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N289.1-18

General requirements for seismic design and qualification of nuclear power plants

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Preface

This is the third edition of CSA N289.1, *General requirements for seismic design and qualification of nuclear power plants*. It supersedes the previous editions, published in 2008 and 1980 under the title *General requirements for seismic qualification of* CANDU *nuclear power plants*. The title has been changed to reflect a scope change from addressing only CANDU® reactors to including any nuclear power plant (NPP).

The CSA N289 series of Standards covers general requirements for seismic hazard evaluation, seismic design, qualification, evaluation, and testing and monitoring. This Standard is used in conjunction with the following CSA N289 series of Standards:

a) CSA N289.2, *Ground motion determination for seismic qualification of nuclear power plants;*
b) CSA N289.3, *Design procedures for seismic qualification of nuclear power plants;*
c) CSA N289.4, *Testing procedures for seismic qualification of nuclear power plant structures, systems, and components;* and
d) CSA N289.5, *Seismic instrumentation requirements for nuclear power plants and nuclear facilities.*

Note: *Automatic shutdown is not a seismic design requirement of the CSA N289 Series of Standards; however, sufficient seismic monitoring instrumentation of high reliability, as specified in CSA N289.5, is needed to collect data in order to facilitate decision-making regarding continued safe operation. The data could also be used in conjunction with other indicators to trip a reactor.*

The 2008 edition of this Standard was restructured to act as an introduction to the CSA N289 series of Standards and to supplement the Standards in this series with current seismic qualification concepts and methodologies. Methods for evaluation of the seismic capacity of NPP safety-related structures, systems, and components (SSCs) are also described. In addition, this Standard incorporates methods developed for demonstrating that NPP safety-related SSCs possess seismic capacity with very low probability of exceedance.

The CSA N289 series provides general requirements for safe response to earthquake ground motions by monitoring ground motions, quantifying effects, and initiating operator actions, and by requiring seismic qualification and design of nuclear safety-related SSCs.

Concrete containment structures (covered in the CSA N287 series of Standards), safety-related structures (covered in CSA N291), and systems and components required to safely shut down, cool, contain, and monitor the plant following a major earthquake should be seismically qualified using the CSA N289 series of Standards. The seismic requirements of the *National Building Code of Canada (NBCC)* may be used for those parts of NPPs that have no effect on nuclear safety, though the operating organization may elect to use the CSA N289 series in place of the *NBCC*.

The CSA N289 series of Standards generally imposes more stringent seismic design requirements than the *NBCC*.

The CSA N289 series of Standards specifies means for the seismic qualification of those NPP SSCs necessary for safe shutdown, fuel cooling, the containment of potential releases of radioactive material, and the monitoring and control of essential safety-related functions in the event of an earthquake. The nuclear facility operating organization may use the CSA N289 series to seismically qualify those parts of a nuclear facility required to prevent an unacceptable release of radioactive material to the environment in the event of an earthquake.

The CSA N-Series Standards provide an interlinked set of requirements for the management of nuclear facilities and activities. CSA N286 provides overall direction to management to develop and implement sound management practices and controls, while the other CSA Group nuclear Standards provide technical requirements and guidance that support the management system. This Standard works in harmony with CSA N286 and does not duplicate the generic requirements of CSA N286; however, it may provide more specific direction for those requirements.

Users of this Standard are reminded that the final approval for the seismic qualification of NPP SSCs is subject to the provisions of the *Nuclear Safety and Control Act* and its supporting *Regulations*.

This Standard was prepared by the Subcommittee on General Requirements for Seismic Design and Qualification of Nuclear Power Plants, under the jurisdiction of the Technical Committee on Seismic Design and the 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 Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*
3) *This Standard 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) *To submit a request for interpretation of this Standard, please send the following information to inquiries@csagroup.org and include "Request for interpretation" in the subject line:*
   a) *define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;*
   b) *provide an explanation of circumstances surrounding the actual field condition; and*
   c) *where possible, phrase the request in such a way that a specific "yes" or "no" answer will address the issue.*

   Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are available on the* Current Standards Activities *page at standardsactivities.csa.ca.*
5) *This Standard is subject to review within five years from the date of publication. 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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General requirements for seismic design and qualification of nuclear power plants

1 Scope

1.1

This Standard sets forth the general requirements for seismic design and qualification of nuclear power plants (NPPs).

Note: *This Standard also provides guidance for preparing a seismic qualification governance document (see Clause 5.3.6).*

1.2

This Standard applies to all structures, systems, and components (SSCs) of NPPs requiring seismic qualification based on nuclear safety considerations (see Annex A). This Standard may also be applied to other SSCs, as deemed appropriate by the operating organization or by the authority having jurisdiction (AHJ) such as the Canadian Nuclear Safety Commission (CNSC).

1.3

This Standard was developed for NPPs in regions of low to moderate seismic hazard, comparable to the levels near Canada's existing NPPs. In regions of higher seismic hazard, the engineering required for reliable design under strong earthquake shaking is more complex, and is beyond the scope of this Standard. Therefore, while the provisions of this Standard can be applied to any NPP site, additional provisions can be required for high seismic hazard sites.

1.4

This Standard may be applied, as appropriate, to nuclear facilities under the jurisdiction of the *Nuclear Safety and Control Act*.

1.5

In this Standard, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; "should" is used to express a recommendation or that which is advised but not required; and "may" is used to express an option or that which is permissible within the limits of the standard.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (nonmandatory) to define their application.