Response to Public Comments on Draft Regulatory Guide (DG)-8060, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses" Proposed Revision 1 of Regulatory Guide 8.34

On December 17, 2021, the U.S. Nuclear Regulatory Commission (NRC) published a notice in the *Federal Register* (86 FR 71676) announcing that Draft Regulatory Guide (DG)-8060, "Monitoring Criteria and Methods to Calculate Occupational Radiation Doses" (proposed Revision 1 of Regulatory Guide (RG) 8.34), was available for public comment. The public comment period closed on March 2, 2022, and the NRC staff received comments from the Wyoming Department of Environmental Quality (WDEQ), U.S. Navy, Nuclear Energy Institute (NEI), and Wyoming Mining Association (WMA), available in the Agencywide Documents Access and Management System (ADAMS) at the accession numbers given below.

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1	Kyle Wendtland (WDEQ)	In Appendix A, the illustrative example uses Equation A.2 for the demonstration of compliance with the 10 CFR 20.1201(e) limit of 10 mg per week of soluble U-nat compounds (Class D and W). The text states that the licensee may use air sampling data, worker exposure, and assigned respiratory protection factors (APF), however the equation itself does not explicitly reflect the use of the exposure duration. In its current form the equation indicates that the fraction of time in hours that the radiological worker is exposed to radiation is 40 hours (2400 minutes), or one full work week. It is recommended that the equation be updated to include a multiplicative term to account for the duration of exposure, so that it is	Comment accepted. The staff has revised the text and equation to provide exposure time in minutes. The APF is dimensionless and does not have units of milligrams; APF and the breathing rate were already defined in equation A.1 and need not be repeated.

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		more generalized for use with any exposure period. The following suggested formula includes the exposure time in minutes. $$m_{i,U} = \frac{C_i * BR * 0.001 * t}{APF * SA_{i,U}}$$ Where: $m_{i,U}$ = the mass intake of uranium isotope *i* (mg), $SA_{i,U}$ = the specific activity of uranium isotope *i* (Ci/g), *BR* = the breathing rate of "Reference Man" under light work conditions (20,000 ml/minutes), *t* = the exposure duration of time (minutes), *APF* = the respiratory assigned protection factor (mg), 0.001 = a conversion constant that yields the mass intake in (mg)	
2	Kyle Wendtland (WDEQ)	It would be helpful to cite RG 8.9 in Page A-2 under "**Soluble Uranium Intakes**" subsection for the other acceptable methods of uranium intake estimate based on bioassay measurements. Alternatively, expanding the example calculation given in Appendix A of the Draft Guidance to add the use of Intake Retention Fraction (IRF) from NUREG/CR-4884 and using Equation 1 from Section 4.3 of RG 8.9 Rev 1, would be helpful.	Comment accepted. The sentence below was added to the end of the section on soluble uranium intakes: "*Regulatory Guide 8.9 describes acceptable methods for using bioassay measurements to estimate uranium intakes.*"
3	Kyle Wendtland (WDEQ)	Table A-1 should be updated to include the three uranium isotope air concentrations, the Cs-137 and the Ce-144 concentrations used in the calculation of the intakes. In addition, the duration of the worker's exposure duration in minutes and the APF used in the calculation of radionuclide intakes in Table A-1 need to be provided for illustration purposes.	Comment not accepted. Equation A.1 shows the reader how intake is calculated for known values of radionuclide concentration in air, duration of the worker's exposure, and APF. It is not necessary to show hypothetical values for these input parameters in table A-1.
4	Kyle Wendtland (WDEQ)	Under "Committed Effective Dose Equivalent (CEDE)" of Appendix A, there is a typo, the data used in calculating	Comment accepted.

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		CEDE were actually taken from Table A-1 and not from Table A-2 as mentioned in the text.	
5	Kyle Wendtland (WDEQ)	The rounding of the U-234 Specific Activity (SA) value found in Table A-2 is incorrect, the value should be written as: 6.2E-3 (Ci/g) instead of 6.3E-3 (Ci/g).	Comment accepted.
6	Kyle Wendtland (WDEQ)	In Section 4.4.2, a statement is made that would be in an overestimation of the CDE to a specific tissue or organ from the combined contributions from all inhaled or ingested radionuclides. The statement is: *"The CDE for all radionuclides combined is then the sum of the CDE from nonstochastic radionuclides and the CDE from stochastic radionuclides."* The combined dose (i.e., combined CDE) should be the sum of the CDEs using the nonstochastic values (whether each value is the limiting conversion factor or not) for each radionuclide as found in Tables 2.1 and 2.2 in FGR No. 11 for inhalation and ingestion pathways, respectively.	Comment accepted. The statement has been removed.
7	U.S. Navy	Comment 1.1 References: a. ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories b. NIST Handbook 150, NVLAP Procedures and General Requirements c. NIST Handbook 150-4, NVLAP Ionizing Radiation Dosimetry d. ANSI/HPS N13.11:2009, Personnel Dosimetry Performance—Criteria for Testing	Comment 1.1 accepted. References a–e have been added to the bibliography.

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		e. ANSI/HPS N13.32:2008, Performance Testing of Extremity Dosimeter Comment 1.2 Draft of Regulatory Guide DG-8060 states the following on page 14, lines 20–34: *3.7 Dosimeter Processing* *Personnel dosimetry that requires processing must be processed and evaluated by a dosimetry processor holding accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) pursuant to 10 CFR 20.1501(c). The NRC interprets processing to mean a process, separate from and independent of the design of the dosimeter, that is required to extract dose information from the dosimeter after exposure to radiation. For example, film dosimeters, thermoluminescent dosimeters, and optically stimulated luminescence dosimeters, require processing by qualified technicians using separate equipment to obtain data to compute the dose measurement.* *Conversely, dose measurements obtained from electronic dosimeters or digital output personnel dosimeters (e.g., direct ion storage dosimeters) do not require processing since the data is extracted directly from the dosimeter (i.e., through a process independent of dosimeter processing). Therefore, since processing is not required for this type of dosimeter, there is no requirement for processors to have NVLAP accreditation." (Italics added)*	Comment 1.2 not accepted. The regulations in 10 CFR 20.1501(d) do not require all dosimeters (such as electronic dosimeters) to be processed by a processor accredited by the NVLAP. The regulations require that dosimeters that are processed to be processed and evaluated by a processor holding NVLAP accreditation.

		Comment 1.2.a Presented description of the NVLAP program is incomplete and in some respect misleading. NVLAP accreditation is not limited to the requirements for the dosimeter processing. References [a–e] provide a comprehensive description of the criteria for NVLAP accreditation and its process. Besides the requirement to have written procedures for dosimetry processing, it also includes management and technical requirements [a–c] and periodic proficiency testing [d–e]. Presence of a quality system which provides consistency in reporting valid doses to personnel is one of the key management requirements. Maintenance of the metrological (NIST) traceability, acceptance testing of new dosimeters, evaluation of radiation dose uncertainty, periodic verification of dosimeters calibration are most important technical requirements. Comment 1.2.b NVLAP accreditation should be required for any dose assessment and assignment process used to determine personal dose of record for workers in the United States, regardless of the measurement technology. Failure to do so could result in the use of sub-standard technology, equipment, algorithms, and review methods to determine occupational personnel dose of record. NVLAP accreditation requirements will ensure that correct doses will be recorded for the personnel. NVLAP accreditation ensures use of competent laboratories and equipment proven to meet NVLAP criteria. Moreover reference [4] includes a description of proficiency testing with caveats for electronic dosimeters and Pacific Northwest National	Comment 1.2.a partially accepted. The draft RG does not describe the NVLAP process. It states only that if a dosimeter is processed, the processor must hold NVLAP accreditation. References a–e have been added to the bibliography. Comment 1.2.b not accepted. An RG cannot establish new requirements. The proposed changes would require rulemaking to add requirements to 10 CFR 20.1501(d).

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		Laboratory performs NVLAP and DOELAP proficiency testing of electronic dosimeters. Management and technical NVLAP requirements are equally important for electronic dosimeters as for passive dosimeters in supporting the production of quality dose of record results. (Navy's) Proposed language (underlined) is the following: 3.7 Dosimeter Processing Personnel dosimetry that requires processing must be processed and evaluated by a dosimetry processor holding accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) pursuant to 10 CFR 20.1501(c). The NRC interprets processing to mean a process, separate from and independent of the design of the dosimeter, that is required to extract dose information from the dosimeter after exposure to radiation. For example, film dosimeters, thermoluminescent dosimeters, and optically stimulated luminescence dosimeters, require processing by qualified technicians using separate equipment to obtain data to compute the dose measurement. <u>Conversely, dose measurements obtained from electronic dosimeters or digital output personnel dosimeters (e.g., direct ion storage dosimeters) do not require processing, since the data is extracted directly from the dosimeter (i.e., through a process independent of dosimeter processing). However, management and technical NVLAP requirements are equally important for electronic dosimeters as for passive ones. Monitoring by NVLAP ensures the presence of a quality system which provides consistency in reporting valid doses to</u>	

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		personnel. Maintenance of the metrological (NIST) traceability, acceptance testing of new dosimeters, evaluation of radiation dose uncertainty, periodic verification of dosimeters calibration are important technical requirements of NVLAP accreditation required for personnel dosimeter systems. Additionally, all personnel dosimeters that are used by licensees to comply with 10 CFR 20.1201, with other applicable provisions of chapter 10 of the CFR, or with conditions specified in a license, must be processed and evaluated by a dosimetry processor holding accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) pursuant to 10 CFR 20.1501(c).	
8	U.S. Navy	Comment 2.1 (for clarity, Comment 2 has been renumbered into two parts, Comment 2.1 and Comment 2.2) Section 3.2, page 13, second sentence: Further clarification is required. It does not take into consideration Electronic Dosimeters (ED) or passive/active dosimeters. For ED and passive/active dosimeters dose results do not have to wait to the end of the year. Comment 2.2 (for clarity, Comment 2 has been renumbered into two parts, Comment 2.1 and Comment 2.2) The radiation worker and licensee can process the dosimeter at a more frequent rate, therefore could make a determination where in the body the dosimeter should be placed.	Comment 2.1 not accepted. The current wording does not specify the type of dosimeter. Electronic dosimeters or passive dosimeters may be used. Comment 2.2 accepted. The staff has updated the wording as follows to include the concept of dosimeter job-specific monitoring and use of the monitoring data from that job-specific monitoring period to determine the annual deep-dose equivalent (DDE).

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			At the end of the job-specific monitoring period, the maximum DDE would be determined and used in determining the annual DDE.
9	Hilary Lane (NEI)	Section 2.1 Footnote 1 appears to have a typo in the phrase "…the term 'should' denote a recommendation…" **Proposed Resolution:** Revise the footnote to use the term "denotes" instead of "denote"	Comment accepted.
10	Hilary Lane (NEI)	Section 2.5 The following sentence appears to contain a typo (emphasis added): "These scenarios do not involve required monitoring because the prospective dose evaluation determined that these types of unplanned, intended exposures may occur and were not likely to exceed occupational dose limits." **Proposed Resolution:** The phrase "…unplanned, intended exposures…" seems to be a typo which needs to be corrected. Based on the guidance in the DG it appears that the phrase should say "…unplanned, unintended exposures…." If this is not a typo, additional guidance is needed on what this term means.	Comment accepted. The staff has corrected the text in section 2.4 to state "unplanned, unintended…."
11	Hilary Lane (NEI)	Section 3.2 The last two sentences of this Section appear to contradict each other: "At the end of the year, doses from each location would be summed. The DDE to be recorded would be that of the dosimeter location receiving the highest dose."	Comment accepted. The staff has revised the text as follows: *At the end of the job-specific monitoring period, the maximum DDE would be determined and used in determining the annual DDE.*

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		It is not possible to sum each location while also only recording the highest location. Clarification on this statement is needed. **Proposed Resolution:** NRC should revise the last two sentences of the section to clarify that the DDE is the sum of each location with the highest dose per wear period. Currently, the draft as written does not convey that meaning.	
12	Hilary Lane (NEI)	Section 3.4 and similar wording in Section 4.5 The following sentence contains unclear language (emphasis added): "For hot particles or contamination on or near the skin, SDE may be calculated using methods described in NUREG/CR-6918, Revision 4, "VARSKIN+ 1.0, A Computer Code for Skin Contamination and Dosimetry Assessments" issued in 2021 (Ref. 25) or more updated versions." The reference to a specific revision of NUREG/CR-6918 and the terminology "or more updated versions" appears to be limiting and may confuse the reader to infer or interpret that an earlier version of Varskin (e.g., Varskin 5, etc.) can't be used. **Proposed Resolution:** For clarity, we recommend not referring to a specific revision of NUREG/CR-6918 and deleting the words "or more updated versions."	Comment partially accepted. The NRC guidance is to use VARSKIN+ 1.0 or more recent versions. Older versions of the NUREG have outdated beta dosimetry models that have been significantly improved in Revision 4. In addition, the staff has revised the RG to provide licensees with information on how to obtain the most recent version of VARSKIN+ 1.0 through the NRC's Radiation Protection Computer Code and Maintenance Program (RAMP) website. *Note: The most recent version of VARSKIN is available on the NRC's website for the Radiation Protection Computer Code and Maintenance Program (RAMP).*

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13	Hilary Lane (NEI)	Appendix A In the Appendix A example, it is not clear to all readers how the uranium calculations are performed. I.e., from the calculations of intake masses (Table A-2) to the calculation of CEDE (Table A-3) **Proposed Resolution:** It would be helpful if the RG provided some additional, more straightforward calculations of other scenarios. It would also be helpful to include an example, or additional guidance, on an acceptable situation for	Comment accepted: Equation A.1 provides a method of calculating the intake (in units of microcuries) of a mix of radionuclides based on air sampling (or bioassay) for a worker who is wearing respiratory protection. Table A-1 is a data set showing radionuclides detected, their solubility class, the mode of intake, and the amount of intake (in units of microcuries). In consideration of chemical toxicity, NRC establishes a limit on the mass intake of soluble uranium in 10 CFR 20.1201(e). Equation A.2 provides a method of calculating this intake of soluble uranium in units of milligrams, based on the results of radioactivity air sampling by converting microcuries of intake into mass of intake in units of milligrams. Equation A.3 is a calculation of committed effective dose equivalent (CEDE) based on the example intake values from Table A-1. Table A-3 shows the results of the CEDE calculation based on Equation A.3 with intake values given in table A-1. Section C.2.2 describes methods of performing prospective dose evaluations for both external and internal exposures. Guidance is given on the acceptable use of historical surveys, anticipated work activities, radiological surveys, and credit

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		documenting a prospective evaluation for the need for monitoring, and how to properly evaluate and document the situation.	for use of protective clothing, use of respiratory equipment.
14	Hilary Lane (NEI)	Appendix A The last sentence before Table A-2 appears to have typo in the language “If bioassay monitoring indicates additional intake occurred…” **Proposed Resolution:** Revise the language to change the word “intake” to “intakes.”	Comment accepted.
15	Hilary Lane (NEI)	Appendix A It appears that the statement “Table A-2 shows the data used in calculating CEDE” incorrectly refers to “Table A-2” when it should refer to Table A-3. **Proposed Resolution:** Revise this to correctly refer to Table A-3 instead of Table A-2.	Comment accepted.

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16	Hilary Lane (NEI)	Appendix A The "Committed Dose Equivalent (CDE)" section at the end of page A-3 appears to incorrectly refer to "Table A-3" when it should refer to Table A-4. **Proposed Resolution:** Revise this to correctly refer to Table A-4 instead of Table A-3.	Comment accepted.
17	Hilary Lane (NEI)	Appendix A The sentence below Table A-4 appears to incorrectly refer to "Equation A.3" instead of Equation A.4. **Proposed Resolution:** Revise this to correctly refer to Equation A.4 instead of Equation A.3.	Comment accepted.
18	Travis Deti (WMA)	**Use of Individual or Material-Specific Information/Soluble Uranium Intakes** The draft document discusses the use of individual or material specific information and soluble uranium intakes. The document should also reference: • Brown, Steven & Chambers, Douglas. (2014). Worker Protection Implications of the Solubility and Human Metabolism of Modern Uranium Mill Products in the U.S. Health physics. 107. 403-409. 10.1097/HP.0000000000000136. This recent (2014) paper should be considered in the document's preparation and referenced in it, since it	Comment partially accepted and partially not accepted. The commenter does not explain how the referenced document either provides additional support for existing recommendations in the draft guide or uses an acceptable alternative approach. However, this document has been added to the bibliography.

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		contains valuable uranium recovery industry specific information and also provides additional references specific to uranium mill products in the United States.	
19	Travis Deti (WMA)	**Voluntary Monitoring** This section states: *Voluntary monitoring beyond that required in 10 CFR 20.1502 may be performed. The results of voluntary monitoring obtained when monitoring was not required by 10 CFR 20.1502 are not subject to dose recording requirements. However, to keep the occupationally exposed individual better informed, a licensee should record and report the results of this monitoring or establish criteria for when to record and report voluntary monitoring (see RG 8.7).* The WMA supports this language since at some uranium recovery facilities monitoring may not be required by 10 CFR 20.1502 but may be performed to inform individuals of exposure conditions, or to alleviate safety concerns. The results of voluntary monitoring, for which reporting is not required, can be provided verbally to employees.	Comment accepted. No change needed.

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20	Travis Deti (WMA)	**Section 4.5—Doses from Intakes through Wounds** A portion of this document (Section 4.5) is devoted to doses from intakes through wounds. The section should clearly state that: *Decontamination or radiological assessment of any wound shall not interfere with or take precedence over proper medical or surgical care. First aid treatment shall always be given priority.*	Comment accepted. The staff has added the proposed wording to section 4.5 as a recommendation.
21	Travis Deti (WMA)	**Bioassaying** The document references RG 8.9, Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program, and RG 8.22, Bioassay at Uranium Mills. It fails however to reference another relevant bioassay guidance specifically: HPS N13.22-1995—American National Standard—Bioassay Programs for Uranium Health Physics Society Journal—Volume 83, Number 5, Special Issue on Inhalation Intake Retention Fractions from Current ICRP Models NUREG-0874, Internal Dosimetry Model for Applications to Bioassay at Uranium Mills NUREG/CR-4884—Interpretation of Bioassay Measurements These additional references should be incorporated.	Comment accepted. These documents have been added to the bibliography.

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		In conclusion, the WMA believes that the document could be strengthened and made more useful, especially to uranium recovery licensees, through the use of additional references specific to uranium processing and bioassay for uranium. In addition, the suggested minor modification specific to Doses from Intake through Wounds should be made.	The staff has incorporated the referenced minor modification (regarding priority of medical care over radiological assessment) into section 4.5.