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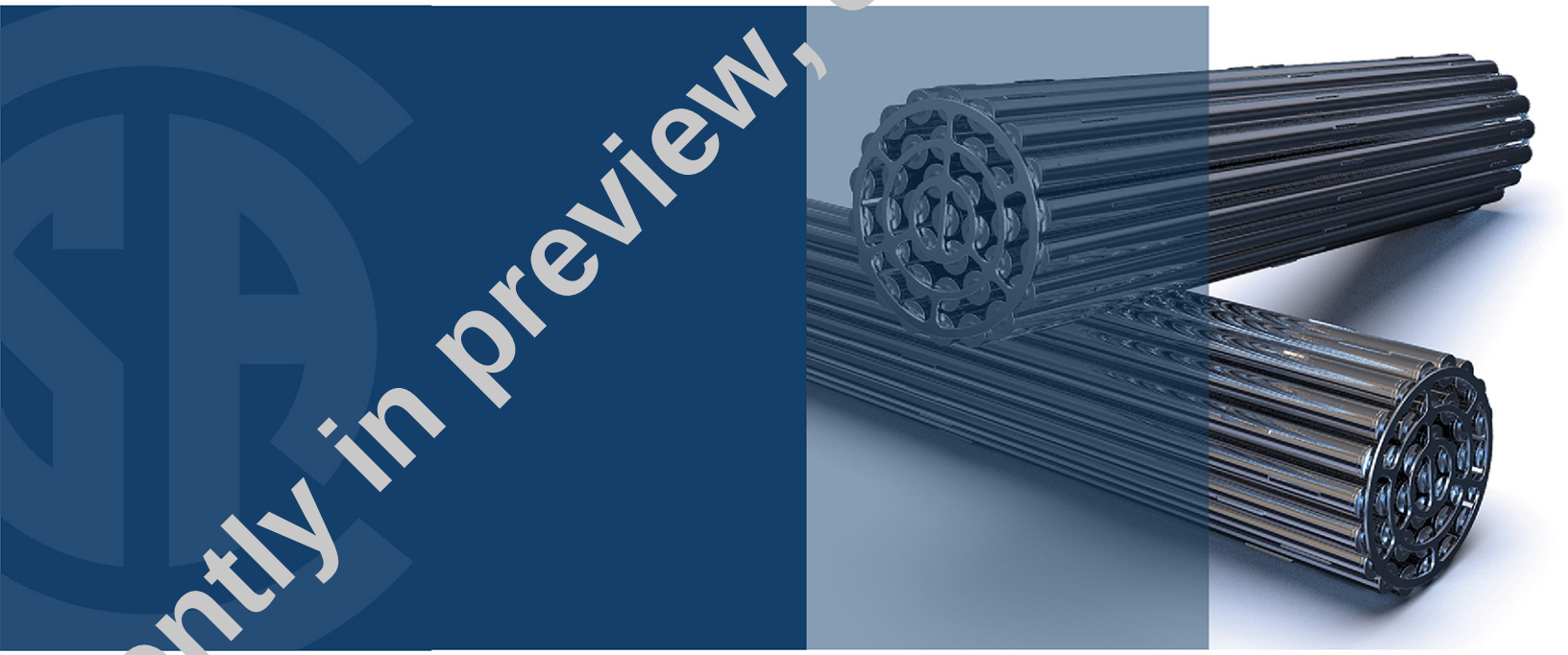
N285.8-15
(reaffirmed 2020)

Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors



REVISED OCTOBER 2019

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Revision History

N285.8-15, Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors

Update No. 1 — October 2019	Revision symbol (in margin)
Clauses 3.1, 4.3, 4.3.1, 4.3.2.1, 7.1.1, 7.1.5, 7.1.6, 7.3.1, 7.4.3.2, 7.4.3.3, A.2.1, A.2.2.1, A.2.2.2.1, A.2.2.2.3.1, A.2.2.2.4, A.2.3.1, B.2.2.2.5, B.2.2.3.3.4, C.1.3, C.3.2.3.4, C.3.3.4, C.3.3.4.3, D.5.3.2.2, D.13.2.3, and D.13.2.3.1 Annexes F and G Tables 1, C.1, D.26, D.27, and D.28 Figures A.30, A.31, and A.32	①

Errata — July 2016	Revision symbol (in margin)
Clauses A.2.3.2.4 and B.2.2.2.5 Table D.22	Δ

Errata — January 2016	Revision symbol (in margin)
Clauses D.5.4.1 and D.8.2 Table C.1	Δ

Standards Update Service

N285.8-15
July 2015

Title: *Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors*

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N285.8-15
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Published in July 2015 by CSA Group
A not-for-profit private sector organization
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3

To purchase standards and related publications, visit our Online Store at store.csagroup.org or call toll-free 1-800-463-6727 or 416-747-4044.

ISBN 978-1-77139-908-1

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Preface

This is the third edition of CSA N285.8, *Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors*. It supersedes the previous editions, published in 2010 and 2005.

This Standard specifies mandatory technical requirements and non-mandatory evaluation procedures for fitness-for-service assessments. Pressure tubes in Canadian CANDU® nuclear power plants are inspected in accordance with CSA N285.4, *Periodic inspection of CANDU nuclear power plant components*. When a detected flaw indication does not satisfy the criteria of acceptance by examination, or when pressure tube to calandria tube contact is detected or predicted, Clause 12 of CSA N285.4 permits a fitness-for-service assessment to determine acceptability. Also, Clause 12 of CSA N285.4 requires evaluation of the results of specified material property surveillance measurements.

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

This Standard is one of a series of CSA N285 Standards that provide consistent rules for the design, fabrication, installation, inspection, and assessment of pressure-retaining systems and components in CANDU nuclear power plants. The series outlines requirements that are particularly applicable to nuclear power plants in Canada and references the appropriate requirements of the ASME *Boiler and Pressure Vessel Code*. Users of this Standard are reminded that the site selection, design, manufacture, construction, installation, commissioning, operation, and decommissioning of nuclear facilities in Canada are subject to the *Nuclear Safety and Control Act* and its Regulations. The Canadian Nuclear Safety Commission might impose additional requirements to those specified in this Standard.

The CSA N-Series of Standards provides 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.

This Standard consists of a mandatory main body and five non-mandatory annexes. The main body contains the mandatory rules and acceptance criteria for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors. The non-mandatory annexes are as follows:

- Annex A — Procedures for the evaluation of pressure tube flaws;
- Annex B — Procedures for the evaluation of pressure tube to calandria tube contact;
- Annex C — Procedures for the assessment of a reactor core;
- Annex D — Material properties and derived quantities; and
- Annex E — Notification of in-service evaluation form.

Annexes A to C contain evaluation procedures that may be used to demonstrate compliance with the acceptance criteria in the main body of the Standard. Annex D contains the material properties and derived quantities that are required when performing an evaluation in accordance with Annexes A to C. Annex E contains a form for providing notification of the evaluation to the authority having jurisdiction (AHJ).

This Standard assumes that the typical evaluation process consists of

a) pressure tube inspection;
b) evaluation of the inspection results;
c) documentation of the inspection results and evaluation;

d) notification of the AHJ regarding the inspection and evaluation; and
e) acceptance by the AHJ of the disposition of pressure tubes prior to returning the reactor to service.

This Standard is based in part on fitness-for-service guidelines developed by a Technical Task Team formed by the CANDU Owners Group (COG).

This Standard was prepared by the Subcommittee on Technical Requirements for In-Service Evaluation of Zirconium Alloy Pressure Tubes in CANDU Reactors, under the jurisdiction of the Technical Committee on Periodic Inspection of CANDU Nuclear Power Plant Components 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****.*
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   a) *Standard designation (number);*
   b) *relevant clause, table, and/or figure number;*
   c) *wording of the proposed change; and*
   d) *rationale for the change.*

N285.8-15
Technical requirements for in-service evaluation of zirconium alloy pressure tubes in CANDU reactors

1 Scope

1.1
This Standard specifies the technical requirements for the owner/operator to ensure structural integrity of cold-worked Zr-2.5 wt% Nb alloy pressure tubes in operating CANDU reactors. Clause 13 of CSA N285.0/N285.6 Series requires that when in-service inspection results or material surveillance results do not satisfy the requirements of the original inspection program, a fitness-for-service evaluation must be performed in accordance with CSA N285.4 to demonstrate acceptance. The requirements of this Standard address the specific fitness-for-service evaluation requirements of CSA N285.4, Clause 12.

1.2
This Standard applies only to cold-worked Zr-2.5 wt% Nb alloy pressure tubes in operating CANDU reactors and to evaluation of the volumetric inspection results, pressure tube to calandria tube contact, and material surveillance measurements listed herein. The definition of pressure tube material types is provided in CSA N285.0/N285.6 Series.

1.3
This Standard does not apply to evaluation of pressure tube dimensional changes (other than pressure tube to calandria tube contact), material property surveillance measurements beyond those defined in CSA N285.4, or to other reactor types. This Standard does not apply to pressure tube materials other than cold-worked Zr-2.5 wt% Nb.

1.4
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 (non-mandatory) to define their application.