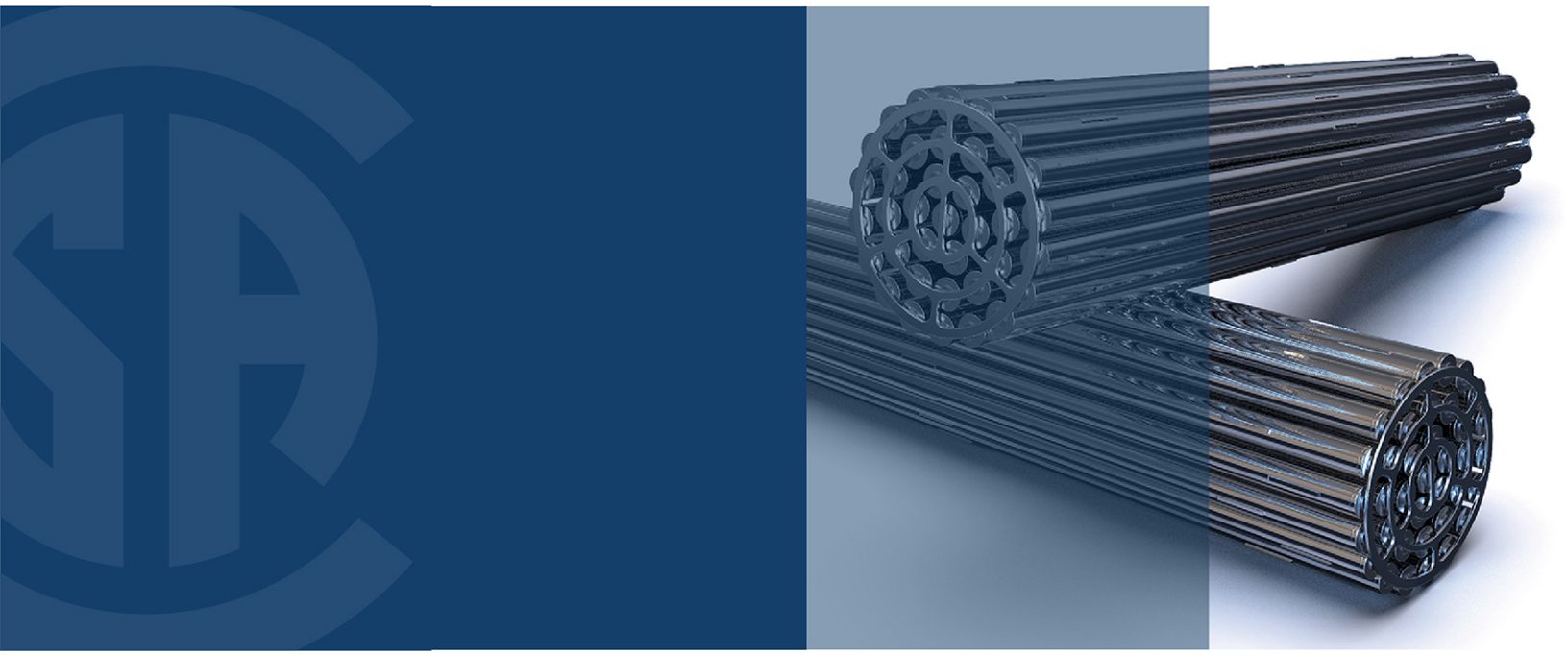
CSA N289.2:10
(reaffirmed 2020)

Ground motion determination for seismic qualification of nuclear power plants



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Preface

This is the second edition of CSA N289.2, *Ground motion determination for seismic qualification of nuclear power plants*. It supersedes the previous edition, published in 1981 under the title *Ground Motion Determination 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.

Note: *CANDU (CANada Deuterium Uranium) is a registered trademark of Atomic Energy of Canada Limited (AECL).*

Standards in the CSA N289 series of Standards are developed in response to a recognition by the utilities and industries concerned with nuclear facilities in Canada of a need for the documentation of standards applicable to the seismic design and qualification of nuclear structures, systems, and components (SSCs) of nuclear power plants. Although the CSA N289 series of Standards includes regulatory requirements in addition to those of a technical nature, 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 regulatory body (in countries other than Canada).

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

(a) CSA N289.1-08, *General requirements for seismic design and qualification of CANDU nuclear power plants* — to provide guidelines for identifying structures and systems requiring seismic qualification based on nuclear safety considerations;

(b) CSA N289.2-10, *Ground motion determination for seismic qualification of nuclear power plants* — to determine the appropriate seismic ground motion parameters for a particular site;

(c) CSA N289.3-10, *Design procedures for seismic qualification of nuclear power plants* — to provide design requirements and methods
   (i) for determining the engineering representation of ground motion, ground response spectra, and floor response spectra for use in the design and seismic qualification of SSCs; and
   (ii) for performing seismic qualification of specified SSCs by analytical methods;

(d) CSA CAN3-N289.4-M86 (R2008), *Testing procedures for seismic qualification of CANDU nuclear power plants* — to provide design requirements and methods for seismic qualification of specific components and systems by testing methods; and

(e) CAN/CSA-N289.5-M91 (R2008), *Seismic instrumentation requirements for CANDU nuclear power plants* — to establish the requirements for seismic instrumentation and for seismic-related inspection of structures and systems before and after a seismic event.

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. Thus, requirements additional to those specified in this Standard may be imposed by the CNSC.

This Standard was prepared by the Subcommittee on Ground Motion Determination for Seismic 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.

May 2010

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 publication 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 publication.*

(4) *CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.*

(5) *All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.*

Requests for interpretation should

(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) be phrased where possible to permit a specific "yes" or "no" answer.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are published in CSA's periodical* Info Update*, which is available on the CSA Web site at www.csa.ca.*

N289.2-10
Ground motion determination for seismic qualification of nuclear power plants

0 Introduction

Determination of ground shaking hazard involves the following:

(a) geological and seismological investigations performed for site, site vicinity, and region;
(b) development of seismic source models;
(c) evaluation of seismogenic potential;
(d) development of earthquake recurrence models;
(e) evaluation of maximum potential earthquake;
(f) development or adoption of ground motion prediction equations;
(g) execution of a probabilistic seismic hazard assessment;
(h) generation of uniform hazard response spectra;
(i) development of scenario earthquakes;
(j) evaluation of seismic hazard uncertainties; and
(k) evaluation of seismically induced phenomena (tsunami, seiche, volcanism, slope instability, surface faults, surface instability, and dam failures) to be accommodated by nuclear power plant siting and design.

Notes:

(1) *Figure 1 is a flowchart outlining the ground motion determination process and the investigation of seismically induced phenomena.*

(2) *In this edition of the Standard, a procedure for the determination of seismic ground motion is described that is generally compatible with procedures described in similar guides (e.g., IAEA Safety Standards Series No. NS-G-3.3) and codes of other countries. The recommended procedures described in Annex A may be replaced by other procedures, provided they are based on an equivalent interpretation of the seismotectonics of the region and provided they include sufficient information to estimate the uncertainties associated with the derived seismic ground motion.*

1 Scope

1.1

This Standard describes the investigations required to obtain the seismological and geological information necessary to determine, for a proposed or existing nuclear power plant site, the seismic ground motion that will be used in seismic qualification of safety-related plant structures and systems, and the potential for seismically induced phenomena that can have a direct or indirect effect on plant safety or operation.

Note: *CSA N289.2 establishes the basis for a family of seismic hazard results that can be used as input to CSA N289.3. CSA N289.2 does not specify*

(a) ground motion parameters to be used in design;
(b) probability level; or
(c) degree of confidence to be achieved.

1.2

This Standard was developed for the determination of ground motions for regions of low to moderate seismic hazard, comparable to the levels near Canada's existing nuclear power plants. In regions of higher seismic hazard, the assessment of strong earthquake shaking can be more complex due to near-fault and