

Update to the NRC Dose3 Code

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Radiological Effluents and Environmental Workshop

June 28, 2022

Savannah, GA

ML22167A106



Topics

- What is NRC Dose3?
- What are the NRC and Industry End Uses?
- Why Update NRC Dose3?
- What are the Updates?
- What Documentation Will be Issued and What is the Schedule for Release?

What is NRC Dose3

- NRC endorsed code system for evaluating exposure pathway doses from reactor effluents to demonstrate compliance with 10 CFR Part 20, Appendix I to 10 CFR Part 50, 40 CFR Part 190, and 10 CFR Part 51
- End use for reactor licensing (applicants, licensees, NRC staff) and inspection activities
- Updates the NRC Dose v2.3.20 (CCC-684) code (version no longer maintained)

What is NRC Dose3 (Cont'd)

- Graphical user interface (GUI) runs industry standard codes (with updates):
 - LADTAP II (NUREG/CR-4013, RSICC CCC-363)
 - GASPAR II (NUREG/CR-4653, RSICC CCC-463)
 - XOQDOQ (NUREG/CR-2919, RSICC CCC-316)
- NRC guidance:
 - RG 1.109 - exposure pathway dose calculations (ML003740384)
 - RG 1.111 - atmospheric transport and dispersion (ML003740354)
 - RG 1.113 - aquatic transport and dispersion (ML003740390)

NRC and Industry End Uses



- NRC licensing reviews
 - Design Certification, Combined License, and Early Site Permit Applications
 - License Amendment Requests
- NRC health physics reactor inspections
 - Independent assessment of potential doses from routine and accidental effluent releases
 - Independent assessment of Offsite Dose Calculation Manual (ODCM) dose conversion factors (DCFs) and effluent dose calculations

NRC and Industry End Uses (Cont'd)

- Calculate doses at locations of interest other than ODCM
 - Evaluate Land Use Census
 - Public interest
- Annual dose assessments
 - Actual river flows and dilutions
 - Meteorology with effluents for evaluated year
- ODCM DCFs

Why Update to NRC Dose3



- There is a need for a licensing tool to support reactor application submittals
- Provides an acceptable method for evaluating exposure pathway doses from reactor effluents
- Improves efficiency in reactor licensing process, and NRC safety and environmental reviews

Overview of Updates

- Improved functionality
 - Updated Windows interface
- User modifiable parameter values
 - Bioaccumulation factors
 - Consumption rates
 - Usage factors
 - Other parameters
- Options for ICRP-2, ICRP-30, and ICRP-72 DCFs

Overview of Updates (Cont'd)

– Dose Conversion Factors (DCFs)

- ICRP-2 DCFs compiled from latest updates:
 - RG 1.109, Revision 1, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I* (October 1977)
 - NUREG-0172, *Age Specific Radiation Dose Commitment Factors for One-Year Chronic Intake* (November 1977)
 - NUREG-0172, *Errata* (August 1983)
 - NUREG/CR-2384, *Age Specific Inhalation Radiation Dose Commitment Factors for Selected Radionuclides* (August 1982)
 - EMP-155, *Review and Expansion of USNRC Regulatory Guide 1.109 Models for Computing Dose Conversion Factors* (February 1983)

Overview of Updates (Cont'd)

– DCFs

- ICRP-30 DCFs*
- ICRP-72 DCFs*
- Ingestion DCFs*: Gastrointestinal Absorption Fractions (f1)
- Inhalation DCFs*: Lung Clearance Classes for Chemical Compounds
 - ICRP-30: D/W/Y
 - ICRP-72: F/M/S

*DCF values obtained from Radiological Toolbox, NRC Radiation Protection Computer Code Analysis and Maintenance program (RAMP) at <https://ramp.nrc-gateway.gov/>

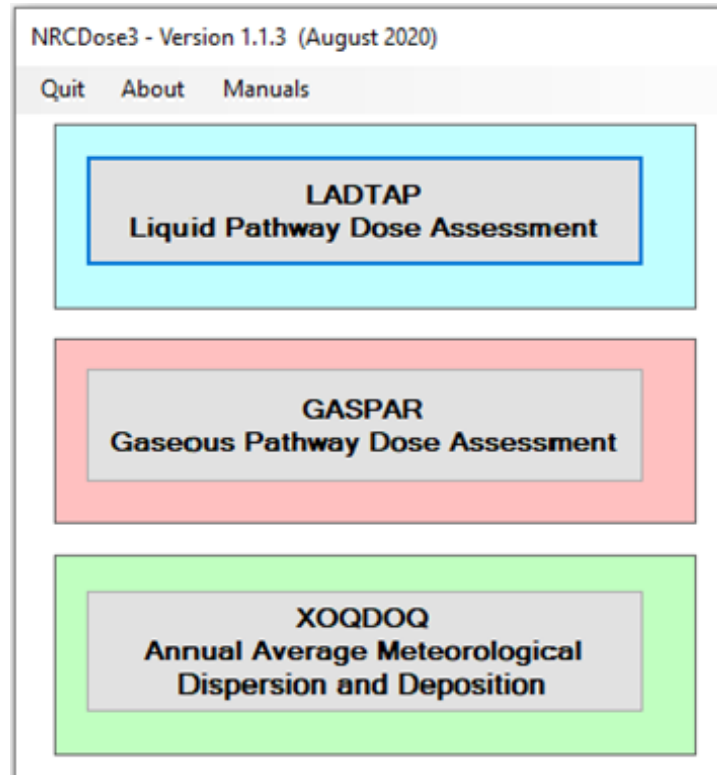
Overview of Updates (Cont'd)

– Biota Dose

- Biota dose added to GASPAR and expanded in LADTAP
- Biota dose calculated at any special location for:
 - LADTAP: algae, muskrat, racoon, duck, heron
 - GASPAR: added cow (herbivore) and fox (carnivore)
 - User defined
- Biota dose based on species mass, effective radius, primary food eaten (produce or meat) and consumption rate

Overview of Updates (Cont'd)

– NRC Dose3 Main Selection Screen



Overview of Updates (Cont'd)

– LADTAP

- Routine liquid effluent releases (RG 1.109)
- Exposure pathways to man: potable water, aquatic foods, shoreline deposits, swimming, boating, and irrigated foods; and to non-human biota (7 surrogate species)
- Pathway (age group, organ) doses to maximum exposed individual (MEI) and population
- Reconcentration models: complete mixing, partial mixing, or plug-flow (RG 1.113)

Overview of Updates (Cont'd)

– GASPAR

- Routine gaseous effluent releases (RG 1.109)
- Meteorological data input from XOQDOQ
- Special locations (MEI doses); standard radial distances and segments (population doses)
- Exposure pathways to person: plume inversion, ground plane, inhalation, vegetation, cow and goat milk, and meat
- External exposure doses to total body and skin (noble gases); ground plane, inhalation, and food pathways (radioiodine and particulates)

Overview of Updates (Cont'd)

– XOQDOQ

- Annual average relative dispersion (X/Q) and deposition (D/Q) values at user specified locations (MEI doses) and various standard radial distances and segments (population doses) for routine releases (RG 1.111)
- Intermittent releases (e.g., containment purge, waste gas tank)
- Elevated, ground level, or mixed mode releases
- Meteorological modeling considerations: building wake effects, plume depletion (dry deposition), and radioactive decay

Overview of Updates (Cont'd)

– XOQDOQ

- Wind direction in 16 compass directions (22.5° sectors), 14 wind speed classes, and 7 atmospheric stability classes (A-G)
- Three different dispersion X/Q values; one deposition D/Q value
 - Undecayed, Undepleted X/Q
 - Decayed, Undepleted X/Q (2.26-day half-life)
 - Decayed, Depleted X/Q (8-day half-life)
 - Deposition D/Q (2.26-day and 8-day half-lives)
- Output used as meteorological data input to GASPAR

Documentation and Release

- NRCDose3 code v1.x (end of 2022)
- NRCDose3 Quick Start Guide v1.x
 - How to install, run, and view output
- Final Draft NUREG on NRCDose3 code: User Guide and Technical Manual
 - Technical basis
- Verification and validation
- Distribution by NRC RAMP*
 - **FREE** with user registration

*NRC RAMP at <https://ramp.nrc-gateway.gov/>

Questions?

10 CFR Part 50, Appendix I, Cost Benefit Analysis Rulemaking

Appendix I – Cost Benefit Analysis

- 10 CFR Part 50, Appendix I, provides numerical design objectives for meeting ALARA in plant effluents.
 - Section II, Paragraph D, currently requires that an applicant include in the radwaste systems all items to ensure that the population dose within 50 miles of the reactor not exceed \$1,000 per total body man-rem and \$1,000 per man-thyroid-rem.

Proposed Rule (Background)

- SRM-SECY-17-0017 – the Commission directed the staff to engage in rulemaking to revise the cost benefit analysis in 10 CFR Part 50, Appendix I, Section II, Paragraph D, consistent with the criteria in NUREG-1530, “Reassessment of NRC’s Dollar Per Person-Rem Conversion Factor Policy,” Revision 1.
 - NUREG-1530, Revision 1, provides an updated dollar per-person-rem value of \$5,200 in 2014 dollars and provides guidance for updating the value based on inflation and real income growth.

Additional Information

- Regulatory Guide (RG) 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors," will also be updated and included with the rule package.
- Considering minor change to include non-LWR commercial power reactors.
- Current schedule is for the proposed rule to be made publicly available for comment in summer or fall of 2023.

Questions?