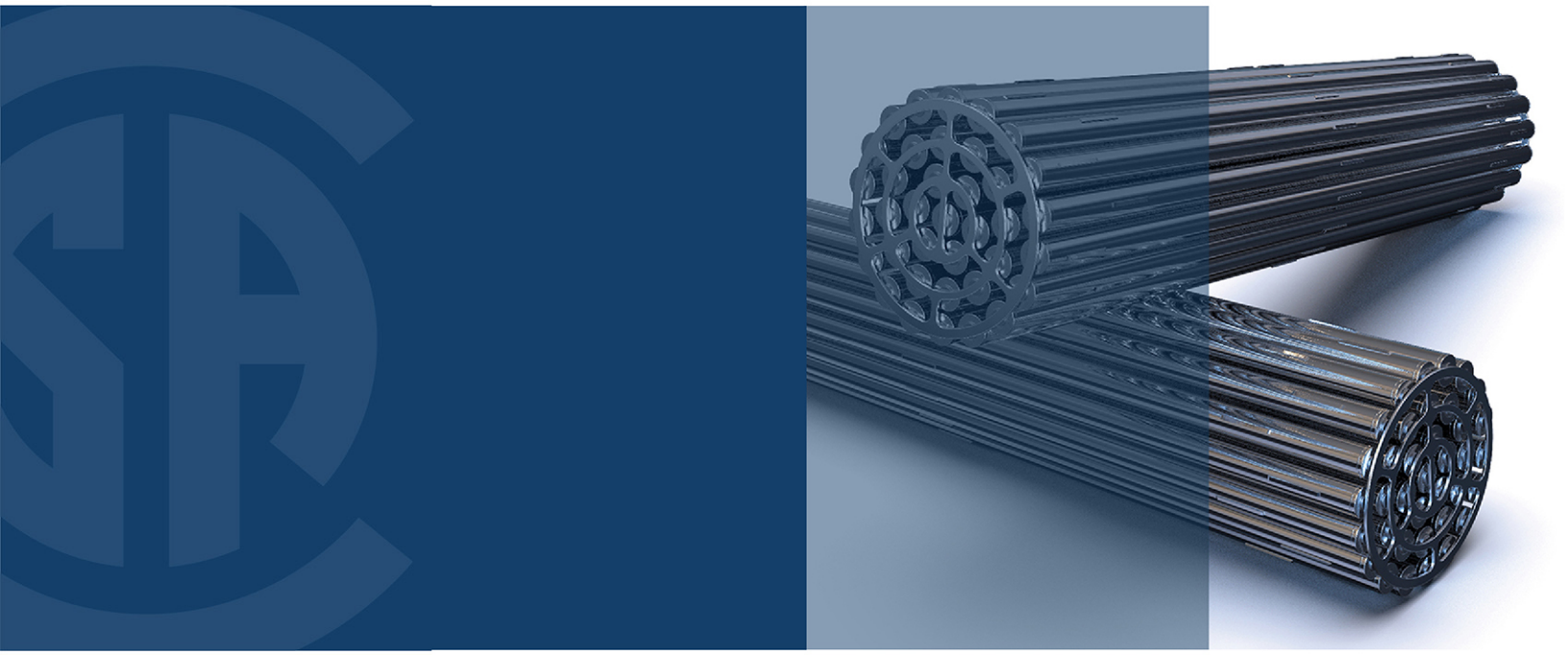
CSA N289.4:22

Testing procedures for seismic qualification of nuclear power plant structures, systems, and components



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Preface

This is the third edition of CSA N289.4, *Testing procedures for seismic qualification of nuclear power plant structures, systems, and components*. It supersedes the previous editions published in 2012 and 1986.

The major changes to this edition include the following:

a) This Standard was re-structured to consolidate all sub-clauses for the following topics: purchaser's scope, testing lab's scope, testing methods, and documentation.
b) The distinction of proof vs. fragility testing was elaborated and enhanced guidance was provided to remove any ambiguity.
c) More explanation was added on the differences between required response spectrum, test response spectrum, required input motion, and table input motion.
d) Requirements related to the disposition of the anomalies found during seismic testing were elaborated.
e) The requirements on seismic aging prior to the seismic testing was made consistent with international practice.
f) Application of the static side load as one of the methods of testing was elaborated.
g) Annex F was improved by clarifying several aspects, such as
    i) affidavit replaced by engineer's certification;
    ii) introduction of separate tables for Category A & B valves;
    iii) relief valves separated from other valves;
    iv) a comprehensive list of available methods of seismic qualification;
    v) clarity on use of side load testing; and
    vi) clarity regarding hard mounted and line mounted components, including definitions of these terms.
h) The previous Annexes D and E have been combined into one Annex (now Annex D).

Standards in the CSA N289 Series of Standards were initiated in response to the recognition on the part of the utilities and industries concerned with nuclear facilities in Canada of a need for consistent standards for seismic design and qualification of nuclear structures, systems, and components (SSCs) of nuclear power plants. Users of this Standard should recognize that it has the force of law only when adopted by the Canadian Nuclear Safety Commission (CNSC) or the appropriate authority having jurisdiction (in countries other than Canada).

The purpose of this Standard is to provide a basis for the development of specifications for seismic qualification by testing, and to aid purchasers, suppliers, and testing laboratories in selecting the appropriate test method(s) for performing acceptable seismic qualification tests that meet a quality and standard commensurate with the safety principles necessary to comply with the Canadian nuclear safety philosophy.

The CSA N289 Series consists of five separate Standards. Some of the objectives of each Standard are summarized as follows:

a) N289.1-18, *General requirements for seismic design and qualification of nuclear power plants*, provides guidelines for identifying structures and systems requiring seismic qualification based on nuclear safety considerations;
b) N289.2:21, *Ground motion determination for seismic qualification of nuclear power plants*, determines the appropriate seismic ground motion parameters for a particular site;

c) N289.3:20, *Design procedures for seismic qualification of nuclear power plants*, provides design requirements, criteria, and methods of analysis for:
   i) determining the design response spectra and ground motion time-histories to be used in the analysis;
   ii) establishing design criteria for structures, systems and components (SSCs), and supports that require seismic qualification; and
   iii) performing seismic analyses, including the effects of the soil-structure-interaction;
d) N289.4:22, *Testing procedures for seismic qualification of nuclear power plant structures, systems, and components*, provides design requirements and methods for seismic qualification of specific components and systems by testing methods; and
e) N289.5-12, *Seismic instrumentation requirements for nuclear reactors and nuclear facilities*, establishes the requirements for seismic instrumentation and for seismic-related inspection of structures and systems before and after a seismic event.

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 can provide more specific direction for those requirements.

Users of this Standard are reminded that the design, manufacture, construction, commissioning, operation, and decommissioning of nuclear facilities in Canada are subject to the provisions of the *Nuclear Safety and Control Act* and its Regulations. The Canadian Nuclear Safety Commission (CNSC) can therefore impose additional requirements to those specified in this Standard.

This Standard was prepared by the Subcommittee on Testing Procedures for Seismic Qualification of Nuclear Power Plant Structures, Systems, and Components, under the jurisdiction of the Technical Committee on Seismic Design for Nuclear Power Plants 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*
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   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:*
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   b) *relevant clause, table, and/or figure number;*

c) *wording of the proposed change; and*
d) *rationale for the change.*

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Testing procedures for seismic qualification of nuclear power plant structures, systems, and components

1 Scope

1.1 Structures, systems, and components requiring seismic qualification

This Standard defines the processes and requirements for performing seismic qualification by testing and presents the test methods, and related content as applicable, that may be used for the seismic qualification of the nuclear power plant structures, systems, and components (SSCs). Seismic qualification by testing is typically used for SSCs that will be performing both an active function and that are required to change state during or following a seismic event in order to perform a safety function, while maintaining structural and/or pressure-boundary integrity or seismic category B per CSA N289.1, Clause 5.2.5.2. Seismic testing can identify contact chatter or unauthorized change of state of contact in electrical and I&C components during seismic excitation.

Notes:

1) *Clause 5.3 of CSA N289.1 specifies acceptable seismic qualification methodologies, including qualification by analysis, testing, or a combination thereof and qualification by similarity, depending on the nature and complexity of the SSC.*
2) *Some mechanical and electrical components are inherently seismically rugged (see Clause 5.3.1.5 of CSA N289.1 or Clause D.6 of this Standard) and do not need to be tested to demonstrate seismic capability.*
3) *Seismic categories are defined in CSA N289.1, Clause 5.2.3.*

1.2 Specification development

This Standard is intended to provide a basis for developing specifications for seismic qualification of SSCs by testing, or by a combination of analysis and testing, and to aid component purchasers, suppliers, and testing laboratories in selecting the appropriate test method(s) for performing a seismic qualification test. The specification provides the basis for the development of the test plan by the testing laboratory.

1.3 Acceptable test methods

This Standard presents several acceptable test methods with the intent of permitting the user to make a judicious selection from among the various options. In making such a selection, the user of this Standard should choose those test methods that best recognize the characteristics of a particular SSC and the seismic environment under which it is required to perform its function.

Notes:

1) *It should be recognized that seismic qualification forms only a portion of the overall equipment qualification program. It is important that the qualification program for a component include consideration of all operational loadings and conditions (e.g., seismic, environmental, aging impact, thermal and mechanical stresses, deformation, etc.) for which the component must demonstrably meet its SSC functionality objectives.*
2) *Tests performed in accordance with the requirements of IEEE/IEC 60980-344 and which satisfy the test specification written as per CSA N289.4 may be considered acceptable.*