



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 3, 2021

MEMORANDUM TO: Louise Lund, Director
Division of Engineering
Office of Nuclear Regulatory Research

A handwritten signature in cursive script, appearing to read "Gregory Bowman".

Bowman, Gregory signing on behalf of Franovich, Michael on 04/27/21

Division of Risk Assessment
Office of Nuclear Reactor Regulation

SUBJECT: RESULTS OF PERIODIC REVIEW OF REGULATORY GUIDE
1.109

This memorandum documents the U.S. Nuclear Regulatory Commission (NRC) staff's periodic review of Regulatory Guide (RG) 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with Title 10 of the *Code of Federal Regulations* Part 50, Appendix I."

This RG, issued in 1977, provides guidance for calculating radiation doses from normal routine radioactive effluents from licensed nuclear power plant operations under annual average environmental conditions. As discussed in Management Directive 6.6, "Regulatory Guides," the staff reviews RGs periodically to ensure that the RGs continue to provide useful guidance. Documentation of the staff's periodic review is enclosed.

Based on the results of the staff's periodic review enclosed, the staff concludes that changes to RG 1.109, Revision 1 are warranted at this time. A revision to the RG could benefit current reactor licensees and new reactor applicants.

CONTACT: Richard Clement, NRR/DRA/ARCB
301-415-1988

Enclosure:
As stated

SUBJECT: RESULTS OF PERIODIC REVIEW OF REGULATORY GUIDE 1.109
DATED: 5/03/2021

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DATE	4/30/2021	5/03/2021		

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REGULATORY GUIDE PERIODIC REVIEW

Regulatory Guide Number: 1.109, Revision 1

Title: Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix I

Office/division/branch: NRR/DRA/ARCB
Technical Lead: Richard Clement

Staff Action Decided: Revise

1. What are the known technical or regulatory issues with the current version of the Regulatory Guide (RG)?

This RG, issued in 1977, provides an acceptable method to calculate radiation doses from normal routine radioactive effluents from licensed nuclear power plant operations under annual average environmental conditions. This RG also demonstrates compliance with the design objectives specified in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion As Low As is Reasonably Achievable (ALARA) for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents." However, as this RG has not been updated since 1977, several improvements could be made.

The dose methodology and terminology used in RG 1.109, Revision 1, and the ALARA design objectives in 10 CFR Part 50, Appendix I, are based on recommendations from the International Commission on Radiological Protection (ICRP) Publication 2 (ICRP-2), "Permissible Dose for Internal Radiation," issued in 1959. However, 10 CFR Part 20, "Standards for Protection Against Radiation," revised in 1991, is based on ICRP-26, "The System of Dose Limitation," issued in 1977, and the ICRP-30 series, "Limits for Intakes of Radionuclides by Workers," issued from 1979 through 1988. The ICRP-2 dose assessment methodology is not directly comparable with ICRP-26 and ICRP-30.

As such, the staff has incorporated references to the latest versions of the XOQDOQ, LADTAP II (as LADTAP), and GASPAR II (as GASPAR) computer codes in the updated NRC Dose3 computer code which are reflected in a NUREG for the NRC Dose3 Code User Guide and Technical Manual included in the installation program and proposes to reflect these conforming changes in the RG update for licensee and applicant use. This RG update would also incorporate references to coding corrections and published errata, non-human biota dose calculations from gaseous effluents, and new reactor licensing lessons learned. An expanded radionuclide listing with ICRP-2, ICRP-26, ICRP-30, and ICRP-72 dose factors and recent parameter values which are available for use in the NRC Dose3 code would be reflected in revised RG 1.109 tables. In addition, the staff will be adding a discussion with equations to assess the recreational boating and swimming exposure pathway from liquid effluents.

Enclosure

2. What is the impact on internal and external stakeholders of not updating the RG for the known issues, in terms of anticipated numbers of licensing and inspection activities over the next several years?

The primary use of this RG is for reactor licensing and implementing operational programs. There is little or no impact on internal or external stakeholders of not updating RG 1.109, Revision 1, for large light-water reactors (LWRs) since the staff is not expecting any applications in the near future; instead, small modular reactor (SMR) and advanced reactor design applications are anticipated. As with large LWRs, the proposed RG update would also provide guidance to assess exposure pathway doses for SMR and advanced reactor designs.

In general, the calculation models, assumptions, parameter values, and methods for assessing the exposure pathway doses in RG 1.109, Revision 1, are adequate and conservative. However, revising the RG may assist new applicants and current licensees to perform more accurate dose calculations, may assist inspectors in determining if regulatory requirements are being adequately implemented, and may improve the effectiveness and efficiency in NRC's licensing process.

3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contractor resources?

An estimate of the effort needed to review relevant technical and regulatory issues of this RG is 1 FTE. This work can be performed by the staff without the need for contract support.

4. Based on the answers to the questions above, what is the staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?

Revise

5. Provide a conceptual plan and timeframe to address the issues identified during the review.

The staff has developed a NUREG on the NRC Dose3 Code User Guide and Technical Manual included in the code installation program reflecting the updates to the code that incorporate a licensee's or applicant's proposed use of other ICRP dose methodologies. The NRC Dose3 code is distributed by the NRC Radiation Protection Computer Code Analysis and Maintenance Program (RAMP) at <https://ramp.nrc-gateway.gov/>. The staff will update the RG to reflect the dose models, dose coefficients, parameter values, and changes implemented in the NRC Dose3 code and NUREG User Guide and Technical Manual. The staff plans to develop a draft revision of this RG by April 2023 and issue it for public comment by the end of FY 2023.

NOTE: This review was conducted in April 2021 and reflects the staff's plans as of that date. These plans are tentative and are subject to change.