Canada's Nuclear Regulator

Reactor Facilities

Licence Application Guide: Licence to Construct a Reactor Facility

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Canada

Licence Application Guide: Licence to Construct a Reactor Facility
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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 of 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 Reactor Facility*, clarifies the requirements for and provides 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, including the documents the application references, become the safety case for the reactor facility.

The information required for the future operating licence application will be added to the construction safety case. The safety case will then be kept up to date over the reactor facility's lifecycle to reflect its current state and condition.

Given the wide range of reactor facilities – especially of advanced and small modular reactors – and given that reactor facilities have risk profiles that vary significantly depending on the particular characteristics of the activity or facility, the applicant or licensee can apply a risk-informed approach that includes grading and alternatives in the development of the application, in accordance with REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents*, and REGDOC-3.5.3, *Regulatory Fundamentals*.

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 clarifies the requirements for and provides guidance on applying to the Canadian Nuclear Safety Commission (CNSC) for a licence to construct a reactor facility.

Following the information in this regulatory document will prepare applicants to 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 an application for a licence to construct a proposed new reactor facility at a new or existing site.

Given the wide range of reactor facilities – especially of advanced and small modular reactors (SMRs) – and given that reactor facilities have risk profiles that vary significantly, the applicant or licensee can apply a risk-informed approach that includes grading and alternatives in the development of the application, in accordance with REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents* [1], and REGDOC-3.5.3, *Regulatory Fundamentals* [2].

The information provided in this document does not prevent applicants from proposing alternative ways to meet a requirement. Any proposed alternative (including the use of other codes and standards) should appropriately address the complexities and hazards of the proposed activities, and the applicant must demonstrate, by providing supporting information, that the proposed alternative meets an equivalent or superior level of safety.

This application guide covers the initial application for construction of a reactor facility.

1.3 Relevant legislation

Appendix A maps a list of relevant sections from the *Nuclear Safety and Control Act* (NSCA) and the regulations made under the NSCA to the related sections of this licence application guide.

1.4 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 before submitting the licence application and request the name and contact information of the single point of contact assigned to the licence application. For additional information, see section 2.3, Structuring 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, form the reference safety case for the reactor facility and thus would form part of the licensing basis. Hence, applicants should be aware that this information needs to be controlled in the same manner as other parts of the licensing basis and could be subject to CNSC compliance verification. Further information on the licensing basis is provided in REGDOC-3.5.3, *Regulatory Fundamentals* [2].

The construction safety case includes requirements for preparing the site, designing and constructing the facility, and fuel-out commissioning.

Applicants should consider that the safety case for the facility will need to be updated as part of an application for a licence to operate.

2.1 Background

Under the *Class I Nuclear Facilities Regulations*, 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

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 adapted to support the construction and commissioning activities encompassed by the licence.

Note 1: Licences can be combined to permit multiple activities. For more information on combined licence applications, see section 2.4.

Note 2: This document applies to various technologies, including those having novelties, such as a liquid fuel. The phrase “to the extent practicable” is used within this document, recognizing that not all requirements are applicable to all technologies in their current state. In addition, for a first-of-a-kind design, information may not be available or verifiable until the facility has been constructed and/or operated. Where the phrase “to the extent practicable” is used, a conservative engineering approach is expected to be demonstrated.

2.2 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.

The licensing process is initiated when the applicant submits a licence application. Applicants should ensure that they have included sufficiently detailed information to allow the licensing process to proceed efficiently. In addition to the information provided in this licence application guide, the CNSC may request additional information by sending supplemental, facility-specific guidance to the applicant prior to the beginning of, or during, the licensing process.

Early engagement with CNSC staff (before submission of the application) is possible and encouraged. For example:

- the applicant may submit a letter to notify the CNSC of the forthcoming application and provide some information on the scope and schedule of the proposed project
- the vendor may request a pre-licensing vendor design review, an optional service provided by the CNSC (when requested by a vendor) that enables CNSC staff to provide feedback early in the design process based on a vendor's reactor technology; for more information, see REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents* [1]

Note: The information provided in this document does not prevent applicants from proposing alternative ways to meet a requirement. However, any proposed alternative (including the use of codes and standards other than those referenced in this licence application guide) should appropriately address the complexities and hazards of the proposed activities, and the applicant must demonstrate (through supporting information and a code comparison) that the proposed alternative provides an equivalent or superior level of safety to Canadian standards.

2.3 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 according to 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, as appropriate, that cover topics addressed in a complete assessment and review. This guide identifies the specific areas relevant to an initial application for a licence to construct, recognizing that CNSC staff may identify additional areas during the application 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.

2.4 Completing the licence application

The applicant is responsible for ensuring that the licence application contains sufficient information to demonstrate that:

- all regulatory requirements are met
- 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 other detailed sources, as appropriate.

The application should cite the CNSC regulatory documents and the codes and standards that the applicant intends to apply and implement (these may form part of the licensing basis). The regulatory documents and the codes and standards support the applicant's ability to implement the safety and control measures.

Applicants are encouraged to discuss with the CNSC the appropriate version (publication date and revision number) of each document (regulatory document, code or standard) planned to be applied. CNSC staff may also provide supplemental guidance on additional documents that the applicant should consider and address in the application. This pre-licensing communication is in alignment with REGDOC-3.5.1, *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills* [3].

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. Appendix D 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 since the previous submission, the applicant must provide the CNSC with the new version number, a copy of the new version, and a summary of major changes between the new version and the version previously reviewed by CNSC staff. Appendix E provides a sample format for listing revisions to the supporting documentation.

Where a subset of the material within a supporting document addresses regulatory requirements, the relevant sections should be clearly identified.

Combined licence applications

The applicant may apply for a combined licence that permits multiple activities (for example, a combined licence to prepare the site and to construct the reactor facility). The applicant may propose any combination of activities, and CNSC staff will review each combined licence application against the applicable regulatory requirements.

The applicant shall address all regulatory requirements pertaining to all stages (for example, construction and operation) covered by the combined licence application.

Applicants are strongly encouraged to discuss a combined licence application strategy with the CNSC prior to submitting an application.

Submission of licence application documentation over a defined period of time

The Commission will require a complete application, containing all information required under the NSCA and its regulations, as clarified through the regulatory framework, in order to make a decision on a licence to construct a reactor facility.

Given the extent of information that is required in an application for a licence to construct a reactor facility, an applicant may provide supporting documentation over a defined period of time. When using this approach, the applicant should provide a detailed project schedule of submissions with the initial licence application.

As described in REGDOC-3.5.1, *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills* [3], a licence to construct enables a licensee to construct, commission and operate some components of the reactor facility (for example, security systems). Some specific commissioning activities may be allowed by the Commission through issuance of a licence to construct in order to demonstrate that the facility has been constructed in accordance with the approved design and that the systems important to safety are functioning as intended. The applicant must demonstrate that the proposed design of the facility conforms to regulatory requirements and is capable of operating safely on the designated site over its proposed lifecycle.

2.5 Submitting the licence application

The applicant should ensure that the application contains all applicable documentation, that it is dated and signed by the appropriate authority, and that all supporting documents are clearly identified and cross-referenced. If documentation is being submitted over a defined period of time, the application should clearly identify how the documents fit into the schedule of submissions.

All information submitted in support of the licence application is subject to the *Access to Information Act* and the *Privacy Act*. The CNSC licensing process should be as transparent as possible. Hence, the applicant must identify and justify any material it believes is confidential.

The licence application is subject to the *Canadian Nuclear Safety Commission Cost Recovery Fees Regulations*. Therefore, the applicant should ensure that payment is enclosed. For further details, contact the CNSC Cost Recovery Group by phone at 613-991-9791 or toll-free at 1-888-229-2672 option 2, or by email at receivables-recevables@cnsc-ccsn.gc.ca.

The applicant may choose instead to submit the licence application in printed (hard copy) format; in this case, the applicant should submit 2 printed copies of the application (signed and dated) to the Commission at:

Commission Registry
Canadian Nuclear Safety Commission
280 Slater St
PO Box 1046 Stn B
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.

Prescribed information, such as details of the security program, shall 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]. Additional guidance, context and recommended practices on handling, submitting and transmitting assets considered security-sensitive (such as prescribed information) can be found in the Treasury Board of Canada Secretariat *Policy on Government Security* [5] and its related directives (which can be accessed through links on the same website).

3. Applicant's General Information

A cross-reference linking legislative clauses to applicable sections of this document is provided in appendix A.

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 confidential.

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).

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, city, province or territory, and postal code.

If no mailing address is provided, any licence issued pursuant 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 Applicant authority

The applicant shall notify the Commission of the persons who have authority to act on its behalf in its dealings with the Commission. In addition, the applicant shall notify the Commission of any change in the information, within 15 days of the change.

The applicant should provide a list of the 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.

3.1.4 Proof of legal status

Applicants should provide proof of legal status by appending proof of incorporation, their corporation number, or their charter. When submitting an application to renew a licence to

construct, 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, including the internal allocation of functions, responsibilities and authority, insofar as it may bear on the applicant's compliance with the NSCA and the regulations made under it.

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 substances, 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 of the change.

To satisfy these requirements, the applicant should provide a list of all persons responsible for management and control of the licensed activity, including:
- name
- position (job title)
- contact information (email, telephone, fax)
- mailing address (if different from the business mailing address), including the complete street name and number, 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, fax)
- mailing address (if different from the business mailing address), including the complete street name and number, 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 issues licences of varying durations. This enables regulation of reactor facilities in a risk-informed manner by adjusting the licence period in consideration of the licensee's previous performance and findings from the 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, practices, and safety concepts, and a comparison of the reactor facility’s design and construction with prevailing modern standards and international practices. This summary 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

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 another 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 Permits, certificates and other licences

The applicant should describe the relationship of the 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.

The applicant should also provide a cross-reference to any permits or certificates issued by any regulatory body for this site. Some examples are:

- a permit issued under the *Species at Risk Act*, authorizing the person to engage in an activity affecting a wildlife species listed in the act, any part of that species' critical habitat or the residences of that species' individuals
- a permit from a provincial or territorial government for an activity that could affect an endangered or threatened plant or animal and its habitat
- a certificate issued by Fisheries and Oceans Canada authorizing an impact on fish habitat

3.3.2 Similar facilities

If applicable, 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. The application should describe the notable design differences between the proposed facility and any similar facilities (for example, those currently operating or under construction). The list should include the following information:

- facility name
- location
- description of the facility

3.3.3 Supporting information

The applicant shall include a description and the results of any tests, analyses or calculations performed to substantiate the information included in the application.

If this information supports the safety case for a facility, or substantiates the analyses for assumptions made in the safety report, it will become part of the licensing basis.

This information should be as detailed as possible. For a construction application, the applicant should include a list of any ongoing test programs and/or analyses to be completed at a later date.

Some examples of supporting information are:

- 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)
- information that has been submitted to, received from, or published by a foreign national regulatory body

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

Structure and organization of the information

This licence application guide is organized according to the CNSC's SCA framework. However, the applicant may choose to organize the information in any structure. For more information on structuring a licence application and organizing the information, see section 2.4.

Risk-informed graded approach

The CNSC's regulatory framework is primarily based on Canadian operational experience. However, the CNSC also takes into account other operating experience, such as the international experience of the International Atomic Energy Agency (IAEA), and the policies of other national regulators. Under the CNSC's framework, consistent with a risk-informed graded approach to regulating, applicants may propose alternative approaches to those suggested in this regulatory document. Where an alternative approach is used, the applicant should provide adequate justification. For additional information on the graded approach, see REGDOC-3.5.3, *Regulatory Fundamentals* [2].

Proponents of and applicants for SMRs should refer to REGDOC-1.1.5, *Supplemental Information for Small Modular Reactor Proponents* [1].

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.1.1 General considerations

The application should describe the management system that has been, or will be, put in place to protect health, safety and the environment, and should also describe the organizational management structure.

4.1.2 Management system

The application should describe the management system and its implementation, including how the main features are compliant with the relevant requirements of CSA N286-12, *Management System Requirements for Nuclear Facilities* [6], and considering the information in REGDOC-2.1.1, *Management System* [7].

The application should set out the process for establishing, implementing, assessing and continually improving the management system in line with the principles set out in CSA N286-12 [6], with sufficient detail to ensure safety.

The application should demonstrate that:

- the management system structure is clear, with a logical hierarchy of processes and procedures
- processes are defined, with clear inputs and outputs
- roles and responsibilities are defined
- processes and procedures are clear and concise

If specific processes or implementation documents are to be developed later, the application should provide a proposed timeline and milestones for the work.

The application should describe how operational experience, from internal and external sources, will be considered and addressed.

4.1.3 Organization

To the extent practicable, the application should describe:

- the applicant's organizational structure and resources, including:
  - plans to ensure that adequate organizational structures and resources will be in place
  - organizational charts to support the governance structure
- the principles used to develop the organizational structure, such as:
  - number of layers of hierarchy
  - length of decision-making chains

    - scope of managerial control
    - use of contracted resources to supplement in-house capability
- the relationship between the applicant and any other organization with which significant interactions will occur, 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
- the approach taken to make sure that the applicant has sufficient "informed customer" capability to ensure nuclear safety and the integrity of the safety case
- how the applicant will retain sufficient in-house core capability to:
    - manage the licensed facility and activities
    - maintain subject-matter expertise for nuclear safety, including "informed customer" capability, where expertise is contracted out and for procurement of items
- how the organization will ensure it has sufficient qualified workers for nuclear safety–related positions
- arrangements to control organizational changes, including:
    - the resource strategy that ensures resources are available, with the skills and experience to support conduct of the licensed activity
    - identifying and mitigating over-reliance on scarce or singular areas of expertise

The application should describe how organizational effectiveness and safety performance will be measured, such as through the use of performance indicators.

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 application should describe how the applicant will ensure that contracted work is carried out to the required level of safety and quality consistent with REGDOC-2.3.1 [8] and CSA N286-12 [6]. Considerations include:

- ensuring that suppliers identify and categorize any deviations from specified requirements and that they refer the deviations to the design authority and the authority having jurisdiction
- ensuring suitable arrangements to mitigate the risk of counterfeit, fraudulent and suspect items entering the supply chain
- providing a detailed account of how the applicant will maintain active accountability for and control of all construction activities to ensure that they meet regulatory, technical and quality requirements

The application should describe:

- the design authority for construction, and the turnover to operation (where applicable)
- organizations, other than the design authority, with responsibility for the design of specific parts of the facility
- the design authority's relationships, including accountabilities and responsibilities between the design authority and the:
    - applicant
    - major technical support organizations
    - prime contractor and subcontractors

  - 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

4.1.4 Configuration management and change control

The application should describe the provisions to establish and maintain configuration throughout the lifecycle of the facility. Considerations include:

- 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* [9]
- 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

4.1.5 Safety culture

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

- CSA N286-12, *Management System Requirements for Nuclear Facilities* [6]
- REGDOC-2.1.2, *Safety Culture* [10]
- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]

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 personnel are in all relevant job areas and have the necessary knowledge, skills, procedures and tools in place to safely carry out their duties.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.2.1 General considerations

As it relates to the construction activities considered in the licence application, the applicant shall document the graded approach it is planning to implement to comply with the requirements and guidance in:

- the *Class I Nuclear Facilities Regulations* and REGDOC-2.2.1, *Human Factors* [11], with regard to the human performance program; the application should include a description of any substantiative efforts to date
- REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue* [12], and REGDOC-2.2.4, *Fitness for Duty Volume II: Managing Alcohol and Drug Use* [13]; the application should include a description of any substantiative efforts to date

The application should describe the qualifications, skills and competencies required by workers at the facility, and identify the number of workers needed.

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

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.

4.2.2 Personnel training

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

4.2.3 Personnel certification

In preparation for the authorization or certification of personnel employed in designated positions, the applicant should provide:

- a reference to or summary of the proposed management system and the concept of operation as they pertain to:
  - the roles and responsibilities of the personnel employed as part of the minimum shift complement
  - the roles and responsibilities of the personnel employed in positions immediately relevant to safety, including, but not limited to, safety-sensitive and safety-critical positions
  - the extent of human intervention in operations under normal, abnormal and emergency conditions, including the potential impact of human actions and decisions on the safety of workers, the public and the environment
- an overview of any proposed simulator facility or system and the manner in which this simulator facility or system will be used to support personnel training
- an overview of the schedule for implementation of the programs relevant to the selection, training and qualification of reactor operators and, where applicable, control room shift supervisors

4.2.4 Work organization and job design

The applicant should demonstrate that, to the extent practicable, the staffing levels are adequate to support the safe construction and commissioning of the reactor facility.

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.3.1 General considerations

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
- hazards relating to the transportation of building materials for construction and associated installation of internal components

For more information on how the applicant can demonstrate how it will exercise overall responsibility for the construction and commissioning 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 processes 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, the applicant 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 structures, systems and components (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, including the use of any concrete that was precast offsite. 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 and 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 the 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* [15]

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 include a plan and timeline for the development, verification, validation and implementation of commissioning programs and procedures that would be completed under the licence to construct.

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 describe the chemistry control of SSCs during construction and commissioning, in accordance with the section of REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8], addressing protection of systems, structures and components important to safety. The application should describe how appropriate chemistry control and monitoring is implemented for SSCs or construction materials whose specifications are to be established on site or during activities carried out under the licence to construct.

The application should describe the maintenance and inspection program that will be implemented during the licence to construct to prevent deterioration of SSCs important to safety once they have been installed, constructed or commissioned and to meet the relevant

requirements in REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]. Relevant requirements within REGDOC-2.3.1 [8] include:

- section 3, addressing management and organization
- section 5.5, regarding protection of systems, structures and components important to safety
- section 8.1, discussing organizational responsibilities
- appendix E, describing the recommended organizational responsibilities

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.4.1 General considerations

The application shall include a preliminary safety analysis report (PSAR) for the reactor facility. The PSAR should include a deterministic safety analysis, a probabilistic safety assessment (PSA) and a hazards analysis commensurate with the level of design. The PSAR should be developed commensurate with the level of design (for additional information, see section 4.5.1, Description of structures, systems and components). 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.

The application should demonstrate that, whenever operator action is considered, the operators will have reliable information, sufficient time to perform the required actions and documented procedures to follow, and will have been trained.

Safety analysis is an iterative process. The safety analyses included in the PSAR should proceed in parallel with the design process, with iteration taking place between the 2 activities. With each iteration, the applicant should provide a higher level of detail. 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. 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 application should describe the programs and oversight that are in place to ensure that the safety analysis is carried out by technically qualified and appropriately trained staff. The programs, oversight and results should demonstrate alignment with the management system program and be in accordance with “informed 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

To the extent practicable and commensurate with the level of design information available at the time of a construction licence application, the safety analysis shall identify postulated initiating events (PIEs) and combinations of events 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* [16]
- REGDOC-2.5.2, *Design of Reactor Facilities* [17]

For more information on external events, see REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [18].

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

To the extent practicable and commensurate with the level of design information, the application shall include a deterministic safety analysis conducted in accordance with REGDOC-2.4.1, *Deterministic Safety Analysis* [16]. 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 are met.

For design-basis accidents (DBAs), the application should demonstrate that there is a high confidence that qualified systems (as identified in REGDOC-2.4.1 [16]) acting alone can mitigate the consequences of the event.

4.4.4 Hazard analysis

To the extent practicable and commensurate with the level of design information, the applicant shall provide a hazard analysis that has been performed in accordance with the requirements of:

- REGDOC-2.4.1, *Deterministic Safety Analysis* [16]
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Reactor Facilities* [19]
- REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [18]

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.

Note: External hazards are different than postulated initiating events.

4.4.5 Probabilistic safety assessment

To the extent practicable and commensurate with the level of design information, 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 Reactor Facilities* [19].

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 that 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

To the extent practicable and commensurate with the level of design information, the applicant shall demonstrate that a severe accident analysis has been performed in accordance with the requirements of:

- REGDOC-2.4.1, *Deterministic Safety Analysis* [16]
- REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Reactor Facilities* [19]

The applicant should also demonstrate that the results of the severe accident analysis are used in the development of an accident management program as described in REGDOC-2.3.2, *Accident Management* [20].

The content of the severe accident 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 severe accident 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 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* [17].

The application should demonstrate the ability of the design to mitigate certain severe accidents. The applicant should explain the choice of the severe accidents that have been analyzed, 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. In addition, the applicant should describe, explain and justify the approach taken.

Severe accidents, for those not addressed as DBAs, are typically sequences involving more than one failure (such as reactor facility blackout or design-basis events with degraded performance of a safety system). 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.

Where applicable, the application should include an explanation of the analysis performed for severe accident sequences and a description of the results used in developing the accident management programs and emergency preparedness planning for the reactor facility.

4.4.7 Summary of analysis

To the extent practicable and commensurate with the level of design information, the application should include information concerning the integrated review of the reactor facility design and operational safety that was carried out in order to confirm that the design meets the design objectives.

4.4.8 Event mitigation

To the extent practicable and commensurate with the level of design information, 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* [20].

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

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 so that independent reviews can be performed as described in the section addressing safety assessment within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 of this regulatory document, to the extent practicable and commensurate with the stage of the project. 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 nuclear and hazardous substances, 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. The design work should be carried out in accordance with the management system program supporting design and in accordance with "informed 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 programs that will demonstrate that the design:

- considers operating experience (OPEX) and the latest research and development (R&D)
- 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 that 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 the characteristics, major components and design basis requirements (such as the functional and performance requirements associated with the definition of design basis), commensurate with the safety classification, and should include 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 facility 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 (I&C) 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
  - 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

- 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 that are new or first of a kind)
  - verify that the SSCs have been correctly installed/constructed

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 confirm the site characteristics (especially for external events) and assess the effects of any updated information.

For additional information on site characterization and exclusion zone authority and control, see REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities* [18], and REGDOC-2.5.2, *Design of Reactor Facilities* [17].

4.5.3 Design principles and requirements

To the extent practicable and commensurate with the level of design information available, 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 applicable codes and standards
- considers OPEX and the latest R&D
- 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 the safety objectives and concepts within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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

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

- REGDOC-2.6.3, *Aging Management* [21]
- the section on aging and wear within REGDOC-2.5.2, *Design of Reactor Facilities* [17]

Safety objectives and goals

The safety objectives and goals are described in detail in REGDOC-2.5.2, *Design of Reactor Facilities* [17].

Where applicable, 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 the sections addressing the general nuclear safety objective and operational limits and conditions within REGDOC-2.5.2 [17], including the actions and supporting evidence the applicant has undertaken to confirm this.

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.

Design authority

The application should demonstrate that the design authority, the entity with overall responsibility for the design, is established in accordance with the section addressing design authority within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 to the extent practicable that the design envelope of the reactor facility is established in accordance with the section addressing plant design envelope within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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. 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, using proven engineering practices, has been applied throughout the design activities to ensure that the design meets all relevant

safety requirements in accordance with the section addressing safety assessment within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. 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
  - 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 facility states and operational configurations

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

- REGDOC-2.4.1, *Deterministic Safety Analysis* [16]
- the section addressing plant states within REGDOC-2.5.2, *Design of Reactor Facilities* [17]

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 facility 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 to provide protection against AOOs and accidents, including DBAs and severe accidents. For more information, see the sections addressing defence in depth and application of defence in depth within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 the section addressing safety functions within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. 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 the section addressing safety classification of SSCs within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. 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 [17]:
  - system-related characteristics, such as the degree of redundancy, diversity, separation and reliability (section addressing design for reliability)
  - environmental qualification (section addressing equipment environmental qualification)
  - seismic qualification (section addressing seismic qualification and design)
- 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 should demonstrate to the extent practicable the basis for any reliability targets that meet the requirements in the section addressing design for reliability within REGDOC-2.5.2, *Design of Reactor Facilities* [17], and REGDOC-2.6.1, *Reliability Programs for Nuclear Power Plants* [22].

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, *Design of Reactor Facilities* [17], the application should include considerations of:

- common-cause failures
- single-failure criterion
- fail-safe design
- allowance for equipment outages
- shared systems

Human factors

The application should describe how the facility design accounts for human factors. It should describe the systematic process that has been followed, for all systems, to incorporate consideration 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 facility 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* [23]
- CSA N290.12-14, *Human Factors in Design for Nuclear Power Plants* [24]
- the section addressing human factors within REGDOC-2.5.2, *Design of Reactor Facilities* [17]

Radiation protection

The application shall include a description of the design approach adopted that demonstrates that the facility design meets the requirements of the *Radiation Protection Regulations* and the radiation protection objectives and dose acceptance criteria in accordance with the sections addressing the radiation protection objective and dose acceptance criteria within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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* [18]
- the section addressing robustness against malevolent acts within REGDOC-2.5.2, *Design of Reactor Facilities* [17]

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. 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 II Nuclear Material* [4]. Additional guidance, context and recommended practices on handling, submitting and transmitting assets considered security-sensitive (such as prescribed information) can be found in the Treasury Board of Canada Secretariat *Policy on Government Security* [5] and its related directives (which can be accessed through links on the same website).

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 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 the section addressing operational experience and safety research within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

With respect to the design and design process, the application should describe how feedback from 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 the sections addressing normal operation and in-service testing, maintenance, repair, inspection and monitoring within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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; for example:

- 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 the sections addressing the exclusion zone and facility layout within REGDOC-2.5.2, *Design of Reactor Facilities* [17]
- 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 the section addressing radiation protection within REGDOC-2.5.2 [17], 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 the sections addressing civil structure and strength of the containment structure within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. To the extent practicable and commensurate with the level of design information, 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 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 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 seismic classification for each structure and building:
  - the descriptions provided should include the extent to which various load combinations have been considered to confirm that the structure/building is able 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 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 present design information that is sufficient for the proper and safe construction of all buildings, civil infrastructure and civil site works. For civil construction, "sufficient information" would typically include drawings, calculations and specifications equivalent to those required for obtaining a provincial building permit. However, for a reactor facility, this design information is based on the requirements from nuclear codes and standards (for example, the CSA N291, N289 and N287 series of standards).

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 internal and external events). The application should also include the main design features of the structures in place 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 the section addressing containment within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. 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 provisions 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.

System description

The applicant should provide, to the extent practicable, 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 the section addressing pressure-retaining SSCs within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. 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 facility 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 the sections addressing design documentation, plant states, design rules and limits, equipment environmental qualification, and in-service testing, maintenance, repair, inspection and monitoring within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 set out in the section addressing I&C within REGDOC-2.5.2, *Design of Reactor Facilities* [17], 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, 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 the section addressing seismic qualification and design within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. The applicant should ensure that 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 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 the sections addressing reactor core, reactor coolant system and means of shutdown within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 I&C 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* [25], and the section addressing fuel handling and storage within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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; for example:

- structures into which the fuel has been assembled
- as applicable, 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 (as applicable to the technology being proposed):

- physical and chemical properties of the fuel components, including:
  - thermal-hydraulic, 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 subsystem 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

To the extent practicable, 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 thermal-hydraulic design

To the extent practicable, the applicant should provide information concerning the reactor and reactor coolant system thermal-hydraulic 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 associated systems
- analytical tools, methods and computer codes (with codes for verification, and validation information and uncertainties) used to calculate thermal and hydraulic parameters
- flow, pressure and temperature distributions, and the specification of their limiting values and a comparison with design limits
- justification for the thermal-hydraulic stability of the core; for example, stability in forced or natural circulation flow against:
  - neutronic/thermal-hydraulic feedback
  - flow oscillations

Reactivity control systems

The design of the reactivity control systems should provide the means for detecting levels and distributions of neutron flux. To the extent practicable, 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 of how diversity and physical separation have been achieved
- description of the rate of reactivity insertion and the depth of each reactivity control system in accordance with the section addressing means of shutdown within REGDOC-2.5.2, *Design of Reactor Facilities* [17]

Taken together, the SSCs important to safety I&C systems and the reactivity control systems should meet the expectations for shutdown means, in accordance with the section addressing means of shutdown within REGDOC-2.5.2 [17].

Reactor materials

The application should describe the materials used for the components of the reactor (examples include materials for the reactor coolant system pressure boundary, the materials for the core support function, and the materials for in-core components such as reactivity control mechanisms 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 reactivity control mechanism materials are addressed in the nuclear design and core nuclear performance section.

Design of the reactor coolant system and reactor auxiliary system

To the extent practicable, 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.

Integrity of the reactor coolant system pressure or fluid boundary

The application should include the results of the 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 in order 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* [17]) 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 safe operating envelope (SOE).

Systems and components supporting emergency core cooling

The application should describe the systems and components that support the emergency core cooling. 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

The application should describe the systems and components that support emergency heat removal, providing for removal of residual heat in order to meet fuel design limits and reactor coolant boundary condition limits in accordance with the section addressing the emergency heat removal system within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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

The applicant should demonstrate that, during design-extension conditions (DECs), the emergency heat removal systems and components will function as required.

Systems, structures and components supporting containment and means of confinement

Note: Much of the information below applies to containment structures. Some reactor designs may use the containment capabilities of other components, such as fuel. The applicant or licensee may propose alternative approaches. For information on alternative approaches, see REGDOC-3.5.3, *Regulatory Fundamentals* [2].

The application should describe the SSCs supporting containment and means of confinement that are in place to minimize the release of radioactive materials to the environment during operational states and DBAs. The containment and means of confinement should also assist in mitigating the consequences of DECs. Containment and means of confinement 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 the section addressing facility layout within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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

- 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 that the fundamental safety functions are available in operational states, DBAs and DECs. 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 the sections addressing the safety support system and electrical power systems within REGDOC-2.5.2, *Design of Reactor Facilities* [17], 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 DECs
- availability and reliability is commensurate with the safety significance of the connected loads

4.5.11 Instrumentation and control

To the extent practicable, the application should describe the 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 DECs, 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* [17]:

- the section addressing I&C for general requirements and guidance
- the section addressing design for reliability for requirements and guidance related to reliability and sharing
- the section on human factors for requirements and guidance on this topic

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 the sections addressing human factors and control facilities within REGDOC-2.5.2, *Design of Reactor Facilities* [17], 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
- long-term 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 steamlines, steam and feedwater system piping and vessels, and turbine generators. The applicant should ensure that 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.

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 the section addressing GSS within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

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 in accordance with the section addressing fuel handling and storage within REGDOC-2.5.2, *Design of Reactor Facilities* [17], 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 the section addressing human factors within REGDOC-2.5.2, *Design of Reactor Facilities* [17])

The application should also include a description of methods for detecting failed fuel within the reactor, in accordance with the section addressing detection of failed fuel within REGDOC-2.5.2, *Design of Reactor Facilities* [17].

4.5.16 Waste treatment and control

To the extent practicable, the application should:

- describe how the generation of radioactive and hazardous wastes is minimized
- describe 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* [17]:

- the section addressing waste treatment and control systems
- the sections addressing I&C and waste treatment and control systems for the safe handling of waste of all types produced at any stage of the reactor facility's lifecycle, from construction to commissioning
- the section addressing 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.

4.6 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.

Fitness for service considerations are addressed within section 4.5 on physical design, and the commissioning considerations within section 4.3 on operating performance.

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).

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

The application shall include a radiation protection program, and should demonstrate how the design of that program is commensurate with the radiological hazards associated with, or encountered during, the licensed activities. The application shall also describe how radiological hazards will be monitored and controlled during construction activities, as applicable.

For more information and detailed guidance on radiation protection, including the development of radiation protection programs and ascertaining of worker doses, see REGDOC-2.7.1, *Radiation Protection* [26], and REGDOC-2.7.2, *Dosimetry, Volume I: Ascertaining Occupational Dose* [27].

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 the *Canada Labour Code,* Part II, and the *Canada Occupational Health and Safety Regulations* or the applicable provincial occupational health and safety legislation. A cross-reference linking NSCA-derived legislative clauses to applicable sections in this guide is provided in appendix A.

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.

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 applicant 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* [28].

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.9.1 General considerations

The application shall include a set of environmental protection measures that meet the requirements of REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* [29]. The application should include detailed information related to the potential environmental effects resulting from the conduct of construction and commissioning activities.

The application should provide proposed timelines and milestones for the development of provisions for environmental protection during the construction phase. It should also include a description of any proposed environmental protection measures that would apply during fuel-in commissioning and reactor facility operation.

The application should identify and describe all standards, guidelines or criteria that have been applied for environmental protection.

4.9.2 Effluent and emissions control (releases)

The application should describe the effluent and emissions monitoring program for the construction phase in terms of releases to air, surface waters, groundwater and soils, from both normal 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* [30].

The applicant should demonstrate that the program encompasses all measures to be carried out related to monitoring releases of nuclear and hazardous substances with potential environmental effects. The application should describe how the program integrates all procedures that will sample, measure and analyze releases of nuclear and hazardous substances, and physical parameters.

The application should include detailed information on:

- the measures that will be taken to identify potential or expected releases of nuclear substances and hazardous substances to the environment
- criteria established to identify the nuclear and hazardous substances that will be monitored, and the detection limits that will be set to verify the performance of the control measures taken to manage releases, including:
  - where applicable, information on the monitoring of routine releases of nuclear or hazardous substances (such as SO_2, NO_2, CO_2, ammonia, hydrazine, chlorine, morpholine and ozone-depleting substances)
- the identification of existing or proposed licensed release limits, action levels and operational targets for releases and the measures taken to comply with them
- alarm systems provided to respond to unplanned releases of nuclear and hazardous substances

- availability targets for the various monitoring devices, and a maintenance program to ensure 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 the effluent and emissions 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 and emissions monitoring program
- a list of all SSCs that are important control measures (for example, engineered barriers, wastewater treatment systems, air pollution control technology systems, liquid waste monitoring equipment and stack monitoring equipment); see also section 4.5, Physical design
- the maintenance program established to ensure the sustained operational performance of control measures
- any alarm systems to be installed to respond to failure of control measures
- the methods to be used to:
  - prepare, store and retain records of releases that will be made routinely from the site
  - compare those records of releases to available performance indicators (for example, internal investigation levels, administrative levels, and other environmental monitoring objectives and targets)
- the identification of the measures that will be taken to make appropriate information available to the authorities and the public (for more information, see REGDOC-3.2.1, *Public Information and Disclosure* [31])

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

The applicant should identify environmental action levels 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* [32].

The applicant should identify the control measures that will be taken to identify any physical effects to biota, such as impingement and entrainment or habitat loss. For more information, see CSA N288.9, *Guideline for Design of Fish Impingement and Entrainment Programs at Nuclear Facilities* [33].

4.9.3 Environmental management system

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

- REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* [29]
- CAN/CSA-ISO 14001, *Environmental Management Systems – Requirements with Guidance for Use* [34]

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
- licensed release limits and action levels
- monitoring of radioactivity in effluents and emissions
- management of the offsite radiological environmental monitoring program
- management of adverse effects on the fish population (fish impingement and entrainment, and thermal effects)

4.9.4 Assessment and monitoring

The application should describe the environmental risk assessment predicted effects and associated monitoring system proposed for the site during construction activities. For more information, see:

- REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures* [29]
- CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [35]
- CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills* [30]
- CSA N288.6, *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills* [36]
- CSA N288.9, *Guideline for Design of Fish Impingement and Entrainment Programs at Nuclear Facilities* [33]

The application should also update the description of environmental components, where applicable, that were included in the application for a licence to prepare site to determine the environmental baseline characteristics of the site and the surrounding area.

The descriptions 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 modelling for radioactive material. The descriptions should also serve as confirmation of the completeness of the set of site-specific hazards that have been taken into account.

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.10.1 General considerations

The applicant shall provide details of the emergency preparedness program that is proposed to be implemented under the licence to construct a reactor facility. The emergency preparedness program shall meet all requirements applicable to the construction phase within:

- REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs* [8]
- REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response* [37]
- CSA N1600:21, *General Requirements for Nuclear Emergency Management Programs* [38]

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

Note: The applicant can develop nuclear emergency plans in stages, leading to a future licence application to load nuclear fuel into the reactor. However, a comprehensive nuclear emergency program as detailed in REGDOC-2.10.1 [37] must be established prior to loading nuclear fuel into a reactor.

4.10.2 Emergency preparedness and response

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

The application shall 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 (such as tornadoes and floods), toxic fume clouds, explosions and airplane crashes).

The application shall describe how the applicant intends to conduct emergency exercises and drills as outlined in its nuclear emergency plan, as applicable to the construction phase.

The application shall describe all non-radiological, non-routine conditions at the facility for which the emergency preparedness program has been established.

For applications to construct a new reactor facility on an existing reactor facility site, the application shall include detailed emergency procedures for the construction site if there is an

emergency initiating from the existing reactor facility that would affect the construction site for the new reactor facility.

The application should:

- address emergency situations that could endanger the safety of onsite workers, the environment and the public
- include emergency procedures to deal with fires, medical emergencies, environmental spills, natural disasters, rescues, offsite accidents that could affect the construction site, and any other emergency situations or accidents that could occur
- include details of emergency response organizations, personnel and equipment for responding to emergencies; some examples are site emergency personnel, municipal emergency response organizations, and provincial or federal organizations
- as applicable, 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 description of the emergency plan should also include:

- a basis for emergency planning
- program management
- emergency response organization, including staffing, roles and responsibilities, and activation
- emergency training, drills and exercises
- emergency response plan and procedures, including:
  - validation of emergency response plans and procedures
  - maintenance of documents
  - communication and information flow
- activation and termination of emergency responses
- protection of facility workers and equipment
- facilities and equipment maintenance
- supporting agreements, plans and procedures between onsite and offsite response organizations

4.10.3 Fire protection program

The application should provide a fire protection program that describes how the fire protection activities will be implemented, managed and monitored during the construction phase to ensure that fire risks are minimized.

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.

For construction, the applicant should consider how to manage existing onsite hazardous substances that have been identified during site evaluation, as well as the hazardous substances that will be produced during activities encompassed by the licence to construct.

Where radioactive contamination above exemption quantities from pre-existing facilities or activities is a potential concern, the applicant shall address the relevant sections of REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste* [39].

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.11.1 Hazardous substances and hazardous wastes

The applicant shall address:

- quantities and physical characteristics (including hazards posed to health and safety) of each substance or waste, including by-products
- for all substances or by-products that are regulated or controlled, the appropriate list of regulations governing their control
- transport, storage and use of hazardous substances
- processing and disposing of hazardous wastes

The applicant should characterize all hazardous substances and hazardous wastes in a list as follows:

- name and origin of hazardous substance or hazardous waste
- anticipated quantity or volume, and anticipated form
- possible by-products that could evolve from:
  - the hazardous substance or hazardous waste
  - any interactions between the hazardous substance or hazardous waste, or between the possible by-products
- hazards to workers and the public who may be exposed to the hazardous substance, hazardous waste or by-products
- how the hazardous substance, hazardous waste or by-products will be processed or disposed of at the site

4.11.2 Waste minimization

The application should describe the measures that will be taken to minimize the accumulation of hazardous waste produced during construction.

The application should describe the methods, such as design measures and technology, that are part of the reactor's design to minimize radioactive waste generation at the source during operation.

4.11.3 Decommissioning practices

At construction, the applicant shall consider 2 areas of decommissioning:

- construction from a decommissioning perspective
- activities encompassed by the licence to construct: a preliminary decommissioning plan and financial guarantee that covers the scope of work and related costs to return the site from the conditions expected at the end of a licence to construct to an agreed-upon end state (including, if the project is halted, restoration of the site to the original condition)

The preliminary decommissioning plan shall be in accordance with REGDOC-2.11.2, *Decommissioning* [40].

For further guidance on decommissioning, refer to REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities* [41].

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.

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

4.12.1 General considerations

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

- REGDOC-2.1.2, *Safety Culture* [10]
- REGDOC-2.12.1, *High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices* [42] (prescribed – available upon request to those who have a need to know)
- REGDOC-2.12.2, *Site Access Security Clearance* [43]
- 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 II: Managing Alcohol and Drug Use* [13]
- REGDOC-2.2.4, *Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness* [44]

For additional information, see IAEA NSS No. 35-G, *Security During the Lifetime of a Nuclear Facility* [45].

Because construction may include 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 should provide information on the following security program elements, including but not limited to:

- threat risk assessment
- facilities and equipment
- security practices
- response arrangements
- security training and qualification

4.12.2 Cyber security

The application should describe a cyber security program that ensures that digital computer-based systems or components 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/IAEA safeguards agreements as well as all other measures arising from the *Treaty on the Non-Proliferation of Nuclear Weapons* (IAEA INFCIRC/140) [46].

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

The legislative clauses ensure that the CNSC is able to achieve conformity with measures of control and international obligations to which Canada has agreed, including the following safeguards agreements:

- *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) [47]
- *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) [48]

4.13.1 General considerations

Either before, or concurrent with, applying for a licence to construct a reactor facility, the applicant must complete and submit to the CNSC an 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* [49].

The applicant shall provide a description of the arrangements made to 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* [50], and REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy* [49], and are in accordance with the sections addressing safeguards and fuel handling and storage within REGDOC-2.5.2, *Design of Reactor Facilities* [17]. A reactor under construction is categorized as a "facility" under REGDOC-2.13.1. The application shall describe how the safeguards program ensures that the requirements in the regulatory document for safeguards equipment and seals, IAEA access, nuclear material accountancy, provision of information, and retention of records are met during the construction phase.

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

4.14 Packaging and transport

The packaging and transport SCA covers programs for the safe packaging and transport of nuclear substances. If applicable, the applicant shall describe the measures that will be in place to ensure compliance with all the requirements of the *Packaging and Transport of Nuclear Substances Regulations*, *2015*, and Transport Canada's *Transportation of Dangerous Goods Regulations*.

If the applicant proposes to transport fuel onto the site under the licence to construct, the applicant shall address the requirements and guidance of the packaging and transport section of REGDOC-1.1.3, *Licence Application Guide: Licence to Operate a Nuclear Power Plant* [51].

5. Other Regulatory Areas

A cross-reference linking legislative clauses to applicable sections of this guide is provided in appendix A.

5.1 Reporting requirements

The applicant should describe, as applicable to the construction phase, how the reporting and trending programs, processes and procedures address the requirements of REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants* [52].

5.2 Public information and disclosure program

The applicant shall describe how its proposed public information and disclosure program (required of all licensees) meets the requirements in REGDOC-3.2.1, *Public Information and Disclosure* [31].

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 " Licence Applications – General Requirements", at paragraph 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 an 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.

The applicant shall describe how its Indigenous engagement plan and activities meet the requirements in REGDOC-3.2.2, *Indigenous Engagement* [53], which clarifies requirements and provides guidance for applicants and 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 applicants and licensees to avoid, mitigate or offset adverse effects on Indigenous or treaty rights may be used by the CNSC in meeting its 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 the CNSC. Payments are normally requested on a quarterly basis and are due to the Receiver General for 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* [41].

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 of this application guide, which are aligned with the CNSC's safety and control areas (SCAs). This table is provided for information and reference purposes; 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 Regulatory Areas
	26(a), (e)	Every SCA (sections 4.1 through 4.14) 5, Other Regulatory Areas
General Nuclear Safety and Control Regulations (GNSCR)	3(1)(a)	3.1.1, Applicant's name and business address
	3(1)(b)	3.2.2, Statement of the main purpose
	3(1)(c)	3.2.5, Nuclear and hazardous 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 4.10, Emergency management and fire protection 4.11, Waste management 4.12, Security
	3(1)(e)	4.4, Safety analysis 4.5, Physical design 4.7, 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 4.7, 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 4.11, Waste management
	3(1)(k)	3.1.6, Identification of persons responsible for management and control of the licensed activity 4.1, Management system 4.2, Human performance management 4.3, Operating performance
	3(1)(l)	5, Other Regulatory Areas
	3(1)(m)	5, Other Regulatory Areas
	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 4.12, Security
	12(1)(b)	Every SCA (sections 4.1 through 4.14)
	12(1)(c)	4.3, Operating performance 4.4, Safety analysis 4.5, Physical design 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 4.9, Environmental protection 4.10, Emergency management and fire protection 4.12, Security
	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 4.7, 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	3.1.6, Identification of persons responsible for management and control of the licensed activity 4.1, Management system
	15(a)	3.1.3, Applicant authority 3.1.8, Legal signing authority
	15(b)	3.1.3, Applicant authority 3.1.6, Identification of persons responsible for management and control of the licensed activity
	15(c)	3.1, Identification and contact information
	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
	17(d)	4.2, Human performance management 4.3, Operating performance 4.7, Radiation protection 4.8, Conventional health and safety

Legislation	Clause(s)	Section(s) in this document
	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 record of all information relating to the licence that is submitted by the licensee to the Commission… see section 3] 2.5, Submitting the licence application 4.1, Management system
	28	4.1, Management system
	28(1)	4.12, Security
	29	4.3, Operating performance 4.7, Radiation protection 4.12, Security 5.1, Reporting requirements
	30	4.3, Operating performance 4.12, Security 4.13, Safeguards and non-proliferation 5.1, Reporting requirements
	31	5.1, Reporting requirements
	32	4.3, Operating performance 5.1, Reporting requirements
Canadian Nuclear Safety Commission Cost Recovery Fees Regulations	All	5.4, Cost recovery and financial guarantees

Legislation	Clause(s)	Section(s) in this document
Class I Nuclear Facilities Regulations	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)	3.1.5, Evidence that the applicant is the owner of the site…
	3(d)	4.1, Management system
	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 4.8, Conventional health and safety 4.10, Emergency management and fire protection 4.11, Waste management
	3(g)	4.9, Environmental protection
	3(h)	4.9, Environmental protection
	3(i)	4.5, Physical design 4.12, Security
	3(j)	5, Other Regulatory Areas
	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
	5(e)	4.3, Operating performance 4.5, Physical design
	5(f)	4.4, Safety analysis 4.5, Physical design
	5(g)	4.1, Management system
	5(h)	4.1, Management system 4.12, Security 4.13, Safeguards and non-proliferation

Legislation	Clause(s)	Section(s) in this document
	5(i)	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 4.10, 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)	4.1, Management system 4.5, Physical design 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 management 4.7, Radiation protection
	5(m)	4.2, Human performance management 4.3, Operating performance
	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
Nuclear Non-proliferation Import and Export Control Regulations	All	4.13, Safeguards and non-proliferation
Nuclear Security Regulations	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

Legislation	Clause(s)	Section(s) in this document
	38	4.1, Management system 4.2, Human performance management
Nuclear Substances and Radiation Devices Regulations	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
Packaging and Transport of Nuclear Substances Regulations, 2015	All	4.14, Packaging and transport
Radiation Protection Regulations	All	4.3, Operating performance 4.4, Safety analysis (all requirements related to dose) 4.5, Physical design 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 3 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	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
		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 characterization
		Facility design
		Structure design
		System design
		Component design
	6. Fitness for service	Equipment fitness for service / equipment performance

Functional area	Safety and control area	Specific area
		Maintenance
		Structural integrity
		Aging management
		Chemistry control
		Periodic inspection and testing
Core control processes	7. Radiation protection	Application of ALARA
		Worker dose control
		Radiation protection program performance
		Radiological hazard control
	8. Conventional health and safety	Performance
		Practices
		Awareness
	9. Environmental protection	Effluent and emissions control (releases)
		Environmental management system (EMS)
		Protection of people
		Assessment and monitoring
		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
		Cyber security
	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 3 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). In addition, the facility design and operation need 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 as explicitly stated in REGDOC-2.5.2, *Design of Reactor Facilities* [17], which requires that reactor facilities "be designed and operated in a manner that will protect individuals, society and the environment from harm".

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

The qualifications objective expresses the high-level expectation that adequately qualified persons will carry out 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

Meeting the design safety objective means satisfying the relevant expectations outlined in:

- REGDOC-2.5.2, *Design of Reactor Facilities* [17]
- REGDOC-2.4.1, *Deterministic Safety Analysis* [16]

Each of the second-level objectives can be subdivided into third-level objectives, which have more specific means of assessment. In reviewing an application for a licence to construct a reactor facility, CNSC staff assess whether the objectives are met for the applicable topical areas.

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 may 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-1.1.2**
Identifier	**Title**				
					e.g., 4.1

Appendix E: Sample Format for Listing Revisions to the Supporting Documentation

If a document version in the supporting information has changed since the previous submission, the applicant must provide the CNSC with the new version number, a copy of the new version, and a summary of major changes between the new version and the version that was reviewed by CNSC staff.

E.1 Sample (suggested) format

This table provides a sample format that the applicant may consider for providing a list of the supporting documents that have changed since the previous submission.

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		**Original version number**	**In LCH for WN (Y/N)**	**Current version number**	**Summary of changes (use as many lines as necessary)**
Identifier	**Title**				

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.
2. CNSC, REGDOC-3.5.3, *Regulatory Fundamentals*, Ottawa, Canada.
3. CNSC, REGDOC-3.5.1, *Licensing Process for Class I Nuclear Facilities and Uranium Mines and Mills*, Ottawa, Canada.
4. CNSC, REGDOC-2.12.3, *Security of Nuclear Substances: Sealed Sources and Category I, II and III Nuclear Material*, Ottawa, Canada.
5. Treasury Board of Canada Secretariat, *Policy on Government Security*.
6. CSA Group, CSA N286-12, *Management System Requirements for Nuclear Facilities*, Mississauga, Canada.
7. CNSC, REGDOC-2.1.1, *Management System*, Ottawa, Canada.
8. CNSC, REGDOC-2.3.1, *Conduct of Licensed Activities: Construction and Commissioning Programs*, Ottawa, Canada.
9. CSA Group, CSA N286.10, *Configuration Management for High Energy Reactor Facilities*, Mississauga, Canada.
10. CNSC, REGDOC-2.1.2, *Safety Culture*, Ottawa, Canada.
11. CNSC, REGDOC-2.2.1, *Human Factors*, Ottawa, Canada.
12. CNSC, REGDOC-2.2.4, *Fitness for Duty: Managing Worker Fatigue*, Ottawa, Canada.
13. CNSC, REGDOC-2.2.4, *Fitness for Duty, Volume II: Managing Alcohol and Drug Use*, Ottawa, Canada.
14. CNSC, REGDOC-2.2.2, *Personnel Training*, Ottawa, Canada.
15. CSA Group, CSA A23.1:19/CSA A23.2:19, *Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete*, Mississauga, Canada.
16. CNSC, REGDOC-2.4.1, *Deterministic Safety Analysis*, Ottawa, Canada.
17. CNSC, REGDOC-2.5.2, *Design of Reactor Facilities*, Ottawa, Canada.
18. CNSC, REGDOC-1.1.1, *Site Evaluation and Site Preparation for New Reactor Facilities*, Ottawa, Canada.
19. CNSC, REGDOC-2.4.2, *Probabilistic Safety Assessment (PSA) for Reactor Facilities*, Ottawa, Canada.
20. CNSC, REGDOC-2.3.2, *Accident Management*, Ottawa, Canada.

21. CNSC, REGDOC-2.6.3, *Aging Management*, Ottawa, Canada.

22. CNSC, REGDOC-2.6.1, *Reliability Programs for Nuclear Power Plants*, Ottawa, Canada.

23. CNSC, REGDOC-2.5.1, *General Design Considerations: Human Factors*, Ottawa, Canada.

24. CSA Group, CSA N290.12-14, *Human Factors in Design for Nuclear Power Plants*, Mississauga, Canada.

25. CNSC, REGDOC-2.4.3, *Nuclear Criticality Safety*, Ottawa, Canada.

26. CNSC, REGDOC-2.7.1, *Radiation Protection*, Ottawa, Canada.

27. CNSC, REGDOC-2.7.2, *Dosimetry, Volume I: Ascertaining Occupational Dose*, Ottawa, Canada.

28. CNSC, REGDOC-2.8.1, *Conventional Health and Safety*, Ottawa, Canada.

29. CNSC, REGDOC-2.9.1, *Environmental Principles, Assessments and Protection Measures*, Ottawa, Canada.

30. CSA Group, CSA N288.5, *Effluent Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, Mississauga, Canada.

31. CNSC, REGDOC-3.2.1, *Public Information and Disclosure*, Ottawa, Canada.

32. CSA Group, CSA N288.8, *Establishing and Implementing Action Levels for Releases to the Environment from Nuclear Facilities*, Mississauga, Canada.

33. CSA Group, CSA N288.9, *Guideline for Design of Fish Impingement and Entrainment Programs at Nuclear Facilities*, Mississauga, Canada.

34. CSA Group, CAN/CSA-ISO 14001, *Environmental Management Systems – Requirements with Guidance for Use*, Mississauga, Canada.

35. CSA Group, CSA N288.4, *Environmental Monitoring Programs at Class I Nuclear Facilities and Uranium Mines and Mills*, Mississauga, Canada.

36. CSA Group, CSA N288.6, *Environmental Risk Assessments at Class I Nuclear Facilities and Uranium Mines and Mills*, Mississauga, Canada.

37. CNSC, REGDOC-2.10.1, *Nuclear Emergency Preparedness and Response*, Ottawa, Canada.

38. CSA Group, CSA N1600:21, *General Requirements for Nuclear Emergency Management Programs*, Mississauga, Canada.

39. CNSC, REGDOC-2.11.1, *Waste Management, Volume I: Management of Radioactive Waste*, Ottawa, Canada.

40. CNSC, REGDOC-2.11.2, *Decommissioning*, Ottawa, Canada.

41. CNSC, REGDOC-3.3.1, *Financial Guarantees for Decommissioning of Nuclear Facilities and Termination of Licensed Activities*, Ottawa, Canada.

42. CNSC, REGDOC-2.12.1, *High-Security Facilities, Volume II: Criteria for Nuclear Security Systems and Devices* (prescribed), Ottawa, Canada.

43. CNSC, REGDOC-2.12.2, *Site Access Security Clearance*, Ottawa, Canada.

44. CNSC, REGDOC-2.2.4, *Fitness for Duty, Volume III: Nuclear Security Officer Medical, Physical, and Psychological Fitness*, Ottawa, Canada.

45. International Atomic Energy Agency (IAEA), Nuclear Security Series (NSS) No. 35-G, *Security During the Lifetime of a Nuclear Facility*, Vienna, Austria.

46. IAEA, *Treaty on the Non-Proliferation of Nuclear Weapons* (INFCIRC/140), Vienna, Austria.

47. 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), Vienna, Austria.

48. 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), Vienna, Austria.

49. CNSC, REGDOC-2.13.1, *Safeguards and Nuclear Material Accountancy*, Ottawa, Canada.

50. CNSC, REGDOC-2.13.2, *Import and Export*, Ottawa, Canada.

51. CNSC, REGDOC-1.1.3, *Licence Application Guide: Licence to Operate a Nuclear Power Plant*, Ottawa, Canada.

52. CNSC, REGDOC-3.1.1, *Reporting Requirements for Nuclear Power Plants*, Ottawa, Canada.

53. CNSC, REGDOC-3.2.2, *Indigenous Engagement*, Ottawa, Canada.

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.

CNSC regulatory documents are classified under the following categories and series:

1.0 Regulated facilities and activities

Series 1.1 Reactor facilities
1.2 Class IB facilities
1.3 Uranium mines and mills
1.4 Class II facilities
1.5 Certification of prescribed equipment
1.6 Nuclear substances and radiation devices

2.0 Safety and control areas

Series 2.1 Management system
2.2 Human performance management
2.3 Operating performance
2.4 Safety analysis
2.5 Physical design
2.6 Fitness for service
2.7 Radiation protection
2.8 Conventional health and safety
2.9 Environmental protection
2.10 Emergency management and fire protection
2.11 Waste management
2.12 Security
2.13 Safeguards and non-proliferation
2.14 Packaging and transport

3.0 Other regulatory areas

Series 3.1 Reporting requirements
3.2 Public and Indigenous engagement
3.3 Financial guarantees
3.4 Commission proceedings
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