PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	In addition to the program codes a simple flow chart of the reverse Bateman algorithm would be useful. Not everyone is used to reading and understanding program code, so flow charts of the algorithms or a brief mathematical treatise would help. The structure of the sections of the User's Guide that deal with land-use and exposure scenarios (Section 4 with sub-sections) is confusing, since it mixes RECEPTORS (4.1 Resident with media (4.1.1 Resident soil, 4.1.3 Resident air, 4.1.4 Resident Tapwater etc.), 4.2 Composite Worker, 4.3 Outdoor Worker, ... 4.6 Recreator, followed by sub-sections of the same level covering MEDIA such as 4.7 Consumption of Fish, again followed by a RECEPTOR, 4.8 Farmer, AGAIN switching to MEDIA, 4.9 Soil-Groundwater, followed by a mixture of miscellaneous stuff such as 4.10 Supporting Equations and Parameter Discussion, including certain activities such as construction works). This structure is highly confusing and should be disentangled, to describe in separate sections RECEPTORS, MEDIA, and miscellaneous formulae. Mushrooms that may have very high transfer factors (soil-produce) seems to entirely missing from the list of produce.	No change on the format of receptor and media. This is consistent with the other Superfund tools for radiological and chemical assessment. No change at this time on the exclusion of mushrooms, the produce choices are currently limited to those with human ingestion rates in the Exposure Factors Handbook. EPA is evaluating other produce and animal choices that are consumed by tribal populations and hunter/fishers, which includes mushrooms, for potential inclusion in a future PRG calculator revision.
Kunze	1a	Resident, in particular the consumption of home grown food	See my comments on Charge Question 3a below. If exposure scenarios involving radioactively contaminated soil (direct radiation, radiation) are taken into account, residents may also be exposed to building materials in which such contaminated soil has been used.	PRG calculator receptor represents high end (RME) exposed individual, as does BPRG receptor (for person exposed to contamination indoors). Since the PRG RME is often outside and the BPRG RME is always indoors, an individual receiving both indoor and outdoor exposures at a site should be protected. New language has been added to section 2.1 of the user guide.
Kunze	1b	Indoor Worker	Section 3.1, figure on p. 26: It is unclear why workers are not receptors of contaminated water. The only reason I can see would be that they drink bottled water. If this is so, it should be stated and explained. Likewise, the exclusion of other exposure pathways (e.g., why are farmers not receptors of fish in the graphic, but fish is included in Section 4.8.1 as produce consumed by farmers?) should briefly be explained and justified.	No change. Fish are included in the graphic illustration for farmers. EPA does not have ingestion of drinking water as part of its standard scenarios for workers in the RSL calculator to which the PRG calculator is generally consistent.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	1c	Outdoor Worker	See 1b The approach to dust impact rests on the methods compiled in US EPA Air Emissions Factors and Quantification, AP-42, Compilation of Air Emissions Factors. It is understood that the PRG provides only an approximate, very generic result. However, these approaches are known to be very simplistic, and may be wrong by several orders of magnitude. In particular, the moisture of the material is of paramount importance for the wind-blown dust emissions (similar to the emission factor for construction works discussed elsewhere in the PRG User's Guide). Another factor are soil types. While regional climatic conditions are indirectly taken into account when discussing vegetation patterns (see Section 2.5.1.2 of the User's Guide), these considerations seem to be completely absent in the context of dust emissions. There have been numerous attempts to improve on the EPA AP 42 approaches, such as Countess Environmental: WRAP Fugitive Dust Handbook Prepared for: Western Governors' Association, Rev. 06, 7 September 2006; R. Countess et al.: Methodology for Estimating Fugitive Windblown and Mechanically Resuspended Road Dust Emissions Applicable for Regional Scale Air Quality Modeling. Final Report for Western Governors' Association, WGA Contract No. 30203-9, April 2001.	No change. The AP 42 approach is still EPA's recommended approach. However, your comment has been forwarded to the EPA staff on this AP-42 issue for their further consideration.
Kunze	1d	Composite Worker	See 1b and other comments made elsewhere in this document.	No change.
Kunze	1e	Construction Worker (site-specific only)	See 1b and other comments made elsewhere in this document.	No change
Kunze	1f	Recreator (site-specific only)	Apart from the general comments made elsewhere in this document, the consumption of fish from local surface water bodies appears to be missing. I would think that catching fish is at least as realistic an activity of recreators as shooting (and eating) game.	No change. Consumption of fish is under Resident fish and Farmer biota scenarios/media only in the calculator. Consumption of fish based on contamination levels in soil or water are under Farmer: combined soil and biota, combined water and biota, and biota combined from both soil and water.
Kunze	1g	Farmer, in particular the consumption of home grown food	See my comments on Charge Question 3a below. It seems unrealistic, or overly conservative, to assume that 100 per cent of the food consumption is sourced locally. Even farmers would certainly buy food from other regions. A "dilution" factor to describe sourcing of part of the daily diet from outside the contaminated area should be included. In Germany, 50 per cent are assumed for some groups of produce. For information, I attach the German radiation dose modelling guidance which may provide additional insights. Exposure pathways of farmer children including breast milk should be mentioned. It is understood that the transfer factor from food via the maternal body to the baby may lead to negligible impacts in most cases, not affecting the PRGs. However, for the sake of completeness, this exposure pathway should be mentioned.	No change - the assumption that all food would be produced onsite is conservative, but at some sites all of certain types of food may be solely homegrown. The user is able to adjust the percentage of homegrown food site-specifically. The intent is not to devise a typical garden, but rather to allow the user maximum flexibility on tailoring the homegrown food to a particular location. Breast milk is not an included exposure pathway. We are not mentioning those potential pathways that are not included, this could become a very long list.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	1h	Soil to Groundwater	It is not enirely clear whether K_d values are dependent on groundwater pH and other soil-chemical parameters. A reference to where the K_d values are tabulated my be useful. On Section 4.9, p. 86, an equilibrium model (based on k-d factors) is used to describe mobilisation of contaminants from soil into groundwater. This is generally acceptable, however, the following problems may arise: A mother nuclide is mobilised within a very short time because of high solubility under given geochemical conditions. The daughter nuclide may be less mobile and remains trapped on soil particles. The new peak risk approach must then be able to describe ingrowth of the daugther nuclide in the solute phase, i.e., during the migration of the mother nuclide in groundwater. This would require input of the groundwater flow velocity, which can be very slow (and hence, ingrowth between point of mobilisation and receptor may become significant). In the figure on p. 86, it appears as if mobilisation is considered only in the saturated phase. However, soil contamination may occur in the vadose zone, and due to the higher saturation of soil pores with oxygen and fluctuating moisture or this soil layer, oxidation processes may lead to significant mobilisation of metallic nuclides. For example, pyritic soils exhibit this behviour in a marked fashion (leading to what had come to be known as ARD/acid rock drainage). Depletion of contaminants in the soil may play a role, expecially over the long-term. This is sometimes referred to "natural attenuation", but does not seem to be taken into account. When the source of contaminants in the soil is exhausted, the nuclide concentration in the plume decreases. It is not clear how this is taken into account in the dynamic PRG calculations (especially in model option #1, peak PRG): ingrowth may be modelled along the transport pathway or in the contamination source in the soil, or in both, but in any case requires information on the characteristic time scale of the groundwater flow.	No Change. Kd is not dependent on pH in our models. No change to our models. The progeny are transported with unique Kd values from the parents. Transport velocity isn't used in our equations.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	In my opinion, they are appropriately addressed. However, a few points need clarification. A simple test was made to check the plausibility of outputs for a parent/daughter pair. Example: Resident tap water scenario, with the following options that have been selected: Target risk of 1E-6 Resident Tap water Site specific Database hierarchy defaults Risk output selected Unit Bq Po-210, Pb-210 Isotopes only, AND THEN Secular equilibrium Show Individual Progeny Contributions yes NO PRODUCE HAS BEEN SELECTED, i.e., only ingestion of drinking water and immersion (which can be neglected since it contributes a VERY small risk) Media concentration Po-210 1 Bq/l and Pb-210 1 Bq/g Results are shown in tab "Results 2". The scenario that concerns me is Scenario #6. If Po-210 is set equal to 0, how can the total risk still be the same as if Po-210 us set equal to 1 Bq/l or assumed to be in equilibrium with Pb-210? One would assume that activities of all nuclides from Pb-210 through Bi-210 produce risk, but activities of all nuclides from Po-210 inclusive are 0 and do not produce any risk. This should be explained or fixed. See also my findings on missing links to references and internet resources for model parameters under Charge Item 3.	No change. when a parent and daughter are selected together both are treated as a parent. For secular equilibrium, only a parent concentration is required and the user cannot change the daughter concentration.

Kunze	3	Is there anything you would suggest to improve the user's guide? In particular:	A list of all technical abbreviations used in the guide would help, either at the beginning or at the end of the document. For example, Section 4.9, p. 87: Abbreviation SSL should be explained. (It is explained somewhere in the text, but this requires the reader to flick back and forth to find what he/she is looking for). A table of contents of the pdf version of the guide would be very helpful. Section 2.5.1.2, p. 14: Bv_wet requires the moisture content (MC) of the produce (see formula Section 2.4.2). The produce-specific MC is not shown in Section 2.5.1.2. I assume that some sort-specific MC is used, but this should be explained. Terms "Primary, secondary,..." transfer should be explained. Section 2.7.2, p. 22, sentence "If the second output option..." is very confusing. On one hand it says "Does not assume secular equilibrium..." but then continues to say "concentrations for the progeny are automatically populated with the concentration entered for the parent", which, in effect, means equilibrium. Section 1, page 2: Links to the report on slope factors https://epa-prgs.ornl.gov:8085/radionuclides/SlopesandDosesFinal.pdf and to the appendix https://epa-prgs.ornl.gov:8085/radionuclides/SlopesandDosesMasterTableFinal.pdf do not work. "Miscellaneous variables", link to ORNL 2014a https://epa-prgs.ornl.gov:8085/radionuclides/ACF_FINAL.pdf does not work. Nor does the link to ORNL 2014c https://epa-prgs.ornl.gov:8085/radionuclides/SlopesandDosesFinal.pdf work. Section 4.10.1, p. 87: The link to the Soil Screening Guidance for Radionuclides: Technical Background Document https://www.epa.gov/superfund/health/contaminants/radiation/pdfs/sstbd.pdf does not work. Section 2.6, p. 21: Link to "Radiation Risk Assessment At CERCLA Sites: Q & A", https://epa-prgs.ornl.gov:8085/radionuclides/RadRiskQAwithtransmitmemo_June_13_2014.pdf does not work. Section p. 29: Link to the RAGS website https://www.epa.gov/oswer/riskassessment/ragsb does not work. NOTE: At this point with so many un-usable links I have given up checking the links. They should be carefully checked and updated where required. Section 6: There are several ambiguous duplications of references, e.g., three times U.S. EPA (2002). They should be diambiguated using letters (2000a, 2000b etc.) Other references, e.g., Cowherd (1985) mentioned in Section Section 4.10.1, p. 87, are missing and should be added. Childrens's consumption of tapwater is not clear, neither from explanatory sections such as Section 4.1.4, nor from the appendix with default values. How can the water consumption rate of children be calculated from that of adults (19,000 litres life-time adjusted)? This is important to assess the plausibility of risk rates.	No change, technical abbreviations are available in Table 1 in the User Guide. No change. The conversion of the User Guide would be too time consuming, particularly since the User Guide is updated more frequently than the Calculator. The equations provided in section 2.4.2 are for informational purposes only. We do not apply produce specific BV dry values in the calculator.No change. Disagree that primary and secondary should be explained. Section 2.7.2 language has been corrected as secular equilibrium is now the second output option. For the convenience of the user, concentrations are populated for the progeny. Broken links have been fixed. The U.S. EPA (2002) reference has been fixed and the Cowherd references has been added. The childrens drinking water rate is take from the assumptions used for drinking water regulations under the Safe Drinking Water Act which have also been adopted in policy for Superfund site risk assessments.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	3a	Section 2.5 "Biota Modeling"		
		Subsection 2.5.1 "Produce Modeling"	A simple test has been madeto check plausibility of produce consumption scenarios with the following options: Target risk of 1E-6 Resident Tap water Site specific Database hierarchy defaults Risk output selected Unit Bq Po-210 Secular equilibrium Show Individual Progeny Contributions yes Show Individual Produce Output yes Fresh weight of produce Media concentration Po-210 1 Bq/l It is not clear (neither from the calculator itself nor from the User's Guide), how the individual sorts of produce contribute to the PRG, and what their relative weights are. The sum of inverse PRG has been checked and is ok, however, the total amount of produce consumed per day by an individual seems to be the sum of all consumption rates (in Section 2.5.1.1 of the User's Guide the intake rates (g/day) are provided, e.g., 73.9 g/d apples, 80.1 g/d tomatoes, etc. for resident adult), which would lead to unrealistically high amounts of several kilograms per day. So, it appears as if the PRG is calculated under the assumption that all sorts of produce are consumed in quantities that correspond to the consumption rate of the single produce, and based on the calculated PRG for each produce the effective PRG is calculated. This should be explained or corrected.	No change. Yes, the PRG calculator assumes that all of the produce and farm animals are eaten at the same rate as if they are the only item at the site. If you keep all of the produce selected that leads to what would generally be an overly conservative value. The User needs to determine which of those produce are grown in the area. The User Guide provides telephone numbers of United States Department of Agriculture county extension offices who will often have that information, or the User can conduct a site-specific survey both of what is grown and ingestion rates for locally grown food.
		Subsection 2.5.2 "Animal Product Modeling"	The amount of dairy products (presumably milk, plus some other types of dairy food such as yoghurt) of 1111.6 L/day shown in Table 2.5.2-A seems very high, especially for children, and taking into account that children also consume drinks made with tap water (0.78 L/day). Table 2.5.2-B may be dropped. The explanatory note just before the table is sufficient, the table itself does not provide any additional information.	No change. The dairy does include all types of dairy food products and is for a child of a family that owns dairy cows, so it should generally be a higher value than for most children. No change. Table 2.5.2-B will be retained as it does provide a visual for the fact that we do not have intake rates, but that those are available in the calculator. Many users prefer the visual tables rather than just text.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	Risk rates can be read off the diagram and exported as Excel, however a tabular format of the peak risk should also be shown on the calculator website. The meaning of the blue shaded ED interval is not clear. I guess it is a visual aid to show where the maximum risk is located, but strictly speaking the maximum risk is confined to a single moment on the time axis. It is not immediately clear whether the calculated risks refer to adults or to children. This should be explained either in the output diagrams/spreadsheets, or in the documentation.	No change. A risk rate output is available. No change. The risks are for the individual that was exposed during their child and adult years.
Kunze	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"		No change
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	This is certainly a nice option, however, compared with the PRG calculator, it appears rather straightforward, almost trivial, to me. Of course, the user can use the results and modify them using his/her own formulae. However, this is nothing that deserves a separate section in the User's Guide (except mentioning that an export feature to xls exists, which allows further manipulation of results).	No change. Since this question has arisen at different sites we wanted to spell out the procedure in the User Guide. It also helps sometimes with stakeholders if the user can point to language that shows EPA had anticipated this alteration.
		2.8.2 "Replicating the Old +D PRGs"	I cannot comment on this feature since I am not familiar with the previous versions, and hence, whether the post-processor allows to replicate the earlier version.	No change
Kunze	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.		No change
Kunze	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	The menu point Equations https://epa-prgs.ornl.gov/radionuclides/equations.html should also include the table of symbols similar to Table 1 at p. 92 in the User's Guide pdf document. The menu point Generic Equations https://epa-prgs.ornl.gov/radionuclides/download.html could (should!) be used to provide up-to-date links to the documents whose links are wong in the User's Guide.	No change. Providing Table 1 in the equations html would require a lot of maintenance and leave room for error. If someone wants to see table 1 they can just use the user guide or open a separate tab. No change. That is not the intent of the download page.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	The results are generally presented very intuitively and in a very clear format. However, for even more clarity, the unit of the y axis should be denoted "Risk rate (risk/yr)" to make it clear that the term rate refers to ANNUAL risk. I have not been able to find out what the "Lasso select" option in the diagram does or what it may be used for. This is not explained in either the User Guide nor in the Peak PRG Guide. The tab "[Tap Water] Risk" seems to provide Risk vs. Time on a linear time scale, while the tab "[Tap Water] PRGs" shows diagrams with the risk rate on a logarithmic time scale. The difference between the two tabs has not been explained in the User's Guide (at least I could not find it anywhere). In the User's Guide, Section 2.2.1, p. 3, the headline "Click Here for a Tutorial on Understanding the Peak PRG Graphs" does not contain a link, there is nowhere to click. Link missing?	Units were added to the y axis for Peak PRG graphs. No change. The use for the lasso is provided in the peak tutorial in section 2.2.1. No change. The user clicks on the blue text for the tutorial, which is a dropdown
Kunze	5	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	Yes, they are sufficiently explained and qualified.	No change
Kunze	6	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?	Section 4.1.2, page 30: While certainly methodologically correct, I doubt that data on specific activities in layers of few centimeters are practically available and make much sense, given soil inhomogeneities significantly larger than a centimeter scale. IMHO, 5 cm are a minimum realistic thickness.	No change - the groundplane, 1 cm, 5 cm, and 15 cm results were expected to be rarely useful for soil. Those risk coefficients were primarily developed for buildings but were thought to have some potential application shortly after an event if material did not have time to transport to lower depths of soil.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Kunze	7	Is there anything else you would recommend to improve the utility, accuracy, completeness, or supportability of the calculator for these scenarios?	It appears that a little bug has been detected: When selecting all sorts of produce and clicking "Retrieve", the complete list of PRG for all sorts of produce is generated, see first results column in tab "Results 1" in the response spreadsheet. When clicking "Back" on the browser (Google Chrome), in order to just check an input parameter, but NOT changing any input parameter, all sorts of produce are still shown as selected (all boxed ticked). When I click in "Retrieve" again, two sorts of produce are missing, see highlighted cells in second column in tab "Results 1". This seems to be a bug.	Yes, the back button should not be used. This is a browser issue that we cannot fix. If you want to see a specific input then you should refer to the table of inputs for the given media.
			The scroll-down menus with "Selected Isotopes" and "Common Isotopes" should perhaps be grouped in decay series such as U-238, Th-232, U-235, so that the user can quickly select groups of nuclides that are typically encountered together. Artificial nuclides such as Pu-241 and Am-241 (and others) might also be clustered because they form parent/daughter pairs. Alphabetical sorting is nice, but professionals working in the field are used to search for nuclides in groups of decay-series that make sense from a physical point of view. C-14 might be added, as it appears relatively frequently in dose estimates.	No Change. The "Common Radionuclides" list provides the shorter list of radionuclides that are the usual risk drivers at radioactively contaminated Superfund sites.
			Users should be given the opportunity to personalise the calculator website. For example, users should be able to define a list of often-used nuclides. These selections can be very different from site to site, so that a set of preferentially pre-set nuclides would save a lot of time. There should also be an opportunity to save scenarios (e.g., nuclides used in the calculation, produce sorts typical for a site, preferences of units, etc.). (Note: the export of modeling results via pdf, csv or xls is NOT what I have in mind, but the user-defined selections). At the end of the calculation, an option to download or save an overview of all selected parameters used for that calculation should be provided. Users should also be able to load a set of parameters used for a previous calculation and modify certain parameters, instead of having to type in the entire set of parameters from scratch.	A save file feature is already planned as a potential future improvement.
			In the "Equations" section of the PRG website (https://epa-prgs.ornl.gov/radionuclides/equations.html), some exposure pathways are missing, even though they are included in the calculations. For example, direct exposure from soils is missing under "Farmer".	No Change. Direct exposure from soil is listed under the soil section beneath Farmer.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Stagich	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	Yes, all models use the most up to date references that I am aware of and are cited appropriately; however, I did notice the following (see 1a notes)	No change
Stagich	1a	Resident, in particular the consumption of home grown food	Lambda(B) in Table 1 of Section 5 in the User Guide says it is Lambda(HL) + Lambda(i); however, in the PRG calculations it is equal to Lambda(HL) The Produce intake rates for some of the produce does not equal the referenced values when calculating for H-3	No change. Lambda i is not used for secular equilibrium because it is a form of decay. The produce intake rates are the same irrespective of the contaminants selected in the calculator.
Stagich	1b	Indoor Worker		
Stagich	1c	Outdoor Worker		
Stagich	1d	Composite Worker		
Stagich	1e	Construction Worker (site-specific only)		
Stagich	1f	Recreator (site-specific only)		
Stagich	1g	Farmer, in particular the consumption of home grown food		
Stagich	1h	Soil to Groundwater		
Stagich	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	I did not find any issues with the radionuclide selection, nor their respective decay chains. All defaults were appropriately referenced	No change
Stagich	3	Is there anything you would suggest to improve the user's guide? In particular:	No suggestions. All references are appropriately given and questions answered in the respective section.	No change
Stagich	3a	Section 2.5 "Biota Modeling"		
		Subsection 2.5.1 "Produce Modeling"		
		Subsection 2.5.2 "Animal Product Modeling"		
Stagich	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG		

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Stagich	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"		
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"		
		2.8.2 "Replicating the Old +D PRGs"		
Stagich	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.		
Stagich	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	Yes, the 'Graph Information and Features' provides a great overview of the output graphs, but it may be beneficial to include the 2.2.1 PRG Output Option #1 paragraph somewhere on the results page as this is a new feature	No change. Maintaining the same text in multiple places that are managed by different people leaves room for human error. Also the calculator main page has hover text explaining what the user is doing before getting to results page.
Stagich	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”		
Stagich	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	Yes. I did have issues with the Peak PRG graphs showing up on my government computer, but I was still able to create the graphs using the provided CSV output files.	No change. We were unable to replicate any issue with the Peak PRG graphs on our government computers.
Stagich	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	Yes, all results can be duplicated based on equations and/or references provided.	No change
Stagich	7	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?	When performing a site-specific scenario, the equations are provided; however, for the tapwater inhalation calculation, the new Aeq equation is not provided nor included in the footnotes. Since all other supporting equations are included on the input page, this equation should also be included.	This has been fixed.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Spreng	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	It is not clear what "the peak PRG models" refers to. The exposure scenarios are described in Section 4 along with their respective equations. The models for the following scenarios seem comprehensive and accurate and, to the best of my experience and knowledge, represents the current state of knowledge. The links at the bottom of 2.1 to the exposure scenarios' "equations on this website" do not open anything.	"The peak PRG models" refers to the PRG Output Option #1: Assumes period of peak risk (with decay and progeny ingrowth) (Peak PRG). We tested the equations link in section 2.1 in both Chrome and Firefox browsers and it correctly went to the equations webpage.
Spreng	1a	Resident, in particular the consumption of home grown food	As stated in 4.1.1 of the User's Guide, the consumption of home grown produce is the main risk driver - by far. The cumulative produce consumption rate (about 2 pounds/day) seems reasonable. The list of produce is a lengthy (and very healthy) mix and assuming that it is all home grown does not seem reasonable. It should be made clear that, for a defensible result, users may have to pare down the list to what could reasonably be home-grown in the area. The "RAGS Part B" link at the bottom of the PRG Equations section of 4.1.1 is to a web page that no longer exists.	In the last paragraph of 4, right before 4.1, we have inserted some additional text regarding how site-specific data may be used. The RAGs Part B link has been fixed (https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-b)
Spreng	1b	Indoor Worker	The equation for inhalation of soil particulates is the same for an indoor worker as for an outdoor worker, except that the exposure frequency for an indoor worker is 25 days longer. It is unclear why an indoor worker would be subject to a greater amount of particulate inhalation.	This is because the PRG calculator assumes no attenuation of dirt coming inside (a conservative assumption) and the indoor worker is exposed more days since weather will keep the outdoor worker from working outside some days.
Spreng	1c	Outdoor Worker	The description of the outdoor worker scenario seem comprehensive and accurate and, to the best of my experience and knowledge, represents the current state of knowledge. The calculator output seems reasonable.	No change
Spreng	1d	Composite Worker	The equation for inhalation of soil particulates is the same for a composite worker as for an outdoor worker, except that the exposure frequency for a composite worker is 25 days longer. It is unclear why a composite worker would be subject to a greater amount of particulate inhalation.	The composite worker is a compilation of the most protective defaults in the outdoor and indoor worker scenarios, as stated in section 4.2.1 of the User Guide for the PRG calculator.
Spreng	1e	Construction Worker (site-specific only)	The description of the construction worker scenario seem comprehensive and accurate and, to the best of my experience and knowledge, represents the current state of knowledge. The calculator output seems reasonable.	No change
Spreng	1f	Recreator (site-specific only)	The description of the construction worker scenario seem comprehensive and accurate and, to the best of my experience and knowledge, represents the current state of knowledge. The calculator output seems reasonable.	No change
Spreng	1g	Farmer, in particular the consumption of home grown food	Section 4.8 explains that most of the risk to a subsistence farmer comes from ingestion of produce. There are total PRG equations for consumption of produce related to soil (4.8.2) and for consumption of produce related to water (4.8.3), but it is unclear in 4.8.4 how they are combined. The text in 4.8.4 refers to section 4.26.7, but it is also unclear where that section is found.	Fixed typo referring to "section 4.26.7" to section 4.10.7 instead.
Spreng	1h	Soil to Groundwater	The calculation methods are clear and accurate and represent the current tat of knowledge.	No change

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Spreng	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	The database for over 1,200 radionuclides and the list of 21 common isotopes in the calculator seems sufficient for any imaginable site. How decay chains are addressed by the calculator is adequately explained in Sections 2.2 and 4.10.8. The paragraph in Section 4.10.8 is lifted from a standard paragraph repeated in Sections 4.1.3, 4.2.3, 4.3.3, 4.4.3, 4.5.3, 4.6.3, 4.8.5 and it needs to be modified to fit that particular section. The recommended default factors are adequately explained, well referenced, and seem reasonable (at least as far as my experience with them can determine). In the *Inhalation, Ingestion, and Consumption Rates* table in Section 5 of the User's Guide, many of the factors are age-adjusted. Several entries in the Reference column use the term, "aged adjusted". In the same table, the reference for the Construction Worker Ingestion Rate is missing. I assume the "Sum of grading kilometers traveled" in the *Mechanical PEF Variables from Other Construction Activities* table should be "site-related".	Fixed paragraph in Section 4.10.8 by not referring to that section. Changed to "age-adjusted" instead of "aged adjusted". Added reference for missing Construction Worker Ingestion rate. Added "site-specific" to "Sum of grading kilometers traveled."
Spreng	3	Is there anything you would suggest to improve the user's guide? In particular:	The User's Guide in general was very well organized and very clear. The explanations, tutorials, and examples throughout were handy and helpful.	No change
Spreng	3a	Section 2.5 "Biota Modeling"		
		Subsection 2.5.1 "Produce Modeling"	At Rocky Flats, the understanding was that actinide deposition on plant surfaces far outweighed root uptake because the vascular system of most plants could not transport the actinides. I don't see this discussed in 2.5.1 or in the ORNL 2021 paper, but I note that default transfer factors listed in the "site-specific" mode reflect the very small plant uptake factors for actinides.	Actinides are not addressed in general, but deposition on plants (Mass Loading Factor or MLF) is part of the model in addition to root uptake.
		Subsection 2.5.2 "Animal Product Modeling"	There are no references provided for the sources that appear in the hierarcy chart in 2.5.2.2.	A reference to section 2.4.1 has been added which describes the sources in the chart.
Spreng	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	It is clear why the Peak PRG option is now the default and the preferred option vs. the secular equilibrium option. The ORNL paper on Integrating Peak Activity was helpful to understand what contamination conditions are appropriate for which output option.	No change
Spreng	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"		
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	The postprocessing example is helpful for those attempting to change parameters, but the advice to "Please contact your EPA regional risk assessor before post processing PRG calculator results for Superfund sites" also seems sensible.	No change
		2.8.2 "Replicating the Old +D PRGs"	The links, "ORNL 2014c" and "appendix", both lead to error messages ("Access Denied" and "This site can't be reached"). The links to these same references in 6-References did work, however.	The links have been fixed.
Spreng	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.	The text states that the "initial PRGs" assume no air exchanges, but later states that a default value of 0.18 was selected. Does "initial PRGs" refer to calculation results using default parameters? The link in ORNL 2000 goes to the RSL Calculator home page and does not provide a " more detailed explanation of the Aeq derivation". This link should be to another source or should give more detailed directions to find the explanation within the RSL Calculator guidance. Typo in 1st sentence: "site-specifc".	The text has been revised to clarify that "initial PRGs" was referring to the PRGs before the application of Aeq. Typo and broken link have been corrected.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Spreng	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	The results are clearly presented in a manner that is either self-explanatory or that has plenty of tutorials and explanations.The output graphs are a great visual benefit. The position of the ED Start on the graphs is unclear to me, however.	No change. The position of the ED Start is the year the period of exposure is assumed to begin.
Spreng	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	It is clear why the Peak PRG option is now the default and the preferred option vs. the secular equilibrium option. The ORNL paper on Integrating Peak Activity was helpful to understand what site settings are appropriate for which calculation option.	No change
Spreng	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	The calculator results are sufficiently described. The accuracy of the results depends on the equations and the input factors, all of which have been qualified and are supported by quality sources.	No change
Spreng	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	The PRG calculator has evolved into a well-explained and well-referenced device that is flexible enough to fit just about any conceivable scenario or site setting. The necessary background and sources are provided so that the output is defensible.	No change
Spreng	7	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?	The ability to get instructions when hovering over any of the section titles in the Peak PRG models is a very convenient, useful feature. It might also be handy to have the 2 Total PRG columns frozen next to the Isotope column rather than at the far right of the output so a user doesn't have to search for these most often sought data.	No change. The user can scroll to the right for the answer. Changing this format for all of the calculators would be an expensive programming exercise.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pepin	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	As the peak PRG addition is transversal to all different exposure scenarios, I don't make a distinct review for each scenario 1a-1h but rather discuss in general terms the peak PRG option. See also response to Question 4 for the implementation of the peak PRG option in the calculator. The peak PRG option is a welcome addition to the PRG calculator. As rightly explained in the user's guide, it allows for a more realistic assessment of PRGs - avoiding an overestimation or underestimation of the PRGS depending on the relationship between the half-lives of the parent and its progenies. To take into account in a correct manner the decay of the parent and the ingrowth of its progenies is fundamental and several other models (such as RESRAD or NORMALYSA) had already previously implemented this characteristics in the context of a dose-based approach. The peak PRG option allows performing more meaningful intercomparison of the PRG calculator with these other models. The peak PRG option is appropriately supported by citations although the reader has to look into the ORNL Technical Memorandum to find them. The reading of the ORNL Technical Memorandum is however necessary to clearly understand the advantages of the peak PRG option compared to the other options (see Section 3b for further discussion on this aspect).	No change.
Pepin	1a	Resident, in particular the consumption of home grown food	See question 1.	No change.
Pepin	1b	Indoor Worker	See question 1.	No change.
Pepin	1c	Outdoor Worker	See question 1.	No change.
Pepin	1d	Composite Worker	See question 1.	No change.
Pepin	1e	Construction Worker (site-specific only)	See question 1.	No change.
Pepin	1f	Recreator (site-specific only)	See question 1.	No change.
Pepin	1g	Farmer, in particular the consumption of home grown food	See question 1.	No change.
Pepin	1h	Soil to Groundwater	- When I ran this model with option #3 or 4 and selected the Bq unit, I noticed that the calculator mentioned "pCi/l" as unit for the “ground-water risk-based concentration” and the "ground-water MCL based concentration". I guess it should rather be Bq/L (see screenshot here attached). - Additional practical explanation on this model either in the user guide or on the display of the calculator could be useful. As an outsider not very familiar with the calculator, I had difficulties to clearly understand the difference between the PRG and the soil-screening level.	The Soil to Groundwater output graph has been fixed to provide Bq/l concentrations for risk and MCL based concentrations when Bq units are selected. Additional text has been added to the User Guide to explain the SSL soil to groundwater pathway.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pepin	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	Yes, the list of radionuclides is comprehensive and adequate. Decay is correctly taken into account through the Bateman equation. References seem also to be up-to-date: although I am not so familiar with US-based references, the user's guide rightly references ICRP 107 report as a source for nuclear decay data and IAEA TRS 472 for transfer factors.	
Pepin	3	Is there anything you would suggest to improve the user's guide? In particular:	As general remark, a Table of content, a list of acronyms and possibly a glossary would be useful additions to the guide (e.g. when reading the description of the section 4.9 of the user's manual, it took me some effort to understand that SSL means "Screening Soil Level" and MCL "Maximum Contaminant Level").	A Table of Contents at the beginning of the User Guide would be much too large to be of much use. Also Table 1 defines all the variables.
Pepin	3a	Section 2.5 "Biota Modeling"		
		Subsection 2.5.1 "Produce Modeling"	A more elaborate discussion on the relationship between dry weight, fresh weight and cooked weight would be beneficial. IAEA TRS472 transfer factors are expressed in dry weight and I didn't find directly which default factors were used to convert dry weight into fresh weight or cooked weight. Appendix I of IAEA TRS 472 for instance mentions a list of fresh weight/dry weight conversion factors. Was this list used ? For the cooked weight, IAEA TRS 472 rather uses processing factors to relate the activity concentration of the prepared food to the activity concentration in the raw product. Also, it is not clear whether the intake rate expressed in cooked weight includes derived products such as fruit juices.	No change. This information is provided in the Technical Manual that is linked to in the User Guide, the *Biota Modeling in EPA's Preliminary Remediation Goal and Dose Compliance Concentration Calculators for Use in EPA Superfund Risk Assessment: Explanation of Intake Rate Derivation, Transfer Factor Compilation, and Mass Loading Factor Sources: 2021 Revision*
		Subsection 2.5.2 "Animal Product Modeling"	Same remark regarding the relationship between dry, fresh and cooked weight and whether cooked weight is similar to weight of processed food.	No change. This information is provided in the Technical Manual that is linked to in the User Guide, the *Biota Modeling in EPA's Preliminary Remediation Goal and Dose Compliance Concentration Calculators for Use in EPA Superfund Risk Assessment: Explanation of Intake Rate Derivation, Transfer Factor Compilation, and Mass Loading Factor Sources: 2021 Revision*

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pepin	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	The clarity of the tutorial on Understanding Peak PRG graphs may be improved. It is not straightforward for the reader to understand the meaning of and the differences between the Final Peak Risk, the Peak Risk Start / end time and the Max Peak Risk Rate. A glossary would be helpful in this respect. I personnally had to read the Technical Memorandum to get a clearer view of the different concepts. The tutorial could perhaps be improved by adding more visual material (screenshots or short videos) . Am-241 is taken as an example in the tutorial: this is a case where the PRG were overestimated without the peak PRG option; all decay or ingrowth curves either stay at zero (as the assessment time is too small to allow ingrowth) or superpose with each other. Consequently, the tutorial is somehow confusing on the usefulness of the Peak PRG option. It would be good to mention another radionuclide (e.g. Ra-226 as in the ORNL Technical Memorandum) where the effect of decay and ingrowth is shown explicitly and which illustrates the case where the PRG of the progenies will dominate over the PRG of the parent. In my opinion, the Technical Memorandum is clearer than the tutorial and illustrates more transparently the advantages of the peak PRG option. The sentence (near the end of the 2nd § of 2.2.1) "*Users should note that for long-lived isotopes, that have a peak risk that begins in the future, progeny are likely already ingrown and the SE PRGs may be appropriate*" may not always be true: in the case of a site contaminated with U-238 without initial contamination with its progeny Ra-226, the activity concentration of Ra-226 with its half-life of 1600 yrs would become significant only after a long period of time - possibly longer than the time-scale of the assessment.	The "Understanding Peak PRG Graphs" screenshots have been updated and section 2.2.5 of the User Guide and the Technical Memorandum provide information on the Peak PRG graphs. During the EPA 8 hour training class these issues are discussed. EPA is considering developing a new longer online training class that would also provide more explanation for users.
Pepin	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"	See below.	
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	I must confess that I am quite confused about this paragraph. Especially, why and in which circumstances are MCNP calculations needed to derive site-specific factors ? In my opinion, site-specific parameters are obtained on basis of on-site observations and measurements and reasonable assumptions taking into account the assessment context. More detailled explanation on what Postprocessing is and why it is needed would be beneficial (in my understanding, post-processing is a manual calculation of the PRGs by the user on basis of the calculator results to take into account a variation in one of the input parameters but I am not sure that my understanding is correct). A simplified tutorial with a practical example would probably help a swifter understanding of this subsection. The user's guide shows an example where GSFi is changed from its default value of 0,4 to a value of 0,2. But why is post-processing needed in such a case (why not simply change the GSFi value in the user's input ?).	This section is now 2.9.1. Additional text was added to clarify how postprocessing calculator results could incorporate factors derived in another program, such as MCNP, to address unusual external exposures at a site.
		2.8.2 "Replicating the Old +D PRGs"	It is not clear why this section is still needed as the Peak PRG option has now been implemented. In which circumstances would a user need to replicate the +D Progenies ? As rightly stated in the text, the use of +D PRG has been discontinued for good reasons (e.g. that the half-life of the parent was used for the progenies). This section could confuse the reader and it may be considered to suppress it or to move it into a technical annex.	No change. Users often are running risk assessments at the same site years apart and this section helps those users understand how to simulate +D runs if they are trying to explain differences between current and older now obsolete runs.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pepin	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.	It is not clear if the Activity Equilibrium Factor is the same as the Equilibrium Factor defined as the ratio between the potential alpha energy concentration in the existing mixture "radon + progenies" and the potential alpha energy of the mixture where all progenies are in equilibrium with radon (see e.g. *World Health Organisation Handbook on Indoor Radon*). I was not able to find the default value for Aeq (is it also 0,4 for dwellings ?) . Or is Aeq calculated taking into account air-exchange rate ? In that case, which equation is used ? Equilibrium between radon and its progenies is dependent on air-exchange rate but may also depend on the aerosol concentration. Is this dependence taken into account ?	No change. Aeq is defined in the User Guide section and there is more detail in the Technical Manual. There is a default air exchange rate for residents and workers, which results in different Aeq for Rn-219, 220, and 222. The aerosol form is not considered.
Pepin	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	See below.	No change
Pepin	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	As a general opinion, I find that the results are displayed clearly - with a summary of input parameters and a clear graphic representation of the peak risk rates. The graphics are particularly welcome to get some perspective on the time-scale (time occurence and duration) of the peak risks. Possibility to export results into an excel or csv file is also an asset. I ran the peak PRG option with Ra-226 in soil and this was quite straightforward. Although there is a warning that the calculations could take a while, I got the results within a few second, which is very satisfactory. As expected, the results I got for total PRG with Ra-226 in soil using the peak PRG option were very similar to the results obtained with the Secular Equilibrium option. See however my remark in question 7 regarding the unrealistically low values (much lower than background concentrations) of the PRG for Ra-226 in soil. When I ran the farmer scenario, I was confused in the "Select Media" input by the option "Combined soil and biota". I didn't find a clear description of the meaning of this "combination" in the user's guide. In the display of the results, "PRG for soil" are mentioned without reference to "combined soil and biota" anymore.	Revised the text in the User Guide to be consistent with the text in the Calculator, "combined soil and biota" instead of "back calculated to soil."
Pepin	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	Yes, but as for the next question, a careful reading of the user's manual and a familiarity with the concept of slope-factors and risk-based approach is necessary. International radiation protection community is rather used to a pure dose-based approach and it requests some thinking to get acquainted with the risk-based approach.	No change.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pepin	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	The method for calculating PRG is made transparent through the user's guide and the accompanying Technical memorandums. Equations are displayed explicitly in the manual allowing the user to understand the meaning and effect of each parameter. References are comprehensive and allow the user to go deeper where necessary. A thorough reading of the user's manual is however necessary for this. As for most calculators, it is possible to use it as a "black box" with no understanding of the parameters but this would be a bad practice of the user. Maybe some warning could be added to discourage the user of doing so. Additional practical guidance and tutorial may help the users in the understanding of the calculator, its methodology and equations. Practical and concrete examples could be added in order to give users a feeling on the kind of results you are expected to find. A list of "do & don't" may also help.	No Change.
Pepin	7	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?	1) It may be useful to draw the attention of the reader on time-scale for assessment : e.g. when U-238 is present as a contaminant without initially being accompanied by Ra-226, ingrowth of Ra-226 will request thousands of years. Is the peak PRG still relevant for such long-term option – given that the site environment and properties will evolve significanlty over such a long time-scale ? 2) A deeper discussion on background concentrations of natural radionuclides would be beneficial as it would allow the user to question the realism of some of the results: by running the PRG calculator for Ra-226 in various scenario, I was surprised by how low the PRG for Ra-226 was. For instance, with a TR of 1E-06, the total peak PRG for Ra-226 in the resident scenario is 7.12E-05 Bq/g and even 2.74E-07 Bq/g for the farmer scenario : these PRG values are order of magnitudes lower than background values for Ra-226 what may be quite confusing for the user and in any case not realistic. Although this issue is briefly addressed in section 3.2 of the user manual (where it says that "*Natural background radiation should be considered prior to applying PRGs as cleanup levels*"), the question of background concentration is worth a deeper discussion. When natural radionuclides are selected by the user in the calculator, maybe a warning could appear in order to draw the attention of the user on the fact that the PRG may not be realistic in that case. An annex or a Table refering to typical natural background concentration of natural radionuclides in the US may be a useful addition (e.g. similar to the European maps of background radiation published in the European Atlas of Natural Radiation : cf. https://publications.jrc.ec.europa.eu/repository/handle/JRC116795) 3) Implementing sensitivity and/or probablistic analysis would allow to identify critical parameters in the determination of the PRGs. Robustness of the PRG results with changes in parameters would be tested. 4) The user's manual is very dense and development of additional practical and simplified tutorial (video, power point or any other form of training material) could be beneficial for the understanding and the correct use of the PRG calculator by the user.	1) No change. This depends on the site circumstances. EPA has had risk assessments evaluate ingrowth thousands of years into the future, but that is more likely for onsite waste disposal. 2) No change. Referring to the "Role of Background" policy document is sufficient. It is not necessary to restate details that are in that guidance document. 3) A short descussion of conducting a sensitivity analyis has been added in a new section 2.8 of the User Guide. 4) No change at this time. EPA is evaluating developing future online training and/or videos of a tutorial nature. EPA has previously conducted over 35 classroom sessions and has been considering another technique to reach a larger audience.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	• It is not clear how the different scenarios fit together. For example, it is likely that a site with contaminated soil could cause exposure both through exposure to the soil (e.g., external radiation, incidental ingestion of soil, ingestion of produce grown in the soil, etc) as well as exposure to contaminated groundwater via a well. It is not clear how this situation would be evaluated using this model. • The inhalation pathways from soil only appear to include the inhalation of particulates (dust). For some volatile radionuclides (e.g., H-3, C-14), the inhalation of the radionuclide in air (gas phase) that came from the soil might cause a higher risk than the inhalation of particulates. • In the PRG calculator website, the feature that shows a description of the form sections is really nice. Consider adding similar text to the scenario and media check boxes. The calculator would be a little more useable if descriptions of the pathways included when the scenarios and media are selected were to show up when hovering over them. For the media check boxes, it is important to make it clear if the media is the one that is initially contaminated (e.g., soil) or if it is a media that becomes contaminated due to relase and transport of contaminants from contaminated soil (e.g., groundwater in the soil to groundwater scenario). • It is not clear from the scenario descriptions, equations, and PRG calculator output if the child and adult receptors are two different receptors or if it is one individual that lives on the site both as a child and as an adult. If the scenarios are for two different individuals, it is not clear why the risks are summed instead of providing separate results for each receptor. Consider adding text to clarify the assumptions for the child and adult, and, if they are intended to be two different individuals, consider editing the model to provide separate results for each.	●No change. Generally each scenario is evaluated seperately to an RME individual. It is rare that the various scenarios that are evaluated at a site are summed. ●No change. Gas intrusion into houses is addressed in the RVISL calculator, which currently includes 3 radons, but EPA is evaluating expansion. ●No change. We evaluated having the text description of the scenario that is in the User Guide appear as a hover in the calculator portion, but the text would be too large. ●FAQs 9 and 12 provide more explanation on the receptor ages for each exposure route and how the exposure duration is considered for adult and children.
Pinkston	1a	Resident, in particular the consumption of home grown food	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the house uses an on site well as its source of water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides. • The description of how the default intake rates for the home grown food were developed was comprehensive, but there did not appear to be a description of how the categories of food selected were chosen. The categories of fruits/vegetables commonly eaten can differ from region to region. Some of the items included are very region specific (e.g., okra) and are consumed much more in some areas of the country than others. Some other common vegetables, such as spinach, are not included. The basis for the selection of the particular foods should be made clear and a justification that the selcted foods bound the possible risk from other fruits and vegetables should be provided. If the risk from growing on site and consuming another fruit or vegetable is not bound by the current list of fuits and vegetables, then consider adding that fruit or vegetable to the model.	●See above ●Added a sentence that the fruits/vegetables selected for the PRG calculator are those where EFH had ingestion rates on homegrown produce. The User Guide also discusses that the local County Extension office of the Department of Agriculture can provide information on the fruits/vegetables grown locally. EPA has a project to examine other produce that may be included in a future revision of the PRG calculator.
Pinkston	1b	Indoor Worker	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the site uses an onsite well for drinking water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides. The inhalation of volatile contaminants from soil contamination could be a particular problem indoors depending on the amount of infiltration from the subsurface and the air exchange rate in the building.	The soil to groundwater scenario could be adjusted if needed to reflect a worker for the risk portion, the MCL portion would remain the same. Per previous answer the RVISL calculator addresses the gas phase.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	1c	Outdoor Worker	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the site uses an onsite well for drinking water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides.	See comment above (indoor worker)
Pinkston	1d	Composite Worker	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the site uses an onsite well for drinking water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides. The inhalation of volatile contaminants from soil contamination could be a particular problem indoors depending on the amount of infiltration from the subsurface and the air exchange rate in the building.	See comment above (indoor worker)
Pinkston	1e	Construction Worker (site-specific only)	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the site uses an onsite well for drinking water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides.	See comment above (indoor worker)
Pinkston	1f	Recreator (site-specific only)	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered (in the event that the site uses an onsite well for drinking water) and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides. • It is not clear if the fish scenario is intended to be a stand alone scenario or a scenario option for the resident. The model has fish consumption as an option for the resident, while the user guide has the fish consumption as a stand alone scenario. In either case, it is not clear why the consumption of fowl and game scenario is part of the recreator scenario, but the fish scenario is not. It might be clearer to include the fish scenario as one of the options for the recreator rather than as a scenario under the resident.	●See comment above (indoor worker) ●No change. Its organized to be consistent with the RSL calculator for chemicals, and Superfund has traditionally had a separate fisher scenario.
Pinkston	1g	Farmer, in particular the consumption of home grown food	• See answer to Question 1: the consumption of contaminated groundwater from leaching from soil should be considered and the inhalation of radionuclides that volatilized from soil should be considered for certain radionuclides. It is likely that a remote farm would be dependent on an onsite groundwater well for its water supply. •See answer to Question 1a regarding the consumption of home grown fruits and vegetables • A more comprehensive description of which pathways are included in the various farmer scenarios is needed. The graphics only depict the consumption of biota, so it is not clear if other pathways, such as incidental ingestion of soil, inhalation, and external exposure are included. Also, the options for media for the farmer in the model do not match the options described in the user guide. Consider using the same names in both places to make it clear which section of the user guide the scenario applies to.	●See comment above (indoor worker) ●See answer above ●No change. When it is Farmer direct consumption of biota, only exposure to contaminated biota is included. When it is back calculated to soil or water, other pathways of exposure to the contaminated soil and/or water are included and mentioned in the graphics and text.
Pinkston	1h	Soil to Groundwater	• The receptors would likely have more routes of exposure to the soil than just the groundwater. It is not clear how the results of this model are combined with the the results of the other pathways (e.g., the results of the farmer or resident scenarios) to ensure that the PRG is protective of all likely routes of exposure.	It is a site-specific decision, but usually the scenarios are not combined. The RME receptor in different scenarios would generally not be the same person.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	• The choice of radionuclides and how decay chains function is generally appropriate. However, it is not clear whether/how the model accounts for different radionuclides having different transport properties in the environment. In some cases, the progeny are far more mobile than the parent, which would cause the actual expected relative ratios to be very different than would be predicted by only considering decay and ingrowth. If the model does not account for this, I suggest making it clear in the documentation that it is a limitation in the model. Guidance should also be provided to the user about the bounds of when this model is appropriate and when assumptions in the modeling of the transport of progeny would result in non-conservative results and a different modeling approach is needed.	Language has been added to sections 2.2.1, 2.2.2, and 2.9.2 of the user guide to clarify that the models independently model progeny half life, migration to groundwater, and biota uptake, while the +D PRGs did not.
Pinkston	3	Is there anything you would suggest to improve the user's guide? In particular:	• The user guide section on developing the conceptual site model would be improved by adding more detail on how a site should develop a CSM. Also, it is not always clear in that section when the CSM is referring to the user's CSM and when it is referring to the CSM that is build into the PRG calculator. • It would be helpful for the user guide to have more information on when the user should choose which scenarios and how the scenarios should be considered if more than one apply (see response to Question 5). • It similarly would be helpful for the user guide to have more information about when each decay and ingrowth option should be selected in the PRG calculator. • The questions at the end of Section 3.1 are useful for the user to consider if they have the appropriate CSM. Consider expanding these questions to include other questions that would need to be considered when developing the CSM (e.g., what is the site used for, what media are contaminated, what media could be contaminated, etc). Also, consider separating out the ecological risk question from this list since the others are all about making sure the human CSM is done correctly. Also, consider adding a link to information about how an ecological risk assessment should be done if needed. • Section 3.3 is a good start to providing information on the limitations of the model. It would be helpful for this section to be expanded to provide more information about the key assumptions in the PRG model when it would and would not be appropriate to use this model. It also would be helpful to have information on when the selection of the different decay/ingrowth models are or are not appropriate. Also, the information in this section is key to the model being used well, so consider moving this information to a more prominent location earlier in the user guide.	●Improved language has been added to section 3.1 of the user guide. ●No change, this is addressed in other CERCLA guidance. ●Information about when to use each decay and ingrowth option was added to section 2 of the user guide. ●Three additional questions were added to the bulleted list in section 3.1 of the user guide. ●No change. Section was not moved but more information on each PRG output option was added to section 2 of the user guide.
Pinkston	3a	Section 2.5 "Biota Modeling"	• See response to Question 1a and 1g: it is not clear how the list of fruits and vegetables was derived	Added a sentence that the fruits/vegetables selected for the PRG calculator are those where EFH had ingestion rates on homegrown produce.
		Subsection 2.5.1 "Produce Modeling"	• See response to Question 1a and 1g: it is not clear how the list of fruits and vegetables was derived	See comment above
		Subsection 2.5.2 "Animal Product Modeling"	• Table 2.5.2-B does not include any information and might not be needed. The text is already clear that the model does not have default values for the intake of sheep and goat meat and milk.	No change. While correct that this table is not absolutely necessary since there are no default human ingestion rates of these animal products, I think it is preferable to retain the table since it reiterates this point.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	• The descriptions of the features of the peak PRG graphs are well done. See response to Question 4 regarding improvements that could be made to the reporting of the peak PRG value. • It would be helpful for the user guide to clarify how the peak PRG values for the different pathways are combined if they occur at different times. For example, if the external radiation risk and the produce ingestion risk have peak risks at different times, is the peak risk for each combined (even if they do not occur at the same time) or is the overall peak PRG calculated based on the time of the peak risk?	●See response above ●Added sentence clarifying that the highest peak exposure for all pathways combined and some seperate pathways (e.g., external, soil ingestion, food ingestion, and inhalation) may differ.
Pinkston	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"	• No comments	No change
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	• Consider if the last sentence should say " Please contact your EPA regional risk assessor before <u>using</u> post processed PRG calculator results…"	Made change
		2.8.2 "Replicating the Old +D PRGs"	• No comments	No change
Pinkston	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.	• No comments	No change

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	• More clarity is needed for which PRG value should be used when the model is run in the period of peak risk mode. The correct value to use seems to be the value in the yellow box at the bottom, but that could be made clearer. It is also unclear what the PRGs in the box above (e.g., "Resident PRGs for Soil") correspond to. It would be helpful if the PRG output file and/or the user guide to have an explanation of what these values correspond to. • The yellow box with the peak PRG value appears at the bottom of the results below a lot of information. The results page would be more usable if this key output information were presented closer to the top of the page. • It is unclear what the reported risk values mean when the model is run with the "select risk output" option turned off given that input concentrations are not provided. Are these risks for a unit concentration? Similarly, it is not clear what is meant by the relative risk (i.e., relative to what?). It would be helpful for a description of what is meant by these reported risk values to be included in the output file and/or the user guide. • It is overall not always clear what media a PRG is for (e.g., is the PRG a remediation goal for soil? for fish?, etc). It would be helpful throughout the output to include what the media is in the units (e.g., report pCi/g-fish, pCi/g-soil instead of just pCi/g). • The way the PRG components are reported for the different pathways (ingestion of soil, ingestion of produce, etc) is a little confusing. Presenting these values as PRGs for the component make it appear that the PRG should be used as the remediation goal for the component (e.g, the produce). Based on the equations in the user guide, it appears that these PRGs represent the contribution from that pathway to the overall PRG though. It would be helpful to have clarification on what these values mean in the user guide and/or the results. • In the output for the peak risk PRG, the first line in the yellow box says "Peak PRG for Cs-137 @ PRG units". It appears that the units need to be added here instead of the word "units".	●It's correct that the yellow box contains the PRG values that should be used. The format has been revised to emphasize these key PRGs. ●No change. All of the Superfund calculator tools provide the results after other information ●The hover box for "risk output" has been made clear that it is for "providing a risk estimate for concentrations of contaminants entered by the user". ●No change. The media for the PRG is presented in multiple locations. Each of the 7 radiation and 2 chemical calculators has a similar format for describing media. ●Text has been added to the User Guide explaining that having seperate PRGs by pathway facilitates the User seeing which components are risk drivers which may help them determine where to focus any efforts on obtaining site-specific information. ●This has been changed to say "Peak PRG for Cs-137 pCi/g"
Pinkston	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	• See answer to question 4	See response above
Pinkston	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	• It is not clear how multiple applicable PRGs should be combined when determining remediation goals for a site. For example, how should a user combine the groundwater and soil PRGs for a site that has soil contamination that could reach the groundwater. Similarly, it is not clear how the PRGs would be determined for a site that has existing contamination of multiple media (e.g., soil, air, fish). It is similarly not clear how PRGs should be applied when multiple radionculdes are present (e.g., is a sum of fractions approach used?). Finally, it is not clear how chemical risk PRGs should be combined with the PRGs for radiological risk. The user guide should include this information or include a link to other documentation that describes this.	Language has been added to section 2.6 of the user guide.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Pinkston	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	• The reporting of the equations used in the model is thorough. The usability of these equations and associated documentation would be improved if the variables were defined when first used in the equations. Table 1 contains this information, but scrolling back and forth to the table was time consuming. Also, consider moving the link to Table 1 to the top of the the sections with the equaitons in the user guide to make it easier for the user to locate.	No change. The nesting structure of how the User Guide is coded would make this very difficult.
Pinkston	7	Do the results provide defensible explanation of how they were derived, or are they the result of a "black box"? Do you recommend anything different?	• Editorial: Check hyperlinks in the PDF user guide. For example, the link to the FAQs on the first page appears to be broken as do some other links, including links to other sections of the PDF document. • Editorial: The following link goes to an empty web site: https://epa-prgs.ornl.gov/radionuclides/download.html • Editorial: The user guide would be more user friendly if a table of acronyms was added. • Editorial: Section 2.2.1 "SE" is not defined on its first usage	●The hyperlinks have been fixed. ●The download page will be replenished with results after the peer review changes have been implemented. ●No change. Most of the acronyms are widely used in the Superfund program. ●SE has been defined.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Abu-Eid	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	The peak PRG models presented in the “Guidance” for different exposure scenarios are comprehensive and could be appropriate to use as a screening tool for evaluation of potential risks to maximally exposed members of the public, assuming that such exposure scenarios occur within a long-term timeframe evaluated encompassing the peak (highest) activities of the specific parent radionuclide and its decay progenies. In this context, the model approaches are highly conservative and include high uncertainties in risk assessment. The models may somehow represent our state of knowledge, but without consideration of uncertainties and site-specific conditions. The input parameters for the different exposure models were based on certain pathway exposure assumptions, selected default physical and behavior parameters, as well as default exposure duration parameters. The selected default physical parameters and food consumptions relied heavily on IAEA listed parameters in “IAEA Technical Report Series No. 472, Handbook of Parameter Values for the Prediction of Radionuclides Transfer in Terrestrial and Freshwater Environments;” IAEA, Vienna, 2010. It should be noted that Technical Report N0. 472, was essentially based on IAEA TECDOC-1616 (IAEA 2009) considering global data from different sources. The citation presented in the text is good. However, it lacks certain important aspects as indicated below. The models in general can be enhanced by considering the following suggestions and recommendations: a) Consider more recent studies and updates of parameters as provided in NRC’s NUREG/CR-7267 (Default Parameter Values and Distributions in RESRAD-Onsite V 7.2; RESRAD-BUILD V3.5; and RESRAD-OFFSITE V4.0,NRC, February 2020; (b) Elucidate how the default parameters were selected including probabilistic distributions, if any, or data from which parameters were selected and basis for such selection. Need also to address uncertainties and how such uncertainties would impact risk results; (c) Need to integration plausible exposure pathways in the scenario models. For example, exposure pathways from drinking groundwater and irrigation of crops by contaminated water drawn from a well onsite may need to be integrated with “Resident,” and/or “Farmer” exposure scenarios. Such pathways could impact the risk/dose from ingestion of homegrown ingestion products. In addition, surface water and source erosion models need further elaboration and discussion. (d) Groundwater transport of radionuclide from the source to the aquifer are over simplified relying mostly on leach rates and retardation factors. In many cases, such transport methodology and assumptions could be inaccurate and lead to high uncertainties in the risk assessment approach. (e) The PRG models and guidance are unclear regarding when and where the PRG screening approach could be used and under what site conditions could prohibit using screening due to complexity of the contaminated site being evaluated. (f) Benchmarking of the peak PRG models used for different exposure scenarios with other codes/models such as DandD screening code and RESRAD codes could be useful.	a) EPA will be incorporating transfer factors from the new 2021 document from IAEA "TECDOC-1979." The NUREG/CR-7267 and RESRAD sources did not seem to be an appropriate replacement for authoritative source document such as the IAEA TRS 472. b)No change. EPA provides links to the sources of the default parameters. The user generally does not need to know how they were derived but can look it up if interested. That information won't change whether it makes sense for them to gain site-specific information to change from a default. c)No change. The CERCLA scenarios are adequately explained in the User Guide. d)No change. The soil to groundwater scenario is supposed to be a very simple conservative approach. EPA provides a chapter in the Soil Screening Guidance for Radionuclides on using more sophisticated soil to groundwater models including a technical analysis of such models. e)Language has been added to section 2.6 of the user guide about the role of the PRG calculator in the CERCLA risk assessment process. f)A benchmark study would be more useful if conducted by an overarching authority such as IAEA or the EU which have done it for other situations and were able to engage model developers in different countries. While the information may be interesting, EPA's policy goal is consistency with how its chemical risk assessment calculators, not other agency's radiation tools.
Abu-Eid	1a	Resident, in particular the consumption of home grown food	The pathways are acceptable, except for lack of groundwater pathways including drinking from a well onsite and irrigation of plants and livestock from contaminated groundwater. (b) basis for selection of parameters, distributions, and uncertainties in the selected parameters.	No change. Soil and groundwater scenarios are generally evaluated seperately in Superfund risk assessments. In the Farmer scenario, the irrigation water is contaminated. The source of the contamination is not relevant to the calculations.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Abu-Eid	1b	Indoor Worker	Pathways are ace[table; (b) occupancy parameters and duration exposure need to be explained; (c) atmospheric transport of source is relying on mass loading factor which is dependent on several factors that need to be addressed; may need to address potential use of resuspension factor.	No change. Links in Table 1 and Reference section of User Guide are provided to sources of defaults. It was an EPA policy determination during cleanup after the World Trade Center incident, that was carried over to the BPRG calculator, not to estimate resuspension of indoor dust due to the variability with different residence and businesses.
Abu-Eid	1c	Outdoor Worker	The selected pathways may be acceptable, however indoor/outdoor atmospheric transport models for transport from contaminated source on building surface need to addressed (see for example NUREG/CR-5512 and RESRAD-BUILD Model).	No change. Section 2.6 of the User Guide discusses use of transport models with the PRG calculator and refers the user to additional EPA guidance on this subject.
Abu-Eid	1d	Composite Worker	The selected pathways may be acceptable, however indoor/outdoor atmospheric transport models for transport from contaminated source on building surface need to addressed (see for example NUREG/CR-5512 and RESRAD-BUILD Model).	No change. Section 2.6 of the User Guide discusses use of transport models with the PRG calculator and refers the user to additional EPA guidance on this subject.
Abu-Eid	1e	Construction Worker (site-specific only)	Agree that site-specific model needs to be appropriately developed	No change
Abu-Eid	1f	Recreator (site-specific only)	agree that site-specific model needs to be appropriately developed	No change
Abu-Eid	1g	Farmer, in particular the consumption of home grown food	Farmer model should incorporate all groundwater and surface water pathways and consider source depletion due to erosion	No change. The use of contaminated water, soil, and the transport from soil to groundwater are evaluated seperately in the Superfund framework, both for radiological and chemical contaminants. Source depletion, other than radioactive decay, is not estimated in the RME exposure scenarios. This is generally a conservative assumption, but is considered consistent with the framework.
Abu-Eid	1h	Soil to Groundwater	This model needs to address GW contaminant transport in the unsaturated zone properly and if necessary, contaminant transport in the aquifer including potential for offsite transport to an off-site receptor.	No change. Section 2.6 of the User Guide refers User to guidance on using a more sophisticated soil to groundwater model.
Abu-Eid	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	The choice of radionuclides decay chains is appropriate based on supportable reasoning applicable to EPA issues at CERCLA facilities. The default factors may need to be updated and justified including explaining uncertainties in the available data and basis for selection of the defaults.	No change. The EPA Exposure Factor Handbook presents the confidence limits and the RME cases are selected. The user can determine the range of the values for uncertainty if they are conducting an uncertainty analysis.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Abu-Eid	3	Is there anything you would suggest to improve the user's guide? In particular:	· The user guide needs to explain in detail the conditions at the site(s) that allow use of the peak PRG screening methodology and when such methodology is inappropriate to use for certain complex site. For example, NRC's NUREG-1757 may allow using DandD Screening analysis code/method with the code defaults for simple sites characterized with surface contamination in the top 15 cm of soil (e.g.; with no volumetric contamination) and with no significant GW or surface water pathways associated with risk/dose impact. In other words, large volumes of radionuclide contamination in subsurface as a well as in GW transport pathways may prohibit using the screening analysis as uncertainties would be so large and risk results would be meaningless.	No change. Section 2.6 of the User Guide refers User to the consultation process if considering another model for risk assessment in lieu of the PRG calculator for all or a portion of the risk assessment.
Abu-Eid	3a	Section 2.5 "Biota Modeling"	· See also remarks and suggestions/recommendation under above items 1(a) – 1(g).	see above
		Subsection 2.5.1 "Produce Modeling"	Twenty-two Individual PRGs were developed with specific intake rates and transfer factors. Intake rates are also influenced by soil-to-plant transfer factors and by mass loading and/or resuspension factor that are dependent on soil type, irrigation type/mode, field cultivation activities, and local climatic conditions. Therefore, uncertainties in the established defaults are anticipated to be quite large. I suggest establishing distribution of such parameters, truncate distributions based on conditions under evaluation, and assess uncertainties in risk analysis based on probabilistic analysis. It seems unrealistic not to consider variabilities in transfer factors or mass loading factors focusing on approximate deterministic consumption rates.	No change. Users can alter the default values with justification, such as conducting site-specific studies of local consumption to alter default ingestion rates, or having site-specific transfer factors developed.
		Subsection 2.5.2 "Animal Product Modeling"	Produce modeling relied on transfer factors from IAEA data as the primary source. I endorse the approach of considering the soil type when selecting soil-to-pant transfer factors. Secondary source data (e.g.; RESRAD) were mentioned for possible use without discussion. I suggest looking at updated review of recent data and distributions of soil-to-plants transfer factors to assess uncertainties as provided in NRC's NUREG/CR-7267 (see also comments 1a). Further, the mass loading factors used are largely uncertain and depend on resuspension and deposition factors that are also largely variables.	The User Guide explains that EPA used a hierachy, first IAEA, then if not available for an element and a plant or animal, use UK EA data, then use RESRAD. The approach taken for MLFs was discussed with IAEA and UK EA experts, as well as EPA Superfund risk assessment experts. EPA is not aware of any authoritative source for MLF values.
Abu-Eid	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	The PRG Outputs do not provide a distinction between "Screening Outputs" and "Site-Specific Outputs." As indicated in the guidance, the PRG calculator provides an option to select risk output. In the calculator, select yes if risk output is desired. Selecting risk output requires the calculator to be run in "Site Specific" mode. It is unclear how to assess risk with some variation of inputs to have risk as an output using screening analysis. The "Soil to Groundwater" medium does not have risk output and the risk option will become disabled when selected. It is unclear how to assess risk based on contaminant transport through water flow into the soil to groundwater in the unsaturated and saturated zones. As indicated in the guidance, the risk values presented as radionuclide-specific values for individual contaminants (e.g.; in air, water, soil and biota) may warrant further investigation to assess site cleanup limits.	On the results page, any site-specific change to default inputs are found in the column "Form-Input Value" and yellow highlighted. This has been relabeled to "Site-Specific Value." No further change. In the Superfund framework, the "Risk Output" is used for making risk estimates, such as early in the process conducting a baseline risk assessment. Screening with the PRG calculator is setting a concentration, usually that corresponds to 1 x 10-6 risk for an isotope, then evaluating whether some portions or all of the site have concentrations of the contaminant below the screening level. If so, the contaminant can be screened out from further investigation.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Abu-Eid	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"	i) "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	No change
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	Response: No comments, need further study	No change
		2.8.2 "Replicating the Old +D PRGs"	May work for short time decay progenies (e.g.; t ½ < 100 years), may need to assess each progeny risk and transport as independent considering decay scheme of the parent and considering specific physical behavior and risk of each progeny	No change.
Abu-Eid	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.	This applies to “Radon” and “Thoron” progenies which needs more detailed risk analysis.	No change. There is a detailed analysis on the relationship between equilibrium levels of radon, thoron, and actinon progenies that is referenced in this section of the User Guide.
Abu-Eid	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?	The results are clear when running the PRG calculator. It would help providing example(s) of the results in the “Guide” for common scenarios applicable to CERCLA sites. It would also be helpful to compare results with other Agencies screening values for similar exposure scenarios.	EPA is considering online training that may include tutorials for various land use scenarios. EPA includes this in the 8 hour classroom training it conducts on the various Superfund radiation calculators.
Abu-Eid	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	4a) In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	No change.
Abu-Eid	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”	Recommend: (1) Addressing uncertainties in input data of physical and behavior parameters and consequence risk outputs; (2) Bench-mark results vs. known models used on national and international arenas; (3) Compare with results obtained using other Federal agencies risk models/codes; (5) consider using “Total Effective Dose Equivalent (TEDE)” derived conversion factors (DCFs) when dealing with radionuclides risks.	(1) to (3) are addressed in responses to other comments. (5) No change. Use of TEDE converted to risk rather than slope factors would lead to unnessary inconsistency to how EPA conducts risk assessments of chemical carcinogens, which are summed with the radionuclide risk. This policy is explained in the EPA guidance "Radiation Risk Assessment At CERCLA Sites: Q & A" see "Q25. How should radionuclide slope factors and dose conversion factors be used?" at this URL https://semspub.epa.gov/work/HQ/176329.pdf. This would also be inconsistent with recommendation in the federal agency consesus document "A Method for Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)" that slope factors should be used for comprehensive risk assessments such as at CERCLA sites, this document may be found at: http://www.iscors.org/doc/RiskTEDE.pdf

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Abu-Eid	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?	The results may be defensible to explain how they were derived using risk-slope factors; however, they could be highly uncertain and rather conservative. To improve the utility and accuracy, I suggest addressing uncertainties in input physical and behavior parameters and limiting screening approach with input defaults to simple sites and transition to site specific risk analysis for complex site analyzing available characterization data or the need for additional data to conduct more accurate risk assessment.	No change. The PRG calculator allows the User to replace default values with site-specific values.
Abu-Eid	7	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?	Conduct comparative analysis and further discussions on radiological risk analysis and risk assessment sing other models, tools, and approaches used by other Federal agencies.	No change. EPA did have several compartive analysis studies conducted of radiation tools which may be found at this URL https://epa-prgs.ornl.gov/radionuclides/prg_comparison.html. EPA in the future may consider further such studies.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Avila	1	Are the peak PRG models for the following scenarios comprehensive and accurate, and do they represent the current state of knowledge? Are they supported appropriately by citations? If not, what do you recommend?	In general the models are fit for purpose, except for the models for H-3 and C-14. In my opinion special models should be used for these radionuclides base on IAEA-TR-1616 [4].	No Change. EPA is evaluating the C-14 and H-3 specific activity models for use in the PRG calculator by reviewing BIOPROTA and other similar guidance. In the meantime, the updated Biota TM provides further justification for the 2% from a reputable carbon expert and includes a section for H-3 as well.
Avila	1a	Resident, in particular the consumption of home grown food	i) The models cover all important exposure pathways. ii) For inadverted soil ingestion and inhalation of particles the model does not consider that soil particles that are ingested and inhalaled are of smaller size (finer) than the average. For example in IAEA SRS 44 [1], it is assumed that for material other than metal, the activity concentrations in the respirable fine fraction are a factor of 4 higher than the average for the material. For the dust that is subject to direct ingestion, a factor of 2 is assumed inbecause this pathway on the average refers to coarser particles. These numbers are based on comprehensive investigations carried out on soillike material in Germany [2]. The chosen factors in IAEA [1] do not correspond to the maximum values observed in these studies, but they are considered reasonable assumptions for covering the broad majority of materia. iii) For H-3 a volatilization factor is considered instead of emissions of particles, but there are some other radionuclides that can be released from the soil in gas form, such as C-14. iv) For H-3 and C-14 concentrations in food is commonly calculated using specific activity models, rather that with transfer factors, see for example IAEA [3]. **References: [1]** IAEA 2005, Derivation of Activity Concentration Values for Exclusion, Exemption and Clearance, IAEA SRS 44, 2005**, [2]** GERMAN FEDERAL MINISTRY FOR THE ENVIRONMENT, NATURE CONSERVATION AND NUCLEAR SAFETY (BMU), Berechnungsgrundlagen zur Ermittlung der Strahlensexposition infolge bergbaubedingter Umweltradioaktivität, Berechungsgrundlagen-Bergbau, Bonn (1999), **[3]** IAEA TRS 472	i) No change ii) No change. This approach would differ from our Superfund guidance and our chemical RSL calculator. However, this comment has been forwarded to EPA staff that develop these recommended defaults for Superfund. iii) When considering future updates to the the PRG calculator, volatilization of C-14 may be considered. Currently volatilization of H-3 is part of the calculator. See section 4.10.1 of the user guide for more information. iv) No change. The model currently is limited to soil uptake and this is explained in the Biota Modelling Technical Manual.
Avila	1b	Indoor Worker		No change
Avila	1c	Outdoor Worker	See comments above about the modelling of inhalation and inadvertent soil ingestion.	See answer above
Avila	1d	Composite Worker	See comments above about the modelling of inhalation and inadvertent soil ingestion.	See answer above
Avila	1e	Construction Worker (site-specific only)	See comments above about the modelling of inhalation and inadvertent soil ingestion.	See answer above
Avila	1f	Recreator (site-specific only)	It is assumed that the transfer factor for game is the same as for beef. This is not a good assumption taking into account that game can vary in sizes and in the diet. Transfer factor values specific for game can be found in the literature. The transfer factors could also be derived using kinetic-allometric models.	No change. EPA is evaluating adding in game species as a subsequent revision to the PRG calculator.
Avila	1g	Farmer, in particular the consumption of home grown food	See above comments for the resident scenario. The irrigation model might not be appropriate for C-14 and H-3.	No change. EPA will evaluate the current irrigation model used in the PRG calculator for C-14 and H-3.
Avila	1h	Soil to Groundwater	The two methods presented are appropiate. It would be useful to provide more explanation about the conservatism of both methods.	New language has been added to the user guide that provides additional explanation on the conservatism of both methods.

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Avila	2	Is the choice of radionuclides and how decay chains are addressed appropriate and based on supportable reasoning? If not, what do you recommend? Are the standard recommended default factors adequately explained, sourced, and reasonable?	The choice of radionuclides and how decay chains are addressed in appropiate and understandable. The recommended default factors are adequately explained, sourced and reasonable.	No change
Avila	3	Is there anything you would suggest to improve the user's guide? In particular:		
Avila	3a	Section 2.5 "Biota Modeling"	The approach presented in Section 2.5.4 for derivation of transfer factors for carbon is not convincing. For example no reference is given for supporting the assumption that 2 % of the carbon in plabts comes from the soil. The values used in the derivation experience a large variation from site to site, for example the organic content of soil is very variable. Transfer factors are not recommended for C-14, see for example IAEA [4]. I understand that the reason for using a tansfer factor for C-14 is to be able to use the same model for all radionuclides. I recommend that if a transfer factor is used for C-14, then it is derived using a specific approach model. In this way different values can be derived for different types of plants, soils and climatic conditions. During the last years substantial development in the modelling of C-14 has been achieved (see for example the BIOPROTA project [5]. **References: [4]** IAEA TR-1616, **[5]**	No Change. EPA is evaluating the C-14 and H-3 specific activity models for use in the PRG calculator by reviewing BIOPROTA and other similar guidance. In the meantime, the updated Biota TM provides further justification for the 2% from a reputable carbon expert and includes a section for H-3 as well.
		Subsection 2.5.1 "Produce Modeling"	See comments above about the use of TF for C-14. It is recommended that special models are used for H-3, as recommended in IAEA [4].	See answer above
		Subsection 2.5.2 "Animal Product Modeling"	The use of animal transfer factors for C-14 and H-3 is not recommended. For H-3 the models consider the form in which H-3 is present (HTO or OBT), see IAEA [4].	See answer above
Avila	3b	Section 2.2.1 "PRG Output Option #1" and its discussion of Peak PRG	The "PRG Output Option #1" is clearly explained. I did not understand why for radionuclides that decay straight into stable isotope the peak and secular equilibrium PRG differ (see second table in Section 2.2.5).	No change. This is discussed in the User Guide.
Avila	3c	Section 2.8 "Advanced Calculator Uses (Postprocessing and Replicating Discontinued PRG Options)"	This option is clearly explained	No change
		2.8.1 "Postprocessing Calculator Results to Incorporate Site-specific MCNP Factors"	This option is clearly explained	No change
		2.8.2 "Replicating the Old +D PRGs"	This option is clearly explained	No change
Avila	3d	Section 4.10.9 "Air Exchange Rates and Activity Equilibrium Factor (A_{eq})" and its discussion of the tapwater inhalation scenario.	This is clearly explained	No change

PEER REVIEW CHARGE RESPONSES: PRG Calculator UPDATE				
Commenter	**Charge Question No.**	**Charge Question**	**Response**	**EPA Response**
Avila	4	Are the results of the calculator clearly explained and presented for these scenarios? If not, what do you recommend?		
Avila	4a	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”		
Avila	5	In particular, we are interested in your review of the calculator results when selecting the PRG Output Option “Peak PRG”		
Avila	6	Are the results appropriately described and qualified (to the extent that they may be relied upon and defended? If not, what do you recommend?		
Avila	7	Do the results provide defensible explanation of how they were derived, or are they the result of a “black box”? Do you recommend anything different?		