 21(1)(a) and (b); and subsection 23(2)
- *Class I Nuclear Facilities Regulations*, paragraph 5(h)
- *Nuclear Non-proliferation Import and Export Control Regulations*

It also addresses the requirements of the following international protocols:

- *Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (IAEA INFCIRC/164) [49]
- *Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (IAEA INFCIRC/164/Add.1) [50]

4.13.1 General considerations

Note: Either before, or concurrent with, applying for a licence to construct a reactor facility, the applicant must complete and submit to the CNSC the IAEA safeguards design information questionnaire (available upon request from the CNSC's International Safeguards Division). The CNSC encourages early engagement on the completion of this questionnaire, particularly for novel technologies where safeguards measures have not yet been developed. For more information, see REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [51].

The applicant shall provide a description of the arrangements made by the applicant that will permit the CNSC to discharge Canada's obligations and provide information to the IAEA. The application shall describe how the arrangements address the requirements in REGDOC-2.13.2, *Import and Export* [52] and REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [51], and are in accordance with sections 7.23 and 8.12 of REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9].

The application should describe measures related to site buildings and structures, operational parameters and the flow and storage of nuclear material, from the reactor facility's design and commissioning phases through to its decommissioning and eventual abandonment.

For reactor facilities, the non-proliferation program is limited to the tracking and reporting of international obligations and origins of nuclear material.

For the purposes of the application and its review, document ownership will vary between the IAEA, the CNSC and the applicant:

- the IAEA is responsible for the generic safeguards approach
- the CNSC is responsible for:
 - coordinating with the IAEA in developing the generic safeguards approach
 - negotiating the safeguards arrangements with the IAEA for the applicant facility

- monitoring the applicant's compliance with safeguards documents, requirements and obligations
- the applicant is responsible for establishing and implementing the safeguards program

4.13.2 Nuclear accountancy and control

The application should describe how the program ensures the collection, storage and reporting of information on the inventory and transfer of nuclear material subject to safeguards to the CNSC and IAEA. The application should describe measures to ensure that nuclear materials are tracked and reports are submitted to the CNSC on the inventory and transfer of nuclear material and the application of IAEA safeguards.

The application should describe provisions for timely submission of accurate reports and information on nuclear material. Further information is available in REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [51].

4.13.3 Access and assistance to the IAEA

The application should describe how the program ensures that the IAEA is able, upon request, to access the facility for inspections and other verification activities. Additionally, the application should describe how the program ensures that such activities are supported by facility workers and resources.

The application should describe how the effectiveness of safeguards procedures, and assistance to the IAEA for site access and inspections, are reviewed.

4.13.4 Operational and design information

The application should describe:

- the processes that collect, store and report relevant operational information to the CNSC and the IAEA
- how the program ensures that the facility's design information questionnaire is complete and correct
- how the program ensures that updates provided under the *Additional Protocol* [50] are reported to the CNSC

The application should also describe methods of development and implementation of an appropriate safeguards approach based on the reactor facility's specific designs.

The application should describe how the program engages both the CNSC and the IAEA to ensure the safeguards approach taken is suitable for its purpose.

The application should describe provisions for the submission of:

- annual operational information
- accurate design information of structures
- processes and procedures

4.13.5 Safeguards equipment, containment and surveillance

The applicant should demonstrate that adequate resources (such as power and lighting) are provided to IAEA equipment and that measures are in place for the protection of IAEA equipment and seals.

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4.14 Packaging and transport

The packaging and transport SCA covers programs for the safe packaging and transport of nuclear substances to and from the licensed facility.

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(e) and 20(a)
- *Class I Nuclear Facilities Regulations*, paragraph 5(i)
- *Packaging and Transport of Nuclear Substances Regulations, 2015*

It also addresses the requirements of the *Transportation of Dangerous Goods Regulations*.

4.14.1 Package design and maintenance

The application should describe how the program ensures that all shipping packages are designed and maintained for the protection and containment of the quantities transported.

The application should describe elements such as package certification, package testing, inspection and maintenance.

4.14.2 Packaging and transport program

The applicant shall describe the measures in place to ensure compliance with all requirements of the *Packaging and Transport of Nuclear Substances Regulations, 2015* and the *Transportation of Dangerous Goods Regulations*.

The application should describe the measures to ensure that appropriate training is provided for workers involved in the handling, preparation for transport, and transport of dangerous goods, and that training certificates are issued to workers.

4.14.3 Registration for use

The application should describe the measures in place to ensure that certified packages are registered for use prior to transport.

5. Other Regulatory Areas

This section addresses the requirements of the following regulations made under the NSCA:

- *General Nuclear Safety and Control Regulations*, paragraphs 3(1)(l) and (m), and sections 29 to 32
- *Class I Nuclear Facilities Regulations*, paragraph 3(j)
- *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*

5.1 Reporting requirements

The applicant shall describe how the reporting and trending programs, processes and procedures meet the requirements of REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* [22].

5.2 Public information and disclosure program

The applicant shall describe how their proposed public information and disclosure program (required by all licensees) meets the requirements in REGDOC-3.2.1, *Public Information and Disclosure* [53].

The description shall include how and with what tools the licensee will communicate with the public, particularly with those persons living in the vicinity of the site, and the general nature and characteristics of the anticipated effects on the environment and the health and safety of persons that may result from the operation of the facility (listed under "General Requirements for Licence Applications" under section 3(j) of the *Class I Nuclear Facilities Regulations*).

For new facilities, the applicant should demonstrate that ongoing engagement with appropriate parties has been continued from construction activities and integrated into operational activities.

5.3 Indigenous engagement

The CNSC, as an agent of the Crown, has the responsibility for fulfilling Canada's legal duty to consult, and where appropriate to accommodate Indigenous peoples when the CNSC's decisions may have had adverse effect on potential or established Indigenous or treaty rights. The CNSC is committed to meaningful ongoing engagement and consultation with Indigenous groups who have an interest in facilities and activities regulated by the CNSC.

REGDOC-3.2.2, *Indigenous Engagement* [54] sets out requirements and guidance for licensees whose proposed projects may raise the Crown's duty to consult. While the CNSC cannot delegate its obligation, it can delegate procedural aspects of the consultation process to licensees, where appropriate. The information collected, and measures proposed, by licensees to avoid, mitigate or offset adverse effects may be used by the CNSC in meeting the CNSC's obligations for consultation.

5.4 Cost recovery and financial guarantees

Each reactor facility licensee in Canada has the prime responsibility for the safety of its facility, including providing adequate financial resources to support the safety of each reactor facility throughout its life.

5.4.1 Cost recovery

A construction licence for a reactor facility is subject to the requirements of Part 2 of the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*. Applicants are responsible for payment of the annual fees determined by CNSC. Payments are normally requested on a quarterly basis and are due to the Receiver General of Canada.

The applicant should discuss the details of the amount and payment plan with the CNSC.

For additional information, refer to the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*.

5.4.2 Financial guarantees

The application should describe the financial guarantees for the costs of decommissioning the reactor facility according to the NSCA and the *General Nuclear Safety and Control Regulations*. The applicant should also provide a cross-reference to the supporting document regarding the value and form of the financial guarantee.

For more information about financial guarantees and licensing, consult REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities* [44].

Appendix A: Legislative Clauses

The information submitted by an applicant for a licence to construct a reactor facility is based on the relevant clauses from legislation, including the *Nuclear Safety and Control Act* (NSCA) and the regulations made under the NSCA. Table A.1 lists select relevant sections; however, applicants are responsible for ensuring that all requirements under the NSCA and regulations for the proposed activities are addressed in an application.

Table A.1: Clauses in the NSCA and the regulations made under the NSCA, mapped to the relevant sections of this licence application guide

Legislation	Clause(s)	Section(s) in this document
NSCA	24(4)	Every SCA (sections 4.1 through 4.14) 5, Other Matters of Regulatory Interest
	26(a), (e)	Every SCA (sections 4.1 through 4.14) 5, Other Matters of Regulatory Interest
<i>General Nuclear Safety and Control Regulations</i> (GNSCR)	3(1)(a)	3.1.2, Applicant's name and business address
	3(1)(b)	3.2.2, Statement of the main purpose
	3(1)(c)	3.2.5, Nuclear substances 4.9, Environmental protection 4.11, Waste management
	3(1)(d)	3.2.2, Statement of the main purpose 4.4, Safety analysis 4.5, Physical design 4.6, Fitness for service 4.10, Emergency management and fire protection 4.11, Waste management 4.12, Security
	3(1)(e)	4.4, Safety analysis 4.5, Physical design 4.6, Fitness for service 4.7, Radiation protection 4.9, Environmental protection 4.11, Waste management 4.12, Security 4.14, Packaging and transport
	3(1)(f)	4.7, Radiation protection
	3(1)(g)	4.5, Physical design 4.12, Security 4.13, Safeguards and non-proliferation
	3(1)(h)	4.5, Physical design 4.12, Security 4.13, Safeguards and non-proliferation

Legislation	Clause(s)	Section(s) in this document
	3(1)(i)	4.4, Safety analysis 4.5, Physical design 4.6, Fitness for service 4.7, Radiation protection 4.9, Environmental protection 4.10, Emergency management and fire protection (all requirements related to fire) 4.11, Waste management 4.12, Security
	3(1)(j)	4.5, Physical design 4.6, Fitness for service 4.11, Waste management
	3(1)(k)	3.1.7, Identification of persons responsible for management and control of the licensed activity 4.1, Management system 4.2, Human performance 4.3, Operating performance
	3(1)(l)	5, Other matters of regulatory interest
	3(1)(m)	5, Other matters of regulatory interest
	3(2)	4.13, Safeguards and non-proliferation
	10(b)	4.13, Safeguards and non-proliferation
	12(1)(a)	4.1, Management system 4.2, Human performance management 4.7, Radiation protection 4.10, Emergency management and fire protection
	12(1)(b)	4.2, Human performance management 4.7, Radiation protection 4.10, Emergency management and fire protection
	12(1)(c)	4.3, Operating performance 4.4, Safety analysis 4.5, Physical design 4.6, Fitness for service 4.7, Radiation protection 4.8, Conventional health and safety 4.9, Environmental protection 4.10, Emergency management and fire protection 4.11, Waste management 4.12, Security
	12(1)(d)	4.7, Radiation protection 4.10, Emergency management and fire protection
	12(1)(e)	4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.10, Emergency management and fire protection

Legislation	Clause(s)	Section(s) in this document
	12(1)(f)	4.3, Operating performance 4.4, Safety analysis 4.5, Physical design 4.6, Fitness for service 4.7, Radiation protection 4.9, Environmental protection 4.10, Emergency management and fire protection
	12(1)(g)	4.10, Emergency management and fire protection 4.12, Security
	12(1)(h)	4.10, Emergency management and fire protection 4.12, Security
	12(1)(i)	4.13, Safeguards and non-proliferation
	12(1)(j)	4.2, Human performance management 4.12, Security
	15	3.1.7, Identification of persons responsible for management and control of the licensed activity 4.1, Management system
	15(a)	3.1.4, All persons who have authority to interact for the applicant with the CNSC 3.1.9, Legal signing authority
	15(b)	3.1.4, All persons who have authority to interact for the applicant with the CNSC 3.1.7, Identification of persons responsible for management and control of the licensed activity
	17(a)	4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety 4.9, Environmental protection
	17(b)	4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety 4.9, Environmental protection
	17(c)	4.1, Management system 4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety 4.9, Environmental protection 4.12, Security

Legislation	Clause(s)	Section(s) in this document
	17(d)	4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety
	17(e)	4.1, Management system 4.2, Human performance management Personnel training 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety 4.9, Environmental protection 4.12, Security
	20(a)	4.14, Packaging and transport
	20(d)	4.13, Safeguards and non-proliferation
	21	4.12, Security
	21(1)(a)	4.13, Safeguards and non-proliferation
	21(1)(b)	4.13, Safeguards and non-proliferation
	22	4.12, Security
	23	4.12, Security
	23(2)	4.13, Safeguards and non-proliferation
	27	[...keep a copy of all info relating to the licence that is submitted by the licensee to the Commission... see section 3] 4.1, Management system
	28	4.1, Management system
	28(1)	4.12, Security
	29	4.3, Operational performance 4.7, Radiation protection 4.12, Security 5.1, Reporting requirements
	30	4.3, Operating performance 4.12, Security 5.1, Reporting requirements
	31	4.3, Operating performance 5.1, Reporting requirements
	32	4.3, Operating performance 5.1, Reporting requirements
<i>Canadian Nuclear Safety Commission Cost Recovery Fees Regulations</i>	all	5.4, Cost recovery, financial guarantees and insurance

Legislation	Clause(s)	Section(s) in this document
<i>Class I Nuclear Facilities Regulations</i>	3(a)	3.2.3, Description of site 4.5, Physical design 4.10, Emergency management and fire protection 4.12, Security
	3(b)	3.2.3, Description of site 4.4, Safety analysis 4.5, Physical design 4.12, Security
	3(c)	3.1.6, Evidence that the applicant is the owner of the site...
	3(d)	4.1, Management system 4.4, Safety analysis 4.5, Physical design
	3(e)	3.2.5, Nuclear and hazardous substances 4.8, Conventional health and safety 4.9, Environmental protection 4.11, Waste management
	3(f)	4.1, Management system 4.2, Human performance management 4.6, Fitness for service 4.8, Conventional health and safety 4.10, Emergency management and fire protection 4.11, Waste management
	3(g)	4.9, Environmental protection
	3(h)	4.8, Conventional health and safety 4.9, Environmental protection
	3(i)	4.5, Physical design 4.12, Security
	3(j)	5, Other matters of regulatory interest
	3(k)	4.11, Waste management
	5(a)	4.5, Physical design
	5(b)	4.5, Physical design 4.9, Environmental protection
	5(c)	4.3, Operating performance
	5(d)	4.5, Physical design 4.6, Fitness for service
	5(e)	4.5, Physical design 4.6, Fitness for service
	5(f)	4.4, Safety analysis 4.6, Fitness for service
	5(g)	4.1, Management system
	5(h)	4.12, Security 4.13, Safeguards and nonproliferation

Legislation	Clause(s)	Section(s) in this document
	5(i)	4.1, Management system 4.2, Human performance 4.3, Operating performance 4.7, Radiation protection 4.9, Environmental protection 4.10, Emergency management and fire protection 4.11, Waste management 4.12, Security 4.14, Packaging and transport
	5(j)	4.7, Radiation protection 4.9, Environmental protection 4.11, Waste management
	5(k)	4.7, Radiation protection 4.9, Environmental protection 4.10, Emergency management and fire protection 4.11, Waste management
	5(l)	4.2, Human performance 4.7, Radiation protection
	5(m)	4.2, Human performance 4.6, Fitness for service 4.7, Radiation protection
	9	4.2, Human performance management
	10	4.2, Human performance management
	11	4.2, Human performance management
	12	4.2, Human performance management
	14	4.7, Radiation protection
	14(1)	4.1, Management system 4.9, Environmental protection 4.11, Waste management
	14(4)	4.1, Management system
	14(5)	4.1, Management system
<i>Nuclear Non-proliferation Import and Export Control Regulations</i>	all	4.13, Safeguards and non-proliferation
<i>Nuclear Security Regulations</i>	all	4.5, Physical design 4.12, Security
	3(b)	3.2.3, Description of site
	16	3.2.3, Description of site
	37(1), (2) and (3)	4.1, Management system
	38	4.1, Management system 4.2, Human performance management

Legislation	Clause(s)	Section(s) in this document
<i>Nuclear Substances and Radiation Devices Regulations</i>	5	4.7, Radiation protection
	8	4.7, Radiation protection
	20	4.7, Radiation protection
	23	4.7, Radiation protection
	36(1)(a)	4.1, Management system 4.12, Security
	36(1)(b)	4.1, Management system
	36(1)(c)	4.1, Management system
	36(1)(d)	4.1, Management system 4.12, Security
	36(1)(e)	4.1, Management system
<i>Packaging and Transport of Nuclear Substances Regulations, 2015</i>	all	4.14, Packaging and transport
<i>Radiation Protection Regulations</i>	all	4.3, Operating performance 4.4, Safety analysis (all requirements related to dose) 4.5, Physical design 4.6, Fitness for service 4.7, Radiation protection 4.9, Environmental protection 4.11, Waste management

Appendix B: Safety and Control Areas

The CNSC's regulatory requirements and expectations for the safety performance of programs are grouped into three functional areas and 14 safety and control areas (SCAs). The SCAs are further divided into specific areas that define the key components of each SCA. Table B.1 shows a list of the functional areas, SCAs and the specific areas that define the key components of each SCA.

Table B.1: The CNSC's functional areas, safety and control areas, and specific areas

Functional area	Safety and control area (SCA)	Specific area
Management	1. Management system	Management system
		Organization
		Performance assessment, improvements and management review
		Operating experience (OPEX)
		Change management
		Safety culture
		Configuration management
		Records management
		Management of contractors
		Business continuity
	2. Human performance management	Human performance program
		Personnel training
		Personnel certification
		Initial certification examinations and requalification tests
		Work organization and job design
		Fitness for duty
	3. Operating performance	Conduct of licensed activities
		Procedures
		Reporting and trending
		Outage management performance
		Safe operating envelope
		Severe accident management and recovery
		Accident management and recovery
Facility and equipment	4. Safety analysis	Deterministic safety analysis
		Hazard analysis
		Probabilistic safety assessment
		Criticality safety
		Severe accident analysis
		Management of safety issues (including R&D programs)
	5. Physical design	Design governance
		Site characterizations
		Facility design
		Structure design
		System design
		Components design

Functional area	Safety and control area (SCA)	Specific area
Core control processes	6. Fitness for service	Equipment fitness for service / equipment performance
		Maintenance
		Structural integrity
		Aging management
		Chemistry control
		Periodic inspections and testing
	7. Radiation protection	Application of ALARA
		Worker dose control
		Radiation protection program performance
		Radiological hazard control
		Estimated dose to public
	8. Conventional health and safety	Performance
		Practice
		Awareness
	9. Environmental protection	Effluent and emissions control (releases)
		Environmental management system (EMS)
		Assessment and monitoring
		Protection of the public
		Environmental risk assessment
	10. Emergency management and fire protection	Conventional emergency preparedness and response
		Nuclear emergency preparedness and response
		Fire emergency preparedness and response
	11. Waste management	Waste characterization
		Waste minimization
		Waste management practices
		Decommissioning plans
	12. Security	Facilities and equipment
		Response arrangements
		Security practices
		Drills and exercises
	13. Safeguards and non-proliferation	Nuclear material accountancy and control
		Access and assistance to the IAEA
		Operational and design information
		Safeguards equipment, containment and surveillance
		Import and export
	14. Packaging and transport	Package design and maintenance
		Packaging and transport
		Registration for use

Appendix C: Review Objectives for an Application for a Licence to Construct a Reactor Facility

When establishing the scope of the review for an application to construct a reactor facility, CNSC staff consider three levels of objectives. These objectives are developed to assist in integrating individual reviews into an overall assessment of the adequacy of a licence application.

C.1 First-level objectives

The first-level objectives are described in subsection 24(4) of the *Nuclear Safety and Control Act* (NSCA). Additionally, the facility design and operation needs to address the mitigation measures identified in the environmental review.

C.2 Second-level objectives

The second-level objectives are:

- S Design safety objective:** The design of a reactor facility to be constructed should make adequate provisions (not pose an unreasonable risk) 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.
- C Construction program objective:** Adequate provisions should be made for the construction of the reactor facility to be carried on in a safe manner and with sufficient quality.
- Q Qualifications objective:** The applicant, and all entities involved in the design, construction and commissioning of the reactor facility, should be qualified to carry on the licensed activity. The program and schedule for recruiting, training, qualifying and certifying workers in respect of the operation and maintenance of the reactor facility should be adequate.

The design safety objective captures a large portion of the general nuclear safety objective, as established by the International Atomic Energy Agency (IAEA) and explicitly stated in REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9] that reactor facilities “be designed and operated in a manner that will protect individuals and society from harm”.

The construction program objective expresses the high-level expectations for the construction program.

The qualifications objective expresses the high-level expectations to have adequately qualified persons for the design, construction and commissioning of the reactor facility. It also addresses the requirements of the *Class I Nuclear Facilities Regulations* related to training, qualification and certification of workers.

C.3 Third-level objectives

In essence, meeting the design safety objective means satisfying the relevant expectations outlined in:

- REGDOC-2.5.2, *Design of Reactor Facilities: Nuclear Power Plants* [9]
- REGDOC-2.4.1, *Deterministic Safety Analysis* [24]
- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [26]

At an intermediate level, the expectations of REGDOC-2.5.2 [9] may be grouped in several main categories, which can be thought of as the third-level objectives for a CNSC staff review of an application for a licence to construct a reactor facility.

Third-level objectives related to the design safety objective are:

- SO1** The design captures all of the mitigation measures identified during the environmental review and ensures that operating performance meets all regulatory requirements concerning the nuclear and hazardous releases.
- SO2** The design follows the ALARA principle.
- SO3** The design complies with the dose acceptance criteria and safety goals.
- SO4** The design complies with the defence-in-depth principle.
- SO5** The fundamental safety functions perform adequately in the design.
- SO6** The design provides adequate means to mitigate and manage accidents.
- SO7** Adequate design provisions have been made for security and design robustness.
- SO8** The management system of programs, policies and procedures fosters a healthy safety culture and it is adequate for the design, construction, and commissioning of the reactor facility.
- SO9** The management system of programs, policies and procedures fosters a healthy safety culture and it is adequate for the future operation and decommissioning of the reactor facility.
- SO10** Adequate design, infrastructure and programmatic provisions are made in the area of safeguards.

Third-level objectives related to the construction program objective are:

- CO1** Adequate assurance that all activities involving construction/erection of structures and systems and fabrication/erection of components are carried out by qualified personnel.
- CO2** Adequate provisions have been made to ensure that relevant rules and regulations will be followed during fabrication, construction and erection activities and that the construction/erection activities are conducted in a safe manner.
- CO3** Sufficient quality of fabrication, erection and construction is assured and adequate provisions are made to minimize design deviations.
- CO4** Adequate plans for inactive commissioning of the built reactor facility (without a fuel load) are in place.

Third-level objectives for the qualifications objective are:

- QO1** The applicant is qualified to oversee all design, construction and commissioning activities carried out by itself, or by contractors or subcontractors.
- QO2** The applicant has enough qualified staff to oversee all design, construction and commissioning activities carried out by itself, or by contractors or subcontractors.
- QO3** All contractors and subcontractors involved in the design, construction and commissioning of the reactor facility are qualified to carry out their respective activities.
- QO4** The proposed full-scope training simulator for the reactor facility is adequate.

Appendix D: Sample Format for Listing the Supporting Documentation

The applicant should ensure that the licence application addresses all of the information requested in this licence application guide. The applicant is encouraged to map the information provided to the related sections and subsections of this document. **Note:** The applicant will have already provided supporting documentation in an application for a licence for site preparation.

For this supporting documentation and information, the application should clearly identify the information that has already been submitted and provide a list of the supporting documents.

D.1 Sample (suggested) format

This table provides a sample format that the applicant may consider for providing a mapping of the supporting information to the SCA framework. It also provides a sample format for cross-referencing applicable information that has been previously provided to the CNSC.

Note: The column heading “In LCH for WN (Y/N)” indicates whether the document is identified in the licensee’s current licence conditions handbook (LCH) as a document requiring written notification (WN) of change to the CNSC.

Document		Version	In LCH for WN (Y/N)	Previously submitted (Y/N)	Related sections and subsections of REGDOC-1.1.3
Identifier	Title				
					e.g., 4.1

Glossary

For definitions of terms used in this document, see [REGDOC-3.6, *Glossary of CNSC Terminology*](#), which includes terms and definitions used in the [Nuclear Safety and Control Act](#) and the regulations made under it, and in CNSC regulatory documents and other publications. REGDOC-3.6 is provided for reference and information.

The following terms are either new terms being defined, or include revisions to the current definition for that term. Following public consultation, the final terms and definitions will be submitted for inclusion in the next version of REGDOC-3.6, *Glossary of CNSC Terminology*.

authority having jurisdiction (AHJ) (*autorité compétente (AC)*)

The regulatory organization, office or agency responsible for approving or accepting designs, equipment, materials, installations or procedures in accordance with applicable codes and standards.

Note 1: In Canada, the regulatory authorities are the Canadian Nuclear Safety Commission (CNSC) and other provincial or federal government agencies that have jurisdiction.

Note 2: AHJ is also referred to as “regulatory authority”.

engineering, procurement and construction (EPC) (*ingénierie, approvisionnement et construction (IAC)*)

A common form of contract used to undertake construction works on large-scale and complex infrastructure projects. Note: This term may also include commissioning.

engineering, procurement and construction management (EPCM) (*gestion de l'ingénierie, approvisionnement et construction (GIAC)*)

A contracting arrangement where the client selects a contractor who provides management services for the entire project on behalf of the client.

EPC (IAC)

See engineering, procurement and construction.

EPCM (IACG)

See engineering, procurement and construction management.

intelligent customer (*client intelligent*)

[A concept that] relates to organization rather than the capabilities of individual personnel. As an intelligent customer, in the context of nuclear safety, the organization should know what is required, should fully understand the need for a contractor's services, should specify requirements, should supervise the work and should technically review the output before, during and after the work. [55]

PMC+C (CGP+E)

See project management consultant or contractor.

project management consultant or contractor (PMC+C) (*consultant en gestion de projet ou entrepreneur (CGP+E)*)

A consultant or contractor who, under a project management contract, oversees the work done by all contractors and suppliers to ensure compliance with the scope of work.

Tier 1 (Niveau 1)

The design consultants and the main contractor who work directly for the employer (that is, they have a direct contract with the client). The main contractor may have a limited chain of their own suppliers.

Tier 2 (*Niveau 2*)

Specialist contractors who provide a variety of service for the main (Tier 1) contractors and suppliers. A Tier 2 specialist is sub-contracted through one of the main (Tier 1) contractors or suppliers.

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References

The CNSC may include references to information on best practices and standards such as those published by CSA Group. With permission of the publisher, CSA Group, all nuclear-related CSA standards may be viewed at no cost through the CNSC Web page “[How to gain free access to all nuclear-related CSA standards](#)”.

1. Canadian Nuclear Safety Commission (CNSC), REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents*, Ottawa, Canada, 2019
2. Canadian Nuclear Safety Commission (CNSC), [REGDOC-3.5.3, Regulatory Fundamentals](#), Ottawa, Canada, 2018
3. CNSC, [REGDOC-3.5.1, Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills](#), Ottawa, Canada, 2017
4. CNSC, [REGDOC-2.12.3, Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material](#), Ottawa, Canada, 2019
5. Treasury Board of Canada Secretariat [Policy on Government Security](#), 2009, revised 2019
6. CNSC, REGDOC-2.1.1, *Management System*, Ottawa, Canada, 2019
7. CSA Group, CSA N286, [Management system requirements for nuclear facilities](#), reaffirmed 2017
8. CNSC, REGDOC-2.3.1, [Conduct of Licensed Activities: Construction and Commissioning Programs](#), Ottawa, Canada, 2016
9. CNSC, REGDOC-2.5.2, [Design of Reactor Facilities: Nuclear Power Plants](#), Ottawa, Canada, 2014
10. CSA Group, CSA N286.10, [Configuration management for high energy reactor facilities](#), 2016
11. CNSC, REGDOC-2.1.2, [Safety Culture](#), Ottawa, Canada, 2018
12. International Organization for Standardization (ISO), [ISO 22301, Societal security – Business continuity management systems – Requirements](#), Geneva, Switzerland, 2012
13. CNSC, REGDOC-2.2.2, [Personnel Training](#), Ottawa, Canada, 2016
14. CNSC, REGDOC-2.2.3, Volume III: [Certification of Persons Working at Nuclear Power Plants](#), Ottawa, Canada, 2019
15. CNSC, REGDOC-2.2.5, [Minimum Staff Complement](#), Ottawa, Canada, 2019
16. CNSC, REGDOC-2.2.4, [Fitness for Duty: Managing Worker Fatigue](#), Ottawa, Canada, 2017
17. CNSC, REGDOC-2.2.4, *Fitness for Duty, Volume II: [Managing Alcohol and Drug Use](#)*, Ottawa, Canada, 2017
18. CNSC, REGDOC-2.2.4, [Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness](#), Ottawa, Canada, 2018
19. CNSC, REGDOC-2.12.1, *High-Security Facilities, Volume I: Nuclear Response Force* (prescribed), Ottawa, Canada, 2018
20. CSA Group, [CSA A23.1:19/CSA A23.2:19, Concrete materials and methods of concrete construction / Test methods and standard practices for concrete](#), 2019

21. CNSC, REGDOC-2.5.1, [*General Design Considerations: Human Factors*](#), Ottawa, Canada, 2019
22. CNSC, REGDOC-3.1.1, [*Reporting Requirements for Nuclear Power Plants*](#), Ottawa, Canada, 2016
23. CNSC, REGDOC-2.3.2, [*Accident Management*](#), Ottawa, Canada, 2015
24. CNSC, REGDOC-2.4.1, [*Deterministic Safety Analysis*](#), Ottawa, Canada, 2014
25. CNSC, REGDOC-2.4.2, [*Probabilistic Safety Assessment \(PSA\) for Nuclear Power Plants*](#), Ottawa, Canada, 2014
26. CNSC, REGDOC-1.1.1, [*Site Evaluation and Site Preparation for New Reactor Facilities*](#), Ottawa, Canada, 2018
27. CNSC, REGDOC-2.6.1, [*Reliability Programs for Nuclear Power Plants*](#), Ottawa, Canada, 2017
28. CSA Group, CSA N290.12-14, [*Human factors in design for nuclear power plants*](#), 2014
29. CNSC, REGDOC-2.4.3, [*Nuclear Criticality Safety*](#), Ottawa, Canada, 2019
30. CNSC, GD-52, [*Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms*](#), Ottawa, Canada, 2010
31. CNSC, REGDOC-2.6.2, [*Maintenance Programs for Nuclear Power Plants*](#), Ottawa, Canada, 2017
32. CNSC, REGDOC-2.6.3, [*Aging Management*](#), Ottawa, Canada, 2014
33. CNSC, REGDOC-2.7.1, *Radiation Protection*, Ottawa, Canada, [currently draft]
34. REGDOC-2.8.1, *Conventional Health and Safety*, Ottawa, Canada, 2019
35. CNSC, REGDOC-2.9.1, *Environmental Protection: Environmental Principles, Assessments and Protection Measures*, Ottawa, Canada, 2017.
nuclearsafety.gc.ca/pubs_catalogue/uploads/REGDOC-2-9-1-Environmental-Principles-eng.pdf
36. CSA Group, [*CSA N288.5, Effluent monitoring programs at Class I nuclear facilities and uranium mines and mills*](#)
37. CSA Group, [*CSA N288.1, Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities*](#)
38. CSA Group, [*CSA N288.8, Establishing and implementing action levels for releases to the environment from nuclear facilities*](#)
39. CSA Group, CAN/CSA-ISO 14001, [*Environmental management systems – Requirements with guidance for use*](#), 2016
40. CNSC, REGDOC-2.10.1, [*Nuclear Emergency Preparedness and Response*](#), Ottawa, Canada, 2017
41. CNSC, REGDOC-2.11, [*Framework for Radioactive Waste Management and Decommissioning in Canada*](#), Ottawa, Canada, 2018
42. CNSC, REGDOC-2.11.1, [*Waste Management, Volume I: Management of Radioactive Waste*](#), Ottawa, Canada, [currently draft]
43. CNSC, REGDOC-2.11.2, [*Decommissioning*](#), Ottawa, Canada, [currently draft]

44. CNSC, REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*, Ottawa, Canada, [currently draft]
45. CNSC, REGDOC-2.12.1, *High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices* (prescribed), Ottawa, Canada, 2018
46. CNSC, REGDOC-2.12.2, [*Site Access Security Clearance*](#), Ottawa, Canada, 2013
47. CNSC, [*Guidance Document on Confidential Filings*](#), Ottawa, Canada, 2014
48. International Atomic Energy Agency (IAEA), *Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/140), Vienna, Austria, 1968
49. IAEA, *Agreement between the Government of Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/164), 1972
50. IAEA, *Protocol Additional to the Agreement between Canada and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/164/Add 1), 2000
51. CNSC, REGDOC-2.13.1, [*Safeguards and Nuclear Material Accountancy*](#), Ottawa, Canada, 2018
52. CNSC, REGDOC-2.13.2, *Import and Export*, Ottawa, Canada, 2018
53. CNSC, REGDOC-3.2.1, [*Public Information and Disclosure*](#), Ottawa, Canada, 2018
54. CNSC, REGDOC-3.2.2, [*Indigenous Engagement*](#), Ottawa, Canada, 2019
55. IAEA, Safety Guide No. GS-G-3.5, [*The Management System for Nuclear Installations*](#), Vienna, Austria, 2009

CNSC Regulatory Document Series

Facilities and activities within the nuclear sector in Canada are regulated by the CNSC. In addition to the *Nuclear Safety and Control Act* and associated regulations, these facilities and activities may also be required to comply with other regulatory instruments such as regulatory documents or standards.

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