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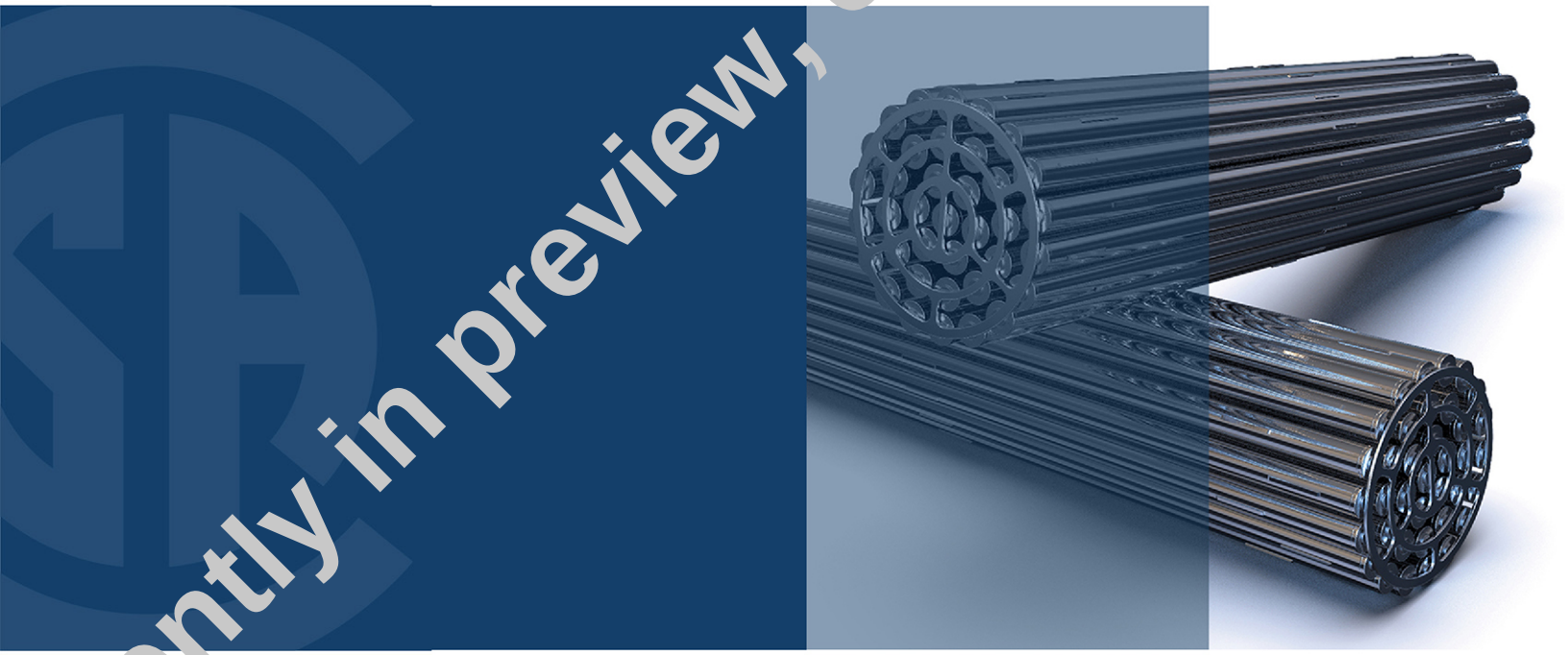
CSA N288.1:14
(reaffirmed 2019)

Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities



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Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities

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Preface

This is the third edition of CSA N288.1, *Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities.* It supersedes the previous editions published in 2008 and 1987.

This edition has been updated to provide improved direction on the applicability of the Guideline. Major changes to this edition include

(a) updates to the following:
  (i) energy expenditures and dietary intake rates for humans;
  (ii) half-lives, gamma energies, and photon yields for all radionuclides;
  (iii) values for many parameters based largely on a new International Atomic Energy Agency (IAEA) handbook of parameter values (IAEA, 2010);
  (iv) wind direction and precipitation data for use in the wet deposition model; and
  (v) specific activity model for tritium in animals;
(b) introduction of a model for wild waterfowl as an additional source of human exposure through ingestion;
(c) extension of the C-14 specific activity model to cover plant to animal transfer;
(d) provision of equations for explicit accounting of decay and ingrowth in all physical media; and
(e) improved direction on when the Guideline can be used to calculate derived release limits (DRLs) for intermittent releases.

Users of this Guideline 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.

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 Guideline 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 Guideline was prepared by the Subcommittee on Derived Release Limits for Radioactivity in Effluents for Normal Operation, under the jurisdiction of the Technical Committee on Environmental Management and the Nuclear Strategic Steering Committee, 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 Guideline is stated in its Scope, it is important to note that it remains the responsibility of the users of the Guideline to judge its suitability for their particular purpose.*

(3) *This Guideline 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 Guideline.*

(4) *To submit a request for interpretation of this Guideline, 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 Guideline is subject to review 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) Guideline designation (number);
(b) relevant clause, table, and/or figure number;
(c) wording of the proposed change; and
(d) rationale for the change.

N288.1-14
Guidelines for calculating derived release limits for radioactive material in airborne and liquid effluents for normal operation of nuclear facilities

0 Introduction

0.1 Derived release limit (DRL)

The DRL for a given radionuclide is the release rate that would cause an individual of the most highly exposed group to receive and be committed to a dose equal to the regulatory annual dose limit due to release of the radionuclide to air or surface water during normal operation of a nuclear facility over the period of a calendar year. The DRL is derived using mathematical equations that describe the transfer of radioactive materials through the environment to humans. It takes into account all exposure pathways, including external exposure from immersion in contaminated air and water, external exposure to contaminated soil and beaches, and internal exposure from inhalation and ingestion of radioactivity. DRLs are normally used in a prospective sense to set release limits for individual radionuclides, but the pathways model described in this Guideline may be adapted for other purposes such as the estimation of annual public doses.

0.2 History of the Guideline

In 1987, CSA Group published CSA N288.1 to provide guidelines and a methodology for calculating DRLs for routine releases of radionuclides to air and surface water from nuclear facilities. Since 1987, significant scientific advances were made in dosimetry and in the understanding of radionuclide behaviour in the environment; thus, there was a general consensus in the Canadian nuclear industry that the models and data in CSA N288.1 needed to be updated. Revision began in 2000 with the development of a derived release limits guidance document prepared for Ontario Power Generation (OPG). This document was specifically designed to calculate DRLs at CANDU® nuclear power generation facilities in southern Ontario (i.e., the Bruce, Pickering, and Darlington stations). In 2006, the document was extended by the CANDU Owners Group (COG) to cover all CANDU facilities in Canada, including the power generation stations at Gentilly (G-2) and Point Lepreau and the research laboratories at Chalk River (CRL). This extended document (Hart, 2008) formed the basis for the second edition of this Guideline and included background material deemed too detailed for inclusion in the Guideline itself. Most of the models and parameter values in the first edition of the Guideline were updated and new exposure pathways were added in producing the second edition, which was issued in 2008. Following publication, users of the Guideline identified a number of minor errors, which were corrected in an amendment issued in July 2011.

0.3 Need for a new edition

Due to lack of time, resources, and information, it was not possible during the development of the second edition to implement all of the changes that were deemed desirable. These changes were set aside so that the second edition could be published in a timely fashion. Work on these changes has continued since through a number of research projects funded by COG. The findings of these projects form the basis for most of the improvements to the third edition. The COG background document (Hart, 2008) was revised

in concert with the third edition; the updated version is referred to hereafter as the COG *Derived Release Limits Guidance* or CDG (Hart, 2013).

0.4 Changes in this edition

The major differences between this and the previous edition of this Guideline include

(a) updated energy expenditures and dietary intake rates for humans;
(b) updated half-lives, gamma energies, and photon yields for all radionuclides;
(c) updated values for many parameters based largely on a new International Atomic Energy Agency handbook of parameter values for environmental transfers of radionuclides (IAEA, 2010);
(d) improved direction on when the Guideline can be used to calculate DRLs for intermittent releases;
(e) updated wind direction and precipitation data for use in the wet deposition model;
(f) introduction of a model for wild waterfowl as an additional source of human exposure through ingestion;
(g) extension of the carbon-14 (C-14) specific activity model to cover plant to animal transfer;
(h) an improved specific activity model for tritium in animals, including an update and extension of the water intake source fractions for fresh and dry feed; and
(i) provision of equations for explicit accounting of decay and progeny ingrowth in all physical media, as an alternative to the use of progeny-inclusive dose coefficients.

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

1 Scope

1.1 Facilities

This Guideline and the CDG are intended to apply primarily to CANDU nuclear power stations in Canada. However, the radionuclides and environmental pathways addressed make this Guideline applicable to releases from many other nuclear facilities, including research reactors, radioisotope processing facilities, waste processing facilities such as incinerators, and power reactors other than those of CANDU design, subject to the limitations detailed in Clauses 1.2 to 1.8. Application to other types of facilities such as fuel fabrication plants and refineries is limited by the radionuclides considered here (see Clause 4.3). This Guideline may be adapted to cover part of the needs of such facilities, but additional models or methodologies might be necessary for other parts. However, neither the radionuclides nor the models included in this Guideline are complete enough to cover releases from sources such as uranium mines and mills, permanent geologic disposal facilities, and other facilities where extensive modelling of groundwater pathways is required.

1.2 Release paths

This Guideline covers releases to the atmosphere and to surface water (both fresh and marine). It does not address releases to groundwater, although transfers from other media to groundwater wells and ponds are considered. Direct gamma irradiation from radioactivity inside the facility is not modelled because it does not involve a release.

1.3 Release duration

The methods specified in this Guideline are designed for routine, continuous, low-level emissions. They also apply to periodic, short-term releases (see Clause 8.2), provided that

(a) the releases are controlled and associated with normal operations;
(b) the release rate is roughly the same from event to event;
(c) for atmospheric releases, the total release duration exceeds approximately 1000 h in the year; for aquatic releases, at least one or two releases occur in each month of the year; and
(d) the releases occur randomly over time.

Where the requirement of Item (d) is not met but the releases are known to occur at a particular time of day or year, this Guideline applies only if the air (water) concentrations are calculated using the meteorological (hydrological) data in effect for that time.