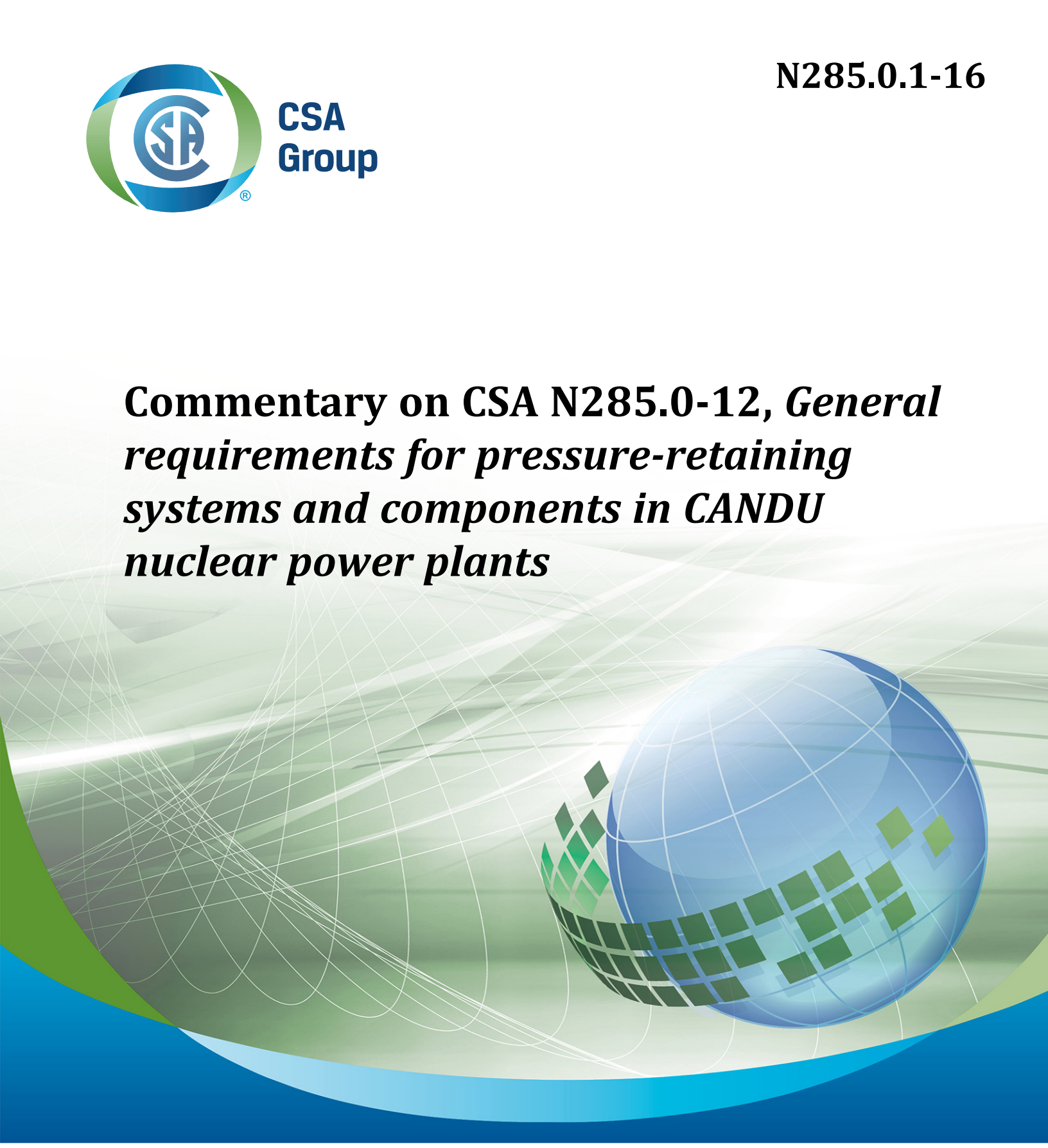
CSA Group

N285.0.1-16

Commentary on CSA N285.0-12, *General requirements for pressure-retaining systems and components in CANDU nuclear power plants*



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Preface

This is the first edition of CSA N285.0.1, *Commentary on CSA N285.0-12*, General requirements for pressure-retaining systems and components in CANDU nuclear power plants. This Commentary is based on the document titled *Explanation of requirements in the CSA N285 series for CANDU nuclear power plants*, which was written by Geoff Legg (AECL) and published in 1998 for members of the N285A Technical Committee only. The discussion provided in this Commentary is directed only towards the requirements in CSA N285.0-12 and does not address the amendments released since 2012. This Commentary also does not address CSA N285.6, *Material standards for reactor components for CANDU nuclear power plants*, which was released in conjunction with CSA N285.0. This Commentary does not provide formal interpretations of CSA N285.0 and should be viewed only as an informative annotation of portions of CSA N285.0. It has been written in informative (non-mandatory) language and is not intended to be adopted by users of CSA N285.0 or regulatory authorities as additional requirements. Significant changes between editions of CSA N285.0 are outlined, along with rationale for the changes, where needed.

This Commentary responds to questions and comments raised by those who have participated in developing and implementing CSA N285.0. It provides a context and explanation for the structure and content of CSA N285.0, and outlines the governing principles and requirements. The Commentary does not cover the entire content of every clause of CSA N285.0.

The intent is to update this Commentary after the publication of each new edition of CSA N285.0 so as to incorporate information associated with amendments to published editions and new editions, and to expand the Commentary as additional needs are identified.

This Commentary was prepared by the Task Force on *Commentary on CSA N285.0*, under the jurisdiction of the Technical Committee on CANDU Nuclear Power Plant Systems and Components and the Nuclear Strategic Steering Committee on Nuclear Standards, and has been formally approved by the Technical Committee.

Notes:

1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

2) *Although the intended primary application of this Commentary is stated in its scope, it is important to note that it remains the responsibility of the users of the Commentary to judge its suitability for their particular purpose.*

3) *This Commentary was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*

4) *This Commentary is subject to periodic review, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line:*

a) *standard designation (number);*
b) *relevant clause, table, and/or figure number;*
c) *wording of the proposed change; and*
d) *rationale for the change.*

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Commentary on CSA N285.0-12, General requirements for pressure-retaining systems and components in CANDU nuclear power plants

1 Scope

1.1 General

The purpose of this Commentary is to provide background information for certain clauses and requirements in CSA N285.0. This background information can help the user to clarify the context of the CSA N285.0 requirements. Also, this Commentary refers to sources of material that were used during the formulation of some of the requirements in CSA N285.0. With the exception of the Annexes, the main clause headings and the main clause numbers used in this Commentary correspond to those in CSA N285.0-12.

This Commentary focuses on CSA N285.0 and is organized as follows:

a) the original intent of CSA N285.0, including
   i) historical background — how the nuclear industry developed in Canada; and
   ii) the differences between ASME *Boiler and Pressure Vessel Code* (*BPVC)*, Section III, Division 1, and CSA N285.0, CANDU-specific requirements;
b) the aim of CSA N285.0, including the provision of
   i) rules for the design of the CANDU reactors consistent with the regulatory requirements;
   ii) requirements not covered by ASME *BPVC*, Section III, Division 1;
   iii) classification requirements;
   iv) registration requirements, including those for welding procedures; and
   v) requirements for repairs, replacements, and modifications;
c) the rationale for many of the requirements, which are derived from
   i) industry practice or experience;
   ii) engineering or safety analysis;
   iii) research or test programs; and
   iv) good engineering judgment; and
d) the evolvement of CSA N285.0 through significant changes in various editions.

This Commentary addresses requirements relating to the design and construction of pressure-retaining systems and components. Standards that relate to periodic inspection of pressure-retaining components are not addressed. Also, the requirements of other interfacing Standards and ASME *BPVC*, Section III, Division 1 are not addressed in this Commentary. The edition of CSA N285.0 that is addressed in this Commentary is the 2012 edition, not including Updates Nos. 1 and 2. Generally, the text is presented in the same sequence used in CSA N285.0, tracing the activities during the design, fabrication and installation of an item.

Although this Commentary can be read by itself, a better understanding of the Commentary will be obtained if a copy of CSA N285.0-12 is available for reference. Many of the requirements in CSA N285.0-12 are described in this Commentary. However, the Standard must always govern since it provides the formal requirements.

Note: *ASME has published a companion guide to the ASME* Boiler and Pressure Vessel and Piping Codes*, which provides the criteria and a commentary on selected aspects of ASME* Boiler and Pressure Vessel and Piping Codes*.*

1.2 Historical background

The requirements in the Standard are based on provincial and federal regulations, practices developed in the design and construction of CANDU nuclear power plants, and the proven and widely adopted rules of ASME *BPVC*, Section III, Division 1. Their fundamental goal is to ensure public safety. Since the first Standard in the CSA N285 series was issued, regulations and best practices have evolved as the industry gained design, construction, commissioning, and operational experience. However the basic pressure boundary requirements have not changed significantly and are based on the long-standing ASME industrial practices. Where such changes have occurred, they are described in the appropriate sections.

The first CSA N285 Standard, a preliminary edition, was issued in 1975 and included both general requirements and specific requirements for Class 1, 2, and 3 components. Because provincial acts and regulations took precedence over ASME *BPVC*, Section III, Division 1, the 1975 edition included an appendix that listed the ASME *BPVC*, Section III, Division 1 paragraphs that were not applicable to nuclear power plants in Canada. These paragraphs dealt with authorization, stamping, and reports. In 1981, the content of CSA N285 were divided between two Standards, with general requirements in CSA N285.0 and requirements for Class 1, 2, and 3 systems and components in CSA N285.1.

The CSA N285 series was further developed as shown in the table below:

Number	Title	Status
CSA N285.0	*General requirements for pressure-retaining systems and components*	1981, amended 1987, 1991, 1995, 2006,2008, and 2012
CSA N285.1	*Requirements for Class 1,2, and 3 pressure-retaining systems and components*	1981, 1991 (This Standard no longer exists as a separate publication; it was incorporated into CAN/CSA-N285.0-95.)
CSA N285.2	*Requirements for Class 1C, 2C, and 3C pressure-retaining components and supports*	1989 (This Standard no longer exists as a separate publication; it was incorporated into CSA N285.0-08 as Annex I and into CSA N285.0-12 as Annex H.)
CSA N285.3	*Requirements for containment system components*	1988 (This Standard no longer exists as a separate publication; it was incorporated into CSA N285.0-08 as Annex J and into CSA N285.0-12 as Annex I.)
CSA N285.4*	*Periodic inspection of CANDU nuclear power plant components*	1978, amended 1983, 1994, and 2005
CSA N285.5*	*Periodic inspection of CANDU nuclear power plant containment components*	1988, amended 1990
CSA N285.6†	*Material standards for reactor components for CANDU nuclear power plants*	1988, 2005 (The N285.6 series of Standards were published as companion documents to the 2008 and 2012 editions of CSA N285.0.)

Number	Title	Status
CSA N285.7*	*Periodic inspection of CANDU nuclear power plant balance of plant systems and components*	In development
CSA N285.8*	*Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors*	2005, amended 2010

* *Explanation of these Standards is not included in this Commentary.*
† *Explanation of these Standards is not included in this Commentary as they will be addressed in a separate publication.*

CSA N285.1, CSA N285.2, and CSA N285.3 were incorporated into CSA N285.0 so that all the technical requirements for pressure-retaining systems and components would be in one Standard. This also had the benefit of lowering overhead costs for CSA Group in terms of number of staff required to manage the program and the cost of publication. Because it was desirable to maintain the numbering system of the various material Standards in CSA N285.6, it was not possible to incorporate them into CSA N285.0. Therefore, CSA N285.6 has been as a companion document to CSA N285.0 as these material Standards are closely related to design rules in CSA N285.0.

CSA N285.0 and ASME *BPVC*, Section III, Division 1 set forth requirements for pressure-retaining components. The current edition of CSA N285.0 is based on years of experience in designing, fabricating, installing, and operating pressure-retaining systems and components that have a high degree of integrity and safety. However, codes and standards cannot consider and address every circumstance. Consequently, whether a circumstance is addressed or not, the designer, certificate holder, installer, and operator are still expected to use good engineering judgment to ensure that nuclear power plants are constructed and operated reliably and safely.

Under the direction of the CSA Nuclear Strategic Steering Committee (NSSC), the work associated with pressure-retaining systems and components has been divided between two technical committees responsible for the various Standards from the CSA N285 series, as follows:

a) N285A Technical Committee, which is responsible for CSA N285.0 (which includes the requirements that used to be in CSA N285.1, CSA N285.2, and CSA N285.3) and CSA N285.6 (now published with CSA N285.0); and
b) N285B Technical Committee, which is responsible for CSA N285.4, CSA N285.5, CSA N285.7, and CSA N285.8.

The work was divided between these two technical committees, and the specialized expertise and knowledge of the members of the committees was also divided along the same lines. These committees are responsible for the Standards and will consider suggestions for improvement. New editions of the Standards are issued on an as needed basis.

1.3 ASME vs. CSA (CANDU design)

1.3.1

The Canadian and American nuclear industries are organized around different reactor concepts and have developed construction rules specific to each type.

In Canada, all nuclear reactors for power production are of the CANDU design at this time. There are both single-unit and multi-unit station configurations. The CANDU reactor is a pressurized heavy water reactor that makes use of multiple horizontal zirconium alloy pressure tubes in its high-pressure heat-transport system, through which the pressurized heavy water coolant flows over natural uranium fuel bundles, removing the heat of the fission reaction. CANDU designs feature a calandria, which houses a

low-pressure heavy water moderator and a relatively low-pressure containment system. In contrast, the fuel in the pressurized water reactor (PWR) and boiling water reactor (BWR) designs is located in a single large pressure vessel through which the coolant flows over the enriched uranium fuel. ASME *BPVC*, Section III, Division 1 was developed based on the PWR and BWR concepts.

Also, ASME *BPVC* and CSA N285.0 were developed according to different philosophies. ASME *BPVC*, Section III, Division 1 is written at a component level and only covers the technical requirements for the construction of new components and supports after they have been classified, whereas CSA N285.0 includes requirements for classification of systems and components, plant and system documentation, and registration. Once the systems have been classified and the classification boundaries have been identified, then the components and supports adopt the classification of the system. The construction of these items is based on technical requirements that are either the same or similar to those in ASME *BPVC*, Section III, Division 1.

Therefore, Canadian standards are needed, both for CANDU reactors located within Canada and those located outside of Canada. Accordingly, the Canadian CSA N285.0 Standard has been written with the following objectives:

a) to be the governing Standard for pressure-retaining systems and components in CANDU nuclear power plants;
b) to specify the administrative practices employed in Canada to satisfy Canadian legislation;
c) to provide requirements for the classification of process and safety systems;
d) to identify the applicable technical requirements and the use of other codes and standards, such as ASME *BPVC*, Section III, Division 1; and
e) to provide additional technical requirements for those unique features of the CANDU concept not adequately addressed or not considered applicable in ASME *BPVC*, Section III, Division 1.

1.3.2

CSA N285.0 specifies the technical requirements for the design, procurement, fabrication, installation, modification, repair, replacement, testing, examination, and inspection of, and other work related to, all pressure-retaining and containment systems, and their components and supports over the service life of a CANDU nuclear power plant. CSA N285.0 also applies to containment components (including systems penetrating containment, containment boundary components, and systems for containment pressure control). CSA N285.0 does not apply to the following:

a) concrete containment structures or embedments, which are covered in the CSA N287 series;
b) portable assemblies of pressurized items that are temporarily connected to a system or component to enable testing, venting, draining, calibration, or other maintenance activities, provided that they do not reduce the ability of a system to perform its design safety function. These are under surveillance when connected and are removed upon completion of their function; they are constructed to standards deemed by the licensee to be suitable for the application; and
c) items not associated with the pressure-retaining function of a component (see ASME *BPVC*, Section III, Division 1 — NX-2121 where X is B, C, D, E, or F), such as
    i) shafts, stems, trim, spray nozzles, bearings, bushings, springs, and wear plates;
    ii) seals, packing, gaskets, and valve seats; and
    iii) ceramic insulating material, and special alloys used as seal material in electrical penetration assemblies.

1.4 Legislation

1.4.1 General

With the introduction of nuclear power and the development of the CANDU concept as Canada's contribution to the power industry, federal legislation was enacted to ensure the use of nuclear energy in Canada does not pose undue risk to health, safety, security, and the environment. Consequently, the requirements in CSA N285.0, which are administrative in nature, relate mostly to providing evidence to substantiate compliance with the relevant acts and regulations. Similarly, requirements of a technical nature are intended to ensure the design, fabrication, installation, and operation of the nuclear power plant will have the integrity needed to meet the objectives of the legislation. CSA N285.0 is an intermediate document, positioned between the regulatory requirements and the practices leading to the design, fabrication, and installation of components.

The federal Nuclear Safety and Control Act and regulations apply to the design, fabrication, installation, commissioning, and operation of nuclear power plants in Canada. The Canadian Nuclear Safety Commission (CNSC, previously the Atomic Energy Control Board [AECB], hereinafter called the regulatory authority) was appointed to specify regulatory and administrative requirements for pressure-retaining systems and components in their regulations and regulatory documents. Where the regulatory documents conflict with the requirements of CSA N285.0, the regulatory documents take precedence. Since 1995, the regulatory authority has taken a more explicit leadership role in the regulation of pressure boundaries at nuclear facilities.

The federal act and regulations normally require the following items for a nuclear power plant: a construction licence, an operating licence, and other licences, certificates, and permits specified by the regulatory authority. These licences and the accompanying licence condition handbooks normally require the licensee to have the following:

a) registered designs for systems, components, and supports;
b) registered welding and brazing procedures;
c) an accepted overpressure protection report;
d) accepted code classifications, including applicable standards;
e) accepted record-keeping systems;
f) accepted quality assurance programs; and
g) accepted periodic inspection programs.

Each province has its own provincial boilers and pressure vessels act; these acts apply to non-nuclear pressure-retaining systems and components installed in the province (outside of the nuclear facility) and manufacturers of equipment. Each province has its own provincial safety authority or department for boilers and pressures vessels, which is designated the Authorized Inspection Agency (hereinafter called the authorized inspection agency or AIA) for the purposes of CSA N285.0.

1.4.2 Separation of federal and provincial requirements

The separation of the requirements between the federal and provincial acts occurs at the security (taut wire) fence.

Outside the security fence, the provincial boilers and pressure vessels acts and regulations apply. This permits the use of the exemptions from registration for systems that are listed in the provincial boilers and pressure vessels acts and regulations, in addition to the exemptions listed in the specified codes and standards. Activities associated with nuclear class systems and components are governed by CSA N285.0. Activities associated with conventional systems and components are governed by CSA B51.

Inside the security fence, the federal act and regulations, power reactor operating licence (PROL), and the licence condition handbook (LCH) apply. The PROL specifies the codes and standards that apply to systems and components, while the LCH specifies the editions and provides guidance for compliance with the PROL. Nuclear class systems and components are governed by CSA N285.0. Class 6 and exempt (from classification) systems and components are also governed by CSA N285.0, which references the administrative and technical requirements of CSA B51. The exemptions from registration for systems that are listed in the provincial boilers and pressure vessels act and regulations do not apply inside the security fence. It is the responsibility of the licensees to ensure compliance with the federal act and regulations.

1.5 Significant changes in scope

1.5.1

In the 2006 edition of CSA N285.0, the following significant changes were introduced:

a) In 1999, the regulatory authority requested the N285A Technical Committee to consider incorporating the former's regulatory philosophy, which consisted of specifying clear requirements and identifying the party responsible for compliance. In addition, CSA N285.0 should not give any discretionary powers to the regulatory authority. This required a complete rewrite of CSA N285.0 so that it would be suitable for use by the regulatory authority in regulations or licence condition handbooks. There was also a further need, identified by industry, to update CSA N285.0 to cover current repair, replacement, and modification practices, and requirements for operating nuclear power plants.
b) Clause 1.1 was clarified to make it clear that CSA N285.0 applied to all the phases of a CANDU nuclear power plant life cycle: the design, procurement, fabrication, installation, modification, repair, replacement, testing, examination, and inspection of, and other work related to, pressure-retaining and containment systems, components, and supports over the service life of a CANDU nuclear power plant.
c) Clause 1.3 was revised stating that CSA N285.0 did not apply to concrete containment structures. This was to ensure separation of the requirements of CSA N285.0 and CSA N287 series.

1.5.2

In the 2008 edition of CSA N285.0, the following significant changes were introduced:

a) Clause 1.3 was further revised to clarify that CSA N285.0 applies to containment components but does not apply to concrete containment structures. This was to delineate those components that CSA N285.0 covered and those covered by the N287 series.
b) Clause 1.4 was added to distinguish formal requirements from good practices. CSA Group and the N285A Technical Committee adopted standardized phrasing, using "shall", "should", and "may". "Shall" is used to express a mandatory requirement. "Should" is used to express a recommendation; if the recommendation was not followed, there should be an accompanying rationale or a documented alternative. "May" is used to express an option or simply to refer to suggested practices that have proven their worth.

1.5.3

In the 2012 edition of CSA N285.0, a new Clause 1.4 was added to state that CSA N285.0 does not apply to portable assemblies of pressurized items that are temporarily connected to a system or component to enable testing, venting, draining, calibration, or other maintenance activities, provided that they:

a) do not reduce the ability of a system to perform its design safety function;
b) are under surveillance when connected and are removed upon completion of their function; and

c) are constructed to Standards deemed by the licensee to be suitable for the application.

The purpose of the new Clause 1.4 was to exempt those components and systems used during construction and maintenance that would not be left attached to the reactor or auxiliary systems during operation of the CANDU nuclear power plant.

2 Reference publications

The reference publications are revised and updated during the publication cycle of a new edition of CSA N285.0. The purpose of providing these reference publications' dates is to provide the user with the specific editions and addenda of the reference documents to be used in conjunction with CSA N285.0. Only publications that are mentioned in the text of CSA N285.0 are cited in Clause 2 of CSA N285.0.

3 Definitions

3.1 General

The terms defined in CSA N285.0 Clause 3 also apply in this Commentary. To the extent possible, they are consistent with the definitions of ASME *BPVC*, Section III, Division 1 and other CSA Standards.

3.2 Significant changes in definitions

Before the publication of the 2012 edition of CSA N285.0, the N285A Technical Committee agreed to align CSA N285.0 definitions with the ASME *BPVC*, Section III, Division 1 definitions, except for some specific provisions related to Canada- or CANDU-specific requirements. In the 2012 edition of CSA N285.0, the following significant changes were introduced:

a) The definition of "component" was changed to "an item such as a vessel, pump, valve, storage tank, or piping system that is part of a system" with a note that components do not include items defined as "material".
b) The definition of "material" was changed to "a metallic material that is produced to an SA, SB, SFA or any other material specification permitted in ASME *BPVC*, Section III, Division 1 or in this Standard (CSA N285.0), and that is manufactured and identified in accordance with this Standard [CSA N285.0]".
c) The definitions of "process system", "special safety system", and "piping system" were clarified throughout the text. A "system" is considered a process or a special safety system, as opposed to a "piping system", which is an assembly of piping and equipment. A piping system is considered a component and is normally part of a system.
d) The term "safety-related systems" was removed.

4 Effective date for Standards

To eliminate the use of different editions of a Standard on a project, CSA N285.0 establishes an "effective date" for Standards. The effective date of CSA N285.0 is the date specified in the construction licence for the plant issued by the regulatory authority. If the date of the CSA N285.0 edition is not specified in the licence, then the effective date of CSA N285.0 is the publication date of the edition in effect as of the date of the construction licence. The effective dates of referenced Standards are established and defined by CSA N285.0. These editions of CSA N285.0 and referenced Standards are the ones to be used for the construction of the plant covered by the construction licence until the plant is declared in-service. This approach is intended to eliminate confusion, such as which edition to use for a