SUMMARY OF REVISIONS

In 2023, the Environmental Science Division at Argonne National Laboratory (ANL) published a report, *ANL-23/37*, summarizing a review of FGR 15 conducted as part of a quality assurance effort related to the RESRAD suite of codes (Gnanapragasam et al., 2023). In response to *ANL-23/37*, the Center for Radiation Protection Knowledge (CRPK) at Oak Ridge National Laboratory (ORNL) performed a thorough review of FGR 15 external dose rate coefficients. This entailed review of intended methods, Monte Carlo simulations, tissue equivalent dose rate coefficients for exposure to monoenergetic photons, bremsstrahlung spectra calculations, and radionuclide-specific dose rate coefficients. As a result of this review, CRPK recalculated all FGR 15 tissue equivalent and effective dose rate coefficients for both monoenergetic and radionuclide-specific sources using the intended methodology. The following revisions were made:

- Calculation of dose rate due to bremsstrahlung was corrected for the air submersion and soil contamination scenarios.
- Representation of adult female with the 15-y-old hermaphrodite phantom was applied consistently across all exposure scenarios.
- Methods for calculating bone surface and red marrow equivalent dose rate coefficients from exposure to monoenergetic photons were applied consistently across all exposure scenarios.
- Calculation of lung dose rates from monoenergetic photons sources in water with energies less than 30 keV was corrected.
- The number of histories run in Monte Carlo simulations were increased to obtain lower statistical uncertainty.
- Monte Carlo results were not smoothed (with respect to age or energy) for development of monoenergetic dose rate coefficients.
- Salivary glands, rather than lungs, are now used as a surrogate for the extrathoracic region to improve dose estimates.

Detailed explanation of the review can be found in ORNL/SPR-2025/3803, *2025 Review and Revision of Federal Guidance Report 15* (Samuels and Leggett, 2025). To reflect these changes, the text of FGR 15 was edited in the following sections:

- Title page: New document number; author list was updated to include Caleigh E. Samuels and Keith F. Eckerman is now listed as last author. Revision Date was updated.
- Preface: Contact information for all comments and suggested revisions was updated.
- Chapter 3, Section 3.2.1: Clarifying edit; closed surface geometry of cylinder was only used for soil sources.
- Chapter 3, Table 3-1: Entries in table were updated (a) to reflect that salivary glands in the phantom were used as a surrogate for the extrathoracic region and (b) to correct a text error that suggested a surrogate tissue was used for the thymus; the thymus was explicitly modeled.
- Chapter 3, Section 3.2.2.6: Clarifying edit in section title; “coupling surface” replaced “cylinder”.
- Chapter 3, Section 3.2.3.2: This paragraph was updated to provide additional details governing the radiation transport methods for estimating absorbed doses and the resulting statistical errors.
- Chapter 3, Section 3.3.1 and Section 3.3.2.3: Clarifying edit; text added to specify geometry of the coupling surface.
- Chapter 3, Section 3.3.3: This paragraph was updated to provide additional details governing the radiation transport methods for estimating absorbed doses and the resulting statistical errors.

- Chapter 3, Section 3.4.2: Additional details added to describe how skeletal dosimetry was performed to derive the dose rate coefficients for bone surface and red marrow.
- Table 4-1: revised dose coefficients for ground surface.
- Table 4-2: revised dose coefficients for soil to 1 cm.
- Table 4-3: revised dose coefficients for soil to 5 cm.
- Table 4-4: revised dose coefficients for soil to 15 cm.
- Table 4-5: revised dose coefficients for soil to infinite depth.
- Table 4-6: revised dose coefficients for air submersion.
- Table 4-7: revised dose coefficients for water immersion.
- Appendix A: Table of radionuclide decay data removed; brief explanation provided.
- Appendix D: Example calculations have been revised with the new dose coefficients values provided in this report.

The 2025 revisions to FGR 15 supersede those implemented in 2019. The 2019 revision of FGR 15 corrected: (1) a coding error which caused an omission of bremsstrahlung emissions for low-energy beta emitting radionuclides in soil; and (2) the use of an interim set of monoenergetic dose coefficients to generate radionuclide-specific dose coefficients for soil. The 2019 text revisions that remain unaltered by the 2025 revisions listed above include:

- Preface and Chapter 1: The following footnote "This also includes cosmic rays that are low linear energy transfer (LET)" was removed from the passage that read: "…radionuclides distributed in air,* water and soil."
- Figure 1-1: Caption text was slightly modified to indicate the comparison between ICRP Publications 60 and 103.
- Chapter 1, Section 1.1, Para. 6: The following sentence, at the end of the paragraph, was removed: "The effective dose coefficients tabulated in this report are sex-averaged per the definition of this quantity in ICRP Publication 103 (2007)."
- Table 2-1 and Section 3.2.2.4: Removal of text indicating that radionuclide-specific dose coefficients for a smooth (0 mm) infinite plane would be available online.
- Chapter 3, Section 3.2.2.3: Section header was changed from, "Ground plane depths" to "Soil depths considered."
- Chapter 5, Section 5.5: The following sentence was added: "However, bremsstrahlung generated as the emitted electrons stop within the soil does contribute to the dose to skin and other tissues."
- Appendix A: equation (A-4) erroneously duplicated equation (A-3). Equation (A-4) now reads as follows:

$$E = A_1^0 \frac{1 - e^{-\lambda_1 T}}{\lambda_1} \sum_{i=1}^{n} e_{E,i}^{gs} \prod_{j=1}^{i-1} f_{j,j+1}$$

- Appendix A: Removal of text indicating that characteristic gamma emissions for 1,252 radionuclides would be available online.

The dose coefficients in this report—as well as the methods used to generate them—went through a rigorous and comprehensive review. If you have questions or would like further information, please contact radiation.questions@epa.gov.