DRINKING WATER PROTECTIVE ACTION GUIDE
Meeting with NGOs

- EPA is releasing **non-regulatory guidance** that authorities can use to protect residents from experiencing the harmful effects from radiation in drinking water following a **nationally significant radiological emergency**.
- EPA is recommending a two-tiered drinking water PAG of:
  - 500 mrem projected dose, for one year, to the general population
  - 100 mrem projected, for one year, to the most sensitive populations (e.g. infants, children, pregnant women and nursing women).
- The PAG does not affect EPA's drinking water standards for radionuclides.
- Affected public water systems must take actions to return to drinking water regulatory limits as soon as practicable.

Background:

The drinking water Protective Action Guide provides levels that can be used to determine when alternative drinking water should be provided and the use of contaminated water supplies should be restricted. The drinking water PAG provides doses of radiation that should be avoided during an emergency event. The radiation doses provided in the PAG do not represent acceptable routine exposures. PAGs trigger safety measures—in this case, provision of alternative drinking water -- to keep doses to the public as low as possible during nationally-significant emergency situations.

The purpose of EPA's Protective Active Guide (PAG) for Radiological Incidents is to guide short-term planning and decision-making efforts by local and state officials during nationally significant radiological emergencies, such as an accident at a nuclear power plant or a fire at a nuclear fuel facility. The PAG does not modify EPA's drinking water standards for radionuclides in any way. Water systems exceeding standards, regardless of the reason, are in violation. EPA expects that the responsible party for any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act (SDWA) maximum contaminant levels as soon as practicable. This guidance does not address or impact actions occurring under other statutory authorities such as the United States Environmental Protection Agency's (EPA) Superfund program, the Nuclear Regulatory Commission's (NRC) decommissioning program, or other federal or state programs.

Public Comment:

EPA published its proposed Drinking Water PAG in the Federal Register on June 10, 2016. In response to the proposal, EPA received approximately 60,000 comments during the public comment period, which ended on July 25, 2016.

A large portion of the comments were sent as part of 2 mass mailing campaigns which are opposed to the PAG proposal. In addition to the mass mailing campaign EPA reviewed close to 2,000 distinct comment letters. Out of these, about 100 substantive comments were addressed by EPA for this PAG effort. EPA received comments from the following organizations:

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Stakeholders Opposed to DW PAG	Stakeholders Supporting the DW PAG
• Attorney General State of New York • Nuclear Energy and Resource Service (NIRS) • Public Employees for Environmental Responsibility (PEER) • Food and Water Watch • Fairewinds Energy Education • Cape Downwinders • Public Watchdogs • Blue Ridge Environmental Defense League • Physicians for Social Responsibility - Chesapeake • Council on Intelligent Energy & Conservation Policy • Committee to Bridge the Gap • Sierra Club • Citizens Environmental Coalition • Beyond Nuclear • Physicians for Social Responsibility – San Francisco • Nevada Nuclear Waste Task Force	• New York City Department of Environmental Protection • Illinois Emergency Management Agency (IEMA) • Conference of Radiation Control Program Directors • American Water Works Association (AWWA) • Nuclear Energy Institute (NEI) • Health Physics Society • Sandia National Laboratories

Concerns Raised During Public Comment:

- **EPA is relaxing its SDWA standards by allowing a significant increase in dose values and corresponding radionuclide concentrations:**
  "Although the current SDWA limits for radionuclides in water are 4 millirems (mrem) per year, the EPA proposes PAGs for drinking water to be as much as 500 mrem per year for the general population (or 100 mrem for pregnant/breastfeeding women, and children under 15). These levels are 125 and 25 times higher than the SDWA's recommended annual radiation dose."

  "the default DRLs would allow higher radioactive concentrations than those proposed in 2008, and thousands of times higher than current legal limits, and would allow the general population to drink water hundreds to thousands of times more radioactive than is now legal."

<u>Recommended EPA Response:</u>

EPA is not relaxing its drinking water standards for radionuclides as a result of the DW PAG. The drinking water PAG is non-regulatory guidance for nationally significant radiological emergencies only. Public water systems must comply with EPA's National Primary Drinking Water Regulations for Radionuclides. Water systems are expected to take corrective measures to meet radionuclide standards as soon as practicable and are in violation of SDWA until they do so. There is indeed an associated increase in the concentration of radionuclides that could yield a dose of 500 or 100 mrem versus a 4 mrem dose. However, these levels are used for different purposes.

- **Bush PAGs versus Obama PAGs**
  "EPA has now reversed itself again, and is proposing water PAGs orders of magnitude higher than its longstanding MCLs under the Safe Drinking Water Act and that are even more troubling than were

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those proposed in the last days of the prior administration. And similar to 2009, EPA again is apparently cutting corners in terms of transparency and public process in order to push through these worrisome proposals in the last months in office."

Recommended Response:

The 2009 drinking water PAG was obtained through a FOIA request, and were never proposed by EPA. For the 2016 proposal different assumptions were used, such as ingestion rates.

- **Duration of event/duration of PAGs in effect & PAGs could cover all radiological releases not only catastrophic nuclear emergencies**
  "the Water PAGs are for the intermediate phase of a release, not the immediate or early phase. The intermediate phase is defined as "the period beginning after the source and releases have been brought under control (has not necessarily stopped but is no longer growing) and reliable environmental measurements are available for use as a basis for decisions on protective actions and extending until these protective actions are no longer needed." Thus, the Water PAGs are not restricted to use in catastrophic events and are not even applicable to the emergency phase of such events. Rather, they apply by their own terms to any radiation release for which actions to protect the public might be contemplated."

Recommended Response:
The PAG manual defines a radiological incident as an event or a series of events, deliberate or accidental, leading to the release or potential release into the environment of radioactive materials in sufficient quantity to warrant consideration of protective actions. PAGs are appropriate for use during a nationally significant radiological incident, such as a disaster at a nuclear power plant, detonation of a radiological dispersal device or an improvised nuclear device. The drinking water PAG assumes the duration of the event requiring protective actions should not exceed 1 year. EPA made additional statements in the chapter to clarify the one-year duration period.

Public Comments on the Proposed Drinking Water PAG

November 9, 2016, 2016

Summary of public comments on the proposed Drinking Water PAG
EPA published its proposed Drinking Water PAG on the Federal Register on June 10, 2016. In response to the proposal EPA received over 60,000 comments from the public during the public comment period which ended on July 25, 2016.

A large portion of the comments were sent as part of 2 mass mailing campaigns (see attached) which are opposed to the PAG proposal. In addition to the mass mailing campaign EPA reviewed close to 2,000 distinct comment letters. Out of these about 100 substantive comments were addressed by EPA.

EPA received comments from the following organizations:

Stakeholders Opposed to DW PAG	Stakeholders Supporting the DW PAG
• Attorney General State of New York • Nuclear Energy and Resource Service (NIRS) • Public Employees for Environmental Responsibility (PEER) • Food and Water Watch • Fairewinds Energy Education • Cape Downwinders • Public Watchdogs • Blue Ridge Environmental Defense League • Physicians for Social Responsibility - Chesapeake • Council on Intelligent Energy & Conservation Policy • Committee to Bridge the Gap • Sierra Club	• New York City Department of Environmental Protection • Illinois Emergency Management Agency (IEMA) • Conference of Radiation Control Program Directors • American Water Works Association (AWWA) • Nuclear Energy Institute (NEI) • Health Physics Society • Sandia National Laboratories

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Citizens Environmental Coalition • Beyond Nuclear • Physicians for Social Responsibility – San Francisco • Nevada Nuclear Waste Task Force	

Common Issues Raised by Stakeholders on the DW PAG proposal:

- **EPA violates Executive Orders 12898 and 13045**.
  "The proposed PAGs violate the Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898) 59 FR 7629 (Feb 16, 1994) and Executive Order on Protection of Children From Environmental Health Risks and Safety Risks (EO 13045) 62 FR 19885 (Apr 23, 1997)."

Recommended EPA Response:
These comments do not create any new legal issue specific to the drinking water PAG.

On the EJ issue, OAR's position is that the guides are better than what exists now and should improve the situation for everyone so there is no EJ concern. In addition during a radiological contamination incident widespread areas and/or entire communities could be impacted, as a result there should not be disproportionate impacts to specific segments of the population. As for the Executive Order dealing with Protection of Children, EPA believes it has complied with it, since in its proposal EPA specifically recommended a more protective PAG level for children to address the higher sensitivity of children to radiation exposure.

- **EPA violates the National Environmental Policy Act (NEPA)**.
  " There is question about conformance with the National Environmental Policy Act (NEPA), which requires review of environmental impacts of all major federal actions that can have a significant impact on the human environment. EPA establishing extremely high radioactivity concentrations and radiation doses below which no protective actions are to be taken could have significant impacts on the human environment, and these are not analyzed in an Environmental Impact Statement or Environmental Assessment"
  "Furthermore, it appears that EPA staff developed the Guides outside of the Administrative Procedure Act framework for rulemakings and in violation of the National Environmental Policy Act."

Recommended EPA Response:
EPA position is that the drinking water PAG action satisfies NEPA because the technical analyses, the documentation and the review procedures conducted by EPA for the development of federal radiation regulations and guidance in accordance with the Atomic Energy Act of 1954 are functionally equivalent to NEPA. Courts have consistently recognized that EPA procedures or environmental reviews under enabling legislation are functionally equivalent to the NEPA process and thus exempt from the procedural requirements in NEPA. (63 Fed. Reg. 58045 [1998]).

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- **EPA violates the Administrative Procedures Act (APA).**
  "The proposed PAGs appear also to be essentially underground regulations, in violation of the Administrative Procedure Act (APA). Adding a phrase or two asserting that the PAGs are not regulatory and are denominated as "guidance" does not change what they really are, de facto rules. There is no pretense that the PAGs are in fact not used. Indeed, the Federal Register notice of availability of the draft PAGs states explicitly, "Emergency management officials use PAGs for making decisions regarding actions to protect the public from exposure to radiation during an emergency." EPA requires incorporation of the PAGs into emergency response plans within one year of the finalization of the PAGs:
  Furthermore, as noted above (supra at 5), EPA appears to have violated the APA notice-and comment requirements by hiding 107 of the 110 proposed PAG values for radionuclides without decay and all 110 of the proposed PAG values with decay. The public cannot comment on what they cannot see. EPA has asked for public comment on Water PAGs that it says will be established only after the PAGs are finalized, defeating the entire purpose of APA notice-and comment requirements."

Recommended EPA Response:
EPA does not agree with the assertion made by commenters regarding the APA notice and comment requirements. The PAGs are non-mandatory guidance and are not binding rules; notice and comment is not required. In addition, EPA provided all relevant and necessary information, assumptions, and technical methodology to derive response levels for all radionuclides. With the information EPA provided interested stakeholders and emergency response officials can calculate derived response levels for all radionuclides listed in Federal Guidance Report #13 (about 800 in total). EPA provided sample calculations to serve as an illustration of the methodology for three radionuclides (the three most likely to be seen during a radiological emergency). Further, dose conversion factors, calculation methodologies as well as other comprehensive information regarding DRL development will be available and updated as needed in the Federal Radiological Monitoring and Assessment Center "FRMAC" Assessment Manual. FRMAC is responsible for coordinating and managing all federal radiological environmental monitoring and assessment activities, within the United States during a nuclear or radiological contamination incident.

- **EPA is relaxing its SDWA standards by allowing a significant increase in dose values and corresponding radionuclide concentrations:**
  "Although the current SDWA limits for radionuclides in water are 4 millirems (mrem) per year, the EPA proposes PAGs for drinking water to be as much as 500 mrem per year for the general population (or 100 mrem for pregnant/breastfeeding women, and children under 15). These levels are 125 and 25 times higher than the SDWA's recommended annual radiation dose."

  "the default DRLs would allow higher radioactive concentrations than those proposed in 2008, and thousands of times higher than current legal limits, and would allow the general population to drink water hundreds to thousands of times more radioactive than is now legal."

Recommended EPA Response:
EPA is not relaxing its drinking water standards for radionuclides as a result of the DW PAG. The drinking water PAG is non-regulatory guidance for nationally significant radiological emergencies only. Public

water systems must comply with EPA's National Primary Drinking Water Regulations for Radionuclides. Water systems are expected to take corrective measures to meet radionuclide standards as soon as practicable and are in violation of SDWA until they do so. There is indeed an associated increase in the concentration of radionuclides that could yield a dose of 500 or 100 mrem versus a 4 mrem dose. However, these levels are used for different purposes.

- **Water PAG is equivalent to 250 Chest X-Rays**
  "a single a chest X-ray emits anywhere from 14 mrem to 2 mrem per a single exposure. That means that the new guidance would permit radiation exposures equivalent to 36 to 250 chest X-rays a year for the general population, and 7 to 50 chest X-rays for pregnant/breastfeeding women and children."

Recommended EPA Response:
These comments are noted, single exposure X-rays range from 1.5 mrem for dental exposure to 10 mrem for single chest exposure to 70 mrem for pelvis exposure. On average, Americans receive a radiation dose of about 620 millirem each year. Half of this dose comes from natural background radiation. Most of this background exposure comes from radon in the air, with smaller amounts from cosmic rays and the earth itself. The other half (310 mrem) comes from man-made sources of radiation, including medical, commercial, and industrial sources.
The drinking water Protective Action Guide is a health-based value that can be used in the event of a nationally significant radiological emergency to determine when alternative drinking water should be provided and the use of contaminated water supplies be restricted. The drinking water PAG are doses of radiation that should be avoided during an emergency event. They do not represent acceptable routine exposures. PAGs trigger safety measures—in this case, provision of alternative drinking water -- to keep doses to the public as low as possible during emergency situations.

- **EPA did not considered cumulative impacts and risks**
  "A fundamental error of environmental impact analysis is to artificially segment the components of the project, which in turn can severely underestimate the environmental effects it can produce. One cannot slice and dice environmental impacts into little pieces and consider only each individual component without considering the whole. Here, the Water PAGs are merely one component of the overall proposal and total radiation exposures contemplated as allowable under the PAGs as a whole."

Recommended Response:
In developing the drinking water PAG, EPA considered the potential for cumulative exposure. PAGs do not represent "acceptable" routine exposures in the way that environmental standards such as MCLs do. PAGs are guidance levels to support emergency decision making by response authorities to avoid unnecessary radiation exposure. Development and implementation of PAGs is always guided by three basic principles: Avoid acute effects, minimize cancer risk, and ensure the actions taken are not more dangerous than the risk being avoided. While the PAGs for various media/pathways are separate, emergency management officials should consider all exposure routes when making protective action decisions in an emergency.

- **Drinking Water is included in the FDA food PAGs**
  "The draft Water PAGs assert that the "FDA food PAG accounts for water intrinsic in food as purchased and EPA's proposed PAG accounts for drinking water, including water added to foods

during preparation." This is inaccurate. The FDA food PAGs (incorporated into the EPA 2013 PAGs) states that its intervention limits are based on the total diet and "the 'entire diet' includes tap water used for drinking."

Recommended Response:
EPA's authorities are separate from FDA's. Whereas the FDA food PAG is relevant for food, EPA's drinking water PAG accounts for possible contamination in the drinking water supply.
The water and food ingestion routes are inherently related because water may be used in the preparation of some food products and radionuclides in water will affect crops and ultimately enter the food supply. However, a strict delineation between the water and food ingestion routes is not straightforward and there are inherent differences in how the food and water supplies are protected. As a result, the intervention/response levels for water and food may differ. Once an event occurs and the actual contamination levels are known, incident-specific factors might be used. The FDA food PAG and the drinking water PAG are designed to complement each other, and allow emergency response officials to account for and address doses from both eating contaminated food and drinking contaminated water.
In implementation, the FDA and EPA PAGs provide protection in the same manner (i.e., via "derived levels" referred to as FDA DILs and EPA DRLs, and by avoiding exposure) but water is taken into account in different ways. The FDA DIL calculations include water as part of the total diet even though FDA does not regulate it. Correspondingly, the EPA DRL calculations account for water added to beverages and to foods during preparation (but not water intrinsic in food) even though EPA does not regulate these. As such, these two approaches are from different perspectives but both account for the possibility that exposure could come from both ingestion routes (food and water). In application, these are pre-set default intervention levels that are subject to change should incident-specific circumstances warrant it.
A main difference between the FDA Food PAG and EPA's Drinking Water PAG is in the technical approach, in that the EPA PAG is based on newer definitions of dosimetry. There is no difference in protection because the underlying objective for both PAGs is to assure individuals will have no significant health risk from ingesting radioactive contamination.

- **Bush PAGs versus Obama PAGs**
  "EPA has now reversed itself again, and is proposing water PAGs orders of magnitude higher than its longstanding MCLs under the Safe Drinking Water Act and that are even more troubling than were those proposed in the last days of the prior administration. And similar to 2009, EPA again is apparently cutting corners in terms of transparency and public process in order to push through these worrisome proposals in the last months in office."

Recommended Response:
The 2009 drinking water PAG was obtained through a FOIA request, not released by EPA. For the 2016 proposal different assumptions were used, such as ingestion rates.

- **Duration of event/duration of PAGs in effect & PAGs could cover all radiological releases not only catastrophic nuclear emergencies**
  "the Water PAGs are for the intermediate phase of a release, not the immediate or early phase. The intermediate phase is defined as "the period beginning after the source and releases have been brought under control (has not necessarily stopped but is no longer growing) and reliable environmental measurements are available for use as a basis for decisions on protective actions and extending until these protective actions are no longer needed." Thus, the Water PAGs are not restricted to use in catastrophic events and are not even applicable to the emergency phase of such

events. Rather, they apply by their own terms to any radiation release for which actions to protect the public might be contemplated."

Recommended Response:
These comments are noted, the PAG manual defines a radiological incident as an event or a series of events, deliberate or accidental, leading to the release or potential release into the environment of radioactive materials in sufficient quantity to warrant consideration of protective actions. PAGs are appropriate for use during a nationally significant radiological incident, such as a disaster at a nuclear power plant, a radiological dispersal device or an improvised nuclear device. In the drinking water PAG proposal the assumption of duration of the event requiring protective actions states it should not exceed 1 year. EPA made additional statements in the chapter to clarify the one year duration period.

To: Beauvais, Joel[Beauvais.Joel@epa.gov]
From: Joshua Tallent
Sent: Mon 11/28/2016 3:35:22 PM
Subject: New York Attorney General Comment Letter; EPA Proposed Drinking Water PAGs
New York Attorney General Letter re RIN 2060-ZA19.pdf

Dear Deputy Assistant Administrator Beauvais:

Attached please find an electronic copy of a letter this office sent to the Office of Information and Regulatory Affairs at the Office of Management and Budget. The letter comments on the EPA's proposed Protective Action Guide for Drinking Water after a Radiological Event (81 Fed. Reg. 37,589). A paper copy of the letter will follow.

Yours truly,

Joshua Tallent

Assistant Attorney General

New York State Office of the Attorney General

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STATE OF NEW YORK
OFFICE OF THE ATTORNEY GENERAL

ERIC T. SCHNEIDERMAN
ATTORNEY GENERAL

DIVISION OF SOCIAL JUSTICE
ENVIRONMENTAL PROTECTION BUREAU

November 21, 2016

By Overnight & Electronic Mail

Howard Shelanski, Administrator
Office of Information and Regulatory Affairs
Office of Management and Budget
725 17th Street NW
Washington, D.C. 20503
OIRA_submission@omb.eop.gov

Re: RIN 2060-ZA19; EPA Protective Action Guidance for Radiological Incidents

Dear Administrator Shelanski:

On October 21 of this year, the United States Environmental Protection Agency (EPA) submitted the above-referenced draft guidance to the Office of Management and Budget for Office of Information and Regulatory Affairs (OIRA) review. The guidance, entitled "Draft Protective Action Guide (PAG) for Drinking Water," purports to establish acceptable levels of radiation in public drinking water supplies in the wake of a radiological incident. However, the draft guidance advances a much less protective standard for drinking water interdiction than is set forth in existing EPA guidance and in EPA regulations promulgated under the Safe Drinking Water Act. Because it would substantially, indefinitely, and unjustifiably increase New Yorkers' exposure to radioactive contamination in drinking water in the aftermath of a potential radiological incident, the State of New York Office of the Attorney General strongly urges that OIRA either disapprove the draft guidance now under review or, in the alternative, return the guidance to the EPA for further consideration.[1]

[1] The Office of the Attorney General expressed its concerns regarding the draft guidance to the EPA by letter dated July 25, 2016. See Letter from State of New York Office of the Attorney General to Joel Beauvais, Deputy Assistant Administrator for the Office of Water, EPA (July 25, 2016) (incorporated herein by reference). The EPA has not responded to these concerns.

By statute, the EPA must advise the President on radiation matters and must formulate radiation standards. See 42 U.S.C. § 2021 (h). The Federal Emergency Management Agency has promulgated regulations directing the EPA to develop protective action guides – PAGs – "for all aspects of radiological emergency planning" and to "[p]repare guidance for State and local governments on implementing PAGs, including recommendations on protective actions which can be taken to mitigate . . . potential radiation dose[s] to the population." 44 C.F.R. § 351.22 (a), (b) (1982). In 1992, EPA issued a PAG manual to "assist [public] officials in establishing emergency response plans and in making decisions during a nuclear incident." 1992 EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, at iii (hereinafter "1992 manual"). The 1992 manual noted that the EPA was "work[ing] to develop PAGs for drinking water." Id. Some 20 years later, in its 2013 update of the 1992 manual, the EPA declined to propose a "specific drinking water PAG"; instead, the agency indicated that response planners should, "to the extent practicable," base drinking water-related protective action decisions on the radiological contamination standards promulgated by the EPA under the authority of the Safe Drinking Water Act. 2013 EPA Protective Action Guides and Planning Guidance for Radiological Incidents, at 42 (hereinafter "2013 manual"). As relevant here, under the Safe Drinking Water Act, the EPA previously established a maximum contaminant level (MCL) of 4 millirem "annual dose equivalent to the total body or any internal organ" for beta- and photon-emitting radionuclides. See 40 C.F.R. § 141.66 (d).

In a significant departure from the position taken in the 2013 manual, the EPA now proposes to "protect the public" in the event of a radiological incident by abandoning its Safe Drinking Water Act-derived standard in favor of a substantially higher, less protective threshold for drinking water interdiction. 2016 EPA Draft Protective Action Guide (PAG) for Drinking Water, at 4 (hereinafter "2016 draft manual"). In the 2016 draft manual, the EPA "propos[es] a two-tiered drinking water PAG" to be "used during the intermediate phase following a radiation incident." Id. According to the manual, drinking water interdiction would occur only when radiological contamination levels exceed 500 millirem per year "committed effective dose" for the general population or 100 millirem per year "committed effective dose" for pregnant or nursing women and children aged 15 or younger. Id. at 4-5. These protective action thresholds are orders of magnitude less protective of public health than either the Safe Drinking Water Act-derived MCLs for radionuclides or the drinking water remediation standards applicable to radioactive contamination at Superfund sites. See 40 C.F.R. § 300.430 (e). Further, because they are intended for use during the "intermediate phase" of radiological incident response – that is, during the period after the acute release has been controlled but before large-scale remediation has begun – the draft PAGs effectively create a variance of indeterminate duration from Safe Drinking Water Act standards. In other words, application of the draft PAGs could allow federal and local emergency officials to permit citizens to be exposed to levels of radiation far above Safe Drinking Water Act limits for "many months" or even "years" following an accident. 1992 manual, at 1-3; see also 2016 draft manual, at 4.

As a procedural matter, OIRA should reevaluate its apparent determination that the EPA's 2016 draft guidance is not a "significant regulatory action" within the meaning of Executive Order 12,866. This executive order defines the term "significant regulatory action" to include "any regulatory action that is likely to result in a rule that may," inter alia, "adversely affect . . . the environment, public health[,] or [public] safety." Exec. Order 12,866, 58 Fed. Reg.

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51,735, 51,738 (Oct. 4, 1993). Though the EPA styles the 2016 draft manual a nonbinding document, the agency clearly intends and expects that federal, state, and local emergency planners will incorporate the draft PAGs into their planning protocols for use in the event of a radiological emergency.[2] Further, since application of the draft drinking water PAGs would allow a significant increase in radiation contamination in both public and private drinking water supplies, it seems evident that the EPA's regulatory action could have significant adverse effects on the economy, agriculture, homeland security, health care, and public health and safety. For these reasons, OIRA should treat the EPA's 2016 draft manual as a significant regulatory action within the meaning of Executive Order 12,866 and should subject it to a level of review commensurate with that status. As a part of this review, OIRA should determine, among other things, whether the EPA has presented a transparent scientific justification for its assertion that its proposed drinking water PAGs come within the cancer risk range reflected in the Safe Drinking Water Act MCLs. See 81 Fed. Reg. 37,589, 37,591 (June 10, 2016).

Substantively, while the 2016 draft manual represents that the EPA set the proposed PAG thresholds with an eye toward "reducing risks associated with ingesting [radioactive] drinking water," the scientific ground for this statement is not clear on the face of the document. See 2016 draft manual, at 7. Indeed, certain studies apparently informing the EPA's analysis are not available publicly. See id. at 7 n 12, 9 n 19.[3] To the extent the EPA relies on non-public scientific data to reach its conclusions, it hampers the public's ability to participate intelligently in these administrative proceedings. The EPA's approach also lacks the level of transparency mandated both by order of the President and by the agency's own internal policy on scientific integrity in the decision-making process. See Memorandum on Scientific Integrity, 74 Fed. Reg. 10,671 (March 11, 2009); EPA Scientific Integrity Policy (2012), http://www.epa.gov/sites/production/files/2014-02/documents/scientific_integrity_policy_2012.pdf.

More troubling is the EPA's apparent abandonment of the organ dose-based radiation exposure measurement used in the Safe Drinking Water Act MCLs in favor of a measure of exposure expressed as "committed effective dose." 2016 draft manual at 5 n 3. The 2016 draft manual makes no attempt to explain the rationale for this critical change in the EPA's approach to radiation dose measurement. As a result of this methodological shift, however, the 2016 draft manual has the effect of substantially understating the increase in radionuclide concentrations allowable under the proposed PAGs over Safe Drinking Water Act levels. As discussed in the Office of the Attorney General's July 2016 comment letter to the EPA, the 2016 draft manual would allow, for example, a 3,450-fold increase in the maximum allowable concentration of iodine-131. Notably, the EPA has in the past rejected reliance on effective dose, recognizing that a shift from organ dose to effective dose understates cancer risk. See EPA Notice of Data Availability, 65 Fed. Reg. 21,576, 21,581-21,583 (April 21, 2000). Inexplicably, the EPA seems

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[2] To wit, the EPA indicated in its Notice of Availability that its ultimate intention is to issue the 2016 draft manual in final form "for incorporation into state, local, tribal, and federal emergency response plans over a one-year implementation timeframe." 81 Fed. Reg. 37,589, 37,591 (June 10, 2016).

[3] While a short excerpt from the National Council on Radiation Protection and Measurements' Report No. 174 is present in the administrative docket, the full report – over 350 pages in length – is not publicly available without charge.

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to have adopted PAGs that could expose the public to levels of cancer risk far in excess of what the agency itself considers the maximum acceptable risk threshold.

Also of note, the 2016 draft manual identifies "derived response levels" – concentrations for each radionuclide that will lead to a PAG exceedance – for only *three* of the 100 radionuclides the agency anticipates may be present in public drinking water systems in the wake of a radiological incident. Neither the State of New York nor members of the general public can plausibly evaluate the protectiveness of the EPA's proposed PAGs without this additional data. Given the information available, however, it seems the EPA has proposed drinking water PAGs that would, when followed, expose the public to unprecedented and unacceptably high levels of radiation. If this is so, then the EPA must explain why it believes this new, divergent approach is justifiable both scientifically and as a matter of sound public policy.

The President has stressed that "[o]ur regulatory system must protect public health, welfare, safety, and our environment" and "allow for public participation and an open exchange of ideas." Exec. Order No. 13563, 76 Fed. Reg. 3,821 (Jan. 21, 2011). To the extent the EPA's proposed PAGs for drinking water would authorize public exposure to a much greater amount of ionizing radiation that would be legally permissible under the Safe Drinking Water Act, and to the extent the scientific bases for the proposed PAGs are either unavailable or simply unclear to members of the public and other interested governmental entities, the 2016 draft manual fails to satisfy the President's threshold standards for benevolent regulatory activity. Accordingly, this Office respectfully requests that OIRA either disapprove the EPA's 2016 draft manual or, in the alternative, return it to the EPA for further review.

Respectfully submitted,

s/Joshua M. Tallent *s/John J. Sipos*

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Margo Schwab, OMB/OIRA
Vlad Dorjets, OMB/OIRA
Joel Beauvais, EPA/OW

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To: Beauvais, Joel[Beauvais.Joel@epa.gov]; Burneson, Eric[Burneson.Eric@epa.gov]
Cc: Greene, Ashley[Greene.Ashley@epa.gov]
From: Grevatt, Peter
Sent: Mon 6/13/2016 9:29:24 PM
Subject: RE: EPA proposes weakening radioactivity standard?
PAG Manual Values for Other Media 6-13-16 clean.docx

Came in while we were in this afternoon's meetings. Please let me know if you want to discuss or whether you need more. Thanks, P.G.

From: Beauvais, Joel
Sent: Monday, June 13, 2016 5:10 PM
To: Grevatt, Peter <Grevatt.Peter@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>
Subject: FW: EPA proposes weakening radioactivity standard?

As Peter and I discussed, it would be helpful for me to have response TPs on the precise rationale for selection of these particular levels (1-year risk levels equivalent to lifetime MCL?), and key points made by the advocates (e.g. these levels are higher than proposed during the Bush Administration, these levels are equivalent to 350 chest x-rays/year, etc.). Does the intermediate phase last beyond 1 year? I reread the rollout materials, and they don't expressly cover these points. Thanks.

Joel

From: John Rumpler [mailto:jrumpler@environmentamerica.org]
Sent: Monday, June 13, 2016 3:29 PM
To: Beauvais, Joel <Beauvais.Joel@epa.gov>
Subject: FW: EPA proposes weakening radioactivity standard?

Hi Joel,

As per my note to Peter below, we're concerned about this radioactivity standard.

John

John Rumpler, Senior Attorney

Environment America

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follow me at @JohnRumpler

We're hiring a new clean water advocate in Washington, DC. Apply here:
http://jobs.environmentamerica.org/clean-water-advocate.html

From: John Rumpler [mailto:jrumpler@environmentamerica.org]
Sent: Thursday, June 09, 2016 12:19 PM
To: Grevatt.peter@Epa.gov
Subject: FW: EPA proposes weakening radioactivity standard?

Hi Peter,

I'm just seeing this, and needless to say, it raises questions and concerns to say the least. I am sure we will be getting questions about this – from the community, allies on the Hill, the media, etc. Feel free to call me at your convenience. 617 997-8296 (cell)

John

John Rumpler, Senior Attorney

Environment America

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follow me at @JohnRumpler

EPA Proposal Allows Radiation Exposure in Drinking Water Equivalent to 250 Chest X-Rays a Year

Food & Water Watch | June 8, 2016 1:33 pm | Comments

The U.S. Environmental Protection Agency (EPA) quietly issued proposals Monday to allow radioactive contamination in drinking water at concentrations vastly greater than allowed under the Safe Drinking Water Act. The new guidance would permit radiation exposures equivalent to 250 chest X-rays a year. Environmental groups are calling the proposal "shocking" and "egregious."

Monday, the U.S. Environmental Protection Agency (EPA) quietly issued proposals to allow radioactive contamination in drinking water at concentrations vastly greater than allowed under the Safe Drinking Water Act. Photo credit: Shutterstock

The EPA proposed Protective Action Guides (PAGs) would allow the general population to drink water hundreds to thousands of times more radioactive than is now legal. For example, radioactive iodine-131 has a current limit of 3 pico-curies per liter (pCi/L), in water but the new guidance would allow 10,350 (pCi/L), 3,450 times higher. For strontium-90, which causes leukemia, the current limit is 8 pCi/L; the new proposed value is 7,400 pCi/L, a 925-fold increase.

"Clean water is essential for health," Dr. Catherine Thomasson, executive director of Physicians for Social Responsibility, said. "Just like lead, radiation when ingested in small amounts is very hazardous to our health. It is inconceivable that EPA could now quietly propose allowing enormous increases in radioactive contamination with no action to protect the public, even if concentrations are a thousand times higher than under the Safe Drinking Water Act."

The Bush Administration in its last days unsuccessfully tried to put forward similar proposals, which the incoming Obama Administration pulled back. Now, in the waning months of the Obama Administration, the EPA's radiation office is trying again.

"These levels are even higher than those proposed by the Bush Administration—really unprecedented and shocking," Diane D'Arrigo, Nuclear Information and Resource Service, said.

The Bush Administration proposal for strontium 90 was 6,650 pCi/L; the new proposal is 7,400 pCi/L. For iodine-131, the Bush proposal was 8,490 pCi/L; the new proposal is 10,350 pCi/L. For cesium-137, the proposal was for 13,600 pCi/L; Obama "beats" Bush with a value of 16,570 pCi/L.

All radionuclides can cause cancer and other health and reproductive problems; there is no completely safe level. Strontium causes bone cancer and leukemia. Babies, children and females are at even greater risk than adult males.

PAGs apply not just to emergencies such as "dirty bombs" and Fukushima-type nuclear power meltdowns but also to any radiological release for which a protective action may be considered—even a radiopharmaceutical transport spill. The proposed drinking water PAG would apply not to the immediate phase after a release, but rather to the intermediate phase, after the release has been stabilized and lasting up to several years thereafter.

Radiation doses (in rems) cannot be measured but are calculated based on some measurements and many assumptions. The current Safe Drinking Water Act limits are based on 4 millirems per year. The PAGs would allow 500 millirems per year for the general population. A single chest X-ray gives about 2 millirems. Because of the way EPA is changing the definition of dose, for many radionuclides, the allowable concentration would be thousands, tens of thousands and even millions of times higher than set under the Safe Drinking Water Act.

Internal EPA documents obtained under the Freedom of Information Act show that the EPA itself concluded that the proposed concentrations "would exceed MCLs [Maximum Contaminant Limits of the Safe Drinking Water Act] by a factor of 100, 1000 and in two instances, 7 million." The EPA internal analysis showed that for one radionuclide, "drinking a very small glass of water of approximately 4 ounces … would result in an exposure that corresponds to a lifetime of drinking … water … at the MCL level."

"All of this is extraordinary, since EPA has recently accepted the National Academy of Sciences' most current risk estimates for radiation, indicating radiation is considerably more dangerous per unit dose than previously believed," D'Arrigo said. "Pushing allowable concentrations of radioactivity in drinking water up orders of magnitude above the longstanding Safe Drinking Water Act levels goes in exactly the opposite direction than the official radiation risk estimates go.

"Under these proposals, people would be forced to get the radiation equivalent of a chest X-ray 5 days a week, 50 weeks a year, for up to several years, with no medical benefit or informed consent, just from drinking water. This is immoral."

The public has 45 days from when it is published in the Federal Register to comment to the EPA on the PAG-Protective Action Guides.

"These proposed changes are a particularly egregious gift to the energy industry, which would essentially be given a free pass whenever nuclear or fracking waste enters our water supply,"

Wenonah Hauter, executive director of Food & Water Watch and author of the new book, *Frackopoly*, said. "The EPA under President Obama has also whitewashed the impact of fracking on drinking water. This is more of the same when it comes to his EPA's pro-industry, hands-off regulation of toxic practices that can harm public health."

PAG Manual Values for Other Media

Early Phase

Shelter in place = 1,000 to 5,000 mrem

Supplemental administration of prophylactic drugs KI = 5,000 mrem

Worker Exposure = 5,000 mrem

Intermediate Phase

Relocation = 2,000 mrem

Food Interdiction = 500 mrem

Drinking Water = 100 mrem (sensitive life-stages) / 500 mrem (general population)

Approach for Selecting the Drinking Water PAG

- The proposed drinking water PAG establishes levels at which alternative sources of drinking water should be considered by local emergency responders to reduce exposure to radiation in drinking water.
- The drinking water PAGs were based on limiting the projected dose to the public to risk levels comparable to risks within the range of risks for lifetime exposure to radionuclides in drinking water.
- Risks for sensitive populations and the general population for exposures considered under the PAG proposal generally fall within the 10-4 to 10-6 risk range for excess cancer cases. This is consistent with risk ranges used for the NPDWR for radionuclides. The variation is due to different nuclides.
- OGWDW evaluated the dose of radiation that would result in a similar excess cancer risk following one year of exposure during an emergency as that estimated for a life time of exposure at the MCL (i.e., 70 years). For the general population the corresponding dose was approximately 500 mrem/year, however for sensitive lifestages the dose was approximately 100 mrem/year.

Annual Radiation Dose by Normal Daily Activities

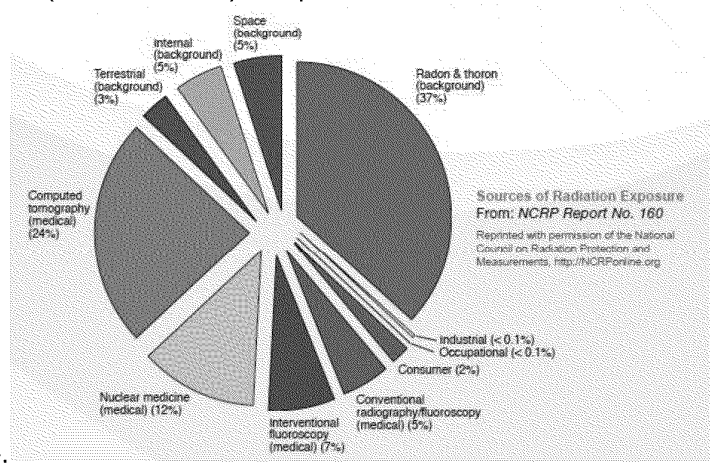
EPA OAR

Calculate Your Annual Radiation Dose
https://www.epa.gov/radiation/calculate-your-radiation-dose

- How many miles have you traveled by jet this year? (1 mrem per every 1000 miles)
- How many times did you go through a screening machine at the airport over the last year? (.003 average mrem each)
- Internal radiation from food and water (e.g., potassium) (40 mrem)
- Do you live in a stone, brick, or concrete building? (7 mrem)

All of us are exposed to radiation every day, from natural sources such as minerals in the ground,

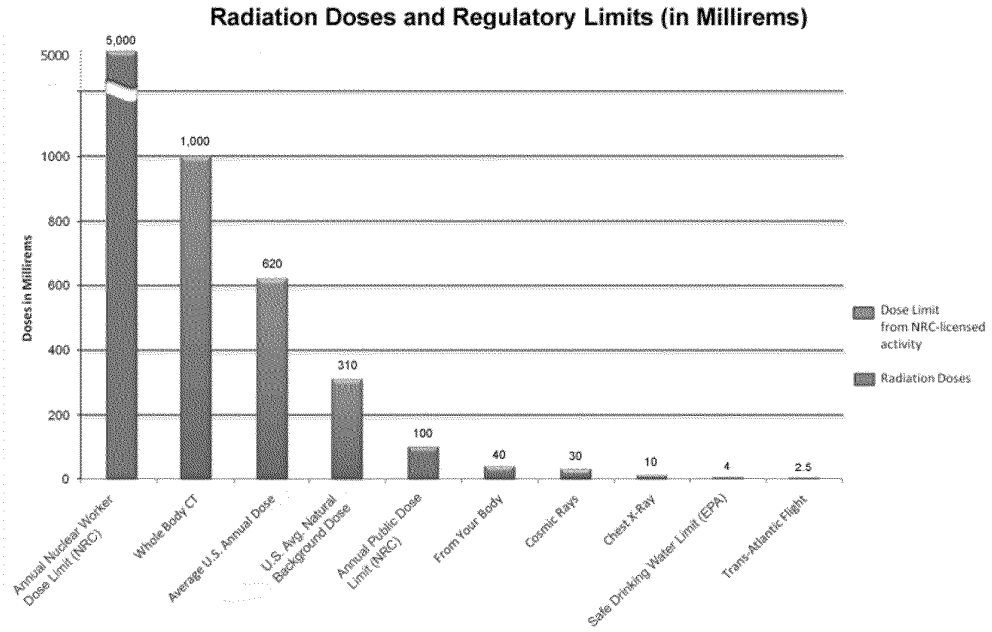
and man-made sources such as medical x-rays. According to the National Council on Radiation Protection and Measurements (NCRP), the average annual radiation dose per person in the U.S. is 620 millirem (6.2 millisieverts). The pie chart below shows the sources of this average



dose.
https://www.epa.gov/radiation/radiation-sources-and-doses

From the Nuclear Regulatory Commission

On average, Americans receive a radiation dose of about 0.62 rem (620 millirem) each year. Half of this dose comes from natural background radiation. Most of this background exposure comes from radon in the air, with smaller amounts from cosmic rays and the Earth itself. (The chart to the right shows these radiation doses in perspective.) The other half (0.31 rem or 310 mrem) comes from man-made sources of radiation, including medical, commercial, and industrial sources. In general, a yearly dose of 620 millirem from all radiation sources has not been shown to cause humans any harm.



Medical Procedure Doses

Procedure	Dose (mrem)
X-Rays-single exposure	
Pelvis	70
Abdomen	60
Chest	10
Dental	1.5
Mammogram (2 views)	72
Nuclear Medicine	400
CT	
Full body	1,000
Chest	700

To: Beauvais, Joel[Beauvais.Joel@epa.gov]; Grevatt, Peter[Grevatt.Peter@epa.gov]
From: Burneson, Eric
Sent: Tue 5/31/2016 10:03:16 PM
Subject: RE: PAG text questions

Joel: The following are responses to your questions about text in the FRN announcing the draft Drinking Water PAG.

•□□□□□□□ Regarding Page 8: The term "defer" was chosen to reflect Stakeholders comment that EPA should defer action on the PAG and base its emergency response measures on the MCL rather than the PAGs. We agree it would be more clear to replace the word "defer" with "base" in the FRN.

•□□□□□□□ Regarding Page 6: Yes the point of the sentence is to convey the expectation that water systems are not exempted from the radionuclides NPDWR and that we expect them to take actions to return to compliance. The following revision may better convey that point. "EPA expects that any drinking water system adversely impacted during a radiation incident will take action to return compliance with MCLs as soon as practicable." Also please note we that chose the word "practicable" over "feasible" (the term used in SDWA 1414 a.(1).A.ii) to reflect the fact that it may be feasible to return to compliance in an emergency however there may be other more pressing public health priorities which make it impractical.

Please let us know if you would like for us to incorporate the changes above into the FRN.

Regarding issuance of a final PAG by the end of the year, the critical factors that influence our schedule are:

1. Commencing and completing the comment period ASAP.

2. Minimizing the changes that are made to the PAG from proposal to final

3. Assuring rapid and constructive feedback from key intra agency partners (i.e., OLEM)

4. Assuring rapid and focused review from OMB.

Eric Burneson, P.E.

Director of Standards and Risk Management

Office of Ground Water and Drinking Water

US Environmental Protection Agency

Phone: 202-564-5250

Fax: 202 564 3760

From: Beauvais, Joel
Sent: Tuesday, May 31, 2016 1:45 PM
To: Grevatt, Peter <Grevatt.Peter@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>
Subject: PAG text questions

Eric, Peter – I just wanted to ask about a couple sentences in the draft PAG FRN that I wasn't sure about. Not a big deal, but I couldn't tell whether these involved typos or I'm missing something . . .

Page 8: ". . . and urged EPA to defer any emergency response measures regarding drinking water solely on the NPDWR . . ." Is that a correct use of the word defer? Do we mean "base" or "predicate"?

Page 6: "EPA assumes that any drinking water system adversely impacted during a radiation incident will be able to achieve compliance with MCLs as soon as practicable." That sounds like a circular statement (they'll be able to comply as soon as they're able). Did we mean to say that we assume they will endeavor to achieve compliance as soon as practicable or something like that?

P.S. The Administrator circled back to once again underscore her desire that we get this done before the end of the year, so please let me know what we need to do to make that happen.

To: Beauvais, Joel[Beauvais.Joel@epa.gov]
Cc: Greene, Ashley[Greene.Ashley@epa.gov]
From: Grevatt, Peter
Sent: Mon 2/1/2016 12:55:25 PM
Subject: OMB follow-up request for economic analysis for Drinking Water PAG

Joel, in follow-up to our briefing with OMB on their review of the draft Protective Action Guidance for Drinking Water, they sent us the following request:

"I understand that EPA has not prepared economic analysis for the other PAGs but, I think that such analysis would be particularly helpful for the drinking water PAG. Can EPA prepare something for OMB and interagency reviewers that can also be included in the docket? Please note that I have spoken with the Council of Economic Advisors, who participated in yesterday's briefing, and they too believe that economic analysis would provide important justification for EPA's choice of levels."

We have worked with our colleagues in OAR and we do not agree with the request from OMB regarding the development of an economic analysis for the drinking water PAG proposal. Our rationale for not preparing an economic analysis is outlined below. When you get a chance, please let me know how you would like us to proceed.

•□□□□□□ The development of an economic analysis will likely not be relevant to inform actual costs that could be experienced by a local jurisdiction or the federal government during the response to an actual radiation contamination incident, due to the variability of scenarios that might trigger such response. Variable factors that might greatly influence the outcome of an economic analysis includes: incident duration, location of release, severity of contamination, population affected, multiple routes of exposure, resiliency of the affected community, preparedness of local emergency managers, and inclement weather among others.

•□□□□□□ The drinking water proposal does not mandate nor require states or other local jurisdictions to take any specific measures or to choose between options outlined in the PAG, but rather it provides a framework that provides decision makers with meaningful, relevant and vetted scientific information to help guide protective actions that reduce adverse health risks to the population while allowing for flexibility of such actions during the response to a radiological contamination incident. In addition, the EPA proposal relieves burden on local jurisdictions of having to develop a PAG, while being involved in the immediate response to an incident.

•□□□□□□ The selection of dose levels for the drinking water PAG was not based on economic considerations, but rather based on an assessment of projected cancer risks resulting from short term

exposure (not to exceed one year) to radionuclides in drinking water. The selected PAG dose levels (i.e. 100 and 500 mrem) result in projected risks that are within the range of risks found for other exposure routes currently covered in the PAGs. In addition emergency response decisions are generally not based on cost considerations.

National Drought Resilience Partnership (NDRP) Presidential Memo Outreach

The week of January 11, OW is participating with the NSC, CEQ and other federal agencies to begin outreach to key stakeholders regarding the release of the NDRP's Presidential Memorandum next month. These stakeholders participated in the drought symposium that the NDRP hosted last summer. The purpose of these outreach efforts is to describe the work that the federal family will undertake to support long term drought resilience prior to the announcement so that these key stakeholders are aware of the PM's pending release and can potentially provide positive amplification of our efforts. As part of the background materials for the outreach sessions, OW provided specific examples of actions EPA either has underway or will launch shortly that support long term drought resilience.

E Enterprise Leadership Council (EELC) – Advance Monitoring – Members of the OW Team will be participating in a meeting of the EELC next week (January 20-21) in Denver to discuss the implications and opportunities that may be afforded by new and emerging advanced monitoring technologies. The group will be exploring technologies, data management and regulatory and policy implications with participating States (e.g. OR, OK, NH) and other EPA partners (ORD, OECA). OW led the development of the paper "Opportunities and Implications of New Water Monitoring Technologies –Regulatory and Policy Considerations".

Small Systems Grants EPA is awarding close to $12.7 million in grants to assist small drinking water and wastewater systems and private well owners across the United States with training and technical assistance to improve water quality. Awardees were the National Rural Water Association (NRWA), Rural Community Assistance Partnership (RCAP) and Environmental Finance Center at University of North Carolina at Chapel Hill. EPA sent letters to the recipients of the grants on 1/11/16.

OMB briefing on Draft Protective Action Guide (PAG) for Drinking Water. On January 14, OGWDW and ORIA managers and staff met with OMB and Interagency Reviewers to provide an overview of the drinking water PAG for radiological emergencies and a summary of the public comments received. The drinking water PAG is non-regulatory guidance that can be used to protect the public in the event of a radiological incident that affects public drinking water supplies. The EPA intends to include the drinking water PAG when it publishes the final "PAG Manual: Protective Action Guides And Planning Guidance for Radiological Incidents" later this year.

Ex. 5 - Deliberative Process

for publicly owned wastewater collection and treatment facilities; stormwater and combined sewer overflow control facilities; and decentralized and onsite wastewater treatment systems.

[Note that this was mentioned in last week's Joel email to the admin – this is updated though]: **Water Infrastructure and Resiliency Finance Center (WIRFC):** On January 14th, I participated in the 1st year anniversary event for WIRFC at EEOB, along with Stan and EPA staff. The event included a welcome from Jason Miller, Deputy Director of the National Economic Council, who noted the importance of water infrastructure to the national economy. Stan provided the keynote with an announcement of the WaterCARE program and the 10 communities selected to receive a robust financial strategy with services ranging from rate and revenue studies, affordability assessments, alternatives analyses, asset management practices, and public engagement customer outreach activities. I followed these remarks by providing an introduction to water infrastructure challenges and how WIRFC is working on providing guidance and expertise for innovative approaches for infrastructure financing, and moderated an engaging panel discussion which included 5 water sector financing experts.

National Aquatic Resource Survey (NARS) Updates

National Wetland Condition Assessment
On January 6, the public comment period closed for the draft 2011 National Wetland Condition Assessment (NWCA) - the very first Wetland Condition Assessment. Most comments were positive and supportive of the effort. Based on our initial assessment of the comments, we anticipate the public and technical reports will require only minimal rewrites and clarifications. We are scheduled to release the final 2011 NWCA report in March, following my request to synchronize the release of the various NARS reports.

National Coastal Condition Assessment
The tentative date for publication of the NCCA 2010 Report via a FR Notice of Availability is January 28. The Report, data, technical report, and a slide show will be posted on the National Aquatic Resource Surveys Website on the date of the FR Notice. Communications materials include a fact sheet, blog posting, infographics, and internal Qs and As. A public Watershed Academy Webinar discussing the coastal survey and results is scheduled for February 25, 2016.

To: Beauvais, Joel[Beauvais.Joel@epa.gov]
From: McCabe, Janet
Sent: Fri 12/30/2016 6:14:33 PM
Subject: FW: info about water PAGS released

Joel—GREAT news that the Water PAGS has cleared OMB.

From: Perrin, Alan
Sent: Friday, December 30, 2016 12:57 PM
To: Edwards, Jonathan <Edwards.Jonathan@epa.gov>; Millett, John <Millett.John@epa.gov>
Cc: McCabe, Janet <McCabe.Janet@epa.gov>
Subject: RE: info about water PAGS released

I tried to follow up on this a bit. A limited FOIA release was made last week by OW, dealing specifically with DRL calculations; interestingly, OW believes neither the article's linked 'graph' nor the linked 'internal EPA analysis' was part of their release. I think the graph could have been generated by anyone using information available in the proposal; I can't say where the 'internal EPA analysis' may have come from, but it certainly does not read like either an OW or an OAR product.

This same material was linked in a PEER website news release on 12/22. [Not significantly different in tenor from the article below, however, Dr. Strangelove was resurrected amongst quotes from Jeff Ruch.] All in all, nothing substantively 'new' in either of these articles.

I agree with Jon, the guidance for DW recommends protective action if a 500 mrem (adults)/1year exposure is *projected*. I'll add that regardless of the concentration comparisons to MCLs, each concentration listed, assuming the math was done correctly, would translate to 500 mrem over one year.

➔ BTW, since I expect this will appear on reginfo.gov fairly soon, OMB concluded its review of the final DW PAG today.

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: Edwards, Jonathan
Sent: Friday, December 30, 2016 10:58 AM
To: Millett, John <Millett.John@epa.gov>
Cc: McCabe, Janet <McCabe.Janet@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: Re: info about water PAGS released

Janet, Jon, and others--this timing surprised me a little bit too. I knew a FOIA request had come in on this to OW as well as a FOIA request we received on the full PAG manual but I was under the impression that collection of the materials and coordination around the materials prior to release was still a ways off.

The frustrating thing around communications involving the PAGs are that the PAGs are not "allowances" as they are portrayed in this news piece--they are trigger values on which action is recommended to be taken if projected doses get close to or exceed the values. However a decision-maker can take action at any time that he or she feels it is necessary. As you know the PAGs are certainly not new statutory limits which so many of the stakeholders either unintentionally or intentionally confuse.--Jon

Sent from my iPhone

On Dec 30, 2016, at 9:46 AM, Millett, John <Millett.John@epa.gov> wrote:

> Thanks for flagging. I didn't get any advance info on it either.
>
> John Millett
>
> 202.510.1822
>
> On Dec 30, 2016, at 9:05 AM, McCabe, Janet <McCabe.Janet@epa.gov> wrote:
>
> > I wasn't aware that we were releasing this information in response to a FOIA request, but perhaps you were….
>
> **EPA Documents Reveal PAG Water Radiation Allowances Far Above SDWA**

December 29, 2016

EPA has released documents that reveal the agency is recommending protective drinking water levels for scores of radionuclides after a radiological emergency that significantly exceed Safe Drinking Water Act (SDWA) limits, and that the agency previously only released a few of these levels publicly in order to "avoid confusion."

The release, in response to a Freedom of Information Act (FOIA) lawsuit by Public Employees for Environmental Responsibility (PEER), reveals new concentration levels under the agency's proposed water chapter for its Protective Action Guides (PAG) for radiological emergencies for dozens of radionuclides. In the draft version of the chapter available for public comment, EPA had only released limits for four of the 110 radionuclides covered, and declined to reveal how much they differed from SDWA limits, according to PEER, which represents local, state and federal environmental agency employees.

"To cover its embarrassment after being caught dissembling about Fukushima fallout on American soil, EPA is pursuing a justification for assuming a radioactive fetal position even in cases of ultra-high contamination," PEER Executive Director Jeff Ruch said in a Dec. 22 press release. "The Safe Drinking Water Act is a federal law; it cannot be nullified or neutered by regulatory 'guidance,'" he added. The PAGs are EPA guidance, rather than a regulation.

The highly controversial water chapter is currently undergoing review at the White House Office of Management & Budget (OMB). Once finalized, it is slated to be included in EPA's PAG manual, which the agency issued in early December. The manual revises a 1992 version and sets radiological protection criteria for federal, state, local and tribal emergency response officials to use in a wide variety of incidents involving a radiological release.

The proposed water chapter would deem protective action dose levels of 500 millirems/year (mrem/yr) in the first year after an incident for the general population, and 100 mrem/yr in the first year for infants, children age 15 and under, and pregnant or nursing women, according to a notice of availability for the draft drinking water PAG.

PEER in October sued EPA to release data on the proposed water PAG that the group has argued would help justify a stricter guidance. The suit

in part sought documents disclosing the allowable concentrations of radioactivity in drinking water that EPA is proposing for 110 radionuclides, after the group repeatedly raised concerns that the proposal would set new concentrations, or Derived Response Levels (DRLs), for 110 radionuclides, but disclosed only three of those concentrations. Even prior to the FOIA release, dozens of environmental groups and the New York's attorney general's office were severely critical of the draft drinking water chapter and urged EPA to scrap it.

Lifetime Dose

According to a graph included in the FOIA release, the proposed water PAGs for two radionuclides would be more than 10,000 times the SDWA limits, and others are shown to be hundreds or thousands of times in exceedance of the SDWA levels.

An internal EPA analysis accompanying the graph indicates that some of the concentrations permitted under the guide would be high enough to deliver the SDWA lifetime permissible dose in a single day, and in other cases DRLs for other radionuclides would reach that lifetime allowable dose within a week or month, PEER notes.

For instance, the graph indicates that the DRL for the radionuclide Calcium-45 (Ca-45) would be more than 10,000 times the SDWA limit. In the internal analysis, EPA says “drinking less than one day at the daily rate of 2 liters of Ca-45 at the DRL concentration would result in an exposure that corresponds to drinking liters of water per day for 70 years at the [SDWA maximum contaminant level].”

The graph also indicates the proposed DRLs exceed those proposed by the Bush EPA -- which were pulled back early on in the Obama administration.

The FOIA release shows development of the water PAGs mainly by EPA’s Office of Radiation & Indoor Air and Office of Water. In one email exchange, in which a Superfund office official sought a table of concentrations regarding the water PAG from the other two offices as part of the Superfund office’s review, a water office engineer eventually sends the table but indicates that the agency would include concentrations for just three radionuclides -- as it eventually did in the proposal released to the public -- and would only include a “more comprehensive list” once the guidance had been issued. “We did not want[] to overwhelm the readers of this chapter with a large table of

derived concentrations," the engineer says.

PEER says in its release that this shows the agency hid the proposed high DRLs from the public to "avoid confusion" and that the documents "reveal that EPA's radiation division even hid the new concentrations from other divisions of EPA that were critical of the proposal, requiring repeated efforts to get them to even be disclosed internally."

Limited Application

In one of the briefing documents EPA provides in the FOIA release, the agency argues environmentalists have been misleading when comparing the draft DRLs with the MCLs, but does not specify EPA's differences with environmentalists. Further, the agency points to the 2011 Fukushima, Japan, nuclear meltdown as a trigger for a need for water PAGs, noting the agency was pressed to develop a guide and failed to provide any guidance at the time.

But one environmentalist points out that EPA at the time stated no radioactivity from Fukushima was reaching the United States above levels of concern despite measurements indicating rainwater was exceeding the SDWA limits. This source argues the water PAG was pulled together because the agency "got caught," and now they are creating new, much higher allowances to say there is no safety concern at, for instance in the case of Iodine-131, thousands of times higher than an MCL.

Meanwhile, the environmental group Nuclear Information and Resource Service (NIRS) is pressing EPA to follow through on verbal commitments it says an agency water office official recently made to NIRS. In those, the official told NIRS that the water PAG DRLs would apply for no more than one year and that they would only apply to incidents of "national significance," and not lesser accidents or releases.

EPA has been criticized for defining the intermediate phase -- during which the DRLs would apply -- to be as long as up to several years after an incident occurs.

In a Dec. 18 letter to Lisa Christ, with EPA's Water Office, NIRS' Diane D'Arrigo seeks assurances that the agency will follow through on commitments made in a phone conversation that the water PAG will be limited to one year's application and that it will only be used for major incidents. D'Arrigo says such a commitment means the PAG manual

also needs to be altered to avoid conflicting language, and lists an array of statements EPA would need to change.

In response to questions regarding NIRS' request, EPA does not respond to questions on whether the agency will make the changes NIRS is seeking but tells *Inside EPA* in a statement that the guidance "is intended for short term use only and is not intended for long-term (i.e. greater than one year) or everyday use." EPA also notes the guidance is "non-regulatory and non-binding," and that SDWA standards for radionuclides "would continue to apply even in the event of an emergency.

"EPA expects that the responsible party for any drinking water system adversely impacted during a radiation incident will take action to return to compliance with regulatory maximum contaminant levels." -- *Suzanne Yohannan* (syohannan@iwpnews.com)

EPA Providing Guidance for Drinking Water After Radiological Emergency

What would happen if there was an emergency in the U.S. that caused radioactive material to contaminate surface or underground sources of drinking water? What steps could your utilities and government take?

This was one of the challes the government of Japan had to address following the Fukushima nuclear power plant incident. To assist local governments and utilities here at home to plan for such a situation, EPA has developed guidance for use only during nationally significant radiological emergencies, such as a disaster at a nuclear power plant or use of an improvised nuclear device.

This non-regulatory guidance, called a drinking water Protection Action Guide (PAG), will help decision-makers to ensure public health protection during an emergency. The drinking water PAG identifies doses of radiation that should be avoided during an emergency event. The PAG can be used to determine when the use of contaminated water supplies should be restricted and alternative drinking water should be provided – to keep doses to the public as low as possible during emergency situations only.

It's important to know that EPA's new guidance is not for use during normal water system operations and the PAG does not affect or change EPA's drinking water standards for radionuclides. They do not represent acceptable routine exposures for drinking water. The guidance also does not impact actions occurring under other statutory authorities such as the EPA's Superfund program, the Nuclear Regulatory Commission's decommissioning program, or other federal or state programs.

As with all drinking water regulations, water systems exceeding standards, regardless of the reason, are in violation. EPA expects that the responsible party for any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act maximum contaminant levels as soon as practicable. **[insert text here on that this is for short-term exposure only – days, weeks, but less than a year, and that provides similar level of protection as radiation drinking water regs, which are calculated based on 70 years of exposure]**

Thinking about these scenarios is certainly not pleasant and we hope that our PAG never has to be used. But EPA takes these actions to ensure that our country can be better prepared to protect public health if emergencies occur.

To: Campbell, Ann[Campbell.Ann@epa.gov]
From: Gude, Karen
Sent: Thur 12/29/2016 3:45:23 PM
Subject: RE: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Diane is checking with the other interested parties to see if they can meet Thursday (1/5) for an hour sometime between 1 – 5 PM, with Friday a possibility if Thursday does not work. She indicated that she'd try to get us an answer by Tuesday (1/3) afternoon --- she's flying in the AM on Tuesday. I'll block this time on Thursday on Joel's calendar, and will give Crystal a heads up about potential timing, so she can keep it in mind on Tuesday as we wait for final confirmation.

Diane talked a little about her primary concerns, and I'm happy to chat about it, if need be, but basically, it sounds like based on the info she's seen in a recent FOIA request, the draft DW PAG, and the final OAR PAG --- There are concerns about the incidents for which the DW PAG would apply (more intermediate spills vs. natural disasters on par with Fukushima), the length of time the PAG could be applied after the incident has been brought under control, and how this would legally be enforced. There are also concerns that different DW levels will be listed in the larger PAG food section vs. the new DW PAG. Finally, Diane indicated that she feels she has received inconsistent info on these general concerns from information provided in comments by the Administrator, program staff, and OGC attorney. She also asked to see a copy of what's at OMB…Which we obviously can't do.

From: Campbell, Ann
Sent: Thursday, December 29, 2016 10:05 AM
To: Gude, Karen <Gude.Karen@epa.gov>
Subject: Fwd: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Ok. Let's see what works on the 5th or 6th. Not sure if we'll have the right folks in on the 6th to do this, so I'd start with the 5th.

Begin forwarded message:

From: "Grevatt, Peter" <Grevatt.Peter@epa.gov>
Date: December 29, 2016 at 10:02:36 AM EST
To: "Campbell, Ann" <Campbell.Ann@epa.gov>
Cc: "Beauvais, Joel" <Beauvais.Joel@epa.gov>, "Gude, Karen" <Gude.Karen@epa.gov>, "Loop, Travis" <Loop.Travis@epa.gov>, "Dennis, Allison" <Dennis.Allison@epa.gov>, "Burneson, Eric" <Burneson.Eric@epa.gov>, "Wadlington, Christina" <Wadlington.Christina@epa.gov>, "Gonzalez, Yvonne V." <Gonzalez.Yvonne@epa.gov>
Subject: Re: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Sounds good. Thx.

Sent from my iPhone

On Dec 29, 2016, at 9:42 AM, Campbell, Ann <Campbell.Ann@epa.gov> wrote:

> Peter, based on what I'm hearing from you and the limitations we're dealing with timing-wise, we'll look to have the meeting with the NGOs scheduled for the latter part of next week and plan for a potential rollout the week of Jan 9. This will give us the early part of next week to work with OMB.
>
> On Dec 29, 2016, at 8:36 AM, Grevatt, Peter <Grevatt.Peter@epa.gov> wrote:
>
>> We sent back our revisions to the FR notice yesterday. We mostly accepted what ONB gave us so hopefully this will be a straightforward transaction and we will have clearance soon. I'd like to have this in the bag before we meet, and that should not be a problem for the week after next. I'll keep you posted as I hear more from OMB. Thx.
>>
>> Sent from my iPhone
>>
>> On Dec 29, 2016, at 7:41 AM, Campbell, Ann <Campbell.Ann@epa.gov> wrote:
>>
>>> Thanks Peter. The groups that want to meet with us have proposed a meeting at the earliest on 1/6, a week from tomorrow. That would put us in to the following week, at the earliest, for the possible release of the PAG. I'd like to see if we can't get it on for 1/4 instead. What are your thoughts about the timing of the meeting?
>>>
>>> On Dec 28, 2016, at 5:31 PM, Grevatt, Peter <Grevatt.Peter@epa.gov> wrote:
>>>
>>>> We're in a good place with OMB on these. Last we heard, they still were touching base with other agencies to make sure everyone is on board. Will keep you posted.
>>>>
>>>> Sent from my iPhone
>>>>
>>>> On Dec 28, 2016, at 8:58 AM, Campbell, Ann <Campbell.Ann@epa.gov> wrote:
>>>>
>>>>> Wanted to give you both the heads up on this meeting request coming your way. I haven't heard where we landed with OMB late last week. The OA wants this scheduled for next week so it would be helpful to know where things are at so we can land this

appropriately on the calendar. cc'ing Travis and Allison from a comms perspective.

From: Gude, Karen
Sent: Wednesday, December 28, 2016 8:55 AM
To: Campbell, Ann <Campbell.Ann@epa.gov>
Subject: FW: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Ann,

A heads up --- The AO is delegating a meeting with NGOs re: DW PAGs to Joel. Liel is reaching out to the requester and will loop me in, once this is done (given that Crystal is out) so that we can get this scheduled next week.

Karen Gude, Special Assistant

U.S. Environmental Protection Agency

Office of Water

Phone: (202) 564-0831

From: Azoolin, Liel
Sent: Tuesday, December 27, 2016 10:09 AM
To: Gude, Karen <Gude.Karen@epa.gov>
Subject: FW: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Hi Karen,

In our scheduling meeting last week, Matt Fritz suggested would be the best person to take this meeting. I just wanted to flag for you and make sure it's something he can do when he returns.

Please let me know if it will be possible and I will loop Crystal in with their contact.

Thank you,

Liel

From: Azoolin, Liel
Sent: Wednesday, November 30, 2016 4:53 PM
To: scheduling <scheduling@epa.gov>
Subject: FW: Request for meeting with EPA Administrator Gina McCarthy re PAGs

From: Leavy, Jacqueline
Sent: Wednesday, November 30, 2016 4:45 PM
To: CMS.Sched <CMS.Sched@epa.gov>
Cc: Gaines, Cynthia <Gaines.Cynthia@epa.gov>; Azoolin, Liel <Azoolin.Liel@epa.gov>
Subject: FW: Request for meeting with EPA Administrator Gina McCarthy re PAGs

From: Diane D'Arrigo [mailto:dianed@nirs.org]
Sent: Wednesday, November 30, 2016 2:36 PM
To: Mccarthy, Gina <McCarthy.Gina@epa.gov>; scheduling <scheduling@epa.gov>
Cc: Diane D'Arrigo <dianed@nirs.org>; Catherine Thomasson <CThomasson@psr.org>; Geoff Fettus <gfettus@nrdc.org>; John Coequyt <John.Coequyt@sierraclub.org>; Damon Moglen <dmoglen@foe.org>; Wenonah Hauter (whauter@fwwatch.org) <whauter@fwwatch.org>; Lynn Thorp CWA <lthorp@cleanwater.org>; Anna Aurilio <asquared@environmentamerica.org>; Allison Fisher <afisher@citizen.org>; Paul Gallay <PGallay@riverkeeper.org>;

Catherine Lincoln <catlincoln@aol.com>; Cindy Folkers <cindy@beyondnuclear.org>
Subject: Request for meeting with EPA Administrator Gina McCarthy re PAGs

Physicians for Social Responsibility ◆ Natural Resources Defense Council

Sierra Club ◆ Friends of the Earth ◆ Food and Water Watch

Clean Water Action ◆ Public Citizen ◆ Beyond Nuclear

Nuclear Information and Resource Service

Environment America ◆ Committee to Bridge the Gap ◆ Riverkeeper

November 30, 2016

Gina McCarthy, US EPA Administrator

US EPA Headquarters

William Jefferson Clinton Building

1200 Pennsylvania Avenue, N. W. Mail Code: 1101A

Washington, DC 20460

202-564-4700

McCarthy.gina@Epa.gov

Dear Administrator McCarthy:

We understand that you are close to deciding whether to approve the 2013 Protective Action Guides (PAGs) and the additional Radionuclide Drinking Water PAGs any day now. Please take one more step before making that important decision: meet with us one more time, to clarify critical information.

As you know our groups and many others have been diligently commenting and raising serious concerns for many years about the PAGs. We believe that some of the premises that are being used to justify your final adoption of these PAGs are incorrect and ask that you meet with us one last time before proceeding.

The pending PAG proposal would upend decades of clean water protections. We think it would be appropriate for you to meet with us and consider seriously the information we have to provide before embarking on such a significant step backwards in terms of public protections.

We call your attention to a recent investigative piece on the issue by NBC Bay Area, which can be watched at http://www.nbcbayarea.com/investigations/E-P-AS-NEW-EMERGENCY-PLAN-FOR-DRINKING-WATER-CONCERNS-MANY-401206656.html.

After many environmental victories and successes throughout your tenure, moving the nation forward to a cleaner, safer, more energy efficient environment, we ask that you not depart with an unnecessary action that will justify enormous increases in radioactivity in drinking water.

We appreciate your service and ask you to reconsider how approving the PAGs will affect your legacy. We would be extremely grateful to meet with you at your earliest convenience, before you make this critical decision.

Sincerely,

Diane D'Arrigo*

Director Radioactive Waste Project

Nuclear Information and Resource Service

Catherine Thomasson, M.D.

Executive Director

Physicians for Social Responsibility

Damon Moglen

Senior Strategic Advisor

Friends of the Earth

Lynn Thorp

National Campaigns Director

Clean Water Action

Geoff Fettus

Senior Attorney

Natural Resources Defense Council

John Coequyt

Director International Climate Programs

Sierra Club

Wenonah Hauter

Executive Director

Food and Water Watch

Anna Aurilio

Washington DC Office Director

Environment America

Allison Fisher

Outreach Director

Public Citizen

Paul Gallay

President

Hudson Riverkeeper

Catherine Lincoln

Executive Coordinator

Committee to Bridge the Gap

Cindy Folkers

Radiation Specialist

Beyond Nuclear

* *Point of contact*: Diane D'Arrigo 202-841-8588 dianed@nirs.org

<request for EPA Admin McCarthy meeting 11-30-16.docx>

OSWER Overarching Comments 9/15/15

We do not believe that the proposed revisions to the draft drinking water PAG document (alone or in combination with the Q&A document) adequately address the major comments OSWER previously provided (including as noted in our previous overarching comments). In particular:

1) No footnote or disclaimer was included affirming that PAGS don't apply to decisions under the Superfund remedial program [see prior comment, #2];

2) Our concerns regarding clarification of the differences between the EPA and international numbers have not been addressed, either with respect to transparency of calculations or providing appropriate context for the international numbers [see prior comments #8 and 9];

    a. International/Other Agency Standards are discussed in a section titled "rationale for the PAG values." If OAR and OW believe they must retain this information, we suggest that it be presented in a new section titled something like "Comparison with Other Standards." We also need to avoid statements implying that these standards are the basis for the PAG because the Agency is on record that some of these standards are not protective.
    b. We suggest OW/ORIA consider including in Section 4.2 (or as an appendix) a table of international and other national values for reference, including the purpose for which the value was developed. We believe such a table would enable readers to more easily see other values that exist, and why/how they might differ (in purpose and scope) from the proposed DW PAG.
    c. We have also included in the body of the draft additional comments regarding lack of transparency for some specific calculations, including the apparent differences between these PAGs and the Japanese values.

3) There is still a lack of clarity regarding the relationship between the DW PAG and the FDA (food and water) PAG, both in general and specifically from a cumulative risk perspective [see prior comments # 6 and 7];

4) We still have concerns regarding the level of detail and context provided for the discussion of fetal risk [prior comment #10].

We also note, regarding the inclusion of pregnant women in the 'sensitive' group, that many women in early pregnancy do not know that they are pregnant. Given that, it is common practice to include 'women of childbearing age' as part of the sensitive population. This issue should be considered in evaluating the feasibility/utility of a two-tiered standard.

As noted previously, we continue to have major concerns regarding the proposal of a two-tier PAG. Although we have agreed that the proposal for two tiers can be put out for public comment, we still need to see the questions, in particular regarding the feasibility/implementability of a 2-tiered PAG versus a single value PAG, to be included in the FR notice prior to its finalization (as previously requested). Also, we had previously requested additional information regarding how the current document will be incorporated into the larger PAG document; that information has not been provided.

Given our continued concerns about the most recent draft of the document (especially as the latest draft does not appear to reflect revisions we thought had been agreed to by OW/ORIA when we met several weeks ago), we will need to see another revised version prior to release.

To: Canzler, Erica[Canzler.Erica@epa.gov]
From: Tulis, Dana
Sent: Tue 9/15/2015 7:29:09 PM
Subject: FW: Drinking Water PAG redline
Draft drinking water Protective Action Guide redline 8-27-2015.docx

Hi! Did you all get this out? I will admit I haven't reviewed all my old emails, thanks.

Dana S. Tulis
Deputy Office Director

Office of Emergency Management, EPA

Office - 202-564-8600

Direct -202-564-7938

Cell - 202-253-8309

From: Tulis, Dana
Sent: Friday, August 28, 2015 6:08 PM
To: Kudarauskas, Paul; Cardarelli, John
Cc: Canzler, Erica
Subject: FW: Drinking Water PAG redline
Importance: High

Kuda and John, please review and get your comments to Erica by September 4.

Here is what I discussed with Barbara Hostage and she sent to Mike Flynn.

We will also provide our comments on the draft Q& A document that Sara Decair shared with us on Monday afternoon.

Finally, we would like to request to review/comment on the FR notice which will announce the Draft DW PAG for review/comment.

We are particularly interested in the "charge questions" that will focus reviewer's comments on the important elements contained in the draft PAG (e.g., the feasibility/implementability of a 2-tiered PAG vs. a single value PAG, including what a possible single value might be).

In addition, OSWER scientific staff would like more detailed information/additional discussion regarding the FDA PAG, the relationship between the FDA PAG and the EPA PAG, and the question of cumulative risk (OSWER Overarching comments #6 & #7).

So with that said, this version still only discusses a Two Tiered approach, which we still believe isn't feasible (I like to say, no way can parents watch their kids 24/7 and ensure they aren't drinking from the taps, especially when their parents are drinking from the tap). I recommended that ORIA discuss one Tier vs two Tiers and then let the public comment. The other option is see their charge questions and leave as is, and ensure they actually give the pros and cons of one vs 2 tiers in the charge questions. Also, please check on how they deal with the FDA PAG issue. Finally, there still appear to be a number of items above that have not been submitted to us for review so we need to see those. Kuda, perhaps you have seen? Also, we need to decide how strongly we feel about the two Tier issue, because OSRTI is backing down.

Thanks all.

Dana T

Dana S. Tulis
Deputy Office Director

Office of Emergency Management, EPA

Office - 202-564-8600

Direct -202-564-7938

Cell - 202-253-8309

From: Hostage, Barbara
Sent: Friday, August 28, 2015 9:19 AM
To: Tulis, Dana
Subject: FW: Drinking Water PAG redline
Importance: High

Dana,

Here is the revised DW PAG.

I am in the process of preparing an email to folks asking form comments by September 8th , so we can also have any internal discussions if there are any potential conflicts, which I am hoping we won't.

Barbara Hostage, Director

Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
Office of Solid Waste and Emergency Response (OSWER)

EPA West Room 4130A
Phone Number: 202-566-1933
Fax Number: 202-566-1934
Mail Code: 5103T

From: Flynn, Mike
Sent: Thursday, August 27, 2015 11:03 PM
To: Hostage, Barbara
Cc: Grevatt, Peter; Edwards, Jonathan; Christ, Lisa; Perrin, Alan
Subject: Drinking Water PAG redline

Barbara,

Attached please find a redline/strikeout version of the drinking water PAG proposal. OW and we have incorporated OSWER's suggestions and made a few other clarifications based on discussion with staff and branch chiefs. We request that you focus on showstopper issues, and would appreciate your comments by next Thursday, Sept 3rd.

Sorry I didn't connect with you today by phone. Peter or I will be in touch to discuss your latest email and the path forward. We recognize the other priorities OSWER is dealing with, and greatly appreciate your efforts in helping us keep this moving as quickly as possible.

Thanks,

Mike

To: Canzler, Erica[Canzler.Erica@epa.gov]
From: Kudarauskas, Paul
Sent: Tue 9/8/2015 11:55:28 AM
Subject: Drinking Water PAG redline & Q&A Comments
Draft drinking water Protective Action Guide redline 8-27-2015 CMAD Comments.docx
Draft Protective Action Guide 6-16-2015 OGWDW-cardarelli comments (2).docx
QA Document 8-21-2015- CMAD comments.docx

Erica

There are comments embedded (yellow highlight) which are very important ones take from John's comments provided at the beginning of July. Many of his initial comments were trying to strengthen the document. I am unsure if OW/ORIA had an opportunity to see them (there were so many version flow around). I have included his original set as a second document here. Again the goal here is to strengthen the document rather than the Agency roll something out which lacks scientific integrity.

The Q&A comments are also attached with some additional suggestions for Q&As to assist the agency.

Overarching Comments from the document and from the Branch meeting:

1) There is still a disproportionate amount of discussion on the risk to fetuses. At the Branch meeting all parties expressed this and it was supposed to be modified. It is not in this version. All life stages with notes of high risk (pregnant, infant, 15yo, etc.), which is why the single tier system is best because it is inclusive of ALL.

2) There is an impasse on the single versus two tiered system. OSRTI, OSWER and OEM requested a single tier. OW and ORIA still seem to want a two tier. I agree, we need to review the questions before they post this to the Fed Reg.

3) In the questions to go with the Fed Reg, there should be language on the international guidance and compare/contrast why the US is choosing to deviate from it. Since, the document used Japan's experience to justify a two-tiered system, it should include a summary of the international methods and how it differs from the proposed method. Japan derived their system from the international guidelines and offered explanation. This will be useful not only to explain to Americans, but also the international community if American populations are advised differently than the host country (e.g., Fukushima and the military families). They are supposed to have a section dedicated to this for the overall document, not the water 'chapter.' We need to see this prior to accepting final language in the water 'chapter' to ensure it is covered. Q&As really do not address this.

4) FDA #s…They were supposed to get back with details on how the FDA numbers and EPA numbers combine for a total risk. FDA is part of a diet but not consumption, so they MAY no

account for water exposure (intake). The Q&As do an okay job explaining this.

Paul G. Kudarauskas, "Kuda"
Chief, Field Operations Branch
CBRN Consequence Management Advisory Division

Office of Emergency Management
United States Environmental Protection Agency
Mobile: 202-344-5382 Office: 202-564-2415

From: Tulis, Dana
Sent: Friday, August 28, 2015 6:08 PM
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Thanks all.

Dana T

Dana S. Tulis
Deputy Office Director

Office of Emergency Management, EPA

Office - 202-564-8600

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Policy Analysis and Regulatory Management Staff (PARMS)
Office of Program Management (OPM)
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EPA West Room 4130A
Phone Number: 202-566-1933
Fax Number: 202-566-1934
Mail Code: 5103T

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Sent: Thursday, August 27, 2015 11:03 PM
To: Hostage, Barbara
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Thanks,

Mike

EPA HQ Rad Response Support Briefing

May 2016

EXERCISE EXERCISE EXERCISE

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Authorities and Obligations

- EPA's response assistance is governed by the following authorities: NCP, CERCLA, Stafford Act, AEA/PHSA
- EPA can provide response assistance with the following activities:
  - Monitoring and Assessment
  - Defining the scope and extent of contamination
  - Responder health and safety
  - Decontamination
  - Application of Protective Action Guidelines (PAGs)
  - Waste Management
  - Analytical Support
  - Provision of technical and operational resources
  - Liaison with the research community both domestically and abroad to provide additional response options/technologies that may be untested

Resources to support Region 3

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Regional Response Assets

- ✓ Responsive, decentralized operations based in the 10 regional offices
- ✓ ~240 EPA On-Scene Coordinators (OSCs) with experience and delegated authority to manage incidents
- ✓ Regions 2, 3 & 4 have approx. 120 OSCs that are being notified to stand by for tasking incl. preparation to drive to the DC area.
- ✓ Extensive working and planning relationships with local, state and federal responders
- ✓ 24/7 scientific and engineering support and state-of-the-art technology

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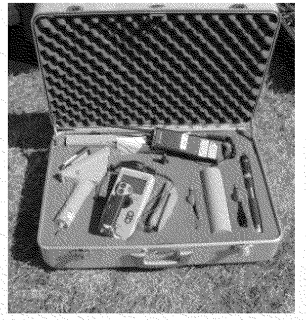
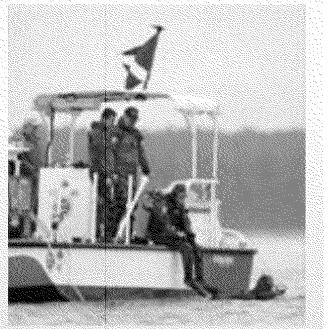
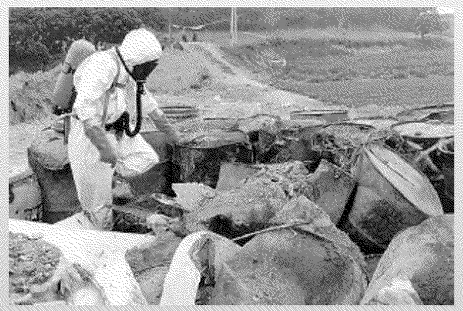
Threat Response and Incident Management

<u>Support for Our On-Scene Coordinators</u>

- 1 National and 13 Regional Response "Teams"
- Federal Special Teams under the NCP, including:
- Immediate Access to Emergency Response Contractors
  - ✓ Approximately 25,000 deep
  - ✓ 22 contracts provide immediate access to field technical expertise & services
  - ✓ 25 contracts for cleanup personnel, equipment, and services
    - ✓ Transportation and disposal of hazardous wastes is a mandated subcontracting activity
- Forensic assistance also available from EPA's Criminal Investigations Program







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Radiological Emergency Response Team (RERT)

- Provide guidance and on-scene assistance
- Field-deployable RERT
  - ✓ Focus is on identifying and assessing potential impacts of low-level contamination
  - ✓ Field monitoring instruments and sample collection equipment
  - ✓ Mobile laboratory and capabilities

RadNet

RADNET
Tracking Environmental Radiation Nationwide

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EPA
Radiological Emergency Response Team

- Nationwide, continuously operating environmental radiation monitoring system
  - ✓ Current upgraded system includes both fixed and deployable components
  - ✓ Air monitoring provides near real-time gamma spectroscopy and beta detection
  - ✓ Milk, precipitation, and drinking water also routinely monitored
- Helps decision-makers estimate the effects of radioactive releases on human health and the environment
- Developing system to meet data quality objectives based on response timeline

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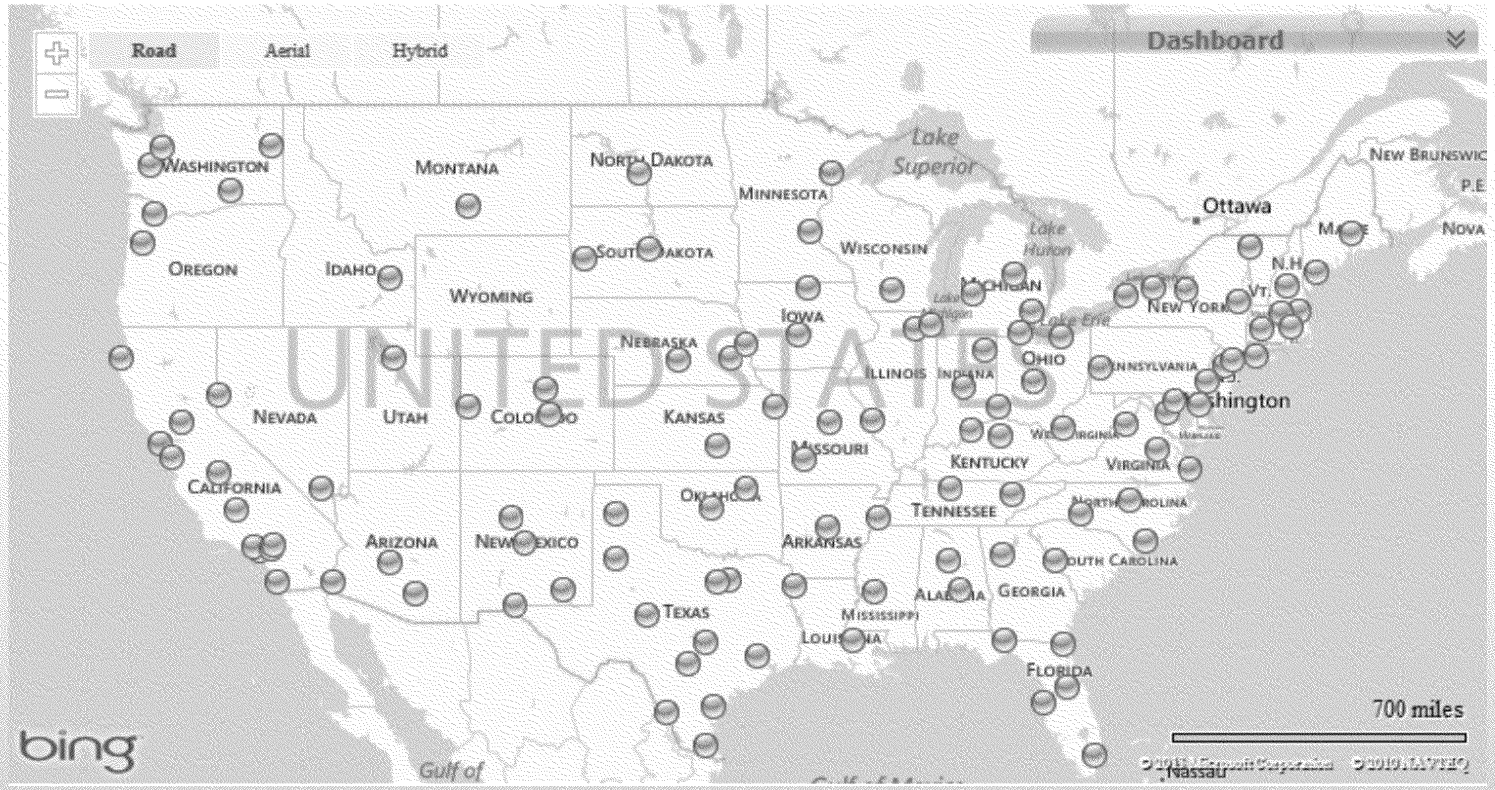
Continuous National Monitoring

RADNET
Tracking Environmental Radiation Nationwide

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
EPA
Radiological Emergency Response Team



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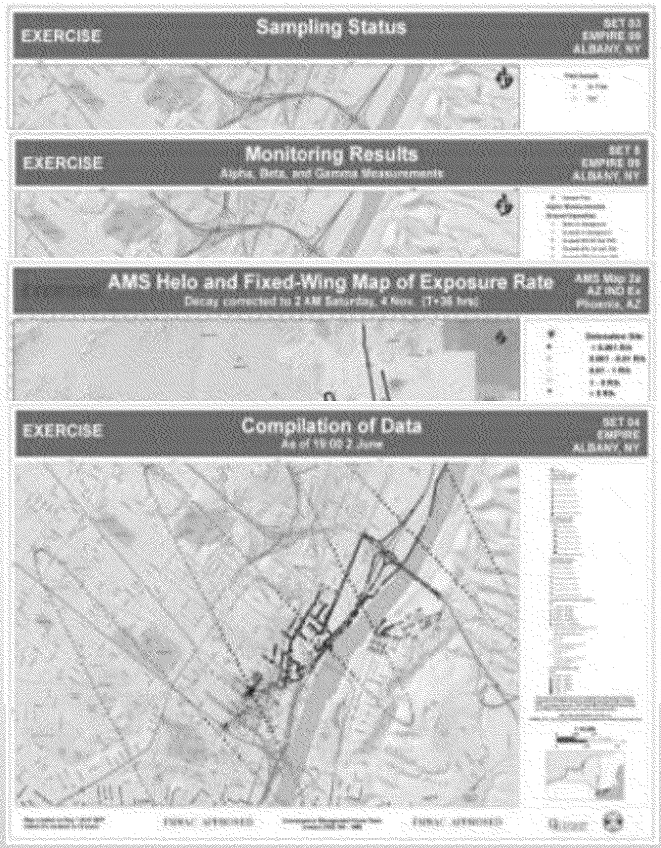
The Advisory Team for Environment, Food, & Health

- The mission of the A-Team is to provide coordinated technical advice and recommendations to the State, Coordinating Agency, and DHS concerning environmental, food, and health matters.
- Membership is comprised principally of :

and other Federal agencies as needed

Federal Radiological Monitoring and Assessment Center

- FRMAC is responsible for coordinating all environmental radiological monitoring, sampling, and assessment activities for the response.



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CMAD Radiation Response Capabilities

- ASPECT aircraft for radiation detection and imagery
- Ground based radiation detection technologies
- Certified Health Physicists to provide technical advice on health and safety, monitoring, sampling, decontamination
- Reach back to the ERLN for analytical support
- Reach back to trained Radiation Task Force Leaders to support the characterization efforts
- Trained Scientific Support Coordinators

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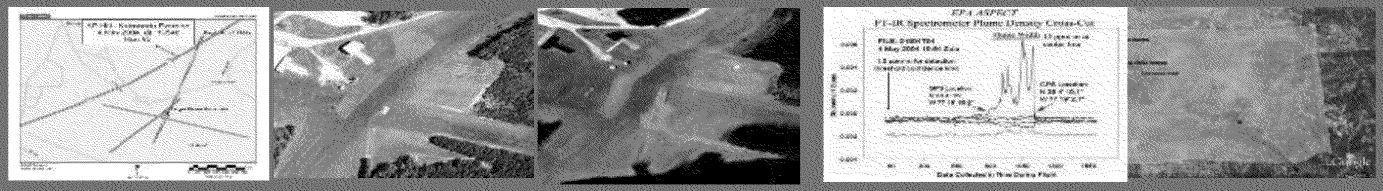
ASPECT - Operational Concept

- Provide a readiness level on a 24/7 basis
- Provide a simple, one phone call activation of the aircraft
- *Wheels up in under 1 hour* from the time of activation
- Once onsite and data is collected it takes about….

~ 5 minutes to process and turn around data to first responders



- Radiological Deployment Simplified:
  - Once on-scene collect radiological and situational data (imagery) using established collection procedures. Use the largest volume of detectors of any aerial platform in CONUS to detect gamma ray and neutron radiation.
  - Process and extract the near real time data from the aircraft using a broadband satellite system and rapidly QA/QC the data by a dedicated scientific reach back team
  - Provide the qualified data to the first responder enabling them to make informed decisions in minimal time

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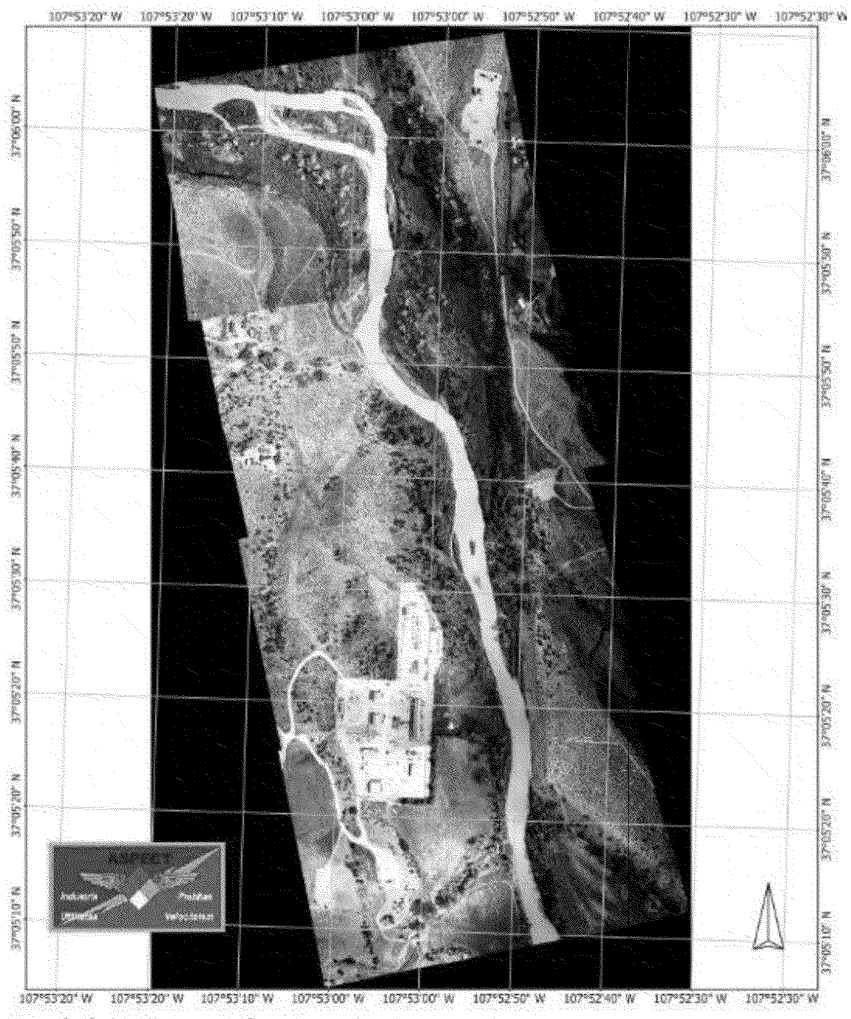
Aerial Photography

- 29 MP High Resolution Digital Camera
  - ✓ ***4 inch resolution!***
- Automated Geo-Rectification/GIS Coded Images
- Full Ortho-Rectification (Camera Model) Correction
- Ability to Process in the
- Compressed Transmission of Data Via SatCom
- Fast Turn Around on Images
- All Products can be imported into:
  - ✓ All EPA GIS formats
  - ✓ Google Earth,
  - ✓ ESRI
  - ✓ Generic Geospatial software packages
  - ✓ *Whatever the customers require*



Gold King Photo Response
North of NM-CO border

Universal Transverse Mercator - Zone 13 (
Lon: 107°52'56" W
Lat: 37°05'37" N
Printed at: 8/20/2015

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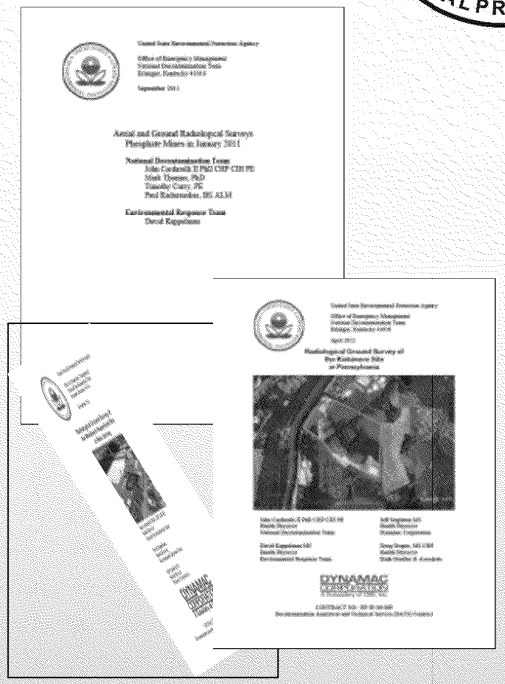
CMAT Ground-Based Radiological Technology/Capabilities - Asphalt

- CMAD Equipment in Erlanger, KY
  - ✓Up to 6 RSX-4 2x4x16 NaI detectors
  - ✓Up to 3 RSX-1 3x3 LaBr detectors
  - ✓Up to 2 RSX-1 4x4x16 NaI detectors
- Data products compatible with all Federal and local partners (DOE, FRMAC, DOD, etc.)
- Can be mounted in any ground based vehicle – car, truck, 4-wheeler, etc.



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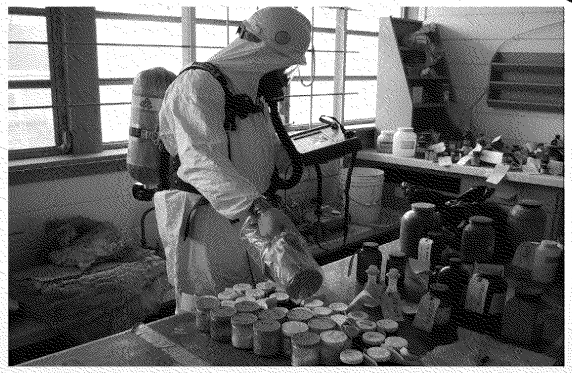
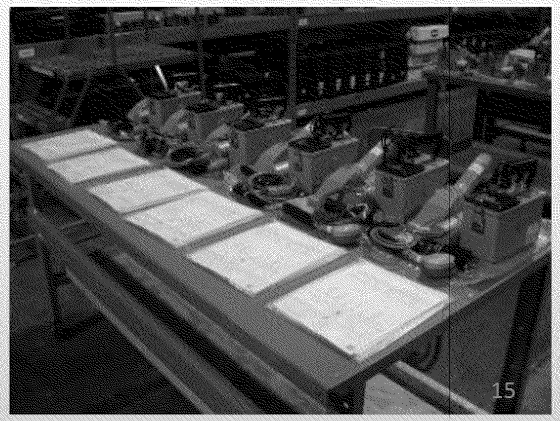
Trained Radiation Task Force Leaders (RTFL)

- ✓10-day radiation safety course for EPA personnel who will augment the existing Emergency Response Program personnel in a response to a major radiological contamination incident
- ✓~ 50 trained to date
- ✓Refresher Training Hammer Facility Richland, Washington (Using Tc-99m sprayed in training areas)
- ✓Two week boot camp course in Erlanger, KY for new RTFL recruits
- ✓Considering development of a Bio and Chem TFL program





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Emergency Response Lab Network

Environmental Lab Capability

- 136 fixed and 7 mobile laboratories nationwide
  - ✓ Labs support multiple missions
  - ✓ Oriented towards routine analysis of industrial chemicals, radiochemicals, pesticides, and conventional pollutants
  - ✓ Specialized for CWAs
  - ✓ Commercial, state, and federal lab make up
  - ✓ Accessible to all Regional analytical service requestors
- EPA is prepared to help with a national need to build environmental laboratory capacity
  - ✓ Charter member of DHS chaired Integrated Consortium of Lab Networks
  - ✓ Developed and manages Consortium of Lab Networks
  - ✓ Stringent membership requirements for lab entry into ERLN
  - ✓ National interconnection with lab networks for water security, BioWatch, and food security

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ERT's Radiation Response Capabilities

- On-site radiation detection and measurement
- Exposure Monitoring
- Contamination Surveys and Sampling
- Air Sampling
- Real Time Gamma Spectroscopy
- Mobile response ready
- SkyLINK (Remote Telemetry/VIPER)
- RSI RSX1
  - Data Compatibility between EPA and other Federal Partners

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ERT's All Hazard Response Capabilities

- VHR Radio Cache w/ Repeater(s)
- Satellite Communications Dishes (4)
- Data management / GIS
- EPA National Buy List Equipment Cache
- Other All Hazzard Detection Equipment
- Mobile Command Post (2)
- SCBA Air Trailer
- Hazmat truck
- Other All Hazzard and Specialized Detection Equipment

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SkyLINK

- Versatile gamma exposure-rate measuring tool consisting of twenty (20) GammaTRACER radio probes, which respond accurately to exposure rates ranging from 2 microRoentgens per hour (uR/hr) to 1,000 R/hr.
- Operating distance up to 60 miles line-of-sight, 10 miles inner city

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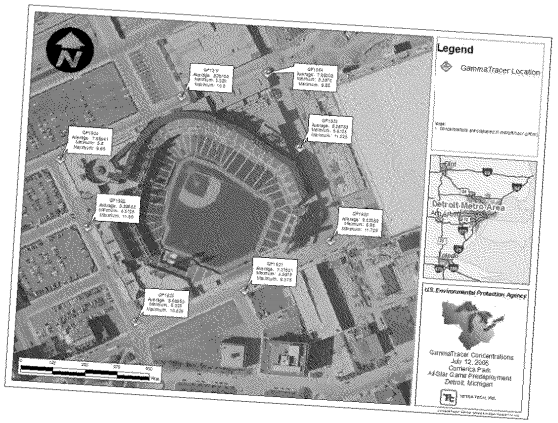
SkyLINK

- Probes broadcast data packets via an FCC-approved band to a mobile receiving and data processing center where exposure rates, environmental conditions, and system quality assurance indicators are visualized and stored in a SQL database.
- Data Replication to VIPER server whenever internet connection available



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Enforcement Response Team (NCERT)

- 11 Agents currently trained and available to assist.
- NCERT has 4 thermo FH-40 G units with pancake probes and 4 Mini radial units available, with ability to access additional 6 FH-40G.
- 6 Ludlum units available from NEIC.
- NCERT agents can be on-scene within 12 hours.

Critical Impact Updates:

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Drinking Water

- It appears that drinking water facilities to the South of the District of Columbia have not been impacted and no special steps need to be taken to protect the water supply in these areas
- Recommend that drinking water systems between DC and Baltimore that are served by surface water sources provide drinking water from their treated water storage facilities as a precaution to minimize impacts on these systems
- The water from these systems is safe to drink, but should only be used for drinking and flushing of toilets at this time in order to extend the availability of drinking water in these areas
- We do not anticipate that groundwater systems or private wells will be impacted at this time

Drinking Water (cont)

- EPA will continue to closely monitor the situation in the coming days to ensure that the proper steps are taken to ensure the availability of safe drinking water for all, including providing alternative sources of water should this become necessary
- We will provide updates to the public as additional information becomes available in the coming days.

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Waste Management

- After immediate exposure threats are addressed, we will begin to characterize the nature and extent of contamination, including waste volumes and characteristics

- Given the area impacted by the event, we do not anticipate existing commercial disposal facilities for radioactive wastes are available to manage the anticipated high volume of waste.

- Will work with our Federal partners to identify options. In addition, we will identify short-term staging areas.

Health and Safety

- SHEMD can provide assistance with dosimetry for responders
- The Special Teams can develop health and safety recommendations including recommended PPE if Region 3 SHEMP needs assistance

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U.S. ENVIRONMENTAL PROTECTION AGENCY
Washington D.C.
November 14, 2014

PROPOSED DRINKING WATER PROTECTIVE ACTION GUIDES (PAGs) DISCUSSION

DATE: November 20, 2014
LOCATION: WJC North 3412
MEETING TIME: 5:00 pm
FROM: Samuel Hernandez

I. REQUESTING OFFICE

Joint Meeting by OW/OGWDW & OAR

II. TIMING

EPA is working towards publishing a Drinking Water PAG proposal by summer 2015.

III. PURPOSE

Present a dose value recommendation for the Drinking Water PAG, Discuss how to address the controversy associated with the proposal, and Discuss how this action would support agency decision making during a radiological contamination incident.

IV. BACKGROUND AND HISTORY (BULLETS ARE FINE)

A PAG provides a projected dose value, at which specific protective action is recommended to avoid or reduce the potential radiation exposure that an individual might be exposed to as a result of an accidental or deliberate release of radioactive material.

PAGs were initially published in 1992, but the drinking water component was not included citing "Protective action recommendations for drinking water are under development by EPA". EPA promised that a drinking water PAG would be developed in a future revision of the PAG document.

During the US response to the radiation incident at Fukushima, Japan in March 2011 rain water samples collected as part of RadNet showed concentration of certain radionuclides above the SDWA Maximum Contaminant Levels (MCL) for gross beta Radiation.

While the detected levels were very low, for certain radionuclides the MCLs were exceeded. This caused alarm in certain sectors of the media and the general public. EPA had major difficulties conveying its message to the public that the detected levels were not of immediate concern to public health.

On April 2013, EPA published the draft PAG Manual for public comment. The Agency requested input on the appropriateness of, and possible values for, a drinking water PAG.

V. KEY ISSUES

The proposed PAG will be criticized by comparing it with the current SDWA regulation for gross and beta radiation which sets the MCL in drinking water at 4 mrem/yr.

In reaction to a previous similar proposal, anti-nuclear and environmental groups publicized misleading comparisons of derived water PAG concentrations alongside MCL concentrations to assert that the SDWA was being weakened.

Stakeholders base their strong objections and opposition on the fact that exposure to drinking water with higher levels of radiation will likely result in an increased risk of cancer cases. The stakeholders go into detail pointing out the differences in concentration levels derived from a PAG of 500 mrem in comparison with an MCL of 4 mrem. For some radionuclides, the resulting difference in concentration could be up to several thousand times.

While responding to the Fukushima incident EPA learned that a drinking water PAG is urgently needed in order to be prepared to respond to a radiological contamination incident in the US. A drinking water PAG would position the EPA to convey its health protection messaging to the American public.

What would happen if there was an emergency in the US that caused radioactive material to be released into the rivers, lakes, and streams? What if those streams were sources of drinking water? What steps could your local, state and federal government take? These were some of the very challenging issues the government of Japan had to address following the Fukushima nuclear power plant incident. To assist state and local governments here at home, EPA has developed guidance for use during nationally significant radiological emergencies such as a disaster at a nuclear power plant, a radiological dispersal device or an improvised nuclear device.

This non-regulatory guidance, called a drinking water Protection Action Guide (PAG) will help decision-makers to balance public health protection with other important factors that may arise during an emergency. As a part of the PAG, EPA recommends protective values for for pregnant women, nursing women and children age 15 and younger, and for the general population. The levels are intended to be used to determine when the use of contaminated water supplies should be restricted and alternative drinking water be provided during short term exposures in emergency situations. The guidance also provides calculations that can be used to compare measured concentrations of radionuclides in drinking water to EPA's recommended PAG levels.

EPA's new PAG guidance is not for use during normal water system operations and the PAG does not affect or change EPA's drinking water standards for radionuclides. As with all National Primary Drinking Water Regulations , water systems exceeding standards, regardless of the reason, are in violation. EPA expects that the responsible party for any drinking water system adversely impacted during a radiation incident will take action to return to compliance with Safe Drinking Water Act maximum contaminant levels as soon as practicable.

To: Christ, Lisa[Christ.Lisa@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Veal, Lee[Veal.Lee@epa.gov]; Edwards, Jonathan[Edwards.Jonathan@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: DeCair, Sara
Sent: Thur 11/13/2014 9:45:42 PM
Subject: Materials for DA briefing on Water PAG
OW-OAR PAG brief final v2.docx
PAGs 101 11-4-2014.ppt
Background for Deputy Administrator 11_20_14.docx

;;
For our joint briefing with Deputy Administrator Stan Meiburg next Thursday, here are the updated materials. PAGs 101 has only one edit. It is a simpler definition of PAG on slide 3, at Mike Flynn's request. The only changes in the joint briefing are the footer date and the end date of the schedule (now March 2016) which I had mistyped previously.

The plan for the briefing is for me to offer to go through the PAGs 101 if Stan would like, and then Lisa and I are going to tag-team the briefing paper. We decided on which sections each of us will do this afternoon. A 'Background for DA' is attached from OW, on the details of how the risk analysis was done. Ken suggested this be provided for a read-ahead, but not to go through during the meeting.

Jon and Alan will send these up through Mike Flynn and Lisa will send materials up to Ken's office in the morning before they go to the DA's office. I will bring extra paper copies to the meeting. Cheers,

Sara

Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

new office

Room 1416 B in WJC West

Protective Action Guide (PAG) for Drinking Water

Background on SDWA MCLs for Radionuclides:
In 1976 EPA issued interim regulations for radionuclides in drinking water. In December 2000, EPA promulgated final regulations for four radionuclide groups:

- Gross Alpha (Minus Radon & Uranium) MCL = 15 pCi/L: Retained from 1976 Rule
- Combined Radium 226 & 228, MCL = 5 pCi/L: Retained from 1976 Rule
- Gross Beta & Photon, MCL = 4 mrem/yr (uses dose conversion factors from 1976 Rule): Retained from 1976 Rule
- Uranium MCL = 30 ug/L: Newly established standard in 2000

The gross beta and photon MCL is unique because it is based on a dose of radiation (measured in mrem) instead of a concentration of a specific radionuclide (measured in pCi/L). There are ~179 radionuclides that are "beta-photon" emitters that are regulated as a group under this standard.

As a point of reference, for the gross beta & photon emitters, the MCL is 4 mrem annual dose:

- For Iodine-131 in drinking water the derived concentration corresponds to **3 pCi/L**
  - Based on limiting the dose to the thyroid to 4 mrem per year
  - In 1976 EPA calculated a lifetime risk at this exposure to be 6 x 10^{-5}, assuming 70 year lifetime exposure through 2 liters drinking water per day
  - Utilizing dose calculation methods developed in 1958 (ICRP 2)

- In 2000, EPA updated the lifetime risk estimates at this exposure to be within the upper and lower bounds of risk (10^{-4} to 10^{-6}) using current science (ICRP 72). The derived concentration would correspond to 55 pCi/L for children and 120 pCi/L for adults for Iodine-131. Due to the SDWA anti backsliding provision EPA retained the original conversion factors.

<u>PAGs Background</u>

- PAGs were initially published in 1992, but the drinking water component was not included citing "*Protective action recommendations for drinking water are under development by EPA*". EPA promised that a drinking water PAG would be developed in a future revision of the PAG document

<u>August 2008</u>

- DHS issued a planning guidance recommending that protective actions for drinking water be implemented if levels were projected to exceed 500 mrem for the first year. DHS guidance was specifically developed for Radiological Dispersion Device (RDD) and Improvised Nuclear Device (IND) incidents.

<u>January 2009</u>

- There was an EPA effort to issue a drinking water PAG in early 2009, but the proposal was held-back by the incoming Administration. At the time it was suggested that the drinking water PAG would be 500 mrem per year.
- OW's position on this issue was that protective actions should be based on the SDWA MCL for radionuclides (4 mrem/yr).

March 2011

- During the US response to the radiation incident at Fukushima, Japan in March 2011, rain water samples collected as part of RadNet showed concentration of certain radionuclides above the SDWA Maximum Contaminant Levels (MCL) for gross beta radiation.
- While the detected levels were very low, for certain radionuclides the MCLs were exceeded. This caused alarm in certain sectors of the media and the general public. EPA had major difficulties conveying its message to the public that the detected levels were not of immediate concern to public health.
- It became evident that EPA was not prepared to promptly respond to a similar incident, and OW was directed to start working on the development a DW PAG.
- Drinking water advisory issued by the Japanese Government during Fukushima for Iodine-131 was 100 Becquerel/liter for Infants and 300 Becquerel/liter for Adults (about 2700 pCi/L for Infants & 8000 pCi/L for Adults). *Note: SDWA MCL for Iodine-131 is 3 pCi/L.*

April 2013

- EPA published the draft PAG Manual for public comment. The Agency requests input on the appropriateness of, and possible values for, a drinking water PAG."

Approach for Developing a Drinking Water PAG

Options considered during PAG development:

a) Do nothing: States may develop individual PAG levels, or EPA will need to create one after an incident occurs.
b) Use the SDWA MCL (4 mrem) as the level to provide an alternate source of drinking water.
c) Adapt DHS & FDA guidelines: 500 mrem from water for first year after any incident (DHS covers water after a terrorist attack and FDA guide applies to food).
d) Consider dose levels within the range recommended by international guidelines while providing additional protection for infants and children.

Range of Dose Options Considered:

4 mrem = Dose for current SDWA MCL
100 mrem = Equivalent to Advisory Level issued in Japan assuming 365 day exposure (Infants)
250 mrem = Equivalent to Advisory Level issued in Japan assuming 365 day exposure (Adults)
500 mrem = Dose Value recommended by DHS (for drinking water) & FDA (for Food)
100 mrem to 2,000 mrem = Range of international guidelines for water to keep total doses below 10,000 mrem (IAEA, ICRP)

Note: Even at a low dose level, newer dosimetry and a shorter duration (i.e., one year vs. a lifetime) will result in a PAG concentration orders of magnitude higher than our MCLs for individual radionuclides.

Evaluation and Findings from Assessment - Drinking Water PAG:

- OGWDW prepared an assessment with a range of dose values and the resulting projected risks for different targeted sub populations and exposure time frames.
- Projected risks levels vary widely depending on age, exposure time frame, and ingestion rates. Projected risks are informed by the most recent and widely accepted dosimetry and dose conversion factors.

Risk Assessment of Two Nuclides Common to Radiological Incidents

Iodine-131
*SDWA Derived MCL Concentration 3 pCi/L

Dose (mrem/yr)	**4 mrem**	**75 mrem**	**100 mrem**	**500 mrem**
Subpopulation Highest Risk	Infant	Infant	Infant	Infant
Projected Risk	4.67E-06	8.70E-05	1.17E-04	5.84E-04
Projected Risk for Adult	8.40E-07	1.57E-05	2.10E-05	1.05E-04
Corresponding Concentration (pCi/L, 5 year olds)	84	1,580	2,110	10,500

** Due to differences in ingestion rates, the derived concentration for I-131 for five year olds is the most restrictive.*

Cesium-137
*SDWA Derived MCL Concentration 200 pCi/L

Dose (mrem/yr)	**4 mrem**	**75 mrem**	**500 mrem**
Subpopulation Highest Risk	Infant	Infant	Infant
Projected Risk	6.45E-06	1.20E-04	8.06E-04
Projected Risk for Adult	1.81E-06	3.40E-05	2.27E-04
Corresponding Concentration (pCi/L, infant)	735	13,797	91,900

Calculated Risk Ranges:
Projected risk for excess cancer cases associated with different exposure scenarios were developed for infants, children and adults. The results from these projections of the estimated excess cases of cancer generally fall within the risks range of 10^{-4} to 10^{-6} for all projected doses evaluated (e.g., 4 mrem to 500 mrem). There are a few exceptions where the risk levels approach the 10^{-3} for dose levels higher than 250 mrem/year for certain nuclides.

Subpopulation of Concern:
Based on the calculated projections, infants and children 5 years old and younger appear to have the greatest risk from exposure to radionuclides in drinking water. A PAG developed to protect infants and children 5 years and younger would also be at least as protective to fetuses and developing embryos.

Supplemental Information

Key Terms:

Bq

One becquerel (Bq) is the amount of a radioactive material (atoms or grams) that decays at a rate of 1 disintegration per second.

Ci, pCi, and dps

A curie (Ci) is an expression of the amount of radioactivity that corresponds to that amount of radioactive material (atoms or grams) that has a decay rate of 3.7E10 disintegrations per second (dps). A picocurie (pCi) is one trillionth (i.e., 10-12) of a Ci.

Rem and mrem

A rem is an expression of the amount of ionizing radiation absorbed by tissue multiplied by the a quality factor that takes into consideration the relative potential amount of damage the radiation might cause; a mrem (millirem) is 0.001 rem.

For example, for an internally deposited radionuclide, such as Cs-137, each time an atom of Cs-137 decays inside the body, it emits a certain amount of ionizing radiation in the form of beta particles (essentially electrons) and gamma rays (i.e., energetic photons). When this energy is deposited in tissue, the molecules that comprise living tissue are ionized, which results in an increased risk of cancer. The product of the absorbed dose to tissue (which is expressed in terms of rad) with the use of a quality factor is referred to as the dose equivalent, expressed in units of rem or millirem. If 100 ergs per gram of any combination of beta particles or photons is deposited into a gram of tissue, the absorbed dose to the exposed tissue is 1 rad and the dose equivalent to that tissue is 1 rem. If the energy deposited in tissue is in due to an alpha particle, the quality factor is 20 and the dose equivalent is 20 rem because the damage caused by the energy of an alpha particle in a gram of tissue is about 20 times greater than the same amount of energy of beta and photon radiation deposited in a gram of tissue. If that energy is deposited uniformly in every gram of tissue in the body (whether alpha, beta or gamma), the exposure is defined as a whole body dose or effective dose.

Sv

A sievert (Sv) is 100 rem. Sv is the International System of Units (SI) derived unit of ionizing radiation dose (the rem and mrem are older, non-SI units).

Effective dose

When ionizing radiation is deposited in tissue, it can be deposited in only a small part of the body or uniformly throughout the body. The potential for harm associated with 1 rem (100 ergs/g) deposited in only a portion of the body is less than the potential for harm if the entire body experiences 1 rem. In order to establish risk equivalency between a partial and a whole body dose when only a portion of the body is exposed, the dose equivalent to the tissue experiencing the exposure is multiplied by a tissue weighting factor which converts the tissue dose to an effective whole body dose, or simply referred to as the effective dose.

For example, if a person ingests I-131, most of the internal dose will be delivered to the thyroid gland. The tissue weighting factor for the thyroid gland is 0.04. This means that the risk of cancer from the exposure of only the thyroid gland is about 0.04 of the risk of cancer if that same dose was delivered to the entire body. Hence, if one rem is delivered to the thyroid gland due to the ingestion of I-131, the effective whole body dose is 0.04 rem. If Cs-137 is ingested, it is distributed to the whole body so there is no need to apply a tissue weighting factor because the whole body is uniformly exposed.

DCF

Dose Conversion Factor (DCF), if a person were to ingest a given radionuclide, the radionuclide might remain in his or her body for a long time. Hence, when we refer to a dose of 500 mrem delivered due to the ingestion of contaminated water for a one year period, the actual dose is the dose delivered to that person over his or her lifetime due to the radionuclides ingested in that year. Hence 500 mrem is actually 500 mrem lifetime dose commitment.

MODELS AND ASSUMPTIONS

The fundamental equations that are used to derive trigger levels are as follows.

The effective whole body dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T* is derived as follows:

$$\mathbf{D_{iaT} = I_{iaT} \times DCF_{ia}}$$

Where:

D_{iaT} = Effective whole body dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T*

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T*

DCF_{ia} = The effective dose coefficient (also referred to as the whole body dose conversion factor or DCF) for the ingestion of radionuclide *i* in drinking water and age group *a* (mrem/Bq or Sv/Bq) using the DCFs from FGR-13.

Risk is expressed in terms of total cancer risk (morbidity) as opposed to fatal cancer risk (i.e., mortality). The lifetime risk of cancer due to the ingestion of radionuclide *i* by age group *a.*:

$$\mathbf{R_{iaT} = I_{iaT} \times RC_{ia}}$$

Where:

R_{iaT} = The lifetime risk of cancer due to the ingestion of radionuclide *i* over time period *T* by age group *a* (life risk of cancer per Bq or per pCi ingested).

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T*.

RC_{ia} = The lifetime risk coefficient for the ingestion of radionuclide *i* in drinking water and age group *a* [lifetime risk per pCi (or per Bq) ingested in water] using the RCs from FGR-13.

To derive the quantity of radionuclide *i* ingested by age group *a* over a given time period, *T*.

$$\mathbf{I_{iaT} = C_i \times Ing_a \times T}$$

Where:

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T* (days)

C_i = The concentration of radionuclide *i* in drinking water (pCi/L or Bq/L). In this analysis, the concentration of the radionuclide is assumed to be constant over the time period *T* of interest.

Ing_a = The daily ingestion rate of water for age group *a* as provided in FGR-13 (L/day).

T = The time period that the population is drinking contaminated water (days

Dose Conversion Factors

DCFs (Sv per Bq ingested at the age indicated)

Isotope	DCFs from FGR-13*			
	Infant (100 day old)	1 year old	5 year old	Adult
Cs-137	2.11E-08	1.24E-08	9.69E-09	1.36E-08
I-131	1.84E-07	1.79E-07	1.04E-07	2.18E-08

Lifetime Morbidity Risk Conversion Factors

(per Bq ingested in water at the indicated age)

Isotope	Infant	1 yr old	5 yr old	Adult (age 25-70)
Cs-137	3.40E-09	2.49E-09	1.97E-09	6.17E-10
I-131	2.15E-08	1.99E-08	1.06E-08	4.58E-10

Drinking Water Ingestion Rates from FGR-13

Age (years)	Tap Water (L/day)*	
	Male	Female
0	0.191	0.188
1	0.223	0.216
5	0.542	0.499
20	1.137	0.754
50	1.643	1.119

EPA Protective Action Guides

PAGs 101

Promoting radiation safety worldwide.

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Outline

- What is a PAG
- Who Uses PAGs
- Exposure Pathways
- Phases of Emergency Response
- Early, Intermediate & Late Phase PAGs
- Key Updates Issued in 2013

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What is a PAG

- A calculated tipping point at which an action to reduce radiation dose is recommended
- Guidance for public officials
- Protective Action Guides are called 'PAGs'

For example:

•Scientists project a dose of 500 mrem in the first year.

•There is a protective action associated with that dose in the PAG Manual.

•Decision makers implement the recommended action as quickly as possible.

•The public actually receives a dose of 200 mrem.

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Global PAGs, and Regulations

- All developed countries have PAGs in some form
  - ✓ The International Atomic Energy Agency provides high level guidelines which our federal guidance echoes
  - ✓ Radiation disasters are rare, but not 100% avoidable
  - ✓ The U.S. PAGs originated in 1960s in response to fallout from weapons testing
- Our public health and environmental regulations remain in effect, every day
  - ✓ Emergency guides are needed when a disaster takes us temporarily and unavoidably out of compliance

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Who Uses the PAG Manual

- State and local emergency managers use EPA PAGs in local emergency response plans
- Nuclear power plant community decision makers
  - ✓ The same EPA PAG levels have been used for several decades around nuclear plants, for preparedness
  - ✓ Nuclear Regulatory Commission and FEMA require use of EPA PAGs in local emergency plans
- Urban areas with Homeland Security plans
  - ✓ EPA PAGs and the planning guidance are incorporated into local plans with assistance from FEMA and others

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Phases of Response

- Early Phase: The first hours to days until the release has stopped, when protective actions decisions must be made with little to no information
- Intermediate Phase: The weeks to months when more information is available, protective actions are more restrictive, and cleanup planning begins
- Late Phase: No longer an emergency; activities shift to long term recovery and cleanup

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Radiation Exposure Pathways

- The worst case scenario is a large release from a damaged nuclear power plant or a terrorist attack using radioactive material:
  - ✓ Airborne plume
  - ✓ Contamination on people
  - ✓ Ground and building contamination
  - ✓ Food and water contamination
  - ✓ Longer term spread into crops and the environment

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Early Phase PAGs

- Evacuation/Shelter 1-5 rem (10-50 mSv); Provide KI 5 rem (50 mSv) child thyroid dose
  - ✓ These levels are used as health-based tipping points at which an action would be warranted. Predictions of dose based on the release or measurements must be compared to these tipping points to determine if prompt action is needed.
- Worker 5, 10, 25+ rem (50, 100, 250+ mSv)
  - ✓ These worker guides are more like limits. They guide stopping work if doses received meet these levels, based on how critical the work is (e.g., lifesaving)

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Intermediate Phase PAGs

- Relocate population
  - ≥ 2 rem (20 mSv) first year (projected dose)
  - 0.5 rem (5 mSv) any subsequent year
- Apply dose reduction techniques
  - < 2 rem (20 mSv)
  - These PAGs are lower, and based on longer-term dose projections (first and second year)
- Food (FDA 1998): Most limiting of
  - 0.5 rem (5 mSv) whole body or
  - 5 rem (50 mSv) to most exposed organ or tissue

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Late Phase

- Actions designed to reduce radiation levels in the environment begin
- Actions are meant to reduce long-term exposures and improve living conditions.
  - ✓ A PAG level, or numeric dose to avoid, is not appropriate for long-term cleanup
  - ✓ The PAG Manual describes a process involving stakeholders in decision making on clean-up goals, technology, land use and approaches
- Community involvement is key

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2013 Revised PAG Manual

- Update to the 1992 PAG Manual
  - ✓ Expanded scope to include terrorism: RDD, IND
  - ✓ Incorporated updated FDA Potassium Iodide guidance
  - ✓ Refers to updated FDA Food guidance
  - ✓ Includes a new matrix on re-entry decisions
  - ✓ Provides brief cleanup and waste management planning guidance
  - ✓ Incorporates DHS 2008 late phase cleanup guidance
  - ✓ Updates science basis to updated international guides

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Wrap Up

- Questions?
- Comments?
- Suggestions?

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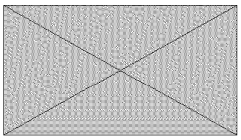
To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
Cc: Jonathan.Koplos@cadmusgroup.com[Jonathan.Koplos@cadmusgroup.com]
From: Brent Ranalli
Sent: Thur 4/30/2015 9:00:45 PM
Subject: Memo - Drinking Water PAGs Based on Doses to Critical Organs - 4-30-15docx.docx
Memo - Drinking Water PAGs Based on Doses to Critical Organs - 4-30-15docx.docx

;;
Hi Sam,

Here is the memo with an approach for using critical organs as the basis for PAGs, with a discussion of pros and cons and a list of critical organs and dose and risk coefficients for the list of 50+ isotopes you provided.

All best,

Brent



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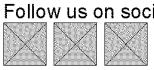

Discussion of Drinking Water PAGs Based on Doses to Critical Organs as Opposed to Effective Whole Body Dose Commitment

SC&A and The Cadmus Group

April 30, 2015

EPA's Office of Water is currently researching strategies for developing Protective Action Guides (PAGs) and associated Derived Response Levels (DRLs) for drinking water. Specifically, the Agency recognizes a short-term emergency drinking water guide may be useful for public health protection in light of the Fukushima nuclear power plant accident, which impacted some Japanese drinking water supplies. One of the issues under consideration by the EPA is whether PAGs and DRLs for drinking water should take into consideration the critical organ. For example, the EPA is currently considering establishing separate drinking water PAGs and associated DRLs for children and adults using dose conversion factors and daily drinking water rates as set forth in Federal Guidance Report No. 13 (FRG-13). Consideration is being given to establishing PAGs of 500 mrem and 100 mrem effective dose commitment for adults and children, respectively. However, it is recognized that certain radionuclides concentrate in specific organs, such as Sr-90 in bone and I-131 in the thyroid gland. The Food and Drug Administration recognizes the importance of radionuclides that seek out and concentrate in specific organs and provides guidance with respect to these issues as applied to the PAGs for food.[1] In summary the food PAGs are as follows:

> *The PAGs are 5 mSv (0.5 rem) for committed effective dose equivalent or 50 mSv (5 rem) committed dose equivalent to an individual tissue or organ, whichever is more limiting.*

This approach takes into consideration that the doses to some organs from the ingestion of some radionuclides could be considerably higher than the effective whole body dose.

Should the Office of Water consider establishing selected organ specific PAGs for drinking water, one defensible strategy that can be used to derive organ-specific PAGs would involve the following steps:

1. Establish benchmark values for the lifetime risk of cancer associated with 100 mrem for children and 500 mrem for adults.
2. Determine the doses to particular organs that would be associated with the equivalent

[1] Food and Drug Administration (FDA). 1998. Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies. Radiation Programs Branch, Division of Mammography Quality and Radiation Programs, Office of Health and Industry Programs. August 13, 1998

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risk. These would then represent the PAGs for particular organs.

3. Identify the radionuclides that might require organ specific PAGs because they tend to concentrate in specific organs.
4. Calculate DRLs for those radionuclides for children and adults.

This memo presents two example of how this might be done, and discusses the pros and cons of the approach.

1.0 Cancer Risk Coefficients

Using the EPA Revised Blue Book[2], the cancer incidence coefficient for uniform whole body dose to low level radiation to a reference stationary population distribution (defined the 2000 U.S. vital statistics) is about 0.001 risk per rem effective dose. A more precise estimate of the risk coefficient for a reference population, in units of risk per Gray (Gy^{-1}), is provided in Table 1.[3]

Table 1. Cancer Risks for a Reference U.S Population (Gy^{-1})

	Whole Population		Females	Males
	mean	90% CI	mean	mean
Morbidity	0.116	0.056-0.213	0.135	0.0955
Mortality	0.058	0.028-0.10	0.0689	0.0469

Source: EPA Blue Book, pp. 2-3

The implications are that if 10,000 people in a standard U.S. population experienced a uniform whole body low linear energy transfer exposure of 500 mrem, 5 people would be expected to develop a radiogenic cancer over the course of the population's life expectancy.

The EPA revised Blue Book explains that *radiogenic risks for childhood exposures are of special interest. Doses received from ingestion or inhalation are often larger for children than adults, and the risks per unit dose are substantially larger for exposures during childhood (here defined as the time period ending at the 15th birthday) than from exposures later in life.* Table 2 presents the cancer risk coefficients for children, which appear to be about twice those for adults.

Table 2. Cancer Risks for Children (under 15 years, (Gy^{-1})

[2] EPA Radiogenic Cancer Risk Models and Projections for the United States, EPA 402-R-11-001, U.S. Environmental protection Agency, Office of Radiation and Indoor Air. April 2011

[3] The conversion from risk per Gray (as found in the revised Blue Book) to risk per rem is performed on the assumption that 1 Gray = 100 rem. This equivalence holds for beta and gamma radiation. The case of alpha emitters is more complicated. For simplicity's sake, for the purpose of this memo, simple equivalence is assumed.

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	Females	90% CI	Males	90% CI
Morbidity	0.33	0.12-0.55	0.2	0.077-0.36
Mortality	0.15	--	0.085	--

Source: EPA Blue Book, p. 3

The revised Blue Book explains that there is generally much more uncertainty in the estimated risks from childhood exposures than in the risks for the entire population. A-bomb survivors who were children at the time of the bombings (ATB) still have substantial years of life remaining in which cancers are to be expressed. Further follow-up will provide more statistical precision and greater clarity as to how these risks vary many decades after the exposure. The implications of these risk coefficients are that if 10,000 children in a standard U.S. population experienced a uniform whole body low linear energy transfer exposure of 100 mrem, between 2 and 3.3 children would be expected to develop a radiogenic cancer over the course of the population's life expectancy. Of course the uncertainties are high, the values differ somewhat between males and females, and, among children, the risks would be higher for younger children.

2.0 Adult Doses to Critical Organs that Would Be Associated with a Lifetime Morbidity Risk of 5E-4

For simplicity, let us assume a lifetime risk coefficient of 0.001 total cancer risk per rem uniform whole body exposure for adults. Hence, a PAG for adults of 500 mrem effective dose would be associated with an individual lifetime excess total cancer risk of about 5E-4. Let us next assume that we would like to determine the I-131 and Sr-90 exposure to the limiting organs that would be equivalent to a lifetime cancer risk of 5E-4. In the following sections, we explore how one would derive PAGs and associated DRLs using the critical organ approach.

2.1 I-131

As can be seen in Appendix A, the limiting adult dose conversion factor for I-131 is 4.32E-7 Sv/Bq for the thyroid, and the limiting adult risk coefficient is 4.39E-10 risk/Bq for thyroid cancer. The organ specific PAG for thyroid cancer associated with the ingestion of I-131 in water would be derived as follows:

Thyroid Cancer: 4.39E-10 risk/Bq ÷ 4.32E-7 Sv/Bq = 1.02E-3 risk per Sv

The dose to the thyroid gland that would result in a lifetime risk of cancer of 5E-4 is as follows:

Thyroid Cancer: 5E-4 risk ÷ 1.02E-3 risk/Sv = 0.490 Sv or 49,000 mrem

Hence, if one were interested in establishing an I-131 PAG based on critical organ, with the same lifetime risk of cancer to that organ as an effective whole body dose of 500 mrem, the PAG would be 49,000 mrem to the thyroid; i.e., 98 times higher than the whole body dose.

The DRL is calculated as follows:

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$DRL_{organ} = PAG_{organ}$ / [Ingestion rate x 365 days x DCF_{organ}]

For easy comparison with the whole-body DRL in the draft PAG chapter, we apply the same drinking water ingestion rate that is used there: 1.643 L/day for 50 year old males.

Thyroid Cancer: DRL = 0.490 Sv / [1.643 L/d x 365 d x 4.32E-7 Sv/Bq] = 1,891 Bq/L

This DRL for thyroid cancer is equivalent to 51,100pCi/L, which is less protective than the parallel whole-body DRL of 10,384 pCi/L.

2.2 Sr-90

In Appendix A, we see that the limiting adult dose coefficient is 4.09E-7 Sv/Bq for bone surface and the limiting risk coefficient for the ingestion of Sr-90 is 9.48E-10 lifetime risk of leukemia (which is primarily due to exposure of red bone marrow) per Bq of Sr-90 ingested. In order to determine which organ should be considered the "critical" organ, we calculate results for both. From the FGR-13 software, version 2.1.13 (the source of the summary information in Appendix A) we find that the dose coefficient for red bone marrow is 1.79E-7 Sv/Bq and the risk coefficient for bone cancer is 3.98E-11 risk/Bq. Using both approaches, we obtain the following:

Leukemia: 9.48E-10 risk/Bq ÷ 1.79E-7 Sv/Bq = 5.30E-3 risk per Sv

Bone Cancer: 3.98E-11 risk/Bq ÷ 4.09E-7 Sv/Bq = 9.73E-5 risk per Sv

Clearly, the risk per Sv is much higher for exposure to the red bone marrow, even though the dose coefficient for bone surface is higher than for bone marrow. Hence, in this case, it would seem that a critical organ-based PAG for Sr-90 ingestion would be based on exposure to red bone marrow.

Organ-specific PAGs associated with a lifetime risk of cancer of 5E-4 would be calculated as follows:

Leukemia: 5E-4 risk ÷ 5.30E-3 risk/Sv = 9.43E-2 Sv or 9,430 mrem

Bone Cancer: 5E-4 risk ÷ 9.73E-5 risk/Sv = 5.14 Sv or 514,000 mrem

Hence, if one were interested in establishing a Sr-90 PAG based on critical organ, one would use red bone marrow, which is associated with the same lifetime risk of cancer as the effective whole body dose 500 mrem, and the PAG would be 9,430 mrem to red bone marrow, instead of 500 mrem effective whole body dose; i.e., about 19 times higher.

DRLs would be calculated as follows (using the 20-year-old male drinking water ingestion rate of 1.137 L/day, as per the draft PAG chapter):

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Leukemia: DRL = 9.43E-2 Sv / [1.137 L/d x 365 d x 1.79E-7 Sv/Bq] = 1,270 Bq/L

Bone Cancer: DRL = 5.14 Sv / [1.137 L/d x 365 d x 4.09E-7 Sv/Bq] = 30,300 Bq/L

These DRLs are equivalent to 34,300 pCi/L (leukemia) and 818,000 pCi/L (bone cancer). The leukemia DRL is about twenty-four times more protective than the bone cancer DRL, but still about five times less protective than the whole-body DRL of 6,743 pCi/L in the draft PAG chapter.

Note that the DRL of 6,743 pCi/L in the draft PAG chapter is not for Sr-90 alone, but for Sr-90 and its decay product Y-90 together. Sr-90 normally occurs in environmental media accompanied by Y-90 in a stable ratio. There are two ways in which the risk posed by Y-90 could be taken into account. One is to calculate a separate PAG for Y-90. In this case, as in the case of Sr-90, we find that the critical organs for dose and risk do not match up. The limiting DCF for Y-90 is 3.15E-08 for the wall of the lower large intestine, while the limiting risk coefficient for Y-90 is a 1.08E-10 risk of colon cancer. Here we encounter an additional complication: the menu of options for DCF does not include the colon as a target organ, and the menu of options for risk coefficient does not include cancer of the large intestine. So there is no straightforward way to determine whether a PAG for the colon or the large intestine is more limiting (or indeed to derive an organ-specific PAG at all for either organ).

Another way to handle the Y-90 that is expected to co-occur with Sr-90 in water is to calculate a single PAG by summing their respective dose and risk coefficients for a single selected target organ (e.g., for bone cancer or leukemia). As it happens, the bone surface dose coefficient for Y-90 and the leukemia risk coefficient for Y-90 are so miniscule that they add nothing (when taken to three decimal places) to the total dose and risk of combined Sr-90 and Y-90. Thus the PAG for combined Sr-90 and Y-90 is identical to the PAG for Sr-90, and the contribution of environmental Y-90 to public health risk becomes invisible.

3.0 Discussion

The critical-organ-specific approach enables policy-makers to focus on risks to particular organs. However, there are several drawbacks and difficulties associated with this approach. One problem with an organ-based PAG is that while a radionuclide may preferentially dose an organ, it does not only dose that one organ. All of the other organs of the body receive a dose as well. As seen in the examples above, the I-131 DRL based on risk to the thyroid is less protective than the DRL based on equivalent risk to the whole body, and the Sr-90 (or Sr-90/Y-90) DRL based on risk of leukemia is less protective than the DRL based on equivalent risk to the whole body. In either case, if the organ-specific PAG is used, the total risk to that individual would exceed the lifetime limit.[4] This problem could potentially be addressed by adjusting the allowable organ

[4] For instance, in order to receive a dose of 0.490 Sv of I-131 to the thyroid gland, an individual would need to ingest 1.13E+6 Bq of I 131 (i.e., 0.490 Sv ÷ 4.32E-7 Sv/Bq = 1.13E+6 Bq). In addition to giving a dose to the

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specific lifetime risk limit downward, so that an individual's total risk would not exceed 5E-4. Options for such adjustment could be discussed.

Regardless of the risk threshold chosen as the basis for an organ-specific PAG, establishing risk-based PAGs to critical organs presents technical challenges. One is that it is not always a straightforward matter to select the target organ. In the case of I-131, the same organ (thyroid) was associated with the highest risk coefficient and the highest dose coefficient. In the case of Sr-90, on the other hand, the highest risk coefficient belonged to leukemia (due to radiation to bone marrow) and the highest dose coefficient belonged to the bone surface (associated with risk of bone cancer). PAGs for both organs needed to be calculated to determine which organ was most limiting. In the case of Y-90, the critical organs for dose and risk were not only mismatched, but the authoritative look-up tables did not provide both dose and risk values, and so did not permit calculation of PAGs for these organs. In Appendix A, it can be seen that many of the radionuclides of interest, like Sr-90, have mismatched critical organs, and a fair number of these radionuclides, like Y-90, have critical organs (e.g., upper large intestine, lower large intestine, colon) that appear in only dose or risk look-up tables but not both. (A complete list of organs from the two sets of look-up tables, showing the extent of compatibility between the tables, appears in Appendix B.)

Another technical challenge, as we have seen in the case of Sr-90 and Y-90, is that PAGs for multiple isotopes cannot be summed in a straightforward manner if the critical organs are different. In the case of parent and daughter radionuclides that are expected to occur together in the environment like Sr-90 and Y-90, normal practice is to combine their dose coefficients and risk coefficients and treat them like one chemical. As we have seen, use of the limiting Sr-90 organ for combined Sr-90/Y-90 results in Y-90 contributing nothing to the resulting PAG and DRL.

All factors taken into consideration, it appears that PAGs based on committed effective whole body dose, as compared to critical organ committed equivalent, are more protective, and the DRLs can be derived in a more straightforward manner.

---

thyroid, the ingested I 131 would result in a whole body dose. The FGR-13 effective whole body dose equivalent for ingestion of I 131 is 2.18E-8 Sv/Bq , so the whole body dose would be 0.025 Sv, or 2,500 mrem—about five timeswhat the whole-body-based PAG would allow.

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Appendix A

Comparison of Dose Conversion Factors and Risk Coefficients

1	2	3	4	5	6	7
Isotope	**Dose Conversion Factor (DCF) for Adults (Sv per Bq ingested in drinking water)**			**Risk Coefficient for Adults Age 25-70 (risk per Bq ingested in drinking water)**		
	Whole Body DCF	**Critical Organ (highest organ-specific DCF)**	**Critical Organ DCF**	**Whole Body Risk Coefficient**	**Critical Organ (highest organ risk coefficient)**	**Critical Organ Risk Coefficient**
Sr-90/Y-90[1]	3.04E-08	Bone Surface	4.09E-07	1.19E-09	Leukemia (Trabecular Bone)	9.48E-10
Cs-137	1.36E-08	LLI Wall	1.67E-08	6.02E-10	Residual	1.27E-10
I-131	2.18E-08	Thyroid	4.32E-07	4.47E-10	Thyroid	4.39E-10
Ba-140	2.60E-09	LLI Wall	2.86E-08	1.04E-10	Colon	8.67E-11
Ba-141	6.99E-11	Stomach Wall	3.94E-10	1.79E-12	Colon	8.81E-13
Ba-142	3.53E-11	Stomach Wall	2.03E-10	8.78E-13	Stomach	4.21E-13
Ce-141	7.11E-10	LLI Wall	8.65E-09	2.87E-11	Colon	2.76E-11
Ce-143	1.12E-09	LLI Wall	1.16E-08	4.44E-11	Colon	4.21E-11
Ce-144	5.23E-09	LLI Wall	6.66E-08	2.16E-10	Colon	2.10E-10
Co-58	7.49E-10	LLI Wall	3.99E-09	2.65E-11	Colon	1.43E-11
Co-58m	2.41E-11	LLI Wall	1.67E-10	9.17E-13	Colon	7.93E-13
Cs-134	1.92E-08	LLI Wall	2.26E-08	8.51E-10	Residual	1.86E-10
Cs-134m	2.01E-11	Stomach Wall	1.15E-10	5.45E-13	Stomach	2.39E-13
Cs-137	1.36E-08	LLI Wall	1.67E-08	6.02E-10	Residual	1.27E-10
Cs-138	9.19E-11	Stomach Wall	7.04E-10	1.91E-12	Stomach	1.46E-12
I-131	2.18E-08	Thyroid	4.32E-07	4.47E-10	Thyroid	4.39E-10
I-133	4.28E-09	Thyroid	8.23E-08	1.35E-10	Thyroid	1.26E-10
I-134	1.08E-10	Stomach Wall	5.51E-10	3.02E-12	Stomach	1.14E-12
I-135	9.35E-10	Thyroid	1.60E-08	3.08E-11	Thyroid	2.44E-11

La-141	3.58E-10	ULI Wall	2.49E-09	1.22E-11	Colon	1.02E-11
La-142	1.82E-10	Stomach Wall	8.50E-10	4.95E-12	Colon	2.41E-12
Mn-54	7.22E-10	LLI Wall	2.44E-09	2.68E-11	Colon	9.49E-12
Mn-56	2.56E-10	ULI Wall	1.36E-09	7.79E-12	Colon	5.06E-12
Mo-99	6.05E-10	Kidneys	3.10E-09	2.41E-11	Liver	4.62E-12
Mo-101	4.15E-11	Stomach Wall	3.25E-10	8.83E-13	Stomach	6.76E-13
Nb-95	5.88E-10	LLI Wall	4.04E-09	2.01E-11	Colon	1.41E-11
Rb-89	4.68E-11	Stomach Wall	3.63E-10	9.58E-13	Stomach	7.55E-13
Ru-103	7.34E-10	LLI Wall	6.61E-09	2.80E-11	Colon	2.18E-11
Ru-106	7.01E-09	LLI Wall	7.18E-08	2.92E-10	Colon	2.30E-10
Sb-128[2]	7.63E-10	ULI Wall	3.95E-09	2.65E-11	Colon	1.92E-11
Sb-129	4.23E-10	ULI Wall	2.87E-09	1.51E-11	Colon	1.22E-11
Sb-130	9.19E-11	Stomach Wall	5.74E-10	2.19E-12	Stomach	1.19E-12
Sb-131	1.03E-10	Thyroid	7.07E-10	2.58E-12	Thyroid	1.08E-12
Sn-128	1.55E-10	Stomach Wall	8.37E-10	3.90E-12	Stomach	1.74E-12
Sr-89	2.57E-09	LLI Wall	2.22E-08	1.11E-10	Colon	7.06E-11
Sr-90	2.77E-08	Bone Surface	4.09E-07	1.08E-09	Leukemia (Trabecular Bone)	9.48E-10
Sr-91	6.50E-10	LLI Wall	3.97E-09	2.44E-11	Colon	1.94E-11
Sr-92	4.26E-10	ULI Wall	3.07E-09	1.64E-11	Colon	1.36E-11
Tc-101	1.88E-11	Stomach Wall	1.50E-10	3.52E-13	Stomach	3.11E-13
Tc-104	8.01E-11	Stomach Wall	6.21E-10	1.56E-12	Stomach	1.29E-12
Te-131	8.75E-11	Thyroid	8.91E-10	2.20E-12	Thyroid	1.36E-12
Te-131m	1.95E-09	Thyroid	1.85E-08	6.75E-11	Colon	3.00E-11
Te-132	3.81E-09	Thyroid	3.11E-08	1.43E-10	Colon	6.36E-11
Te-133	7.24E-11	Thyroid	8.14E-10	1.91E-12	Thyroid	1.24E-12
Te-133m	2.83E-10	Thyroid	3.22E-09	8.18E-12	Thyroid	4.91E-12
Te-134	1.08E-10	Thyroid	5.26E-10	3.24E-12	Stomach	9.30E-13
Y-91	2.37E-09	LLI Wall	3.03E-08	9.74E-11	Colon	9.59E-11
Y-92	4.95E-10	ULI Wall	3.34E-09	1.64E-11	Colon	1.33E-11
Y-93	1.15E-09	LLI Wall	8.75E-09	4.46E-11	Colon	4.18E-11

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Y-94	8.15E-11	Stomach Wall	6.42E-10	1.54E-12	Stomach	1.33E-12
Y-95	4.63E-11	Stomach Wall	3.75E-10	8.43E-13	Stomach	7.80E-13
Zr-95	9.61E-10	LLI Wall	7.83E-09	3.53E-11	Colon	2.60E-11
Zr-97	2.07E-09	LLI Wall	1.78E-08	8.03E-11	Colon	7.37E-11
Sr-90	2.77E-08	Bone Surface	4.09E-07	1.08E-09	Leukemia (Trabecular Bone)	9.48E-10
Y-90	2.69E-09	LLI Wall	3.15E-08	1.10E-10	Colon	1.08E-10

Source: FGR-13 software, version 2.1.13. This is the same version used in development of the draft PAG chapter. For an explanation of abbreviations, see Appendix B.

[1] For combined Sr-90 and Y-90, the contribution of both Sr-90 and Y-90 to the critical organ of Sr-90 is summed. The contribution of Y-90 turns out to be negligible.

[2] The FGR-13 software has two listings for Sb-128, with half lives of 10.4 minutes and 9.01 hours. The listing with the longer half-life was selected for the purpose of this table.

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Appendix B

Target Organs Listed in Dose and Risk Lookup Tables from FGR-13

Organs In Dose Tables	Organs (Cancer Types) In Risk Tables
Adrenals	
B_Surface (bone surface)	Bone
Brain	
Breast	Breast
St_Wall (stomach wall)	Stomach
SI_Wall (small intestine wall)	
ULI_Wall (upper large intestine wall)	
LLI_Wall (lower large intestine wall)	
Kidneys	Kidney
Liver	Liver
ET-Region (extrathoracic region)	
Lung	Lung
Muscle	
Ovaries	Ovary
Pancreas	
R_Marrow (red bone marrow)	Leukemia (trabecular bone)
Skin	Skin
Spleen	
Testes	
Thymus	
Thyroid	Thyroid
Uterus	
UB_Wall (urinary bladder wall)	Bladder
	Colon
	Esophagus
	Residual

Source: FGR-13 software, version 2.1.13

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To: Cardarelli, John[Cardarelli.John@epa.gov]; Hudson, Scott[Hudson.Scott@epa.gov]; Ellis, Jerry[Ellis.Jerry@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Kudarauskas, Paul[Kudarauskas.Paul@epa.gov]; Walker, Stuart[Walker.Stuart@epa.gov]; Nguyen, Lyndsey[Nguyen.Lyndsey@epa.gov]; Kappelman, David[Kappelman.David@epa.gov]; Telofski, Scott[telofski.scott@epa.gov]
From: DeCair, Sara
Sent: Mon 8/17/2015 5:21:33 PM
Subject: Spreadsheet for tomorrow's webinar on drinking water PAG DRL derivation
PAG DRLs Calcs for OSWER.xlsx

,,,,,,
All, please see the attached spreadsheet for tomorrow's webinar. We'll also walk through the derivation and discuss assumptions with you. I'm putting a webinar link and phone bridge on the invitation in a minute. Talk to you tomorrow,

Sara

From: Hernandez-Quinones, Samuel
Sent: Monday, August 17, 2015 11:50 AM
To: DeCair, Sara
Subject: Fw: Draft Drinking Water PAG for OSWER review

Hi Sara,

I think you can send this file to Cardilleri. This is the same document that was sent to Mr Scozzafava.

Thank You

Sam

==========

Samuel Hernández Quiñones, P.E.
Environmental Engineer
Environmental Protection Agency
Office of Water
1200 Pennsylvania Ave. NW
Washington, DC 20460
202-564-1735

"USEPA Protecting Human Health and the Environment"

From: Hernandez-Quinones, Samuel
Sent: Monday, June 29, 2015 9:06 AM
To: Scozzafava, MichaelE; DeCair, Sara
Cc: Stalcup, Dana; Veal, Lee; Fitz-James, Schatzi; Christ, Lisa; Cogliano, Gerain; Kudarauskas, Paul
Subject: Re: Draft Drinking Water PAG for OSWER review

Hi,

The table with derived concentrations is attached. Let me know if you have any questions.

Sam

==========

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"USEPA Protecting Human Health and the Environment"

From: Scozzafava, MichaelE
Sent: Monday, June 29, 2015 8:09 AM
To: Hernandez-Quinones, Samuel; DeCair, Sara
Cc: Stalcup, Dana; Veal, Lee; Fitz-James, Schatzi; Christ, Lisa; Cogliano, Gerain; Kudarauskas, Paul
Subject: RE: Draft Drinking Water PAG for OSWER review

Good Morning Sam and Sara,

Just wanted to check back in to see if you are able to send this Table? Our RAD expert is out after today and was hoping to make a lot of progress on our review today.

Thanks and hope you had a great weekend.

Mike

Michael Scozzafava, Chief

Science Policy Branch

OSRTI, OSWER

p: 703-603-8833

cell: 202-407-2555

From: Hernandez-Quinones, Samuel
Sent: Thursday, June 25, 2015 2:03 PM
To: Scozzafava, MichaelE; DeCair, Sara
Cc: Stalcup, Dana; Veal, Lee; Fitz-James, Schatzi; Christ, Lisa; Cogliano, Gerain; Kudarauskas, Paul
Subject: RE: Draft Drinking Water PAG for OSWER review

Hi Mr. Scozzafava,

We included derived concentrations for 3 radionuclides (I-131, Cs-137, & Sr-90) of interest in Table #1 of Section 7. We intend to provide a more comprehensive list of radionuclides likely to occur following a radiation contamination incident once the proposal is issued. We did not wanted to overwhelm the readers of this chapter with a large table of derived concentrations.

If needed to support your organization's review we can provide a Table with the derived concentrations of other Radionuclides as we have this information ready and available.

Thank You

Sam

==========

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"USEPA Protecting Human Health and the Environment"

From: Scozzafava, MichaelE
Sent: Thursday, June 25, 2015 1:52 PM
To: DeCair, Sara; Hernandez-Quinones, Samuel

Cc: Stalcup, Dana; Veal, Lee; Fitz-James, Schatzi; Christ, Lisa; Cogliano, Gerain; Kudarauskas, Paul
Subject: RE: Draft Drinking Water PAG for OSWER review

Sara and Samuel,

Thank you for the very informative presentation on Tuesday. We look forward to reviewing the document and providing comments.

In our initial scan of the document that was sent to Jim Woolford yesterday, we noticed that it did not include a table of concentrations correlating to the 100/500 mrem/yr drinking water PAG. Do you have that information and can you provide it? We think it's important to see as part of our review.

Thanks in advance for your consideration and have a great day.

Mike

Michael Scozzafava, Chief

Science Policy Branch

OSRTI, OSWER

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Assessment of Water contamination Levels

Purpose:
Determine the radioactive contamination levels of drinking water that would produce an effective (whole body) dose of 500 mrem. The radioactive contamination considered in this analysis is the fallout from a uranium-fueled nuclear detonation.

Methods:
It should be noted that FDA's 1998 guidance provides methodologies to assess the contamination levels in food for individual radionuclides. FDA methodologies do not recommend that the dose from all radionuclides be summed up to determine acceptable food contamination levels from all radionuclide contaminants. However because many radionuclides comprise the radioactive fallout, failure to consider all radionuclide contaminants is likely to result in the dose limit being exceeded if only one radionuclide is considered. Therefore, the dose from all radionuclide contaminants is considered in this analysis.

The following inputs and assumptions are used in this analysis:

- Dose limit: 500 mrem, effective dose, this dose is integrated over the standard ICRP lifetime integration periods of 50 to 70 years (depending on the age of the individual drinking the contaminated water).
- Consumption period: 365 days beginning at the time that the fallout was deposited on the ground
- Dosimetry model : ICRP 60
- Intake rate: FDA default intake rate for tap water (FDA 1998)
- FDA methodology was used to assess the dose from individual radionuclides
- Fraction of water contaminated: 100% of the tap water consumed over the intake period is assumed to be contaminated
- It is assumed that the relative radionuclide activity concentrations in the water are the same as those in the radioactive fallout.

This analysis demonstrated that the one-year old age group is most restrictive for drinking water contaminated with this fallout radionuclide mixture. Table 1 shows the radionuclide activity concentrations (µCi/l) for the "parent" radionuclides, considered in this analysis, that would result in the one-year old receiving an effective dose of 500 mrem from consuming contaminated water over the course of a one year period.

It is recommended that Laboratory Analysis efforts should select one or more long-lived and easily detected radionuclides (e.g., Cs-137/Ba-137m) to serve as "marker" radionuclides to assess the contaminated water and to determine if water meets or exceeds the dose limit.

Table 1: Water concentration limits producing 500 mrem effective dose to one-year old

Radio-nuclide	Water DRL (µCi/l)	Radio-nuclide	Water DRL (µCi/l)
Ba-140	1.62E-01	Ru-106	6.32E-04
Ba-141	1.65E+01	Sb-128	2.47E-01
Ba-142	5.07E+00	Sb-129	1.48E+00
Ce-141	6.28E-03	Sb-130	3.95E+00
Ce-143	1.32E+00	Sb-131	1.04E+01
Ce-144	6.35E-03	Sn-128	2.16E+00
Co-58	1.47E-03	Sr-89	2.73E-02
Co-58m	2.36E-01	Sr-90	1.77E-04
Cs-134	2.22E-06	Sr-91	4.59E+00
Cs-134m	8.99E-03	Sr-92	1.37E+01
Cs-137	1.95E-04	Tc-101	2.88E+01
Cs-138	3.88E+01	Tc-104	6.35E+00
I-131	6.86E-02	Te-131	1.89E+01
I-133	2.16E+00	Te-131m	6.59E-02
I-134	3.01E+01	Te-132	4.97E-01
I-135	7.13E+00	Te-133	7.43E+00
La-141	9.96E+00	Te-133m	9.12E+00
La-142	2.09E+01	Te-134	2.87E+01
Mn-54	2.56E-04	Y-91	1.44E-03
Mn-56	1.77E+01	Y-92	2.79E+00
Mo-99	7.43E-01	Y-93	4.75E+00
Mo-101	1.02E+01	Y-94	1.76E+01
Nb-95	2.10E-05	Y-95	5.20E+00
Rb-89	1.14E+01	Zr-95	3.25E-02
Ru-103	3.01E-02	Zr-97	2.85E+00

References:

FDA 1998, Accidental Radioactive Contamination of Human Food and Animal feeds: Recommendations for State and Local Agencies, U.S. Department of Health and Human Services, Food and Drug Administration, 1998.

TRIGGER LEVELS ASSOCIATED WITH ALTERNATIVE PROTECTIVE ACTION GUIDES FOR DRINKING WATER

Prepared by
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March 4, 2014

We would like to express our appreciation for the assistance provided by Dr. Joyce Lipsztein and Dr. Richard Leggett in the preparation of this report.

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KEY DEFINITIONS

Rad

A rad is the amount of absorbed radiation that delivers 100 ergs of energy per gram of absorbing medium.

For example, it is not unusual for a radionuclide to emit 1 MeV of photon or electron radiation each time it disintegrates. Since 1 MeV = 1.6E-6 ergs and the amount of energy required to break a chemical bond and create a free electron and a positively charged molecule (an ion pair) is typically about 30 to 40 eV, one rad will create about 2E12 ion pairs per gram of tissue exposed. These ion pairs are the cause of the damage associated with exposure to ionizing radiation, which at high whole body doses (>25 rad) can result in observable clinical damage, death at doses above about 400 rad, and a lifetime cancer risk of about between 0.0005 and 0.001 per rad delivered to the whole body.

rem and mrem

A rem is an expression of the amount of ionizing radiation absorbed by tissue multiplied by the a quality factor that takes into consideration the relative potential amount of damage the radiation might cause; a mrem (millirem) is 0.001 rem.

For example, for an internally deposited radionuclide, such as Cs-137, each time an atom of Cs-137 decays inside the body, it emits a certain amount of ionizing radiation in the form of beta particles (essentially electrons) and gamma rays (i.e., energetic photons). When this energy is deposited in tissue, the molecules that comprise living tissue are ionized, which results in an increased risk of cancer. The product of the absorbed dose to tissue (which is expressed in terms of rad) with the quality factor is referred to as the dose equivalent, expressed in units of rem or millirem. If 100 ergs per gram of any combination of beta particles ot photons is deposited into a gram of tissue, the absorbed dose to the exposed tissue is 1 rad and the dose equivalent to that tissue is 1 rem. If the energy deposited in tissue is in due to an alpha particle, the quality factor is 20 and the dose equivalent is 20 rem because the damage caused by the energy of an alpha particle in a gram of tissue is about 20 times greater than the same amount of energy of beta and photon radiation deposited in a gram of tissue is 20 times greater. If that energy is deposited uniformly in every gram of tissue in the body (whether alpha, beta or gamma), the exposure is defined as a whole body dose or effective dose.

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Sv	A sievert (Sv) is 100 rem. Sv is the International System of Units (SI) derived unit of ionizing radiation dose (the rem and mrem are older, non-SI units).
Effective dose	When ionizing radiation is deposited in tissue, it can be deposited in only a small part of the body or uniformly throughout the body. The potential for harm associated with 1 rem (100 ergs/g) deposited in only a portion of the body is less than the potential for harm if the entire body experiences 1 rem. In order to establish risk equivalency between a partial and a whole body dose when only a portion of the body is exposed, the dose equivalent to the tissue experiencing the exposure is multiplied by a tissue weighting factor which converts the tissue dose to an effective whole body dose, or simply referred to as the effective dose. For example, if a person ingests I-131, most of the internal dose will be delivered to the thyroid gland. The tissue weighting factor for the thyroid gland is 0.04. This means that the risk of cancer from the exposure of only the thyroid gland is about 0.04 of the risk of cancer if that same dose was delivered to the entire body. Hence, if one rem is delivered to the thyroid gland due to the ingestion of I-131, the effective whole body dose is 0.04 rem. If Cs-137 is ingested, it is distributed to the whole body so there is no need to apply a tissue weighting factor because the whole body is uniformly exposed.
Ci, pCi, and dps	A curie (Ci) is an expression of the amount of radioactivity that corresponds to that amount of radioactive material (atoms or grams) that has a decay rate of 3.7E10 disintegrations per second (dps). A picocurie (pCi) is one trillionth (i.e., 10^{-12}) of a Ci.
Bq	One becquerel (Bq) is the amount of a radioactive material (atoms or grams) that decays at a rate of 1 disintegration per second.
DCF	**Throughout this report, the terms dose and dose conversion factor (DCF) are used. If a person were to ingest a given radionuclide, the radionuclide might remain in his or her body for a long time. Hence, when we refer to a dose of 500 mrem delivered due to the ingestion of contaminated water for a one year period, the actual dose is the dose delivered to that person over his or her lifetime due to the radionuclides ingested in that year. Hence 500 mrem is actually 500 mrem lifetime dose commitment.** **Dose conversion factor, expressed in terms of Sv/Bq or mrem/Bq, actually is an expression of the lifetime dose**

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commitment due to the ingestion of one Bq of a given radionuclide. If the Bq is ingested in one day or one year, that dose rate is referred to as 1 Bq/day or per year, but the actual dose is delivered over a lifetime. For long lived radionuclides, like U-238, it could take an entire lifetime for uranium to be entire cleared from the body. For relatively short-lived radionuclides, such as I-131, the iodine is entirely cleared in a relative short period of time. It is still referred to as a lifetime dose commitment, but the dose is actually all delivered in a relatively short period of time because it decays away relatively quickly.

LET — **Linear Energy Transfer (LET) is an expression of the energy lost by a charged particle per unit distance traveled in a material (in KeV per micron traveled in an absorbing medium), such as living tissue. In general, for the same amount of energy deposited in a gram of tissue, the damage caused by high LET radiation, such as alpha particles and neutrons, is much greater than that same amount of energy deposited by beta and photon radiation. The reason for the difference in potential damage is the number of ions produced per unit path traveled by the high LET particle is much denser than that for low LET radiation, making it more difficult for the body to repair the damage caused by the radiation. For example, the carcinogenic risks associated with a rad of alpha particle exposure is estimated to be about 20 times greater than a rad of beta or photon exposure.**

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1.0 INTRODUCTION

During the early stages of a radiological emergency, such as following an accident at a nuclear power plant or other type of incident where drinking water supplies could become contaminated with a variety of radionuclides, it may become necessary for emergency response personnel to interdict drinking water resources for some time period until there is assurance that the concentration of radionuclides in the drinking water resources have declined to an acceptable level, either through natural attenuation or treatment. As part of the planning process for such incidents, a relationship needs to be established between the concentration of a given radionuclide in a drinking water resource and the radiation dose and health risk members of the population might experience as a result of drinking contaminated water. This report presents the results of investigations that will help the U.S. Environmental Protection Agency (EPA) make judgments regarding when intervention might be needed.

A number of factors must be taken into consideration when making judgments regarding interdiction decision making. Of particular importance are the types of radionuclides of concern, the duration that members of the public might be exposed to contaminated drinking water, and the radiation dose and health risk that different members of a population might experience as a result of drinking water contaminated with radionuclides. In this particular investigation, the EPA has selected six radionuclides that require investigation, including Sr-90, Cs-137, and I-131, which are of particular interest with respect to nuclear power plant accidents, and Ir-192, Po-210, and Co-60, which are of interest because of their potential to be used in a dirty bomb or other incidents where drinking water resources might be contaminated. However, it is important to note that Sr-90, Cs-137, and I-131 are also of interest as radionuclides that might be used by terrorists or involved in some other type of incident where drinking water resources might be contaminated.

The concentration of a given radionuclide in drinking water that requires interdiction depends primarily on the radiation dose and health risk that members of an exposed population might experience. In this particular investigation, we are interested in the concentration of the above six radionuclides that could result in radiation exposures of 4, 10, 15, 25, 100, 250, 300, 400, and 500 mrem/yr.[1] These exposures were selected because they bracket the range of radiation exposures that might be of public health concern. For example, 4 mrem/yr is associated with the current drinking water standards as set for in 40 CFR 141. If radionuclides in drinking water resources are below the concentration that can result in a whole body dose below 4 mrem/yr, the water is considered safe for drinking by EPA. At the other extreme, 500 mrem, has been selected by the Food and Drug Administration (FDA) as the radiation dose where it is appropriate to interdict food that might become contaminated with radionuclides. Hence, this range of doses represents potential interdiction levels, or Protective Action Guides (PAGs), that might warrant interdiction of contaminated water supplies. It is noted that under some circumstances higher interdiction levels might warrant consideration, including 1 rem, 5 rem, and perhaps as high as 25 rem.

[1] These values are actually the lifetime effective dose commitment associated with radionuclides ingested during the course of year or any of the other ingestion time periods addressed in this report.

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Interdiction decision making is complicated by the fact that, for the same quantity of a given radionuclide ingested in drinking water, different members of the public will experience different doses and health risks. For example, the dose and potential health risk that an adult might experience due to the ingestion of 1 Bq of a given radionuclide is different than the dose and health risk that a child might experience. In addition, since different members of the public consume different daily quantities of water, the amount of a given radionuclide that one member of the public might ingest in a day, such as an adult, will be different from the amount of that radionuclide that a child might ingest in a day for water containing the same concentration of a given radionuclide.

Ultimately, the radiation dose and health risk a given member of a population might experience from a given concentration of a radionuclide in drinking water will depend on the total amount of water consumed over the time period that the water resource is ingested. Hence, the radiation dose that a population might experience from drinking water contaminated with a given concentration of a radionuclide in water will be greater if the population is exposed for long periods of time, as opposed to short periods of time.

In light of these considerations, this report presents the concentrations of radionuclides in water and associated radiation health risks for the following array of circumstances and potential decision criteria (i.e., PAGs):

- Decision criteria or PAGs established at 4, 10, 15, 25, 100, 250, 300, 400, and 500 mrem/yr.
- Isotopes of interest: Sr-90, Cs-137, I-131, Ir-192, Po-210, Co-60.
- The dose and risk and conversion parameters contained in Federal Guidance Report 13 (FGR-13) (EPA 2002).
- Exposed subpopulations, including the embryo and fetus of pregnant women, infants, children, adults, elderly, and women of child bearing age. As discussed later in this report, dose conversion factors are not available separately for males or females or for pregnant women or the elderly in FGR-13 and International Commission on Radiological Protection (ICRP) publications . On the other hand, separate risk coefficients (RCs) are available for males and females and the elderly. With respect to the elderly, the dose commitment per unit intake of a given radionuclide is expected to be comparable to or less than the dose commitment per unit intake for other adults because of the shorter life expectancy of the elderly, which results in a shorter time period over which dose is delivered following intake. Hence, all other factors being equal regarding state of health and predisposition to cancer, if young adults are protected, so are the elderly. Rather than "children" generically, the sources support an evaluation of trigger levels and risks for 1 year olds, 5 year olds, 10 year olds, and 15 year olds.
- Consumption factors for exposure at different ages for each subpopulation as recommended in FGR 13. Since we were unable to make a distinction between males and females with respect to dose conversion factors, we had to make a choice regarding which drinking water values we should use: males, females, or the average for adults. In general, we chose to use the average for adults. However, in order to derive the doses to

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the developing fetus, we used the water ingestion rate for pregnant women as provided in the *EPA Exposure Factors Handbook* (EPA 2011).

- Exposure durations of 30, 60, 90, and 365 days for each age group considered. In the case of the child in utero the maximum duration of the ingestion period for the pregnant women is 270 days because that is (approximately) the duration of the gestation period.

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2.0 MODELS AND ASSUMPTIONS

The fundamental equations that are used to derive trigger levels in this report are as follows.

The first step in the process is to derive the quantity of radionuclide *i* ingested by age group *a* over a given time period, *T*.

$$I_{iaT} = C_i \times Ing_a \times T$$

Where:

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T* (days)

C_i = The concentration of radionuclide *i* in drinking water (pCi/L or Bq/L). In this analysis, the concentration of the radionuclide is assumed to be constant over the time period *T* of interest. In the real world, the concentration of a given radionuclide in water will likely vary widely over a given time period of interest, especially over long time periods.

Ing_a = The daily ingestion rate of water for age group *a* as provided in FGR-13 (L/day).

T = The time period that the population is drinking contaminated water (days). In this analysis, the time periods of interest are 30, 60, 90, and 365 days.

The effective whole body dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T* is derived as follows:

$$D_{iaT} = I_{iaT} \times DCF_{ia}$$

Where:

D_{iaT} = Effective whole body dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T*

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T*

DCF_{ia} = The effective dose coefficient (also referred to as the whole body dose conversion factor or DCF) for the ingestion of radionuclide *i* in drinking water and age group *a* (mrem/Bq or Sv/Bq) using the DCFs from FGR-13.

Risk, in this report, is expressed in terms of total cancer risk (morbidity) as opposed to fatal cancer risk (i.e., mortality). The lifetime risk of cancer due to the ingestion of radionuclide *i* by age group *a.*:

$$R_{iaT} = I_{iaT} \times RC_{ia}$$

Where:

R_{iaT} = The lifetime risk of cancer due to the ingestion of radionuclide *i* over time period *T* by age group *a* (life risk of cancer per Bq or per pCi ingested).

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T*.

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RC_{ia} = The lifetime risk coefficient for the ingestion of radionuclide *i* in drinking water and age group *a* [lifetime risk per pCi (or per Bq) ingested in water] using the RCs from FGR-13.

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3.0 MODEL INPUT PARAMETERS

3.1 Effective Dose Coefficients (Sv/Bq Ingested)

Table 1 presents the effective whole body dose per Bq ingested of each radionuclide in water by each age group. The values apply to both males and females because DCFs are not provided separately for males and females. All the FGR 13 values are the average values for males and females.

Table 1. Dose Conversion Factors

Isotope	DCFs (Sv per Bq ingested at the age indicated) from FGR-13*					
	Infant (100 day old)	1 year old	5 year old	10 year old	15 year old	Adult
Sr-90	2.27E-07	7.24E-08	4.69E-08	5.97E-08	7.89E-08	2.77E-08
Y-90	3.13E-08	2.00E-08	9.97E-09	5.90E-09	3.34E-09	2.69E-09
Cs-137	2.11E-08	1.24E-08	9.69E-09	1.01E-08	1.34E-08	1.36E-08
I-131	1.84E-07	1.79E-07	1.04E-07	5.24E-08	3.42E-08	2.18E-08
Ir-192	1.34E-08	8.74E-09	4.59E-09	2.85E-09	1.71E-09	1.37E-09
Po-210	5.30E-06	1.79E-06	8.88E-07	5.25E-07	3.19E-07	2.45E-07
Co-60	5.43E-08	2.68E-08	1.69E-08	1.12E-08	7.94E-09	3.42E-09

* The values in this table were taken from the CD that accompanies FGR-13 (EPA 2002).

Doses on the order of 1E-5 to 1E-9 Sv/Bq imply that the ingestion of 1 Bq (i.e., the quantity of a radionuclide associated with 1 disintegration per second) is an extremely small quantity of radioactive material and is associated with a very small dose commitment.

For radionuclides like Po-210, which can be present in soluble or insoluble form in water, the DCFs for the soluble form are used because they have the higher DCFs and are more likely to reach receptors before they deposit or are filtered from the drinking water resource.

Although it is not among the six radionuclides of primary interest, Y-90 is also included in this table and other tables in this report because it is likely that Y-90, which is the progeny of Sr-90, will be present in equilibrium, or close to equilibrium, with Sr-90 in drinking water. If the Sr-90 is freshly separated, the Y-90 might not be initially present, because it has a 64-hour half-life, and it will take several weeks of growth before it achieves equilibrium with its parent, Sr-90. However, upon deposition in a drinking water resource, the Y-90 might already be present at levels close to equilibrium. The implications are that, when making use of these tables, a judgment will need to be made whether the DCFs and RCs for Sr-90 and Y-90 should be summed. However, since the DCFs and RCs for Y-90 are small compared to those for Sr-90, the additional dose or risk associated with Y-90 is small relative to that of Sr-90 and will not have a significant impact on interdiction decision making. The Y-90 values are provided here for completeness.

3.2 Effective Whole Body Dose (Sv/Bq) to Offspring Due to Ingestion of Radionuclides by the Mother between Conception and Birth

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Table 2 presents the Dose Conversion Factors corresponding to the effective whole body dose that will be experienced by the offspring while in utero and after birth due to the ingestion of the indicated radionuclides by the mother from conception to birth. More precisely, these values represent the doses (in Sv) that the offspring will experience in utero and from age 0 to 70 if the mother ingests 1 Bq of the indicated radionuclide during the course of the 9-month period from conception to birth of the child. The dose conversion factors apply to both male and female offspring. The results presented in Appendix 2 were calculated using the "in utero" dose conversion factors only, representing the dose incurred by the offspring before birth. Alternatively, the "in utero" and "after birth" values could be summed to enable calculation of a total lifetime dose.

Table 2. Dose Conversion Factors for Offspring Exposed in Utero

Isotope	DCFs (Sv per Bq ingested by mother during pregnancy) from ICRP 88*	
	In Utero	After Birth through the Age of 70
Sr-90	2.8E-08	1.5E-08
Y-90	Not available	Not available
Cs-137	5.2E-09	4.8E-10
I-131	2.1E-08	2.1E-09
Ir-192	Not available	Not available
Po-210	1.1E-07	2.0E-08
Co-60	1.5E-09	4.1E-10

Source: ICRP 2012

This rather unique subject has been discussed in two relatively recent reports:

- NCRP 2013. "Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance," NCRP Report No. 174. National Council of Radiation Protection and Measurement.
- ICRP 2001. *Doses to Embryo and Fetus from Intakes of Radionuclides by the Mother*. ICRP Publication 88. Oxford, Pergamon Press.

A review of these documents helps to enrich our understanding of this important issue. It is quite conceivable that a woman might ingest radionuclides in water (or by inhalation or the ingestion or food) and accumulate a body burden before becoming pregnant. At the time of pregnancy, the radionuclides present in the woman's body can result in exposure of the developing embryo (conception to 8 weeks) and the developing fetus (from week 8 until birth) (ICRP 2001, Section 4.20.2, pg. 228). Of course, while the woman is pregnant, radionuclides ingested by the woman can expose the embryo and developing fetus to varying degrees. This report explicitly considers these exposure scenarios as part of investigations into alternative PAGs and trigger levels. Note, however, that the limiting exposure would occur if the woman ingests radionuclides while she is pregnant. Hence, this report is limited to that aspect of this exposure scenario.

3.3 Risk Coefficients (RCs)

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Table 3 presents, for different isotopes and different age groups, the lifetime risk of cancer (fatal plus nonfatal) per Bq ingested in water at that age. If the isotope could exist in organic vs. inorganic form, inorganic was assumed. The values presented here apply to both males and females. However, in the case of these RCs, separate values can be developed for males and females, if so desired. (Risk Tab Ver. 2.2.1, the source of the information in the table, presents risk conversion factors for both males and females and for both--i.e., the average of the two values. We used the average. We could develop a separate set of risk tables for males and females and also a separate set for morbidity and mortality.)

Table 3. Lifetime Morbidity Risk Conversion Factors (per Bq ingested in water at the indicated age)

Isotope	In utero	Infant	1 yr old	5 yr old	10 yr old	15 yr old	Adult (age 25-70)
Sr-90	not available	1.35E-08	8.59E-09	5.13E-09	3.21E-09	3.36E-09	1.10E-09
Y-90	not available	1.11E-08	8.08E-09	4.25E-09	2.54E-09	1.44E-09	1.13E-10
Cs-137	not available	3.40E-09	2.49E-09	1.97E-09	1.99E-09	2.44E-09	6.17E-10
I-131	not available	2.15E-08	1.99E-08	1.06E-08	5.04E-09	2.96E-09	4.58E-10
Ir-192	not available	4.12E-09	3.04E-09	1.65E-09	1.01E-09	5.94E-10	5.34E-11
Po-210	not available	1.77E-07	9.51E-08	5.15E-08	3.18E-08	1.95E-08	6.73E-09
Co-60	not available	7.52E-09	5.22E-09	3.30E-09	2.16E-09	1.42E-09	1.33E-10

These values were taken from Risk Tab Ver. 2.2.1 by K.F. Eckerman & N.S. Nelson (Nov. 8, 2012).

The term morbidity risk is an expression of the probability that the individual will contract a cancer during his or her lifetime. Risk conversion factors express the additional lifetime risk of cancer a person might experience as a result of ingesting one Bq of a radionuclide. As may be noted, the additional cancer risks associated with the ingestion of 1 Bq is extremely small relative to the lifetime risk of cancer due to other (often unknown) causes. Note that the lifetime risk of cancer per Bq ingested is higher for young people than for old people.

Risk conversion factors for the developing embryo and developing fetus are not available from Risk Tab Ver. 2.2.1 or any other source consulted. Therefore, although the risk for exposure in the womb may be non-zero, we are unable to quantify it.

3.4 Water Ingestion Rate

Two sources were used to derive ingestion rates, FGR-13 (EPA 2002) and the *EPA Exposure Factors Handbook: 2011 Edition* (EPA 2011).

Table 4 presents the mean values for tap water consumption taken from Table 3-1 of FGR-13 (EPA 2002). Values are provided for males and females in various age groups. Most of the ingestion values used in this report were taken from this table, which was designed to be used in conjunction with other data from FGR-13. Since the ingestion rates for males are higher (and therefore more conservative) than those for females, we elected to use the values for males to represent each age group. We could have used the average drinking water value for each age

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group, but then that would have underestimated the doses for males. If so desired, we can derive separates tables of risks for males and females.

Table 4. Drinking Water Ingestion Rates from FGR-13

Age (years)	Tap Water (L/day)*	
	Male	Female
0	0.191	0.188
1	0.223	0.216
5	0.542	0.499
10	0.725	0.649
15	0.900	0.712
20	1.137	0.754
50	1.643	1.119
75	1.564	1.179

*Values Extracted from EPA 2002, Table 3.1.

Table 5 presents the drinking water ingestion rates provided in "The Executive Summary" of the *EPA Exposure Factors Handbook: 2011 Edition* (EPA 2011). This table provides both mean and 95th percentile ingestion values for individuals (males and females aggregated) in various age groups, as well as in special cohorts such as pregnant and lactating women. The mean ingestion rate for pregnant women from this table (i.e., 0.819 L/day, which is slightly higher than for non-pregnant women) was used to calculate trigger levels for the developing fetus in Appendix 2 of this report.

Table 5. Per Capita Drinking Water Ingestion Rates from *EPA Exposure Factors Handbook* (2011)

Age	Mean mL/day	95th percentile mL/day
Children		
Birth to 1 month	184	839*
1 to<3 months	227*	896*
3 to <6 months	362*	1,056
6 months to <12 months	360	1,055
1 to <2 years	271	837
2 to <3 years	317	877
3 to <6 years	327	959
6 to <11 years	414	1,316
11 to <16 years	520	1,821
16 to <18 years	573	1,783
18 to <20 years	681	2,368
Adults		
>21 years	1,043	2,958
>65 years	1,046	2,730
Pregnant women	819*	2,503*
Lactating women	1,379*	3,434*

* Estimates are less statistically reliable, based on guidance published in NCHS 1993.

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An important judgment needs to be made whether the trigger levels and risks provided in this report are for use in protecting the average member of a given age group or the 95th percentile members of a given age group. We used the mean drinking water values, which means that some people will experience slightly higher doses and risks and some will experience slightly lower doses and risks. If the 95th percentile drinking water values from Table 5 were to be used, 95% of the population would be protected at the indicated levels. Finally, other values in the calculation, including the effective dose coefficients and risk conversion factors, have a degree of uncertainty and individual variability. The values used in this report are those recommended by the EPA in FGR-13 and represent a best estimate for a given population group. The uncertainty and individual variability in these values are described in the published literature.

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4.0 RESULTS – EXAMPLES

Using the models described in Section 2 and the input parameters in Section 3, we can derive the trigger levels and lifetime cancer risks associated with the ingestion of the six radionuclides in water (Sr-90, Cs-137, I-131, Ir-192, Po-210, and Co-60) for the different age groups, alternative PAGs (4, 10, 15, 25, 100, 250, 300, 400, and 500 mrem/yr), and the four different exposure time periods (30, 60, 90, and 365 days). These calculations are best performed using a spreadsheet. However, to aid the reader (and as part of the quality assurance check on the spreadsheet values), we will first perform selected calculations by hand for Cs-137. In these example calculations, the PAG is 500 mrem/yr and the time period of exposure is assumed to be 1 year.

4.1 Example 1: Cs-137 Dose and Risk to an Infant (100 day old)

Let us assume that a PAG is set at 500 mrem/yr (5 mSv or 0.005 Sv) and we are concerned with protecting an infant (100 day old) who might consume contaminated drinking water for 1 year. As described in Section 2, the basic equation used to perform this calculation is as follows:

$$D_{iaT} = C_i \times Ing_a \times T \times DCF_{ia}$$

Where:

D_{iaT} = Effective whole body dose (mrem or Sv) due to the ingestion of radionuclide *i* to age group *a* over time period *T*.

DCF_{ia} = The effective dose coefficient (or effective whole body DCF) for the ingestion of radionuclide *i* in drinking water and age group *a* (mrem/Bq or Sv/Bq) using the DCFs from FGR-13.

C_i = The concentration of radionuclide *i* in drinking water (pCi/L or Bq/L). In this analysis, the concentration of the radionuclide is assumed to be constant over the time period *T* of interest. In the real world, the concentration of a given radionuclide in water will likely vary widely over a given time period of interest, especially if long time periods are involved.

Ing_a = The daily ingestion rate of water for age group *a* as provided in FGR-13 (L/day).

T = The time period that the population is drinking contaminated water (days). In this analysis, the time periods of interest are 30, 60, 90, and 365 days.

The equation takes the following form when deriving the radionuclide concentrations:

$$C_i = D_{iaT} \div (Ing_a \times T \times DCF_{ia})$$

Where:

D_{iaT} = 0.005 Sv (or 500 mrem)

Ing_a = 0.191 L/day for a male 100 day old child

T = 365 days

DCF_{ia} = 2.11E-08 Sv/Bq ingested

C_i = 0.005 Sv ÷ (0.191 l/day × 365 × 2.11E-08 Sv/Bq) = 3,399 Bq/L = 91,773 pCi/L

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Hence, the trigger level would be 3,399 Bq/L, or 91,773 pCi/L, of Cs-137.

The lifetime risk of cancer to the child associated with this intake of Cs-137 in water is derived as follows:

$$R_{iaT} = I_{iaT} \times RC_{ia}$$

Where:

R_{iaT} = The lifetime risk of health detriment due to the ingestion of radionuclide *i* by age group *a* over time period *T*.

I_{iaT} = The total intake of radionuclide *i* for age group *a* (pCi or Bq) over time period *T*. (Calculated as the drinking water concentration, C_i in the previous equation, multiplied by the water ingestion rate, in this case for a newborn male from Table 4 above, multiplied by the time period, in this case 365 days.)

RC_{ia} = The lifetime risk coefficient for the ingestion of radionuclide *i* in drinking water and age group *a* [lifetime risk per pCi (or per Bq) ingested in water] using the RCs from FGR-13. Risk is expressed in terms of total cancer risk (morbidity), as opposed to fatal cancer risk (i.e., mortality).

R_{iaT} = 3,399 Bq/L × 0.191 L/day × 365 days × 3.40E-09/Bq = 8.06E-04 lifetime risk of cancer.

4.2 Example 2: Cs-137 Dose and Risk to an Adult

Performing the same exercise, we obtain the following results:

C_i = $D_{iaT} \div (Ing_a \times T \times DCF_{ia})$

C_i = 0.005 Sv ÷ 1.137 L/day × 365 days × 1.36E-08 Sv/Bq = 886 Bq/L = 23,922 pCi/L

R_{iaT} = 886 Bq/L × 1.137 L/day × 365 days × 6.02E-10/Bq = 2.2E-04 lifetime risk of cancer

Note that the concentration of Cs-137 in drinking water that is associated with a dose of 500 mrem for 1 year of exposure to a child is 3,399 Bq/L, while the concentration of Cs-137 in drinking water that results in 500 mrem to an adult from 1 year of exposure is 886 Bq/L. Hence, in order to achieve the same dose-based PAG, the concentration of Cs-137 in water must be about 3.8 times lower in order to protect an adult as opposed to a child (0–1 year old). This unexpected result is due to the fact that, even though the DCF for a child is about 1.6 times higher, adults ingest much larger quantities of water (1.137 versus 0.191 L/day). Therefore, the dose to the adult is limiting in this example.

4.3 Example 3: Cs-137 Dose In Utero

Performing the same exercise for in utero dose calculations, we obtain the following results:

C_i = $D_{iaT} \div (Ing_a \times T \times DCF_{ia})$

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C_i = 0.005 Sv ÷ (0.819 L/day × 270 days × 5.2E-09 Sv/Bq) = 4,348 Bq/L = 117,396 pCi//L

An estimate of risk to the developing fetus is not provided for the reasons described elsewhere in this report.

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5.0 RESULTS – COMPLETE SETS OF TABLES

In this section, we briefly describe and present the concentrations of radionuclides in water and associated lifetime risks of cancer for the following combination of alternative PAGs, isotopes, members of the exposed population, and time periods of exposure to contaminated water:

- PAGs established at 4, 10, 15, 25, 100, 250, 300, 400, and 500 mrem/yr.
- Isotopes of interest: Sr-90, Cs-137, I-131, Ir-192, Po-210, and Co-60.
- Exposed subpopulations: The data do not support analysis of all categories exactly as listed in the charge statement, but they support analysis that sheds at least some light on each category.
    - Embryo and fetus: Dose data are available for this population (with the exception of isotopes Y-90 and Ir-192); risk data are not. Ingestion rates for pregnant women are applied.
    - Infants: Dose data are available representing newborn infants (100 day old). Risk data representing both sexes in this age group are applied; drinking water ingestion rates for males in this age group are applied as more conservative than ingestion rates for females or the average.
    - Children: Dose data are available representing 1- 5-, 10-, and 15-year olds. Risk data representing both sexes in these age groups are applied; drinking water ingestion rates for males in these age groups are applied as more conservative than ingestion rates for females or the average.
    - Adults: Dose data are available for generic adults. Risk data representing both sexes in this age group are applied; drinking water ingestion rates for males in this age group are applied as more conservative than ingestion rates for females or the average.
    - Elderly: Dose data are not available specifically for the elderly population; general adult dose data may be consulted for the sake of comparison. The dose commitment per unit intake of a given radionuclide is expected to be comparable to or less than the dose commitment per unit intake for younger adults due to the shorter life expectancy after exposure and, therefore, the shorter time period over which dose is delivered following intake. Risk data and ingestion data for the elderly population are available (risk data for both sexes and ingestion rates for males would be applied, as in other population categories).
    - Women of child bearing age: Dose data are not available specifically for women of child-bearing age; general adult dose data may be consulted. Risk data and ingestion rates specific to this age and gender group are available and could be applied.
    - We also provide a set of tables with the results of the limiting age group for each radionuclide and each alternative PAG.

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- Exposure durations of 30, 60, 90, or 365 days. (In the case of in utero exposure, a duration of 270 days, approximating full-term pregnancy, is used.)

We have organized the information into separate appendices, as follows:

Appendix 1 – All Age Groups: This appendix presents the most restrictive concentrations of radionuclides in water for each radionuclide and each alternative PAG. These are the lowest concentrations in water, among the different age groups, for each candidate PAG. Specifically, we sorted on the values of trigger levels among each age group that are most limiting (lowest concentration) for each isotope, each alternative candidate PAG, and each exposure duration. This appendix allows the user of these tables to quickly determine the trigger level for each radionuclide that is most protective for each candidate PAG, and each time period of exposure, and which age group is the limiting.

Appendix 2 – Developing Embryo and Fetus: This appendix presents the radionuclide concentrations in drinking water associated with specified doses for developing embryos and fetuses whose mothers consume the indicated radionuclides in drinking water over the specified time periods during gestation. (The figures represent only the dose incurred during gestation, not the lifetime dose that results from exposure in utero.) The longest ingestion period considered in this appendix is 270 days, or the approximate length of a full-term pregnancy. Note that trigger levels could not be calculated for Y-90 or Ir-192, and lifetime risks could not be calculated for any isotope in utero.

Appendix 3 – Infant (100 day old): This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for an infant who consumes the indicated radionuclides in drinking water over the specified time periods.

Appendix 4 – 1 Year Old: This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for a 1 year old who consumes the indicated radionuclides in drinking water over the specified time periods at that age.

Appendix 5 – 5 Year Old: This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for a 5 year old who consumes the indicated radionuclides in drinking water over the specified time periods at that age.

Appendix 6 – 10 Year Old: This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for a 10 year old who consumes the indicated radionuclides in drinking water at that age.

Appendix 7 – 15 Year Old: This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for a 15 year old who consumes the indicated radionuclides in drinking water at that age.

Appendix 8 – Adult: This appendix presents the radionuclide concentrations in drinking water and associated lifetime risks for an adult who consumes the indicated radionuclides in drinking water over the specified time periods. The FGR 13 CD provides DCFs for adults and does not

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make a distinction among adults of different ages because the actual age when the adult ingests the drinking water has little effect on the trigger level or lifetime risk, until he or she is quite old; then the trigger levels decline due to declining DCFs because the time period over which the dose is delivered begins to decrease. Risks declines because of the latency period associated with cancer induction, which can extend beyond normal life expectancy.

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APPENDIX 1: ALL AGE GROUPS

Most Restrictive (i.e., Lowest)
Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	5.07E+02	1.27E+03	1.90E+03	3.17E+03	1.27E+04	3.17E+04	3.81E+04	5.07E+04	6.34E+04
Y-90	6.03E+03	1.51E+04	2.26E+04	3.77E+04	1.51E+05	3.77E+05	4.52E+05	6.03E+05	7.53E+05
Cs-137	2.33E+03	5.83E+03	8.74E+03	1.46E+04	5.83E+04	1.46E+05	1.75E+05	2.33E+05	2.91E+05
I-131	6.39E+02	1.60E+03	2.40E+03	4.00E+03	1.60E+04	4.00E+04	4.79E+04	6.39E+04	7.99E+04
Ir-192	1.41E+04	3.52E+04	5.28E+04	8.80E+04	3.52E+05	8.80E+05	1.06E+06	1.41E+06	1.76E+06
Po-210	3.56E+01	8.90E+01	1.33E+02	2.22E+02	8.90E+02	2.22E+03	2.67E+03	3.56E+03	4.45E+03
Co-60	3.47E+03	8.69E+03	1.30E+04	2.17E+04	8.69E+04	2.17E+05	2.61E+05	3.47E+05	4.34E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.54E+02	6.34E+02	9.52E+02	1.59E+03	6.34E+03	1.59E+04	1.90E+04	2.54E+04	3.17E+04
Y-90	3.01E+03	7.53E+03	1.13E+04	1.88E+04	7.53E+04	1.88E+05	2.26E+05	3.01E+05	3.77E+05
Cs-137	1.17E+03	2.91E+03	4.37E+03	7.28E+03	2.91E+04	7.28E+04	8.74E+04	1.17E+05	1.46E+05
I-131	3.20E+02	7.99E+02	1.20E+03	2.00E+03	7.99E+03	2.00E+04	2.40E+04	3.20E+04	4.00E+04
Ir-192	7.04E+03	1.76E+04	2.64E+04	4.40E+04	1.76E+05	4.40E+05	5.28E+05	7.04E+05	8.80E+05
Po-210	1.78E+01	4.45E+01	6.67E+01	1.11E+02	4.45E+02	1.11E+03	1.33E+03	1.78E+03	2.22E+03
Co-60	1.74E+03	4.34E+03	6.51E+03	1.09E+04	4.34E+04	1.09E+05	1.30E+05	1.74E+05	2.17E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.69E+02	4.23E+02	6.34E+02	1.06E+03	4.23E+03	1.06E+04	1.27E+04	1.69E+04	2.11E+04
Y-90	2.01E+03	5.02E+03	7.53E+03	1.26E+04	5.02E+04	1.26E+05	1.51E+05	2.01E+05	2.51E+05
Cs-137	7.77E+02	1.94E+03	2.91E+03	4.86E+03	1.94E+04	4.86E+04	5.83E+04	7.77E+04	9.71E+04
I-131	2.13E+02	5.33E+02	7.99E+02	1.33E+03	5.33E+03	1.33E+04	1.60E+04	2.13E+04	2.66E+04
Ir-192	4.69E+03	1.17E+04	1.76E+04	2.93E+04	1.17E+05	2.93E+05	3.52E+05	4.69E+05	5.87E+05
Po-210	1.19E+01	2.97E+01	4.45E+01	7.42E+01	2.97E+02	7.42E+02	8.90E+02	1.19E+03	1.48E+03
Co-60	1.16E+03	2.90E+03	4.34E+03	7.24E+03	2.90E+04	7.24E+04	8.69E+04	1.16E+05	1.45E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.17E+01	1.04E+02	1.56E+02	2.61E+02	1.04E+03	2.61E+03	3.13E+03	4.17E+03	5.21E+03
Y-90	4.95E+02	1.24E+03	1.86E+03	3.10E+03	1.24E+04	3.10E+04	3.72E+04	4.95E+04	6.19E+04
Cs-137	1.92E+02	4.79E+02	7.18E+02	1.20E+03	4.79E+03	1.20E+04	1.44E+04	1.92E+04	2.39E+04
I-131	5.25E+01	1.31E+02	1.97E+02	3.28E+02	1.31E+03	3.28E+03	3.94E+03	5.25E+03	6.57E+03
Ir-192	1.16E+03	2.89E+03	4.34E+03	7.23E+03	2.89E+04	7.23E+04	8.68E+04	1.16E+05	1.45E+05
Po-210	2.93E+00	7.31E+00	1.10E+01	1.83E+01	7.31E+01	1.83E+02	2.19E+02	2.93E+02	3.66E+02
Co-60	2.86E+02	7.14E+02	1.07E+03	1.78E+03	7.14E+03	1.78E+04	2.14E+04	2.86E+04	3.57E+04

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Most Restrictive (i.e., Lowest)
Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

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Age Group With the Most Restrictive Drinking Water Concentration

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old
Y-90	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Cs-137	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
I-131	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old
Ir-192	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Po-210	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Co-60	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	15 yr old	15 yr old	15 yr old	10 yr old	15 yr old	10 yr old	15 yr old	15 yr old	15 yr old
Y-90	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Cs-137	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
I-131	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old
Ir-192	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Po-210	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Co-60	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old
Y-90	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Cs-137	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
I-131	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old
Ir-192	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Po-210	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Co-60	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old	15 yr old
Y-90	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Cs-137	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult	Adult
I-131	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old	5 yr old
Ir-192	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Po-210	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant
Co-60	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant	Infant

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APPENDIX 2: DEVELOPING EMBRYO AND FETUS*

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.57E+03	3.93E+03	5.89E+03	9.82E+03	3.93E+04	9.82E+04	1.18E+05	1.57E+05	1.96E+05
Y-90*									
Cs-137	8.46E+03	2.12E+04	3.17E+04	5.29E+04	2.12E+05	5.29E+05	6.35E+05	8.46E+05	1.06E+06
I-131	2.10E+03	5.24E+03	7.86E+03	1.31E+04	5.24E+04	1.31E+05	1.57E+05	2.10E+05	2.62E+05
Ir-192*									
Po-210	4.00E+02	1.00E+03	1.50E+03	2.50E+03	1.00E+04	2.50E+04	3.00E+04	4.00E+04	5.00E+04
Co-60	2.93E+04	7.33E+04	1.10E+05	1.83E+05	7.33E+05	1.83E+06	2.20E+06	2.93E+06	3.67E+06

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	7.86E+02	1.96E+03	2.95E+03	4.91E+03	1.96E+04	4.91E+04	5.89E+04	7.86E+04	9.82E+04
Y-90*									
Cs-137	4.23E+03	1.06E+04	1.59E+04	2.64E+04	1.06E+05	2.64E+05	3.17E+05	4.23E+05	5.29E+05
I-131	1.05E+03	2.62E+03	3.93E+03	6.55E+03	2.62E+04	6.55E+04	7.86E+04	1.05E+05	1.31E+05
Ir-192*									
Po-210	2.00E+02	5.00E+02	7.50E+02	1.25E+03	5.00E+03	1.25E+04	1.50E+04	2.00E+04	2.50E+04
Co-60	1.47E+04	3.67E+04	5.50E+04	9.17E+04	3.67E+05	9.17E+05	1.10E+06	1.47E+06	1.83E+06

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	5.24E+02	1.31E+03	1.96E+03	3.27E+03	1.31E+04	3.27E+04	3.93E+04	5.24E+04	6.55E+04
Y-90*									
Cs-137	2.82E+03	7.05E+03	1.06E+04	1.76E+04	7.05E+04	1.76E+05	2.12E+05	2.82E+05	3.53E+05
I-131	6.98E+02	1.75E+03	2.62E+03	4.37E+03	1.75E+04	4.37E+04	5.24E+04	6.98E+04	8.73E+04
Ir-192*									
Po-210	1.33E+02	3.33E+02	5.00E+02	8.33E+02	3.33E+03	8.33E+03	1.00E+04	1.33E+04	1.67E+04
Co-60	9.78E+03	2.44E+04	3.67E+04	6.11E+04	2.44E+05	6.11E+05	7.33E+05	9.78E+05	1.22E+06

270 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.75E+02	4.37E+02	6.55E+02	1.09E+03	4.37E+03	1.09E+04	1.31E+04	1.75E+04	2.18E+04
Y-90*									
Cs-137	9.40E+02	2.35E+03	3.53E+03	5.88E+03	2.35E+04	5.88E+04	7.05E+04	9.40E+04	1.18E+05
I-131	2.33E+02	5.82E+02	8.73E+02	1.46E+03	5.82E+03	1.46E+04	1.75E+04	2.33E+04	2.91E+04
Ir-192*									
Po-210	4.44E+01	1.11E+02	1.67E+02	2.78E+02	1.11E+03	2.78E+03	3.33E+03	4.44E+03	5.56E+03
Co-60	3.26E+03	8.15E+03	1.22E+04	2.04E+04	8.15E+04	2.04E+05	2.44E+05	3.26E+05	4.07E+05

* DCFs for Y-90 and Ir-192 for the developing fetus have not been developed. Hence these rows are left blank. This does not mean there are zero doses. We are not able to assign doses at this time.

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Risks Associated with Exposure in Utero

Risk conversion factors are not available for in utero exposure; therefore lifetime risks cannot be quantified.

Though we suspect that there might be some level of health risk to the developing fetus due to exposures resulting from the ingestion of contaminated water by the mother during gestation, Table 1-1 NCRP Report No. 17 titled, *Preconception and Prenatal Radiation Exposure: Health Effects and Protective Guidance* (2013) states that minimal non-stochastic health effects are anticipated at acute doses of low LET radiation below 15 rem during the most radiosensitive gestation time periods. Table 1-1 also states that "The lifetime risk of oncogenic effects following in utero irradiation appears to be lower than that following irradiation during childhood." Table 1-1 also states that "There is no data available that informs on which stages of pregnancy may be the most vulnerable to the oncogenic effects of radiation."

On this basis, we assume that exposures to other age groups are limiting or at least as radiosensitive with respect to health risk for chronic low levels of low LET radiation.

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APPENDIX 3: INFANT

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	8.31E+02	2.08E+03	3.12E+03	5.19E+03	2.08E+04	5.19E+04	6.23E+04	8.31E+04	1.04E+05
Y-90	6.03E+03	1.51E+04	2.26E+04	3.77E+04	1.51E+05	3.77E+05	4.52E+05	6.03E+05	7.53E+05
Cs-137	8.94E+03	2.24E+04	3.35E+04	5.59E+04	2.24E+05	5.59E+05	6.71E+05	8.94E+05	1.12E+06
I-131	1.03E+03	2.56E+03	3.85E+03	6.41E+03	2.56E+04	6.41E+04	7.69E+04	1.03E+05	1.28E+05
Ir-192	1.41E+04	3.52E+04	5.28E+04	8.80E+04	3.52E+05	8.80E+05	1.06E+06	1.41E+06	1.76E+06
Po-210	3.56E+01	8.90E+01	1.33E+02	2.22E+02	8.90E+02	2.22E+03	2.67E+03	3.56E+03	4.45E+03
Co-60	3.47E+03	8.69E+03	1.30E+04	2.17E+04	8.69E+04	2.17E+05	2.61E+05	3.47E+05	4.34E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.16E+02	1.04E+03	1.56E+03	2.60E+03	1.04E+04	2.60E+04	3.12E+04	4.16E+04	5.19E+04
Y-90	3.01E+03	7.53E+03	1.13E+04	1.88E+04	7.53E+04	1.88E+05	2.26E+05	3.01E+05	3.77E+05
Cs-137	4.47E+03	1.12E+04	1.68E+04	2.79E+04	1.12E+05	2.79E+05	3.35E+05	4.47E+05	5.59E+05
I-131	5.13E+02	1.28E+03	1.92E+03	3.20E+03	1.28E+04	3.20E+04	3.85E+04	5.13E+04	6.41E+04
Ir-192	7.04E+03	1.76E+04	2.64E+04	4.40E+04	1.76E+05	4.40E+05	5.28E+05	7.04E+05	8.80E+05
Po-210	1.78E+01	4.45E+01	6.67E+01	1.11E+02	4.45E+02	1.11E+03	1.33E+03	1.78E+03	2.22E+03
Co-60	1.74E+03	4.34E+03	6.51E+03	1.09E+04	4.34E+04	1.09E+05	1.30E+05	1.74E+05	2.17E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.77E+02	6.93E+02	1.04E+03	1.73E+03	6.93E+03	1.73E+04	2.08E+04	2.77E+04	3.46E+04
Y-90	2.01E+03	5.02E+03	7.53E+03	1.26E+04	5.02E+04	1.26E+05	1.51E+05	2.01E+05	2.51E+05
Cs-137	2.98E+03	7.45E+03	1.12E+04	1.86E+04	7.45E+04	1.86E+05	2.24E+05	2.98E+05	3.73E+05
I-131	3.42E+02	8.54E+02	1.28E+03	2.14E+03	8.54E+03	2.14E+04	2.56E+04	3.42E+04	4.27E+04
Ir-192	4.69E+03	1.17E+04	1.76E+04	2.93E+04	1.17E+05	2.93E+05	3.52E+05	4.69E+05	5.87E+05
Po-210	1.19E+01	2.97E+01	4.45E+01	7.42E+01	2.97E+02	7.42E+02	8.90E+02	1.19E+03	1.48E+03
Co-60	1.16E+03	2.90E+03	4.34E+03	7.24E+03	2.90E+04	7.24E+04	8.69E+04	1.16E+05	1.45E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	6.83E+01	1.71E+02	2.56E+02	4.27E+02	1.71E+03	4.27E+03	5.12E+03	6.83E+03	8.54E+03
Y-90	4.95E+02	1.24E+03	1.86E+03	3.10E+03	1.24E+04	3.10E+04	3.72E+04	4.95E+04	6.19E+04
Cs-137	7.35E+02	1.84E+03	2.76E+03	4.59E+03	1.84E+04	4.59E+04	5.51E+04	7.35E+04	9.19E+04
I-131	8.43E+01	2.11E+02	3.16E+02	5.27E+02	2.11E+03	5.27E+03	6.32E+03	8.43E+03	1.05E+04
Ir-192	1.16E+03	2.89E+03	4.34E+03	7.23E+03	2.89E+04	7.23E+04	8.68E+04	1.16E+05	1.45E+05
Po-210	2.93E+00	7.31E+00	1.10E+01	1.83E+01	7.31E+01	1.83E+02	2.19E+02	2.93E+02	3.66E+02
Co-60	2.86E+02	7.14E+02	1.07E+03	1.78E+03	7.14E+03	1.78E+04	2.14E+04	2.86E+04	3.57E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.38E-06	5.95E-06	8.92E-06	1.49E-05	5.95E-05	1.49E-04	1.78E-04	2.38E-04	2.97E-04
Y-90	1.42E-05	3.55E-05	5.32E-05	8.87E-05	3.55E-04	8.87E-04	1.06E-03	1.42E-03	1.77E-03
Cs-137	6.45E-06	1.61E-05	2.42E-05	4.03E-05	1.61E-04	4.03E-04	4.83E-04	6.45E-04	8.06E-04
I-131	4.67E-06	1.17E-05	1.75E-05	2.92E-05	1.17E-04	2.92E-04	3.51E-04	4.67E-04	5.84E-04
Ir-192	1.23E-05	3.07E-05	4.61E-05	7.69E-05	3.07E-04	7.69E-04	9.22E-04	1.23E-03	1.54E-03
Po-210	1.34E-06	3.34E-06	5.01E-06	8.35E-06	3.34E-05	8.35E-05	1.00E-04	1.34E-04	1.67E-04
Co-60	5.54E-06	1.38E-05	2.08E-05	3.46E-05	1.38E-04	3.46E-04	4.15E-04	5.54E-04	6.92E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.38E-06	5.95E-06	8.92E-06	1.49E-05	5.95E-05	1.49E-04	1.78E-04	2.38E-04	2.97E-04
Y-90	1.42E-05	3.55E-05	5.32E-05	8.87E-05	3.55E-04	8.87E-04	1.06E-03	1.42E-03	1.77E-03
Cs-137	6.45E-06	1.61E-05	2.42E-05	4.03E-05	1.61E-04	4.03E-04	4.83E-04	6.45E-04	8.06E-04
I-131	4.67E-06	1.17E-05	1.75E-05	2.92E-05	1.17E-04	2.92E-04	3.51E-04	4.67E-04	5.84E-04
Ir-192	1.23E-05	3.07E-05	4.61E-05	7.69E-05	3.07E-04	7.69E-04	9.22E-04	1.23E-03	1.54E-03
Po-210	1.34E-06	3.34E-06	5.01E-06	8.35E-06	3.34E-05	8.35E-05	1.00E-04	1.34E-04	1.67E-04
Co-60	5.54E-06	1.38E-05	2.08E-05	3.46E-05	1.38E-04	3.46E-04	4.15E-04	5.54E-04	6.92E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.38E-06	5.95E-06	8.92E-06	1.49E-05	5.95E-05	1.49E-04	1.78E-04	2.38E-04	2.97E-04
Y-90	1.42E-05	3.55E-05	5.32E-05	8.87E-05	3.55E-04	8.87E-04	1.06E-03	1.42E-03	1.77E-03
Cs-137	6.45E-06	1.61E-05	2.42E-05	4.03E-05	1.61E-04	4.03E-04	4.83E-04	6.45E-04	8.06E-04
I-131	4.67E-06	1.17E-05	1.75E-05	2.92E-05	1.17E-04	2.92E-04	3.51E-04	4.67E-04	5.84E-04
Ir-192	1.23E-05	3.07E-05	4.61E-05	7.69E-05	3.07E-04	7.69E-04	9.22E-04	1.23E-03	1.54E-03
Po-210	1.34E-06	3.34E-06	5.01E-06	8.35E-06	3.34E-05	8.35E-05	1.00E-04	1.34E-04	1.67E-04
Co-60	5.54E-06	1.38E-05	2.08E-05	3.46E-05	1.38E-04	3.46E-04	4.15E-04	5.54E-04	6.92E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.38E-06	5.95E-06	8.92E-06	1.49E-05	5.95E-05	1.49E-04	1.78E-04	2.38E-04	2.97E-04
Y-90	1.42E-05	3.55E-05	5.32E-05	8.87E-05	3.55E-04	8.87E-04	1.06E-03	1.42E-03	1.77E-03
Cs-137	6.45E-06	1.61E-05	2.42E-05	4.03E-05	1.61E-04	4.03E-04	4.83E-04	6.45E-04	8.06E-04
I-131	4.67E-06	1.17E-05	1.75E-05	2.92E-05	1.17E-04	2.92E-04	3.51E-04	4.67E-04	5.84E-04
Ir-192	1.23E-05	3.07E-05	4.61E-05	7.69E-05	3.07E-04	7.69E-04	9.22E-04	1.23E-03	1.54E-03
Po-210	1.34E-06	3.34E-06	5.01E-06	8.35E-06	3.34E-05	8.35E-05	1.00E-04	1.34E-04	1.67E-04
Co-60	5.54E-06	1.38E-05	2.08E-05	3.46E-05	1.38E-04	3.46E-04	4.15E-04	5.54E-04	6.92E-04

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APPENDIX 4: 1 YEAR OLD

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.23E+03	5.58E+03	8.37E+03	1.39E+04	5.58E+04	1.39E+05	1.67E+05	2.23E+05	2.79E+05
Y-90	8.08E+03	2.02E+04	3.03E+04	5.05E+04	2.02E+05	5.05E+05	6.06E+05	8.08E+05	1.01E+06
Cs-137	1.30E+04	3.26E+04	4.89E+04	8.14E+04	3.26E+05	8.14E+05	9.77E+05	1.30E+06	1.63E+06
I-131	9.03E+02	2.26E+03	3.39E+03	5.64E+03	2.26E+04	5.64E+04	6.77E+04	9.03E+04	1.13E+05
Ir-192	1.85E+04	4.62E+04	6.93E+04	1.16E+05	4.62E+05	1.16E+06	1.39E+06	1.85E+06	2.31E+06
Po-210	9.03E+01	2.26E+02	3.39E+02	5.64E+02	2.26E+03	5.64E+03	6.77E+03	9.03E+03	1.13E+04
Co-60	6.03E+03	1.51E+04	2.26E+04	3.77E+04	1.51E+05	3.77E+05	4.52E+05	6.03E+05	7.54E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.12E+03	2.79E+03	4.18E+03	6.97E+03	2.79E+04	6.97E+04	8.37E+04	1.12E+05	1.39E+05
Y-90	4.04E+03	1.01E+04	1.51E+04	2.52E+04	1.01E+05	2.52E+05	3.03E+05	4.04E+05	5.05E+05
Cs-137	6.52E+03	1.63E+04	2.44E+04	4.07E+04	1.63E+05	4.07E+05	4.89E+05	6.52E+05	8.14E+05
I-131	4.51E+02	1.13E+03	1.69E+03	2.82E+03	1.13E+04	2.82E+04	3.39E+04	4.51E+04	5.64E+04
Ir-192	9.24E+03	2.31E+04	3.47E+04	5.78E+04	2.31E+05	5.78E+05	6.93E+05	9.24E+05	1.16E+06
Po-210	4.51E+01	1.13E+02	1.69E+02	2.82E+02	1.13E+03	2.82E+03	3.39E+03	4.51E+03	5.64E+03
Co-60	3.01E+03	7.54E+03	1.13E+04	1.88E+04	7.54E+04	1.88E+05	2.26E+05	3.01E+05	3.77E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	7.44E+02	1.86E+03	2.79E+03	4.65E+03	1.86E+04	4.65E+04	5.58E+04	7.44E+04	9.30E+04
Y-90	2.69E+03	6.73E+03	1.01E+04	1.68E+04	6.73E+04	1.68E+05	2.02E+05	2.69E+05	3.37E+05
Cs-137	4.34E+03	1.09E+04	1.63E+04	2.71E+04	1.09E+05	2.71E+05	3.26E+05	4.34E+05	5.43E+05
I-131	3.01E+02	7.52E+02	1.13E+03	1.88E+03	7.52E+03	1.88E+04	2.26E+04	3.01E+04	3.76E+04
Ir-192	6.16E+03	1.54E+04	2.31E+04	3.85E+04	1.54E+05	3.85E+05	4.62E+05	6.16E+05	7.70E+05
Po-210	3.01E+01	7.52E+01	1.13E+02	1.88E+02	7.52E+02	1.88E+03	2.26E+03	3.01E+03	3.76E+03
Co-60	2.01E+03	5.02E+03	7.54E+03	1.26E+04	5.02E+04	1.26E+05	1.51E+05	2.01E+05	2.51E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.83E+02	4.59E+02	6.88E+02	1.15E+03	4.59E+03	1.15E+04	1.38E+04	1.83E+04	2.29E+04
Y-90	6.64E+02	1.66E+03	2.49E+03	4.15E+03	1.66E+04	4.15E+04	4.98E+04	6.64E+04	8.30E+04
Cs-137	1.07E+03	2.68E+03	4.02E+03	6.69E+03	2.68E+04	6.69E+04	8.03E+04	1.07E+05	1.34E+05
I-131	7.42E+01	1.86E+02	2.78E+02	4.64E+02	1.86E+03	4.64E+03	5.57E+03	7.42E+03	9.28E+03
Ir-192	1.52E+03	3.80E+03	5.70E+03	9.50E+03	3.80E+04	9.50E+04	1.14E+05	1.52E+05	1.90E+05
Po-210	7.42E+00	1.86E+01	2.78E+01	4.64E+01	1.86E+02	4.64E+02	5.57E+02	7.42E+02	9.28E+02
Co-60	4.96E+02	1.24E+03	1.86E+03	3.10E+03	1.24E+04	3.10E+04	3.72E+04	4.96E+04	6.19E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.75E-06	1.19E-05	1.78E-05	2.97E-05	1.19E-04	2.97E-04	3.56E-04	4.75E-04	5.93E-04
Y-90	1.62E-05	4.04E-05	6.06E-05	1.01E-04	4.04E-04	1.01E-03	1.21E-03	1.62E-03	2.02E-03
Cs-137	8.03E-06	2.01E-05	3.01E-05	5.02E-05	2.01E-04	5.02E-04	6.02E-04	8.03E-04	1.00E-03
I-131	4.45E-06	1.11E-05	1.67E-05	2.78E-05	1.11E-04	2.78E-04	3.34E-04	4.45E-04	5.56E-04
Ir-192	1.39E-05	3.48E-05	5.22E-05	8.70E-05	3.48E-04	8.70E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.13E-06	5.31E-06	7.97E-06	1.33E-05	5.31E-05	1.33E-04	1.59E-04	2.13E-04	2.66E-04
Co-60	7.79E-06	1.95E-05	2.92E-05	4.87E-05	1.95E-04	4.87E-04	5.84E-04	7.79E-04	9.74E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.75E-06	1.19E-05	1.78E-05	2.97E-05	1.19E-04	2.97E-04	3.56E-04	4.75E-04	5.93E-04
Y-90	1.62E-05	4.04E-05	6.06E-05	1.01E-04	4.04E-04	1.01E-03	1.21E-03	1.62E-03	2.02E-03
Cs-137	8.03E-06	2.01E-05	3.01E-05	5.02E-05	2.01E-04	5.02E-04	6.02E-04	8.03E-04	1.00E-03
I-131	4.45E-06	1.11E-05	1.67E-05	2.78E-05	1.11E-04	2.78E-04	3.34E-04	4.45E-04	5.56E-04
Ir-192	1.39E-05	3.48E-05	5.22E-05	8.70E-05	3.48E-04	8.70E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.13E-06	5.31E-06	7.97E-06	1.33E-05	5.31E-05	1.33E-04	1.59E-04	2.13E-04	2.66E-04
Co-60	7.79E-06	1.95E-05	2.92E-05	4.87E-05	1.95E-04	4.87E-04	5.84E-04	7.79E-04	9.74E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.75E-06	1.19E-05	1.78E-05	2.97E-05	1.19E-04	2.97E-04	3.56E-04	4.75E-04	5.93E-04
Y-90	1.62E-05	4.04E-05	6.06E-05	1.01E-04	4.04E-04	1.01E-03	1.21E-03	1.62E-03	2.02E-03
Cs-137	8.03E-06	2.01E-05	3.01E-05	5.02E-05	2.01E-04	5.02E-04	6.02E-04	8.03E-04	1.00E-03
I-131	4.45E-06	1.11E-05	1.67E-05	2.78E-05	1.11E-04	2.78E-04	3.34E-04	4.45E-04	5.56E-04
Ir-192	1.39E-05	3.48E-05	5.22E-05	8.70E-05	3.48E-04	8.70E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.13E-06	5.31E-06	7.97E-06	1.33E-05	5.31E-05	1.33E-04	1.59E-04	2.13E-04	2.66E-04
Co-60	7.79E-06	1.95E-05	2.92E-05	4.87E-05	1.95E-04	4.87E-04	5.84E-04	7.79E-04	9.74E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.75E-06	1.19E-05	1.78E-05	2.97E-05	1.19E-04	2.97E-04	3.56E-04	4.75E-04	5.93E-04
Y-90	1.62E-05	4.04E-05	6.06E-05	1.01E-04	4.04E-04	1.01E-03	1.21E-03	1.62E-03	2.02E-03
Cs-137	8.03E-06	2.01E-05	3.01E-05	5.02E-05	2.01E-04	5.02E-04	6.02E-04	8.03E-04	1.00E-03
I-131	4.45E-06	1.11E-05	1.67E-05	2.78E-05	1.11E-04	2.78E-04	3.34E-04	4.45E-04	5.56E-04
Ir-192	1.39E-05	3.48E-05	5.22E-05	8.70E-05	3.48E-04	8.70E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.13E-06	5.31E-06	7.97E-06	1.33E-05	5.31E-05	1.33E-04	1.59E-04	2.13E-04	2.66E-04
Co-60	7.79E-06	1.95E-05	2.92E-05	4.87E-05	1.95E-04	4.87E-04	5.84E-04	7.79E-04	9.74E-04

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APPENDIX 5: 5 YEAR OLD

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.42E+03	3.54E+03	5.32E+03	8.86E+03	3.54E+04	8.86E+04	1.06E+05	1.42E+05	1.77E+05
Y-90	6.67E+03	1.67E+04	2.50E+04	4.17E+04	1.67E+05	4.17E+05	5.00E+05	6.67E+05	8.34E+05
Cs-137	6.86E+03	1.72E+04	2.57E+04	4.29E+04	1.72E+05	4.29E+05	5.15E+05	6.86E+05	8.58E+05
I-131	6.39E+02	1.60E+03	2.40E+03	4.00E+03	1.60E+04	4.00E+04	4.79E+04	6.39E+04	7.99E+04
Ir-192	1.45E+04	3.62E+04	5.43E+04	9.05E+04	3.62E+05	9.05E+05	1.09E+06	1.45E+06	1.81E+06
Po-210	7.49E+01	1.87E+02	2.81E+02	4.68E+02	1.87E+03	4.68E+03	5.62E+03	7.49E+03	9.36E+03
Co-60	3.93E+03	9.84E+03	1.48E+04	2.46E+04	9.84E+04	2.46E+05	2.95E+05	3.93E+05	4.92E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	7.09E+02	1.77E+03	2.66E+03	4.43E+03	1.77E+04	4.43E+04	5.32E+04	7.09E+04	8.86E+04
Y-90	3.33E+03	8.34E+03	1.25E+04	2.08E+04	8.34E+04	2.08E+05	2.50E+05	3.33E+05	4.17E+05
Cs-137	3.43E+03	8.58E+03	1.29E+04	2.14E+04	8.58E+04	2.14E+05	2.57E+05	3.43E+05	4.29E+05
I-131	3.20E+02	7.99E+02	1.20E+03	2.00E+03	7.99E+03	2.00E+04	2.40E+04	3.20E+04	4.00E+04
Ir-192	7.24E+03	1.81E+04	2.72E+04	4.53E+04	1.81E+05	4.53E+05	5.43E+05	7.24E+05	9.05E+05
Po-210	3.74E+01	9.36E+01	1.40E+02	2.34E+02	9.36E+02	2.34E+03	2.81E+03	3.74E+03	4.68E+03
Co-60	1.97E+03	4.92E+03	7.38E+03	1.23E+04	4.92E+04	1.23E+05	1.48E+05	1.97E+05	2.46E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.73E+02	1.18E+03	1.77E+03	2.95E+03	1.18E+04	2.95E+04	3.54E+04	4.73E+04	5.91E+04
Y-90	2.22E+03	5.56E+03	8.34E+03	1.39E+04	5.56E+04	1.39E+05	1.67E+05	2.22E+05	2.78E+05
Cs-137	2.29E+03	5.72E+03	8.58E+03	1.43E+04	5.72E+04	1.43E+05	1.72E+05	2.29E+05	2.86E+05
I-131	2.13E+02	5.33E+02	7.99E+02	1.33E+03	5.33E+03	1.33E+04	1.60E+04	2.13E+04	2.66E+04
Ir-192	4.83E+03	1.21E+04	1.81E+04	3.02E+04	1.21E+05	3.02E+05	3.62E+05	4.83E+05	6.04E+05
Po-210	2.50E+01	6.24E+01	9.36E+01	1.56E+02	6.24E+02	1.56E+03	1.87E+03	2.50E+03	3.12E+03
Co-60	1.31E+03	3.28E+03	4.92E+03	8.20E+03	3.28E+04	8.20E+04	9.84E+04	1.31E+05	1.64E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.17E+02	2.91E+02	4.37E+02	7.28E+02	2.91E+03	7.28E+03	8.74E+03	1.17E+04	1.46E+04
Y-90	5.48E+02	1.37E+03	2.06E+03	3.43E+03	1.37E+04	3.43E+04	4.11E+04	5.48E+04	6.85E+04
Cs-137	5.64E+02	1.41E+03	2.11E+03	3.52E+03	1.41E+04	3.52E+04	4.23E+04	5.64E+04	7.05E+04
I-131	5.25E+01	1.31E+02	1.97E+02	3.28E+02	1.31E+03	3.28E+03	3.94E+03	5.25E+03	6.57E+03
Ir-192	1.19E+03	2.98E+03	4.46E+03	7.44E+03	2.98E+04	7.44E+04	8.93E+04	1.19E+05	1.49E+05
Po-210	6.15E+00	1.54E+01	2.31E+01	3.85E+01	1.54E+02	3.85E+02	4.62E+02	6.15E+02	7.69E+02
Co-60	3.23E+02	8.08E+02	1.21E+03	2.02E+03	8.08E+03	2.02E+04	2.43E+04	3.23E+04	4.04E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.38E-06	1.09E-05	1.64E-05	2.73E-05	1.09E-04	2.73E-04	3.28E-04	4.38E-04	5.47E-04
Y-90	1.71E-05	4.26E-05	6.39E-05	1.07E-04	4.26E-04	1.07E-03	1.28E-03	1.71E-03	2.13E-03
Cs-137	8.13E-06	2.03E-05	3.05E-05	5.08E-05	2.03E-04	5.08E-04	6.10E-04	8.13E-04	1.02E-03
I-131	4.08E-06	1.02E-05	1.53E-05	2.55E-05	1.02E-04	2.55E-04	3.06E-04	4.08E-04	5.10E-04
Ir-192	1.44E-05	3.59E-05	5.39E-05	8.99E-05	3.59E-04	8.99E-04	1.08E-03	1.44E-03	1.80E-03
Po-210	2.32E-06	5.80E-06	8.70E-06	1.45E-05	5.80E-05	1.45E-04	1.74E-04	2.32E-04	2.90E-04
Co-60	7.81E-06	1.95E-05	2.93E-05	4.88E-05	1.95E-04	4.88E-04	5.86E-04	7.81E-04	9.76E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.38E-06	1.09E-05	1.64E-05	2.73E-05	1.09E-04	2.73E-04	3.28E-04	4.38E-04	5.47E-04
Y-90	1.71E-05	4.26E-05	6.39E-05	1.07E-04	4.26E-04	1.07E-03	1.28E-03	1.71E-03	2.13E-03
Cs-137	8.13E-06	2.03E-05	3.05E-05	5.08E-05	2.03E-04	5.08E-04	6.10E-04	8.13E-04	1.02E-03
I-131	4.08E-06	1.02E-05	1.53E-05	2.55E-05	1.02E-04	2.55E-04	3.06E-04	4.08E-04	5.10E-04
Ir-192	1.44E-05	3.59E-05	5.39E-05	8.99E-05	3.59E-04	8.99E-04	1.08E-03	1.44E-03	1.80E-03
Po-210	2.32E-06	5.80E-06	8.70E-06	1.45E-05	5.80E-05	1.45E-04	1.74E-04	2.32E-04	2.90E-04
Co-60	7.81E-06	1.95E-05	2.93E-05	4.88E-05	1.95E-04	4.88E-04	5.86E-04	7.81E-04	9.76E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.38E-06	1.09E-05	1.64E-05	2.73E-05	1.09E-04	2.73E-04	3.28E-04	4.38E-04	5.47E-04
Y-90	1.71E-05	4.26E-05	6.39E-05	1.07E-04	4.26E-04	1.07E-03	1.28E-03	1.71E-03	2.13E-03
Cs-137	8.13E-06	2.03E-05	3.05E-05	5.08E-05	2.03E-04	5.08E-04	6.10E-04	8.13E-04	1.02E-03
I-131	4.08E-06	1.02E-05	1.53E-05	2.55E-05	1.02E-04	2.55E-04	3.06E-04	4.08E-04	5.10E-04
Ir-192	1.44E-05	3.59E-05	5.39E-05	8.99E-05	3.59E-04	8.99E-04	1.08E-03	1.44E-03	1.80E-03
Po-210	2.32E-06	5.80E-06	8.70E-06	1.45E-05	5.80E-05	1.45E-04	1.74E-04	2.32E-04	2.90E-04
Co-60	7.81E-06	1.95E-05	2.93E-05	4.88E-05	1.95E-04	4.88E-04	5.86E-04	7.81E-04	9.76E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.38E-06	1.09E-05	1.64E-05	2.73E-05	1.09E-04	2.73E-04	3.28E-04	4.38E-04	5.47E-04
Y-90	1.71E-05	4.26E-05	6.39E-05	1.07E-04	4.26E-04	1.07E-03	1.28E-03	1.71E-03	2.13E-03
Cs-137	8.13E-06	2.03E-05	3.05E-05	5.08E-05	2.03E-04	5.08E-04	6.10E-04	8.13E-04	1.02E-03
I-131	4.08E-06	1.02E-05	1.53E-05	2.55E-05	1.02E-04	2.55E-04	3.06E-04	4.08E-04	5.10E-04
Ir-192	1.44E-05	3.59E-05	5.39E-05	8.99E-05	3.59E-04	8.99E-04	1.08E-03	1.44E-03	1.80E-03
Po-210	2.32E-06	5.80E-06	8.70E-06	1.45E-05	5.80E-05	1.45E-04	1.74E-04	2.32E-04	2.90E-04
Co-60	7.81E-06	1.95E-05	2.93E-05	4.88E-05	1.95E-04	4.88E-04	5.86E-04	7.81E-04	9.76E-04

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APPENDIX 6: 10 YEAR OLD

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	8.33E+02	2.08E+03	3.12E+03	5.20E+03	2.08E+04	5.20E+04	6.24E+04	8.33E+04	1.04E+05
Y-90	8.42E+03	2.11E+04	3.16E+04	5.27E+04	2.11E+05	5.27E+05	6.32E+05	8.42E+05	1.05E+06
Cs-137	4.92E+03	1.23E+04	1.85E+04	3.08E+04	1.23E+05	3.08E+05	3.69E+05	4.92E+05	6.15E+05
I-131	9.49E+02	2.37E+03	3.56E+03	5.93E+03	2.37E+04	5.93E+04	7.11E+04	9.49E+04	1.19E+05
Ir-192	1.74E+04	4.36E+04	6.54E+04	1.09E+05	4.36E+05	1.09E+06	1.31E+06	1.74E+06	2.18E+06
Po-210	9.47E+01	2.37E+02	3.55E+02	5.92E+02	2.37E+03	5.92E+03	7.10E+03	9.47E+03	1.18E+04
Co-60	4.44E+03	1.11E+04	1.66E+04	2.77E+04	1.11E+05	2.77E+05	3.33E+05	4.44E+05	5.55E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.16E+02	1.04E+03	1.56E+03	2.60E+03	1.04E+04	2.60E+04	3.12E+04	4.16E+04	5.20E+04
Y-90	4.21E+03	1.05E+04	1.58E+04	2.63E+04	1.05E+05	2.63E+05	3.16E+05	4.21E+05	5.27E+05
Cs-137	2.46E+03	6.15E+03	9.23E+03	1.54E+04	6.15E+04	1.54E+05	1.85E+05	2.46E+05	3.08E+05
I-131	4.74E+02	1.19E+03	1.78E+03	2.96E+03	1.19E+04	2.96E+04	3.56E+04	4.74E+04	5.93E+04
Ir-192	8.72E+03	2.18E+04	3.27E+04	5.45E+04	2.18E+05	5.45E+05	6.54E+05	8.72E+05	1.09E+06
Po-210	4.73E+01	1.18E+02	1.78E+02	2.96E+02	1.18E+03	2.96E+03	3.55E+03	4.73E+03	5.92E+03
Co-60	2.22E+03	5.55E+03	8.32E+03	1.39E+04	5.55E+04	1.39E+05	1.66E+05	2.22E+05	2.77E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.78E+02	6.94E+02	1.04E+03	1.73E+03	6.94E+03	1.73E+04	2.08E+04	2.78E+04	3.47E+04
Y-90	2.81E+03	7.02E+03	1.05E+04	1.76E+04	7.02E+04	1.76E+05	2.11E+05	2.81E+05	3.51E+05
Cs-137	1.64E+03	4.10E+03	6.15E+03	1.03E+04	4.10E+04	1.03E+05	1.23E+05	1.64E+05	2.05E+05
I-131	3.16E+02	7.90E+02	1.19E+03	1.98E+03	7.90E+03	1.98E+04	2.37E+04	3.16E+04	3.95E+04
Ir-192	5.81E+03	1.45E+04	2.18E+04	3.63E+04	1.45E+05	3.63E+05	4.36E+05	5.81E+05	7.27E+05
Po-210	3.16E+01	7.89E+01	1.18E+02	1.97E+02	7.89E+02	1.97E+03	2.37E+03	3.16E+03	3.94E+03
Co-60	1.48E+03	3.70E+03	5.55E+03	9.25E+03	3.70E+04	9.25E+04	1.11E+05	1.48E+05	1.85E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	6.84E+01	1.71E+02	2.57E+02	4.28E+02	1.71E+03	4.28E+03	5.13E+03	6.84E+03	8.55E+03
Y-90	6.92E+02	1.73E+03	2.60E+03	4.33E+03	1.73E+04	4.33E+04	5.19E+04	6.92E+04	8.66E+04
Cs-137	4.04E+02	1.01E+03	1.52E+03	2.53E+03	1.01E+04	2.53E+04	3.03E+04	4.04E+04	5.06E+04
I-131	7.80E+01	1.95E+02	2.92E+02	4.87E+02	1.95E+03	4.87E+03	5.85E+03	7.80E+03	9.75E+03
Ir-192	1.43E+03	3.58E+03	5.38E+03	8.96E+03	3.58E+04	8.96E+04	1.08E+05	1.43E+05	1.79E+05
Po-210	7.78E+00	1.95E+01	2.92E+01	4.86E+01	1.95E+02	4.86E+02	5.84E+02	7.78E+02	9.73E+02
Co-60	3.65E+02	9.12E+02	1.37E+03	2.28E+03	9.12E+03	2.28E+04	2.74E+04	3.65E+04	4.56E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.15E-06	5.38E-06	8.07E-06	1.34E-05	5.38E-05	1.34E-04	1.61E-04	2.15E-04	2.69E-04
Y-90	1.72E-05	4.31E-05	6.46E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.15E-03
Cs-137	7.88E-06	1.97E-05	2.96E-05	4.93E-05	1.97E-04	4.93E-04	5.91E-04	7.88E-04	9.85E-04
I-131	3.85E-06	9.62E-06	1.44E-05	2.40E-05	9.62E-05	2.40E-04	2.89E-04	3.85E-04	4.81E-04
Ir-192	1.42E-05	3.54E-05	5.32E-05	8.86E-05	3.54E-04	8.86E-04	1.06E-03	1.42E-03	1.77E-03
Po-210	2.42E-06	6.06E-06	9.09E-06	1.51E-05	6.06E-05	1.51E-04	1.82E-04	2.42E-04	3.03E-04
Co-60	7.71E-06	1.93E-05	2.89E-05	4.82E-05	1.93E-04	4.82E-04	5.79E-04	7.71E-04	9.64E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.15E-06	5.38E-06	8.07E-06	1.34E-05	5.38E-05	1.34E-04	1.61E-04	2.15E-04	2.69E-04
Y-90	1.72E-05	4.31E-05	6.46E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.15E-03
Cs-137	7.88E-06	1.97E-05	2.96E-05	4.93E-05	1.97E-04	4.93E-04	5.91E-04	7.88E-04	9.85E-04
I-131	3.85E-06	9.62E-06	1.44E-05	2.40E-05	9.62E-05	2.40E-04	2.89E-04	3.85E-04	4.81E-04
Ir-192	1.42E-05	3.54E-05	5.32E-05	8.86E-05	3.54E-04	8.86E-04	1.06E-03	1.42E-03	1.77E-03
Po-210	2.42E-06	6.06E-06	9.09E-06	1.51E-05	6.06E-05	1.51E-04	1.82E-04	2.42E-04	3.03E-04
Co-60	7.71E-06	1.93E-05	2.89E-05	4.82E-05	1.93E-04	4.82E-04	5.79E-04	7.71E-04	9.64E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.15E-06	5.38E-06	8.07E-06	1.34E-05	5.38E-05	1.34E-04	1.61E-04	2.15E-04	2.69E-04
Y-90	1.72E-05	4.31E-05	6.46E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.15E-03
Cs-137	7.88E-06	1.97E-05	2.96E-05	4.93E-05	1.97E-04	4.93E-04	5.91E-04	7.88E-04	9.85E-04
I-131	3.85E-06	9.62E-06	1.44E-05	2.40E-05	9.62E-05	2.40E-04	2.89E-04	3.85E-04	4.81E-04
Ir-192	1.42E-05	3.54E-05	5.32E-05	8.86E-05	3.54E-04	8.86E-04	1.06E-03	1.42E-03	1.77E-03
Po-210	2.42E-06	6.06E-06	9.09E-06	1.51E-05	6.06E-05	1.51E-04	1.82E-04	2.42E-04	3.03E-04
Co-60	7.71E-06	1.93E-05	2.89E-05	4.82E-05	1.93E-04	4.82E-04	5.79E-04	7.71E-04	9.64E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.15E-06	5.38E-06	8.07E-06	1.34E-05	5.38E-05	1.34E-04	1.61E-04	2.15E-04	2.69E-04
Y-90	1.72E-05	4.31E-05	6.46E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.15E-03
Cs-137	7.88E-06	1.97E-05	2.96E-05	4.93E-05	1.97E-04	4.93E-04	5.91E-04	7.88E-04	9.85E-04
I-131	3.85E-06	9.62E-06	1.44E-05	2.40E-05	9.62E-05	2.40E-04	2.89E-04	3.85E-04	4.81E-04
Ir-192	1.42E-05	3.54E-05	5.32E-05	8.86E-05	3.54E-04	8.86E-04	1.06E-03	1.42E-03	1.77E-03
Po-210	2.42E-06	6.06E-06	9.09E-06	1.51E-05	6.06E-05	1.51E-04	1.82E-04	2.42E-04	3.03E-04
Co-60	7.71E-06	1.93E-05	2.89E-05	4.82E-05	1.93E-04	4.82E-04	5.79E-04	7.71E-04	9.64E-04

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APPENDIX 7: 15 YEAR OLD

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	5.07E+02	1.27E+03	1.90E+03	3.17E+03	1.27E+04	3.17E+04	3.81E+04	5.07E+04	6.34E+04
Y-90	1.20E+04	3.00E+04	4.50E+04	7.49E+04	3.00E+05	7.49E+05	8.99E+05	1.20E+06	1.50E+06
Cs-137	2.99E+03	7.47E+03	1.12E+04	1.87E+04	7.47E+04	1.87E+05	2.24E+05	2.99E+05	3.74E+05
I-131	1.17E+03	2.93E+03	4.39E+03	7.32E+03	2.93E+04	7.32E+04	8.78E+04	1.17E+05	1.46E+05
Ir-192	2.34E+04	5.85E+04	8.78E+04	1.46E+05	5.85E+05	1.46E+06	1.76E+06	2.34E+06	2.93E+06
Po-210	1.26E+02	3.14E+02	4.71E+02	7.84E+02	3.14E+03	7.84E+03	9.41E+03	1.26E+04	1.57E+04
Co-60	5.04E+03	1.26E+04	1.89E+04	3.15E+04	1.26E+05	3.15E+05	3.78E+05	5.04E+05	6.30E+05

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	2.54E+02	6.34E+02	9.52E+02	1.59E+03	6.34E+03	1.59E+04	1.90E+04	2.54E+04	3.17E+04
Y-90	5.99E+03	1.50E+04	2.25E+04	3.75E+04	1.50E+05	3.75E+05	4.50E+05	5.99E+05	7.49E+05
Cs-137	1.49E+03	3.74E+03	5.60E+03	9.34E+03	3.74E+04	9.34E+04	1.12E+05	1.49E+05	1.87E+05
I-131	5.85E+02	1.46E+03	2.20E+03	3.66E+03	1.46E+04	3.66E+04	4.39E+04	5.85E+04	7.32E+04
Ir-192	1.17E+04	2.93E+04	4.39E+04	7.32E+04	2.93E+05	7.32E+05	8.78E+05	1.17E+06	1.46E+06
Po-210	6.28E+01	1.57E+02	2.35E+02	3.92E+02	1.57E+03	3.92E+03	4.71E+03	6.28E+03	7.84E+03
Co-60	2.52E+03	6.30E+03	9.46E+03	1.58E+04	6.30E+04	1.58E+05	1.89E+05	2.52E+05	3.15E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.69E+02	4.23E+02	6.34E+02	1.06E+03	4.23E+03	1.06E+04	1.27E+04	1.69E+04	2.11E+04
Y-90	4.00E+03	9.99E+03	1.50E+04	2.50E+04	9.99E+04	2.50E+05	3.00E+05	4.00E+05	5.00E+05
Cs-137	9.96E+02	2.49E+03	3.74E+03	6.23E+03	2.49E+04	6.23E+04	7.47E+04	9.96E+04	1.25E+05
I-131	3.90E+02	9.76E+02	1.46E+03	2.44E+03	9.76E+03	2.44E+04	2.93E+04	3.90E+04	4.88E+04
Ir-192	7.81E+03	1.95E+04	2.93E+04	4.88E+04	1.95E+05	4.88E+05	5.85E+05	7.81E+05	9.76E+05
Po-210	4.18E+01	1.05E+02	1.57E+02	2.61E+02	1.05E+03	2.61E+03	3.14E+03	4.18E+03	5.23E+03
Co-60	1.68E+03	4.20E+03	6.30E+03	1.05E+04	4.20E+04	1.05E+05	1.26E+05	1.68E+05	2.10E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	4.17E+01	1.04E+02	1.56E+02	2.61E+02	1.04E+03	2.61E+03	3.13E+03	4.17E+03	5.21E+03
Y-90	9.85E+02	2.46E+03	3.69E+03	6.16E+03	2.46E+04	6.16E+04	7.39E+04	9.85E+04	1.23E+05
Cs-137	2.46E+02	6.14E+02	9.21E+02	1.53E+03	6.14E+03	1.53E+04	1.84E+04	2.46E+04	3.07E+04
I-131	9.62E+01	2.41E+02	3.61E+02	6.01E+02	2.41E+03	6.01E+03	7.22E+03	9.62E+03	1.20E+04
Ir-192	1.92E+03	4.81E+03	7.22E+03	1.20E+04	4.81E+04	1.20E+05	1.44E+05	1.92E+05	2.41E+05
Po-210	1.03E+01	2.58E+01	3.87E+01	6.45E+01	2.58E+02	6.45E+02	7.74E+02	1.03E+03	1.29E+03
Co-60	4.14E+02	1.04E+03	1.55E+03	2.59E+03	1.04E+04	2.59E+04	3.11E+04	4.14E+04	5.18E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.70E-06	4.26E-06	6.39E-06	1.06E-05	4.26E-05	1.06E-04	1.28E-04	1.70E-04	2.13E-04
Y-90	1.72E-05	4.31E-05	6.47E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.16E-03
Cs-137	7.28E-06	1.82E-05	2.73E-05	4.55E-05	1.82E-04	4.55E-04	5.46E-04	7.28E-04	9.10E-04
I-131	3.46E-06	8.65E-06	1.30E-05	2.16E-05	8.65E-05	2.16E-04	2.60E-04	3.46E-04	4.33E-04
Ir-192	1.39E-05	3.47E-05	5.21E-05	8.68E-05	3.47E-04	8.68E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.45E-06	6.11E-06	9.17E-06	1.53E-05	6.11E-05	1.53E-04	1.83E-04	2.45E-04	3.06E-04
Co-60	7.15E-06	1.79E-05	2.68E-05	4.47E-05	1.79E-04	4.47E-04	5.37E-04	7.15E-04	8.94E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.70E-06	4.26E-06	6.39E-06	1.06E-05	4.26E-05	1.06E-04	1.28E-04	1.70E-04	2.13E-04
Y-90	1.72E-05	4.31E-05	6.47E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.16E-03
Cs-137	7.28E-06	1.82E-05	2.73E-05	4.55E-05	1.82E-04	4.55E-04	5.46E-04	7.28E-04	9.10E-04
I-131	3.46E-06	8.65E-06	1.30E-05	2.16E-05	8.65E-05	2.16E-04	2.60E-04	3.46E-04	4.33E-04
Ir-192	1.39E-05	3.47E-05	5.21E-05	8.68E-05	3.47E-04	8.68E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.45E-06	6.11E-06	9.17E-06	1.53E-05	6.11E-05	1.53E-04	1.83E-04	2.45E-04	3.06E-04
Co-60	7.15E-06	1.79E-05	2.68E-05	4.47E-05	1.79E-04	4.47E-04	5.37E-04	7.15E-04	8.94E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.70E-06	4.26E-06	6.39E-06	1.06E-05	4.26E-05	1.06E-04	1.28E-04	1.70E-04	2.13E-04
Y-90	1.72E-05	4.31E-05	6.47E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.16E-03
Cs-137	7.28E-06	1.82E-05	2.73E-05	4.55E-05	1.82E-04	4.55E-04	5.46E-04	7.28E-04	9.10E-04
I-131	3.46E-06	8.65E-06	1.30E-05	2.16E-05	8.65E-05	2.16E-04	2.60E-04	3.46E-04	4.33E-04
Ir-192	1.39E-05	3.47E-05	5.21E-05	8.68E-05	3.47E-04	8.68E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.45E-06	6.11E-06	9.17E-06	1.53E-05	6.11E-05	1.53E-04	1.83E-04	2.45E-04	3.06E-04
Co-60	7.15E-06	1.79E-05	2.68E-05	4.47E-05	1.79E-04	4.47E-04	5.37E-04	7.15E-04	8.94E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.70E-06	4.26E-06	6.39E-06	1.06E-05	4.26E-05	1.06E-04	1.28E-04	1.70E-04	2.13E-04
Y-90	1.72E-05	4.31E-05	6.47E-05	1.08E-04	4.31E-04	1.08E-03	1.29E-03	1.72E-03	2.16E-03
Cs-137	7.28E-06	1.82E-05	2.73E-05	4.55E-05	1.82E-04	4.55E-04	5.46E-04	7.28E-04	9.10E-04
I-131	3.46E-06	8.65E-06	1.30E-05	2.16E-05	8.65E-05	2.16E-04	2.60E-04	3.46E-04	4.33E-04
Ir-192	1.39E-05	3.47E-05	5.21E-05	8.68E-05	3.47E-04	8.68E-04	1.04E-03	1.39E-03	1.74E-03
Po-210	2.45E-06	6.11E-06	9.17E-06	1.53E-05	6.11E-05	1.53E-04	1.83E-04	2.45E-04	3.06E-04
Co-60	7.15E-06	1.79E-05	2.68E-05	4.47E-05	1.79E-04	4.47E-04	5.37E-04	7.15E-04	8.94E-04

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APPENDIX 8: ADULT

Drinking Water Concentration (pCi/L) for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.14E+03	2.86E+03	4.29E+03	7.15E+03	2.86E+04	7.15E+04	8.58E+04	1.14E+05	1.43E+05
Y-90	1.18E+04	2.95E+04	4.42E+04	7.36E+04	2.95E+05	7.36E+05	8.84E+05	1.18E+06	1.47E+06
Cs-137	2.33E+03	5.83E+03	8.74E+03	1.46E+04	5.83E+04	1.46E+05	1.75E+05	2.33E+05	2.91E+05
I-131	1.45E+03	3.63E+03	5.45E+03	9.09E+03	3.63E+04	9.09E+04	1.09E+05	1.45E+05	1.82E+05
Ir-192	2.31E+04	5.78E+04	8.68E+04	1.45E+05	5.78E+05	1.45E+06	1.74E+06	2.31E+06	2.89E+06
Po-210	1.29E+02	3.23E+02	4.85E+02	8.09E+02	3.23E+03	8.09E+03	9.70E+03	1.29E+04	1.62E+04
Co-60	9.27E+03	2.32E+04	3.48E+04	5.79E+04	2.32E+05	5.79E+05	6.95E+05	9.27E+05	1.16E+06

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	5.72E+02	1.43E+03	2.15E+03	3.58E+03	1.43E+04	3.58E+04	4.29E+04	5.72E+04	7.15E+04
Y-90	5.89E+03	1.47E+04	2.21E+04	3.68E+04	1.47E+05	3.68E+05	4.42E+05	5.89E+05	7.36E+05
Cs-137	1.17E+03	2.91E+03	4.37E+03	7.28E+03	2.91E+04	7.28E+04	8.74E+04	1.17E+05	1.46E+05
I-131	7.27E+02	1.82E+03	2.73E+03	4.54E+03	1.82E+04	4.54E+04	5.45E+04	7.27E+04	9.09E+04
Ir-192	1.16E+04	2.89E+04	4.34E+04	7.23E+04	2.89E+05	7.23E+05	8.68E+05	1.16E+06	1.45E+06
Po-210	6.47E+01	1.62E+02	2.43E+02	4.04E+02	1.62E+03	4.04E+03	4.85E+03	6.47E+03	8.09E+03
Co-60	4.63E+03	1.16E+04	1.74E+04	2.90E+04	1.16E+05	2.90E+05	3.48E+05	4.63E+05	5.79E+05

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	3.81E+02	9.53E+02	1.43E+03	2.38E+03	9.53E+03	2.38E+04	2.86E+04	3.81E+04	4.77E+04
Y-90	3.93E+03	9.82E+03	1.47E+04	2.45E+04	9.82E+04	2.45E+05	2.95E+05	3.93E+05	4.91E+05
Cs-137	7.77E+02	1.94E+03	2.91E+03	4.86E+03	1.94E+04	4.86E+04	5.83E+04	7.77E+04	9.71E+04
I-131	4.85E+02	1.21E+03	1.82E+03	3.03E+03	1.21E+04	3.03E+04	3.63E+04	4.85E+04	6.06E+04
Ir-192	7.71E+03	1.93E+04	2.89E+04	4.82E+04	1.93E+05	4.82E+05	5.78E+05	7.71E+05	9.64E+05
Po-210	4.31E+01	1.08E+02	1.62E+02	2.70E+02	1.08E+03	2.70E+03	3.23E+03	4.31E+03	5.39E+03
Co-60	3.09E+03	7.72E+03	1.16E+04	1.93E+04	7.72E+04	1.93E+05	2.32E+05	3.09E+05	3.86E+05

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	9.40E+01	2.35E+02	3.53E+02	5.88E+02	2.35E+03	5.88E+03	7.05E+03	9.40E+03	1.18E+04
Y-90	9.68E+02	2.42E+03	3.63E+03	6.05E+03	2.42E+04	6.05E+04	7.26E+04	9.68E+04	1.21E+05
Cs-137	1.92E+02	4.79E+02	7.18E+02	1.20E+03	4.79E+03	1.20E+04	1.44E+04	1.92E+04	2.39E+04
I-131	1.19E+02	2.99E+02	4.48E+02	7.47E+02	2.99E+03	7.47E+03	8.96E+03	1.19E+04	1.49E+04
Ir-192	1.90E+03	4.75E+03	7.13E+03	1.19E+04	4.75E+04	1.19E+05	1.43E+05	1.90E+05	2.38E+05
Po-210	1.06E+01	2.66E+01	3.99E+01	6.65E+01	2.66E+02	6.65E+02	7.97E+02	1.06E+03	1.33E+03
Co-60	7.62E+02	1.90E+03	2.86E+03	4.76E+03	1.90E+04	4.76E+04	5.71E+04	7.62E+04	9.52E+04

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Drinking Water Risk for Specified Dose (mrem) Over Specified Time

30 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

60 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

90 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

365 days

	4	10	15	25	100	250	300	400	500
Sr-90	1.59E-06	3.97E-06	5.96E-06	9.93E-06	3.97E-05	9.93E-05	1.19E-04	1.59E-04	1.99E-04
Y-90	1.68E-06	4.20E-06	6.30E-06	1.05E-05	4.20E-05	1.05E-04	1.26E-04	1.68E-04	2.10E-04
Cs-137	1.81E-06	4.54E-06	6.81E-06	1.13E-05	4.54E-05	1.13E-04	1.36E-04	1.81E-04	2.27E-04
I-131	8.40E-07	2.10E-06	3.15E-06	5.25E-06	2.10E-05	5.25E-05	6.30E-05	8.40E-05	1.05E-04
Ir-192	1.56E-06	3.90E-06	5.85E-06	9.74E-06	3.90E-05	9.74E-05	1.17E-04	1.56E-04	1.95E-04
Po-210	1.10E-06	2.75E-06	4.12E-06	6.87E-06	2.75E-05	6.87E-05	8.24E-05	1.10E-04	1.37E-04
Co-60	1.56E-06	3.89E-06	5.83E-06	9.72E-06	3.89E-05	9.72E-05	1.17E-04	1.56E-04	1.94E-04

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SR-90/Y-90 RISKS DUE TO THE INGESTION OF WATER BY AN ADULT OVER A 90 DAY PERIOD, ASSUMING AN EFFECTIVE WHOLE BODY DOSE OF 100 MREM AND 250 MREM

The first step in this calculation is to determine the Sr-90/Y-90 intake that results in an effective dose (e_50) of 100 mrem and 250 mrem to an adult (the values represent both male and female adults). Federal Guidance Report No. 13 (CD Supplement, Revised 2002) cites a Sr-90 dose conversion factor of 2.77E-8 Sv per Bq ingested and a Sr-90 mortality risk coefficient for an adult (25-70 years) of 1.02E-9 risk per Bq of water ingested. The mortality risk coefficient for Sr-90 includes the risk associated with Y-90 that forms from decay of Sr-90 in the body, but not the risk associated with the Y-90 present in the ingested water due to Sr-90 decay in the water source. With a half-life of 64 hours, Y-90 has dose and adult mortality risk conversion factors of 2.69E-9 Sv/Bq and 6.12E-11 per Bq, respectively. The dose coefficients and risk coefficients for ingested Sr-90 and ingested Y-90 must be summed.

The Sr-90/Y-90 intakes that result in an effective dose commitment of 100 mrem and 250 mrem are derived as follows:

$$(3.04E\text{-}8\ Sv/Bq)\ (X\ Bq)\ (1E5\ mrem/Sv) = 100\ mrem$$
$$(3.04E\text{-}8\ Sv/Bq)\ (Y\ Bq)\ (1E5\ mrem/Sv) = 250\ mrem$$
$$X = 3.3E4\ Bq$$
$$Y = 8.2E4\ Bq$$

The second step is the derivation of the lifetime cancer mortality risk (R) associated with this intake, as follows:

$$R = 3.3E4\ Bq \times 1.08E\text{-}9\ Bq^{-1} = 3.56E\text{-}5$$
$$R = 8.2E4\ Bq \times 1.08E\text{-}9\ Bq^{-1} = 8.86E\text{-}5$$

This same approach can be used to derive total cancer risk (i.e., morbidity) by using the Sr-90 and Y-90 morbidity risk coefficients of 1.08E-9 Bq^{-1} and 1.1E-10 Bq^{-1} for water ingestion by an adult, as follows:

$$R = 3.3E4\ Bq \times 1.19E\text{-}9\ Bq^{-1} = 3.93E\text{-}5$$
$$R = 8.2E4\ Bq \times 1.19E\text{-}9\ Bq^{-1} = 9.79E\text{-}5$$

A table presenting these values can take the following form (Table 1):

Table 1. Adult Dose and Associated Mortality and Morbidity Risks Associated with Drinking Water Ingestion that Results in an Effective Dose Commitment of 100 and 250 mrem

50 Year Effective Dose	Lifetime Mortality Risk	Lifetime Morbidity Risk

Commitment (mrem)		
100	3.56E-5	3.93E-5
250	8.86E-5	9.79E-5

Risks can be readily derived in a similar manner for any age group and by gender using tables of dose and risk coefficients that are currently available in software developed by ICRP.

The dose associated with a particular risk level can be spread out over a longer or shorter time period. Derived intervention levels (DILs) can be calculated for any age group by dividing the radionuclide intake over a given time period (e.g., 90 days) by the appropriate volume of water ingested over that time period, as specified in the EPA Exposure Factors Handbook.

DRAFT

To: jtbushberg@ucdavis.edu[jtbushberg@ucdavis.edu]
Cc: Christ, Lisa[Christ.Lisa@epa.gov]; Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: DeCair, Sara
Sent: Wed 10/26/2016 9:44:53 PM
Subject: Help answer SDWA questions for DW PAG conversation
US-Intl Compilation 5-25-2012.docx

Good to talk to you today, Jerry. I've attached the comparison table for international and US PAG-type guides, for messaging purposes.

Sam or Lisa, could you give Jerry a call to help him with how long water systems have to get back into compliance under normal circumstances if the MCL(s) are exceeded? I think the guidance links in our proposal have that info, but I hesitated to guess. His phone number is 916-734-5620. He is interested as a colleague in the radiation protection field. Thanks!

Sara D. DeCair

202-343-9108

Room 1416 B in WJC West

www.epa.gov/radiation/protective-action-guides-pags

To: Christ, Lisa[Christ.Lisa@epa.gov]
Cc: Veal, Lee[Veal.Lee@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
From: DeCair, Sara
Sent: Thur 10/13/2016 7:58:24 PM
Subject: PAG Manual/Water at and soon to at OMB: status update

Lisa, thanks for your message. Good to hear that OP says they only need a week with the DW piece, so we hope it'll get to OMB by Tuesday or so next week.

We've continued to go back and forth with steadily smaller and smaller edits on the full Manual, and just handed back to OMB what we hope to be the very last set of tweaks for them to clear the Manual by tomorrow, possibly! One wild card is a FEMA/NRC disagreement about a single word that has cropped up just recently, so it's still not a sure thing.

Do keep us up to date as these process pathways very much influence each other. I'm traveling next week but will be attached to email constantly, and I'll be rooting for us to make good progress. Thanks!

Sara D. DeCair

202-343-9108

Room 1416 B in WJC West

www.epa.gov/radiation/protective-action-guides-pags

For Electronic Submission:
Federal eRulemaking Portal: http://www.regulations.gov
Docket ID No. EPA-HQ-OAR-2007-0268

RE: Opportunity to Comment on the Draft Protective Action Guide for Drinking Water after a Radiological Incident

The Illinois Emergency Management Agency (IEMA) has reviewed the Draft Drinking Water Protective Action Guide (PAG). IEMA believes that the changes represent a positive step in the protection of our citizens who could be affected by a radiological incident. While we initially supported an approach consistent with the Protective Action Guide for ingestion of food, we favor the approach taken to base the PAG on the established food threshold and extend an additional protective guide value for more-sensitive populations.

IEMA appreciates the efforts of the EPA to provide clear and technically sound guidance in implementing the new drinking water PAG. In particular, we feel that providing a quick screening tool using Strontium, Cesium and Iodine to determine a default DRL for drinking water concentrations is a useful technique. IEMA also agrees that the technical basis used for determining water PAGs is technically sound and conservative.

The Agency appreciates the opportunity to comment on this important document. If you have any questions, please feel free to contact Jason Fields at (217) 524-8961 or via e-mail at jason.fields@illinois.gov.

Sincerely,

Joseph G. Klinger
Assistant Director

To: Grevatt, Peter[Grevatt.Peter@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Greene, Ashley[Greene.Ashley@epa.gov]
From: Christ, Lisa
Sent: Fri 4/15/2016 4:45:22 PM
Subject: PAG response to OMB comments
DRAFT Resonse to Comment Proposed Drinking Water PAG 4-15-16.docx

Peter –

Attached is the draft response to comment document. Included is the qualitative analysis we prepared with input from AI. We have not checked in with him on this latest version, but it includes additional detail he suggested. I have not yet reviewed this part, but will do so today. Let me know if you have any questions or concerns.

Lisa

To: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]
From: Christ, Lisa
Sent: Mon 4/11/2016 2:11:33 PM
Subject: FW: PAG summary of OMB comments for Joel
Beauvais DW PAG Interagency Comments 4-11-16.docx

FYI – waiting for comments from Peter.

Please finalize the response to comment document with a placeholder for the responses in this attachment. Also, send me the revised proposal so I can start my review and get it to Peter asap. I'm waiting for Al to provide comments on the qualitative analysis.

Thanks-

Lisa

From: Christ, Lisa
Sent: Monday, April 11, 2016 8:13 AM
To: Greene, Ashley <Greene.Ashley@epa.gov>
Subject: PAG summary of OMB comments for Joel

Hi Ashley,

Attached is the revised summary of PAG comments based on input from Peter. I assume Peter will want to review before this goes to Joel?

Thanks-

Lisa

10 GROUP G: FOOD CONSUMPTION

10.1 INTRODUCTION

Four subgroups of operational guidelines for food are presented here. These guidelines complement and supplement the DILs published by the FDA (FDA 1998). The first subgroup of guidelines is in terms of limiting concentration in food, which is similar to the FDA DILs, but includes additional radionuclides and utilizes updated dose conversion factors. The other three subgroups of operational guidelines are expressed as limiting concentrations in surface soil. They were developed by considering consumption of crops (vegetables, fruits, and grains) and animal products (meat and milk) that are linked to contaminated soils through uptake pathways. The ingestion of crops and animal products from affected areas would not result in radiation doses that exceed the corresponding PAGs, if their concentrations or the soil concentrations in which they grow are below the Group G operational guidelines.

The first subgroup of operational guidelines was derived by using a methodology consistent with the one used by the FDA for developing the DILs for foods after a nuclear accident (FDA 1998). It considers potential radiation exposure from food ingestion and is based on a food PAG of either 5,000 mrem/yr committed equivalent dose to an individual organ or tissue, or 500 mrem/yr committed effective dose (CED), whichever is more limiting. Age-dependent food ingestion rates and ICRP 72 (ICRP 1996) dose conversion factors were used in the derivation. The final operational guidelines were expressed in terms of food concentrations and were the most conservative values among the different age groups considered. To differentiate from the published FDA DILs, the derived food concentration values that use the FDA methodology are called planning values (PVs). These PVs are used as Group G, Subgroup 1, operational guidelines. These PVs could be used as an alternative to FDA DILs in the early phase of response after an RDD event.

In deriving the Group G, Subgroups 2 and 3, operational guidelines, the PVs for Subgroup 1 were applied for comparison with calculated concentrations in crops harvested or animal products produced after an RDD event. The operational guidelines of Subgroup 2 were developed by considering crops or fodder that had been growing during the event and became contaminated as a result of a passing contamination plume from the event. The methodology developed by FRMAC (Rhodes et al. 2003) was used to relate the plant/fodder concentration to

the deposited concentration on the ground surface. The operational guidelines are the concentrations in surface soil that would result in plant/milk concentrations equivalent to the PVs of Subgroup 1. Subgroup 2 soil operational guidelines supplement the PVs and are also intended for use in the early phase of response when measured concentrations of crops or animal products are not readily available.

Subgroup 3 soil operational guidelines consider crops planted after an RDD event that are intended for use in the intermediate phase of response after the event. Deposited soil and air concentrations, which were caused by resuspension from soil, were adjusted for weathering and radiological decay during the plant growing period. The RESRAD methodology (Yu et al. 2001) that accounts for foliar deposition and root uptake was used to calculate plant-to-soil concentration ratios, which were then used to back-calculate the soil operational guidelines.

Subgroup 4 soil operational guidelines also were developed by using the RESRAD methodology, except that they are based on a PAG of 500 mrem/yr (CED) rather than the PVs. To obtain the average concentrations in crops and animal products that are consumed over a year, the deposited soil and air concentrations were corrected for weathering and radiological decay over a 1-year period. The ingestion dose-to-source ratios were calculated and then were used to back-calculate the soil operational guidelines. The Subgroup 4 operational guidelines are dose (CED) based rather than PV based. They can be used for estimating the potential radiation doses that correspond to the Subgroup 3 soil operational guidelines. The Subgroup 4 operational guidelines are intended for use in the intermediate-to-late phase of response after an RDD event.

For Subgroups 2 to 4 operational guidelines, different types of plants (fodder, leafy vegetable, and grain and nonleafy vegetable) that link to the production of different types of food (meat, milk, and vegetables) were modeled. The most limiting food-to-soil concentration ratio (for Subgroups 2 and 3) or the sum of dose-to-source ratios (for Subgroup 4) was used to determine the final soil guideline.

It is important to note that Group G soil operational guidelines (Subgroups 2, 3, and 4) were developed by considering radiation exposure only through the food ingestion pathway. They can be used to determine whether ingestion of agricultural products (plant foods, meat, and milk) that are exposed to the contamination plume during an RDD event (Subgroup 2) or that will be cultivated and produced after an RDD event (Subgroups 3 and 4) would result in unacceptable human health risks. Because radiation exposure that would result from cultivating crops or raising livestock was not considered, Group G soil operational guidelines should not be

used to replace Group B operational guidelines for evacuation/sheltering or Group C operational guidelines for relocation. They can, however, be used in conjunction with the Group B or Group C operational guidelines to determine whether restriction on food ingestion or agricultural activities should be imposed on a contaminated area where residents are allowed to stay after an RDD event.

Comparisons of operational guidelines for the four subgroups in terms of their applications and derivations are presented in Appendix 10.A.

10.2 SUBGROUP 1 FOOD OPERATIONAL GUIDELINES FOR THE EARLY PHASE

For Subgroup 1, the derived food concentration PVs are used as operational guidelines. The derivation of PVs was based on the methodology used by the FDA for developing the DILs after a nuclear accident (FDA 1998). The PVs are not the same as the DILs, because updated dose conversion factors were used.

The FDA DIL for a specific radionuclide was calculated by using Equations 10.1–10.3:

$$DIL = \frac{PAG}{f \times FI \times DC} \tag{10.1}$$

$$FI = Annual\,Intake\,Rate \times IPC \tag{10.2}$$

$$IPC = \min\left[1 \;\; or \;\; -\frac{Ln(0.01)}{\lambda}\right] \tag{10.3}$$

where:

DIL = derived intervention levels (Bq/kg);

DC = dose coefficient, the radiation dose received per unit of radioactivity ingested (mSv/Bq);

f = fraction of the food ingested assumed to be contaminated;

IPC = ingestion period correction (yr);

λ = radionuclide decay constant (yr^{-1});

FI = food intake (kg); and

PAG = protective action guide for food ingestion (mSv).

Two PAGs were used in the calculation: 500 mrem (5 mSv) for CEDE, and 5 rem (50 mSv) for committed dose equivalent to an individual tissue or organ. The FDA DILs were calculated for nine radionuclides (I-131, Cs-134, Cs-137, Ru-103, Ru-106, Sr-90, Pu-238, Pu-239, and Am-241) and considered the receptors of six different age groups. In the calculation, age-dependent food ingestion rates and dose coefficients were used. The age groups considered were 3 months, 1 year, 5 years, 10 years, 15 years, and adult (>17 years).

The dose coefficients used by the FDA were from the International Commission on Radiation Protection (ICRP) Publication 56 (ICRP 1989). The food ingestion rates were based on the "entire diet" for each age group, which included tap water used for drinking. In deriving DILs, it was assumed that 30% of the food intake was contaminated (i.e., $f = 0.3$ in Equation 10.1). An exception was made for I-131 in the diets of the 3-month and 1-year age groups, for which the entire intake over a 60-day period was assumed to be contaminated. Table 10.1 provides the annual intake rates for the six age groups considered in deriving DILs. In the derivation of DILs, correction for radiological decay was not applied. However, the intake period was selected to be either 1 year or the time required for a radionuclide to decay to ~1% of its initial activity, whichever is smaller. As a result, for short-lived radionuclides, the intake period considered could be less than 1 year, and the yearly intake rate would be adjusted by the intake period correction factor (IPC in Equation 10.2). None of the radionuclides concerned for an RDD event in this report has a half-life short enough to require this correction. Appendix D in the FDA report (FDA 1998) describes in detail how DILs were calculated and lists the values of dose coefficients used. Among all the DILs that were calculated, combining different PAGs and age groups, the most limiting one was selected by FDA to be the recommended value for use after a nuclear accident.

TABLE 10.1 Dietary Intake Rates for Different Age Groups

Age Group	Annual Intake Rate (kg)
3-months	418
1-year	506
5-years	660
10-years	779
15-years	869
Adult	943

Later, the FDA calculated DILs for 15 more

radionuclides by using the same equations. Among all the radionuclides considered by the FDA (FDA 1998), six are among the RDD radionuclide list analyzed in this report. Table 10.2 lists the FDA DILs for those six radionuclides.

In deriving the DILs, the FDA followed the principles and general guidance provided by the ICRP Publication 40 (ICRP 1984). The ICRP has since updated its general concepts on intervention and has documented them in ICRP Publication 63 (ICRP 1991). The PVs for Subgroup 1 were calculated on the basis of the FDA methodology described previously, but with the updated concept (ICRP 1991) and revised dose coefficients obtained from ICRP Publication 72 (ICRP 1996). The dietary intake rates used for different age groups were the same as those listed in Table 10.1. Table 10.3 lists the dose coefficients from ICRP 72. Table 10.4 lists the calculated PVs for different age groups and different PAGs. The most restrictive value was selected to be the final operational guideline for Subgroup 1. The values are listed in Table 10.5, along with the corresponding age group and PAG. Measured radionuclide concentrations in crops or animal products produced from the affected area after an RDD event should be compared with the Subgroup 1 operational guidelines.

10.3 SUBGROUP 2 SOIL OPERATIONAL GUIDELINES FOR THE EARLY PHASE

Subgroup 2 soil operational guidelines were intended for use in the early phase of response after an RDD event. For this purpose, they consider the crops that have been growing during the event. As for the animal products, they consider those from livestock that fed on fodders grown in the field during the event. Because the crops or fodders are already growing during the event, the main contamination mechanism would be the uptake of radionuclides that

TABLE 10.2 FDA DILs with Corresponding PAG and Age Group for RDD Radionuclides

Radionuclide	DIL (Bq/kg)	Limiting Age Group	PAG (mSv)
Am-241	2	3-month	50
Cm-244	2	3-month	50
Cs-137	1,400	Adult	5
Pu-238	2	3-month	50
Pu-239	2	3-month	50
Sr-90	160	15-year	50

TABLE 10.3 Dose Coefficients (mSv/Bq)a from ICRP Publication 72 Used in Deriving the PVs for Food Operational Guidelines for the Early Phase (Subgroup 1)

Radionuclide	3-month	1-year	5-year	10-year	15-year	Adult
Am-241(BS)b	8.30E-02	8.30E-03	7.40E-03	7.30E-03	8.00E-03	9.00E-03
Am-241	3.70E-03	3.70E-04	2.70E-04	2.20E-04	2.00E-04	2.00E-04
Cf-252(BS)	0.11	9.90E-03	6.90E-03	4.00E-03	2.90E-03	2.90E-03
Cf-252	5.00E-03	5.10E-04	3.20E-04	1.90E-04	1.00E-04	9.00E-05
Cm-244(BS)	5.90E-02	5.80E-03	4.50E-03	3.90E-03	4.20E-03	4.90E-03
Cm-244	2.90E-03	2.90E-04	1.90E-04	1.40E-04	1.20E-04	1.20E-04
Co-60(LLI)b	9.9E-5(L)b	6.30E-05	3.70E-05	2.40E-05	1.5E-5(L)b	1.20E-05
Co-60	5.40E-05	2.70E-05	1.70E-05	1.10E-05	7.90E-06	3.40E-06
Cs-137(LLI)	4.90E-05	3.10E-05	1.90E-05	1.60E-05	1.60E-05	1.70E-05
Cs-137	2.10E-05	1.20E-05	9.60E-06	1.00E-05	1.30E-05	1.30E-05
Ir-192 (LLI)	1.40E-04	8.90E-05	4.60E-05	2.80E-05	1.60E-05	1.30E-05
Ir-192	1.30E-05	8.70E-06	4.60E-06	2.80E-06	1.70E-06	1.40E-06
Po-210 (Spleen)	2.20E-01	7.60E-02	4.10E-02	2.50E-02	1.60E-02	1.3E-02(K)b
Po-210	2.60E-02	8.80E-03	4.40E-03	2.60E-03	1.60E-03	1.20E-03
Pu-238(BS)	6.80E-02	6.90E-03	6.20E-03	5.90E-03	6.30E-03	7.40E-03
Pu-238	4.00E-03	4.00E-04	3.10E-04	2.40E-04	2.20E-04	2.30E-04
Pu-239(BS)	7.40E-02	7.60E-03	7.00E-03	6.80E-03	7.20E-03	8.20E-03
Pu-239	4.20E-03	4.20E-04	3.30E-04	2.70E-04	2.40E-04	2.50E-04
Ra-226(BS)	1.60E-01	2.90E-02	2.30E-02	3.90E-02	9.40E-02	1.20E-02
Ra-226	4.70E-03	9.60E-04	6.20E-04	8.00E-04	1.50E-03	2.80E-04
Sr-90(BS)	2.30E-03	7.30E-04	6.30E-04	1.00E-03	1.80E-03	4.10E-04
Sr-90	2.30E-04	7.30E-05	4.70E-05	6.00E-05	8.00E-05	2.80E-05

a The first listed value for each radionuclide is the most restrictive committed equivalent dose to an individual organ or tissue, $h_T(\tau)$. The second listed value for each radionuclide is the committed effective dose, $e(\tau)$. (τ is the time period over which the dose is calculated; that is, 50 years for adults and $(70-t_0)$ for children, where t_0 is the age considered for the age group.)

b BS = bone surface; LLI = lower large intestine; L = liver; K = kidney.

TABLE 10.4 PVsa (Bq/kg) for Different Age Groups and PAGs

Radionuclide	PAGs (mSv/yr)	3-month	1-year	5-year	10-year	15-year	Adult
Am-241(BS)[b]	50	4.8E+00	4.0E+01	3.4E+01	2.9E+01	2.4E+01	2.0E+01
Am-241	5	1.1E+01	8.9E+01	9.4E+01	9.7E+01	9.6E+01	8.8E+01
Cf-252(BS)	50	3.6E+00	3.3E+01	3.7E+01	5.3E+01	6.6E+01	6.1E+01
Cf-252	5	8.0E+00	6.5E+01	7.9E+01	1.1E+02	1.9E+02	2.0E+02
Cm-244(BS)	50	6.8E+00	5.7E+01	5.6E+01	5.5E+01	4.6E+01	3.6E+01
Cm-244	5	1.4E+01	1.1E+02	1.3E+02	1.5E+02	1.6E+02	1.5E+02
Co-60(LLI)[b]	50	4.0E+03	5.2E+03	6.8E+03	8.9E+03	1.3E+04	1.5E+04
Co-60	5	7.4E+02	1.2E+03	1.5E+03	1.9E+03	2.4E+03	5.2E+03
Cs-137(LLI)	50	8.1E+03	1.1E+04	1.3E+04	1.3E+04	1.2E+04	1.0E+04
Cs-137	5	1.9E+03	2.7E+03	2.6E+03	2.1E+03	1.5E+03	1.4E+03
Ir-192 (LLI)	50	2.8E+03	3.7E+03	5.5E+03	7.6E+03	1.2E+04	1.4E+04
Ir-192	5	3.1E+03	3.8E+03	5.5E+03	7.6E+03	1.1E+04	1.3E+04
Po-210 (Spleen)	50	1.8E+00	4.3E+00	6.2E+00	8.6E+00	1.2E+01	1.4E+01
Po-210	5	1.5E+00	3.7E+00	5.7E+00	8.2E+00	1.2E+01	1.5E+01
Pu-238(BS)	50	5.9E+00	4.8E+01	4.1E+01	3.6E+01	3.0E+01	2.4E+01
Pu-238	5	1.0E+01	8.2E+01	8.1E+01	8.9E+01	8.7E+01	7.7E+01
Pu-239(BS)	50	5.4E+00	4.3E+01	3.6E+01	3.1E+01	2.7E+01	2.2E+01
Pu-239	5	9.5E+00	7.8E+01	7.7E+01	7.9E+01	8.0E+01	7.1E+01
Ra-226(BS)	50	2.5E+00	1.1E+01	1.1E+01	5.5E+00	2.0E+00	1.5E+01
Ra-226	5	8.5E+00	3.4E+01	4.1E+01	2.7E+01	1.3E+01	6.3E+01
Sr-90(BS)	50	1.7E+02	4.5E+02	4.0E+02	2.1E+02	1.1E+02	4.3E+02
Sr-90	5	1.7E+02	4.5E+02	5.4E+02	3.6E+02	2.4E+02	6.3E+02

a The PVs are based on a PAG of either 50 mSv/yr committed equivalent dose to an individual organ or tissue (first listed value) or 5 mSv/yr committed effective dose (the second listed value).

b BS = bone surface; LLI = lower large intestine.

TABLE 10.5 Final Food Operational Guidelines (or PVs) for the Early Phase (Subgroup 1)

Radionuclide	Operational Guideline (PVs)		Age Group	PAG (mSv)
	Bq/kg	pCi/kg		
Am-241	4.8E+00	1.30E+02	3-month	50
Cf-252	3.6E+00	9.72E+01	3-month	50
Cm-244	6.8E+00	1.84E+02	3-month	50
Co-60	7.4E+02	2.00E+04	3-month	5
Cs-137	1.4E+03	3.78E+04	Adult	5
Ir-192	2.8E+03	7.56E+04	3-month	50
Po-210	1.5E+00	4.05E+01	3-month	5
Pu-238	5.9E+00	1.59E+02	3-month	50
Pu-239	5.4E+00	1.46E+02	3-month	50
Ra-226	2.0E+00	5.40E+01	15 year	50
Sr-90	1.1E+02	2.97E+03	15 year	50

were directly deposited on foliage from a contamination plume that passed the agriculture field. The potential contamination mechanism caused by root uptake of radionuclides deposited on surface soil would be much less because (1) it takes time for radionuclides to infiltrate to deeper soil, and the plants would be harvested or consumed before that occurs; and (2) the radionuclide concentration in the root zone would be greatly diluted by the bulk volume of soil. Although the root uptake mechanism would not contribute significantly to plant contamination during the plume phase, it was included in the modeling for completeness.

For the early phase of response (Subgroup 2), modeling of plant concentration was performed by using the FRMAC methodology (Rhodes et al. 2003). The crops considered for human consumption were leafy vegetables that were assumed to have a growing period of 0.2 year and a productivity of 2 kg/m2. Both are RESRAD default values (Yu et al. 2001). The radionuclide concentrations that were intercepted and retained on the foliage of crops during the plume phase were assumed to be 20% of those deposited on surface soil. This 20% value is the default used by FRMAC (Rhodes et al. 2003). The animal product considered for human consumption was milk. Contamination of meat products was not considered because it was not included in the FRMAC methodology. The growing period of fodder grazed by milk cows was assumed to be 0.08 year and the productivity to be 0.7 kg/m2. Both are RESRAD default values (Yu et al. 2001). The radionuclide concentrations directly deposited on the fodder were 50% of those deposited on surface soil, which was the default value used by FRMAC (Rhodes et al.

2003), and all fodder consumed by milk cows was assumed contaminated. The root uptake transfer factors and food-to-milk transfer factors used in the modeling were the default values used by FRMAC (Rhodes et al. 2003), and these are listed in Table 10.6. Note that the plant/soil transfer factors for root uptake used by FRMAC are taken from the RESRAD database (Yu et al. 2001).

Table 10.7 lists the calculated food-to-soil concentration ratios and soil operational guidelines corresponding to the PVs listed in Table 10.5. The calculated milk concentration was converted from pCi/L to pCi/kg by using an assumed milk density of 1 kg/L. For the plant concentration, washing or rinsing vegetables to remove radionuclides deposited on leaves was not considered. For each radionuclide, two operational guidelines were calculated on the basis of crop and milk consumption. The more conservative value from these two (the smaller one) was selected for use in the early response phase after an RDD event. For all radionuclides except Cs-137, the final operational guidelines were derived on the basis of leafy vegetable consumption. For Cs-137, the final operational guideline was derived on the basis of milk consumption because of the large fodder-to-milk transfer factor (0.0079 d/L) for Cs.

TABLE 10.6 Transfer Factors Used by the FRMAC and RESRAD Methodologies

	FRMAC Methodology		RESRAD Methodology		
Radionuclide	Plant/Soil Transfer Factor for Root Uptake	Milk Transfer Factor (d/L)	Plant/Soil Transfer Factor for Root Uptake	Meat Transfer Factor (d/kg)	Milk Transfer Factor (d/L)
Am-241	1.0E-03	1.5E-06	1.0E-03	5.0E-05	2.0E-06
Cf-252	1.0E-03	2.0E-06	1.0E-03	6.0E-05	7.5E-07
Cm-244	1.0E-03	2.0E-06	1.0E-03	2.0E-05	2.0E-06
Co-60	8.0E-02	2.0E-03	8.0E-02	2.0E-02	2.0E-03
Cs-137	4.0E-02	7.9E-03	4.0E-02	3.0E-02	8.0E-03
Ir-192	3.0E-02	2.0E-06	3.0E-02	2.0E-03	2.0E-06
Po-210	1.0E-03	3.4E-04	1.0E-03	5.0E-03	3.4E-04
Pu-238	1.0E-03	1.1E-06	1.0E-03	1.0E-04	1.0E-06
Pu-239	1.0E-03	1.1E-06	1.0E-03	1.0E-04	1.0E-06
Ra-226	4.0E-02	1.3E-03	4.0E-02	1.0E-03	1.0E-03
Sr-90	3.0E-01	2.8E-03	3.0E-01	8.0E-03	2.0E-03

TABLE 10.7 Subgroup 2 Soil Operational Guidelines for the Early Phase of Response after an RDD Incident

	Food/Soil Concentration Ratio [(pCi/kg)/(pCi/m2)]		Operational Guideline for Individual Food Category (pCi/m2)		Final Soil Operational Guideline (pCi/m2)
Radionuclide	Vegetable	Milk	Vegetable	Milk	
Am-241	1.00E-01	5.36E-05	1.30E+03	2.42E+06	1.30E+03
Cf-252	9.99E-02	7.13E-05	9.73E+02	1.36E+06	9.73E+02
Cm-244	1.00E-01	7.14E-05	1.84E+03	2.57E+06	1.84E+03
Co-60	1.00E-01	7.14E-02	2.00E+05	2.80E+05	2.00E+05
Cs-137	1.00E-01	2.82E-01	3.78E+05	1.34E+05	1.34E+05
Ir-192	9.91E-02	7.01E-05	7.63E+05	1.08E+09	7.63E+05
Po-210	9.95E-02	1.20E-02	4.07E+02	3.37E+03	4.07E+02
Pu-238	1.00E-01	3.93E-05	1.59E+03	4.06E+06	1.59E+03
Pu-239	1.00E-01	3.93E-05	1.46E+03	3.71E+06	1.46E+03
Ra-226	1.00E-01	4.64E-02	5.40E+02	1.16E+03	5.40E+02
Sr-90	1.00E-01	1.00E-01	2.97E+04	2.97E+04	2.97E+04

10.4 SUBGROUP 3 SOIL OPERATIONAL GUIDELINES FOR THE INTERMEDIATE PHASE

Subgroup 3 operational guidelines were intended for use in the intermediate phase of response after an RDD event. They consider crops or fodders that grow after the passage of the contamination plume. Plants become contaminated as a result of foliage deposition of airborne radionuclides that originate from the ground surface through resuspension. In addition to foliage deposition, radionuclides that infiltrate from the ground surface to deeper soils could also be taken up by root systems and transferred to plant tissues. Modeling of plant concentrations was performed by using the RESRAD methodology (Yu et al. 2001), because the consideration of direct plume deposition by the FRMAC methodology does not apply to the plants grown after the plume phase.

Two types of crops were modeled: (1) leafy vegetables and (2) grain and nonleafy vegetables. For animal products, meat and milk produced by livestock feeding on fodders grown after the plume phase were considered. The Subgroup 3 soil operational guidelines were derived in terms of the concentrations of radionuclide deposited surface soil that would result in the production of crops or animal products with contamination levels equivalent to the PVs (i.e., Subgroup 1 operational guidelines). In the modeling, average soil and air concentrations

over the growing periods of vegetables and fodders were used to calculate the respective plant concentrations. The use of average plant concentrations accounts for the decrease with time due to radiological decay and weathering. The methodology for calculating the average soil and air concentrations is consistent with that used in the operational guidelines for Groups B–E, which is described in Chapter 2.

The other assumptions used in the modeling include the following:

1. The growing period for leafy vegetables is 0.25 year, 0.17 year for grain and nonleafy vegetables, and 0.08 year for fodder.

2. The ingestion rate of fodder by meat cows is 68 kg/d and 55 kg/d by milk cows.

3. The ingestion rate of soil by meat and milk cows is 0.5 kg/d.

4. The storage times for grain and nonleafy vegetables, leafy vegetables, meat, and milk are 14, 1, 20, and 1 day, respectively.

5. The depth of soil mixing layer is the plow depth of 0.15 m.

6. The depth of roots is the same as the plow depth, 0.15 m.

7. The soil density is 1.5 g/cm3.

The root uptake transfer factors and fodder-to-meat and -milk transfer factors are listed in Table 10.6. Except for the depth of roots, all parameter values used in the modeling are RESRAD default values. The depth of roots is taken from FRMAC (Rhodes et al. 2003).

Table 10.8 lists the Subgroup 3 soil operational guidelines for different food categories. The food category that resulted in the minimum soil concentration was selected to be the final soil guideline value. For most of the radionuclides, except for Co-60, Cs-137, and Po-210, the final guidelines were determined by consumption of leafy vegetables. For Co-60, Cs-137, and Po-210, the final guidelines were determined by consumption of meat products.

TABLE 10.8 Subgroup 3 Soil Operational Guidelines for the Intermediate Phase of Response after an RDD Incident

ED_001057_00007754

Radionuclide	Food/Soil Concentration Ratio [(pCi/kg)/(pCi/m2)]				Soil Operational Guideline for Individual Food Category (pCi/m2)				Final Soil Operational Guideline (pCi/m2)
	Nonleafy Vegetable	Leafy Vegetable	Meat	Milk	Nonleafy Vegetable	Leafy Vegetable	Meat	Milk	
Am-241	8.84E-06	2.00E-05	2.70E-07	9.59E-09	1.47E+07	6.49E+06	4.79E+08	1.35E+10	6.49E+06
Cf-252	8.62E-06	1.96E-05	3.18E-07	3.57E-09	1.13E+07	4.95E+06	3.06E+08	2.72E+10	4.95E+06
Cm-244	8.81E-06	1.99E-05	1.08E-07	9.58E-09	2.08E+07	9.21E+06	1.70E+09	1.92E+10	9.21E+06
Co-60	3.48E-04	3.56E-04	5.75E-04	4.76E-05	5.74E+07	5.61E+07	3.48E+07	4.20E+08	3.48E+07
Cs-137	1.79E-04	1.88E-04	5.12E-04	1.14E-04	2.12E+08	2.01E+08	7.39E+07	3.32E+08	7.39E+07
Ir-192	9.10E-05	1.00E-04	2.09E-05	2.08E-08	8.31E+08	7.53E+08	3.62E+09	3.63E+12	7.53E+08
Po-210	7.44E-06	1.79E-05	2.33E-05	1.54E-06	5.44E+06	2.26E+06	1.74E+06	2.63E+07	1.74E+06
Pu-238	8.83E-06	2.00E-05	5.41E-07	4.80E-09	1.80E+07	7.98E+06	2.95E+08	3.32E+10	7.98E+06
Pu-239	8.84E-06	2.00E-05	5.41E-07	4.80E-09	1.65E+07	7.30E+06	2.69E+08	3.04E+10	7.30E+06
Ra-226	1.79E-04	1.89E-04	1.71E-05	1.42E-05	3.02E+05	2.86E+05	3.16E+06	3.79E+06	2.86E+05
Sr-90	1.31E-03	1.31E-03	7.58E-04	1.54E-04	2.27E+06	2.27E+06	3.92E+06	1.92E+07	2.27E+06

10.5 SUBGROUP 4 SOIL OPERATIONAL GUIDELINES FOR THE INTERMEDIATE-TO-LATE PHASE

Subgroup 4 soil operational guidelines were developed on the basis of a PAG of 500 mrem/yr, rather than the PVs of Subgroup 1. They can be used for estimating the potential radiation doses that correspond to the Subgroup 3 soil operational guidelines and are intended for use during the intermediate-to-late phases of response after an RDD event. Like Subgroup 3 operational guidelines, they consider crops or fodders that grow in a contaminated area after an RDD event. The methodology used to calculate the concentrations in crops and fodder was consistent with that used in Subgroup 3, except that the soil and air concentrations were corrected for weathering and radiological decay for a 1-year period. This was done to calculate the average concentrations in food products that were assumed to be produced continuously throughout a year for consumption. The total radioactivity ingested within a year was calculated by multiplying the average concentrations in food products by the annual consumption rate of the products. The annual

ingestion of radioactivity was then converted to annual dose with the use of dose conversion factors.

An average adult was considered as the general receptor and was assumed to ingest 160 kg/yr of grain and nonleafy vegetables, 14 kg/yr of leafy vegetables, 92 L/yr of milk, and 63 kg/yr of meat. Among all food ingested, 30% was assumed to be contaminated, which was also the assumption used by the FDA when deriving the DILs. These consumption rates are consistent with RESRAD default values. Dose conversion factors were obtained from ICRP 72 (ICRP 1996). The derived soil operational guidelines for different food categories for Subgroup 4 are listed in Table 10.9. They are the surface soil concentrations that would produce contaminated crops and animal products through uptake pathways that, after consumption, individually would result in a radiation dose of 500 mrem/yr (CED).

The final soil operational guidelines were obtained by considering consumption of all the different types of food are produced from the same contaminated area. In reality, because of the limitation in size or location of the contaminated area, the agricultural activities may be limited to produce only a certain type, or types, of food. In that case, the final soil operational guidelines can be increased to reflect the real situations. The last column of Table 10.9 shows the soil operational guidelines that pertain to consumption of only leafy and nonleafy vegetables.

BLE 10.9 Subgroup 4 Soil Operational Guidelines for the Intermediate-to-Late Phase of Response after an RDD Incident

	Annual Dose/Soil Concentration Ratio ([mrem/yr)/(pCi/m2])				Soil Operational Guidelines for Individual Food Category (pCi/m2)				Final Soil Operational Guideline (all foods combined) (pCi/m2)	Soil Operation Guideline (lea and nonleafy vegetables combined) (pCi/
ionuclides	Nonleafy Vegetable	Leafy Vegetable	Meat	Milk	Nonleafy Vegetable	Leafy Vegetable	Meat	Milk		
-241	1.78E-07	2.74E-08	1.85E-09	1.03E-10	2.80E+09	1.82E+10	2.71E+11	4.86E+12	2.41E+09	2.43E+09
52	7.15E-08	1.15E-08	8.80E-10	1.55E-11	6.99E+09	4.37E+10	5.68E+11	3.23E+13	5.96E+09	6.03E+09
244	1.79E-07	1.63E-08	4.35E-10	6.07E-11	2.79E+09	3.07E+10	1.15E+12	8.23E+12	2.55E+09	2.56E+09
60	1.82E-07	1.62E-08	1.08E-07	1.30E-08	2.75E+09	3.09E+10	4.65E+09	3.83E+10	1.57E+09	2.52E+09
37	3.69E-07	3.31E-08	3.58E-07	1.17E-07	1.35E+09	1.51E+10	1.39E+09	4.27E+09	5.70E+08	1.24E+09
92	7.98E-09	8.49E-10	5.37E-10	7.88E-13	6.26E+10	5.89E+11	9.31E+11	6.35E+14	5.34E+10	5.66E+10
210	5.42E-07	1.09E-07	5.22E-07	5.36E-08	9.22E+08	4.58E+09	9.58E+08	9.32E+09	4.07E+08	7.67E+08
238	2.04E-07	3.15E-08	4.23E-09	5.90E-11	2.45E+09	1.59E+10	1.18E+11	8.47E+12	2.08E+09	2.12E+09
239	2.23E-07	3.43E-08	4.62E-09	6.44E-11	2.24E+09	1.46E+10	1.08E+11	7.77E+12	1.91E+09	1.94E+09
226	8.05E-06	7.21E-07	2.61E-07	3.19E-07	6.21E+07	6.93E+08	1.92E+09	1.57E+09	5.35E+07	5.70E+07
0	6.50E-06	5.71E-07	1.43E-06	4.25E-07	7.69E+07	8.75E+08	3.49E+08	1.18E+09	5.60E+07	7.07E+07

10.6 REFERENCES

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APPENDIX 10.A:

COMPARISON OF OPERATIONAL GUIDELINES FOR GROUP G

APPENDIX 10.A:

COMPARISON OF OPERATIONAL GUIDELINES FOR GROUP G

Comparisons of operational guidelines among the four subgroups are presented in this appendix. Table 10.A.1 compares the intended applications and the methodology used in the guideline derivation. Table 10.A.2 compares the parameter values used in the derivation.

TABLE 10.A.1 Comparison of Intended Uses and Derivation of Operational Guidelines for Subgroups 1–4

Parameters	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Expression form	In terms of limiting concentrations in food (pCi/kg)	In terms of limiting concentrations in surface soil (pCi/m2)	In terms of limiting concentrations in surface soil (pCi/m2)	In terms of limiting concentrations in surface soil (pCi/m2)
PAG	5,000 mrem/yr committed equivalent dose to an individual organ or 500 mrem/yr CED	Not required – use PVs (operational guidelines for Subgroup 1) as target food concentrations	Not required – use PVs (operational guidelines for Subgroup 1) as target food concentrations	500 mrem/yr CED
Intended uses	For placing embargo and consumption restriction on plant food or animal products that are exposed during an RDD event	For placing embargo and consumption restriction on plant food or animal products that are exposed during an RDD event	For placing land use restriction for agricultural activities after an RDD event	For (1) evaluating potential radiation doses corresponding to Subgroup 3 operational guidelines, and (2) placing land use restriction for agricultural activities after an RDD event
When to apply	In the early phase of response	In the early phase of response	In the intermediate phase of response	In the intermediate-to-late phase of response
How to apply	Compare with measured concentrations taken from food that was exposed during an RDD event	Compare with measured concentrations taken from surface soil in which plant foods/fodder were growing during an RDD event	Compare with measured concentrations taken from surface soil in the contaminated area	Compare with measured concentrations taken from surface soil in the contaminated area
Methodology	Based on FDA methodology for deriving DILs, but with updated dose coefficients	Used FRMAC methodology to relate concentrations in plant food/milk to the deposited surface soil concentration during the plume phase	Used RESRAD model to relate concentrations in plant food/meat/milk to the residual surface soil concentration; soil and air concentrations were corrected for weathering and radiological decay during the growing period	Used RESRAD model to relate the potential annual ingestion dose to the residual surface soil concentration, through the calculation of average concentrations in plant food/meat/milk; soil and air concentrations were corrected for weathering and radiological decay for 1-year period
Specific consideration/ comments	Different age groups and the respective dose coefficients	Foliar deposition results from a passing plume	Foliar deposition results from airborne contaminants that originate from ground surface due to resuspension	Same as Subgroup 3

TABLE 10.A.2 Comparison of Parameter Values Used in the Derivation of Operational Guidelines for Subgroups 1–4

Parameters	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Contaminated food types	All food types, including water	Leafy vegetables and milk	Grain and nonleafy vegetables, leafy vegetables, meat, and milk	Grain and nonleafy vegetables, leafy vegetables, meat, and milk
Contaminated soil	NR[a]	Mixing depth – 15 cm; soil density – 1.5 g/cm3	Same as Subgroup 2	Same as Subgroup 2
Dietary intake of human	Age-dependent: 3-month – 418 kg; 1-yr – 506 kg; 5-yr – 660 kg; 10-yr – 779 kg; 15-yr – 869 kg; adult – 943 kg.	NR	NR	Adult – 160 kg/yr of grain and nonleafy vegetables; 14 kg/yr of leafy vegetables; 93 L/yr of milk; and 63 kg/yr of meat
Dietary intake of livestock	NR	Milk cow – 50 kg/d fodder	Meat cows – 68 kg/d fodder and 0.5 kg/d soil; milk cows – 55 kg/d fodder and 0.5 kg/d soil	Meat cows – 68 kg/d fodder and 0.5 kg/d soil; milk cows – 55 kg/d fodder and 0.5 kg/d soil
Contaminated fraction of human food	0.3	NR	NR	0.3
Contaminated fraction of animal fodder	NR	1	1	1
Food growing period	NR	Leafy vegetables – 0.25 yr; fodder – 0.08 yr	Grain and nonleafy vegetables – 0.17 yr; leafy vegetables – 0.25 yr; fodder – 0.08 yr	Same as Subgroup 3
Crop productivity	NR	Leafy vegetables – 2 kg/m2; fodder – 0.7 kg/m2	Grain and nonleafy vegetables – 0.7 kg/m2; leafy vegetables – 1.5 kg/m2; fodder – 1.1 kg/m2	Same as Subgroup 3
Storage time	NR	Leafy vegetables – 1 d; fodder – 0 d; and milk – 2 d	Grain and nonleafy vegetables – 14 d; leafy vegetables – 1 d; fodder – 0 d; meat – 20 d; milk – 1 d	Same as Subgroup 3

TABLE 10.A.2 (Cont.)

Parameters	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Transfer factors	NR	Root uptake transfer factors and milk transfer factors are listed in Table 10.6	Root uptake transfer factors and meat and milk transfer factors are listed in Table 10.6; root uptake transfer factors are the same as Subgroup 2; milk transfer factors are slightly different from Subgroup 2	Same as Subgroup 3
Deposition velocity	NR	NR	0.001 m/s	0.001 m/s
Weathering removal constant	NR	NR	20 yr^{-1} for plants	20 yr^{-1} for plants
Foliage to food transfer factor	NR	1	Nonleafy – 0.1; leafy – 1; fodder – 1	Nonleafy – 0.1; leafy – 1; fodder – 1
Fraction of the initially retained deposition at harvest	NR	1	1	1
Fraction of deposition initially retained	NR	0.2 for crops, 0.5 for fodder	0.25	0.25

[a] NR indicates the information is not required.

9 GROUP F-4: RELEASE OF REAL PROPERTY FROM RADIOLOGICALLY CONTROLLED AREAS

Group F operational guidelines address the release of property from radiological control. It is noteworthy to highlight that, in particular, operational guidelines for real property (subgroup F-4, buildings and lands) are designed to support implementation of the optimization process as presented in the PAGs for RDD and IND incidents (*Federal Register,* 73 FR 149). Subgroup F-4 guidelines are unique in that there is no one specific predefined numerical criterion (e.g., expressed in terms of dose or risk) on which to base protective action decisions. These guidelines are intended to be applied in the optimization process, which will likely consider the magnitude and extent of the contamination and the radionuclide(s) involved, proposed long-term land and building use in the affected areas, the degree of need for expedited recovery, public welfare issues, cost impacts for each proposed cleanup option, ecological considerations, and other factors.

Group F-4 operational guidelines are provided as reference values (e.g., soil and building-surface concentrations or risks) that can be used as a starting point for evaluating optimization process attributes and impacts relative to a range of dose- or risk-based benchmarks (e.g., 500, 100, 25, or 4 millirem per year; comparative lifetime risk ranges, and others) that could be considered as part of recovery-phase options. Thus, they are not regulatory dose limits or criteria, but serve as concentration values that provide perspective and aid in the optimization analyses. Chapter 11 includes data that may be used to develop operational guidelines for other types of property (e.g., vehicles and equipment).

The operational guidelines for subgroup F-4 were developed for use in releasing real properties — soils and buildings — located within radiologically controlled areas after an RDD event. Because the distribution of radionuclides on different contaminated surfaces would have changed from the original state as a result of any cleanup/remediation activities, the default ratios of radionuclide concentrations among different contaminated surfaces assumed for Groups C–E were not used. The operational guidelines for soil were derived by using the RESRAD code (Yu et al. 2001) and considering only soil contamination. The operational guidelines for buildings were derived by using the RESRAD-BUILD code (Yu et al. 2003) and considering only building contamination existing on the interior floor, on the inside and outside of the surrounding four walls, and on the roof.

The operational guidelines for soil and buildings can be applied separately to release a contaminated land area or building facility for unrestricted use, if the actual contamination exists only in the soil or on the building materials. If both the soil and the building materials are contaminated, then the sum of fractions rule must be applied with the measured concentrations for the soil and building materials to ensure that the PAG will not be exceeded after the properties are released.

Because of the uncertainty pertaining to the location of an RDD event and the affected population, probabilistic analyses were conducted to derive the operational guidelines. In the probabilistic analyses, distribution functions were assigned to the RESRAD and RESRAD-BUILD input parameters that were identified as sensitive in terms of influencing the radiation dose results. Parameters not identified as sensitive were assigned RESRAD or RESRAD-BUILD default values. To derive the operational guidelines, the 50th-percentile peak DSRs and the mean plus two standard deviations of the peak DSRs were used, along with dose criteria of 100 and 4 mrem/yr. These operational guidelines are derived considering the uncertainty of the location of a potential RDD event and the building types involved in an RDD incident. In a real case, the probabilistic methodology described in this chapter can be used to derive incident- and site-specific operational guidelines.

Appendix 9.A provides comparisons of the derived operational guidelines with published screening criteria for release of real properties or contaminated materials. Appendix 9.B presents distribution functions assigned to RESRAD and RESRAD-BUILD input parameters. Appendix 9.C discusses the different building characteristics assumed for deriving the building operational guidelines and their impacts on the DSRs.

9.1 RELEASE OF SOILS

To take into account the uncertainty regarding the environmental setting of an RDD event and the use of the affected area, two resident and two worker scenarios were analyzed to derive the soil release criteria. The two resident scenarios considered reflect two environmental settings, rural and urban. For the rural setting, a subsistence farmer was assumed so that all RESRAD exposure pathways (i.e., external radiation, inhalation of radon and dust, ingestion of soil, plant, meat, milk, fish, and water) could be analyzed. For the urban setting, exposures through ingestion of plant, meat, milk, fish, and water are unlikely in the late phase of response after an RDD event; therefore, only external radiation, inhalation of dust and radon, and ingestion of soil

were analyzed. Both residential receptors were assumed to follow the living and food consumption patterns of the general public. To consider different use of the affected area, two worker scenarios were selected to contrast the resident scenarios. The two worker scenarios, one indoor and one outdoor, would bound the potential dose associated with industrial use of the affected area. All dose analyses were accomplished by using a probabilistic approach in which the sensitive physical and behavioral parameters were assigned distribution functions, so that the distribution of potential doses could be analyzed. The sensitive parameters had been identified in previous studies (Yu et al. 2000) and characterized as having a great influence on calculated dose results. Appendix 9.B lists the distribution functions used in the dose analyses. For parameters that were not identified as sensitive, the RESRAD default values were used. The dose analysis spans a time frame of 1,000 years to consider long-term effects resulting from leaching of radionuclides to groundwater.

9.1.1 Scenario Description for Release of Soils

9.1.1.1 Resident Scenarios

In the subsistence farmer scenario, a farmer was assumed to settle on the contaminated area after the release. The farmer built a house, grew plant foods, and raised livestock for consumption. In addition, he drilled a well at the downgradient edge of the contaminated area and pumped out groundwater for use. Occasionally, he fished in a nearby pond and consumed the catch. All RESRAD exposure pathways were selected for dose calculations, including external radiation, inhalation of dust particles and radon, and ingestion of plant foods, meat, milk, soil, and groundwater.

The area of contamination was assumed to be 10,000 m^2. Over time, after an RDD event, the contaminants were assumed to be homogeneously mixed within the top 15 cm of soil for the subsistence farmer scenario assumed as a result of weathering and human activities, including root growth, plowing, shrinking and swelling cycles, rain drop impact, or freezing-thawing of top layer of soils. Note that for some radionuclides, such as Cs-137 and plutonium isotopes, this 15 cm thickness may be a conservative estimate, especially for areas not undergoing agricultural activities such as plowing and cultivating. NCRP Report No. 129 (NCRP 1999) suggested a thickness of 5 cm as an effective depth of deposition contributing to resuspension. If data are

available, the actual thickness (and area) can be used in RESRAD to calculate site-specific doses and operational guidelines.

The sensitive physical parameters associated with the local environment and soils were assigned distribution functions representing conditions throughout the country. The distribution functions were obtained from NUREG/CR-6697 (Yu et al. 2000).

On the basis of the area assumption and RESRAD default assumptions, 50% of the plant foods, 50% of the fish, 50% of the meat and milk, and 100% of the drinking water (if radionuclides reach the groundwater table) consumed by the farmer would be contaminated. In dose calculation, the inhalation rate was assigned a triangular distribution, with a minimum of 4,380 m^3/yr (0.5 m^3/h), a maximum of 13,100 m^3/yr (1.5 m^3/h), and a mode of 8,400 m^3/yr (0.96 m^3/h). The soil ingestion rate also assumed a triangular distribution, with a minimum, a maximum, and a mode of 0 g/yr (0 mg/d), 36.5 g/yr (100 mg/d), and 18.3 g/yr (50 mg/d), respectively. The inhalation and ingestion rates were consistent with the recommendation from NUREG/CR-6697 (Yu et al. 2000) for the general public. The indoor time fraction was assigned a continuous distribution function (Yu et al. 2000) on the basis of the EPA's comprehensive review (EPA 1997) of human activity patterns, which contains statistics on the amount of time spent inside a house. According to the distribution, the 50th-percentile value is 0.625, corresponding to 15 h/d. To obtain realistically conservative dose estimates, the RESRAD code was modified so that the outdoor time fraction was calculated and assumed a value to make the sum with the indoor time fraction equal 1. In other words, the receptor was assumed to spend 100% of the time in the contaminated area.

For the urban resident scenario, only the external radiation, inhalation of dust particles and radon, and ingestion of soil pathways were considered. Ingestion of plant, meat, milk, and fish, as well as use of contaminated water, were excluded. All input parameters used for dose calculations were the same as those used for the residential farmer scenario.

9.1.1.2 Worker Scenarios

Aside from residential use, industrial use of the contaminated area that could potentially expose many workers was also considered. For the worker scenarios, exposure pathways considered for dose calculations were external radiation, inhalation of dust particles and radon, and ingestion of soil, which are the same as those for the urban resident scenario. However, the

time fraction a worker spent in the contaminated area was less than that spent by a resident. The workers were assumed to be in the area 250 d/yr instead of 365 d/yr. The duration of work per day assumed a continuous distribution, as recommended by NUREG/CR-6697 (Yu et al. 2000) for workers, which was on the basis of the distribution for full-time workers in plants, factories, or warehouses (EPA 1997). The 50th-percentile value is 0.365, corresponding to 8.76 hours per workday. To obtain bounding estimates of potential exposures, it was further assumed that a worker worked either 100% indoors (indoor worker scenario) or 100% outdoors (outdoor worker scenario).

Because of different activity patterns, workers were assigned a higher inhalation rate than residents. The triangular distribution assumed a minimum, a maximum, and a mode of 4,380 m^3/yr (0.5 m^3/h), 16,790 (1.92 m^3/h), and 12,264 m^3/yr (1.4 m^3/h), respectively (Yu et al. 2000). The soil ingestion rate was the same as that for residents, which was the EPA's recommendation for adults (EPA 1997). The other input parameters were assigned values or distribution functions that were the same as those for the residential scenarios.

9.1.2 Dose Calculation for Release of Soils

The Latin hypercube sampling technique was used in sampling input parameter values. A total of 1,500 sets of dose results were obtained (a specification of 500 observations and 3 repetitions). Table 9.1 shows the percentiles, mean, and standard deviation of the peak dose for each individual radionuclide for a soil concentration of 1 pCi/g for the residential farmer scenario. Table 9.2 shows the same information for the urban resident scenario. Tables 9.3 and 9.4 list results for the indoor and outdoor worker scenarios, respectively.

9.1.3 Operational Guideline Derivation for Release of Soils

Tables 9.5 and 9.6 provide the operational guidelines for releasing an area with contaminated soils. Operational guidelines listed in Table 9.5 were obtained by using the 50th-percentile values from the peak DSR distributions (listed in Tables 9.1–9.4) with a dose criteria of 100 and 4 mrem/yr. Table 9.6 lists the operational guidelines obtained by using the mean + 2σ DSR values. The values for the worker scenario are those for outdoor workers, because the radiation doses the outdoor workers receive would be greater than those received by indoor workers if they work the same amount of time in the contaminated area. The default

operational guidelines for soils should be based on the residential farmer scenario to ensure the maximum protection for human health. However, the values can be reduced to reflect the actual and likely land use of the contaminated area.

The operational guidelines were derived by considering only exposures from contaminated soils; potential exposures from contaminated buildings were not included. Therefore, when applying the operational guidelines, it is important to make sure that the assumption associated with the guidelines is met by the real contamination situation. For instance, if both the soil and the building are contaminated, then the sum of fractions rule must be used to determine compliance with operational guidelines. See Section 9.3 for a more detailed discussion.

The operational guidelines were derived through a probabilistic analysis to account for the uncertainty in (1) the RDD event location, (2) physical conditions of the contaminated area, and (3) exposure patterns of the receptor. Conservative measures, such as assuming the residents spend 100% of the time in the contaminated area, were incorporated in the guideline derivation. In reality, when site-specific information is available, the level of conservatism can be reduced by conducting a site-specific analysis using the RESRAD code.

TABLE 9.1 Peak Dose-to-Source Ratio Distributions for the Residential Farmer Scenario from Contaminated Soil

	DSR (mrem/yr per pCi/g) for Radionuclides in Contaminated Soil										
Percentile	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	2.15E-02	4.51E-01	4.48E-03	2.50E+00	7.10E-01	2.29E-01	6.77E-02	9.72E-03	1.08E-02	2.21E+01	8.65E-02
10	2.61E-02	6.00E-01	5.73E-03	3.32E+00	8.98E-01	2.98E-01	8.52E-02	1.18E-02	1.30E-02	2.59E+01	1.11E-01
15	2.88E-02	6.99E-01	6.55E-03	3.87E+00	1.02E+00	3.47E-01	9.63E-02	1.32E-02	1.45E-02	2.79E+01	1.38E-01
20	3.09E-02	7.85E-01	7.37E-03	4.34E+00	1.14E+00	3.97E-01	1.09E-01	1.49E-02	1.64E-02	2.97E+01	1.65E-01
25	3.29E-02	8.63E-01	8.11E-03	4.75E+00	1.24E+00	4.36E-01	1.19E-01	1.62E-02	1.78E-02	3.13E+01	1.95E-01
30	3.45E-02	9.45E-01	8.86E-03	5.17E+00	1.34E+00	4.74E-01	1.30E-01	1.76E-02	1.92E-02	3.24E+01	2.23E-01
35	3.60E-02	1.02E+00	9.60E-03	5.57E+00	1.41E+00	5.11E-01	1.46E-01	1.92E-02	2.11E-02	3.35E+01	2.58E-01
40	3.75E-02	1.07E+00	1.04E-02	5.86E+00	1.49E+00	5.35E-01	1.57E-01	2.09E-02	2.29E-02	3.49E+01	3.01E-01
45	3.89E-02	1.12E+00	1.15E-02	6.15E+00	1.55E+00	5.64E-01	1.71E-01	2.23E-02	2.43E-02	3.62E+01	3.41E-01
50	4.02E-02	1.16E+00	1.23E-02	6.45E+00	1.61E+00	5.90E-01	1.82E-01	2.38E-02	2.61E-02	3.75E+01	3.97E-01
55	4.19E-02	1.21E+00	1.33E-02	6.71E+00	1.67E+00	6.10E-01	1.96E-01	2.54E-02	2.78E-02	3.89E+01	4.58E-01
60	4.40E-02	1.26E+00	1.42E-02	6.95E+00	1.73E+00	6.34E-01	2.10E-01	2.69E-02	2.98E-02	4.02E+01	5.24E-01
65	4.59E-02	1.31E+00	1.51E-02	7.25E+00	1.80E+00	6.61E-01	2.27E-01	2.91E-02	3.19E-02	4.17E+01	6.01E-01
70	4.82E-02	1.36E+00	1.61E-02	7.51E+00	1.87E+00	6.89E-01	2.50E-01	3.16E-02	3.46E-02	4.36E+01	6.95E-01
75	5.10E-02	1.41E+00	1.77E-02	7.80E+00	1.93E+00	7.17E-01	2.77E-01	3.48E-02	3.80E-02	4.59E+01	8.68E-01
80	5.45E-02	1.47E+00	1.94E-02	8.11E+00	2.02E+00	7.48E-01	3.10E-01	3.80E-02	4.18E-02	4.82E+01	1.04E+00
85	5.84E-02	1.55E+00	2.19E-02	8.55E+00	2.13E+00	7.87E-01	3.51E-01	4.25E-02	4.63E-02	5.04E+01	1.25E+00
90	6.60E-02	1.65E+00	2.60E-02	9.10E+00	2.28E+00	8.45E-01	3.95E-01	5.05E-02	5.54E-02	5.46E+01	1.73E+00
95	8.18E-02	1.82E+00	3.35E-02	1.01E+01	2.49E+00	9.27E-01	4.90E-01	6.41E-02	7.05E-02	5.88E+01	2.67E+00
Mean	4.53E-02	1.15E+00	1.50E-02	6.33E+00	1.61E+00	5.80E-01	2.22E-01	3.01E-02	3.29E-02	3.87E+01	7.81E-01
σ	2.84E-02	4.00E-01	1.29E-02	2.22E+00	5.48E-01	2.04E-01	1.56E-01	3.01E-02	3.30E-02	1.13E+01	1.34E+00
Mean + 2σ	1.02E-01	1.95E+00	4.09E-02	1.08E+01	2.70E+00	9.88E-01	5.35E-01	9.03E-02	9.90E-02	6.13E+01	3.46E+00

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TABLE 9.2 Peak Dose-to-Source Ratio Distributions for the Urban Resident Scenario from Contaminated Soil

	DSR (mrem/yr per pCi/g) for Radionuclides in Contaminated Soil										
Percentile	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	1.58E-02	4.49E-01	2.25E-03	2.48E+00	5.93E-01	2.28E-01	5.97E-03	4.34E-03	4.82E-03	2.18E+01	8.47E-03
10	1.92E-02	5.97E-01	2.89E-03	3.29E+00	7.76E-01	2.98E-01	8.43E-03	5.60E-03	6.15E-03	2.50E+01	1.06E-02
15	2.16E-02	6.93E-01	3.54E-03	3.83E+00	9.22E-01	3.46E-01	1.05E-02	6.86E-03	7.58E-03	2.69E+01	1.25E-02
20	2.37E-02	7.79E-01	3.87E-03	4.29E+00	1.02E+00	3.96E-01	1.23E-02	7.52E-03	8.25E-03	2.89E+01	1.41E-02
25	2.51E-02	8.56E-01	4.33E-03	4.71E+00	1.13E+00	4.35E-01	1.39E-02	8.35E-03	9.21E-03	3.03E+01	1.55E-02
30	2.64E-02	9.34E-01	4.73E-03	5.13E+00	1.23E+00	4.73E-01	1.57E-02	9.14E-03	1.01E-02	3.16E+01	1.69E-02
35	2.78E-02	1.01E+00	5.20E-03	5.52E+00	1.31E+00	5.09E-01	1.69E-02	1.00E-02	1.11E-02	3.27E+01	1.84E-02
40	2.91E-02	1.06E+00	5.64E-03	5.81E+00	1.38E+00	5.34E-01	1.85E-02	1.09E-02	1.20E-02	3.43E+01	1.94E-02
45	3.02E-02	1.11E+00	5.98E-03	6.12E+00	1.44E+00	5.63E-01	2.00E-02	1.16E-02	1.27E-02	3.56E+01	2.03E-02
50	3.15E-02	1.16E+00	6.46E-03	6.41E+00	1.50E+00	5.89E-01	2.20E-02	1.25E-02	1.38E-02	3.68E+01	2.13E-02
55	3.26E-02	1.20E+00	7.03E-03	6.67E+00	1.56E+00	6.09E-01	2.38E-02	1.36E-02	1.50E-02	3.83E+01	2.22E-02
60	3.39E-02	1.25E+00	7.69E-03	6.92E+00	1.62E+00	6.34E-01	2.58E-02	1.49E-02	1.63E-02	3.96E+01	2.30E-02
65	3.53E-02	1.30E+00	8.30E-03	7.21E+00	1.69E+00	6.60E-01	2.83E-02	1.61E-02	1.77E-02	4.10E+01	2.38E-02
70	3.66E-02	1.36E+00	8.95E-03	7.47E+00	1.75E+00	6.88E-01	3.11E-02	1.73E-02	1.90E-02	4.29E+01	2.48E-02
75	3.82E-02	1.41E+00	9.71E-03	7.78E+00	1.82E+00	7.16E-01	3.36E-02	1.88E-02	2.07E-02	4.51E+01	2.59E-02
80	3.97E-02	1.47E+00	1.06E-02	8.08E+00	1.89E+00	7.47E-01	3.65E-02	2.05E-02	2.24E-02	4.73E+01	2.68E-02
85	4.14E-02	1.54E+00	1.14E-02	8.53E+00	1.99E+00	7.84E-01	4.04E-02	2.20E-02	2.40E-02	4.95E+01	2.80E-02
90	4.41E-02	1.65E+00	1.28E-02	9.06E+00	2.13E+00	8.44E-01	4.61E-02	2.50E-02	2.73E-02	5.35E+01	2.99E-02
95	4.82E-02	1.82E+00	1.44E-02	1.01E+01	2.35E+00	9.24E-01	5.32E-02	2.79E-02	3.07E-02	5.80E+01	3.31E-02
Mean	3.17E-02	1.14E+00	7.27E-03	6.29E+00	1.48E+00	5.79E-01	2.48E-02	1.41E-02	1.55E-02	3.79E+01	2.08E-02
σ	9.70E-03	3.99E-01	3.80E-03	2.22E+00	5.09E-01	2.04E-01	1.42E-02	7.38E-03	8.06E-03	1.13E+01	7.33E-03
Mean + 2σ	5.11E-02	1.94E+00	1.49E-02	1.07E+01	2.50E+00	9.87E-01	5.33E-02	2.89E-02	3.16E-02	6.04E+01	3.55E-02

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TABLE 9.3 Peak Dose-to-Source Ratio Distributions for the Indoor Worker Scenario from Contaminated Soil

	DSR (mrem/yr per pCi/g) for Radionuclides in Contaminated Soil										
Percentile	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	5.04E-04	1.22E-02	1.42E-04	6.71E-02	1.60E-02	6.27E-03	4.33E-04	2.76E-04	3.02E-04	1.38E+00	2.31E-04
10	1.27E-03	3.18E-02	3.49E-04	1.73E-01	4.13E-02	1.62E-02	9.44E-04	6.70E-04	7.44E-04	3.57E+00	6.46E-04
15	2.11E-03	4.78E-02	5.18E-04	2.54E-01	6.09E-02	2.37E-02	1.46E-03	1.01E-03	1.10E-03	5.97E+00	9.57E-04
20	2.68E-03	6.05E-02	6.50E-04	3.33E-01	7.92E-02	3.00E-02	2.00E-03	1.26E-03	1.38E-03	8.18E+00	1.20E-03
25	3.14E-03	7.18E-02	7.92E-04	3.94E-01	9.34E-02	3.62E-02	2.41E-03	1.54E-03	1.69E-03	9.55E+00	1.43E-03
30	3.55E-03	8.24E-02	8.97E-04	4.55E-01	1.07E-01	4.19E-02	2.91E-03	1.74E-03	1.91E-03	1.05E+01	1.62E-03
35	3.88E-03	9.27E-02	1.02E-03	5.04E-01	1.19E-01	4.64E-02	3.35E-03	1.99E-03	2.17E-03	1.12E+01	1.80E-03
40	4.18E-03	1.02E-01	1.14E-03	5.55E-01	1.32E-01	5.06E-02	3.81E-03	2.21E-03	2.42E-03	1.18E+01	2.00E-03
45	4.59E-03	1.11E-01	1.24E-03	6.10E-01	1.45E-01	5.62E-02	4.21E-03	2.40E-03	2.64E-03	1.23E+01	2.18E-03
50	4.89E-03	1.22E-01	1.36E-03	6.69E-01	1.58E-01	6.19E-02	4.70E-03	2.65E-03	2.90E-03	1.28E+01	2.37E-03
55	5.30E-03	1.34E-01	1.54E-03	7.28E-01	1.76E-01	6.82E-02	5.12E-03	2.98E-03	3.27E-03	1.33E+01	2.59E-03
60	5.78E-03	1.49E-01	1.68E-03	8.21E-01	1.94E-01	7.51E-02	5.76E-03	3.25E-03	3.56E-03	1.39E+01	2.84E-03
65	6.18E-03	1.63E-01	1.89E-03	8.94E-01	2.13E-01	8.25E-02	6.46E-03	3.64E-03	4.00E-03	1.45E+01	3.14E-03
70	6.64E-03	1.79E-01	2.08E-03	9.90E-01	2.31E-01	9.00E-02	7.11E-03	4.03E-03	4.42E-03	1.51E+01	3.43E-03
75	7.11E-03	1.97E-01	2.34E-03	1.09E+00	2.55E-01	9.89E-02	8.02E-03	4.55E-03	5.00E-03	1.57E+01	3.76E-03
80	7.74E-03	2.19E-01	2.56E-03	1.21E+00	2.85E-01	1.08E-01	9.04E-03	4.97E-03	5.43E-03	1.64E+01	4.14E-03
85	8.42E-03	2.56E-01	2.88E-03	1.41E+00	3.25E-01	1.27E-01	1.03E-02	5.61E-03	6.11E-03	1.73E+01	4.69E-03
90	9.40E-03	2.92E-01	3.33E-03	1.62E+00	3.76E-01	1.50E-01	1.17E-02	6.49E-03	7.08E-03	1.86E+01	5.48E-03
95	1.09E-02	3.54E-01	3.95E-03	1.96E+00	4.58E-01	1.83E-01	1.38E-02	7.63E-03	8.41E-03	2.00E+01	6.51E-03
Mean	5.29E-03	1.47E-01	1.66E-03	8.09E-01	1.90E-01	7.42E-02	5.66E-03	3.22E-03	3.53E-03	1.22E+01	2.79E-03
σ	3.14E-03	1.08E-01	1.21E-03	5.94E-01	1.38E-01	5.48E-02	4.25E-03	2.35E-03	2.57E-03	5.40E+00	1.96E-03
Mean + 2σ	1.16E-02	3.62E-01	4.08E-03	2.00E+00	4.67E-01	1.84E-01	1.42E-02	7.92E-03	8.67E-03	2.30E+01	6.71E-03

TABLE 9.4 Peak Dose-to-Source Ratio Distributions for the Outdoor Worker Scenario from Contaminated Soil

DSR (mrem/yr per pCi/g) for Radionuclides in Contaminated Soil

Percentile	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	1.15E-03	4.97E-02	1.82E-04	2.81E-01	6.43E-02	2.52E-02	4.25E-04	3.54E-04	3.88E-04	2.08E-01	8.82E-04
10	3.52E-03	1.41E-01	4.70E-04	7.58E-01	1.84E-01	7.13E-02	9.65E-04	9.13E-04	1.00E-03	6.08E-01	2.26E-03
15	5.60E-03	2.34E-01	6.57E-04	1.30E+00	3.06E-01	1.16E-01	1.62E-03	1.27E-03	1.41E-03	9.96E-01	3.83E-03
20	7.78E-03	3.21E-01	8.39E-04	1.74E+00	4.18E-01	1.56E-01	2.12E-03	1.62E-03	1.80E-03	1.43E+00	5.12E-03
25	9.15E-03	3.86E-01	1.01E-03	2.15E+00	5.22E-01	1.95E-01	2.49E-03	1.97E-03	2.16E-03	1.73E+00	6.33E-03
30	9.89E-03	4.37E-01	1.17E-03	2.41E+00	5.75E-01	2.25E-01	2.90E-03	2.25E-03	2.49E-03	1.86E+00	7.38E-03
35	1.05E-02	4.61E-01	1.29E-03	2.55E+00	6.03E-01	2.34E-01	3.26E-03	2.51E-03	2.77E-03	1.94E+00	8.11E-03
40	1.10E-02	4.79E-01	1.44E-03	2.64E+00	6.24E-01	2.43E-01	3.74E-03	2.80E-03	3.08E-03	2.02E+00	8.49E-03
45	1.15E-02	4.96E-01	1.56E-03	2.73E+00	6.47E-01	2.52E-01	4.28E-03	3.01E-03	3.34E-03	2.09E+00	8.81E-03
50	1.19E-02	5.12E-01	1.73E-03	2.81E+00	6.65E-01	2.60E-01	4.72E-03	3.36E-03	3.69E-03	2.14E+00	9.13E-03
55	1.25E-02	5.25E-01	1.97E-03	2.91E+00	6.80E-01	2.68E-01	5.21E-03	3.79E-03	4.18E-03	2.20E+00	9.43E-03
60	1.30E-02	5.40E-01	2.11E-03	2.99E+00	6.98E-01	2.76E-01	5.82E-03	4.10E-03	4.52E-03	2.26E+00	9.77E-03
65	1.34E-02	5.55E-01	2.34E-03	3.08E+00	7.16E-01	2.83E-01	6.44E-03	4.53E-03	4.96E-03	2.32E+00	1.00E-02
70	1.40E-02	5.69E-01	2.58E-03	3.16E+00	7.35E-01	2.89E-01	7.26E-03	5.00E-03	5.48E-03	2.37E+00	1.03E-02
75	1.47E-02	5.89E-01	2.87E-03	3.25E+00	7.57E-01	2.98E-01	8.12E-03	5.55E-03	6.11E-03	2.45E+00	1.06E-02
80	1.54E-02	6.10E-01	3.16E-03	3.38E+00	7.90E-01	3.09E-01	9.03E-03	6.13E-03	6.75E-03	2.55E+00	1.09E-02
85	1.61E-02	6.42E-01	3.53E-03	3.55E+00	8.32E-01	3.28E-01	1.02E-02	6.85E-03	7.53E-03	2.68E+00	1.15E-02
90	1.71E-02	6.80E-01	3.93E-03	3.76E+00	8.76E-01	3.47E-01	1.15E-02	7.62E-03	8.38E-03	2.82E+00	1.22E-02
95	1.87E-02	7.35E-01	4.53E-03	4.07E+00	9.54E-01	3.76E-01	1.38E-02	8.81E-03	9.68E-03	3.07E+00	1.33E-02
Mean	1.14E-02	4.71E-01	2.03E-03	2.60E+00	6.12E-01	2.39E-01	5.67E-03	3.93E-03	4.32E-03	1.98E+00	8.34E-03
σ	5.05E-03	1.96E-01	1.37E-03	1.08E+00	2.51E-01	1.00E-01	4.16E-03	2.67E-03	2.92E-03	8.07E-01	3.62E-03
Mean + 2σ	2.15E-02	8.64E-01	4.78E-03	4.77E+00	1.11E+00	4.39E-01	1.40E-02	9.27E-03	1.02E-02	3.59E+00	1.56E-02

TABLE 9.5 Operational Guidelines (pCi/g) for Contaminated Soils Obtained by Using the 50th-Percentile Values from Peak Dose-to-Source Ratio Distributions

	Residential Farmer		Urban Resident		Worker	
Radionuclides	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr
Am-241	2.49E+03	9.96E+01	3.17E+03	1.27E+02	8.38E+03	3.35E+02
Cf-252	8.61E+01	3.44E+00	8.64E+01	3.46E+00	1.95E+02	7.81E+00
Cm-244	8.14E+03	3.25E+02	1.55E+04	6.19E+02	5.77E+04	2.31E+03
Co-60	1.55E+01	6.20E-01	1.56E+01	6.24E-01	3.55E+01	1.42E+00
Cs-137	6.22E+01	2.49E+00	6.68E+01	2.67E+00	1.50E+02	6.01E+00
Ir-192	1.70E+02	6.78E+00	1.70E+02	6.79E+00	3.85E+02	1.54E+01
Po-210	5.50E+02	2.20E+01	4.54E+03	1.82E+02	2.12E+04	8.48E+02
Pu-238	4.21E+03	1.68E+02	7.97E+03	3.19E+02	2.98E+04	1.19E+03
Pu-239	3.83E+03	1.53E+02	7.26E+03	2.90E+02	2.71E+04	1.08E+03
Ra-226	2.67E+00	1.07E-01	2.72E+00	1.09E-01	4.67E+01	1.87E+00
Sr-90	2.52E+02	1.01E+01	4.69E+03	1.88E+02	1.10E+04	4.38E+02

TABLE 9.6 Operational Guidelines (pCi/g) for Contaminated Soils Obtained by Using the Mean + 2σ Values from Peak Dose-to-Source Ratio Distributions

	Residential Farmer		Urban Resident		Worker	
Radionuclides	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr
Am-241	9.80E+02	3.92E+01	1.96E+03	7.83E+01	4.64E+03	1.86E+02
Cf-252	5.13E+01	2.05E+00	5.15E+01	2.06E+00	1.16E+02	4.63E+00
Cm-244	2.44E+03	9.77E+01	6.73E+03	2.69E+02	2.09E+04	8.38E+02
Co-60	9.28E+00	3.71E-01	9.32E+00	3.73E-01	2.10E+01	8.39E-01
Cs-137	3.70E+01	1.48E+00	4.00E+01	1.60E+00	8.98E+01	3.59E+00
Ir-192	1.01E+02	4.05E+00	1.01E+02	4.05E+00	2.28E+02	9.10E+00
Po-210	1.87E+02	7.48E+00	1.88E+03	7.51E+01	7.15E+03	2.86E+02
Pu-238	1.11E+03	4.43E+01	3.47E+03	1.39E+02	1.08E+04	4.32E+02
Pu-239	1.01E+03	4.04E+01	3.17E+03	1.27E+02	9.84E+03	3.93E+02
Ra-226	1.63E+00	6.53E-02	1.65E+00	6.62E-02	2.78E+01	1.11E+00
Sr-90	2.89E+01	1.16E+00	2.82E+03	1.13E+02	6.42E+03	2.57E+02

9.2 RELEASE OF BUILDINGS

Two types of buildings were considered when deriving the operational guidelines: residential buildings and commercial buildings. To account for the differences in the building characteristics, three residential buildings (urban apartment, suburban house, and small rural house) and two commercial buildings (large warehouse and small store/office) with different building dimensions and shielding thicknesses were analyzed. The characteristics of the buildings are described in Appendix 9.C.

Contamination was assumed to exist on the interior floor, the inside and outside of the four surrounding walls, and the roof. The contamination levels on all surfaces were assumed to be equal, in order to safeguard against the uncertainty associated with cleanup/remediation activities. A receptor staying inside a contaminated building (either a resident or a worker) was assumed to incur radiation doses through (1) external radiation from the floor, interior and exterior walls, and roof; (2) inhalation of contaminated particles suspended from the floor and interior walls; (3) ingestion of deposited dust particles; (4) external radiation from submersion in contaminated air; (5) inhalation of radon released from the floor and interior walls contaminated with radon precursors; and (6) external radiation from deposited dust particles.

To account for uncertainty in the type of receptor and in the receptor's activities, a probabilistic approach was used to quantify the distribution of potential radiation doses. The RESRAD-BUILD parameters that were identified as being sensitive in terms of having great influence on the dose results were assigned distribution functions obtained from NUREG/CR-6697 (Yu et al. 2000). Appendix 9.B lists the distribution functions used in the analyses. The other parameters were assigned the RESRAD-BUILD default values. The most sensitive parameters on the basis of the probabilistic analysis results are also discussed in Appendix 9.B.

9.2.1 Scenario Description for Release of Buildings

9.2.1.1 Resident Scenario

The receptors considered for residential buildings were residents of the buildings. The indoor time fraction they spent in the buildings was assigned a continuous distribution function

(Yu et al. 2000) on the basis of EPA's comprehensive review (EPA 1997) of human activity patterns that contains statistics on the amount of time spent inside a house. According to the distribution, the 50th-percentile value is 0.625, corresponding to 15 h/d. This assumption is consistent with that used for deriving soil operational guidelines. The inhalation rate of the residents was assumed to have a triangular distribution ranging from 12 to 35.9 m^3/d (0.5 to 1.5 m^3/h), with a mode at 23 m^3/d (0.96 m^3/d), which is characteristic for the general public (EPA 1997). The indirect ingestion rate of deposited dust particles was assigned a loguniform distribution with a minimum of 2.8E-5 m^2/d and maximum of 2.9E-4 m^2/d (Yu et al. 2000). According to the distribution, the average ingestion rate of deposited dust particles is 1.1 cm^2/h, which is very close to 1 cm^2/h reported in different studies (Healy 1971; Kennedy et al. 1981; ANSI/HPS 1999). Although the receptors may stay at any location inside the building, for external dose calculations, they were assumed to be at the center of the buildings.

9.2.1.2 Worker Scenario

The receptors considered for commercial buildings were workers working inside the buildings. The time fraction they spent inside a building per workday was assumed to follow a continuous distribution, as recommended in NUREG/CR-6697 (Yu et al. 2000). The 50th-percentile value is 0.365, corresponding to 8.76 hours per day. They were further assumed to work 250 days per year. Their inhalation rate was assumed to be greater than that of residents, with a triangular distribution ranging from 12 to 46 m^3/d (0.5 to 1.92 m^3/h) and a mode at 33.6 m^3/d (1.4 m^3/h). The ingestion rate of dust particles was the same as that for residents, which is considered conservative for use in risk assessments. Like the residents, the workers were assumed to be positioned at the center of the commercial buildings for external dose calculations.

9.2.2 Dose Calculations for Release of Buildings

The Latin hypercube sampling technique was used in sampling input parameter values. The dose calculation was repeated 1,500 times (500 observations and 3 repetitions) for the three different residential buildings and two different commercial buildings, and the dose results were analyzed for statistical distribution. Tables 9.7 and 9.8 show the most restrictive dose results for each individual radionuclide for residential and commercial buildings, respectively. Detailed

information on dose-to-source ratios associated with different building characteristics is provided in Appendix 9.C.

9.2.3 Operational Guideline Derivation for Release of Buildings

Tables 9.9 and 9.10 provide the operational guidelines in terms of surface concentrations on building materials for releasing residential and commercial buildings. They were obtained by using the 50th-percentile and mean + 2σ values, respectively, from the distributions of dose-to-source ratios (listed in Tables 9.7 and 9.8) and dose criteria of 100 and 4 mrem/yr. Measured concentrations on building surfaces, no matter whether they are from the floor, interior walls, exterior walls, or roof, should be compared with the guideline values. A building can be released for unrestricted use after confirmation that the contamination levels on all surfaces are less than the guideline values. To reduce the conservatism associated with the release, a site-specific analysis can be conducted with measured concentration data by using the RESRAD-BUILD code to demonstrate that the release dose criterion is not exceeded.

The operational guidelines were derived by considering only exposures from contaminated buildings; potential exposures from contaminated soils outside the buildings were not included. Therefore, when applying the operational guidelines, it is important to make sure that the assumption associated with the guidelines is met by the real contamination situation.

TABLE 9.7 Dose-to-Source Ratio Distributions for the Resident Scenario from Contaminated Buildings

Percentile (%)	DSR (mrem/yr per pCi/m2) for Radionuclides in Residential Buildings										
	Am-241[a]	Cf-252[b]	Cm-244[a]	Co-60[b]	Cs-137[b]	Ir-192[b]	Po-210[a]	Pu-238[a]	Pu-239[a]	Ra-226[a]	Sr-90[a]
5	3.89E-05	5.87E-05	2.20E-05	7.49E-05	1.84E-05	2.06E-05	1.68E-06	4.29E-05	4.74E-05	6.40E-05	2.38E-06
10	6.26E-05	7.53E-05	3.42E-05	8.44E-05	2.06E-05	2.31E-05	2.71E-06	6.86E-05	7.65E-05	8.07E-05	2.70E-06
15	8.56E-05	9.29E-05	4.70E-05	9.17E-05	2.26E-05	2.52E-05	3.65E-06	9.55E-05	1.07E-04	8.97E-05	2.98E-06
20	1.05E-04	1.07E-04	5.92E-05	9.93E-05	2.44E-05	2.72E-05	4.49E-06	1.16E-04	1.30E-04	9.71E-05	3.29E-06
25	1.33E-04	1.20E-04	7.30E-05	1.07E-04	2.61E-05	2.93E-05	5.53E-06	1.49E-04	1.66E-04	1.04E-04	3.48E-06
30	1.60E-04	1.38E-04	8.86E-05	1.11E-04	2.71E-05	3.05E-05	6.61E-06	1.78E-04	2.00E-04	1.12E-04	3.66E-06
35	1.89E-04	1.56E-04	1.04E-04	1.15E-04	2.83E-05	3.16E-05	7.79E-06	2.12E-04	2.36E-04	1.22E-04	3.83E-06
40	2.20E-04	1.77E-04	1.22E-04	1.20E-04	2.93E-05	3.28E-05	9.08E-06	2.44E-04	2.74E-04	1.32E-04	4.04E-06
45	2.50E-04	2.01E-04	1.38E-04	1.24E-04	3.04E-05	3.40E-05	1.03E-05	2.76E-04	3.13E-04	1.42E-04	4.25E-06
50	2.90E-04	2.24E-04	1.60E-04	1.28E-04	3.15E-05	3.51E-05	1.18E-05	3.23E-04	3.62E-04	1.51E-04	4.46E-06
55	3.39E-04	2.53E-04	1.87E-04	1.36E-04	3.33E-05	3.72E-05	1.33E-05	3.74E-04	4.26E-04	1.63E-04	4.73E-06
60	4.01E-04	2.88E-04	2.24E-04	1.43E-04	3.51E-05	3.93E-05	1.58E-05	4.45E-04	5.02E-04	1.75E-04	4.93E-06
65	4.58E-04	3.31E-04	2.57E-04	1.51E-04	3.70E-05	4.13E-05	1.85E-05	5.11E-04	5.75E-04	1.90E-04	5.17E-06
70	5.36E-04	3.81E-04	2.99E-04	1.58E-04	3.88E-05	4.34E-05	2.13E-05	6.01E-04	6.73E-04	2.04E-04	5.42E-06
75	6.43E-04	4.49E-04	3.57E-04	1.66E-04	4.06E-05	4.55E-05	2.55E-05	7.12E-04	8.09E-04	2.26E-04	5.70E-06
80	8.00E-04	5.41E-04	4.48E-04	1.74E-04	4.28E-05	4.79E-05	3.15E-05	8.87E-04	1.01E-03	2.55E-04	5.98E-06
85	9.96E-04	6.77E-04	5.55E-04	1.83E-04	4.50E-05	5.03E-05	3.93E-05	1.13E-03	1.24E-03	2.97E-04	6.26E-06
90	1.32E-03	8.79E-04	7.34E-04	1.93E-04	4.73E-05	5.28E-05	5.07E-05	1.46E-03	1.69E-03	3.68E-04	7.16E-06
95	1.99E-03	1.30E-03	1.05E-03	2.03E-04	4.95E-05	5.57E-05	7.04E-05	2.27E-03	2.54E-03	4.79E-04	9.28E-06
Mean	5.77E-04	4.15E-04	3.17E-04	1.33E-04	3.27E-05	3.66E-05	2.22E-05	6.39E-04	7.33E-04	2.03E-04	4.87E-06
σ	9.36E-04	6.97E-04	5.11E-04	4.20E-05	1.04E-05	1.15E-05	3.42E-05	1.03E-03	1.21E-03	2.12E-04	3.67E-06
Mean + 2σ	2.45E-03	1.81E-03	1.34E-03	2.17E-04	5.35E-05	5.96E-05	9.06E-05	2.70E-03	3.16E-03	6.28E-04	1.22E-05

a The most restrictive DSR is based on a rural residential building (area = 36 m2, height = 2.4 m, shielding thickness = 3.5 cm, and shielding density = 1 g/cm3 for concrete).

b The most restrictive DSR is based on a suburban residential building (area = 196 m2, height = 2.4 m, shielding thickness = 3.5 cm, and shielding density = 1 g/cm3 for concrete).

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TABLE 9.8 Dose-to-Source Ratio Distributions for the Worker Scenario from Contaminated Buildings

	DSR (mrem/yr per pCi/m2) for Radionuclides in Commercial Buildings										
Percentile (%)	Am-241[a]	Cf-252[a]	Cm-244[a]	Co-60[b]	Cs-137[b]	Ir-192[b]	Po-210[a]	Pu-238[a]	Pu-239[a]	Ra-226[a]	Sr-90[c]
5	8.82E-06	4.60E-06	5.10E-06	4.21E-06	9.83E-07	1.16E-06	3.78E-07	9.88E-06	1.08E-05	6.55E-06	1.74E-07
10	2.02E-05	1.19E-05	1.09E-05	1.26E-05	2.99E-06	3.45E-06	8.37E-07	2.26E-05	2.49E-05	1.61E-05	4.44E-07
15	2.98E-05	1.86E-05	1.65E-05	2.11E-05	4.89E-06	5.81E-06	1.24E-06	3.28E-05	3.67E-05	2.65E-05	7.66E-07
20	4.12E-05	2.19E-05	2.25E-05	2.95E-05	6.88E-06	8.09E-06	1.69E-06	4.60E-05	5.17E-05	3.31E-05	1.13E-06
25	5.16E-05	2.45E-05	2.88E-05	3.80E-05	8.79E-06	1.04E-05	2.15E-06	5.78E-05	6.41E-05	3.68E-05	1.25E-06
30	6.33E-05	2.72E-05	3.51E-05	3.95E-05	9.16E-06	1.08E-05	2.62E-06	7.16E-05	7.90E-05	4.05E-05	1.31E-06
35	7.54E-05	2.98E-05	4.24E-05	4.10E-05	9.54E-06	1.12E-05	3.18E-06	8.47E-05	9.47E-05	4.31E-05	1.39E-06
40	9.14E-05	3.36E-05	4.91E-05	4.25E-05	9.86E-06	1.16E-05	3.63E-06	1.02E-04	1.14E-04	4.68E-05	1.45E-06
45	1.05E-04	3.69E-05	5.92E-05	4.39E-05	1.02E-05	1.20E-05	4.36E-06	1.19E-04	1.32E-04	5.09E-05	1.52E-06
50	1.24E-04	4.04E-05	6.86E-05	4.53E-05	1.05E-05	1.24E-05	4.99E-06	1.37E-04	1.56E-04	5.62E-05	1.59E-06
55	1.45E-04	4.46E-05	8.19E-05	4.63E-05	1.08E-05	1.27E-05	5.81E-06	1.61E-04	1.83E-04	6.05E-05	1.66E-06
60	1.77E-04	5.05E-05	9.89E-05	4.73E-05	1.10E-05	1.30E-05	6.84E-06	1.99E-04	2.23E-04	6.48E-05	1.73E-06
65	2.11E-04	5.68E-05	1.19E-04	4.82E-05	1.12E-05	1.32E-05	8.31E-06	2.35E-04	2.65E-04	7.19E-05	1.80E-06
70	2.39E-04	6.30E-05	1.37E-04	4.92E-05	1.14E-05	1.35E-05	9.76E-06	2.71E-04	3.02E-04	7.77E-05	1.92E-06
75	2.94E-04	7.10E-05	1.60E-04	5.02E-05	1.17E-05	1.37E-05	1.14E-05	3.28E-04	3.69E-04	8.61E-05	2.04E-06
80	3.64E-04	8.56E-05	2.04E-04	5.28E-05	1.23E-05	1.45E-05	1.43E-05	4.04E-04	4.59E-04	9.70E-05	2.18E-06
85	4.59E-04	1.02E-04	2.58E-04	5.55E-05	1.29E-05	1.52E-05	1.80E-05	5.15E-04	5.78E-04	1.15E-04	2.42E-06
90	6.19E-04	1.32E-04	3.44E-04	5.84E-05	1.37E-05	1.60E-05	2.38E-05	6.95E-04	7.76E-04	1.42E-04	2.81E-06
95	9.14E-04	1.83E-04	5.03E-04	6.40E-05	1.50E-05	1.75E-05	3.45E-05	1.04E-03	1.21E-03	1.95E-04	3.61E-06
Mean	2.61E-04	6.29E-05	1.44E-04	4.14E-05	9.64E-06	1.14E-05	9.97E-06	2.89E-04	3.31E-04	7.55E-05	1.79E-06
σ	4.39E-04	8.01E-05	2.40E-04	1.67E-05	3.90E-06	4.57E-06	1.58E-05	4.84E-04	5.67E-04	8.68E-05	1.49E-06
Mean + 2σ	1.14E-03	2.23E-04	6.24E-04	7.47E-05	1.74E-05	2.05E-05	4.17E-05	1.26E-03	1.46E-03	2.49E-04	4.77E-06

a The most restrictive DSR is based on a small commercial building (area = 36 m2, height = 2.4 m, shielding thickness = 5 cm, and shielding density = 2.4 g/cm3 for concrete).

b The most restrictive DSR is based on a large commercial building (area = 900 m2, height = 3.7 m, shielding thickness = 10 cm, and shielding density = 2.4 g/cm3 for concrete).

c For strontium-90, the values listed are based on a small commercial building. However, the most restrictive DSR at 50th percentile occurs for a large commercial building (see Table 9.C.5).

TABLE 9.9 Operational Guidelines (pCi/m2) for Contaminated Buildings Obtained by Using the 50th-Percentile Values from Dose-to-Source Ratio Distributions

	Residential Buildings		Commercial Buildings	
Radionuclide	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr
Am-241	3.5E+05	1.4E+04	8.06E+05	3.22E+04
Cf-252	4.5E+05	1.8E+04	2.48E+06	9.91E+04
Cm-244	6.2E+05	2.5E+04	1.46E+06	5.83E+04
Co-60	7.8E+05	3.1E+04	2.21E+06	8.83E+04
Cs-137	3.2E+06	1.3E+05	9.52E+06	3.81E+05
Ir-192	2.8E+06	1.1E+05	8.06E+06	3.23E+05
Po-210	8.4E+06	3.4E+05	2.01E+07	8.02E+05
Pu-238	3.1E+05	1.2E+04	7.29E+05	2.92E+04
Pu-239	2.8E+05	1.1E+04	6.43E+05	2.57E+04
Ra-226	6.6E+05	2.7E+04	1.78E+06	7.12E+04
Sr-90	2.2E+07	9.0E+05	4.98E+07	1.99E+06

TABLE 9.10 Operational Guidelines (pCi/m2) for Contaminated Buildings Obtained by Using the Mean + 2σ Values from Dose-to-Source Ratio Distributions

	Residential Buildings		Commercial Buildings	
Radionuclide	100 mrem/yr	4 mrem/yr	100 mrem/yr	4 mrem/yr
Am-241	4.1E+04	1.6E+03	8.79E+04	3.52E+03
Cf-252	5.5E+04	2.2E+03	4.48E+05	1.79E+04
Cm-244	7.5E+04	3.0E+03	1.60E+05	6.41E+03
Co-60	4.6E+05	1.8E+04	1.34E+06	5.35E+04
Cs-137	1.9E+06	7.5E+04	5.75E+06	2.30E+05
Ir-192	1.7E+06	6.7E+04	4.88E+06	1.95E+05
Po-210	1.1E+06	4.4E+04	2.40E+06	9.60E+04
Pu-238	3.7E+04	1.5E+03	7.96E+04	3.18E+03
Pu-239	3.2E+04	1.3E+03	6.83E+04	2.73E+03
Ra-226	1.6E+05	6.4E+03	4.01E+05	1.60E+04
Sr-90	8.2E+06	3.3E+05	2.10E+07	8.38E+05

9.3 APPLICATION OF THE SUM OF FRACTIONS RULE

The operational guidelines presented in Tables 9.5, 9.6, 9.9, and 9.10 were derived by considering a single contamination source in soils and buildings independently. In reality, it is very likely that residual contamination would exist both in the buildings and in the soils surrounding the buildings. Under such conditions, the operational guidelines would need to be reduced to ensure that the total dose a potential receptor would receive does not exceed the dose criterion. The revised operational guidelines (OG) would need to satisfy the following expression:

$$\frac{(OG_{soil})_{revised}}{OG_{soil}} + \frac{(OG_{building})_{revised}}{OG_{building}} \leq 1 .$$

9.4 REFERENCES

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Yu, C., et al., 2001, *User's Manual for RESRAD Version 6*, ANL/EAD-4, Argonne National Laboratory, Argonne, Ill.

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APPENDIX 9.A:

COMPARISON OF RELEASE OF REAL PROPERTY FROM RADIOLOGICALLY CONTROLLED AREA (GROUP F-4) OPERATIONAL GUIDELINES WITH PUBLISHED RELEASE OR CLEARANCE CRITERIA

APPENDIX 9.A:

COMPARISON OF RELEASE OF REAL PROPERTY FROM RADIOLOGICALLY CONTROLLED AREA (GROUP F-4) OPERATIONAL GUIDELINES WITH PUBLISHED RELEASE OR CLEARANCE CRITERIA

This appendix compares the Group F-4 operational guidelines with published screening criteria for release of real properties or contaminated materials. Tables 9.A.1 and 9.A.3 list the comparison of the operational guidelines for soil with the U.S. Nuclear Regulatory Commission's (NRC's) screening guidelines for unrestricted release of soil (Schmidt et al. 2003), the U.S. Environmental Protection Agency's (EPA's) soil screening levels (EPA 2000), the National Council on Radiation Protection and Measurements' (NCRP's) soil screening limits (NCRP 1999), and the International Atomic Energy Agency's (IAEA's) Safety Guide No. RS-G-1.7 for clearance of material containing radionuclides (IAEA 2004). While the NRC's, NCRP's, and IAEA's guideline values are dose-based, the EPA's screening levels are risk-based, which would protect human health against a lifetime cancer risk of 1E-6. The dose criteria used to derive the NRC's, NCRP's, and IAEA's guidelines/standards are 25, 25, and 1 mrem/yr, respectively. Note that the IAEA's RS-G-1.7 also uses 100 mrem/yr for radionuclides of natural origin and for low-probability events leading to higher radiation exposures. Tables 9.A.2 and 9.A.4 list the cancer risks corresponding to the operational guidelines derived on the basis of the 50th-percentile and the mean + 2σ peak dose-to-source ratios, respectively, at t = 0, 50, and 100 years after the release of the contaminated area. They were obtained by setting the initial soil concentration to the guideline value, then performing a probabilistic analysis with the same input parameter distributions. The cancer risks reported correspond to the exposure duration of 30 years and were the 50th-percentile values from distributions.

The operational guidelines for residential and commercial buildings were compared with the American National Standards Institute/Health Physics Society (ANSI/HPS) N13.12 standards (ANSI/HPS 1999) for release of surface contaminated materials and NRC's screening guidelines (Schmidt et al. 2003) for release of contaminated buildings. They are listed in Tables 9.A.5–9.A.8. While the dose limits used in ANSI/HPS N13.12 standards range from 1 to 10 mrem/yr, the NRC's screening guidelines were developed on the basis of 25 mrem/yr.

TABLE 9.A.1 Comparison of Group F-4 Operational Guidelines for Contaminated Soils (Based on 50th-Percentile Peak Dose-to-Source Ratios) with Published Screening Guidelines or Limits

Radionuclide	Operational Guidelinea (pCi/g)		NRC Screening Guidelineb (pCi/g)	EPA Soil Screening Limitc,d (pCi/g)	NCRP Soil Screening Limite (pCi/g)	IAEA Safety Standardf (pCi/g)
	100 mrem/yr	4 mrem/yr				
Am-241	2.49E+03	9.96E+01	2.1E+00	2.6E+00	8.9E+00	2.7E+00
Cf-252	8.61E+01	3.44E+00	2.4E+00g	NAh	9.2E+00	2.7E+01
Cm-244	8.14E+03	3.25E+02	4.2E+00	7.4E+00	1.3E+01	2.7E+01
Co-60	1.55E+01	6.20E-01	3.8E+00	3.6E-02	6.2E-01	2.7E+00
Cs-137	6.22E+01	2.49E+00	1.1E+01	6.1E-02	3.0E+00	2.7E+00
Ir-192	1.70E+02	6.78E+00	4.1E+01	NAh	1.2E+01	2.7E+01
Po-210	5.50E+02	2.20E+01	8.9E+00g	NAh	1.2E+00	2.7E+01i
Pu-238	4.21E+03	1.68E+02	2.5E+00	1.8E+00	8.6E+00	2.7E+00
Pu-239	3.83E+03	1.53E+02	2.3E+00	1.6E+00	7.8E+00	2.7E+00
Ra-226	2.67E+00	1.07E-01	7.0E-01	1.3E-02	1.0E-01	2.7E+01i
Sr-90	2.52E+02	1.01E+01	1.7E+00g	6.9E-02	3.8E-01	2.7E+01

a The operational guidelines were developed on the basis of two dose criteria, 100 and 4 mrem/yr, and a residential farmer scenario.

b The NRC's screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol.2, Table H.2 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The EPA's soil screening limits were developed on the basis of a lifetime cancer risk of 1E-6. They were obtained from the EPA's *Soil Screening Guidance for Radionuclides: Appendix A*, which is available at http://www.epa.gov/superfund/resources/radiation/tbd-appendix-a-clean.pdf (EPA 2000).

d The screening limits were the smallest (most conservative) values among different exposure pathways, including ingestion of homegrown produce, direct ingestion of soil, inhalation of fugitive dusts, external radiation, and ingestion of groundwater (migration to groundwater). Radioactive decay was accounted for, and the dilution factor for the migration to groundwater was 20.

e The NCRP's soil screening limits (NCRP 1999) were developed on the basis of 25 mrem/yr and considered different land uses. The values listed are the most restrictive ones.

f The IAEA Safety Standards RS-G1.7 (IAEA 2004) were developed for clearance of material containing radionuclides. The dose limit used was 1 mrem/yr for radionuclides of artificial origin.

footnotes continued on next page.

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TABLE 9.A.1 (Cont.)

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g The value was calculated by using DandD (McFadden et al. 2001) by following the NRC guidance (Schmidt et al. 2003). The value was also verified/confirmed by Ralph Cady of NRC (Cady 2005).

h The value is not available from the EPA document.

i The clearance level for radionuclides of natural origin. The dose limit was 100 mrem/yr for radionuclides of natural origin.

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TABLE 9.A.2 Excess Cancer Risks Corresponding to the Operational Guidelines (Based on 50th-Percentile Peak Dose-to-Source Ratios)

Radionuclides	Operational Guideline Based on 100 mrem/yr (pCi/g)	Cancer Risk[a]			Operational Guideline Based on 4 mrem/yr (pCi/g)	Cancer Risk[a]		
		t = 0 yr	*t* = 50 yr	*t* = 100 yr		*t* = 0 yr	*t* = 50 yr	*t* = 100 yr
Am-241	2.49E+03	1.2E-03	4.2E-04	6.8E-09	9.96E+01	4.8E-05	1.7E-05	2.7E-10
Cf-252	8.61E+01	1.4E-06	1.5E-10	5.2E-14	3.44E+00	5.4E-08	6.2E-12	2.1E-15
Cm-244	8.14E+03	3.6E-04	2.0E-05	6.1E-09	3.25E+02	1.4E-05	8.1E-07	2.4E-10
Co-60	1.55E+01	5.5E-04	1.2E-07	0.0E+00	6.20E-01	2.2E-05	4.9E-09	0.0E+00
Cs-137	6.22E+01	1.4E-03	1.1E-04	7.2E-26	2.49E+00	5.7E-05	4.5E-06	2.9E-27
Ir-192	1.70E+02	8.2E-05	0.0E+00	0.0E+00	6.78E+00	3.3E-06	0.0E+00	0.0E+00
Po-210	5.50E+02	6.0E-05	0.0E+00	0.0E+00	2.20E+01	2.4E-06	0.0E+00	0.0E+00
Pu-238	4.21E+03	4.0E-04	8.0E-05	2.6E-08	1.68E+02	1.6E-05	3.2E-06	1.0E-09
Pu-239	3.83E+03	4.2E-04	1.2E-04	6.4E-10	1.53E+02	1.7E-05	4.8E-06	2.6E-11
Ra-226	2.67E+00	1.6E-03	7.4E-04	3.7E-07	1.07E-01	6.3E-05	3.0E-05	1.5E-08
Sr-90	2.52E+02	8.0E-04	2.0E-06	4.4E-22	1.01E+01	3.2E-05	8.2E-08	1.7E-23

[a] The cancer risks are for *t* = 0, *t* = 50, and *t* = 100 years, respectively, after the release of the contaminated area. They were calculated by assuming an exposure duration of 30 years. The risk values reported are the 50th-percentile values from distributions.

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TABLE 9.A.3 Comparison of Group F-4 Operational Guidelines for Contaminated Soils (Based on Mean + 2σ Peak Dose-to-Source Ratios) with Published Screening Guidelines or Limits

	Operational Guidelinea (pCi/g)		NRC Screening Limitb	EPA Soil Screening Limitc,d	NCRP Soil Screening Limite	IAEA Safety Standardf
Radionuclide	100 mrem/yr	4 mrem/yr	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
Am-241	9.80E+02	3.92E+01	2.1E+00	2.6E+00	8.9E+00	2.7E+00
Cf-252	5.13E+01	2.05E+00	2.4E+00g	NAh	9.2E+00	2.7E+01
Cm-244	2.44E+03	9.77E+01	4.2E+00	7.4E+00	1.3E+01	2.7E+01
Co-60	9.28E+00	3.71E-01	3.8E+00	3.6E-02	6.2E-01	2.7E+00
Cs-137	3.70E+01	1.48E+00	1.1E+01	6.1E-02	3.0E+00	2.7E+00
Ir-192	1.01E+02	4.05E+00	4.1E+01	NAh	1.2E+01	2.7E+01
Po-210	1.87E+02	7.48E+00	8.9E+00g	NAh	1.2E+00	2.7E+01i
Pu-238	1.11E+03	4.43E+01	2.5E+00	1.8E+00	8.6E+00	2.7E+00
Pu-239	1.01E+03	4.04E+01	2.3E+00	1.6E+00	7.8E+00	2.7E+00
Ra-226	1.63E+00	6.53E-02	7.0E-01	1.3E-02	1.0E-01	2.7E+01i
Sr-90	2.89E+01	1.16E+00	1.7E+00g	6.9E-02	3.8E-01	2.7E+01

a The operational guidelines were developed on the basis of two dose criteria, 100 and 4 mrem/yr, and a residential farmer scenario.

b The NRC's screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol.2, Table H.2 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The EPA's soil screening limits were developed on the basis of a lifetime cancer risk of 1E-6. They were obtained from the EPA's *Soil Screening Guidance for Radionuclides: Appendix A*, which is available at http://www.epa.gov/superfund/resources/radiation/tbd-appendix-a-clean.pdf (EPA 2000).

d The screening limits were the smallest (most conservative) values among different exposure pathways, including ingestion of homegrown produce, direct ingestion of soil, inhalation of fugitive dusts, external radiation, and ingestion of groundwater (migration to groundwater). Radioactive decay was accounted for, and the dilution factor for the migration to groundwater was 20.

e The NCRP's soil screening limits (NCRP 1999) were developed on the basis of 25 mrem/yr and considered different land uses. The values listed are the most restrictive ones.

f The IAEA Safety Standards RS-G1.7 (IAEA 2004) were developed for clearance of material containing radionuclides. The dose limit used was 1 mrem/yr for radionuclides of artificial origin.

footnotes continued on next page.

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TABLE 9.A.3 (Cont.)

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g The value was calculated by using DandD (McFadden et al. 2001) by following the NRC guidance (Schmidt et al. 2003). The value was also verified/confirmed by Ralph Cady of NRC (Cady 2005).

h The value is not available from the EPA document.

i The clearance level for radionuclides of natural origin. The dose limit was 100 mrem/yr for radionuclides of natural origin.

TABLE 9.A.4 Excess Cancer Risks Corresponding to the Operational Guidelines (Based on Mean + 2σ Peak Dose-to-Source Ratios)

Radionuclides	Operational Guideline Based on 100 mrem/yr (pCi/g)	Cancer Risk[a]			Operational Guideline Based on 4 mrem/yr (pCi/g)	Cancer Risk[a]		
		t = 0 yr	*t* = 50 yr	*t* = 100 yr		*t* = 0 yr	*t* = 50 yr	*t* = 100 yr
Am-241	9.80E+02	4.7E-04	1.6E-04	2.7E-09	3.92E+01	1.9E-05	6.5E-06	1.1E-10
Cf-252	5.13E+01	8.1E-07	9.2E-11	3.1E-14	2.05E+00	3.2E-08	3.7E-12	1.2E-15
Cm-244	2.44E+03	1.1E-04	6.1E-06	1.8E-09	9.77E+01	4.3E-06	2.4E-07	7.3E-11
Co-60	9.28E+00	3.3E-04	7.3E-08	0.0E+00	3.71E-01	1.3E-05	2.9E-09	0.0E+00
Cs-137	3.70E+01	8.4E-04	6.8E-05	4.3E-26	1.48E+00	3.4E-05	2.7E-06	1.7E-27
Ir-192	1.01E+02	4.9E-05	0.0E+00	0.0E+00	4.05E+00	2.0E-06	0.0E+00	0.0E+00
Po-210	1.87E+02	2.0E-05	0.0E+00	0.0E+00	7.48E+00	8.1E-07	0.0E+00	0.0E+00
Pu-238	1.11E+03	1.1E-04	2.1E-05	6.9E-09	4.43E+01	4.2E-06	8.4E-07	2.8E-10
Pu-239	1.01E+03	1.1E-04	3.2E-05	1.7E-10	4.04E+01	4.4E-06	1.3E-06	6.8E-12
Ra-226	1.63E+00	9.7E-04	4.5E-04	2.3E-07	6.53E-02	3.9E-05	1.8E-05	9.0E-09
Sr-90	2.89E+01	9.1E-05	2.3E-07	5.0E-23	1.16E+00	3.7E-06	9.4E-09	2.0E-24

[a] The cancer risks are for *t* = 0, *t* = 50, and *t* = 100 years, respectively, after the release of the contaminated area. They were calculated by assuming an exposure duration of 30 years. The risk values reported are the 50th-percentile values from distributions.

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TABLE 9.A.5 Comparison of Group F-4 Operational Guidelines for Residential Buildings (Based on 50th-Percentile Dose-to-Source Ratios) with the ANSI/HPS N13.12 Standards and NRC's Screening Guidelines

Radionuclide	Operational Guidelines[a] (pCi/m2) 100 mrem/yr	4 mrem/yr	ANSI/HPS N13.12 (pCi/m2) Standard	NRC Screening (pCi/m2) Guidelines[b]
Am-241	3.5E+05	1.4E+04	2.7E+04	1.2E+03c
Cf-252	4.5E+05	1.8E+04	2.7E+04	3.9E+03c
Cm-244	6.2E+05	2.5E+04	2.7E+04	2.2E+03c
Co-60	7.8E+05	3.1E+04	2.7E+05	3.20E+05
Cs-137	3.2E+06	1.3E+05	2.7E+05	1.30E+06
Ir-192	2.8E+06	1.1E+05	2.7E+05	3.30E+06
Po-210	8.4E+06	3.4E+05	2.7E+04	1.1E+05c
Pu-238	3.1E+05	1.2E+04	2.7E+04	1.4E+03c
Pu-239	2.8E+05	1.1E+04	2.7E+04	1.3E+03c
Ra-226	6.6E+05	2.7E+04	2.7E+04	5.0E+04c
Sr-90	2.2E+07	9.0E+05	2.7E+05	3.90E+05

a The operational guidelines were developed for two different dose criteria, 100 and 4 mrem/yr.

b The NRC screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol.2, Table H.1 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The value was calculated by using DandD (McFadden et al. 2001).

TABLE 9.A.6 Comparison of Group F-4 Operational Guidelines for Residential Buildings (Based on Mean + 2σ Dose-to-Source Ratios) with the ANSI/HPS N13.12 Standards and NRC's Screening Guidelines

Radionuclide	Operational Guidelines[a] (pCi/m2) 100 mrem/yr	4 mrem/yr	ANSI/HPS N13.12 (pCi/m2) Standard	NRC Screening (pCi/m2) Guidelines[b]
Am-241	4.1E+04	1.6E+03	2.7E+04	1.2E+03[c]
Cf-252	5.5E+04	2.2E+03	2.7E+04	3.9E+03c
Cm-244	7.5E+04	3.0E+03	2.7E+04	2.2E+03c
Co-60	4.6E+05	1.8E+04	2.7E+05	3.20E+05
Cs-137	1.9E+06	7.5E+04	2.7E+05	1.30E+06
Ir-192	1.7E+06	6.7E+04	2.7E+05	3.30E+06
Po-210	1.1E+06	4.4E+04	2.7E+04	1.1E+05c
Pu-238	3.7E+04	1.5E+03	2.7E+04	1.4E+03c
Pu-239	3.2E+04	1.3E+03	2.7E+04	1.3E+03c
Ra-226	1.6E+05	6.4E+03	2.7E+04	5.0E+04c
Sr-90	8.2E+06	3.3E+05	2.7E+05	3.90E+05

a The operational guidelines were developed for two different dose criteria, 100 and 4 mrem/yr.

b The NRC screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol.2, Table H.1 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The value was calculated by using DandD (McFadden et al. 2001).

TABLE 9.A.7 Comparison of Group F-4 Operational Guidelines for Commercial Buildings (Based on 50th-Percentile Dose-to-Source Ratios) with the ANSI/HPS N13.12 Standards and NRC's Screening Guidelines

Radionuclide	Operational Guideline[a] (pCi/m2) 100 mrem/yr	4 mrem/yr	ANSI/HPS N13.12 (pCi/m2) Standard	NRC Screening (pCi/m2) Guidelines[b]
Am-241	8.06E+05	3.22E+04	2.7E+04	1.2E+03c
Cf-252	2.48E+06	9.91E+04	2.7E+04	3.9E+03c
Cm-244	1.46E+06	5.83E+04	2.7E+04	2.2E+03c
Co-60	2.21E+06	8.83E+04	2.7E+05	3.20E+05
Cs-137	9.52E+06	3.81E+05	2.7E+05	1.30E+06
Ir-192	8.06E+06	3.23E+05	2.7E+05	3.30E+06
Po-210	2.01E+07	8.02E+05	2.7E+04	1.1E+05c
Pu-238	7.29E+05	2.92E+04	2.7E+04	1.4E+03c
Pu-239	6.43E+05	2.57E+04	2.7E+04	1.3E+03c
Ra-226	1.78E+06	7.12E+04	2.7E+04	5.0E+04c
Sr-90	4.98E+07	1.99E+06	2.7E+05	3.90E+05

a The operational guidelines were developed for two different dose criteria, 100 and 4 mrem/yr.

b The NRC screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol. 2, Table H.1 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The value was calculated by using DandD (McFadden et al. 2001).

TABLE 9.A.8 Comparison of Group F-4 Operational Guidelines for Commercial Buildings (Based on Mean + 2σ Dose-to-Source Ratios) with the ANSI/HPS N13.12 Standards and NRC's Screening Guidelines

Radionuclide	Operational Guideline[a] (pCi/m2) 100 mrem/yr	Operational Guideline[a] (pCi/m2) 4 mrem/yr	ANSI/HPS N13.12 Standard (pCi/m2)	NRC Screening Guidelines[b] (pCi/m2)
Am-241	8.79E+04	3.52E+03	2.7E+04	1.2E+03[c]
Cf-252	4.48E+05	1.79E+04	2.7E+04	3.9E+03[c]
Cm-244	1.60E+05	6.41E+03	2.7E+04	2.2E+03[c]
Co-60	1.34E+06	5.35E+04	2.7E+05	3.20E+05
Cs-137	5.75E+06	2.30E+05	2.7E+05	1.30E+06
Ir-192	4.88E+06	1.95E+05	2.7E+05	3.30E+06
Po-210	2.40E+06	9.60E+04	2.7E+04	1.1E+05[c]
Pu-238	7.96E+04	3.18E+03	2.7E+04	1.4E+03[c]
Pu-239	6.83E+04	2.73E+03	2.7E+04	1.3E+03[c]
Ra-226	4.01E+05	1.60E+04	2.7E+04	5.0E+04[c]
Sr-90	2.10E+07	8.38E+05	2.7E+05	3.90E+05

a The operational guidelines were developed for two different dose criteria, 100 and 4 mrem/yr.

b The NRC screening guidelines were developed on the basis of 25 mrem/yr. The values were obtained from NUREG-1757, Vol. 2, Table H.1 (Schmidt et al. 2003), or were calculated by using DandD (McFadden et al. 2001) by following the NRC guidance.

c The value was calculated by using DandD (McFadden et al. 2001).

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APPENDIX 9.B:

DISTRIBUTION FUNCTIONS USED IN DOSE ANALYSES

APPENDIX 9.B:

DISTRIBUTION FUNCTIONS USED IN DOSE ANALYSES

The distribution functions used in dose analyses are listed in this appendix. Tables 9.B.1 and 9.B.2 list the distribution functions used by RESRAD to consider soil contamination. Depending on the dominant pathways, the most sensitive parameters for different radionuclides are not the same. Generally speaking, the most sensitive physical parameters include the soil/water distribution coefficient (Kd), mass loading for inhalation, external gamma shielding factor, contaminated zone erosion rate, density of the contaminated zone, saturated zone hydraulic conductivity, saturated zone hydraulic gradient, unsaturated zone thickness, depth of roots, and transfer factors for plants, meat, and milk. Exposure parameters such as time fraction indoors, inhalation rate, soil ingestion rate, and drinking water intake rate also affect the dose results.

Table 9.B.3 lists the distribution functions used by RESRAD-BUILD to consider building contamination. It was found that in building occupancy scenarios, for strong gamma emitting radionuclides (Co-60, Cs-137, and Ir-192), indoor time fraction was the most sensitive parameter and had the most influence on the calculated dose results. For other radionuclides, in addition to the indoor time fraction, the building air exchange rate, removable fraction, fraction of removable material released to air, and lifetime of removable fraction were also identified as sensitive parameters.

TABLE 9.B.1 Distribution Functions Assigned to RESRAD Parameters for the Residential Farmer Scenario

Parameters	Distribution Function[a]
Density of contaminated zone	Truncated normal (1.52, 0.23, 0.001, 0.999)
Density of saturated zone	Truncated normal (1.52, 0.23, 0.001, 0.999)
Density of unsaturated zone	Truncated normal (1.52, 0.23, 0.001, 0.999)
Depth of roots	Uniform (0.3, 4)
Contaminated zone total porosity	Truncated normal (0.425, 0.0867, 0.001, 0.999)
Unsaturated zone total porosity	Truncated normal (0.425, 0.0867, 0.001, 0.999)
Saturated zone total porosity	Truncated normal (0.425, 0.0867, 0.001, 0.999)
Unsaturated zone effective porosity	Truncated normal (0.355, 0.0906, 0.001, 0.999)
Saturated zone effective porosity	Truncated normal (0.355, 0.0906, 0.001, 0.999)
Contaminated zone hydraulic conductivity	Bounded lognormal-N (2.3, 2.11, 0.004, 9250)
Unsaturated zone hydraulic conductivity	Bounded lognormal-N (2.3, 2.11, 0.004, 9250)
Saturated zone hydraulic conductivity	Bounded lognormal-N (2.3, 2.11, 0.004, 9250)
Contaminated zone b-parameter	Bounded lognormal-N (1.06, 0.66, 0.5, 30)
Unsaturated zone b-parameter	Bounded lognormal-N (1.06, 0.66, 0.5, 30)
Saturated zone b-parameter	Bounded lognormal-N (1.06, 0.66, 0.5, 30)
Saturated zone hydraulic gradient	Bounded lognormal-N (-5.11, 1.77, 0.00007, 0.5)
Thickness of unsaturated zone	Bounded lognormal-N (2.296, 1.276, 0.18, 320)
Contaminated zone erosion rate	Continuous logarithmic[b]
Well pumping rate	Uniform (250, 1519)
Well pumping intake depth	Triangular (6, 10, 30)
Depth of soil mixing layer	Triangular (0., 0.15, 0.6)
Runoff coefficient	Uniform (0.1, 0.8)
Evapotranspiration coefficient	Uniform (0.5, 0.75)
Wind speed	Bounded lognormal-N (1.445, 0.2419, 1.4, 12)
Mass loading for inhalation	Continuous linear[c]
Inhalation rate	Triangular (4380, 8400, 13100)
Drinking water intake rate	Truncated lognormal-N (6.015, 0.489, 0.001, 0.999)
Milk consumption rate	Triangular (60, 102, 200)
Fruit, vegetable, and grain consumption rate	Triangular (135, 178, 318)
Aquatic food contamination fraction	Triangular (0., 0.39, 1)
Soil ingestion rate	Triangular (0., 18.3, 36.5)
Wet-weight crop yield for fruit, grain, and nonleafy vegetables	Truncated lognormal-N (0.56, 0.48, 0.001, 0.999)
Weathering removal constant of all vegetation	Triangular (5.1, 18, 84)
Wet foliar interception fraction of leafy vegetables	Triangular (0.06, 0.67, 0.95)
Indoor dust filtration factor	Uniform (0.15, 0.95)
Indoor time fraction	Continuous linear[d]
External gamma shielding factor	Bounded lognormal-N (-1.3, 0.59, 0.044, 1)
Plant transfer factor	Nuclide dependent
Meat transfer factor	Nuclide dependent
Milk transfer factor	Nuclide dependent
Fish transfer factor	Nuclide dependent
Kd in contaminated zone	Nuclide dependent
Kd in unsaturated zone	Nuclide dependent
Kd in saturated zone	Nuclide dependent

footnotes on next page.

TABLE 9.B.1 (Cont.)

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a The parameters assigned to different distribution functions are:
- Truncated normal (mean, standard deviation, lower quantile, upper quantile);
- Uniform (minimum, maximum);
- Bounded lognormal-N (mean of underlying normal distribution, standard deviation of underlying normal distribution, minimum, maximum);
- Triangular (minimum, mode, maximum);
- Truncated lognormal-N (mean of underlying normal distribution, standard deviation of underlying normal distribution, lower quantile, upper quantile); and
- Lognormal-N (mean of underlying normal distribution, standard deviation of underlying normal distribution).

b The parameter values for the continuous logarithmic function are (5.0E-8, 0), (0.0007, 0.22), (0.005, 0.95), and (0.2, 1), where the first number in parenthesis is value, and the second number in parenthesis is cumulative probability.

c The parameter values for the continuous linear function are (0, 0), (8E-6, 0.0151), (1.6E-5, 0.1365), (3E-5, 0.8119), (4E-5, 0.9495), (6E-5, 0.9937), (7.6E-5, 0.9983), and (1E-4, 1), where the first number in parenthesis is value, and the second number in parenthesis is cumulative probability.

d The parameter values for the continuous linear function are (0, 0), (0.375, 0.05), (0.521, 0.25), (0.625, 0.5), (0.809, 0.75), (0.938, 0.9), (0.992, 0.95), and (1, 1), where the first number in parenthesis is value, and the second number in parenthesis is cumulative probability.

TABLE 9.B.2 Distribution Functions Assigned to Kd and Plant, Meat, and Milk Transfer Factor Parameters

	Lognormal-N Distribution[a]				
Radionuclide	Kd	Plant	Meat	Milk	Fish
Ac-227[b]	(6.72, 3.22)	(-6.91, 1.10)	(-10.82, 1.03)	(-13.12, 0.92)	(2.7, 1.1)
Am-241	(7.28, 3.15)	(-6.91, 0.92)	(-9.9, 0.2)	(-13.12, 0.69)	(3.4, 1.1)
Cf-252	(7.23, 3.22)	(-6.91, 1.10)	(-9.72, 1.03)	(-13.12, 0.92)	(3.2, 1.1)
Cm-244, Cm-248[c]	(8.82, 1.82)	(-6.91, 0.92)	(-10.82, 1.03)	(-13.12, 0.92)	(3.4, 1.1)
Co-60	(5.46, 2.53)	(-2.53, 0.92)	(-3.51, 1.03)	(-6.21, 0.7)	(5.7, 1.1)
Cs-137	(6.1, 2.33)	(-3.22, 0.99)	(-3, 0.41)	(-4.61, 0.47)	(7.6, 0.7)
Ir-192	(5.32, 3.22)	(-3.51, 1.10)	(-6.21, 1.03)	(-13.12, 0.92)	(2.3, 1.1)
Np-237[d]	(2.84, 2.25)	(-3.91, 0.92)	(-6.91, 0.69)	(-11.51, 0.69)	(3.4, 1.1)
Pa-231[b]	(5.94, 3.22)	(-4.61, 1.10)	(-12.21, 1.03)	(-12.21, 0.92)	(2.3, 1.1)
Pb-210[e]	(7.78, 2.76)	(-5.52, 0.92)	(-7.13, 0.69)	(-8.11, 0.92)	(5.7, 1.1)
Po-210[e]	(5.2, 1.68)	(-6.9, 0.9)	(-5.3, 0.69)	(-7.82, 0.69)	(4.6, 1.1)
Pu-238, Pu-239, Pu-240,[c,f] Pu-244[c]	(6.86, 1.89)	(-6.91, 0.92)	(-9.21, 0.2)	(-13.82. 0.47)	(3.4, 1.1)
Ra-226,[e] Ra-228[c,f]	(8.17, 1.7)	(-3.22, 0.92)	(-6.91, 0.69)	(-6.91, 0.47)	(3.9, 1.1)
Sr-90	(3.45, 2.12)	(-1.2, 0.99)	(-4.61, 0.41)	(-6.21, 0.47)	(4.1, 1.1)
Th-228,[c,f] Th-229,[d] Th-230,[e] Th-232[c,f]	(8.68, 3.62)	(-6.91, 0.92)	(-9.21, 1.03)	(-12.21, 0.92)	(4.6, 1.1)
U-233,[d] U-234,[e] U-235,[b] U-236[c,f]	(4.84, 3.13)	(-6.21, 0.92)	(-7.13, 0.69)	(-7.82, 0.59)	(2.3, 1.1)

a The parameters assigned to a lognormal-N distribution function are the mean and standard deviation of the underlying normal distribution.

b Ac-227, Pa-231, and U-235 are decay products of Pu-239.

c Cm-248, Pu-240, Pu-244, Ra-228, Th-228, Th-232, and U-236 are decay products of Cf-252.

d Np-237, Th-229, and U-233 are decay products of Am-241.

e Pb-210, Po-210, Ra-226, Th-230, and U-234 are decay products of Pu-238.

f Pu-240, Ra-228, Th-228, Th-232, and U-236 are decay products of Cm-244.

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TABLE 9.B.3 Distribution Functions Assigned to RESRAD-BUILD Parameters for the Building Occupancy Scenario

Parameters	Distribution Function[a]
Indoor time fraction	Continuous linear[b]
Deposition velocity	Loguniform (2.7E-06, 2.7E-03)
Resuspension rate	Loguniform (2.8E-10, 1.4E-05)
Building air exchange rate	Truncated lognormal-N (0.4187, 0.88, 0.001, 0.999)
Removable fraction	Triangular (0, 0.2, 1)
Lifetime of removable fraction	Triangular (1,000, 10,000, 100,000)
Breathing rate of receptor	Triangular (12, 33.6, 46)
Ingestion rate of deposited dust particles	Loguniform (0.000028, 0.00029)
Fraction of removable material released to air	Triangular (1E-06, 0.07, 1)

a The parameters assigned to different distribution functions are as follows:
- Loguniform (minimum, maximum);
- Truncated lognormal-N (mean of underlying normal distribution, standard deviation of underlying normal distribution, lower quantile, upper quantile); and
- Triangular (minimum, mode, maximum).

b The parameter values for the continuous linear function are (0.003, 0), (0.0347, 0.05), (0.306, 0.25), (0.365, 0.5), (0.403, 0.75), (0.469, 0.9), (0.542, 0.98), and (0.692, 1) for workers; (0, 0), (0.375, 0.05), (0.521, 0.25), (0.625, 0.5), (0.809, 0.75), (0.938, 0.9), (0.992, 0.95), and (1, 1) for residents; where the first number in parenthesis is value, and the second number in parenthesis is cumulative probability.

APPENDIX 9.C:

DOSE RESULTS FOR DIFFERENT TYPES OF CONTAMINATED BUILDINGS

APPENDIX 9.C:

DOSE RESULTS FOR DIFFERENT TYPES OF CONTAMINATED BUILDINGS

To capture the variability in building characteristics, three different residential buildings and two different commercial buildings were analyzed. The residential buildings considered were an apartment in an urban area, a single-family house in a suburban area, and a small house in a rural area. The commercial buildings considered were a large warehouse and a small store/office. Table 9.C.1 provides the characteristics of these residential and commercial buildings.

The operational guidelines for releasing contaminated buildings were derived by using the most conservative dose-to-source ratios (DSRs) among the buildings with different characteristics. The percentile values, mean, and standard deviation obtained for each radionuclide are listed in the following tables. Tables 9.C.2–9.C.4 list the results for the residential buildings — an urban apartment, a suburban house, and a rural house, respectively. For strong gamma emitting radionuclides, occupancy in a suburban house resulted in the most restrictive dose-to-source ratios; for other radionuclides, occupancy in a small rural house resulted in the most restrictive ratios. Tables 9.C.5 and 9.C.6 list the results for the commercial buildings — a warehouse and a small store/office, respectively. For strong gamma-emitting radionuclides, working at a large warehouse resulted in the most restrictive dose-to-source ratios; for other radionuclides, working at a small store/office resulted in the most restrictive ratios. The most restrictive dose-to-source ratios for the residential and commercial buildings are listed in Tables 9.7 and 9.8, respectively, in Chapter 9.

TABLE 9.C.1 Building Characteristics Used in the Building Occupancy Scenario

	Residential Buildings			Commercial Buildings	
Parameter	Urban Apartmen	Suburba n	Small Rural House	Large Warehous	Small Store/Office
Floor area, m2	100	196	36	900	36
Building height, m	2.4	2.4	2.4	3.7	2.4
Shielding thickness, cm	10	3.5	3.5	10	5
Shielding material	Concrete	Concrete	Concrete	Concrete	Concrete
Shielding density, g/cm3	2.4	1	1	2.4	2.4

TABLE 9.C.2 Dose-to-Source Ratio Distributions for a Residential Building: Urban Apartment

Percentile (%)	DSR (mrem/yr per pCi/m2) for Radionuclides in an Urban Residential Building[a]										
	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	2.85E-05	3.03E-05	1.51E-05	5.31E-05	1.23E-05	1.46E-05	1.18E-06	3.12E-05	3.47E-05	4.91E-05	2.20E-06
10	4.39E-05	3.87E-05	2.44E-05	5.97E-05	1.38E-05	1.63E-05	1.91E-06	4.90E-05	5.45E-05	6.30E-05	2.54E-06
15	6.12E-05	4.43E-05	3.39E-05	6.49E-05	1.49E-05	1.78E-05	2.58E-06	6.74E-05	7.52E-05	7.03E-05	2.82E-06
20	7.63E-05	4.90E-05	4.29E-05	7.04E-05	1.63E-05	1.93E-05	3.30E-06	8.55E-05	9.48E-05	7.66E-05	3.10E-06
25	9.30E-05	5.36E-05	5.12E-05	7.56E-05	1.74E-05	2.07E-05	3.89E-06	1.04E-04	1.16E-04	8.22E-05	3.31E-06
30	1.14E-04	5.79E-05	6.33E-05	7.86E-05	1.80E-05	2.16E-05	4.74E-06	1.27E-04	1.41E-04	8.87E-05	3.46E-06
35	1.36E-04	6.25E-05	7.53E-05	8.16E-05	1.88E-05	2.24E-05	5.64E-06	1.52E-04	1.69E-04	9.67E-05	3.64E-06
40	1.58E-04	6.71E-05	8.87E-05	8.47E-05	1.95E-05	2.32E-05	6.71E-06	1.78E-04	1.98E-04	1.04E-04	3.86E-06
45	1.79E-04	7.36E-05	9.97E-05	8.77E-05	2.02E-05	2.41E-05	7.49E-06	2.02E-04	2.24E-04	1.11E-04	4.06E-06
50	2.09E-04	7.89E-05	1.16E-04	9.06E-05	2.10E-05	2.49E-05	8.55E-06	2.33E-04	2.63E-04	1.20E-04	4.25E-06
55	2.44E-04	8.63E-05	1.34E-04	9.61E-05	2.22E-05	2.64E-05	9.83E-06	2.71E-04	3.06E-04	1.27E-04	4.51E-06
60	2.88E-04	9.46E-05	1.63E-04	1.01E-04	2.34E-05	2.78E-05	1.14E-05	3.24E-04	3.61E-04	1.38E-04	4.72E-06
65	3.34E-04	1.03E-04	1.86E-04	1.07E-04	2.47E-05	2.93E-05	1.34E-05	3.72E-04	4.19E-04	1.47E-04	4.92E-06
70	3.93E-04	1.15E-04	2.20E-04	1.12E-04	2.59E-05	3.07E-05	1.56E-05	4.42E-04	4.95E-04	1.59E-04	5.17E-06
75	4.74E-04	1.29E-04	2.64E-04	1.18E-04	2.70E-05	3.22E-05	1.86E-05	5.27E-04	5.93E-04	1.76E-04	5.43E-06
80	5.78E-04	1.51E-04	3.22E-04	1.24E-04	2.84E-05	3.39E-05	2.27E-05	6.45E-04	7.35E-04	1.99E-04	5.70E-06
85	7.63E-04	1.77E-04	4.11E-04	1.30E-04	2.99E-05	3.56E-05	2.88E-05	8.42E-04	9.66E-04	2.29E-04	6.05E-06
90	1.01E-03	2.22E-04	5.38E-04	1.37E-04	3.16E-05	3.74E-05	3.79E-05	1.12E-03	1.31E-03	2.77E-04	6.69E-06
95	1.50E-03	3.00E-04	8.04E-04	1.44E-04	3.28E-05	3.94E-05	5.48E-05	1.64E-03	1.96E-03	3.77E-04	8.33E-06
Mean	4.34E-04	1.16E-04	2.38E-04	9.45E-05	2.18E-05	2.59E-05	1.67E-05	4.81E-04	5.51E-04	1.58E-04	4.73E-06
σ	7.59E-04	1.41E-04	4.21E-04	2.98E-05	7.02E-06	8.16E-06	2.82E-05	8.43E-04	9.73E-04	1.60E-04	3.01E-06
Mean + 2σ	1.95E-03	3.98E-04	1.08E-03	1.54E-04	3.59E-05	4.22E-05	7.31E-05	2.17E-03	2.50E-03	4.78E-04	1.07E-05

a For an urban residential building: area = 100 m2, height = 2.4 m, shielding thickness = 10 cm, and shielding density = 2.4 g/cm3 concrete.

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TABLE 9.C.3 Dose-to-Source Ratio Distributions for a Residential Building: Suburban Apartment

Percentile (%)		DSR (mrem/yr per pCi/m2) for Radionuclides in a Suburban Residential Building[a]									
		Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192 Sr-90	Po-210	Pu-238	Pu-239	Ra-226
5	2.33E-05	5.87E-05	1.27E-05	7.49E-05	1.84E-05	2.06E-05	9.85E-07	2.53E-05	2.76E-05	6.40E-05	2.38E-06
10	3.64E-05	7.53E-05	1.96E-05	8.44E-05	2.06E-05	2.31E-05	1.50E-06	4.03E-05	4.42E-05	8.07E-05	2.70E-06
15	4.90E-05	9.29E-05	2.74E-05	9.17E-05	2.26E-05	2.52E-05	2.08E-06	5.42E-05	5.99E-05	8.97E-05	2.98E-06
20	6.31E-05	1.07E-04	3.48E-05	9.93E-05	2.44E-05	2.72E-05	2.66E-06	6.88E-05	7.76E-05	9.71E-05	3.29E-06
25	7.66E-05	1.20E-04	4.17E-05	1.07E-04	2.61E-05	2.93E-05	3.18E-06	8.47E-05	9.46E-05	1.03E-04	3.48E-06
30	9.35E-05	1.38E-04	5.09E-05	1.11E-04	2.71E-05	3.05E-05	3.86E-06	1.04E-04	1.15E-04	1.11E-04	3.66E-06
35	1.11E-04	1.56E-04	6.16E-05	1.15E-04	2.83E-05	3.16E-05	4.57E-06	1.25E-04	1.38E-04	1.19E-04	3.83E-06
40	1.32E-04	1.77E-04	7.32E-05	1.20E-04	2.93E-05	3.28E-05	5.33E-06	1.47E-04	1.63E-04	1.28E-04	4.04E-06
45	1.53E-04	2.01E-04	8.40E-05	1.24E-04	3.04E-05	3.40E-05	6.29E-06	1.70E-04	1.90E-04	1.37E-04	4.25E-06
50	1.74E-04	2.24E-04	9.74E-05	1.28E-04	3.15E-05	3.51E-05	7.16E-06	1.95E-04	2.18E-04	1.44E-04	4.46E-06
55	2.05E-04	2.53E-04	1.12E-04	1.36E-04	3.33E-05	3.72E-05	8.18E-06	2.28E-04	2.57E-04	1.53E-04	4.73E-06
60	2.39E-04	2.88E-04	1.33E-04	1.43E-04	3.51E-05	3.93E-05	9.55E-06	2.66E-04	2.99E-04	1.61E-04	4.93E-06
65	2.81E-04	3.31E-04	1.57E-04	1.51E-04	3.70E-05	4.13E-05	1.10E-05	3.11E-04	3.53E-04	1.71E-04	5.17E-06
70	3.25E-04	3.81E-04	1.82E-04	1.58E-04	3.88E-05	4.34E-05	1.33E-05	3.63E-04	4.10E-04	1.81E-04	5.42E-06
75	4.02E-04	4.49E-04	2.21E-04	1.66E-04	4.06E-05	4.55E-05	1.55E-05	4.45E-04	5.03E-04	1.98E-04	5.70E-06
80	4.97E-04	5.41E-04	2.73E-04	1.74E-04	4.28E-05	4.79E-05	1.93E-05	5.53E-04	6.27E-04	2.15E-04	5.98E-06
85	6.22E-04	6.77E-04	3.52E-04	1.83E-04	4.50E-05	5.03E-05	2.46E-05	7.02E-04	8.00E-04	2.37E-04	6.26E-06
90	8.75E-04	8.79E-04	4.66E-04	1.93E-04	4.73E-05	5.28E-05	3.22E-05	9.62E-04	1.12E-03	2.80E-04	6.74E-06
95	1.26E-03	1.30E-03	7.09E-04	2.03E-04	4.95E-05	5.57E-05	4.78E-05	1.42E-03	1.61E-03	3.69E-04	8.24E-06
Mean	3.73E-04	4.15E-04	2.05E-04	1.33E-04	3.27E-05	3.66E-05	1.43E-05	4.13E-04	4.73E-04	1.73E-04	4.87E-06
σ	6.95E-04	6.97E-04	3.88E-04	4.20E-05	1.04E-05	1.15E-05	2.61E-05	7.76E-04	8.86E-04	1.43E-04	2.80E-06
Mean + 2σ	1.76E-03	1.81E-03	9.82E-04	2.17E-04	5.35E-05	5.96E-05	6.64E-05	1.96E-03	2.25E-03	4.59E-04	1.05E-05

a For a suburban residential building: area = 196 m2, height = 2.4 m, shielding thickness = 3.5 cm, and shielding density = 1 g/cm3 concrete.

TABLE 9.C.3 Dose-to-Source Ratio Distributions for a Residential Building: Subsurface Soil

Percentile (%)		DSR (mrem/yr per pCi/m2) for Radionuclides in a Rural Residential Building[a]									
		Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192 Sr-90	Po-210	Pu-238	Pu-239	Ra-226
5	3.89E-05	3.92E-05	2.20E-05	6.46E-05	1.61E-05	1.77E-05	1.68E-06	4.29E-05	4.74E-05	6.08E-05	2.05E-06
10	6.26E-05	5.01E-05	3.42E-05	7.27E-05	1.80E-05	1.99E-05	2.71E-06	6.86E-05	7.65E-05	7.90E-05	2.44E-06
15	8.56E-05	5.78E-05	4.70E-05	7.90E-05	1.95E-05	2.17E-05	3.65E-06	9.55E-05	1.07E-04	8.80E-05	2.70E-06
20	1.05E-04	6.37E-05	5.92E-05	8.57E-05	2.12E-05	2.35E-05	4.49E-06	1.16E-04	1.30E-04	9.58E-05	2.98E-06
25	1.33E-04	6.92E-05	7.30E-05	9.21E-05	2.27E-05	2.52E-05	5.53E-06	1.49E-04	1.66E-04	1.04E-04	3.16E-06
30	1.60E-04	7.53E-05	8.86E-05	9.56E-05	2.35E-05	2.62E-05	6.61E-06	1.78E-04	2.00E-04	1.12E-04	3.37E-06
35	1.89E-04	8.09E-05	1.04E-04	9.94E-05	2.46E-05	2.73E-05	7.79E-06	2.12E-04	2.36E-04	1.22E-04	3.56E-06
40	2.20E-04	8.90E-05	1.22E-04	1.03E-04	2.54E-05	2.82E-05	9.08E-06	2.44E-04	2.74E-04	1.32E-04	3.77E-06
45	2.50E-04	9.54E-05	1.38E-04	1.07E-04	2.64E-05	2.93E-05	1.03E-05	2.76E-04	3.13E-04	1.42E-04	3.97E-06
50	2.90E-04	1.04E-04	1.60E-04	1.10E-04	2.74E-05	3.03E-05	1.18E-05	3.23E-04	3.62E-04	1.51E-04	4.20E-06
55	3.39E-04	1.13E-04	1.87E-04	1.17E-04	2.90E-05	3.21E-05	1.33E-05	3.74E-04	4.26E-04	1.63E-04	4.42E-06
60	4.01E-04	1.26E-04	2.24E-04	1.23E-04	3.05E-05	3.38E-05	1.58E-05	4.45E-04	5.02E-04	1.75E-04	4.64E-06
65	4.58E-04	1.38E-04	2.57E-04	1.30E-04	3.21E-05	3.56E-05	1.85E-05	5.11E-04	5.75E-04	1.90E-04	4.85E-06
70	5.36E-04	1.53E-04	2.99E-04	1.37E-04	3.37E-05	3.74E-05	2.13E-05	6.01E-04	6.73E-04	2.04E-04	5.08E-06
75	6.43E-04	1.72E-04	3.57E-04	1.43E-04	3.53E-05	3.92E-05	2.55E-05	7.12E-04	8.09E-04	2.26E-04	5.36E-06
80	8.00E-04	2.00E-04	4.48E-04	1.51E-04	3.71E-05	4.13E-05	3.15E-05	8.87E-04	1.01E-03	2.55E-04	5.74E-06
85	9.96E-04	2.35E-04	5.55E-04	1.58E-04	3.91E-05	4.33E-05	3.93E-05	1.13E-03	1.24E-03	2.97E-04	6.20E-06
90	1.32E-03	2.93E-04	7.34E-04	1.66E-04	4.13E-05	4.55E-05	5.07E-05	1.46E-03	1.69E-03	3.68E-04	7.16E-06
95	1.99E-03	3.96E-04	1.05E-03	1.75E-04	4.29E-05	4.80E-05	7.04E-05	2.27E-03	2.54E-03	4.79E-04	9.28E-06
Mean	5.77E-04	1.52E-04	3.17E-04	1.15E-04	2.85E-05	3.15E-05	2.22E-05	6.39E-04	7.33E-04	2.03E-04	4.83E-06
σ	9.36E-04	1.71E-04	5.11E-04	3.63E-05	9.16E-06	9.93E-06	3.42E-05	1.03E-03	1.21E-03	2.12E-04	3.67E-06
Mean + 2σ	2.45E-03	4.93E-04	1.34E-03	1.88E-04	4.68E-05	5.14E-05	9.06E-05	2.70E-03	3.16E-03	6.28E-04	1.22E-05

a For a rural residential building: area = 36 m2, height = 2.4 m, shielding thickness = 3.5 cm, and shielding density = 1 g/cm3 concrete.

TABLE 9.C.2 Dose to Source Ratio Distributions for a Commercial Building: Large Warehouse

Percentile (%)	DSR (mrem/yr per pCi/m2) for Radionuclides in a Large Commercial Building[a]										
	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	3.21E-06	2.77E-06	1.69E-06	4.21E-06	9.83E-07	1.16E-06	1.26E-07	3.30E-06	3.63E-06	4.48E-06	1.99E-07
10	6.29E-06	6.73E-06	3.44E-06	1.26E-05	2.99E-06	3.45E-06	2.62E-07	6.81E-06	7.42E-06	1.19E-05	5.55E-07
15	9.65E-06	1.15E-05	5.25E-06	2.11E-05	4.89E-06	5.81E-06	4.04E-07	1.04E-05	1.15E-05	2.13E-05	9.50E-07
20	1.36E-05	1.48E-05	7.43E-06	2.95E-05	6.88E-06	8.09E-06	5.71E-07	1.49E-05	1.65E-05	2.96E-05	1.38E-06
25	1.69E-05	1.67E-05	9.36E-06	3.80E-05	8.79E-06	1.04E-05	7.05E-07	1.84E-05	2.08E-05	3.32E-05	1.64E-06
30	2.07E-05	1.79E-05	1.16E-05	3.95E-05	9.16E-06	1.08E-05	8.66E-07	2.29E-05	2.53E-05	3.51E-05	1.73E-06
35	2.41E-05	1.91E-05	1.35E-05	4.10E-05	9.54E-06	1.12E-05	1.02E-06	2.67E-05	3.01E-05	3.71E-05	1.82E-06
40	2.93E-05	2.03E-05	1.61E-05	4.25E-05	9.86E-06	1.16E-05	1.23E-06	3.24E-05	3.60E-05	3.88E-05	1.89E-06
45	3.51E-05	2.16E-05	1.98E-05	4.39E-05	1.02E-05	1.20E-05	1.50E-06	3.92E-05	4.36E-05	4.08E-05	1.95E-06
50	4.18E-05	2.34E-05	2.33E-05	4.53E-05	1.05E-05	1.24E-05	1.76E-06	4.60E-05	5.16E-05	4.31E-05	2.01E-06
55	4.88E-05	2.50E-05	2.74E-05	4.63E-05	1.08E-05	1.27E-05	2.03E-06	5.49E-05	6.06E-05	4.52E-05	2.06E-06
60	5.75E-05	2.68E-05	3.29E-05	4.73E-05	1.10E-05	1.30E-05	2.40E-06	6.44E-05	7.19E-05	4.73E-05	2.11E-06
65	6.91E-05	2.90E-05	3.93E-05	4.82E-05	1.12E-05	1.32E-05	2.85E-06	7.79E-05	8.61E-05	5.00E-05	2.17E-06
70	8.31E-05	3.16E-05	4.71E-05	4.92E-05	1.14E-05	1.35E-05	3.46E-06	9.38E-05	1.04E-04	5.33E-05	2.25E-06
75	1.05E-04	3.52E-05	5.77E-05	5.02E-05	1.17E-05	1.37E-05	4.14E-06	1.16E-04	1.31E-04	5.65E-05	2.34E-06
80	1.30E-04	3.97E-05	7.27E-05	5.28E-05	1.23E-05	1.45E-05	5.22E-06	1.43E-04	1.62E-04	6.06E-05	2.45E-06
85	1.64E-04	4.74E-05	9.24E-05	5.55E-05	1.29E-05	1.52E-05	6.48E-06	1.82E-04	2.06E-04	6.69E-05	2.60E-06
90	2.30E-04	5.82E-05	1.27E-04	5.84E-05	1.37E-05	1.60E-05	8.90E-06	2.58E-04	2.92E-04	7.65E-05	2.82E-06
95	3.44E-04	7.89E-05	1.89E-04	6.40E-05	1.50E-05	1.75E-05	1.36E-05	3.83E-04	4.29E-04	9.82E-05	3.22E-06
Mean	9.76E-05	3.16E-05	5.45E-05	4.14E-05	9.64E-06	1.14E-05	3.88E-06	1.09E-04	1.23E-04	4.81E-05	1.96E-06
σ	2.00E-04	3.91E-05	1.14E-04	1.67E-05	3.90E-06	4.57E-06	7.82E-06	2.25E-04	2.54E-04	3.84E-05	1.02E-06
Mean + 2σ	4.99E-04	1.10E-04	2.82E-04	7.47E-05	1.74E-05	2.05E-05	1.95E-05	5.59E-04	6.30E-04	1.25E-04	3.99E-06

a For a large commercial building: area = 900 m^2, height = 3.7 m, shielding thickness = 10 cm, and shielding density = 2.4 g/cm^3 concrete.

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TABLE 9.C.6 Dose-to-Source Ratio Distributions for a Commercial Building: Small Store/Office

	DSR (mrem/yr per pCi/m2) for Radionuclides in a Small Commercial Building[a]										
Percentile (%)	Am-241	Cf-252	Cm-244	Co-60	Cs-137	Ir-192	Po-210	Pu-238	Pu-239	Ra-226	Sr-90
5	8.82E-06	4.60E-06	5.10E-06	3.90E-06	9.42E-07	1.07E-06	3.78E-07	9.88E-06	1.08E-05	6.55E-06	1.74E-07
10	2.02E-05	1.19E-05	1.09E-05	1.16E-05	2.81E-06	3.18E-06	8.37E-07	2.26E-05	2.49E-05	1.61E-05	4.44E-07
15	2.98E-05	1.86E-05	1.65E-05	1.95E-05	4.68E-06	5.35E-06	1.24E-06	3.28E-05	3.67E-05	2.65E-05	7.66E-07
20	4.12E-05	2.19E-05	2.25E-05	2.73E-05	6.59E-06	7.47E-06	1.69E-06	4.60E-05	5.17E-05	3.31E-05	1.13E-06
25	5.16E-05	2.45E-05	2.88E-05	3.52E-05	8.31E-06	9.61E-06	2.15E-06	5.78E-05	6.41E-05	3.68E-05	1.25E-06
30	6.33E-05	2.72E-05	3.51E-05	3.65E-05	8.67E-06	9.99E-06	2.62E-06	7.16E-05	7.90E-05	4.05E-05	1.31E-06
35	7.54E-05	2.98E-05	4.24E-05	3.79E-05	9.04E-06	1.04E-05	3.18E-06	8.47E-05	9.47E-05	4.31E-05	1.39E-06
40	9.14E-05	3.36E-05	4.91E-05	3.92E-05	9.37E-06	1.07E-05	3.63E-06	1.02E-04	1.14E-04	4.68E-05	1.45E-06
45	1.05E-04	3.69E-05	5.92E-05	4.05E-05	9.68E-06	1.11E-05	4.36E-06	1.19E-04	1.32E-04	5.09E-05	1.52E-06
50	1.24E-04	4.04E-05	6.86E-05	4.19E-05	9.97E-06	1.15E-05	4.99E-06	1.37E-04	1.56E-04	5.62E-05	1.59E-06
55	1.45E-04	4.46E-05	8.19E-05	4.28E-05	1.02E-05	1.17E-05	5.81E-06	1.61E-04	1.83E-04	6.05E-05	1.66E-06
60	1.77E-04	5.05E-05	9.89E-05	4.37E-05	1.04E-05	1.20E-05	6.84E-06	1.99E-04	2.23E-04	6.48E-05	1.73E-06
65	2.11E-04	5.68E-05	1.19E-04	4.45E-05	1.07E-05	1.22E-05	8.31E-06	2.35E-04	2.65E-04	7.19E-05	1.80E-06
70	2.39E-04	6.30E-05	1.37E-04	4.54E-05	1.08E-05	1.24E-05	9.76E-06	2.71E-04	3.02E-04	7.77E-05	1.92E-06
75	2.94E-04	7.10E-05	1.60E-04	4.64E-05	1.12E-05	1.27E-05	1.14E-05	3.28E-04	3.69E-04	8.61E-05	2.04E-06
80	3.64E-04	8.56E-05	2.04E-04	4.89E-05	1.17E-05	1.34E-05	1.43E-05	4.04E-04	4.59E-04	9.70E-05	2.18E-06
85	4.59E-04	1.02E-04	2.58E-04	5.14E-05	1.23E-05	1.40E-05	1.80E-05	5.15E-04	5.78E-04	1.15E-04	2.42E-06
90	6.19E-04	1.32E-04	3.44E-04	5.41E-05	1.31E-05	1.48E-05	2.38E-05	6.95E-04	7.76E-04	1.42E-04	2.81E-06
95	9.14E-04	1.83E-04	5.03E-04	5.92E-05	1.42E-05	1.62E-05	3.45E-05	1.04E-03	1.21E-03	1.95E-04	3.61E-06
Mean	2.61E-04	6.29E-05	1.44E-04	3.83E-05	9.18E-06	1.05E-05	9.97E-06	2.89E-04	3.31E-04	7.55E-05	1.79E-06
σ	4.39E-04	8.01E-05	2.40E-04	1.54E-05	3.75E-06	4.21E-06	1.58E-05	4.84E-04	5.67E-04	8.68E-05	1.49E-06
Mean + 2σ	1.14E-03	2.23E-04	6.24E-04	6.91E-05	1.67E-05	1.89E-05	4.17E-05	1.26E-03	1.46E-03	2.49E-04	4.77E-06

[a] For a small commercial building: area = 36 m2, height = 2.4 m, shielding thickness = 5 cm, and shielding density = 2.4 g/cm3 concrete.

1 INTRODUCTION

The government's ability to respond to a radiological terrorist incident has been a central focus since the terrorist attacks in New York City on September 11, 2001. At the direction of the White House Office of Science and Technology Policy, the interagency Consequence Management, Site Restoration/Cleanup and Decontamination Subgroup (CMS) of the Radiological Dispersal Device (RDD)/Improvised Nuclear Device (IND) Preparedness Working Group has addressed this need. The CMS identified protective action guides (PAGs) appropriate for early and intermediate phases of response; provided a risk management framework for addressing long-term cleanup and recovery that incorporates the principles of optimization, stakeholder involvement, and shared accountability; and highlighted needs and concepts for operational guidelines to implement the PAGs. These PAGs and recommendations were reviewed by the Federal agencies and approved for government use as "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents" (*Federal Register*, 73 FR 149).

1.1 NEED FOR OPERATIONAL GUIDELINES

The basis and need for operational guidelines is discussed in Section 1.1.1, and the process used to develop operational guidelines is described in Section 1.1.2.

1.1.1 Basis and Need for Operational Guidelines

The primary purpose of the operational guidelines is to support implementation of the Department of Homeland Security's (DHS) PAGs for RDDs published in the *Federal Register* (73 FR 149). As cited in the DHS PAGs, by agreement with the Environmental Protection Agency (EPA), the DHS PAG guidance and its substance will be incorporated without change into the revision of the 1992 *EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents* (the EPA PAG Manual; currently EPA 400-R-92-001). As such, the operational guidelines presented in this report will also support implementation of the EPA PAG Manual.

A PAG is the projected dose to a reference individual from an accidental or deliberate release of radioactive material at which a specific protective action (e.g., sheltering or evacuation

of the public and restriction of water and food consumption) to reduce or avoid that dose is recommended. Protective actions are designed to be taken before the anticipated dose is realized. The PAGs are not regulatory limits or firm distinctions between safe and unsafe. Rather, they are guidelines for determining if protective actions for public and worker safety are warranted for a specific radiological incident. Tables 1.1 and 1.2, taken from *Federal Register* 73 FR 149, present the PAGs and Emergency Worker Guidelines appropriate for use in various phases of emergency preparedness and in response to an RDD. For context, Figure 1.1 depicts the relationship between possible routes of exposure from an RDD incident, protective measures, and time frames for exposure effects relative to the early, intermediate, and late or long-term recovery phases of the emergency response.

TABLE 1.1 Protective Action Guidelines for RDD and IND Incidents

Phase	Protective Action Recommendation	Protective Action Guide
Early	Sheltering-in-place or evacuation of the public[a]	1 to 5 rem (0.01-0.05 Sv) projected dose[b]
	Administration of prophylactic drugs – potassium iodide[c, d]; administration of other prophylactic or decorporation agents[e]	5 rem (0.05 Sv) projected dose to child's thyroid[c, d]
Intermediate	Relocation of the public	2 rem (0.02 Sv) projected dose first year; subsequent years, 0.5 rem/yr (0.005 Sv/yr) projected dose[b]
	Food interdiction	0.5 rem (0.005 Sv) projected dose, or 5 rem (0.05 Sv) to any individual organ or tissue in the first year, whichever is limiting
	Drinking water interdiction	0.5 rem (0.005 Sv) projected dose in the first year

a Should normally begin at 1 rem (0.01 Sv); take whichever action (or combination of actions) that results in the lowest exposure for the majority of the population. Sheltering may begin at lower levels, if advantageous.

b Total effective dose equivalent (TEDE). The sum of the effective dose equivalent from external radiation exposure and the committed effective dose equivalent from internal radiation exposure.

c Provides thyroid protection from radioactive iodine only.

d Committed dose equivalent (CDE). The FDA understands that a potassium iodide (KI) administration program that sets different projected thyroid radioactive dose thresholds for treatment of different population groups may be logistically impractical to implement during a radiological emergency. If emergency planners reach this conclusion, FDA recommends that KI be administered to both children and adults at the lowest intervention threshold (i.e., >5 rem (0.05 Sv) projected internal thyroid dose in children) (FDA 2001).

e For other information on other radiological prophylactics and medical countermeasures, refer to http://www.fda.gov/cder/drugprepare/default.htm, http:/www.bt.cdc.gov/radiation, or http://www.orau.gov/reacts.

TABLE 1.2 Emergency Worker Guidelines in the Early Phase 1a

Total Effective Dose Equivalent (TEDE) Guideline[b]	Activity	Condition
5 rem (0.05 Sv)	All occupational exposures.	All reasonably achievable actions have been taken to minimize dose.
10 rem (0.1 Sv)	Protecting valuable property necessary for public welfare (e.g., a power plant).	• All appropriate actions and controls have been implemented; however, exceeding 5 rem (0.05 Sv) is unavoidable. • Responders have been fully informed of the risks of exposures they may experience. • Dose >5 rem (0.05 Sv) is on a voluntary basis. • Appropriate respiratory protection and other personal protection is provided and used. • Monitoring available to project or measure dose.
25 rem (0.25 Sv)[c]	Lifesaving or protection of large populations. It is highly unlikely that doses would reach this level in an RDD incident; however, worker doses higher than 25 rem (0.25 Sv) are conceivable in a catastrophic incident such as an IND incident.	• All appropriate actions and controls have been implemented; however, exceeding 5 rem (0.05 Sv) is unavoidable. • Responders have been fully informed of the risks of exposures they may experience. • Dose >5 rem (0.05 Sv) is on a voluntary basis. • Appropriate respiratory protection and other personal protection are provided and used. • Monitoring available to project or measure dose.

a In the intermediate and late phases, standard worker protections, including the 5 rem occupational dose limit, would normally apply.

b The projected sum of the effective dose equivalent from external radiation exposure and committed effective dose equivalent from internal radiation exposure.

c EPA's 1992 PAG Manual states, "Situations may also rarely occur in which a dose in excess of 25 rem for emergency exposure would be unavoidable in order to carry out a lifesaving operation or avoid extensive exposure of large populations." Similarly, the National Council on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP) raise the possibility that emergency responders might receive an equivalent dose that approaches or exceeds 50 rem (0.5 Sv) to a large portion of the body in a short time (NCRP 1993). If lifesaving emergency responder doses approach or exceed 50 rem (0.5 Sv) emergency responders must be made fully aware of both the acute and the chronic (cancer) risks of such exposure.

The PAGs and Emergency Worker Guidelines are dose-based, and it is often difficult to readily measure the dose. Therefore, a need exists for operational measurements of radiation levels, or concentrations in various media, that can be related to the PAGs to facilitate decisions regarding the need for protective actions. As a result, operational guidelines are prederived levels of radioactivity or radionuclide concentrations in various media that can be measured in the field and compared to the PAGs to quickly determine if protective actions are warranted. For example, in the hours and days following an incident, there could be an urgent need for decisions about evacuation or relocation of the public. Determinations regarding critical infrastructures such as access to roads and medical facilities, as well as restoration of power, water, and sewer facilities, may also have to be made. Although some values already exist (e.g., derived response levels [DRLs] from the Federal Radiological Monitoring and Assessment Center [FRMAC] for generic cases, from the U.S. Environmental Protection Agency [EPA] for water, and derived intervention levels [DILs] from the U.S. Food and Drug Administration [FDA] for food) that could potentially serve as operational guidelines, many more were needed for handling various situations.

1.1.2 Relationship of Operational Guidelines to PAGs and Other Guidelines

The operational guidelines in this report complement related guidelines called DRLs published by FRMAC. The DRLs support implementation of the current EPA PAG Manual. The operational guidelines presented here and the FRMAC DRLs are analogous, but have been developed to address different audiences.

The DHS PAGs were promulgated to extend the scope of existing federal guidance (EPA's PAGs) to specifically address RDDs and INDs. The EPA PAGs were designed to be generic to all radiological accidents or incidents, although they were principally designed for nuclear power plant accidents. The two sets of PAGs are generally compatible; a revised version of the EPA PAGs (currently in draft) subsume the DHS PAGs and are fully compatible.

The FRMAC DRLs are derived for generic radiological disasters and are designed to address the early phase and initial portion of the intermediate phase of a radiological accident or incident. They are valid in general and most appropriate for suburban or rural areas. The operational guidelines are derived specifically to address RDDs with an emphasis on issues unique to a dense urban area during the later portion of the intermediate phase and the late phase, and to suburban and rural areas during the late phases, of response. The operational guidelines

are immediately applicable to an RDD involving any of the 11 most likely radionuclides expected to be employed for an RDD (Am-241, Cf-252, Cm 244, Co 60, Cs 137, Ir-192, Po-210, Pu-238, Pu-239, Ra-226, and Sr-90). The FRMAC DRLs are adequate and appropriate for immediate application to any radiological event, including RDDs, especially if more than one radionuclide is involved or if the radionuclide is unknown. Differences will arise between these operational guidelines and FRMAC DRLs because of the tailoring of computations to make them less generic and more incident-specific.

1.1.3 Operational Guidelines Development Process

Appropriations language from House Report 108-076, "Making Emergency Wartime Supplemental Appropriations for the Fiscal Year 2003, and for Other Purposes," directed the U.S. Department of Energy (DOE) "to develop standards for the cleanup of contamination resulting from a potential RDD event" (U.S. Congress 2003). In response to this direction and the needs highlighted above, DOE (working through DHS) established the interagency Operational Guidelines Task Group (OGT), a technical support element of the CMS, to develop preliminary operational guidelines for a wide range of property types (e.g., vehicles, roads and bridges, residential and commercial buildings and lands, and special use areas such as parks and monuments) likely to be affected by an RDD incident. The strategic objective of the operational guidelines initiative was to provide numerical guidelines, along with end-user guidance and assistance tools for implementation, that could be incorporated into Federal and State planning and response documents and used by decision makers and first responders in emergency preparedness and emergency response activities.

The OGT consists of regulatory and subject matter experts in radiological and nuclear preparedness and response from many agencies and organizations, including the EPA, U.S. Nuclear Regulatory Commission (NRC), U.S. Department of Defense (DOD), Centers for Disease Control and Prevention (CDC), National Institute of Standards and Technology (NIST), DOE, FRMAC, Washington State Department of Health, and others. The OGT also included health physicists and radiological dose and risk assessment modelers from Argonne National Laboratory (ANL) as a core technical resource, with additional health physics support from Dade Moeller and Associates (DM&A). The OGT coordinated its work through conference calls,

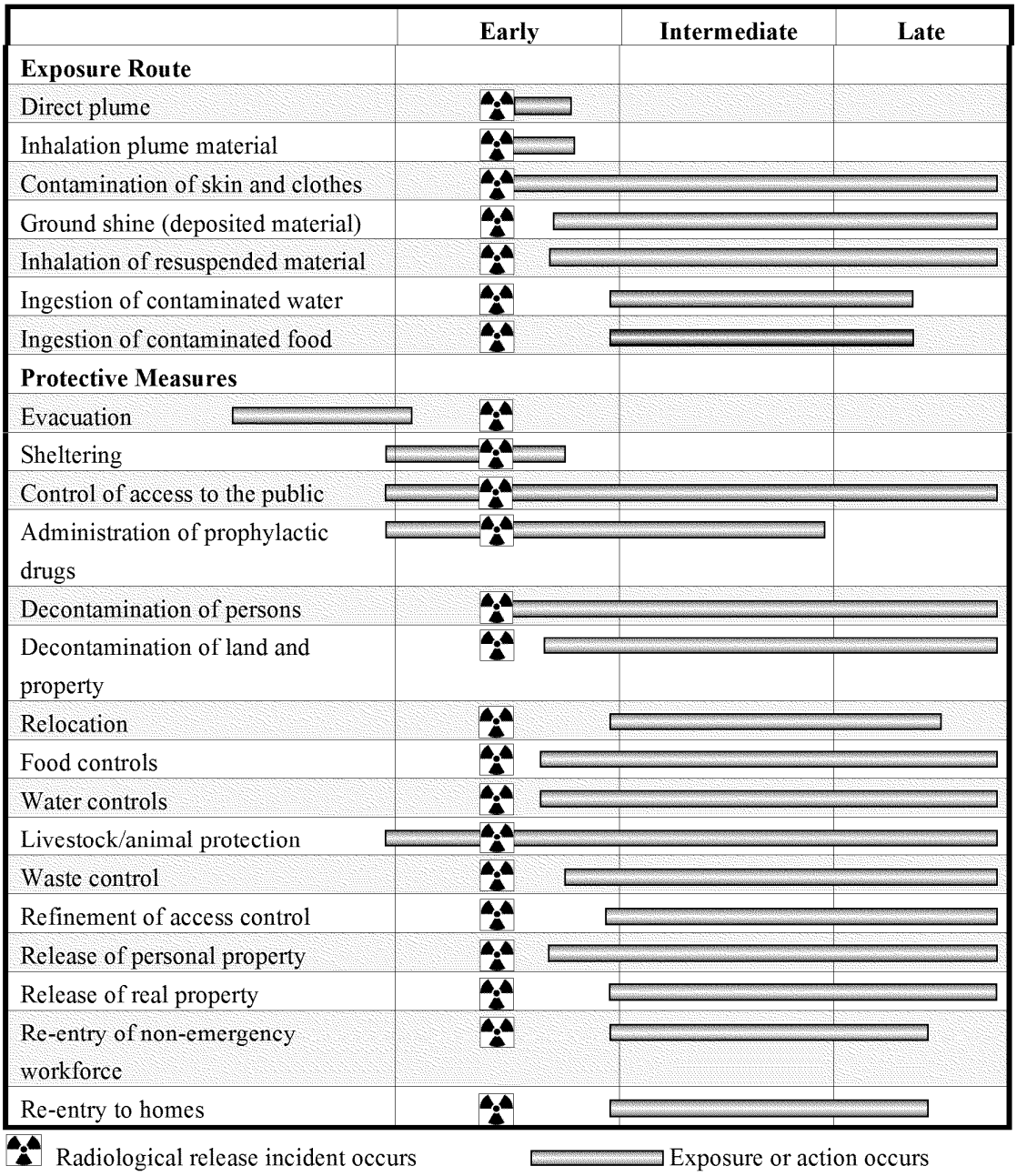

FIGURE 1.1 Relationships among Exposure Routes, Protective Measures, and Time Frames for Effects[1,2]

formal meetings, and use of the OGT Web site. A set of core guiding principles was agreed upon

1 For some activities, the figure indicates that protective actions may be taken before a release occurs. This would be the case if authorities have prior warning about a potential RDD/IND incident.

2 In certain circumstances, food and water interdiction may occur in early phases. In addition, some exposure routes (e.g., ingestion of contaminated food) may occur earlier than depicted in the figure, depending on the unique characteristics of the incident.

by the OGT as a foundation for the consensus-based approach used to develop the guidelines (Table 1.3). Individual OGT members volunteered to serve as "lead coordinators" for each of the operational guidelines groups and subgroups being developed. Lead coordinators generally served as the primary OGT points of contact for facilitating the review and comment of draft operational guidelines products by all OGT members, and leading and summarizing discussions within the OGT on the resolution of comments and refinement of work products, with a goal of achieving a consensus among all OGT members on the appropriate operational guidelines.

TABLE 1.3 Guiding Principles Used to Focus the Development of Operational Guidelines within the OGT

1. Be consistent with PAGs developed through Federal consensus.
2. Strive for consistency with PAGs to be incorporated into the revision of the EPA PAG Manual (EPA 1992).
3. Strive for consistency with available methodologies from FRMAC.
4. Document the rationale and benefits of approaches that might be different from or represent refinements to FRMAC methodologies. Use these to foster improvements to available FRMAC methodologies.
5. Apply the current state of science in radiation protection appropriate for addressing an RDD.
6. Apply a consensus-based process, obtain independent technical peer review, and seek public comment on key products and resources.
7. Respect the views and contributions of fellow OGT members as well as the integrity of OGT work products.

1.2 OPERATIONAL GUIDELINE GROUPS AND SUBGROUPS

The operational guidelines are organized into seven groups that are generally categorized by the phase of emergency response in which they would be implemented or used for planning purposes. Individual groups are further categorized into subgroups as appropriate. Table 1.4 provides a summary of the operational guideline groups and subgroups. A detailed overview of these groups and subgroups is provided below.

TABLE 1.4 Operational Guidelines: Groups and Subgroups

Groups	Subgroups

A. Access control during emergency response operations	1. Life- and property-saving measures 2. Emergency worker demarcation
B. Early-phase protective action	1. Evacuation 2. Sheltering
C. Relocation from different areas and critical infrastructure utilization in relocation areas	1. Residential areas 2. Commercial and industrial areas 3. Other areas, such as parks and monuments 4. Hospitals and other health care facilities 5. Critical transport facilities 6. Water and sewer facilities 7. Power and fuel facilities
D. Temporary access to relocation areas for essential activities	1. Worker access to businesses for essential actions 2. Public access to residences for retrieval of property, pets, records
E. Transportation and access routes	1. Bridges 2. Streets and thoroughfares 3. Sidewalks and walkways
F. Release of property from radiologically controlled areas	1. Personal property, except wastes 2. Waste 3. Hazardous waste 4. Real property, such as lands and buildings
G. Food consumption	1. Early-phase food guidelines 2. Early-phase soil guidelines 3. Intermediate-phase soil guidelines 4. Intermediate- to late-phase soil guidelines

1.2.1 Group A: Access Control during Emergency Response Operations

These operational guidelines are designed to assist responders in decision making for worker health and safety in the early to intermediate phases of response to an RDD incident when the situation has not been fully stabilized or characterized. They are designed to guide responders in establishing radiological control zones or boundaries for the areas directly impacted by the RDD incident where first responders and emergency response personnel are working. They are not intended to restrict emergency responder access, but rather to inform responders of potential radiological hazards existing in the areas and to provide tools to those persons who are responsible for radiation protection during response activities. These operational guidelines may be used to restrict the access of nonessential personnel and members of the public to specific areas. Examples of operational guidelines developed in this group include life-

and property-saving measures and emergency worker zone demarcation.

Group A operational guidelines are expressed as a series of reference "stay time" tables for responders who may have access to only limited health physics information and personal protective equipment at the time of the response. For example, the health physics information could include or be limited to measurements of the external exposure rate, gross alpha surface contamination, beta/gamma surface contamination, and/or air concentration. Radionuclide-specific correction factors as well as radionuclide-specific and respiratory protection-specific tables are provided. A detailed discussion about these stay time tables is provided in Chapter 3.

1.2.2 Group B: Early-Phase Protective Action (Evacuation or Sheltering)

These operational guidelines are designed to help decision makers make timely protective action decisions, such as evacuation or sheltering of the general public in the early response phase (i.e., the first four days following the incident). Group B operational guidelines are typically expressed as limiting concentrations of radioactivity in ground surface soil. Group B operational guidelines are discussed in Chapter 4.

1.2.3 Group C: Relocation from Different Areas and Critical Infrastructure Utilization in Relocation Areas

These operational guidelines are intended for early- to intermediate-phase protective actions. They are designed for use in deciding whether to relocate the public from affected areas for a protracted period of time. Screening values are provided to delineate areas that exceed the relocation PAGs. These areas include residential areas, commercial/industrial areas, and other areas such as parks, cemeteries, and monuments. Group C operational guidelines also ensure that facilities critical to the public welfare can continue to operate, if needed. These facilities include hospitals, airports, railroads and ports, water and sewer facilities, and power and fuel facilities. These operational guidelines are typically expressed as soil or street-surface contamination concentrations (e.g., pCi/m2). Group C operational guidelines are discussed in Chapters 5 and 6.

1.2.4 Group D: Temporary Access to Relocation Areas for Essential Activities

Group D operational guidelines pertain to intermediate-phase protective actions. They are

designed to assist in determining the protective action decisions or restrictions necessary to allow for temporary access to relocation areas. For example, the public or owners/employees of businesses may need temporary access to residences or commercial, agricultural, or industrial facilities in order to retrieve essential records, conduct maintenance to protect facilities, prevent environmental damage, attend to animals, or retrieve pets. These operational guidelines describe the level at which these actions can be taken without radiological supervision. The public or employees may occasionally access (i.e., a few days per month) areas that do not exceed these guidelines. Temporary access to relocation areas that exceed these levels should be permitted only under the supervision or with the permission of radiation protection personnel. Examples of these operational guidelines include worker access to businesses for essential actions and public access to residences for retrieval of critical property, pets, or records. They are typically expressed in terms of stay times during which the public or employees may access the areas without receiving the prescribed dose. Group D operational guidelines are discussed in Chapter 7.

1.2.5 Group E: Transportation and Access Routes

These operational guidelines apply to intermediate-phase protective actions. They are designed to assist in determining whether transportation routes (e.g., bridges, highways, streets) or access ways (e.g., sidewalks and walkways) may be used by the public for general, limited, or restricted use. The relocation PAGs serve as the basis for the operational guidelines for general access. For example, operational guidelines may be defined for industrial or commercial use of various roads, bridges, or access ways. These may be necessary to allow for access between nonrelocation areas via a highway that passes through a relocation area or for access to emergency recovery activities in the immediate area of an incident. These operational guidelines assume regular or periodic use and are not appropriate for one-time events, such as evacuation or relocation actions. They are typically expressed as surface contamination concentrations (e.g., pCi/m2). Group E operational guidelines are discussed in Chapter 8.

1.2.6 Group F: Release of Property from Radiologically Controlled Areas

Group F operational guidelines are intended for intermediate to long-term recovery-phase protective actions. During response and recovery operations, property and wastes (e.g., vehicles, equipment, debris and nonradiological wastes, hazardous waste, buildings and land, etc.) must be cleared from radiologically controlled areas (relocation areas). These operational guidelines support such actions. Because retrieval of cleared or released properties will be difficult, wherever practicable, these levels should be similar to those likely to define late-phase goals. For this reason, they should not be applied to property that will remain in use in controlled areas. These operational guidelines should also be used for screening property that was located outside the controlled area. In general, the operational guidelines in this group provide reasonable assurance that the cleared property is acceptable for long-term unrestricted use (or designated disposition, in the case of wastes) without further reassessment. Property includes personal property, debris and waste, hazardous waste, and real property (i.e., buildings and lands). The operational guidelines for release of real property are discussed in Chapter 9. The operational guidelines for release of contaminated vehicles are discussed in Chapter 11.

It is noteworthy to highlight that, in particular, operational guidelines for real property (subgroup F4, buildings and lands) are designed to support implementation of the CMS's risk management framework, as presented in the PAGs for RDD and IND incidents (73 FR 149). The CMS risk management framework for addressing long-term cleanup and recovery incorporates the principles of optimization, stakeholder involvement, and shared accountability. Subgroup F4 guidelines are unique in that there is no one specific predefined numerical criterion (e.g., expressed in terms of dose or risk) on which to base protective action decisions. These guidelines are intended to be applied in the optimization process, which will likely consider the magnitude and extent of the contamination and the radionuclide(s) involved, proposed long-term land and building use in the affected areas, degree of need for expedited recovery, public welfare issues, cost impacts for each proposed cleanup option, ecological considerations, and other factors. Group F4 operational guidelines are provided as reference values (e.g., soil and building surface concentrations or risks) that can be used as a starting point for evaluating optimization process attributes and impacts relative to a range of dose or risk-based benchmarks (e.g., 500, 100, 25, or 4 millirem per year; comparative lifetime risk ranges, and others) that could be considered as part of recovery phase options. Thus, they are not regulatory dose limits or criteria, but serve as concentration values that provide perspective and aid in the optimization analyses.

1.2.7 Group G: Food Consumption

Group G operational guidelines apply to early through long-term recovery phase protective actions, as needed. They are designed to aid in decision making about the need for placing restrictions on consumption of potentially contaminated foods or on agricultural activities during and following an RDD incident.

Four subgroups of operational guidelines were developed, which are intended for use in conjunction with operational guidelines for other groups. Subgroup G.1 guidelines pertain to the early response phase immediately after the RDD incident. These guidelines can be used to screen against measured concentrations taken from previously harvested food or from animal products exposed during the incident. Subgroup G.1 guidelines also can be used to determine the need for placing an embargo and consumption restrictions on contaminated foods. Subgroup G.2 guidelines also apply to the early phase of response, but they are intended for use in evaluating crops or animal products exposed during the RDD incident (e.g., after the plume has passed). They serve as a comparison with measured concentrations taken from surface soil in which plant foods and fodder had been growing during the incident. Subgroups G.3 and G.4 are intended for the intermediate to long-term recovery phases and can be used for placing land use restrictions on agricultural activities after an RDD incident. They can be used to determine if crops can be grown on residually contaminated soil to produce a harvest that would be acceptable for public consumption. These operational guidelines are discussed in detail in Chapter 10.

1.3 MODELING OF RDD SCENARIOS AND DERIVATION OF OPERATIONAL GUIDELINES

The core methodology and modeling employed in deriving the operational guidelines was developed through a consensus-based process that involved all OGT members. Operational guidelines (Groups A-G), which correspond to specific PAGs, were derived for 11 potential RDD radionuclides: Am-241, Cf-252, Cm-244, Co-60, Cs-137, Ir-192, Po-210, Pu-238, Pu-239, Ra-226, and Sr-90. These radionuclides were determined by a joint DOE and NRC study to be the most likely sources available for potential terrorist use in an RDD (DOE/NRC 2003). For the early response phase (Group A), a straightforward concentration method or an exposure-to-dose conversion method was used to derive stay time tables. For the late response phase (Group F), the probabilistic RESRAD and RESRAD-BUILD programs (Yu et al. 2001, 2003) were used to derive property release criteria. The concepts and overarching methodology used to derive

operational guidelines for RDD-related radionuclides could also be generally applied, with modifications, to radionuclides associated with an IND.

The methodology developed for the intermediate response phase (Groups B-E) assumes that an outdoor RDD event would contaminate streets, soils, and building surfaces with radioactive materials. Building interiors would also be contaminated as a result of air exchange and human traffic. The methodology can be modified for an indoor RDD event by considering different source partitioning factors. The model considers decay, weathering, a time-dependent resuspension factor, and concentration ratios (partitioning factors) between contaminated areas. A set of exposure pathways was considered in the model: external exposure from contaminants on streets, soils, and buildings; inhalation of dust particles; external exposure from submersion; ingestion of dust particles and plant foods; and indoor radon inhalation. Operational guidelines for each group were derived by using a systematic approach in which (1) applicable scenarios for each group were defined, (2) appropriate receptors for each scenario were identified, and (3) the receptor doses from applicable exposure pathways were estimated. A detailed discussion of the specific methodologies and approaches used to derive the operational guidelines is provided in Chapter 2.

1.4 ADDITIONAL EXPOSURE SCENARIOS AND OPERATIONAL GUIDELINES

Chapter 11 presents additional RDD incident scenarios that were analyzed to support the derivation of the operational guideline groups and subgroups described earlier. Two of these additional scenarios involve the use of water to flush streets and clean vehicles. Accordingly, operational guidelines for street flushing and cleaning contaminated vehicles are provided.

1.5 COMPANION SOFTWARE TOOL FOR FACILITATING IMPLEMENTATION OF OPERATIONAL GUIDELINES

A companion software tool, RESRAD-RDD, was developed to facilitate application of the default set of operational guidelines and to allow calculation of incident-specific operational guidelines through application of user-specified assumptions and environmental transfer parameters that correspond to exposure pathways for incident-specific analyses. The software tool utilizes elements of other codes already within the RESRAD family of codes, along with newly derived models and supporting parameters specific to the RDD scenarios used to

determine the operational guidelines. A detailed overview of the RESRAD-RDD software tool and a general user's guide is provided in Chapter 12 of this report.

1.6 COORDINATION OF OGT AND DEVELOPMENT OF OPERATIONAL GUIDELINES WITH FRMAC AND FRMAC ASSESSMENT METHODS

Consistent with the OGT's guiding principles, development efforts for the operational guidelines were coordinated with FRMAC on several occasions. Coordination was achieved through participation of FRMAC representatives in OGT conference calls and meetings, and through OGT representation in a FRMAC Assessment Working Group meeting. Coordination between the DOE's Office of Emergency Response and Office of Nuclear Safety, Quality Assurance, and Environment helped to foster FRMAC–OGT relationships and ensure harmonization of approaches and tools for emergency response being developed through these initiatives. The goals of the coordination were (1) to identify areas of consistency between OGT methods and operational guidelines with existing FRMAC assessment methods for response to more traditional radiological incidents (e.g., nuclear power plant accidents), and (2) to determine the rationale and benefits of OGT approaches that might differ from, or represent refinements to, FRMAC methodologies, which might be applied in future improvements to currently available FRMAC methodologies.

A key activity that resulted from this coordination and set of goals was a methods comparison exercise that involved independent OGT and FRMAC analysis of mutually agreed upon, predefined assessment scenarios, sample data, and decision-support questions that could likely be expected in the event of a radiological incident. The OGT analysis of and results from the OGT/FRMAC methods comparison exercise is provided in Chapter 13 of this report.

Draft versions of this report were coordinated through the Office of Emergency Response and FRMAC for comments. A complete discussion and analysis of review comments received is provided in Chapter 14 of this report. Through this review and comment process, useful input was provided, especially on some of the parameters (e.g., breathing rates, resuspension factor, ground roughness factor, and soil ingestion rate) used in the OGT methodology. The general comments were positive, and no significant issues were identified.

The review cited that:

"The OGT report is seen as an important contribution to response readiness in three key ways:

- First, the OGT work addressed the problem of an RDD in a congested urban environment. FRMAC has prepared six generic 'Pre-Assessed Default Scenarios,' which provide 'operational guidelines' tailored to specific scenarios. The OGT work complements and supplements the recently published FRMAC Pre-Assessed Default Scenario for RDDs.

- Secondly, the OGT work addresses topics associated with the later Intermediate Phase and Late Phase. FRMAC has only addressed the Early Phase and initial portion of the Intermediate Phase. Thus the work of the groups is again quite complementary.

- Finally, OGT has illuminated new methods that will be very useful for analyzing more complex cases, particularly those found after the Early Phase. Clearly, RESRAD has an important role in radiological assessment in the later phases. It is expected that RESRAD-RDD will become an important FRMAC assessment tool."

The review also provided a comparison of OGT operational guidelines and FRMAC's default DRLs and pointed out that some differences are large for a few radionuclides. After examining the parameters and dose factors used in both methods, the differences can be reduced to minimum, and, in some cases, would be negligible, if the parameters and dose factors were made the same. Chapter 14 of this report has a detailed discussion on this comparison study.

Finally, review comments were provided on the OGT food operational guidelines presented in Chapter 10. These food operational guidelines are derived using current state-of-science methods and dose conversion factors. As suggested, Chapter 10 was sent to FDA for a final review, and no issues were identified by FDA.

1.7 REFERENCES

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2 RDD OPERATIONAL GUIDELINES METHODOLOGY: CONCEPTUAL MODEL AND SENSITIVE PARAMETERS

2.1 INTRODUCTION

This chapter describes the model used to assess doses after an RDD event and discusses the assumptions involved in its application. This model is applicable for deriving operational guidelines for Groups B–E (Chapters 4–7) in the early and intermediate response phases. To derive operation guidelines for Group F (release of real property from a radiologically controlled area) in the late response phase, the probabilistic RESRAD code (Yu et al. 2000, 2001) was used for soil contamination, and the probabilistic RESRAD-BUILD code (Yu et al. 2003) was used for building contamination. The conceptual model developed here is mainly applicable to situations after the direct plume phase is over. It was assumed that surface concentrations of dispersal radionuclides were known (i.e., measured). The model was designed for flexibility and ease of application under a variety of conditions. It was developed specifically for the derivation of operational guidelines and/or stay time tables for Groups B–E.

The model assumes that an RDD event occurred outdoors and contaminated streets and soils, exterior walls and roofs of buildings, and interior walls and floors of buildings with radioactive materials. With some modifications, the model can also be used for an RDD event occurring inside a building. The model considers default concentration ratios (partitioning factors) between streets/soils and other contaminated areas, accounts for change in surface concentration over time (includes decay and weathering), and uses a time-dependent resuspension factor to calculate air concentration.

To derive operational guidelines for each group (Groups B–E), different receptors were considered. The doses from different exposure pathways and contaminated areas were added to arrive at the total dose for an individual receptor. The RESRAD-BUILD computer code was used to calculate the external exposure and radon inhalation pathway doses. The dose for the critical receptor was used to derive the operational guideline for a particular group.

The operational guidelines were derived for 11 radionuclides: Am-241, Cf-252, Cm-244, Co-60, Cs-137, Ir-192, Po-210, Pu-238, Pu-239, Ra-226, and Sr-90. It was assumed that the short-lived (half-life <30 days) progenies with half-life <30 days are in equilibrium with the parent nuclide. For example, Sr-90 is assumed to be in equilibrium with its short-lived progeny Y-90.

Calculations indicated that for Groups B–E, the long-lived progeny contribution to the dose for these 11 radionuclides would not be significant for at least the first 9 years after the RDD event. However, the radon dose from Ra-226 was computed separately. For Group B, which corresponds to operational guidelines for early phase protective action (evacuation or sheltering), the PAGs are 1 rem (for the general public) or 5 rem (for early response workers). The early phase was defined as the first four days following the RDD event. For Groups C–E, the PAG for occupational exposure is 5 rem/yr. For the general public, the PAGs are 2 rem/yr for the first year and 0.5 rem/yr for subsequent years. Unless otherwise specified, the doses calculated were the average yearly dose for the first and second years. For Group F, the PAG is optimization, not to exceed 0.1 rem annually. The operational guidelines were derived on the basis of two PAGs (0.1 and 0.004 rem).

2.2 CONCEPTUAL MODEL

The conceptual model of radiological contaminant transport following an RDD event is illustrated in Figure 2.1. It was assumed that the RDD event occurred outdoors. It was also assumed that the event resulted in surface contamination on the streets (in an urban/suburban environment) or soil (in a rural environment) and on the exterior walls and roof of residential/commercial building. In addition, the contaminants were assumed to get inside the residential/commercial building and be deposited on indoor floors and walls, either directly during the event through open windows or indirectly after the event through indoor/outdoor air exchange or through contaminants trapped to the bottom or on the surface of shoes of people who entered the building.

The model accepts input surface concentration ratios between outdoor walls, roof, indoor floor, and indoor walls, respectively, to soil/street. If the surface concentration ratios are not known, the model calculates dose values using the default relative ratios of 0.5, 1.0, 0.1, and 0.05 for surface concentrations for outdoor walls, roof, indoor floor, and indoor walls, respectively, to soil/street. The indoor wall concentration was assumed to be half (factor of 0.5) the concentration of the floor contamination, which is consistent with indoor deposition patterns (Raunemaa et al. 1989). The outdoor wall concentration was also assumed to be a factor of 0.5 of the soil/street contamination. The concentrations on outdoor walls actually could be much lower than the soil/street contamination level (Andersson et al. 2003).

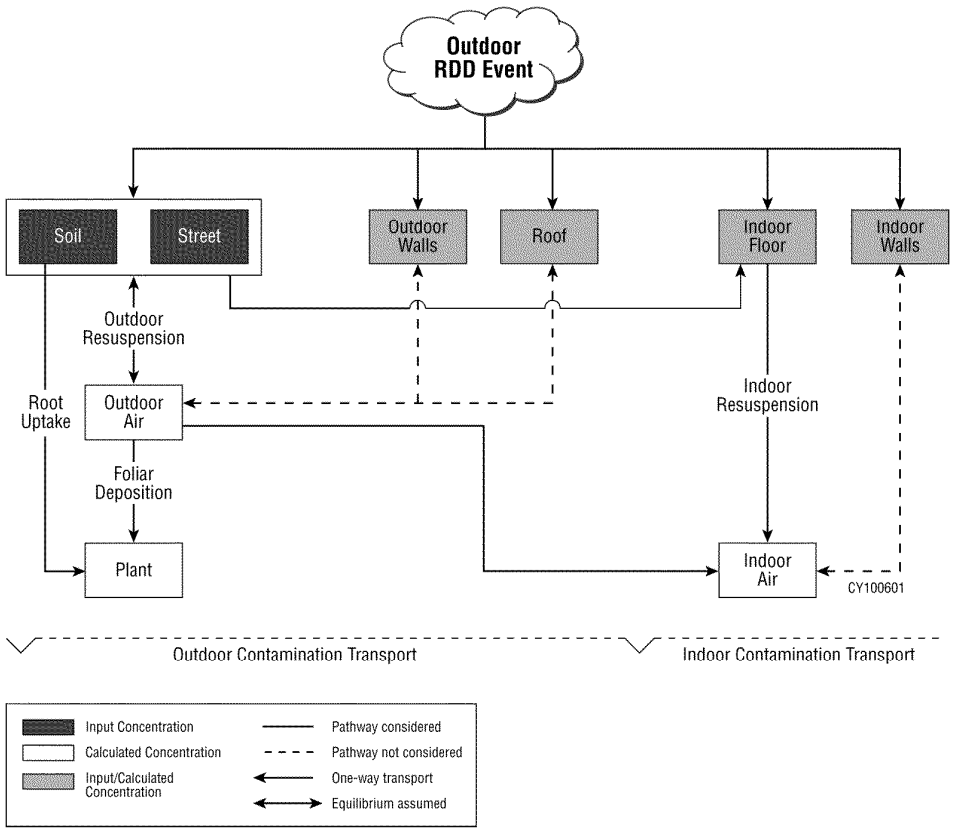

FIGURE 2.1 Conceptual Model of Environmental Transport after an RDD Event

At a minimum, soil/street surface concentration data should be available to use with this model. If data become available for other surfaces or surface measurements indicate other partitions, these other values can be used to obtain specific guidelines.

The surface contamination results in external exposure and inadvertent ingestion of contaminated dust particles deposited on the surface. The external dose was corrected by a factor that accounts for radioactive decay and weathering. In accordance with the specific scenarios developed for various operational groups, different dimensions were used for the commercial/residential buildings.

As shown in Figure 2.1, the secondary contamination sources include the outdoor air resulting from resuspension. A time-dependent resuspension factor accounting for weathering, source depletion, and radioactive decay was applied. In addition, the average resuspension factor

was corrected to account for vehicular traffic. In accordance with the scenario defined for each operational group or subgroup, the resuspension factor was averaged over the appropriate time period, and the resulting outdoor air concentration was used to calculate the outdoor inhalation and submersion dose.

Another secondary contamination source shown in Figure 2.1 is indoor air contamination. It represents computed values and has two components. The exposure of a receptor inside the building is from the outdoor contaminated air, as well as through the resuspension of contaminated material deposited on the floor. A distribution function was developed for the indoor dust filtration factor (Yu et al. 2000). The dust filtration factor represents the fraction of outdoor contaminated dust that is available indoors. The median value (0.55) from this distribution was assumed for the ratio of indoor to outdoor air. The indoor resuspension factor was assumed to be constant at 10^{-6} m^{-1} (IAEA 2002; NRC 2001; EPA 1991). The calculated contaminated indoor air concentration was then used to compute the indoor inhalation and submersion dose. Plants also may get contaminated from foliar deposition and root uptake, but the dose contribution from the plant ingestion pathway was not included in deriving the operational guidelines for Groups B–E.

2.3 EXPOSURE PATHWAYS

The model considers the following exposure pathways for a receptor:

1. External exposure (groundshine) to contaminants on streets/soils while staying outdoors,

2. External exposure to contaminants on exterior walls while staying indoors,

3. External exposure to contaminants on roofs while staying indoors,

4. External exposure to contaminants on interior walls while staying indoors,

5. External exposure to contaminants on interior floors while staying indoors,

6. External exposure to contaminants on streets/soils while staying indoors,

7. Inhalation exposure while staying outdoors (resuspension of contaminants from streets/soils only),

8. Inhalation exposure while staying indoors (indoor air contamination results from both outdoor air contamination and resuspension from contaminants on interior floors),

9. Submersion in contaminated air while staying outdoors,

10. Submersion in contaminated air while staying indoors,

11. Ingestion of dust particles on streets/soils while staying outdoors,

12. Ingestion of dust particles while staying indoors (assumed to be from the floors or walls, whichever is more conservative),

13. Radon inhalation while staying indoors.

Outdoor radon concentration was expected to be much smaller than indoor radon concentration because of the large dilution in an open environment. Therefore, the radiation dose from radon inhalation while staying outdoors was not included in the model.

The operational guidelines for Groups B–E were derived on the basis of appropriate exposure scenarios. The computations involved in the derivations were coded in a series of spreadsheets that are directed by a master sheet accepting input parameter values. These spreadsheets are the precursor of the RESRAD-RDD software. To obtain incident-specific operational guidelines for Groups B-E, the RESRAD-RDD user may input measured concentration ratios and adjust transfer factors as that information becomes available. The operational guidelines for Group F (release of real property) were obtained by using the RESRAD (onsite) code to simulate a subsistence farmer scenario for soil contamination and the RESRAD-BUILD code to simulate building occupancy scenarios for building contamination.

2.4 SENSITIVE PARAMETERS

The generic guidelines for each operational guideline group were developed on the basis

of several assumptions and the corresponding parameter values. The common and most sensitive scenario parameters were as follows:

- Outdoor and indoor resuspension factors,
- Multiplication factor for outdoor resuspension, to account for vehicular traffic,
- Dust ingestion rate,
- Indoor/outdoor exposure duration and duration in different environments,
- Indoor/outdoor inhalation rates, and
- Building dimensions for external exposure.

The scenario-specific parameters used to derive the operational guidelines for each group (Groups B–E) are discussed in the subsequent chapters for each group. Probabilistic dose analysis was performed for Group F, and the default parameter distribution values in the RESRAD and RESRAD-BUILD codes were used. The 50th percentile and mean + 2σ values from peak dose/source ratio distributions were used to derive operational guideline values for Group F.

2.5 WEATHERING CORRECTION

Surface contamination would result in external exposure, inadvertent ingestion of contaminated dust particles deposited on the surface, and inhalation of contaminated air resulting from resuspension of dust particulates from contaminated surfaces.

It was observed from the Chernobyl accident data that in an urban environment, different surfaces have different initial retentions when compared with the reference surface and that they behave differently over time (Andersson et al. 2003). The reference surface was defined as an infinite smooth (surface with no roughness associated with it) air-ground interface with radionuclides deposited on the ground with no initial penetration. According to the Andersson study, the weathering process and the effect of migration generally follow a two-class

exponential behavior with time, as represented by Equation 2.1:

$$w(t) \quad = \quad a\, e^{-(bt)} + (1-a)\, e^{-(ct)}, \tag{2.1}$$

where $w(t)$ is the activity fraction retained after weathering at time t, and a, b, and c are parameters for each surface. In this equation, there is a mobile fraction a with a shorter half-life b due to loose binding to the surface or due to the higher migration rate in the case of permeable surfaces. There is also a fixed fraction $(1 - a)$ with a longer half-life c due to strong binding to the surface or the lower migration rate. Table 2.1 summarizes the values for these parameters for various media. The data were collected primarily for Cs-137, but are used as defaults for other radionuclides in the analysis. However, the user may input radionuclide-specific values in the RESRAD-RDD software if data are available. It is expected that the longer half-life c is more likely to be radionuclide dependent. For the short time period (less than a few years) considered in the derivation of operational guidelines and stay-time tables, this radionuclide dependency of the longer half-life may not be important.

External and ingestion pathway doses from different contaminated media (surfaces) were corrected by a factor that accounts for radioactive decay and weathering. The average weathering correction from time t_1 to t_2, which includes correction for radioactive decay, can be given by Equation 2.2:

$$\overline{WCF} = \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} [\, a\, e^{-(bt)} + (1-a) e^{-(ct)} \,] e^{-\lambda t} dt \quad . \tag{2.2}$$

The weathering correction factors reported by Andersson et al. (2003) are for outdoor surfaces. In the dose assessments, the weathering correction factors for the outdoor soil/street were also applied to the interior floor, and those for exterior walls were applied to interior walls,

TABLE 2.1 Weathering and Migration of Contaminants for Urban Surfaces

Surface	Mobile Fraction (a)	Shorter Half-Life (ln2/b), yr	Longer Half-Life (ln2/c), yr
Windows	0.8	0.2	2
Vertical walls	0.2	0.2	20
Roofs with tiles	0.5	1–4	25–50

Paved areas	0.5	0.2	2
Trees	0.8	0.2	2
Lawn	0.46	1.5	50

Source: Andersson et al. (2003).

to consider the transport of contaminants by human activities (e.g., walking from outdoors to indoors) and air exchange.

The average weathering correction factors for different radionuclides were calculated for the first and second year, as well as for short durations (first 4 days, first 2 weeks, and 6 months) of exposure. The first 4-day period was considered because it was assumed in the operational decision making on evacuation or sheltering (Group B) that the early phase would last for 4 days. The 6-month period was considered because it was assumed (in the description for the operational guideline Group C) that the remediation for critical infrastructure could be completed within this period. Similarly, the correction factors for the first 2 weeks of exposure were used in Group C dose assessment and guideline calculations. Table 2.2 provides the correction factors for various surfaces and radionuclides. The operational decision making on evacuation and sheltering (Group B) also involved guideline derivation based on FRMAC methodology (Rhodes et al. 2003a). To simulate the FRMAC methodology, it was assumed that the mobile fraction (a) was 0.4 with half-life of 1.505 years and that the half-life for the fixed fraction $(1-a)$ was 49.5 years.

2.6 RESUSPENSION FACTOR CORRECTION

Walsh (2002) reviewed two types of resuspension methodologies — those using a resuspension factor and those using a dust-loading approach — and found that resuspension factor methodology is appropriate for use with fresh deposits and, therefore, is applicable to emergency response. For these situations, Walsh (2002) recommends a time-dependent resuspension factor based on Garland's formula, modified to account for long-term outdoor resuspension, as shown in Equation 2.3:

$$RF_o(t) = \frac{A}{t} + B \quad , \qquad (2.3)$$

where t is time in days after deposition and the coefficients A (1.2×10^{-6}) and B (1×10^{-9} m^{-1}) were the initial and long-term resuspension factors, respectively. Equation 2.3 is applicable only

for times greater than 1 day; during the first day, a resuspension factor of 1.2×10^{-6} m^{-1} was assumed.

TABLE 2.2 Average Correction Factors

Radionuclide	Streets	Soil	Exterior Walls	Roofs	Interior Floor for Buildings Surrounded by Streets	Interior Floor for Buildings Surrounded by Soils	Interior Walls	Outdoor Air above Streets	Outdoor Air above Soils
Average Correction Factor[a,b] for First Year									
Am-241	5.62E-01	9.04E-01	8.42E-01	9.55E-01	5.62E-01	9.04E-01	8.42E-01	1.60E-08	1.84E-08
Cf-252	5.05E-01	7.99E-01	7.44E-01	8.42E-01	5.05E-01	7.99E-01	7.44E-01	1.56E-08	1.78E-08
Cm-244	5.53E-01	8.88E-01	8.27E-01	9.38E-01	5.53E-01	8.88E-01	8.27E-01	1.59E-08	1.83E-08
Co-60	5.33E-01	8.49E-01	7.91E-01	8.96E-01	5.33E-01	8.49E-01	7.91E-01	1.58E-08	1.80E-08
Cs-137	5.57E-01	8.95E-01	8.33E-01	9.45E-01	5.57E-01	8.95E-01	8.33E-01	1.59E-08	1.83E-08
Ir-192	2.02E-01	2.68E-01	2.53E-01	2.76E-01	2.02E-01	2.68E-01	2.53E-01	1.29E-08	1.38E-08
Po-210	2.98E-01	4.27E-01	4.00E-01	4.44E-01	2.98E-01	4.27E-01	4.00E-01	1.39E-08	1.52E-08
Pu-238	5.60E-01	9.01E-01	8.39E-01	9.52E-01	5.60E-01	9.01E-01	8.39E-01	1.60E-08	1.83E-08
Pu-239	5.62E-01	9.05E-01	8.42E-01	9.56E-01	5.62E-01	9.05E-01	8.42E-01	1.60E-08	1.84E-08
Ra-226	5.62E-01	9.04E-01	8.42E-01	9.55E-01	5.62E-01	9.04E-01	8.42E-01	1.60E-08	1.84E-08
Sr-90	5.57E-01	8.94E-01	8.33E-01	9.45E-01	5.57E-01	8.94E-01	8.33E-01	1.59E-08	1.83E-08
Average Correction Factor[a,b] for Second Year									
Am-241	3.02E-01	7.59E-01	7.59E-01	8.74E-01	3.02E-01	7.59E-01	7.59E-01	5.87E-10	1.45E-09
Cf-252	2.07E-01	5.16E-01	5.15E-01	5.93E-01	2.07E-01	5.16E-01	5.15E-01	4.07E-10	1.00E-09
Cm-244	2.87E-01	7.19E-01	7.19E-01	8.27E-01	2.87E-01	7.19E-01	7.19E-01	5.58E-10	1.38E-09
Co-60	2.50E-01	6.26E-01	6.26E-01	7.20E-01	2.50E-01	6.26E-01	6.26E-01	4.89E-10	1.21E-09
Cs-137	2.93E-01	7.35E-01	7.35E-01	8.46E-01	2.93E-01	7.35E-01	7.35E-01	5.70E-10	1.41E-09
Ir-192	3.07E-03	7.30E-03	7.11E-03	8.27E-03	3.07E-03	7.30E-03	7.11E-03	6.97E-12	1.64E-11
Po-210	2.36E-02	5.73E-02	5.64E-02	6.53E-02	2.36E-02	5.73E-02	5.64E-02	5.03E-11	1.21E-10
Pu-238	3.00E-01	7.52E-01	7.52E-01	8.65E-01	3.00E-01	7.52E-01	7.52E-01	5.82E-10	1.44E-09
Pu-239	3.03E-01	7.61E-01	7.61E-01	8.76E-01	3.03E-01	7.61E-01	7.61E-01	5.89E-10	1.46E-09
Ra-226	3.03E-01	7.60E-01	7.61E-01	8.75E-01	3.03E-01	7.60E-01	7.61E-01	5.88E-10	1.46E-09
Sr-90	2.93E-01	7.34E-01	7.35E-01	8.45E-01	2.93E-01	7.34E-01	7.35E-01	5.69E-10	1.41E-09

TABLE 2.2 (Cont.)

Radionuclide	Streets	Soil	Exterior Walls	Roofs	Interior Floor for Buildings Surrounded by Streets	Interior Floor for Buildings Surrounded by Soils	Interior Walls	Outdoor Air above Streets	Outdoor Air above Soils
Average Correction Factor[a,b] for 6 Months									
Am-241	6.97E-01	9.49E-01	8.88E-01	9.77E-01	6.97E-01	9.49E-01	8.88E-01	3.04E-08	3.35E-08
Cf-252	6.58E-01	8.90E-01	8.34E-01	9.16E-01	6.58E-01	8.90E-01	8.34E-01	2.99E-08	3.29E-08
Cm-244	6.91E-01	9.40E-01	8.80E-01	9.68E-01	6.91E-01	9.40E-01	8.80E-01	3.03E-08	3.34E-08

Co-60	6.77E-01	9.19E-01	8.61E-01	9.46E-01	6.77E-01	9.19E-01	8.61E-01	3.01E-08	3.32E-08
Cs-137	6.94E-01	9.44E-01	8.83E-01	9.72E-01	6.94E-01	9.44E-01	8.83E-01	3.03E-08	3.35E-08
Ir-192	3.66E-01	4.62E-01	4.38E-01	4.72E-01	3.66E-01	4.62E-01	4.38E-01	2.57E-08	2.73E-08
Po-210	4.81E-01	6.27E-01	5.91E-01	6.43E-01	4.81E-01	6.27E-01	5.91E-01	2.75E-08	2.97E-08
Pu-238	6.96E-01	9.47E-01	8.87E-01	9.75E-01	6.96E-01	9.47E-01	8.87E-01	3.03E-08	3.35E-08
Pu-239	6.97E-01	9.49E-01	8.88E-01	9.77E-01	6.97E-01	9.49E-01	8.88E-01	3.04E-08	3.35E-08
Ra-226	6.97E-01	9.49E-01	8.88E-01	9.77E-01	6.97E-01	9.49E-01	8.88E-01	3.04E-08	3.35E-08
Sr-90	6.93E-01	9.43E-01	8.83E-01	9.72E-01	6.93E-01	9.43E-01	8.83E-01	3.03E-08	3.35E-08
Average Correction Factor[a,b] for 2 Weeks									
Am-241	9.65E-01	9.96E-01	9.87E-01	9.98E-01	9.65E-01	9.96E-01	9.87E-01	2.55E-07	2.59E-07
Cf-252	9.60E-01	9.91E-01	9.82E-01	9.93E-01	9.60E-01	9.91E-01	9.82E-01	2.54E-07	2.59E-07
Cm-244	9.64E-01	9.95E-01	9.86E-01	9.97E-01	9.64E-01	9.95E-01	9.86E-01	2.55E-07	2.59E-07
Co-60	9.62E-01	9.93E-01	9.84E-01	9.96E-01	9.62E-01	9.93E-01	9.84E-01	2.55E-07	2.59E-07
Cs-137	9.64E-01	9.95E-01	9.86E-01	9.98E-01	9.64E-01	9.95E-01	9.86E-01	2.55E-07	2.59E-07
Ir-192	9.05E-01	9.33E-01	9.25E-01	9.36E-01	9.05E-01	9.33E-01	9.25E-01	2.47E-07	2.51E-07
Po-210	9.32E-01	9.62E-01	9.53E-01	9.64E-01	9.32E-01	9.62E-01	9.53E-01	2.50E-07	2.55E-07
Pu-238	9.65E-01	9.96E-01	9.87E-01	9.98E-01	9.65E-01	9.96E-01	9.87E-01	2.55E-07	2.59E-07
Pu-239	9.65E-01	9.96E-01	9.87E-01	9.98E-01	9.65E-01	9.96E-01	9.87E-01	2.55E-07	2.59E-07
Ra-226	9.65E-01	9.96E-01	9.87E-01	9.98E-01	9.65E-01	9.96E-01	9.87E-01	2.55E-07	2.59E-07
Sr-90	9.64E-01	9.95E-01	9.86E-01	9.98E-01	9.64E-01	9.95E-01	9.86E-01	2.55E-07	2.59E-07

TABLE 2.2 (Cont.)

Radionuclide	Streets	Soil	Exterior Walls	Roofs	Interior Floor for Buildings Surrounded by Streets	Interior Floor for Buildings Surrounded by Soils	Interior Walls	Outdoor Air above Streets	Outdoor Air above Soils
Average Correction Factor[a,b] for 4 Days									
Am-241	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Cf-252	9.88E-01	9.97E-01	9.95E-01	9.98E-01	9.88E-01	9.97E-01	9.95E-01	5.91E-07	5.95E-07
Cm-244	9.89E-01	9.99E-01	9.96E-01	9.99E-01	9.89E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07

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Co-60	9.89E-01	9.98E-01	9.95E-01	9.99E-01	9.89E-01	9.98E-01	9.95E-01	5.92E-07	5.96E-07
Cs-137	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Ir-192	9.71E-01	9.80E-01	9.78E-01	9.81E-01	9.71E-01	9.80E-01	9.78E-01	5.84E-07	5.88E-07
Po-210	9.80E-01	9.89E-01	9.86E-01	9.90E-01	9.80E-01	9.89E-01	9.86E-01	5.88E-07	5.92E-07
Pu-238	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Pu-239	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Ra-226	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Sr-90	9.90E-01	9.99E-01	9.96E-01	9.99E-01	9.90E-01	9.99E-01	9.96E-01	5.92E-07	5.96E-07
Average Correction Factor[a,b] for 4 Days (for FRMAC methodology)									
Am-241	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Cf-252	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	5.95E-07	5.95E-07
Cm-244	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Co-60	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	9.98E-01	5.96E-07	5.96E-07
Cs-137	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Ir-192	9.80E-01	9.80E-01	9.80E-01	9.80E-01	9.80E-01	9.80E-01	9.80E-01	5.88E-07	5.88E-07
Po-210	9.89E-01	9.89E-01	9.89E-01	9.89E-01	9.89E-01	9.89E-01	9.89E-01	5.92E-07	5.92E-07
Pu-238	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Pu-239	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Ra-226	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07
Sr-90	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	9.99E-01	5.96E-07	5.96E-07

a Average correction factors are WCFs for streets, soils, exterior walls, roofs, interior floors, and interior walls. For outdoor air, they are products of the WCF for streets/soil and resuspension factor averaging over the considered period.

b Scientific notation: 5.62E-01 = 5.62×10^{-1}, or 0.562.

However, somewhat different resuspension factor coefficients were used in the FRMAC methodology (Rhodes 2003a), where the coefficient A is 1×10^{-6} (m^{-1}) for days 1 to 1,000 after plume deposition, then changes to zero after 1,000 days; the coefficient B is initially zero for 1,000 days, then changes to 1×10^{-9} m^{-1} for longer times. To be consistent with the FRMAC methodology in the default case, it is assumed that the resuspension factor is fixed at 1×10^{-6} m^{-1} for the first day; for days 1 to 1,000, it varies with time as $1 \times 10^{-6}/t$ (m^{-1}); it then remains fixed at 1×10^{-9} m^{-1} after 1,000 days. The RESRAD-RDD software has the flexibility of accepting two user-defined coefficients, A and B, for use in resuspension factor calculations.

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Combining with the average weathering correction factor discussed in Section 2.5, an average outdoor air concentration correction factor from time $t1$ to $t2$ that accounts for radioactive decay, resuspension, and source depletion due to weathering, can be defined as follows:

$$\overline{WCF \times RF_o} = \frac{\int_{t_1}^{t_2} RF_o(t)[a e^{-(bt)} + (1-a)e^{-(ct)}]e^{-\lambda t} dt}{t_2 - t_1} \quad . \qquad (2.4)$$

This factor is used in the analyses to obtain an average outdoor air concentration of contaminants from a contaminated surface source (see Figure 2.1). As opposed to the integration in Equation 2.2, which has an analytic solution, the integration in Equation 4 was solved numerically by using the Gautschi and Cahill approximation (Gautschi and Cahill 1965). The results of the calculation for the first and second exposure years, as well as for the shorter durations of exposure (first 6 months, 2 weeks, and first 4 days) are also shown in Table 2.2.

In addition to the resuspension factors discussed above, a list of “rule of thumb” multiplication factors is given by Walsh (2002) to adjust for resuspended air concentrations resulting from variations in atmospheric conditions. The multiplication factors (Table 2.3) were used to adjust the average resuspension factors in accordance with the specific scenarios defined in deriving the operational guidelines for Groups B–E.

TABLE 2.3 Multiplication Factors to Be Applied to the Resuspension Factor Results

Condition	Multiplication Factor
Rural conditions, light-medium winds	1
Arid climate	10
Urban conditions, light traffic, light pedestrian activity[a]	10
Urban conditions, heavy traffic	100
Plowing in dry conditions	100

[a] Given that some countermeasures might restrict the movement of vehicles, this factor need not always be applied.

2.7 DOSE CALCULATION

It is assumed that a receptor could be exposed via up to 13 exposure pathways, as described in Section 2.3. To calculate doses, first the dose-to-source ratio (DSR) for each exposure pathway resulting from different contaminated media (street/soil, building roof, exterior walls of the building, interior floor of the building, and interior walls of the building) are calculated by using the relationships discussed previously among the media for each receptor in a group/subgroup. The doses from relevant pathways are then added to obtain the total dose for each receptor.

2.7.1 External Pathway Dose[1]

For pathway 1, a 10,000-m^2 homogenously contaminated surface area is assumed for outdoor external pathway dose calculations. An exception is made for the operational Group B, which involved guideline derivation based on the FRMAC methodology where it is assumed that an infinitely large ground surface is contaminated. The outdoor receptor is assumed to be at the center of the contaminated area. The RESRAD-BUILD computer code is used to calculate the external exposure pathway dose (Yu et al. 2003). The external pathway dose is also corrected for ground roughness; a correction factor of 0.82 based on the default value of Turbo FRMAC 2.0 was used.

1 Pathway numbers correspond to the list of potential exposure pathways given in Section 2.3.

For pathways 2–5, the indoor receptor is assumed to be located at the center of the contaminated building and is exposed to contamination on the floor, indoor walls, outdoor walls, and outdoor roof. The RESRAD-BUILD computer code is used to calculate the external dose (Yu et al. 2003), which is corrected for source configuration, receptor distance from the source, and shielding between the source and receptor. In accordance with the specific scenarios developed for various groups, different dimensions are used for the commercial/residential buildings. Table 2.4 lists different dimensions (geometries) used to calculate the external dose from different contaminated media (roof, exterior walls, interior walls, and floor).

For pathway 6, the external exposure to contaminants on streets/soils while staying indoors is calculated by using the dose-conversion factor (DCF) from contaminated streets/soil corrected by a shielding factor. The FRMAC provides shielding factors for a receptor inside the building from ground surface deposition for different types of structures (Rhodes 2003b). The values vary from 0.4 (one- and two-story wood frame house) to 0.005 (in the basement of a multistory structure). Table 2.4 provides the shielding factor used in different exposure configurations.

The dose from external exposure pathways (pathways 1-6) is calculated by using Equation 2.5. The receptor could spend some time outdoors and some time indoors inside the contaminated building and could be exposed to all contaminated media. The total external pathway dose would be the sum from all external exposure to these media. The RESRAD-BUILD computer code is used to calculate the dose conversion factors from these six exposure pathways, as shown in Equation 2.5:

$$pathway\,dose_{ext,n,g} = C_s \times P_n \times \overline{WCF_n} \times OF_{n,g} \times SF_{n,g} \times GRC_{n,g} \times DCF_{n,g}\,, \qquad (2.5)$$

where:

$pathway\ dose_{ext,\,n,g}$ = dose from external radiation pathways (mrem/yr);

C_s = concentration on streets/soil at $t = 0$ (pCi/m2);

TABLE 2.4 Different Geometries Used in External Pathway Dose Calculations

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Geometry	Receptor Location	Shielding Factor	Air Exchange Rate (h^{-1})	Floor Area (m^2)	Building Height (m)	Shielding Thickness (cm)	Shielding Material	Shielding Density (g/cm^3)
Rural house	Indoor	0.4	1.52	36	2.4	3.5	Concrete	1
Suburban house	Indoor	0.4	1	196	2.4	3.5	Concrete	1
Urban apartment	Indoor	0.2	0.63	100	2.4	10	Concrete	1
Store	Indoor	0.2	1.52	36	2.4	5	Concrete	2.4
Warehouse	Indoor	0.2	2	900	3.7	10	Concrete	2.4
Monument	Indoor	0.2	2	900	9.1	10	Concrete	2.4
Street/soil	Outdoor	1	NA[a]	10,000	NA	NA	NA	NA
Street/soil	Outdoor	1	NA	Infinitely large	NA	NA	NA	NA
Street	Inside vehicle	1	NA	10,000	NA	0.07	Steel	7.8
Bridge[b]	Inside vehicle	1	NA	10,000	NA	0.07	Steel	7.8
Subway station	Indoor	0.2	5	Rectangular (4 × 46)	4	5	Concrete	2.4
Rail car	Indoor	0.4	5	Rectangular (2.8 × 17)	2.4	0.1	Steel	7.8

a NA = not applicable.

b The bridge geometry includes two additional surface sources of 610 m^2 that are set perpendicular to the contaminated street to represent guard rails on a bridge.

P_n = partitioning factor (concentration ratio between media n and streets/soil) at $t = 0$ (1 for street/soil and roof, 0.5 for exterior walls, 0.1 for interior floor, and 0.05 for interior walls);

$\overline{WCF_n}$ = average weathering and radiological decay correction factor (ratio of average concentration during the first or second year to the concentration at $t = 0$ for media n; see Equation 2.2 and Table 2.2);

n = index for media (1 and 6 for street/soil, 2 for roof, 3 for exterior walls, 4 for interior floor, and 5 for interior walls);

g = index for geometries (see Table 2.4 for different geometries for which external DCFs were calculated);

$OF_{n,g}$ = occupancy factor (time fraction);

$SF_{n,g}$ = shielding factor (1 for n = 1 to 5, for n = 6; see Table 2.4 for values for different geometries);

$GRC_{n,g}$ = ground roughness correction factor (0.7 for n = 1, 1 for n = 2 to 6); and

$DCF_{n,g}$ = external dose conversion factor (dose per unit exposure for 1 year from different contaminated media for receptor indoors and outdoors) (mrem/yr per pCi/m2).

2.7.2 Inhalation Pathway Dose

To calculate the dose from inhalation pathways, first, the air concentrations outdoors and indoors are calculated by using Equations 2.6 and 2.7. As discussed in Sections 2.5 and 2.6, a time-dependent resuspension factor and weathering correction are then applied.

$$C_o = C_s \times \overline{WCF_s \times RF_o} \times MF \quad , \tag{2.6}$$

$$C_i = C_o \times SHF1 + C_{floor} \times RF_i \times \overline{WCF_{floor}} \quad , \tag{2.7}$$

where:

Co = outdoor air concentration (pCi/m3);

Ci = indoor air concentration (pCi/m3);

Cs = concentration on streets/soil at t = 0 (pCi/m2);

$Cfloor$ = concentration on interior floor at t = 0 (pCi/m2);

$\overline{WCF_s \times RF_o}$ = average outdoor air concentration correction factor (weathering and radioactive decay included; see Equation 2.4) (m-1);

MF = multiplication factor to account for influence of meteorological conditions or traffic (see Table 2.3);

$SHF\ 1$ = indoor dust filtration factor = 0.55;

$\overline{WCF_{floor}}$ = weathering correction factor for interior floor, including radioactive decay; and

RFi = indoor resuspension factor = 1 × 10-6 m-1.

As shown in Equation 2.7, the indoor air concentration is calculated from contamination in outdoor air corrected by the indoor dust filtration factor and from contamination on the interior floor corrected by a resuspension factor. The outdoor (pathway 7) and indoor (pathway 8) doses from inhalation exposure can be calculated with Equations 2.8 and 2.9, respectively:

$$pathway\,dose_{inh-outdoor} = C_o \times OF_o \times IR_o \times DCF_{inh}, \tag{2.8}$$

$$pathway\,dose_{inh-indoor} = C_i \times OF_i \times IR_i \times DCF_{inh}, \tag{2.9}$$

where:

IR = inhalation rate while staying outdoors or indoors, respectively (m3/yr);

OF = occupancy factor (time fraction spent outdoors or indoors, respectively); and

$DCFinh$ = inhalation dose conversion factor from Federal Guidance Report (FGR) No. 11 (Eckerman et al. 1988) (mrem/pCi).

2.7.3 Air Submersion Pathway Dose

The outdoor (pathway 9) and indoor (pathway 10) doses from air submersion exposure can be calculated with Equations 2.10 and 2.11, respectively. For pathway 9, the dose is calculated by using only outdoor air concentration; for pathway 10, the dose is calculated by using indoor air concentration:

$$pathway\,dose_{sub-outdoor} = C_o \times OF_o \times DCF_{sub}, \tag{2.10}$$

$$pathway\,dose_{sub-indoor} = C_i \times OF_i \times DCF_{sub}, \tag{2.11}$$

where:

DCF_{sub} = submersion dose conversion factor from FGR No. 12 (Eckerman and Ryman 1993) (mrem/yr per pCi/m3).

2.7.4 Dust Ingestion Pathway Dose

The outdoor (pathway 11) and indoor (pathway 12) doses from dust ingestion exposure are calculated using Equation 2.12. For pathway 11, the dose is calculated from contamination on the streets/soil. For pathway 12, the dose is calculated from the contamination on the interior floor or wall of the building, whichever is greater. An ingestion rate of 3 × 10-4 m2/d is assumed for adults (residents and workers), which was obtained by reducing the value suggested in Rhodes et al. (2003a) by 50%. The reduction was made to respond to the FRMAC comments on the draft report (See Appendix 1.A) to avoid overly estimating the ingestion dose. This assumed value is within the range reported in the literature for secondary ingestion (Kennedy and Strenge 1992):

$$pathway\,dose_{ing} = C_s \times P \times WCF \times IngR \times OF \times DCF_{ing}, \tag{2.12}$$

where:

$pathway\ dose_{ing}$ = dose from dust ingestion pathways (mrem/yr);

Cs = concentration on streets/soil at $t = 0$ (pCi/m2);

P = partitioning factor (1 for pathway 11, and 0.1 for pathway 12);

WCF = weathering correction factor ($\overline{WCF_s}$ for pathway 11, and $\overline{WCF_{floor}}$ for pathway 12);

$IngR$ = ingestion rate (3 × 10-4 m2/day); and

$DCFing$ = ingestion dose conversion factor (mrem/pCi).

2.7.5 Radon Inhalation Pathway Dose

The dose from the radon inhalation pathway (pathway 13) is calculated only for indoor exposure. The calculation uses the methodology described in the RESRAD-BUILD manual for surface sources (Yu et al. 2003). The radon emanation fraction is set at 0.1. The radon DSR (mrem/yr per pCi of radium on interior surfaces) is calculated for different building geometries with the RESRAD-BUILD code. The building geometries are listed in Table 2.4. The radon pathway dose for an indoor receptor can be calculated with Equation 2.13. First, the total radon activity corrected for weathering is calculated for a given building. The total activity is then multiplied by the corresponding DSR to get the radon inhalation pathway dose:

$$pathway\,dose_{radon_inh_g} = (\sum_n C_s \times P_n \times surface\ area_n \times WCF_n) \times OF_i \times DSR_g \quad , \qquad (2.13)$$

where:

$pathway\ dose_{radon_inh_g}$ = dose from radon inhalation pathway in a given building (mrem/yr),

Cs = concentration on streets/soil at $t = 0$ (pCi/m2);

Pn = partitioning factor (concentration ratio between indoor media n and streets/soil) at $t = 0$ (0.1 for interior floor [$n = 1$], and 0.05 for interior walls

[n = 2–5]);

$WCFn$ = weathering correction factor (ratio of average concentration over the exposure duration to the concentration at $t = 0$ for a surface media, see Equation 2.2 and Table 2.2);

n = index for indoor media (1 interior floor and 2–5 for interior walls);

g = index for building geometry (see Table 2.4);

$surface\ area_n$ = area for surface media n (m2);

OFi = occupancy factor (time fraction spent indoors); and

$DSRg$ = dose-to-source ratio calculated by using RESRAD-BUILD for radon inhalation in the given building (mrem/yr per pCi).

2.8 GUIDELINE DERIVATION

To derive operational guidelines for each group (Groups B–E), a systematic approach was applied. First, scenarios applicable to each group were defined. Each scenario identified appropriate receptors. Then, for each receptor, doses from all applicable exposure pathways and contaminated areas were computed in accordance with the methodology described in Section 2.7. Finally, the pathway doses were added to get the total dose for each individual receptor. The dose for the critical receptor (the receptor that gives the highest total dose) was used to derive the concentration guideline for that particular operational group, as shown in Equation 2.14:

$$Group\ Guideline = PAG / \sum_p (pathway\ dose)_p \quad for\ the\ critical\ receptor, \qquad (2.14)$$

where PAG is the protective action guide (rem/yr) and p is the index for each pathway, as discussed in Sections 2.3 and 2.7.

The PAG for decision making on evacuation or sheltering in the early phase is 1 rem for the general public and 5 rem for the workers. After the early phase, the PAG for occupational exposure is set to 5 rem/yr, and the PAGs for the general public are set to 2 rem/yr for the first year and 0.5 rem/yr for subsequent years.

Unless otherwise stated, the operational guidelines are given in surface activity concentration deposited on soil or streets (pCi/m2). Depending on the analyzed scenario within the operational group, other guidelines may be expressed in volume concentration (pCi/g), as for Group F, or in stay times (the maximum time a person could stay and still remain within the PAG) as for Group D.

Table 2.5 provides brief descriptions for the receptors considered in different groups. Table 2.6 summarizes the exposure pathways considered applicable for each receptor. Table 2.7 lists the common and most important parameters assumed for the generic guideline derivation. The inhalation rates listed in Table 2.7 were developed by considering different activities that may be taken by the receptors while staying indoors and outdoors. Corresponding inhalation rates for the different activities were taken from the ICRP 66 (ICRP 1994) resport, which was also used by FRMAC for developing its default inhalation rate. Table 2.8 provides the assumptions used for developing the inhalation rates listed in Table 2.7.

TABLE 2.5 Receptors and Group Descriptions

Receptor ID	Group Description	Receptor Description	Applicable PAGs (rem)	
			First Year[a]	After First Year
B1-1	Evacuation – FRMAC Method	Receptor spending 100% time indoors	1, 5	
B1-2	Evacuation – FRMAC Method	Receptor spending time working outdoors	1, 5	
B1-3	Evacuation – FRMAC Method	Receptor spending 100% time outdoors	1, 5	
B2-1	Evacuation – OGT Method	Receptor spending 100% time indoors	1, 5	
B2-2	Evacuation – OGT Method	Receptor spending time working outdoors	1, 5	
B2-3	Evacuation – OGT Method	Receptor spending 100% time outdoors	1, 5	
C1-1	Relocation from Residential Areas (urban setting)	Resident spending 100% of the time indoors	2	0.5
C1-2	Relocation from Residential Areas (urban setting)	Adults working outside	2	0.5
C1-3	Relocation from Residential Areas (rural)	Resident spending 100% of the time indoors	2	0.5
C1-4	Relocation from Residential Areas (rural)	Adults working outside	2	0.5
C2-1	Relocation from Commercial/Industrial Areas	Indoor office worker	2	0.5
C2-2	Relocation from Commercial/Industrial Areas	Outdoor worker	2	0.5
C3-1	Relocation from Other Areas	Indoor worker at a monument or park	2	0.5
C3-2	Relocation from Other Areas	Outdoor worker at a monument or park	2	0.5
C4-1	Hospital and Other Health Care Facilities	Hospital outdoor worker	5	
C4-2	Hospital and Other Health Care Facilities	Hospital indoor worker	5	
C4-3	Hospital and Other Health Care Facilities	Patient staying in hospital	2	0.5
C5-1	Critical Transport Facilities	Ticket clerk staying inside	5	

TABLE 2.5 (Cont.)

Receptor ID	Group Description	Receptor Description	Applicable PAGs (rem)	
			First Year[a]	After First Year
C5-2	Critical Transport Facilities	Baggage handler staying outside	5	
C5-3	Critical Transport Facilities	Passenger staying inside	2	0.5
C5-4	Critical Transport Facilities	Passenger staying both outside and inside	2	0.5
C6-1	Water and Sewer Facilities	Facility outdoor worker	5	
C6-2	Water and Sewer Facilities	Facility indoor worker	5	
C6-3	Water and Sewer Facilities	Contractor works indoors	2	0.5
C6-4	Water and Sewer Facilities	Contractor works outdoors	2	0.5
C7-1	Power and Fuel Facilities	Facility outdoor worker	5	
C7-2	Power and Fuel Facilities	Facility indoor worker	5	
C7-3	Power and Fuel Facilities	Contractor works indoors	2	0.5
C7-4	Power and Fuel Facilities	Contractor works outdoors	2	0.5
D1-1	Temporary Access to Relocation Area	Outdoor worker accessing essential business location	0.5	
D1-2	Temporary Access to Relocation Area	Indoor worker accessing essential business buildings	0.5	
D2-1	Temporary Access to Relocation Area	Public accessing residential area and staying outside	0.5	
D2-2	Temporary Access to Relocation Area	Public accessing residential area and staying inside	0.5	
E1-1	Bridges	Occupational workers drive through bridges under restricted condition	5	
E1-2	Bridges	Public drive through bridges under unrestricted condition	2	0.5
E2-1	Streets and Thoroughfares	Occupational workers drive through streets under restricted condition	5	

TABLE 2.5 (Cont.)

Receptor ID	Group Description	Receptor Description	Applicable PAGs (rem)	
			First Year[a]	After First Year
E2-2	Streets and Thoroughfares	Public drive through streets under unrestricted condition	2	0.5
E3-1	Sidewalks and Walkways	Essential service worker under restricted condition	5	
E3-2	Sidewalks and Walkways	Volunteer collecting donations near streets	2	0.5
E3-3	Sidewalks and Walkways	Vendor selling merchandise away from streets	2	0.5
F4-1	Release of Real Property from Radiologically Controlled Area (Soil)	Subsistence farmer	0.1, 0.004	
F4-2	Release of Real Property from Radiologically Controlled Area (Soil)	Urban resident	0.1, 0.004	
F4-3	Release of Real Property from Radiologically Controlled Area (Soil)	Indoor worker	0.1, 0.004	
F4-4	Release of Real Property from Radiologically Controlled Area (Soil)	Outdoor worker	0.1, 0.004	
F4-5	Release of Real Property from Radiologically Controlled Area (Residency)	Urban resident	0.1, 0.004	
F4-6	Release of Real Property from Radiologically Controlled area (Residency)	Suburban resident	0.1, 0.004	
F4-7	Release of Real Property from Radiologically Controlled Area (Residency)	Rural resident	0.1, 0.004	
F4-8	Release of Real Property from Radiologically Controlled Area (Commercial Buildings)	Large warehouse indoor worker	0.1, 0.004	
F4-9	Release of Real Property from Radiologically Controlled Area (Commercial Buildings)	Small store/office indoor worker	0.1, 0.004	

a The applicable PAG for Group B for decision making on evacuation or sheltering in the early phase is set to 1 rem or 5 rem. The early phase is defined as the first four days following the RDD incident. The applicable PAG for Group F for release of real properties is set to 0.1 rem or 0.004 rem.

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TABLE 2.6 Exposure Pathways Considered in Operational Guideline Derivation

	External						Inhalation		Radon	Air Submersion		Dust Ingestion	
Scenarios/ Pathways	Street, Outdoor	Street, Indoor	Exterior Walls, Indoor	Roof, Indoor	Interior Walls, Indoor	Interior Floor, Indoor	Outdoor	Indoor	Indoor	Outdoor	Indoor	Outdoor	Indoor
B1-1		x						x			x		
B1-2	x	x					x	x		x	x	x	
B1-3	x							x		x		x	
B2-1		x	x	x				x			x		
B2-2	x	x	x	x			x	x		x	x	x	
B2-3	x						x			x		x	
C1-1	x	x	x	x	x	x	x	x	x	x	x	x	x
C1-2	x	x	x	x	x	x	x	x	x	x	x	x	x
C1-3	x	x	x	x	x	x	x	x	x	x	x	x	x
C1-4	x	x	x	x	x	x	x	x	x	x	x	x	x
C2-1		x	x	x	x	x		x	x		x		x
C2-2	x						x			x		x	
C3-1		x	x	x	x	x		x	x		x		x
C3-2	x						x			x		x	
C4-1	x						x			x		x	
C4-2		x	x	x	x	x		x	x		x		x
C4-3		x	x	x	x	x		x	x		x		x
C5-1		x	x	x	x	x		x	x		x		x
C5-2	x						x			x		x	
C5-3		x	x	x	x	x		x	x		x		x
C5-4	x	x	x	x	x	x	x	x	x	x	x	x	x
C6-1	x						x			x		x	
C6-2		x	x	x	x	x		x	x		x		x
C6-3		x	x	x	x	x		x	x		x		x
C6-4	x						x			x		x	
C7-1	x						x			x		x	
C7-2		x	x	x	x	x		x	x		x		x
C7-3		x	x	x	x	x		x	x		x		x
C7-4	x						x			x		x	
D1-1	x						x			x		x	
D1-2		x	x	x	x	x		x	x		x		x
D2-1	x						x			x		x	
D2-2		x	x	x	x	x		x	x		x		x

TABLE 2.6 (Cont.)

Scenarios/ Pathways	External						Inhalation		Radon	Air Submersion		Dust Ingestion	
	Street, Outdoor	Street, Indoor	Exterior Walls, Indoor	Roof, Indoor	Interior Walls, Indoor	Interior Floor, Indoor	Outdoor	Indoor	Indoor	Outdoor	Indoor	Outdoor	Indoor
E1-1	x						x			x			
E1-2	x						x			x			
E2-1	x						x			x			
E2-2	x						x			x			
E3-1	x						x			x		x	
E3-2	x						x			x		x	
E3-3	x						x			x		x	

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TABLE 2.7 Common Most Sensitive Parameters and Receptor Descriptions Used in Operational Guideline Derivation

Group-Receptor No.	Multiplication Factor for Outdoor Resuspension	Exposure Frequency (d/yr)	Dust Ingestion Rate (m^2/h)	Indoor Exposure Duration (h/d)	Outdoor Exposure Duration (h/d)	Indoor Inhalation Rate (m^3/h)	Outdoor Inhalation Rate (m^3/h)	Geometry No. for External Exposure to Buildings	Building/Source Description	Initial Outdoor Source
B1-1	1	4	1.25E-5	24	0	0.92	0.92	3	Urban house	Streets
B1-2	1	4	1.25E-5	16.4	7.6	0.92	0.92	3	Urban house	Streets
B1-3	1	4	1.25E-5	0	24	0.92	0.92	3	Urban house	Streets
B2-1	10	4	1.25E-5	24	0	0.92	1.2	3	Urban house	Streets
B2-2	10	4	1.25E-5	16.4	7.6	0.9	1.2	3	Urban house	Streets
B2-3	10	4	1.25E-5	0	24	0.9	1.2	3	Urban house	Streets
C1-1	10	365	1.25E-5	24	0	0.9	1.2	3	Urban house	Streets
C1-2	10	365	1.25E-5	16.4	7.6	0.9	1.2	3	Urban house	Streets
C1-3	1	365	1.25E-5	24	0	0.9	1.2	1	Rural house	Soils
C1-4	1	365	1.25E-5	16.4	7.6	0.9	1.2	1	Rural house	Soils
C2-1	10	250	1.25E-5	8	0	1.2	1.2	5	Warehouse	Streets
C2-2	10	250	1.25E-5	0	8	1.2	1.6	5	Warehouse	Streets
C3-1	10	250	1.25E-5	8	0	1.2	1.2	6	Monument	Soils
C3-2	10	250	1.25E-5	0	8	1.2	1.6	6	Monument	Soils
C4-1	10	125	1.25E-5	0	8	1.2	1.6	5	Warehouse	Streets
C4-2	10	125	1.25E-5	8	0	1.2	1.2	5	Warehouse	Streets
C4-3	10	14	1.25E-5	24	0	0.958	1.5	5	Warehouse	Streets
C5-1	10	250	1.25E-5	8	0	1.2	1.2	7	Subway station	Streets
C5-2	10	250	1.25E-5	0	8	1.2	1.6	7	Subway station	Streets
C5-3	10	250	1.25E-5	1.25	0	1	1.5	8	Rail car	Streets
C5-4	10	250	1.25E-5	1	0.25	1	1.5	8	Rail car	Streets
C6-1	10	250	1.25E-5	0	8	1.2	1.6	5	Warehouse	Streets
C6-2	10	250	1.25E-5	8	0	1.2	1.2	5	Warehouse	Streets
C6-3	10	250	1.25E-5	2	0	1.2	1.2	5	Warehouse	Streets
C6-4	10	250	1.25E-5	0	2	1.2	1.6	5	Warehouse	Streets
C7-1	10	250	1.25E-5	0	8	1.2	1.6	5	Warehouse	Streets
C7-2	10	250	1.25E-5	8	0	1.2	1.2	5	Warehouse	Streets
C7-3	10	250	1.25E-5	2	0	1.2	1.2	5	Warehouse	Streets
C7-4	10	250	1.25E-5	0	2	1.2	1.6	5	Warehouse	Streets

TABLE 2.7 (Cont.)

Group-Receptor No.	Multiplication Factor for Outdoor Resuspension	Exposure Frequency (d/yr)	Dust Ingestion Rate (m^2/h)	Indoor Exposure Duration (h/d)	Outdoor Exposure Duration (h/d)	Indoor Inhalation Rate (m^3/h)	Outdoor Inhalation Rate (m^3/h)	Geometry No. for External Exposure to Buildings	Building/Source Description	Initial Outdoor Source
D1-1	1	NAa	1.25E-5	NA	NA	1.2	1.6	5	Warehouse	Streets
D1-2	1	NA	1.25E-5	NA	NA	1.2	1.2	5	Warehouse	Streets
D2-1	1	NA	1.25E-5	NA	NA	1.2	1.2	3	Urban house	Streets
D2-2	1	NA	1.25E-5	NA	NA	1.2	1.2	3	Urban house	Streets
E1-1	10	250	0	0	1	1.2	1.2	NA	Vehicle passing bridges	Streets
E1-2	100	250	0	0	0.02	1.2	1.2	NA	Vehicle passing bridges	Streets
E2-1	10	250	0	0	1	1.2	1.2	NA	Vehicle passing streets	Streets
E2-2	100	250	0	0	0.02	1.2	1.2	NA	Vehicle passing streets	Streets
E3-1	10	250	1.25E-5	0	1	1.2	1.2	NA	Streets	Streets
E3-2	100	250	1.25E-5	0	1	1.2	1.2	NA	Streets	Streets
E3-3	10	250	1.25E-5	0	8	1.2	1.2	NA	Streets	Streets

a NA = not applicable.

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Table 2.8 Inhalation Rates Used for Different Scenarios

Scenario	Indoor (m^3/hr)	Outdoor (m^3/hr)	Basis for inhalation rate
B1-1	0.92	0.92	Average breathing rate for sedentary worker
B1-2	0.92	0.92	Same as B1-1
B1-3	0.92	0.92	Same as B1-1
B2-1	0.9	1.2	Scale the average indoor breathing rate for sedentary worker with exposure duration for indoor and scale the average outdoor breathing rate for sedentary worker with exposure duration for outdoor
B2-2	0.9	1.2	Same as B2-1
B2-3	0.9	1.2	Same as B2-1
C1-1	0.9	1.2	Same as B2-1
C1-2	0.9	1.2	Same as B2-1
C1-3	0.9	1.2	Same as B2-1
C1-4	0.9	1.2	Same as B2-1
C2-1	1.2	1.2	Use the sedentary worker indoor hourly rate, excluding sleeping for indoor and scale the average outdoor breathing rate for sedentary worker with exposure duration for outdoor
C2-2	1.2	1.6	Use the outdoor worker indoor hourly rate excluding sleeping for indoor and use the average outdoor breathing rate for outdoor worker for outdoor
C3-1	1.2	1.2	Same as C2-1
C3-2	1.2	1.6	Same as C2-2
C4-1	1.2	1.6	Same as C2-2
C4-2	1.2	1.2	Same as C2-1
C4-3	0.5	1.5	Use the average for sleeping, sitting, and awake for indoor, use the average for light activity for outdoor
C5-1	1.2	1.2	Same as C2-1
C5-2	1.2	1.6	Same as C2-2
C5-3	1.0	1.5	Use the average for sitting, awake, and light activity for indoor and the average for light activity for outdoor
C5-4	1.0	1.5	Same as C5-3
C6-1	1.2	1.6	Same as C2-2
C6-2	1.2	1.2	Same as C2-1
C6-3	1.2	1.2	Same as C2-1
C6-4	1.2	1.6	Same as C2-2

Table 2.8 (Cont.)

Scenario	Indoor (m^3/hr)	Outdoor (m^3/hr)	Basis for inhalation rate
C7-1	1.2	1.6	Same as C2-2
C7-2	1.2	1.2	Same as C2-1
C7-3	1.2	1.2	Same as C2-1
C7-4	1.2	1.6	Same as C2-2
D1-1	1.2	1.6	Same as C2-2
D1-2	1.2	1.2	Same as C2-1
D2-1	1.2	1.2	Same as C2-1
D2-2	1.2	1.2	Same as C2-1
E1-1	-	1.2	Use the breathing rate for micellaneous activities indoors
E1-2	-	1.2	Same as E1-1
E2-1	-	1.2	Same as E1-1
E2-2	-	1.2	Same as E1-1
E3-1	-	1.2	Use the average outdoor breathing rate for sedentary worker for outdoor
E3-2	-	1.2	Same as E3-1
E3-3	-	1.2	Same as E3-1

Note: "-" means the parameter is not needed in the calculations.

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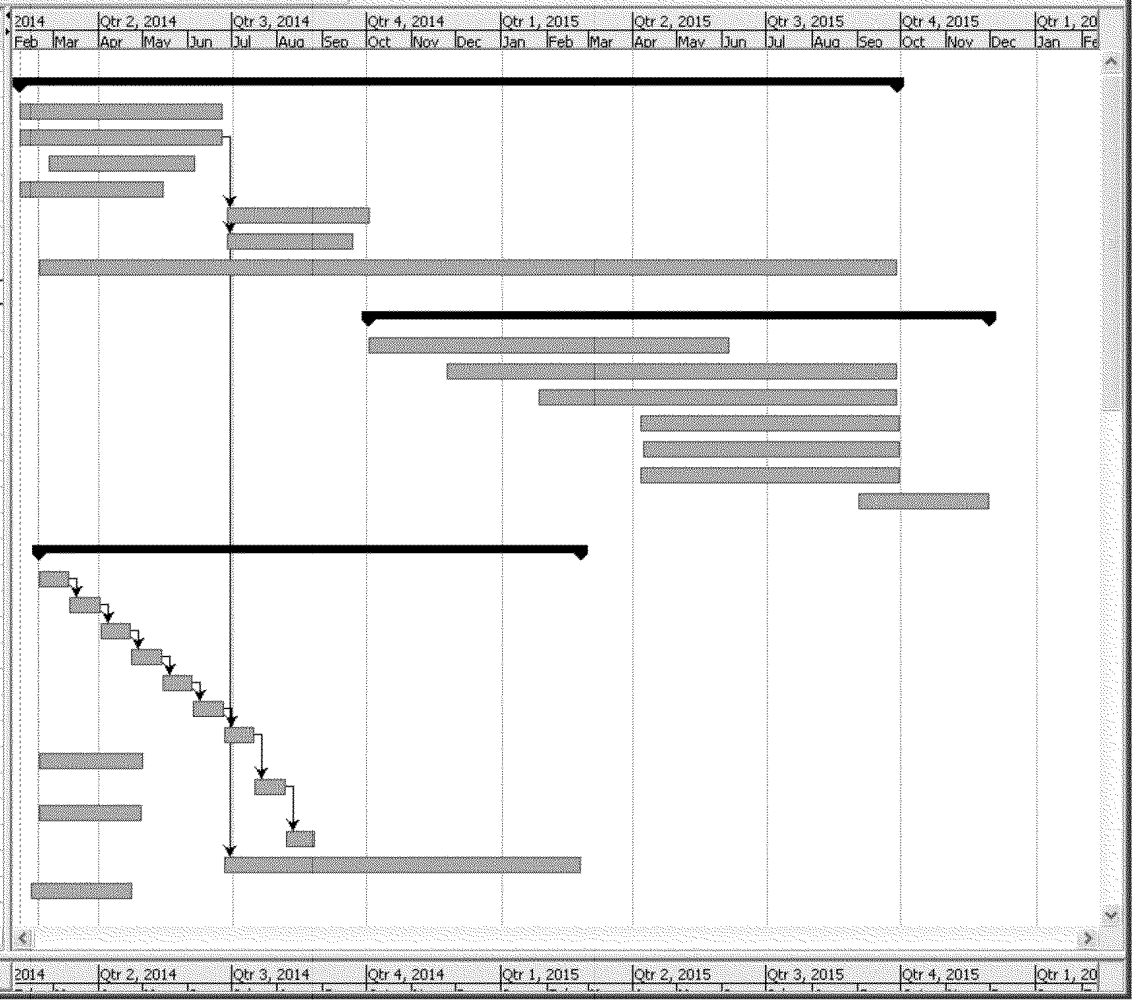
Operational Guideline...

	Name
1	**RESRAD-RDD Software (Charlie Yu and Team) FY 14**
2	RESRAD-RDD Excel based Code to New MS Visual Net
3	Update OGT of 11 RAM to 55 + RAM (RDD & IND)
4	Add DCF Pack 3.02 (ICRP 60+, ICRP 107)
5	Adjust PAG Values to EPA PAGs 2013. Include Water PAGs Option(Currently Fixed in Group G)
6	Include Resupension Factors
7	Remove FRMAC Calculations
8	ANL review of Chapters with input and edits by OGT Working Group
9	**RESRAD-RDD/IND Software (Charlie Yu and team) FY 15**
10	Include IND Scenarios in RESRAD-RDD including comments and edits by OGT Working Group
11	SOP on using RESRAD-RDD based on real world events in Fukushima (Rice, Fish, transportation
12	Add addtional Scenarios (Car cleaninig, Streets)
13	Look @ POTW based on new dosimetry. User Changable. To reflect on final document
14	Link RESRAD-RDD to other RESRAD Codes
15	RESRAD Users Guide
16	Publication of OGT Manual
17	**Revise Chapters (OGT Manual Working group)**
18	Chapter 1: Introduction
19	Chapter 2: RDD Op Guidelines Methods
20	Chapter 3: Group A-Access Control during Emergency Response
21	Chapter 4: Group B-Early Phase protective Action
22	Chapter 5: Group C- Relocation Part 1 Residential, commercial, Industrial
23	Chapter 6: Group C- Relocation Part 2:- Critical Infrastructure
24	Chapter 7: Group D-Temporary Access to relocation Areas
25	Chapter 8: Group E: Transportation and Access Routes
26	Chapter 9: Group F-4 - Release of Real Property...
27	Chapter 10: Group G - Food Consumption
28	Chapter 11: Additional Exposure Scenarios & Op Guides
29	IND Chapter
30	Scenario Reviews (All Chapters) Refine as needed



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To: DeCair, Sara[DeCair.Sara@epa.gov]
From: YOUNG, David
Sent: Wed 2/1/2017 3:49:59 PM
Subject: Industry questions and comments concerning implementation of EPA-400/R-17/001
Summary of Changes to EPA-400.docx
Impacts and Recommendations for Revised PAG Manual January 14 2017.pdf

Sara,

In preparation for the discussion on March 10, please see below and the attached two documents. These are some of the questions and comments I've received related to implementing the EPA-400 changes. This information has also been provided to the NRC staff.

Feel free to contact me with any questions.

David

There appears to be numerous impacts from changes to dose assessment with child thyroid, KI impacts (including different dosage levels), effluent EAL setpoint impacts, as well as impacts to PARs and the PAR process.

The new PAG Manual has been issued and licensees and OROs are expected to be in compliance by 12/8/17 per the FRN you emailed. The potential issue described below was not identified or addressed by the contractor performing the gap analysis between the current and new revision of the PAG Manual. The information below may have already been analyzed, addressed by NRC or my interpretation could be wrong, but I would like a response to relieve my concern.

The new PAG Manual EPA-400/R-16/001 November 2016 replacing EPA-400-R-92-001 May 1992 removes the guidance for CDE to the thyroid may be 5 times larger referring to the 1 Rem TEDE. The new guidance adds a "supplementary PAG" for 5 Rem CDE child thyroid to administer KI to children, pregnant women and lactating women. From page 20: "KI is a supplemental action, secondary to evacuation or sheltering. It should not be used as a substitute for evacuation or sheltering-in-place. Many communities do not use KI."

The EAL ICs AS1 & AG1 use EPA-400 PAGs as the basis for these EALs. The 1/5 ratio for evacuation or sheltering is no longer valid as described in NEI 99-02 Rev 5. To implement the new PAG manual guidance should the CDE thyroid 0.5 Rem for AS1 and 5 Rem for AG1 be removed or their basis revised because the referenced document has been updated?

Are we vulnerable to any findings if we declare a GE based on AG1 using the 5 Rem CDE thyroid and evacuate the public for the GE?

If the 5 Rem CDE thyroid is removed from the EAL there is a potential scenario where a (supplemental?) PAR may be required at a SAE using the abnormal rad EALs for an unfiltered release where iodine/noble gas ratio is greater than 5. In this scenario, the 5 Rem CDE child thyroid can be exceeded before the 1 Rem TEDE which would invoke the supplemental PAG to issue KI to children, pregnant women and lactating women. Some states do not issue KI to the public which may require an evacuation PAD.

Some of the specific questions and concerns raised by OROs and [the utility] included:

1. Are OROs and licensees expected to implement the supplemental PAG for the child thyroid and in what capacity? Will they be expected to issue a PAR and implement PADs on the supplemental child thyroid PAG?

2. Using this new supplemental PAG may mean that PARs must be made earlier than traditionally practiced under the current PAGs. For example, in an unfiltered release, TEDE could be below 1 REM, which would not meet the PAG for evacuation, but if you consider the supplemental 5 Rem child thyroid, you may need to take action to evacuate or issue KI. Then the ORO is faced with determining if they evacuate just children and pregnant mothers or the entire population. Or, in states where KI is provided to the general public, THE ORO must determine when will they issue to PAR/PAD for KI? Understanding the expectations on this is critical in making the most appropriate changes to the plans and procedure.

3. [The utility] is concerned that this supplemental PAG may trigger a change to the Emergency Action Level (EAL) scheme. For example, if the expectation is to make a PAD based on the child thyroid supplemental PAG, then in some cases, that PAG may be exceeded at what is currently defined under EALs as a Site Area Emergency (SAE). Historically, PADs such as evacuation and sheltering of the general public are done at a General Emergency (GE). This is a big concern for both [the utility] and the ORO.

4. The PAGs specifically refer to FRMAC Assessment Manuals for dose assessment calculation values (DP and DCL). The ORO and [the utility] are unfamiliar with the methodology for FRMAC calculations. Do they differ from the methods used in the 1992 “EPA 400?” In other words, will the dose code software commonly used by utilities and OROs, RASCAL, be comparable to the assessments from FRMAC? If not, does this precipitate a need for the utility and OROs to revise their dose codes (or NRC to revise RASCAL)? Revising dose code software is a large project and [the utility] and OROs would like that to be taken into consideration when looking at implementation of the new PAGs. Does RASCAL use the child thyroid DCL values?

5. The EPA PAGs have dropped the use of TEDE and replaced it with TED. The calculation is generally the same, but does FEMA expect the OROs to convert their plans and procedures to use TED instead of TEDE? If so this may cause issues because [the utility] license under 10 CFR 20 uses TEDE, so they will

not be changing their plans and procedures to TED. If OROs are required to use TED then we are setting up a situation where [the utility] and state are using slightly different terminology and this has the potential to cause communication problems between [the utility] and ORO.

I have had a few conversations with industry peers, as well as folks in our Fleet, since we first talked and I believe that regardless of exactly how it is handled the industry needs some guidance on how to implement the change. I would compare this to the revision to NUREG 0654 Supplement 3, for which we developed an NEI guidance document (12-10) to assist the industry in implementation. I think the changes in this PAG manual, for example evacuation based on a projected thyroid CDE no longer being required, are more significant than those required by Supplement 3.

Our offsite partners will potentially have an even more difficult time, given the changes that impact the ingestion or intermediate phase. I also do not believe that implementation by 12/8/17 is possible or prudent given both the impact of the changes as well as the fact that this impacts our most important planning standards and we cannot afford to get this wrong.

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Changes of Significance to Industry in Revised Protective Actions Manual
EPA-400/R-16/001 – November 2016
EPA-400/R-17/001 – January 2017

Executive Summary:

The Environmental Protection Agency has updated the Protective Action Guidelines impacting Protective Action Recommendations, and Emergency Worker Limits. The current implementation date per the December 8, 2016, Federal Register is December 8, 2017. The impacts require coordinated implementation with the respective OROs. As written Emergency Preparedness software, procedures, public guidance and ERO training (for both OROs and sites) will be impacted.

The EPA changes impact 10 CFR 50.47 Planning Standard b (9), Assessment and Planning Standard b(10) Protective Measures. With respect to the Reactor Oversight Program, both Planning Standards are considered Risk Significant and programmatic deficiencies in implementation could result in findings up to Yellow for each Planning Standard.

The limited time for implementation involving detailed coordination with ORO's and software changes and validation present a clear challenge to the industry.

Specific areas of substantial change and areas of potential confusion in the manual as written are provided in the body of this review.

Evaluation

The revised Protective Action Manual has significant impacts to site programs in a number of areas. Additionally, intermediate phase changes have additional major impacts on Offsite Response Organization programs and demonstrations of performance.

Specific Impacts:

1. Modification of Thyroid PAG to Child Thyroid from Regulatory Adult (EPA-400) (Section 1.4.2)
    a. Revised Guidance effectively eliminates the 5 Rem CDE recommendation as a primary PAR/PAG
    b. Guidance modifies thyroid guidance to effectively a secondary PAR recommending the administration of KI if child thyroid dose is expected to exceed 5 Rem CDE to the child thyroid.
    c. All dose projection inputs (dose models) based on EPA-400-1992, are likely to a different thyroid target and the software will have to be modified to account for child thyroid dose.
    d. Impact on the Thyroid Emergency Action Levels is not specified in any current guidance. Elimination of the class of EALs without submittal is going to require some specific guidance.
    e. Elimination of thyroid recommendations may cause some political concern.
    f. Impact on new guidance for States who 'considered' KI but didn't adopt in not clear (Ex. Georgia)
    g. Protective Action Recommendations and subsequent ORO Protective Action Decision making must be consistent in this area to protect public health and confidence.
    h. Cost impact for modification of software and procedures for OROs and licensees.

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Recommendations:

- Conduct a meeting with impacted OROs as soon as possible to develop coordinated plan of action.
- Evaluate dose assessment software to determine capability to perform child thyroid assessment as currently formulated. *Note: RASCAL 4.3 has child thyroid as a selectable output*. In earlier versions it's not clearly available. Based on results of the assessment:
  - Perform software modifications as determined by assessment
- Revise dose assessment and PAR procedures to align with elimination of primary thyroid PAG and new terminology
- Monitor Impact on Effluent EALs and subsequent revisions to EAL Plans and Procedures.
- Coordinate ERO training.

2. Updated KI guidance to FDA standards

   a. Language updated to align with current FDA guidance but focuses on differing values for different classes of people. States the one-year-old is the most limiting (> 5 Rem) and therefore should be the basis for decision making.
   b. NRC guidelines when Protective Action guidelines were enhanced to address consideration of KI was focused on a single decision point consistent with offsite plans. Is the single decision point still valid or does an assessment of dose based on the table provided in the PAG Manual for different classes of subjects have to be made?
      - Detailed discussion of limits based on age etc. which could result in complex PARs/PAGs
        1. Adult over 40 shouldn't take KI unless dose > 500 Rem
        2. Table 2-2 provides limits for different risk groups.
      - Ability to make useful and timely PARs for KI administration could get very difficult if ORO or parts of industry try to implement the entire section.
      - Table 2-2 also establishes different dosage for various classes that differ from many of the existing stockpiles.
   c. Cost impact for modifying ORO Plans and procedures and KI stockpiles.
   d. Potential impact of revision of licensee PAR philosophy to align with classification of subjects.

      NRC intent appears to be stick with the standard distributed pill and make decisions based on child thyroid dose assessment but to date as not clearly stated the intent. Extent of discussion in PAG Manual may lead others to different conclusions.

Recommendations:

- Conduct a meeting with impacted OROs as soon as possible to develop coordinated plan of action.
- Determine impact of change on ORO policy. Could be none to significant
- Evaluate procedural changes necessary to align with any change in ORO policy (may be limited to PAR procedure, however this needs to be verified)

3. Enhancement of discussion of Applicability of variable Evacuation Limits for Special Circumstances – Use of Shelter in Place vs. Evacuation (Section 2.2.2)
    a. Severe Weather/Special Needs Populations the evacuation decision may be 10 times higher than public limit.
    b. Potential for confusion and JIC impacts as message is conveyed.
    c. Establishes a potential new decision point for Shelter-In-Place that may be unknown to site.
    d. Cost impact for modifying ORO and licensee Plans and procedures.

    Recommendations:
    - Conduct a meeting with impacted OROs as soon as possible to develop coordinated plan of action.
    - Determine impact of change on ORO policy. Could be none to significant
    - Evaluate procedural changes necessary to align with any change in ORO policy (may be limited to PAR procedure, however this needs to be verified)

4. Ingestion Pathway Exercise (Depends on level of site involvement in exercise planning)
    a. Changes to contamination levels for food
    b. Revised Re-entry guidelines
    c. Significant change to drinking water standards
    d. Current tools for Exercise development must be modified to align with the new limits and decision points.
    e. Cost impact for modifying ORO Plans and procedures.
    f. Cost impact for modifying IPX development tools.

    Recommendations (Dependent on when IPX is scheduled)
    - Evaluate current tools used for IPX development
    - Revise tools to new standards
    - Review Ingestion pathway decision making procedures for changes in values for decision making (likely belong to ORO but a few sites at least used to have some IGX decision making PAR procedures)
    - Revise as necessary

5. Public Information
    a. JIC Information - Updated PAGS and Language may differ from pre-planned JIC messaging
    b. Annual Information to Members of the Public - Updated PAGs and Language may differ from pre-planned JIC messaging
    c. Annual Media Training - Updated PAGs and Language may differ from pre-planned training

    Recommendations
    - Evaluate existing JIC information pertaining to revised PAGs
    - Evaluate Information provided annually to the public
    - Revise as necessary
    - Conduct JIC ERO training as required

Considerations for Implementation

To successfully implement the new guidance additional regulatory clarity is needed. This document states that it contains "…non-mandatory language…. " and, "…only provides recommendations and does not confer any legal rights or impose any legally binding requirements upon any member of the public, state, tribe, locality, or any federal agency.". As such, what will be the regulatory basis for implementing all or portions of this guidance and how will assessment of any such implementation be reviewed and/or inspected?

- Will NUREG-0654/FEMA-REP-1 version 1 and the FEMA REP Program Manual be amended via interim staff guidance or implemented with Revision 2 of NUREG-0654?
- Is it FEMA's intent, upon implementation, to mandate KI issuance to the public for those OROs who currently do not?
- Is it FEMA's intent at implementation to eliminate protective actions for the public associated with 5 Rem thyroid CDE?
- Is it FEMA/NRC's intent that all ORO and licensees implement the use of child thyroid vs. adult thyroid? If so, is it the intent that these changes, including modification of dose assessment software, be made within the implementation time frame provided in the FRN?
- Is it the NRC's intent that licensees revise EAL set point calculations for child thyroid dose conversion factors within the implementation time frame provided in the FRN?
- Is it the NRC's intent that licensees modify existing EAL schemes to eliminate the use of the 5 Rem thyroid CDE PAG criteria within the implementation time frame provide in the FRN?
- Has the NRC evaluated the aggregate impact on licensees associated with implementing the new EPA PAG Manual concurrent with 10 CFR 50.155?
- Has the NRC determined whether revision to RASCAL and/or URI software will be required, and, if so, has a schedule for issuance of the revised software been developed?
- In light of the discretionary language contained in the EPA PAG Manual guidance, what clarifying guidance will the NRC provide for licensees who will need to make changes to their emergency plans as the result of changes to EALs, PARs, dose assessment software, etc. For example, will a change to eliminate PARs associated with 5 Rem CDE thyroid or the elimination of CDE thyroid from the radiological effluent EALs be considered a reduction in effectiveness and/or an EAL scheme change requiring prior approval via 10 CFR 50.90?

Summary

The application of public and emergency worker protective action guidance is critical to ensure public and worker confidence in emergency response around nuclear power plants. A consistent coordinated effort must be applied. This change requires potentially extensive software, Plan, procedural and ERO training changes. The considerations list above will need to be addressed in order to determine whether the current implementation schedule of less than one year is insufficient to ensure an effective transition to maintain the overall program.

Summary of Changes to EPA-400

Changes:	Programmatic Effects:	Comments:
Dosimetry based on ICRP60 methodology.	ICRP60 has not been implemented by the NRC (effluent releases, occupational dose, or emergency preparedness). 10 CFR 20 only allows for calculation of TEDE for occupationally exposed individuals (workers). TED cannot be used to meet 10 CFR 20. Additionally, thyroid dose (CDE) is calculated using different weighting factors in ICRP 60 than 10 CFR 20 allows for workers. It is not ideal to be calculating dose differently for workers than for the public. Dose definitions are different – TEDE becomes TED. EAL and PARs would have to be changed to use this language. New lung model = significant scientific changes. Additional age groups considered.	The changes to lung model calculations will not be easy to predict if the changes will raise or lower EAL values. Using the child age group (1 year) may be more restrictive than the average age group currently used. RP Technicians and ERO are not educated in ICRP 60 or FRMAC terminology and training should probably be provided.
Dose assessment methodology is no longer included in EPA-400.	Users are expected to implement dose assessments using a FRMAC document that can be easily updated. EPA-400 now specifically states we are to use the most current version of this manual. How are we to follow future updates? Any regulatory process for future document revisions????	There may be high costs associated with updates as newer ICRP methodologies are adopted by FRMAC. Section 2.3 on Dose projections uses the terms "should" and "may be modified" – could this allow us to continue use of ICRP30 methodology to implement new EPA-400 changes?
Update of the PAGs for interdiction of food.	None for NPPs. States may have changes to their programs.	N/A

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Lowered PAG for the administration of KI from 25 rem adult thyroid (CDE) to 5 rem (CDE) projected child thyroid dose.	Based on a one-year-old child. This is a significant change, however [a state] already utilized 5 rem child thyroid and therefore, [this site] was already more restrictive. PAR would change away from shelter/evacuate on 5 rem child thyroid and would be to administer KI instead (Ref Table 1-1 pg 6 and Section 2.2.1 pg 15).	New age groupings according to ICRP 60 (multiple are "child")
Includes references to other FDA-approved medical countermeasures	None for NPPs	N/A
Removes the intermediate phase relocation PAG of 5 rem over 50 years.	None for NPPs	N/A
New briefing guides for reentry of emergency workers/public	None for NPPs. States may have changes to their programs.	N/A

Details about changes from ICRP 30 to ICRP 60:

Tissue weighting factors listed in 10 CFR 20 are based upon ICRP 30. ICRP 60 has different issue weighting factors for thyroid. Therefore, we are not allowed to calculated occupational dose with ICRP 60 methodology. Additionally, 10 CFR 20 defines specific quality factors according to ICRP 30, which change to radiation weighting factors in ICRP 60. This means that the biological effect assigned to each type of radiation is different. Between the changes in radiation weighting factors and tissue weighting factors, we cannot implement ICRP 60 and stay in compliance with 10 CFR 20 for occupational dose.

ICRP 30 assumes committed dose equivalent (CDE) is based on a 50 year exposure period for both occupationally exposed individuals and members of the public. In ICRP 60, the exposure period is 50 years for occupational workers and 70 years for members of the public. I am unsure of the significance for this difference.

Additionally, ICRP 2 is used for public dose calculations. It uses age-groups defined as "infant" (0-1 year old), "child" (1 – 11 years old), "teen" (11 – 17 years old) and "adult" (17 years and older). ICRP 60 and FRMAC documents further breakdown the age groups to 3 month, 1 year, 5 year, 10 year 15 year and adult. Using a more restrictive age group methodology may have an effect on EAL values.

Conclusions:

Implementation of the new revision to EPA-400 will have significant impacts on EAL values, terminology and methodology. The FRMAC document provides all the necessary information to make these changes, and in my opinion, it is possible to implement at [this site]. Major changes to the EAL values will be warranted and because the methodology changes, a 50.54Q evaluation (not screen) and NRC approval would be required before changes can be implemented, unless the NRC issues some form of generic guidance on this issue.

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DRAFT Topic Outline of 2013 Draft PAG Manual Web-based Training (WBT) Modules

The PAG training course would be designed as a standalone WBT that would allow EPA to reach a larger and more geographically-dispersed audience. The primary audience is state and local officials who need to learn about pre-incident planning and preparedness necessary prior to radiological incidents to protect the public during radiological emergencies. The PAG WBT would provide learners with a basic introduction to the 2013 Draft PAG Manual and how to use it. The PAG WBT would be launched from an EPA website and learners could work on the modules at their own pace without an instructor.

The PAG WBT consists of 10 modules, and the topic areas under each module are outlined below. Each topic area would consist of one or more screens, as needed. Two WBT scenarios would be introduced in Module #1 and those two scenarios would be used throughout the WBT for learning examples. The 10 modules are:

1) INTRODUCTION,
2) PAG UPDATE SUMMARY,
3) EARLY PHASE,
4) INTERMEDIATE PHASE,
5) FRMAC ASSESSMENT METHODS,
6) DRINKING WATER PAG (would be included later),
7) FOOD PAG,
8) GUIDANCE FOR EMERGENCY WORKERS,
9) LATE PHASE, and
10) CONCLUSION/SUMMARY.

1) INTRODUCTION

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Overview/Instructions** (provide overview of WBT modules; also explain how to download learning aids that learners can use during WBT)
    a. Learning Aid #1: PDF with comparisons between 1992 PAG Manual and 2013 Draft PAG Manual (which will be created from PAG Webinar slides)
    b. Learning Aid #2: PDF with list of key guidance materials/resources from EPA, DOE, DHS, FDA to plan/prepare for radiological emergency response
    c. Learning Aid #3: PDF with FRMAC Quick Reference Guide or QRG (will either use or develop from existing QRGs for EPA staff)
2. **Background** (summarize history of 1992 PAG Manual and EPA responsibility for guidance)
3. **What is a PAG?** (provide definitions/explanation)
4. **When do PAGs Apply?** (provide explanation and examples)

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5. **Radiological Incident Phases** (introduce early, intermediate, late phase)
6. **Types of Radiological Incidents** (explain that EPA made PAGs relevant to all types of radiological incidents; no longer nuclear-power-plant-centric; list examples of potential incidents involving relatively significant releases of radionuclides)
7. **Relationship between EPA and DHS Guidance** (provides brief explanation)
8. **WBT Scenarios** (introduce WBT scenarios that will be used for learning examples; will develop these scenarios and related learning examples starting with the two scenarios used in 2007 PAG Manual Workshop)
    a. Commercial nuclear power plant (NPP) incident that causes an atmospheric release of radioactive isotopes
    b. Terrorist threat involving potential detonation of radiological dispersal device (RDD) that would release a plume of radioactive material

2) PAG UPDATE SUMMARY

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Overview** (provides overview of changes that EPA made in 2013 Draft PAG Manual; brief list of major changes, which along with other slides in this module will be created from PAG Webinar slides)
2. **Early Phase–Differences between 1992 and 2013** (provides/explains comparison table)
3. **Guidance for Administration of Potassium Iodide** (provides summary table and briefly explains why EPA recommends new simplified approach)
4. **Guidance for Emergency Workers** (provides brief summary and explains emergency worker dose limits remain unchanged)
5. **Intermediate Phase–Differences between 1992 and 2013** (provides/explains comparison table)
6. **Reentry Matrix** (summarizes new reentry guidance and briefly explains why added)
7. **Drinking Water PAG** (summarizes why EPA is developing new short-term emergency drinking water PAG)
8. **Food PAGs–Differences between 1992 and 2013** (provides/explains comparison table)
9. **Late Phase** (summarizes new guidance for cleanup and waste management and explains why added)
10. **Summary** (briefly summarizes EPA's expectations for finalizing updated PAG Manual)

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3) EARLY PHASE

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Early Phase–Introduction** (provides an overview of module)
2. **Early Phase–What are the Basics?** (provides Q&A format from FAQ)
3. **Early Phase–Initial Response Steps** (provides/explains list)
4. **Early Phase–Exposure Pathways** (summarizes three main exposure pathways)
    a. Learning example for NPP Scenario (based on direct exposure pathway)
    b. Learning example for RDD Scenario (based on inhalation pathway)
5. **Establishing Exposure Patterns** (provides brief summary of potential approaches during Early Phase when data will not be sufficient to accurately estimate projected doses)
6. **Early Phase PAG for Sheltering-in-Place or Evacuation** (provides explanation)
7. **Evacuation** (defines; outlines objectives of evacuation as protective action; summarizes when most effective)
    a. Learning example for RDD Scenario (to protect public from exposures via inhalation if directly immersed in potential plume from RDD terrorist threat)
    b. Quiz to check knowledge of importance of advance planning/preparedness for efficient and effective evacuation for NPP incidents
    c. Quiz to check knowledge of evacuation to protect public from groundshine where suitable shelter is not available
8. **Sheltering-in-Place** (defines; outlines objectives of sheltering-in-place as protective action; summarizes when most effective)
    a. Learning example for NPP Scenario (to protect public from exposures via primary pathway of concern identified as external exposure to gamma radiation)
    b. Quiz to check knowledge of key factors in using sheltering to protect public from exposures via inhalation pathway
9. **Administration of KI–Overview** (explains why a supplemental protective action and outlines situations when KI is an effective protective action)
10. **Early Phase KI Administration–Recommendations** (summarizes FDA guidance and EPA's recommended simplified approach)
    a. Quiz to check knowledge of EPA's new simplified approach from 2013 Draft PAG Manual
    b. Quiz to check knowledge of when decisions to administer KI are relevant
11. **Surface Contamination Control** (summarizes general guidance; explains this applies to both early and intermediate phase)
    a. Look-up example/quiz from 2013 Draft PAG Manual Table 2-5
    b. Look-up example/quiz from 2013 Draft PAG Manual Table 2-6
12. **Summary** (reviews "Key Points" for Early Phase; taken from 2013 Draft PAG Manual)

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4) INTERMEDIATE PHASE

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Intermediate Phase–Introduction** (provides an overview of module)
2. **Intermediate Phase–What are the Basics?** (provides Q&A format from FAQ)
3. **Intermediate Phase–Sequence of Events** (provides list and also explains events/activities will be similar for RDD and NPP incidents during this phase)
4. **Intermediate Phase–Exposure Pathways** (summarizes three principal exposure pathways)
    a. Learning example for NPP Scenario (based on exposure pathway of whole body external dose of gamma radiation resulting from deposited radioactivity or groundshine)
    b. Learning example for RDD Scenario (based on exposure pathway of internal dose associated with inhalation of resuspended radioactive particles)
5. **Intermediate Phase–Considerations for Dose Projections** (summarizes selected basic information/concepts; makes cross-reference to Module #5 on FRMAC)
    a. Quiz to check knowledge that FRMAC Assessment Manuals have updated dosimetry models
    b. Quiz to check knowledge that exposure/doses from ingestion of food and water are usually considered independently of decisions for relocation and decontamination
6. **Intermediate Phase PAGs–Overview** (provides/explains summary table)
    a. Quiz to check knowledge of Relocation PAG for first year
    b. Quiz to check knowledge of Relocation PAG for any subsequent years
    c. Quiz to check knowledge of why dose reduction techniques may be needed to protect public where exposure rates not high enough to warrant relocation
7. **Intermediate Phase PAG for Relocation** (provides explanation)
8. **Relocation Areas–Overview** (defines; outlines objectives of relocation as protective action; explains three groups of affected individuals/actions)
    a. Quiz to check knowledge that relocation is the primary protective action for the public from deposited radioactivity
    b. Quiz to check knowledge of three groups of affected individuals/three different actions that may be associated with creation of relocation area
9. **Relocation Areas–Establishing and Controlling Boundaries** (expands learning about relocation as protective action; summarizes selected information/concepts)
    a. Learning example for NPP Scenario (based on relocation in first year would be necessary)
    b. Learning example for RDD Scenario (based on relocation is not necessary)
10. **Intermediate Phase PAG for Apply Simple Dose Reduction Techniques** (provides explanation)

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11. **Examples of Simple Dose Reduction Techniques** (provides list/explanation)
    a. Quiz to check knowledge of protecting people who are not relocated from contaminated areas near, but outside of, relocation area by applying simple dose reduction techniques (decontamination, shielding, time limits on exposure)
    b. Quiz to check knowledge of how officials could support residents to implement simple dose reduction techniques through monitoring and guidance on appropriate actions and disposal
12. **Reentry Matrix** (defines reentry; explains new reentry matrix/guidance)
    a. Look-up example/quiz from Reentry Matrix in 2013 Draft PAG Manual
    b. Look-up example/quiz from Reentry Matrix in 2013 Draft PAG Manual
13. **Summary** (reviews "Key Points" for Intermediate Phase; taken from 2013 Draft PAG Manual)

5) FRMAC ASSESSMENT METHODS

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **FRMAC–Introduction** (explains who developed FRMAC Assessment Manuals and where to find detailed information and FRMAC training)
2. **FRMAC–Basic Terms for Estimating Projected Dose** (define dose parameters/DP and derived response level/DRL methods; ask learners to download Learning Aid #3: PDF with FRMAC Quick Reference Guide or QRG to review more detailed information)
3. **Overview of Other Available Tools and Calculation Methods** (provides brief explanation of DOE's TURBO FRMAC and NRC's RASCAL)
4. **Summary** (refers learner to relevant sections of 2013 Draft PAG Manual)

6) DRINKING WATER PAG

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

- This module will be included later, when EPA completes emergency drinking water PAG

7) FOOD PAG

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **FDA Food PAGs–Introduction** (provides an overview of module, explains that 1998 FDA

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Guidance, available online, is incorporated by reference into 2013 Draft PAG Manual)

2. **1998 FDA Guidance** (explains key information/concepts)
3. **EPA's Recommended Set of Food PAGs** (provides/explains one set of Food PAGs recommended in 2013 Draft PAG Manual)
4. **Relationship of Food PAGs to Intermediate Phase** (provides explanation of Intermediate Phase exposure pathway of internal exposure from ingestion of food and water; explains how/when food interdiction as a protective action might be needed during Intermediate Phase; explains not relevant to Early Phase)
5. **Relationship of Food PAGs to Drinking Water PAG** (includes brief explanation and states this will be updated later after Module #6 is completed)
6. **Summary** (refers learner to relevant sections of 2013 Draft PAG Manual)

8) GUIDANCE FOR EMERGENCY WORKERS

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Overview** (explains dose guidelines for emergency workers are not PAGs; instead apply to total doses incurred over entire response)
2. **Dose Guidance for Emergency Workers** (provides/explains summary table of emergency worker dose limits)
3. **ALARA Principle** (summarizes ALARA and provides examples of practices to maintain worker exposures as far below dose limits as practicable)

9) LATE PHASE

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Late Phase–Introduction** (provides an overview of module)
2. **Late Phase–What are the Basics?** (provides Q&A format from FAQ)
3. **Late Phase–Overview of Step-wise Cleanup Process** (explains how 2103 Draft PAG Manual now includes basic cleanup planning guidance; provides list of steps and also introduces key elements of new planning guidance, specifically optimization concept/method, flexibility of approach, stakeholder involvement)
    a. Quiz to check knowledge that late phase can begin after population is protected according to Relocation PAG and that beginning late phase cleanup process can overlap with and proceed independently of Intermediate Phase protective action activities
    b. Quiz to check knowledge that DHS Workgroup agreed on optimization approach that is incorporated in 2013 Draft PAG Manual

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    c. Quiz to check knowledge that 2013 Draft PAG Manual does not provide PAGs for late phase; instead provides brief planning guidance (for cleanup and waste management/disposal) that incorporated DHS guidance
    d. Quiz to check knowledge about importance of stakeholder involvement, especially importance of including members of affected population
4. **Cleanup–Characterization and Stabilization** (defines/describes both)
5. **Cleanup–Establishing Cleanup Goals and Levels** (describes cleanup goal for Late Phase and making decisions to determine cleanup levels)
    a. Quiz to check knowledge of variety of dose or risk benchmarks from state, federal, or other sources that could be used (also provide look-up information to help learner find relevant sections of PAG Manual)
    b. Quiz to check knowledge of many factors that could be considered (also provide look-up information to help learner find relevant sections of PAG Manual)
6. **Cleanup–Consensus/Decision-making Organizations** (lists/explains different teams or working groups that could focus on process for reaching consensus about cleanup)
7. **Cleanup–Implementation and Reoccupancy** (highlights key issues for both)
8. **Late Phase–Waste Management Overview** (explains how 2013 Draft PAG Manual now includes basic planning guidance for waste management; emphasizes waste volumes will affect decision-making; explains decisions must be appropriate for level of hazard; provides list of waste disposal options)
    a. Quiz to check knowledge of whether adequate disposal capacity currently exists in United States for waste volumes from wide-scale radiological incident
    b. Quiz to check knowledge of whether local governments could make waste management decisions for limited radiological incidents with relatively small waste volumes (potentially yes, if existing LLRW capacity is available/sufficient)
9. **Waste Management–Federal, State, and Local Roles/Responsibilities** (explains roles; emphasizes that states bear primary responsibility for waste disposal)
    a. Quiz to check knowledge that LLRW disposal facilities are licensed by Agreement States through NRC authorities (also provide look-up information to find relevant sections of PAG Manual for more information about these agreements)
    b. Quiz to check knowledge of federal/state authorities for hazardous waste disposal (also provide look-up information to find relevant sections of PAG Manual for more information about state role/authority in potential disposal of radiological waste at hazardous waste landfills)
10. **Waste Disposal Options–Licensed Commercial LLRW Disposal Facilities** (summarizes advantages and disadvantages, based on planning guidance in 2013 Draft PAG Manual)
11. **Waste Disposal Options–RCRA Solid and Hazardous Waste Landfills** (summarizes advantages and disadvantages, based on planning guidance in 2013 Draft PAG Manual)
12. **Waste Disposal Options–Federal Facilities/Sites** (summarizes advantages and disadvantages, based on planning guidance in 2013 Draft PAG Manual)
13. **Waste Disposal Options–Newly Developed Disposal Capacity** (summarizes advantages and disadvantages, based on planning guidance in 2013 Draft PAG Manual)
14. **EPA Waste Management Resources** (provides information about such resources from PAG Webinar slide)

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15. **Summary** (reviews "Key Points" for Late Phase; taken from 2013 Draft PAG Manual)

10) CONCLUSION/SUMMARY

Learning Objectives	• XXXXXX (to be completed) • XXXXXX

1. **Summary Knowledge Check** (provides quiz with targeted questions, and refers learner back to relevant WBT module if questions answered incorrectly)
2. **EPA PAG Website** (explain why to visit for more information, resources)
3. **Course Feedback** (how to provide feedback to EPA on PAG WBT)

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To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Howe, Michael[Michael.Howe@fema.dhs.gov]
From: Fiore, Craig
Sent: Thur 1/12/2017 5:14:13 PM
Subject: FW: EPA PAG Manual *FINAL* with drinking water guidance, on the web

Greetings Sara, Happy Belated New Year!

Based on your message, we have had a couple of our Regions ask if EPA would be open to conducting some onsite outreach meetings if state & local governments request it. Is this something you would consider and be amenable to?

Thank you,

Craig

Craig J. Fiore

Craig J. Fiore

Section Chief (Acting), Exercise Operations

Radiological Emergency Preparedness (REP) Branch

Technological Hazards Division, National Preparedness Directorate

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FEMA Mission: *To support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards*

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Wednesday, January 11, 2017 2:34 PM
To: Amy Doll <adoll@endyna.com>; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; MacKinney, John A <john.mackinney@HQ.DHS.GOV>; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael <Michael.Howe@fema.dhs.gov>; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul <Paul.Ward@fema.dhs.gov>; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee <Veal.Lee@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; william.cunningham@nist.gov; Azzam, Nidal <Azzam.Nidal@epa.gov>; Chen, Gary <chen.gary@epa.gov>; Ellis, Jerry <Ellis.Jerry@epa.gov>; Freed, Rachel <freed.rachel@epa.gov>; Hallam, Christopher <Hallam.Christopher@epa.gov>; Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov>; Prioleau, Wagnus <prioleau.wagnus@epa.gov>
Cc: Hale, Olin <olin.hale@fema.dhs.gov>; Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Snead, Kathryn <Snead.Kathryn@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; White, Rick <White.Rick@epa.gov>
Subject: PAG Manual *FINAL* with drinking water guidance, on the web

Fantastic news!! Thanks to the best team of scientists, communicators, contractors and managers in town, the drinking water guidance was finalized and signed by EPA's Office of Water today, and it is now incorporated in Chapter 4 of our PAG Manual. The new completely complete, truly final, finished Manual is on the web here:

https://www.epa.gov/radiation/protective-action-guides-pags

You'll also find Frequently Asked Questions and the {pre-publication} Federal Register notice announcing it, which will likely be published in the FR in a week or so. Meanwhile, you can read the new Manual, print your own copy, and in your radiation emergency preparedness activities, help the organizations that use the PAGs to get their plans and procedures updated within twelve months, when the new PAGs will be the only ones expected to be in use. Remember that PAGs are merely guidelines, and state, local, tribal, territorial or federal organizations can use any PAGs as they see fit, or as the incident warrants.

Outreach webinars will begin in early February and we're glad to hear any questions you get, to help make our outreach materials more effective. You are a messenger! Spread the word to your colleagues and partners.

Sara D. DeCair

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Fitz-James, Schatzi
Sent: Fri 1/6/2017 9:32:16 PM
Subject: Re: Water PAGs meeting Thurs jan 5 at 3 PM

Haha

Sent from my iPhone

On Jan 6, 2017, at 2:34 PM, DeCair, Sara <DeCair.Sara@epa.gov> wrote:

Lee and Jon said it was pretty typical and poor OW thought they could reason with them.

Sent from my iPhone

On Jan 6, 2017, at 9:44 AM, Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov> wrote:

From: Scozzafava, MichaelE
Sent: Friday, January 06, 2017 9:43 AM
To: Walker, Stuart <Walker.Stuart@epa.gov>; Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov>
Subject: Re: Water PAGs meeting Thurs jan 5 at 3 PM

Apparently not. They brought up the emails from you and Charles from back in 2009, but apparent OGC Water Law Office was able to respond to that.

From: Walker, Stuart
Sent: Thursday, January 5, 2017 10:56 PM
To: Scozzafava, MichaelE; Fitz-James, Schatzi
Subject: Re: Water PAGs meeting Thurs jan 5 at 3 PM

Did anything happen at the meeting

From: Scozzafava, MichaelE
Sent: Thursday, January 5, 2017 7:10 AM
To: Walker, Stuart; Fitz-James, Schatzi
Subject: RE: Water PAGs meeting Thurs jan 5 at 3 PM

That's kind of the point.

From: Walker, Stuart
Sent: Wednesday, January 04, 2017 9:20 PM
To: Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov>
Cc: Scozzafava, MichaelE <Scozzafava.MichaelE@epa.gov>
Subject: Re: Water PAGs meeting Thurs jan 5 at 3 PM

ok, if you guys change your minds I can be reached at Ex. 6 - Personal Privacy Pam knows the issue real well, Stiven I doubt it.

From: Fitz-James, Schatzi
Sent: Wednesday, January 4, 2017 6:53 PM
To: Walker, Stuart
Cc: Scozzafava, MichaelE
Subject: Re: Water PAGs meeting Thurs jan 5 at 3 PM

Dana will discuss stiven attending with Pam in the am. Think osrti should decline the invite
Ex. 6 - Personal Privacy

Sent from my iPhone

> On Jan 4, 2017, at 5:26 PM, Walker, Stuart <Walker.Stuart@epa.gov> wrote:
>
> fyi, Ex. 6 - Personal Privacy but can call in if needed. Not sure if Jim or Pam are responding.
>
>
> _____
> From: Diane D'Arrigo <dianed@nirs.org>
> Sent: Wednesday, January 4, 2017 4:02 PM
> To: Woolford, James; Barr, Pamela
> Cc: Openchowski, Charles; Walker, Stuart

> Subject: FW: Water PAGs meeting Thurs jan 5 at 3 PM
>
>
> Dear James Woolford and Pamela Barr
>
> Cc: Walker Openchowski
>
>
>
> Dozens of organizations have been expressing concerns and opposition to the Water PAGs for over a decade nearly 2. We have a meeting with the Office of Water tomorrow at 3 and are requesting that Charles Openchowski and Stuart Walker be present because their comments are very relevant to the decision.
>
>
>
> Sincerely,
>
>
>
> Diane D'Arrigo
>
> NIRS
>
> dianed@nirs.org<mailto:dianed@nirs.org>
>
> 202 841 8588
>
>
>
>
>
> From: Diane D'Arrigo
> Sent: Tuesday, January 03, 2017 2:47 PM
> To: 'Gude.Karen@epa.gov'
> Cc: Geoff Fettus; Emily Wurth; Paul Gallay; Damon Moglen; Catherine Thomasson; Dalal Aboulhosn; Cindy Folkers (cindy@beyondnuclear.org); Lynn Thorp CWA; Dan Hirsch 2; John Coequyt ; McKinzie, Matthew; Wenonah Hauter (whauter@fwwatch.org); Jeff Carter; Diane D'Arrigo
> Subject: Water PAGs meeting Thurs jan 5 at 3 PM
>
>
>
> Karen Gude
>
> EPA Office of Water
>
> Gude, Karen <Gude.Karen@epa.gov<mailto:Gude.Karen@epa.gov>>
>
>
>
> Jan 3, 2017
>
>
>
> Dear Karen Gude:

>
>
>
> Thank you for setting up the meeting on WATER PAGs Jan 5th at 3 PM at the EPA East building at Federal Triangle with EPA Office of Water Assistant Administrator Joel Beauvais and Peter Grevatt, Director, Office of Ground Water & Drinking Water . The list of organizations attending is attached… and could be added to as I continue to receive responses. We will have several (3-5) people joining by speaker phone, 2 of whom are confirmed and listed.
>
>
>
> We very much need for the meeting to include both Charles Openchowski and Stuart Walker to participate as well who are quoted in the press release [pasted and highlighted below and link provided here] raising concerns about the Water PAGs back in 2010.
http://www.peer.org/news/news-releases/radiation-exposure-debate-rages-inside-epa.html<http://www.peer.org/news/news-releases/radiation-exposure-debate-rages-inside-epa.html>
>
>
>
> Based on the FOIA materials received by PEER in December 2016, it appears that your Office of Water has not been briefed by OSWER or OGC or the critics of these Water PAGs from within EPA. Especially if you include OAR, you must include these individuals.
>
>
>
> We believe it is essential to hear from them as well as our groups before the final decision.
>
>
>
> Also I am attaching the letter I sent to Lisa Christ specifically outlining how the 2016 PAGs define Intermediate Phase and Incident important to the potential implementation of the Water PAGs.
>
>
>
> THANK you so much,
>
>
>
> Diane D'Arrigo
>
> Nuclear Information and Resource Service
>
> dianed@nirs.org<mailto:dianed@nirs.org>
>
> mobile 202 841 8588
>
> office 302 270-6477 x 15
>
>
>
>
>
>

>
> [PEER]
>
>
>
> For Immediate Release: Apr 05, 2010
>
> Contact: Kirsten Stade (202) 265-7337
>
>
>
> RADIATION EXPOSURE DEBATE RAGES INSIDE EPA
>
> Plan to Radically Hike Post-Accident Radiation in Food & Water Sparks Hot Dissent
>
>
>
> Posted on Apr 05, 2010 | Tags: EPA
>
>
>
> Washington, DC — A plan awaiting approval by the U.S. Environmental Protection Agency that would dramatically increase permissible radioactive releases in drinking water, food and soil after “radiological incidents” is drawing vigorous objections from agency experts, according to agency documents released today by Public Employees for Environmental Responsibility (PEER). At issue is the acceptable level of public health risk following a radiation release, whether an accidental spill or a “dirty bomb” attack.
>
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>
> The radiation arm of EPA, called the Office of Radiation and Indoor Air (ORIA), has prepared an update of the 1992 “Protective Action Guides” (PAG) governing radiation protection decisions for both short-term and long-term cleanup standards. Other divisions within EPA contend the ORIA plan geometrically raises allowable exposure to the public. For example, as Charles Openchowski of EPA’s Office of General Counsel wrote in a January 23, 2009 e-mail to ORIA:
>
>
>
> “[T]his guidance would allow cleanup levels that exceed MCLs [Maximum Contamination Limits under the Safe Drinking Water Act] by a factor of 100, 1000, and in two instances 7 million and there is nothing to prevent those levels from being the final cleanup achieved (i.e., it’s not confined to immediate response of emergency phase).”
>
>
>
> Another EPA official, Stuart Walker of the Office of Superfund Remediation and Technology Innovation, explains what the proposed new radiation limits in drinking water would mean:
>
>
>
> “It also appears that drinking water at the PAG concentrations…may lead to subchronic (acute) effects following exposures of a day or a week. In a population, one should see some express acute effects…that is vomiting, fever, etc.”
>
>

>
> “This critical debate is taking place entirely behind closed doors because this plan is ‘guidance’ and does not require public notice as a regulation would,” stated PEER Counsel Christine Erickson. Today, PEER sent EPA Administrator Lisa Jackson a letter calling for a more open and broader examination of the proposed radiation guidance. “We all deserve to know why some in the agency want to legitimize exposing the public to radiation at levels vastly higher than what EPA officially considers dangerous.”
>
>
>
> The internal documents show that under the updated PAG a single glass of water could give a lifetime’s permissible exposure. In addition, it would allow long-term cleanup limits thousands of times more lax than anything EPA has ever before accepted. These new limits would cause a cancer in as much as every fourth person exposed.
>
>
>
> PEER obtained the internal e-mails after filing a lawsuit this past fall under the Freedom of Information Act (FOIA) but the EPA has yet to turn over thousands more communications. “EPA touts its new transparency but when it comes to matters of controversy the agency still puts up a wall,” added Erickson, who filed the FOIA suit. “Besides the months of stonewalling, we are seeing them pull stunts such as ORIA giving us rebuttals to other EPA documents they have yet to release.”
>
>
>
> ###
>
>
>
> Examine the Office of General Counsel e-mail<http://www.peer.org/assets/docs/epa/4_5_10_EPA_Office_Gen_Counsel_Email.pdf>
>
> Look at the Office of Superfund Remediation and Technology Innovation concerns<http://www.peer.org/assets/docs/epa/4_5_10_OSRTI_Comments.pdf>
>
> Read the PEER letter to Administrator Jackson<http://www.peer.org/assets/docs/epa/4_5_10_PEER_Radiation_ltr_to_EPA.pdf>
>
> See tables detailing how many times more radiation the PAG would allow<http://www.peer.org/assets/docs/epa/4_5_10_Radionuclide_Tables.pdf>
>
> View the PEER lawsuit and additional background on the issue<http://www.peer.org/news/news-releases/suit-to-air-internal-epa-protests-on-radiation-exposure-plan.html>
>
>
> <image001.gif>
> <WATER PAGs 12-18-16 letter to Lisa Christ.pdf>
> <attendees WATER PAGs jan 5 2017 meeting with Office of Water.pdf>

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Amy Doll[adoll@endyna.com]; siddhanti@endyna.com[siddhanti@endyna.com]
From: Marissa McDonough
Sent: Thur 1/5/2017 8:22:16 PM
Subject: 2016 PAGs Manual Overview Presentation - 5 Jan 2017 Draft
2016 PAGs Manual Overview Presentation_5 Jan 2017 -DRAFT.pptx

Good afternoon, Sara;

Attached is a rough draft of the PAGs presentation we discussed in yesterday's meeting. I made sure that the suggestions from the meeting, as well as from Wagnus today were incorporated in this draft. I was sure to expand on the speaker notes a bit, and I feel this is enough for a 45-minute timeframe.

Please let me know if you have any questions or concerns.

Thank you!

-Marissa

Marissa K. McDonough, MPH
Occupational Health and Safety Specialist
EnDyna, Inc.
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www.endyna.com

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Module Objectives

- PAG Purpose – Scope – Field Use
- PAG History
- 2013 PAG Manual Changes – Approved in December 2016
- 2013 PAG Manual Implementation Plan
- Other PAG Resources
-

What is a PAG?

- Protective Action Guide or PAG = a radiation dose to avoid by taking protective actions:
  - Evacuation, sheltering, food embargo or alternative water, removing contamination
- Non-regulatory guidance crafted by interagency group of radiation emergency experts
- Implemented by
  - State radiation and emergency management groups
  - Nuclear power plants
  - Military, research and medical facilities

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Why PAGs?

- Radiation emergencies are rare
- Nuclear power:
  - Chernobyl
  - Three Mile Island
  - Fukushima
- Terrorism:
  - Radiological Dispersal Device (RDD), also known as “dirty bomb”
  - Non-state nuclear detonation
- For emergency plans, where do officials draw the line?
  - Where a PAG dose might be predicted

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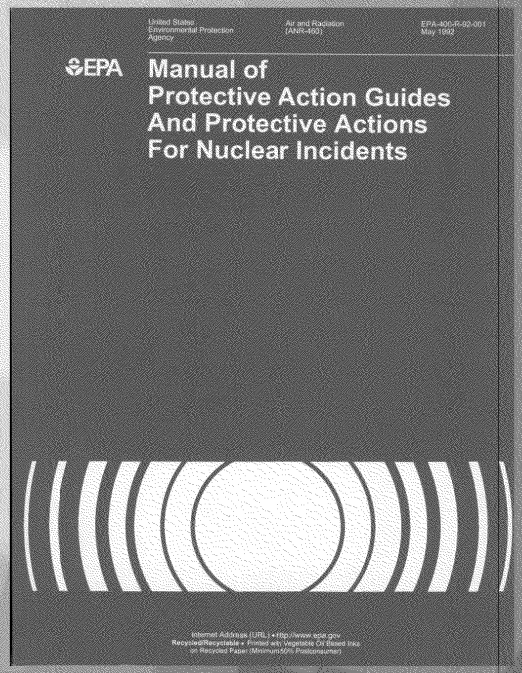
PAGS Manual

- 1960s fallout guidance refined in 1975 & 1980
- Protective Action Guides (PAGs) Manual (1992)
  - Guidance for Action in Nuclear Emergencies
  - Early, Intermediate Phases only
  - Promised Water and Late Phase (Recovery) PAGs



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When Do PAGs Apply?

- Not for radioactively contaminated sites
- Releases, incidents, or accidents
- Public protection is the focus
- Guidance, not regulatory
- Not related to CERCLA or Superfund
- Avoided dose ≠ safe limit to allow

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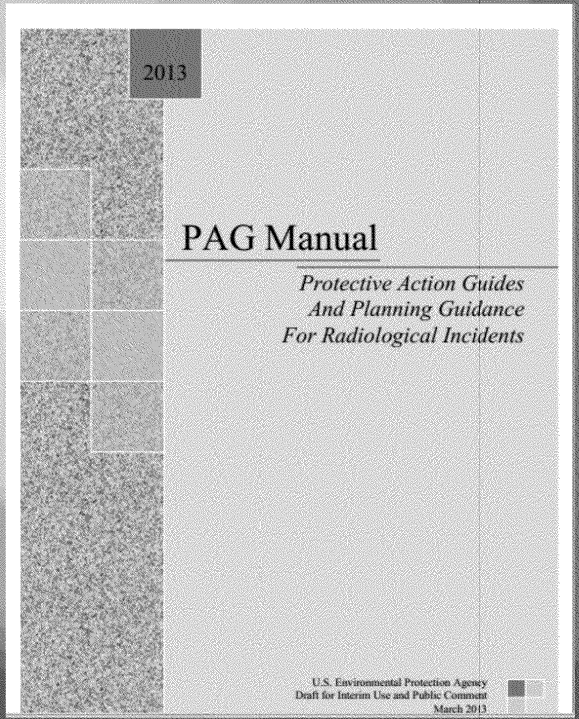
March 2013 Proposed Revision of PAG Manual

- Clarified the use of PAGs for all radiological incidents, including terrorism
- Requested input on drinking water guidance
- Refers to FDA 'KI' and food guidance
- Includes guidance for long-term site restoration
- Updates dosimetry



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Summary of Comments

- Around 5,000 comments received. Changes include:
  - Clarifications and consistent terminology
  - Additional explanation to better describe how the PAGs were set originally
  - Describing how conservative PAGs levels are
  - Further emphasizing how environmental standards are not changing because of this guidance
- Though some guidance is beyond PAGs
  - Exactly how clean is clean
  - Concern about responsibility/capacity for waste

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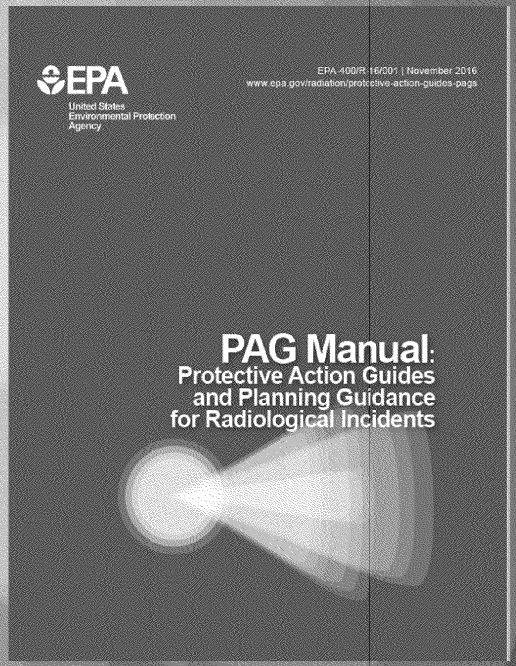
November 2016 PAG Manual

- OMB review concluded
- Federal Register Notice signed
- EPA posted pre-publication draft in November 2016
- Plans to facilitate implementation:
  - Anticipate one year to incorporate into local/state plans
  - Training opportunities through webinars and conferences
- For more information
  - See our web page at https://www.epa.gov/radiation/protective-action-guides-pags



ED_001057_00007969

To: Hale, Olin[olin.hale@fema.dhs.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
From: Wieder, Jessica
Sent: Tue 12/20/2016 2:35:15 PM
Subject: PAG Comm Tools - Show stopper review
PAGs_Comm_Tool_P6.pdf

Olin,

I would like to do an FRPCC show-stopper review on the attached comm tool. With the holiday coming up, should we distribute now and ask for feedback by Jan 13 or should we distribute in the New Year and ask for feedback by Jan 13. I don't want to push the due date back.

Jess

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: siddhanti@endyna.com[siddhanti@endyna.com]; Amy Doll[adoll@endyna.com]
From: Marissa McDonough
Sent: Fri 12/16/2016 6:47:03 PM
Subject: Draft PAG Webinar - Module 2 for review
PAG_Webinar_Module 2_16Dec 2016.pptx

Good afternoon, Sara;

Attached please find the draft for Module 2 for the Drinking Water PAG Webinar. Amy and I reviewed this draft, which is based on the outline, and decided to send you one module for review.

Please let us know if you like the template and style for this initial module.

This module is based on your previous slides, but we have made a few edits/revisions.

We will continue working on Module 3 and look forward to your feedback!

Thanks,

-Marissa

Marissa K. McDonough, MPH
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To: Nesky, Anthony[Nesky.Tony@epa.gov]; Davis, Matthew[Davis.Matthew@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]
Cc: White, Rick[White.Rick@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
From: Wieder, Jessica
Sent: Tue 12/6/2016 7:17:11 PM
Subject: RE: Signed - PAG Manual

Dear Matthew,

Having overcome some listserv technical difficulties, we just sent the following message regarding PAG Manual finalization to our stakeholders.

Please let me know if you have any questions. - Jessica

Subject: EPA Protective Action Guides Manual Finalized

On December 1, 2016, EPA Administrator Gina McCarthy signed the Federal Register notice announcing the finalization of the 2016 *Protective Action Guides and Planning Guidance for Radiological Incidents*, also known as the PAG Manual. Last revised in 1992, this action brings the PAG Manual up to date with the best available radiation science, giving emergency response officials the tools they need to base critical decisions on current health and safety data.

A copy of the prepublication Federal Register Notice and 2016 PAG Manual can be found at https://www.epa.gov/radiation/pag-manuals-and-resources.

The PAG Manual is a federally coordinated radiation emergency planning guide for state and local emergency response organizations. It contains science-based radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to minimize or prevent radiation exposure during an emergency. Radiation scientists and emergency response planners from multiple federal agencies- including DHS/FEMA, DOE, HHS, DOL/OSHA, USDA, NRC and DOD- worked together to revise the PAG Manual.

An interim version of this guidance was published in 2013. EPA received approximately 5,000 comments from members of the public, state and local emergency response and health organizations, industry associations, and from national and international radiation protection organizations. Significant changes we made based on these comments include:

- Clarifying planning considerations related to the lower FDA Potassium Iodide (KI) guidance
- Explaining the deletion of the thyroid-based evacuation threshold more thoroughly
- Providing additional language on using Federal Radiological Monitoring and Assessment Center (FRMAC) derived value tables
- Providing explanation about the removal of the Relocation PAG of 5 rem over 50 years to avoid confusion with long-term cleanup goals

Adding information from the appendices of the 1992 PAG Manual on how the PAG levels were set

This version of the 2016 PAG Manual does not include the drinking water guidance currently undergoing OMB review.

The 2016 PAG Manual may be used immediately. FEMA and NRC require certain organizations associated with nuclear power plant operations to use the PAGs in their emergency management plans. Those organizations will be expected to incorporate the 2016 guidance within twelve months from publication in the Federal Register.

The PAG Manual is a planning guide for emergency situations only, it does not replace or affect the agency's Superfund authorities, existing clean up regulations, or current health and safety standards.

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

From: Nesky, Anthony
Sent: Thursday, December 01, 2016 5:20 PM
To: Davis, Matthew <Davis.Matthew@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: Signed - PAG Manual

Dear Matthew:

Pre-Federal Register versions of the PAG Manual and the signed FR notice are on the web at:

https://www.epa.gov/radiation/pag-manuals-and-resources

Background information has been updated at:

https://www.epa.gov/radiation/protective-action-guides-pags

An email blast to stakeholders will be sent out tomorrow morning.

Tony Nesky

202-343-9597

From: Davis, Matthew
Sent: Thursday, December 01, 2016 4:53 PM
To: Perrin, Alan <Perrin.Alan@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: Signed - PAG Manual

Great, thanks, I appreciate being kept in the loop on this! I plan to notify a few staffers who have expressed interest in this in the past when this goes online.

-Matthew

From: Perrin, Alan
Sent: Thursday, December 01, 2016 2:48 PM
To: Davis, Matthew <Davis.Matthew@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: Signed - PAG Manual

Hi Dave,

It was a beautiful signing! **I'm adding in our Comms folks, so that they can notify you when it goes online and provide the notification of posting** (I assume that is what you mean by announcement?) that will be going out to stakeholders once it is up. -Alan

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl Ex. 6 - Personal Privacy

From: Davis, Matthew
Sent: Thursday, December 01, 2016 2:37 PM
To: Perrin, Alan <Perrin.Alan@epa.gov>
Subject: FW: Signed - PAG Manual

Alan,

Looks like the signature happened this afternoon. Can you let me know when this is posted online, and forward along the announcement when it is going to go out?

Thanks,

Matthew

Matthew H. Davis

Office of Congressional and Intergovernmental Relations

U.S. EPA

1200 Pennsylvania Ave NW, MC 1301A

Washington, DC 20460

(202) 564-1267

From: Knapp, Kristien
Sent: Thursday, December 01, 2016 1:24 PM
To: Meiburg, Stan <Meiburg.Stan@epa.gov>; Fritz, Matthew <Fritz.Matthew@epa.gov>;

Garbow, Avi <Garbow.Avi@epa.gov>; McCabe, Janet <McCabe.Janet@epa.gov>; Goffman, Joseph <Goffman.Joseph@epa.gov>; Shaw, Betsy <Shaw.Betsy@epa.gov>; Niebling, William <Niebling.William@epa.gov>; Rupp, Mark <Rupp.Mark@epa.gov>; Vaught, Laura <Vaught.Laura@epa.gov>; Wachter, Eric <Wachter.Eric@epa.gov>; Pieh, Luseni <Pieh.Luseni@epa.gov>; Jordan, Deborah <Jordan.Deborah@epa.gov>; Scaggs, Ben <Scaggs.Ben@epa.gov>; Purchia, Liz <Purchia.Liz@epa.gov>; Harrison, Melissa <Harrison.Melissa@epa.gov>; Rennert, Kevin <Rennert.Kevin@epa.gov>; Beauvais, Joel <Beauvais.Joel@epa.gov>; Ragland, Micah <Ragland.Micah@epa.gov>; Grantham, Nancy <Grantham.Nancy@epa.gov>; Distefano, Nichole <DiStefano.Nichole@epa.gov>; Asher, Jonathan <Asher.Jonathan@epa.gov>; Vargas, Melissa <vargas.melissa@epa.gov>; Brown, Tristan <Brown.Tristan@epa.gov>; Banister, Beverly <Banister.Beverly@epa.gov>; Herckis, Arian <Herckis.Arian@epa.gov>; Benenati, Frank <benenati.frank@epa.gov>; Strauss, Alexis <Strauss.Alexis@epa.gov>
Cc: Chappell, Regina <Chappell.Regina@epa.gov>; Adams, Darryl <Adams.Darryl@epa.gov>; Baldwin, Mark <Baldwin.Mark@epa.gov>; Birgfeld, Erin <Birgfeld.Erin@epa.gov>; Bowles, Jack <Bowles.Jack@epa.gov>; Brooks, Phillip <Brooks.Phillip@epa.gov>; Brown, Stephanie N. <Brown.StephanieN@epa.gov>; Cook, Leila <cook.leila@epa.gov>; Cortelyou-Lee, Jan <Cortelyou-Lee.Jan@epa.gov>; Davis, Alison <Davis.Alison@epa.gov>; Dennis, Allison <Dennis.Allison@epa.gov>; Dibble, Christine <Dibble.Christine@epa.gov>; Drinkard, Andrea <Drinkard.Andrea@epa.gov>; Dunham, Sarah <Dunham.Sarah@epa.gov>; Eagles, Tom <Eagles.Tom@epa.gov>; Edwards, Jonathan <Edwards.Jonathan@epa.gov>; Flynn, Mike <Flynn.Mike@epa.gov>; Free, Laura <Free.Laura@epa.gov>; Grundler, Christopher <grundler.christopher@epa.gov>; Haman, Patricia <Haman.Patricia@epa.gov>; Hanley, Mary <Hanley.Mary@epa.gov>; Hengst, Benjamin <Hengst.Benjamin@epa.gov>; Henigin, Mary <Henigin.Mary@epa.gov>; Hufford, Drusilla <Hufford.Drusilla@epa.gov>; Jutras, Nathaniel <Jutras.Nathaniel@epa.gov>; Kenny, Shannon <Kenny.Shannon@epa.gov>; Kime, Robin <Kime.Robin@epa.gov>; Krieger, Jackie <Krieger.Jackie@epa.gov>; Hart, Daniel <Hart.Daniel@epa.gov>; Lewis, Josh <Lewis.Josh@epa.gov>; Lubetsky, Jonathan <Lubetsky.Jonathan@epa.gov>; Maddox, Donald <Maddox.Donald@epa.gov>; Mazakas, Pam <Mazakas.Pam@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>; Mcquilkin, Wendy <Mcquilkin.Wendy@epa.gov>; Metzger, Philip <Metzger.Philip@epa.gov>; Milbourn, Cathy <Milbourn.Cathy@epa.gov>; Millett, John <Millett.John@epa.gov>; Morgan, Ruthw <morgan.ruthw@epa.gov>; Morin, Jeff <Morin.Jeff@epa.gov>; Morris, Stephanie <Morris.Stephanie@epa.gov>; Muellerleile, Caryn <Muellerleile.Caryn@epa.gov>; Sutton, Tia <sutton.tia@epa.gov>; Mylan, Christopher <Mylan.Christopher@epa.gov>; Noonan, Jenny <Noonan.Jenny@epa.gov>; Owens, Nicole <Owens.Nicole@epa.gov>; Page, Steve <Page.Steve@epa.gov>; Jones, Knolyn <Jones.Knolyn@epa.gov>; Emerson, Michael <Emerson.Michael@epa.gov>; Pritchard, Eileen <Pritchard.Eileen@epa.gov>; Rimer, Kelly <Rimer.Kelly@epa.gov>; Rush, Alan <Rush.Alan@epa.gov>; Schillo, Bruce <Schillo.Bruce@epa.gov>; Schmidt, Lorie <Schmidt.Lorie@epa.gov>; Scoville, Pat <Scoville.Pat@epa.gov>; South, Peter <South.Peter@epa.gov>; Klasen, Matthew <Klasen.Matthew@epa.gov>; Washington, Stephanie <Washington.Stephanie@epa.gov>; Washington, Valerie <Washington.Valerie@epa.gov>; Wortman, Eric <Wortman.Eric@epa.gov>; Shenkman, Ethan <Shenkman.Ethan@epa.gov>; Kim, Hyon <Kim.Hyon@epa.gov>; Hambrick, Amy <Hambrick.Amy@epa.gov>; Orlin, David <Orlin.David@epa.gov>; Gaines, Cynthia <Gaines.Cynthia@epa.gov>; Leavy, Jacqueline <Leavy.Jacqueline@epa.gov>; Naples, Eileen <Naples.Eileen@epa.gov>; Lee, Michael <lee.michaelg@epa.gov>; Srinivasan, Gautam <Srinivasan.Gautam@epa.gov>; Doster, Brian <Doster.Brian@epa.gov>; Smith, Kristi <Smith.Kristi@epa.gov>; Rodman, Sonja <Rodman.Sonja@epa.gov>; Cyran, Carissa <Cyran.Carissa@epa.gov>; Iglesias, Amber <Iglesias.Amber@epa.gov>; Tsirigotis, Peter <Tsirigotis.Peter@epa.gov>; Thompson, Fred

<Thompson.Fred@epa.gov>; Hautamaki, Jared <Hautamaki.Jared@epa.gov>; VonDemHagen, Rebecca <VonDemHagen.Rebecca@epa.gov>; Threet, Derek <Threet.Derek@epa.gov>; Elman, Barry <Elman.Barry@epa.gov>; VanLare, Paula <VanLare.Paula@epa.gov>; Nickerson, William <Nickerson.William@epa.gov>; Bailey, KevinJ <Bailey.KevinJ@epa.gov>; Corrales, Mark <Corrales.Mark@epa.gov>; Perez, Idalia <Perez.Idalia@epa.gov>; Burch, Julia <Burch.Julia@epa.gov>; Burden, Susan <Burden.Susan@epa.gov>; Zenick, Elliott <Zenick.Elliott@epa.gov>; Harvey, Reid <Harvey.Reid@epa.gov>; Clarke, Deirdre <clarke.deirdre@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: Signed - PAG Manual

This afternoon, Administrator McCarthy signed a notice of availability for the final revision to the PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents (SAN 5198). A copy of the signed notice is attached. Please let me know if you have any questions or concerns.

Thanks,

Kristien

Kristien Knapp

Special Assistant, Office of the Administrator
U.S. Environmental Protection Agency

Office: (202) 564-3277

Cell: Ex. 6 - Personal Privacy

To: Shogren, Angela[Shogren.Angela@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
From: Wieder, Jessica
Sent: Mon 12/5/2016 2:18:18 PM
Subject: FW: PAGs Outreach

Angela – Please send the following note to the PAG Listserv and cc me and Sara. Thank you so much! - Jess

Subject: EPA Protective Action Guides Manual Finalized

On December 1, 2016, EPA Administrator Gina McCarthy signed the Federal Register notice announcing the finalization of the 2016 *Protective Action Guides and Planning Guidance for Radiological Incidents*, also known as the PAG Manual. Last revised in 1992, this action brings the PAG Manual up to date with the best available radiation science, giving emergency response officials the tools they need to base critical decisions on current health and safety data.

A copy of the prepublication Federal Register Notice and 2016 PAG Manual can be found at https://www.epa.gov/radiation/pag-manuals-and-resources.

The PAG Manual is a federally coordinated radiation emergency planning guide for state and local emergency response organizations. It contains science-based radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to minimize or prevent radiation exposure during an emergency. Radiation scientists and emergency response planners from multiple federal agencies- including DHS/FEMA, DOE, HHS, DOL/OSHA, USDA, NRC and DOD- worked together to revise the PAG Manual.

An interim version of this guidance was published in 2013. EPA received approximately 5,000 comments from members of the public, state and local emergency response and health organizations, industry associations, and from national and international radiation protection organizations. Significant changes we made based on these comments include:

- Clarifying planning considerations related to the lower FDA Potassium Iodide (KI) guidance

- Explaining the deletion of the thyroid-based evacuation threshold more thoroughly

- Providing additional language on using Federal Radiological Monitoring and Assessment Center (FRMAC) derived value tables

- Adding information from the appendices of the 1992 PAG Manual on how the PAG levels were set

- Providing explanation about the removal of the Relocation PAG of 5 rem over 50 years to avoid confusion with long-term cleanup goals

This version of the 2016 PAG Manual does not include the drinking water guidance currently undergoing OMB review.

The 2016 PAG Manual may be used immediately. FEMA and NRC require certain organizations associated with nuclear power plant operations to use the PAGs in their emergency management plans. Those organizations will be expected to incorporate the 2016 guidance within twelve months of this announcement.

The PAG Manual is a planning guide for emergency situations only, it does not replace or affect the agency's Superfund authorities, existing clean up regulations, or current health and safety standards.

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

From: DeCair, Sara
Sent: Monday, December 05, 2016 9:15 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>
Subject: Re: PAGs Outreach

Looks great to me, since the recipients are really broad spectrum I can't add more about people's role in being a messenger. I put that in my Subcommittee note on Thursday... Thank you and let's go with this!

From: Wieder, Jessica
Sent: Monday, December 5, 2016 8:51 AM
To: DeCair, Sara
Subject: RE: PAGs Outreach

For your review: PAG Listserv Announcement

Subject: EPA Protective Action Guides Manual Finalized

On December 1, 2016, EPA Administrator Gina McCarthy signed the Federal Register notice announcing the finalization of the 2016 *Protective Action Guides and Planning Guidance for Radiological Incidents*, also known as the PAG Manual. Last revised in 1992, this action brings the PAG Manual up to date with the best available radiation science, giving emergency response officials the tools they need to base critical decisions on current health and safety data.

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PAG Manuals and Resources | Radiation Protection | US EPA

www.epa.gov

The 2013 PAG Manual (for interim use) and other applicable resources are available for download below: You will need Adobe Reader to view some of the files on this ...

The PAG Manual is a federally coordinated radiation emergency planning guide for state and local emergency response organizations. It contains science-based radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to minimize or prevent radiation exposure during an emergency. Radiation scientists and emergency response planners from multiple federal agencies- including DHS/FEMA, DOE, HHS, DOL/OSHA, USDA, NRC and DOD- worked together to revise the PAG Manual.

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Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

From: DeCair, Sara
Sent: Monday, December 05, 2016 8:17 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>
Subject: Re: PAGs Outreach

You please - thank you!!

From: Wieder, Jessica
Sent: Monday, December 5, 2016 8:16 AM
To: DeCair, Sara
Subject: RE: PAGs Outreach

Are you asking me to draft it or are you? Either is fine, I just need to know.

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

From: DeCair, Sara
Sent: Monday, December 05, 2016 8:15 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>
Subject: Re: PAGs Outreach

We did not, and I thought of it yesterday like a nerd - heh! I don't even think we need content, since the FR notice says the important 12 months to adopt thing (but who reads instructions, really). But I'm glad to help with words. I know Angela maintained the list, or rebuilt it or something when we converted. Thank you!!

From: Wieder, Jessica
Sent: Monday, December 5, 2016 7:58 AM
To: DeCair, Sara
Subject: PAGs Outreach

Sara – Did we get a Listserv message out last week to the stakeholders regarding the PAG Manual publication? If so, please send me a copy so that I can forward it to OCIR. If not, let me know if you need any assistance getting that out the door.

Thank you.

Jess

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

C: Ex. 6 - Personal Privacy

To: DeCair, Sara[DeCair.Sara@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]
Cc: White, Rick[White.Rick@epa.gov]
From: Nesky, Anthony
Sent: Thur 12/1/2016 4:09:53 PM
Subject: PAG Website: Fact Sheet and Disclaimer text for pre-publication document.
PAGFactSheet-2016.docx

Dear Sara:

Your changes to the fact sheet make perfect sense. I am attaching a clean version of the document.

Also, do you have the disclaimer text for pre-publication version? We have used something like this before—

EPA Administrator Gina McCarthy signed this guidance document on December 1, 2016. This copy is being provided to inform the public about EPA's intentions, and will be replaced with the official document upon its publication in the Federal Register.

Tony

From: DeCair, Sara
Sent: Wednesday, November 30, 2016 8:29 PM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>
Subject: Re: PAG website: when do we update?/Updated Fact Sheet attached

I made some suggestions on the fact sheet, attached. I defer to your wisdom, though, and I think we don't necessarily have to launch it at the same time as the Manual itself, which might be early afternoon tomorrow? As soon as we have the PDF of the signed FR! We'll need to put that red text at the top of the FR Notice that says it's been signed and will be replaced with the regs.gov version once published! Millions of thanks, S.

From: Nesky, Anthony
Sent: Wednesday, November 30, 2016 6:19 PM
To: Wieder, Jessica; DeCair, Sara
Cc: White, Rick
Subject: RE: PAG website: when do we update?/Updated Fact Sheet attached

Are there any differences between the 2013 Interim Final and the 2016 Final? Do we want to keep the 2013 document on line?

Also, do you want a current Fact Sheet? I have taken the liberty of editing the current one to bring it up to date. It is attached. Changes are in redline/strikeout.

Tony

From: Wieder, Jessica
Sent: Wednesday, November 30, 2016 5:04 PM
To: Nesky, Anthony <Nesky.Tony@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>; Thornton, Marisa <Thornton.Marisa@epa.gov>
Subject: Re: PAG website: when do we update?

As soon as we have the signed document. :-)

Jessica Wieder

U.S. Environmental Protection Agency

Radiation Protection Program

202-343-9201

m: Ex. 6 - Personal Privacy

Sent from my iPhone

On Nov 30, 2016, at 4:37 PM, Nesky, Anthony <Nesky.Tony@epa.gov> wrote:

Dear Sara and Jess:

At what point will we update the website? As soon as it is signed?

Marisa will need the final document for posting.

Tony

To: DeCair, Sara[DeCair.Sara@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; McMichael, Nate[McMichael.Nate@epa.gov]
From: Nesky, Anthony
Sent: Mon 11/28/2016 6:30:47 PM
Subject: Re: Latest version attached: PAGs Rollout Materials

Yes, this is a top priority!

From: DeCair, Sara
Sent: Monday, November 28, 2016 1:29 PM
To: Nesky, Anthony; Wieder, Jessica; McMichael, Nate
Subject: Re: Latest version attached: PAGs Rollout Materials

I'm keeping latest versions of the whole FR Pkg on this OneDrive: https://usepa-my.sharepoint.com/personal/decair_sara_epa_gov/_layouts/15/guestaccess.aspx?guestaccesstoken=

I've also attached the latest Comms Plan. I think it's good for you and then Jess and Nate to be sure it does what you all need, as the package is probably headed to OA for signature any day. Thank you!!

From: Nesky, Anthony
Sent: Monday, November 28, 2016 1:22 PM
To: DeCair, Sara; Wieder, Jessica; McMichael, Nate
Subject: Re: Latest version attached: PAGs Rollout Materials

Hi Sara,

I have been in and out of this project, so I am a little worried about version control. I'm working remotely today without access to the G Drive. Could you please send me the latest version of the comms plan, and I'll make it reflect this.

From: DeCair, Sara
Sent: Monday, November 28, 2016 11:46 AM
To: Wieder, Jessica; McMichael, Nate; Nesky, Anthony
Subject: Re: Latest version attached: PAGs Rollout Materials

So -- that sounds good to me.

Tony, are you able to make the Comms Plan reflect this, and then I will convey it to the OAR docs team (Ruth and Wendy) to put into the electronic package that is being tracked.

Let me know if any part of that sounds problematic! Thx,

S.

From: Wieder, Jessica
Sent: Monday, November 28, 2016 11:41 AM
To: McMichael, Nate; Nesky, Anthony; DeCair, Sara
Subject: Re: Latest version attached: PAGs Rollout Materials

I am fine with that as a desk statement.

Jessica Wieder
U.S. EPA
Radiation Protection Program
Center for Radiation Information and Outreach
w: 202-343-9201
c: Ex. 6 - Personal Privacy

From: McMichael, Nate
Sent: Monday, November 28, 2016 11:40:33 AM
To: Wieder, Jessica; Nesky, Anthony; DeCair, Sara
Subject: RE: Latest version attached: PAGs Rollout Materials

Thanks – makes sense. I would still prefer to use something closer to the updated statement. John suggested tweaking it to focus on updating old science after his one on one with Janet a few weeks ago – that's what prompted the check in on the 15th.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

From: Wieder, Jessica
Sent: Monday, November 28, 2016 11:30 AM
To: McMichael, Nate <McMichael.Nate@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: Re: Latest version attached: PAGs Rollout Materials

Nate - We can't use the version you sent. The version you sent has drinking water included. This version of the PAG Manual will not have drinking water included.

If you want to make the following change in the overview, that is fine with me. That doesn't change the meaning of the overview, but keep in mind that the version Sara sent is the version that went with the package up to OP and the Administrator. - Jess

Ex. 5 - Deliberative Process

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

From: McMichael, Nate
Sent: Monday, November 28, 2016 11:00:38 AM
To: Nesky, Anthony; Wieder, Jessica
Subject: FW: Latest version attached: PAGs Rollout Materials

It looks like we're having a version control issue. A week or two ago we wanted to work in more messages about updated science up top and wanted to make it more plain language. That's what we were going for with the revised statement in the chain below. The attached uses a previous version. Please let me know if there are any concerns with using the update.

I think that I also suggested not naming reporters in the 'suggested reaction' section.

From: DeCair, Sara
Sent: Monday, November 28, 2016 10:49 AM
To: Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Cc: Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>
Subject: Latest version attached: PAGs Rollout Materials

All, here is the more up to date Comms Plan. All of the ORIA staff & mgrs associated with the project have access to the OneDrive folder with the latest versions, too, in case you can't reach me. Plz let me know if there are any questions.

PS, the FR pkg is still in OP with Glynis as of Friday. Thanks, and I hope everyone has a good day,

S.

From: Perrin, Alan
Sent: Monday, November 28, 2016 9:58 AM
To: DeCair, Sara; Veal, Lee
Subject: FW: PAGs Rollout Materials

FYI

~~~~~~~~~~~~~

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl Ex. 6 - Personal Privacy

From: McMichael, Nate
Sent: Monday, November 28, 2016 9:40 AM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: RE: PAGs Rollout Materials

Hi Everyone -

Digging this back up to send downstairs – I added the updated statement to the rollout plan. Before I send it, please let me know if you have any other changes and if we have an estimate on timing.

Thanks!

-Nate

From: Nesky, Anthony
~~~~~~~~~~~~~

Sent: Tuesday, November 15, 2016 1:02 PM
To: McMichael, Nate <McMichael.Nate@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: RE: PAGs Rollout Materials

Dear Nate:

Wow—thanks for sending this! Your edits are very helpful Drinking water guidance will not be part of this manual, so I deleted all references to it.

Ex. 5 - Deliberative Process

Tony Nesky

Center for Radiation Information and Outreach

Tel: 202-343-9597

nesky.tony@epa.gov

From: McMichael, Nate
Sent: Tuesday, November 15, 2016 12:48 PM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: PAGs Rollout Materials

Hi - I see the Jess is out of the office but I wanted to check in on the latest PAGs materials. I have a draft comm plan that she sent a few weeks ago, but I don't know if I've seen a final. I think that the draft looks good, but one suggestion is beef up the topline statement to enforce the message that we are using the best available science to protect health and safety; a much needed updated to the 1992 version. Please see my suggestion below and let me know if there have been any other updates to the draft that I have. Thanks!

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Nate McMichael

Office of Air and Radiation

202-564-0382 (o)

Ex. 6 - Personal Privacy (c)

To: DeCair, Sara[DeCair.Sara@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; McMichael, Nate[McMichael.Nate@epa.gov]
From: Nesky, Anthony
Sent: Mon 11/28/2016 6:22:52 PM
Subject: Re: Latest version attached: PAGs Rollout Materials

Hi Sara,

I have been in and out of this project, so I am a little worried about version control. I'm working remotely today without access to the G Drive. Could you please send me the latest version of the comms plan, and I'll make it reflect this.

From: DeCair, Sara
Sent: Monday, November 28, 2016 11:46 AM
To: Wieder, Jessica; McMichael, Nate; Nesky, Anthony
Subject: Re: Latest version attached: PAGs Rollout Materials

So -- that sounds good to me.

Tony, are you able to make the Comms Plan reflect this, and then I will convey it to the OAR docs team (Ruth and Wendy) to put into the electronic package that is being tracked.

Let me know if any part of that sounds problematic! Thx,

S.

From: Wieder, Jessica
Sent: Monday, November 28, 2016 11:41 AM
To: McMichael, Nate; Nesky, Anthony; DeCair, Sara
Subject: Re: Latest version attached: PAGs Rollout Materials

I am fine with that as a desk statement.

Jessica Wieder
U.S. EPA
Radiation Protection Program
Center for Radiation Information and Outreach

To: DeCair, Sara[DeCair.Sara@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; McMichael, Nate[McMichael.Nate@epa.gov]
From: Nesky, Anthony
Sent: Mon 11/28/2016 6:22:52 PM
Subject: Re: Latest version attached: PAGs Rollout Materials

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Jessica Wieder
U.S. EPA
Radiation Protection Program
Center for Radiation Information and Outreach

w: 202-343-9201
c: Ex. 6 - Personal Privacy

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Sent: Monday, November 28, 2016 11:40:33 AM
To: Wieder, Jessica; Nesky, Anthony; DeCair, Sara
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From: Wieder, Jessica
Sent: Monday, November 28, 2016 11:30 AM
To: McMichael, Nate <McMichael.Nate@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
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Ex. 5 - Deliberative Process

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: Ex. 6 - Personal Privacy

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Sent: Monday, November 28, 2016 11:00:38 AM
To: Nesky, Anthony; Wieder, Jessica
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To: Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>

Cc: Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>
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Subject: FW: PAGs Rollout Materials

FYI

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Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl Ex. 6 - Personal Privacy

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202-564-0382 (o)

Ex. 6 - Personal Privacy (c)

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From: McMichael, Nate
Sent: Mon 11/28/2016 4:50:04 PM
Subject: RE: Latest version attached: PAGs Rollout Materials

Cool thanks, everyone!

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Sent: Monday, November 28, 2016 11:46 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>
Subject: Re: Latest version attached: PAGs Rollout Materials

So -- that sounds good to me.

Tony, are you able to make the Comms Plan reflect this, and then I will convey it to the OAR docs team (Ruth and Wendy) to put into the electronic package that is being tracked.

Let me know if any part of that sounds problematic! Thx,

S.

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U.S. EPA

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C: Ex. 6 - Personal Privacy

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Office of Air and Radiation

202-564-0382 (o)

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Sent: Mon 11/28/2016 4:47:26 PM
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202-564-0382 (o)

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Cc: Nesky, Anthony <Nesky.Tony@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>
Subject: Latest version attached: PAGs Rollout Materials

All, here is the more up to date Comms Plan. All of the ORIA staff & mgrs associated with the project have access to the OneDrive folder with the latest versions, too, in case you can't reach me. Plz let me know if there are any questions.

PS, the FR pkg is still in OP with Glynis as of Friday. Thanks, and I hope everyone has a good day,

S.

From: Perrin, Alan
Sent: Monday, November 28, 2016 9:58 AM
To: DeCair, Sara; Veal, Lee
Subject: FW: PAGs Rollout Materials

FYI

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl Ex. 6 - Personal Privacy

From: McMichael, Nate
Sent: Monday, November 28, 2016 9:40 AM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: RE: PAGs Rollout Materials

Hi Everyone -

Digging this back up to send downstairs – I added the updated statement to the rollout plan. Before I send it, please let me know if you have any other changes and if we have an estimate on timing.

Thanks!

-Nate

From: Nesky, Anthony
Sent: Tuesday, November 15, 2016 1:02 PM
To: McMichael, Nate <McMichael.Nate@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: RE: PAGs Rollout Materials

Dear Nate:

Wow—thanks for sending this! Your edits are very helpful Drinking water guidance will not be part of this manual, so I deleted all references to it.

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Tony Nesky

Center for Radiation Information and Outreach

Tel: 202-343-9597

nesky.tony@epa.gov

From: McMichael, Nate
Sent: Tuesday, November 15, 2016 12:48 PM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; White, Rick <White.Rick@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Subject: PAGs Rollout Materials

Hi - I see the Jess is out of the office but I wanted to check in on the latest PAGs materials. I have a draft comm plan that she sent a few weeks ago, but I don't know if I've seen a final. I think that the draft looks good, but one suggestion is beef up the topline statement to enforce the message that we are using the best available science to protect health and safety; a much needed updated to the 1992 version. Please see my suggestion below and let me know if there have been any other updates to the draft that I have. Thanks!

Ex. 5 - Deliberative Process

Nate McMichael

Office of Air and Radiation

202-564-0382 (o)

Ex. 6 - Personal Privacy (c)

To: Millett, John[Millett.John@epa.gov]; Dennis, Allison[Dennis.Allison@epa.gov]; McMichael, Nate[McMichael.Nate@epa.gov]; Loop, Travis[Loop.Travis@epa.gov]; Fuld, John[Fuld.John@epa.gov]
Cc: Wieder, Jessica[Wieder.Jessica@epa.gov]; White, Rick[White.Rick@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]; Perrin, Alan[Perrin.Alan@epa.gov]; Lynn, Tricia[lynn.tricia@epa.gov]; Valentine, Julia[Valentine.Julia@epa.gov]; Jones, Enesta[Jones.Enesta@epa.gov]
From: Jones, Enesta
Sent: Wed 10/26/2016 5:21:20 PM
Subject: RE: OAR REVIEW: Radiation PAG Statement

Thanks very much, everyone, for the fast turnaround on edits. Here's where we are (with both OAR and OW's sign-off) on the statement. Please continue to work with both Tricia and I on any PAG media inquiries.

FINAL PAG STATEMENT – 10/26/16

The OMB-completed PAG Manual: Protective Action Guides And Planning Guidance For Radiological Incidents contains radiation dose guidelines that would trigger public safety measures to minimize or prevent radiation exposure during an emergency. This includes guidance on evacuation, sheltering, relocation, food safety, potassium iodide administration, cleanup and waste disposal.

EPA anticipates publishing the PAG Manual: Protective Action Guides And Planning Guidance For Radiological Incidents by the end of the year.

EPA submitted additional emergency response drinking water guidance for OMB review. During a radiological emergency, radioactive material could be released into the rivers, lakes, and streams used by public water suppliers. This drinking water PAG is non-regulatory guidance that authorities can use to protect residents from the harmful effects from radiation in drinking water following a nationally significant radiological emergency.

The purpose of EPA's drinking water Protective Active Guide (PAG) for radiological incidents will be to guide the first year short-term planning and decision-making efforts by local and state officials. It is not intended for long-term or everyday use. The PAG will not affect EPA's drinking water standards for radionuclides. Therefore, affected public water systems are expected to take actions to return to compliance with drinking water standards after a radiological emergency as soon as practicable.

For more information: https://www.epa.gov/radiation/protective-action-guides-pags

Also, note EPA does not comment on current litigation. For any questions on lawsuits, please reach out to Wyn Hornbuckle (Wyn.Hornbuckle@usdoj.gov) at the Department of Justice.

Enesta Jones

U.S. EPA

Office of Media Relations

Office: 202.564.7873

Cell: 202.236.2426

"The root of all joy is gratefulness."

From: Millett, John
Sent: Wednesday, October 26, 2016 12:58 PM
To: Dennis, Allison <Dennis.Allison@epa.gov>; Jones, Enesta <Jones.Enesta@epa.gov>; McMichael, Nate <McMichael.Nate@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>; Fuld, John <Fuld.John@epa.gov>; Loop, Travis <Loop.Travis@epa.gov>
Subject: RE: OAR REVIEW: Radiation PAG Statement

Thanks -- + Nate for awareness

From: Dennis, Allison
Sent: Wednesday, October 26, 2016 12:56 PM
To: Jones, Enesta <Jones.Enesta@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>; Fuld, John <Fuld.John@epa.gov>; Loop, Travis <Loop.Travis@epa.gov>
Subject: Re: OAR REVIEW: Radiation PAG Statement

+ John and Travis (I'm off today)

Sent from my iPhone

On Oct 26, 2016, at 10:56 AM, Jones, Enesta <Jones.Enesta@epa.gov> wrote:

Thanks, Jessica.

Enesta Jones

U.S. EPA

Office of Media Relations

Office: 202.564.7873

Cell: 202.236.2426

"The root of all joy is gratefulness."

On Oct 26, 2016, at 10:56 AM, Wieder, Jessica <Wieder.Jessica@epa.gov> wrote:

Yes. Here is my suggestion:

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The EPA anticipates publishing the *PAG Manual: Protective Action Guides And Planning Guidance For Radiological Incidents* by the end of the year.

EPA submitted additional emergency response drinking water guidance for OMB review.
During a radiological emergency, radioactive material could be released into the rivers, lakes, and streams used by public water suppliers. This drinking water PAG is ~~EPA will be publishing releasing~~ non-regulatory guidance that authorities can use to protect residents from ~~experiencing~~ the harmful effects from radiation in drinking water following a nationally significant radiological emergency.

The purpose of EPA's drinking water Protective Active Guide (PAG) for r~~R~~adiological i~~I~~ncidents will be to guide the first year short-term planning and decision-making efforts by local and state officials. It is not intended for long-term or everyday use. The PAG will not affect EPA's drinking water standards for radionuclides. Therefore, affected public water systems are expected to take actions to return to compliance with drinking water standards after a radiological emergency as soon as practicable.

~~EPA plans to release the drinking water PAG before the end of the calendar year.~~

For more information: https://www.epa.gov/radiation/protective-action-guides-pags

Also, note EPA does not comment on current litigation. For any questions on lawsuits , please reach out to Wyn Hornbuckle (Wyn.Hornbuckle@usdoj.gov) at the Department of Justice.

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: 202-420-9353

From: Jones, Enesta
Sent: Wednesday, October 26, 2016 10:04 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Cc: Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>; Dennis, Allison <Dennis.Allison@epa.gov>
Subject: RE: OAR REVIEW: Radiation PAG Statement

Jessica: Thanks for the edits! We want to marry the two efforts into one statement. That said, can you weave the larger doc language into it?

Enesta Jones

U.S. EPA

Office of Media Relations

Office: 202.564.7873

Cell: 202.236.2426

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Sent: Wednesday, October 26, 2016 10:02 AM
To: Jones, Enesta <Jones.Enesta@epa.gov>; Millett, John <Millett.John@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Cc: Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>;

Dennis, Allison <Dennis.Allison@epa.gov>
Subject: RE: OAR REVIEW: Radiation PAG Statement

Enesta – Just to be clear, this is for drinking water PAG questions only. If there are questions on the larger PAG document, we will have a different response.

Please see our edits below. Note: the publication of the drinking water PAG is dependent on the ongoing OMB review.

Jessica

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: 202-420-9353

From: Jones, Enesta
Sent: Wednesday, October 26, 2016 9:24 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>
Cc: Jones, Enesta <Jones.Enesta@epa.gov>; Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>
Subject: OAR REVIEW: Radiation PAG Statement

Good morning!

Below, for your review, is a draft "holding" statement for any radiation PAG media inquiries going forward. OW has approved. Please let us know if you have any edits. Tricia and I are both the leads in OMR on this issue and will tag team media inquiries.

Draft PAG Statement

During a radiological emergency, radioactive material could be released into the rivers, lakes, and streams used by public water suppliers. EPA will be publishing ~~releasing~~ non-regulatory guidance that authorities can use to protect residents from ~~experiencing~~ the harmful effects from radiation in drinking water following a nationally significant radiological emergency.

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~~EPA plans to release the drinking water PAG before the end of the calendar year.~~

For more information: https://www.epa.gov/radiation/protective-action-guides-pags

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Enesta Jones

U.S. EPA

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"The root of all joy is gratefulness."

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From: Millett, John
Sent: Wed 10/26/2016 4:58:24 PM
Subject: RE: OAR REVIEW: Radiation PAG Statement

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From: Dennis, Allison
Sent: Wednesday, October 26, 2016 12:56 PM
To: Jones, Enesta <Jones.Enesta@epa.gov>
Cc: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Lynn, Tricia <lynn.tricia@epa.gov>; Valentine, Julia <Valentine.Julia@epa.gov>; Fuld, John <Fuld.John@epa.gov>; Loop, Travis <Loop.Travis@epa.gov>
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+ John and Travis (I'm off today)

Sent from my iPhone

On Oct 26, 2016, at 10:56 AM, Jones, Enesta <Jones.Enesta@epa.gov> wrote:

Thanks, Jessica.

Enesta Jones

U.S. EPA

Office of Media Relations

Office: 202.564.7873

Cell: 202.236.2426

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Also, note EPA does not comment on current litigation. For any questions on lawsuits ,

please reach out to Wyn Hornbuckle (Wyn.Hornbuckle@usdoj.gov) at the Department of Justice.

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: 202-420-9353

From: Jones, Enesta
Sent: Wednesday, October 26, 2016 10:04 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>; Millett, John <Millett.John@epa.gov>; White, Rick <White.Rick@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
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Subject: RE: OAR REVIEW: Radiation PAG Statement

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Office: 202.564.7873

Cell: 202.236.2426

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Jessica

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

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Enesta Jones

U.S. EPA

Office of Media Relations

Office: 202.564.7873

Cell: 202.236.2426

"The root of all joy is gratefulness."

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Adams, Darryl[Adams.Darryl@epa.gov]
From: Owens, Nicole
Sent: Thur 10/20/2016 1:44:54 PM
Subject: FW: DW PAG and Full PAG Manual

Hi Sara –

Would you please send me the PAG files and we can take care of getting these uploaded.

Thanks,

Nicole

From: Veal, Lee
Sent: Wednesday, October 19, 2016 11:11 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: Perrin, Alan <Perrin.Alan@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Subject: OMB ready to clear, clean versions attached

Glynis,

I think that we have the files that you are seeking here as attachments.

1. The Federal Register notice redline/strikeout (RLSO), that includes just a few changes from OMB.

2. The Federal Register notice clean copy that incorporates OMB's changes.

3. The PAG Manual with RLSO reflecting OMB comments noted below (includes NRC, FEMA and OSHA information), shows the removal of the sentence on page 32, footnote changes from OMB/NRC on page 48, OSHA comments starting on page 58.

4. The PAG Manual CLEAN copy, with the aforementioned RLSO and comment fields removed.

Lee

Lee Ann B. Veal

CREM Center Director

Office of Radiation and Indoor Air

Office: 202-343-9448; Cell: 202-617-4322

www.epa.gov/radiation

From: Dorjets, Vlad EOP/OMB <Vladik_Dorjets@omb.eop.gov>
Sent: Tuesday, October 18, 2016 2:48 PM
To: DeCair, Sara
Cc: Hill, Glynis
Subject: RE: Rad PAGs

Sara/Glynis – Please go ahead and upload clean versions of the latest PAG Manual and associated FRN to ROCIS. Please note that the original draft FRN was never uploaded to ROCIS so please load that version as well. In the PAG Manual you upload, please be sure that it reflects the final agreemen between NRC and FEMA (i.e. that the entire sentence with "usually" be removed and that none of the other language be added). Let me know if you have any questions.

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Monday, October 17, 2016 3:19 PM
To: Dorjets, Vlad EOP/OMB <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>

Subject: Re: Rad PAGs

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Perrin, Alan
Sent: Wed 10/19/2016 10:12:45 PM
Subject: Re: DW PAG and Full PAG Manual

Good note. I left very similar VM.

Exercise going well? Staying busy?

~~~~~~~~~~~~~~
Alan Perrin
dsk 202-343-9775
mbl 202-279-0376

On Oct 19, 2016, at 5:48 PM, DeCair, Sara <DeCair.Sara@epa.gov> wrote:

Uh oh this doesn't make sense --- Let's hold on a second.

Certainly during the finalization process for the PAG Manual (which we can start now), we plan to finalize the header, the TOC, and the cover as well as update the section numbers for the entire Manual.

I don't think it's necessary to update the Section #s in the DW PAG for it to be reviewed by OMB. I think they're focused on the content. It is our hope that the drinking water guidance will be a new chapter in the full PAG Manual, with corresponding section numbers. OMB asked us to mention it as a placeholder in Table 1-1 and maybe it's best to be ready to either 1) insert it as a chapter or 2) publish as an addendum. Flexibility might require less work now!

Please email if I'm off base, my phone is not working well but I'm working thru the evening. Thank you!

Sara

From: Hill, Glynis
Sent: Wednesday, October 19, 2016 5:04 PM
To: Veal, Lee; Christ, Lisa
Cc: Perrin, Alan; DeCair, Sara; Hernandez-Quinones, Samuel; Boyle, Kathryn; Corrales, Mark
Subject: DW PAG and Full PAG Manual

Good evening PAG Team:
~~~~~~~~~~~~~~

I just started reviewing the clean version of the full PAG Manual you sent this morning and two things jumped out immediately:

1. The header still has "Draft Final for Review"

2. The table of contents – section 4.4, page 59 states that the DW PAG will be added as "an addendum"; however the DW PAG that is currently under review in OP is formatted as Section 3.5.2. Upper management is under the impression that it is supposed to be an addendum not a section in the full PAG Manual…Please reformat the DW PAG to reflect the verbiage in section 4.4 on page 59.

Thanks in advance and if I have any additional comments I will forward them to you ASAP.

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Veal, Lee
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Lee

Lee Ann B. Veal

CREM Center Director

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From: Dorjets, Vlad EOP/OMB <Vladik_Dorjets@omb.eop.gov>
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Subject: RE: Rad PAGs

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Cc: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Re: Rad PAGs

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Milligan, Patricia
Sent: Wed 10/12/2016 1:12:00 PM
Subject: FW: Revised EPA PAG Manual

From: Albert, Michelle
Sent: Friday, October 07, 2016 2:31 PM
To: Milligan, Patricia <Patricia.Milligan@nrc.gov>
Subject: FW: Revised EPA PAG Manual

FYI

From: Albert, Michelle
Sent: Friday, October 07, 2016 2:31 PM
To: 'Dorjets, Vlad' Ex. 6 - Personal Privacy
Cc: Ammon, Bernice <Bernice.Ammon@nrc.gov>; Clark, Michael <Michael.Clark@nrc.gov>; Clark, Lisa <Lisa.Clark@nrc.gov>; Michel, Eric <Eric.MichelOGC@nrc.gov>
Subject: RE: Revised EPA PAG Manual

Vlad,

The NRC staff appreciates the changes made to the draft EPA PAG Manual and has only a few additional comments:

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Thank you,

Michelle D. Albert

Senior Attorney | Office of the General Counsel

Legal Counsel, Legislation, and Special Projects Division

U.S. Nuclear Regulatory Commission

(301) 287-9259 | Michelle.Albert@nrc.gov

From: Dorjets, Vlad EOP/OMB Ex. 6 - Personal Privacy
Sent: Tuesday, October 04, 2016 6:46 PM
To: Malliou, Ekaterini (OS/IOS) <Ekaterini.Malliou@hhs.gov>; Michel, Eric <Eric.MichelOGC@nrc.gov>; DOLRegPolicy@DOL.gov
Cc: OS HHSExecSec <HHSExecSec@hhs.gov>; Ammon, Bernice <Bernice.Ammon@nrc.gov>; Clark, Michael <Michael.Clark@nrc.gov>; Adler, James <James.Adler@nrc.gov>; Albert, Michelle <Michelle.Albert@nrc.gov>; Schwab, Margo EOP/OMB Ex. 6 - Personal Privacy
Subject: [External_Sender] Revised EPA PAG Manual

Colleagues,

Attached please find the updated versions of the PAG Manual and the associated FRN. Based on the way EPA manages the PAG program, the updated documents do not include EPA's responses to comments submitted by OMB and interagency reviewers. EPA has provided those responses in separate, un-updated documents which I have also attached.

Please take a look at these documents and let me know **by the end of the week** whether they address your concerns or whether you have additional comments.

Regards,

Vlad

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hill, Glynis[Hill.Glynis@epa.gov]
From: Dorjets, Vlad EOP/OMB
Sent: Tue 10/11/2016 11:05:26 PM
Subject: Updated OMB Comments on PAG Manual
EPA PAG Manual (OMB Comments 10-11-16).docx
EPA PAG Manual FRN (OMB Comments 10-11-16).docx

Sara,

Attached please find some final comments on the PAG Manual. I think they're pretty straight forward and won't take long for EPA to address.

Ex. 5 - Deliberative Process

Also, once you have had a chance to review the attached comments, it would be helpful if you could give me a sense of how much time you would need to address them. OIRA has agreed to conclude review of the Manual by the end of the week if at all possible, so I would like to know whether you think that is feasible.

Vlad

To: DeCair, Sara[DeCair.Sara@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
From: Wieder, Jessica
Sent: Tue 10/11/2016 1:37:46 PM
Subject: RE: Recent PAG Key Msgs, Desk Stmt & Web lingo?

I think some of this happened while I was out on leave. I will look through the G drive files.

Happy to meet. I am in the office today and tomorrow and my schedule is wide open today.

Jess

Jessica Wieder

U.S. EPA

Radiation Protection Program

Center for Radiation Information and Outreach

w: 202-343-9201

c: 202-420-9353

From: DeCair, Sara
Sent: Tuesday, October 11, 2016 9:29 AM
To: Wieder, Jessica <Wieder.Jessica@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>
Subject: Recent PAG Key Msgs, Desk Stmt & Web lingo?

Tony and Jess –

I'm doing a pre-routing FR package review by our bosses for the PAG Manual finalization, and I have a kind of up to date Comms Plan, attached, but I think either you have more recent Key Msgs and Web lingo (from water proposal), or we need to work on them…

Glad to set up a meeting to run thru and update what we have – just say the word. Thank you!!

Sara D. DeCair

202-343-9108

Room 1416 B in WJC West

www.epa.gov/radiation/protective-action-guides-pags

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hill, Glynis
Sent: Thur 9/22/2016 2:37:10 PM
Subject: RE: PAG Manual passback: FRN, PAG redline & cmt responses

Was our AA invited to the Gina briefing? Also is there a briefing deck prepared for that meeting? What was the overall issues that held up the review process?

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Thursday, September 22, 2016 10:29 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: RE: PAG Manual passback: FRN, PAG redline & cmt responses

Yep! They are done with edits from internal review, and are preparing the passback to send maybe even before they brief Gina on 9/29. We'll keep you posted!

From: Hill, Glynis
Sent: Thursday, September 22, 2016 9:40 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: PAG Manual passback: FRN, PAG redline & cmt responses

Thanks Sara!! Any news on the DW PAG?

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Thursday, September 22, 2016 9:20 AM
To: Dorjets, Vlad <Ex. 6 - Personal Privacy
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: PAG Manual passback: FRN, PAG redline & cmt responses

Vlad,

I've got a few attachments for you, in fact two FR Notices and two PAG Manuals. To maintain version control with our support contractor, I kept the responses to your comments in one document, and made the changes {in addition to the last round's} in redline in a separate set of documents. It should be clear from the file names which is the response to cmts and which is the redline. Since it might be tedious to go back and forth from one to the other, I'm glad to talk thru them over the phone if it would help. Hopefully we are getting really close to having all issues resolved! Let me know how I can be helpful, and thank you for all your help on this,

Sara

Sara D. DeCair

202-343-9108

Room 1416 B in WJC West

www.epa.gov/radiation/protective-action-guides-pags

From: FRPCC
Location: Room GH-035, Department of Energy Headquarters, 1000 Independence Avenue SW, Washington DC (Documents Attached)
Importance: Normal
Subject: FW: FRPCC EPA PAG Communication Tool, Read-Aheads and Other Information for the FRPCC Quarterly Meeting: Thursday, September 15, 2016 from 0900-1200h.
Start Date/Time: Thur 9/15/2016 1:00:00 PM
End Date/Time: Thur 9/15/2016 4:00:00 PM
NUSTL_RDD_15SEP16_FRPCC_PDF.PDF
Aug2016_NUSTL RNRR_One-Pager_RDD Guidance.pdf
PAGs Comm Tool QA 091216.docx
PAGs Comm Tool 090816.pptx

;;;
Good Morning FRPCC Colleagues!

1. Please find attached the EPA Protective Action Guide Communication Tool and Guide for your review and comment. Please provide comments no later than September 30, 2016. You may reply to this address and we will forward or you may send directly to Ms. Jessica Wieder (Wieder.Jessica@epa.gov).

2. Attached also are the read-aheads for the NUSTL RDD presentation.

3. Today is *last call* for the Strategic Action Plan Initiatives slides. If you have an Initiative slide(s) you wish to update please provide by the end of today.

4. Please be reminded that Thursday's meeting will begin at 0930h, not the usual 1000h we expect. The 0900 time is more towards the DOE HQ morning 'rush-hour' so arriving a bit early to pass through DOE Security is advised. Also note that near the Visitor's desk is a small kiosk that looks like an ATM: this device may be used to register your HSPD-12 PIV card, giving you direct access through the Security gates. Highly recommended. Also of note is that the GH-035 conference room we have available for this meeting is smaller than our June conference room so if you would prefer to call-in it would be helpful in avoiding a space issue. GH-035 is located in the basement of DOE HQ near the Dunking Donuts.

5. A draft agenda is still under review and will be sent as soon as finalized.

Please do not hesitate to contact us with any questions, updates, advice or other information.
We look forward to seeing you there!
Best Regards,
FRPCC Staff
frpcc@fema.dhs.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Fitz-James, Schatzi
Sent: Thur 9/1/2016 10:32:07 AM
Subject: FW: Revised Drinking Water PAG chapter
Clean Draft DW PAG OGWDW 8-31.pdf
Draft DW PAG OGWDW 8-31.docx
Redline Draft DW PAG OGWDW 8-31.pdf

I find Peter's email a tad awkward. Isn't ORIA responsible for the entire PAG of which the drinking water PAG will be a part/chapter? Is the briefing with the Ax on the DW PAG or the entire document?

From: Woolford, James
Sent: Wednesday, August 31, 2016 8:45 PM
To: Stalcup, Dana <Stalcup.Dana@epa.gov>; Fitz-James, Schatzi <Fitz-James.Schatzi@epa.gov>; Scozzafava, MichaelE <Scozzafava.MichaelE@epa.gov>
Subject: FW: Revised Drinking Water PAG chapter

Sent from my Windows Phone

From: Grevatt, Peter
Sent: 8/31/2016 5:25 PM
To: Woolford, James; Cheatham, Reggie; Neugeboren, Steven
Cc: Burneson, Eric; Christ, Lisa; Beauvais, Joel; Shapiro, Mike; Edwards, Jonathan; Greene, Ashley; Perrin, Alan
Subject: Revised Drinking Water PAG chapter

Jim, Reggie and Steve,

Please see attached to this message the revised draft drinking water radiation protective action guidelines (in track changes and clean formats). These documents have been revised in response to public comments (~60,000) received during the public comment period that ended on July 25. We are still on target for releasing the final PAG document this year, and to stay on that schedule, we would greatly appreciate any comments your offices can provide by Friday, September 9. We plan to brief the Administrator later in September and we would be glad to set up a meeting to discuss any comments you have during the week of September 12.

Thanks very much for your assistance on this!

P. Grevatt

Conference of Radiation Control Program Directors, Inc.

Office of Executive Director ❖ 1030 Burlington Lane, Suite 4B ❖ Frankfort, KY 40601
Phone: 502/227-4543 ❖ Fax: 502/227-7862 ❖ Web Site: www.crcpd.org

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Ruth E. McBurney, CHP
rmcburney@crcpd.org

July 25, 2016

Air and Radiation Docket and Information Center
Environmental Protection Agency
Mail Code 6102 T
Pennsylvania Ave
NW Washington DC, 20460

Attn: Docket ID No EPA-HQ-OAR2007-0268

The Conference of Radiation Control Program Directors, Inc. (CRCPD) is a professional organization dedicated to radiation protection. The mission of CRCPD is to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education. CRCPD's primary goal is to make sure radiation exposure to individuals is kept to the lowest practical level, while not restricting its beneficial uses. CRCPD's membership includes the directors and members of State radiation control programs across the nation as well as other individuals interested in radiation protection issues. Many of our member States have nuclear power plants within their jurisdictions, and many of them also have actual long-term contaminated site clean-up experience.

CRCPD believes the efforts of the EPA to revise the draft 2013 PAG Manual to provide additional guidance for drinking water Protective Action Guideline (PAG) is a positive and necessary step. The CRCPD previously commented on the draft 2013 PAG Manual in 2013 and in those comments we strongly encouraged the EPA to develop a drinking water PAG. In particular, we suggested a PAG of 500 mrem per year.

EPA states that the two tiered approach, 100 mrem projected dose in the first year for infants, children and pregnant or nursing women and 500 mrem projected dose in the first year for the general population, is consistent with other guidance developed for consideration during the intermediate phase of a radiological incident. The FDA PAGs for food are developed based on the application of the PAG limit to the most sensitive population and the most sensitive organ for the radionuclide of concern. At 500 mrem, this effectively makes the FDA PAG for food less conservative than the EPA's proposed drinking water PAG. This may cause public messaging issues and difficult questions to address from the public.

CRCPD appreciates the efforts of the EPA to provide clear and technically sound guidance in implementing the new drinking water PAG. In particular, recognizing that strontium, cesium and iodine can provide a quick screening tool for determining a default derived reference level (DRL) for drinking water concentrations is a useful technique. Also CRCPD agrees that the technical basis used for determining water PAGs is technically sound and conservative.

On a final note the CRCPD would like to recommend that the new EPA PAGs eventually be adopted as Presidential Guidance. As this will take additional time we also recommend that the new EPA PAGs are not held up while this Presidential Guidance is sought.

Thank you for considering these comments and requests. The CRCPD stands ready to assist our Federal partners and are available to provide additional details on any of these issues should you desire. I look forward to your response.

Sincerely,

Jared W. Thompson
Chairperson

Conference of Radiation Control Program Directors, Inc.
Office of Executive Director ❖ 1030 Burlington Lane, Suite 4B ❖ Frankfort, KY 40601
Phone: 502/227-4543 ❖ Fax: 502/227-7862 ❖ Web site: www.crcpd.org

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Desai, Lisa
Sent: Thur 7/28/2016 7:31:35 PM
Subject: FW: Drinking Water PAG Comments
Draft Comments on Drinking Water PAG.docx

Sara,

I have received the attached information and it has been reviewed by Asst Director Klinger. I understand the agency missed the deadline but Kay Foster indicated that you would still like for us to submit. I trust you will get it in the appropriate hands. Please find attached .

Should you have any questions please let me know.

Thanks in advance.

Lisa M. Desai, Office of the Director

Assistant to the Director

2200 South Dirksen Parkway

Springfield, Illinois 62703

Office: 217-557-6225

Fax: 217-524-7967

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Amber Brewer[abrewer@endyna.com]; siddhanti@endyna.com[siddhanti@endyna.com]
From: Amy Doll
Sent: Mon 7/25/2016 8:53:07 PM
Subject: Water PAG Comment Matrix and Docket List (posted thru 7/20)
Water PAG Docket List_072016.xlsx
Water PAG_Comment Matrix_072516#2.xlsx

Hi Sara

Until late this afternoon, the docket had not posted any more comments since 7/20, when I sent the "docket list" last week (attached again). The attached Water PAG Comment Matrix Spreadsheet includes all those comments posted through 7/20, which as noted below in the docket list were in:

-- S category -- means "substantive" and those will be included in appropriate Tabs in the Comment Matrix Spreadsheet

-- G category -- means "general" and those will be included only in the General Tab in the Comment Matrix Spreadsheet

EnDyna anticipates that you might move some of those "substantive" comments into General Tab, but if there was any doubt we've put those "substantive" comments in the most relevant Tabs in the Comment Matrix Spreadsheet.

The docket posted only two more comments today (7/25), one of which from Food & Water Watch is "substantive" and the other is a request for extension from Sierra Club. EnDyna will begin including additional comments in the matrix tomorrow, as they get posted by the docket.

I will give you a call tomorrow, when you are back in office, to discuss version control and plan ahead.

Hope you had a good trip,

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: Amy Doll
Sent: Wednesday, July 20, 2016 3:05 PM
To: DeCair, Sara (DeCair.Sara@epa.gov) (DeCair.Sara@epa.gov)
Cc: Hernandez-Quinones, Samuel (Hernandez.Samuel@epa.gov); Amber Brewer; 'Smita Siddhanti (siddhanti@endyna.com)'
Subject: Water PAG Docket List (posted thru 7/20)

Hi Sara

The attached Water PAG Docket List will provide a "snapshot" of what has been posted in the Water PAG Docket through 7/20 (today).

At the top, I show the "categories" that EnDyna is using to track the comments, please note in particular:

-- S category -- means "substantive" and those will be included in appropriate Tabs in the

Comment Matrix Spreadsheet

-- G category -- means “general” and those will be included only in the General Tab in the Comment Matrix Spreadsheet

The others are: general opposition and not relevant to any tabs in the comment matrix (D category), and not relevant to Water PAG Docket (B category).

EnDyna will prioritize entering the “S category” comments into the Comment Matrix Spreadsheet by COB Monday.

Is there any decision yet about whether or not to extend the comment period?

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Mon 7/25/2016 6:45:43 PM
Subject: Supplemental OMB Comments on PAG Manual
EPA PAG Manual (Supplemental OMB Comments 07-25-16).docx

Glynis,

Attached please find additional comments from OMB on the PAG Manual. Almost all of these comments can be found in Section 5.2 but there are is a suggested edit earlier in the document as well. Please note that these comments were submitted to us by the National Security Council who, I understand, was heavily involved in the original drafting of Section 5.2 following Fukushima. Please address these comments together with the other comments you have received from OMB and interagency reviewers in your passback. You should now have all of our comments. I look forward to seeing EPA's passback.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Perrin, Alan
Sent: Fri 7/22/2016 7:17:28 PM
Subject: RE: OMB Comments on PAG Manual

Hmmm. Skimmed this and the manual comments. Ex. 5 - Deliberative Process
Ex. 5 - Deliberative Process

Alan Perrin, Deputy Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Friday, July 22, 2016 2:59 PM
To: Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: Fw: OMB Comments on PAG Manual

FYI, cmts on the FR. I have plenty to keep me busy for a few days!

S.

From: Dorjets, Vlad <Ex. 6 - Personal Privacy @omb.eop.gov>
Sent: Friday, July 22, 2016 12:55 PM
To: Hill, Glynis
Cc: DeCair, Sara
Subject: RE: OMB Comments on PAG Manual

Attached please find OMB's comments on the FRN.

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]

Sent: Thursday, July 21, 2016 12:14 PM
To: Dorjets, Vlad Ex. 6 - Personal Privacy @omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Vlad,

Thanks again; do you have an idea when we will receive the additional Section 5.2 and FRN comments?

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto: Ex. 6 - Personal Privacy @omb.eop.gov]
Sent: Thursday, July 21, 2016 12:09 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Glynis,

DOL/OSHA consulted with CDC/NIOSH about NIOSH's comment that workers who perform tasks in which they are expected to receive dose in excess of 5 rem should only undertake those activities voluntarily. The two agencies agreed that the language proposed by DOL on page 43 of their comments should take precedence over NIOSH's comments because it brings the document in line with other forthcoming federal guidance on radiation emergency response. I'll share your passback with CDC to confirm this matter but you should disregard their comment and refer to DOL's comments instead.

Also, DOL noticed that there was a typo in one of their comments. The suggested language included in the second comment on page 43 should read "complete a particular mission," not "complete a particular mention."

Vlad

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Wednesday, July 20, 2016 12:53 PM
To: Dorjets, Vlad <Ex. 6 - Personal Privacy @omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Thanks Vlad!!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto: Ex. 6 - Personal Privacy @omb.eop.gov]
Sent: Wednesday, July 20, 2016 12:16 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: OMB Comments on PAG Manual

Glynis,

Attached please find OMB's comments on EPA's draft final PAG Manual. Please note that we will have additional comments on Section 5.2 and on the FRN but did not want to delay getting you our other comments.

I have also attached comments we received from DOL. Due to an oversight, OMB failed to

include DOL on the original interagency distribution. Given their equity in this rule, OMB gave DOL some extra time to review the rulemakings documents and provide comments. Please review DOL's comments and address them in the passback as you would the comments OMB received from other interagency reviewers (shared with EPA earlier).

In regards to those comments from interagency reviewers, please note that OMB fully supports the comments made by NRC, DHS, and DOE. With respect to DHS comment, you will see recommended changes in the Manual suggesting that EPA use some of the language we agreed upon for the proposed water PAGs.

In regards to the comment we received from CDC/NIOSH, we are in the process of checking with DOL/OSHA to see if they support it. We defer to EPA (and FDA) on how to address the NIH comments. In regards to the FDA comments, OMB is particularly interested in EPA's response to the request that the document include references to other FDA-approved medical counter-measures since due to their potential use in mitigating effects associated with radiation emergencies (e.g. radioisotope de-corporation agents calcium-DTPA, zinc-DTPA, Prussian blue, leukocyte growth factors filgrastim and pegfilgrastim, etc.).

I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | Ex. 6 - Personal Privacy @omb.eop.gov

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Fri 7/22/2016 4:55:29 PM
Subject: RE: OMB Comments on PAG Manual
EPA PAG Manual FRN (OMB Comments 07-22-16).docx

Attached please find OMB's comments on the FRN.

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Thursday, July 21, 2016 12:14 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Vlad,

Thanks again; do you have an idea when we will receive the additional Section 5.2 and FRN comments?

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, July 21, 2016 12:09 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

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Also, DOL noticed that there was a typo in one of their comments. The suggested language included in the second comment on page 43 should read "complete a particular mission," not "complete a particular mention."

Vlad

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Wednesday, July 20, 2016 12:53 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Thanks Vlad!!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Wednesday, July 20, 2016 12:16 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: OMB Comments on PAG Manual

Glynis,

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In regards to those comments from interagency reviewers, please note that OMB fully supports the comments made by NRC, DHS, and DOE. With respect to DHS comment, you will see recommended changes in the Manual suggesting that EPA use some of the language we agreed upon for the proposed water PAGs.

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I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hooper, Charles A.
Sent: Thur 7/21/2016 2:29:33 PM
Subject: RE: PAG Manual Update

Good idea, I'll send a copy to George. I'm getting input from our R7 FEMA folks too before sending out to the larger group.

Btw, I think drinking water for special populations at 100 mrem is pretty solid. I can't imagine that we'd ever use it anyway with all the bottled water that's available.

Chuck Hooper, CHP

Radiation Safety Officer

EPA Region 7

11201 Renner Boulevard

Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

From: DeCair, Sara
Sent: Thursday, July 21, 2016 9:24 AM
To: Hooper, Charles A. <Hooper.CharlesA@epa.gov>
Subject: RE: PAG Manual Update

That is fab. I hope you'll share with other Regions to use, too, before or after you get the feedback on the note (it's always interesting to hear what questions people have…) I'm at HPS and got two Qs from HPS-ers about how I can live with how low the PAGs are. Typical!

From: Hooper, Charles A.
Sent: Thursday, July 21, 2016 10:14 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: PAG Manual Update

Sara; I'm planning on sending the following message out to our local Region 7 REP community and just wanted to make sure this sounds okay and is accurate. Thanks!

I just wanted to give everybody a status update on the long-awaited PAG Manual. As most folks know the Drinking Water portion of the PAG cleared OMB back in June which began a 45-day public comment period that will be ending on July 25th. I recently received a briefing from EPA's PAG coordinator in HQ, Sara DeCair. Pending any unforeseen issues and a timely OMB review of the response to comments on the Drinking Water proposal, the Drinking Water section will be inserted into the larger PAG Manual **and will likely be finalized this year**. Please understand that anything can happen at the end of an administration and things could get held up, but if this goes final as planned there will be a **one-year training and adoption period to allow emergency management officials to update their response plans**. Since the larger PAG Manual has been on hold for a while to work out the drinking water proposal I didn't want this to come as a complete surprise to our local REP community.

https://www.epa.gov/radiation/protective-action-guides-pags

From the EPA PAG website ("PAG Manual" tab):

In 2013, EPA sought public comment on a revision to the 1992 PAG manual, to update dose calculations based on current science. EPA believes that guidance based on the best available science can help local authorities save lives and minimize the impact of a radiological emergency.

EPA is assessing public comments received and ***plans to issue a final PAG Manual in 2016****. There will then be a* ***one-year training and adoption period to allow emergency management officials to update their response plans****.*

Significant changes from the 1992 PAG Manual include:

- *Applying the PAG Manual to incidents other than just nuclear power plant accidents.*
- *Referring users to current food guidance from the Food and Drug Administration (FDA).*
- *Providing guidance for potassium iodide (KI) based the latest FDA guidance.*
- *Providing basic planning guidance on reentry, cleanup and waste disposal.*
- *Incorporating late phase (cleanup) guidance from the Department of Homeland Security's Radiological Dispersal Device/Improvised Nuclear Device Planning Guidance.*
- *Incorporating the new Drinking Water PAG.*

The 2013 PAG Manual provides a list of considerations for planning and initiating a cleanup process as the emergency is brought under control. The PAG Manual does not set cleanup levels. One of the recommendations in the Manual is a community involvement process for setting cleanup levels.

From the EPA PAG website ("Drinking Water Proposal" tab):

EPA is proposing non-regulatory guidance that authorities can use to protect residents from experiencing the harmful effects from radiation in drinking water following an emergency. EPA is seeking public comment on the proposed drinking water Protective Action Guide (PAG) for Radiological Incidents for up to 45 days following publication in the Federal Register.

The proposed PAG does not affect EPA's drinking water standards for radionuclides.

Background

EPA is proposing a two-tiered approach for drinking water to address the people at the most sensitive life stage and to address the general population The tiered approach may help officials prioritize potentially scarce water resources for those most at risk in a disaster response.

The proposed PAGs are developed for up to one year of exposure. In comparison, the Maximum Contaminant Levels (MCL) were developed assuming 70 years of continuous exposure. The PAGs are intended to 1) prevent short-term health effects, 2) balance protection with other important factors that may arise during an emergency (ensuring the actions result in more benefit than harm), and 3) reduce the potential for longer term health effects. In considering these key principles, EPA is proposing drinking water PAGs of:

•500 mrem projected dose, for one year, to the general population.

•100 mrem projected dose, for one year, to the most sensitive populations (e.g. infants, children, pregnant women and nursing women).

Chuck Hooper, CHP

Radiation Safety Officer

EPA Region 7

11201 Renner Boulevard

Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hooper, Charles A.
Sent: Thur 7/21/2016 2:14:01 PM
Subject: PAG Manual Update

Sara; I'm planning on sending the following message out to our local Region 7 REP community and just wanted to make sure this sounds okay and is accurate. Thanks!

I just wanted to give everybody a status update on the long-awaited PAG Manual. As most folks know the Drinking Water portion of the PAG cleared OMB back in June which began a 45-day public comment period that will be ending on July 25th. I recently received a briefing from EPA's PAG coordinator in HQ, Sara DeCair. Pending any unforeseen issues and a timely OMB review of the response to comments on the Drinking Water proposal, the Drinking Water section will be inserted into the larger PAG Manual **and will likely be finalized this year**. Please understand that anything can happen at the end of an administration and things could get held up, but if this goes final as planned there will be a **one-year training and adoption period to allow emergency management officials to update their response plans**. Since the larger PAG Manual has been on hold for a while to work out the drinking water proposal I didn't want this to come as a complete surprise to our local REP community.

https://www.epa.gov/radiation/protective-action-guides-pags

-

From the EPA PAG website ("PAG Manual" tab):

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EPA is assessing public comments received and ***plans to issue a final PAG Manual in 2016****.*

There will then be a ***one-year training and adoption period to allow emergency management officials to update their response plans****.*

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Background

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The proposed PAGs are developed for up to one year of exposure. In comparison, the Maximum Contaminant Levels (MCL) were developed assuming 70 years of continuous exposure. The PAGs are intended to 1) prevent short-term health effects, 2) balance protection with other important factors that may arise during an emergency (ensuring the actions result in more benefit than harm), and 3) reduce the potential for longer term health effects. In considering these key principles, EPA is proposing drinking water PAGs of:

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Chuck Hooper, CHP

Radiation Safety Officer

EPA Region 7

11201 Renner Boulevard

Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Wed 7/20/2016 4:15:52 PM
Subject: OMB Comments on PAG Manual
EPA PAG Manual (OMB Comments 07-20-16).docx
EPA PAG Manual (DOL Comments).docx

Glynis,

Attached please find OMB's comments on EPA's draft final PAG Manual. Please note that we will have additional comments on Section 5.2 and on the FRN but did not want to delay getting you our other comments.

I have also attached comments we received from DOL. Due to an oversight, OMB failed to include DOL on the original interagency distribution. Given their equity in this rule, OMB gave DOL some extra time to review the rulemakings documents and provide comments. Please review DOL's comments and address them in the passback as you would the comments OMB received from other interagency reviewers (shared with EPA earlier).

In regards to those comments from interagency reviewers, please note that OMB fully supports the comments made by NRC, DHS, and DOE. With respect to DHS comment, you will see recommended changes in the Manual suggesting that EPA use some of the language we agreed upon for the proposed water PAGs.

In regards to the comment we received from CDC/NIOSH, we are in the process of checking with DOL/OSHA to see if they support it. We defer to EPA (and FDA) on how to address the NIH comments. In regards to the FDA comments, OMB is particularly interested in EPA's response to the request that the document include references to other FDA-approved medical counter-measures since due to their potential use in mitigating effects associated with radiation emergencies (e.g. radioisotope de-corporation agents calcium-DTPA, zinc-DTPA, Prussian blue, leukocyte growth factors filgrastim and pegfilgrastim, etc.).

I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Kraus, Terrence D[tdkraus@sandia.gov]; Hunt, Brian[bhunt@sandia.gov]
From: Kraus, Terrence D
Sent: Fri 7/15/2016 12:44:48 PM
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

Sara,

If you are in the office today, please give me a call.

No hurries; we can also talk next week.

Ex. 5 - Deliberative Process

We have been holding off to see if the Water DRL method is approved and then once it is approved we planned to get our software team working to implement the method this FYI.

We are hesitant to start the software team working until we are confident of the form of the final method.

I wanted to get you thoughts on what you think is the appropriate course of action.

I'm thinking the proposed Water DRL that we have seen is very likely going to be the final, approved method.

If this is the case, we can try to get with our software team to start implementing the method before we run out of time this FY.

Let's talk when you get a chance.

Have a great weekend.

Terry Kraus, CHP

Nuclear Incident Response Programs

Sandia National Laboratories

(505) 284-9708

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 3:11 PM
To: Kraus, Terrence D
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

I thought it would be fun to discuss :D **Ex. 6 - Personal Privacy**
Ex. 6 - Personal Privacy

I'm off tomorrow but if I do come in, shall I call you?

From: Kraus, Terrence D [mailto:tdkraus@sandia.gov]
Sent: Thursday, July 14, 2016 5:00 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

Hi Sara,

Sorry to cause you trouble, but that was my comment which was submitted through Dan Blumenthal.

I think your proposed revision will help clarify and minimize my concerns, so I would be happy with the proposed revision.

Will you be in the office on Friday 7/15?

Thank you.

Terry Kraus, CHP

Nuclear Incident Response Programs

Sandia National Laboratories

(505) 284-9708

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 12:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.mackinney@dhs.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; michael.howe@fema.dhs.gov; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; paul.ward@fema.dhs.gov; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; Kraus, Terrence D; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
Subject: [EXTERNAL] Interesting PAG question: 'except nuclear war'

PAG Subcommittee;

Hopefully you've had a chance to provide input on the PAG Manual (the rest of the Manual,

minus drinking water which is out for comment) which is in OMB review now. An interesting suggestion came up and I wanted to find out if anyone has strong feelings about the caveat, or knowledge of why it's there.

The PAG Manual states, "This Manual provides radiological protection criteria for application to all incidents that would require consideration of protective actions, with the exception of nuclear war."

Ex. 5 - Deliberative Process

Recommend adding a sentence similar to, "The PAGs in this Manual may not be appropriate for protecting the public following a nuclear detonation because of the magnitude of the impacts. EPA will work with decision-makers on a case-by-case basis to develop appropriate PAGs following a nuclear detonation."

I might suggest just cutting 'with the exception of nuclear war' and/or adding only the first of two sentences suggested above. This echoes the point that separate guidance for INDs is available, and that in addition to military actions in the case of war, PAGs might indeed be used to inform protective actions. As always, I'm open to suggestions here and the no-action path would be to just leave the language how it is.

Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Kraus, Terrence D
Sent: Thur 7/14/2016 9:00:10 PM
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

Hi Sara,

Sorry to cause you trouble, but that was my comment which was submitted through Dan Blumenthal.

I think your proposed revision will help clarify and minimize my concerns, so I would be happy with the proposed revision.

Will you be in the office on Friday 7/15?

Thank you.

Terry Kraus, CHP

Nuclear Incident Response Programs

Sandia National Laboratories

(505) 284-9708

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 12:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.mackinney@dhs.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; michael.howe@fema.dhs.gov; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov;

paul.ward@fema.dhs.gov; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; Kraus, Terrence D; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
Subject: [EXTERNAL] Interesting PAG question: 'except nuclear war'

PAG Subcommittee;

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Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: siddhanti@endyna.com[siddhanti@endyna.com]
From: Amy Doll
Sent: Fri 7/8/2016 3:19:56 PM
Subject: RE: Mockup of Water PAG comment spreadsheet/matrix
Water PAG docket_export 070816ad.pdf

Great! Attached is a snapshot of what was posted in the Water PAG docket through yesterday.

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Friday, July 08, 2016 10:54 AM
To: Amy Doll
Subject: RE: Mockup of Water PAG comment spreadsheet/matrix

Amy, I think we're in good shape to go into Monday's call. Thank you and have a good weekend!

From: Amy Doll [mailto:adoll@endyna.com]
Sent: Friday, July 08, 2016 10:23 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: siddhanti@endyna.com
Subject: FW: Mockup of Water PAG comment spreadsheet/matrix

Hi Sara

Just checking whether there is anything we need to discuss about the mockup before the 11am

call you scheduled for Monday with OW staff?

After we get any feedback/comments on the draft mockup of the comment spreadsheet/matrix, EnDyna could begin reviewing the Water PAG comments.

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: Amy Doll
Sent: Thursday, June 23, 2016 2:24 PM
To: DeCair, Sara (DeCair.Sara@epa.gov) (DeCair.Sara@epa.gov)
Cc: 'Smita Siddhanti (siddhanti@endyna.com)'
Subject: Mockup of Water PAG comment spreadsheet/matrix

Hi Sara

Attached is a draft mockup of the comment spreadsheet/matrix to get the thinking/discussion process started for how to organize the Water PAG comments.

- The yellow tabs relate to the specific questions in the FR notice (where a specific section of Water PAG document also seemed related, I've noted that)

- The blue tabs relate to other info in the FR notice that I thought commenters might comment on.

- The green tabs relate to comments on "EPA Draft Protective Action Guide (PAG) for Drinking Water" document

One question that I have is – what is the difference between "the guidance for advance planning" in the first question in the FR notice (which in reading the Water PAG document, I interpreted to be related to most of Section 6) and the final question in the FR notice (which I interpreted as a more general/broad question about the whole Water PAG document)?

Please let me know if you have any questions, or if you want any revisions to the spreadsheet/matrix prior the proposed conference call next week.

Finally, of the comments currently posted in your docket, the substantive ones are #214, #218, #226, and #229. Two of those (#214, #218) mention BIER VII a part of their rationale and that's why I thought they should be considered substantive instead of general opposition – it might be worth talking to the EPA/OW staffers about how any comments referencing BIER VII should be handled.

The remainder of comments currently posted in the docket are either general opposition to Water PAG (16 total) or simply general comments about radiation and/or cancer, etc. (3 total).

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hill, Glynis[Hill.Glynis@epa.gov]
From: Dorjets, Vlad
Sent: Tue 6/14/2016 7:31:13 PM
Subject: RE: Any news from interagency on PAG Manual review?
EPA PAG Manual (DOE Comments).docx
EPA PAG Manual (HHS-CDC Comments).docx
EPA PAG Manual (HHS-FDA Comments).docx
EPA PAG Manual (HHS-NIH Comments).docx
EPA PAG Manual (NRC Comments).docx

Sara,

Attached please find comments from DOE, DHS (CDC, FDA, and NIH) and NRC. OMB comments are still forthcoming. Once I have finished those comments we can discuss next steps but, in the meantime, you may want to look through these to see what Agencies are saying.

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Tuesday, June 14, 2016 3:09 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Re: Any news from interagency on PAG Manual review?

Vlad,

It would be very helpful to have some of the feedback sooner to get a start on digesting it, with the knowledge that there is more coming. I appreciate the idea!

Let me know if there is anything I can do to be helpful.

Sara

From: Dorjets, Vlad [Ex. 6 - Personal Privacy]@omb.eop.gov>
Sent: Tuesday, June 14, 2016 3:03 PM
To: DeCair, Sara
Cc: Hill, Glynis
Subject: RE: Any news from interagency on PAG Manual review?

Sara,

Thanks for checking in. Comments were due at the end of last week and I am currently working through them and finalizing OMB's comments. So you know, I received substantive comments from DOE, NRC and HHS. What I can do is send you those comments as-is so that you can start reviewing them and then send you OMB's comments (which may include some of the comments received from other agencies) once they're ready.

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Tuesday, June 14, 2016 2:59 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Any news from interagency on PAG Manual review?

Vlad,

I'm just wondering if there is any update on the interagency review of the PAG Manual. I think it's been a couple weeks and I am hopeful that you're getting some good input. My management would love to have any hints on where it stands and when to expect feedback that we can work on. Thanks so much!

Sara

202-343-9108

To: Brozowski, George[brozowski.george@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
From: Ferguson, Rafaela
Sent: Mon 6/13/2016 4:32:16 PM
Subject: RE: Handling Press Response Regarding New Water PAG

George,

Looks fine to me. Thanks for sending it out to the regions.

Rafie

From: Brozowski, George
Sent: Wednesday, June 08, 2016 10:14 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>; Ferguson, Rafaela <Ferguson.Rafaela@epa.gov>
Subject: Handling Press Response Regarding New Water PAG

Good evening ladies and I got an email from a reporter from the Santa Fe New Mexican regarding the new water PAGs. I got in touch with Tony Nesky and let me know what you think on the following to go out to the regions:

The Office of Water is the lead office for the new water PAGs. Reporters should go through your regional press office or HQ Press Office and they can arrange a discussion with a senior drinking water official.

The HQ Press Office Contact for drinking water issues is Julia Valentine:

Desk: (202) 564-2663

Cell: (202) 740-1336

valentine.julia@epa.gov

George P. Brozowski

Regional Health Physicist/Radon Coordinator

US EPA – R6

1445 Ross Avenue

Mail Stop - 6MM-XU

Dallas, TX 75202

214-665-8541 o

214-755-1530 c

To: DeCair, Sara[DeCair.Sara@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
From: Perrin, Alan
Sent: Fri 6/10/2016 7:17:51 PM
Subject: RE: Water PAG rollout - contacts we need to make

Done, done and done. Mr. White sent out emails earlier this week. I'll forward what went out to you.

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Friday, June 10, 2016 3:06 PM
To: Perrin, Alan <Perrin.Alan@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>
Subject: Water PAG rollout - contacts we need to make

According to the attached Rollout plan, we are to make contact with the Nuclear Energy Institute, Committee to Bridge the Gap, and the National Alliance for Radiation Readiness.

It might be simplest if we have Alan place phone calls to key people at each of these orgs on Monday. Or we can do an email with the Regs.gov link:

https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2007-0268-0210

What is your preference? I can supply contact information for all of these. Meantime, today I'm sending the link above to key people in HPS, FRMAC, A Team, the PAG Subcommittee and encouraging them to share so we get plenty of input.

Thanks!

Sara

From: Wadlington, Christina
Sent: Monday, June 06, 2016 7:46 AM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Ellis, Jerry <Ellis.Jerry@epa.gov>; Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: RE: PAG Webpages Ready for Your Review--the words "trigger level" have been replaced.

Anthony,

I apologize, but I don't think you were provided with the OPA approved language for the PAGS release.

It might be easier if we set up a quick meeting to chat?

Christina Wadlington

Communications Director

Office of Ground Water and Drinking Water

U.S. Environmental Protection Agency

Tel: 202.566.1859

Email: wadlington.christina@epa.gov

From: Nesky, Anthony
Sent: Friday, June 03, 2016 8:44 PM
To: Ellis, Jerry <Ellis.Jerry@epa.gov>; Wadlington, Christina <Wadlington.Christina@epa.gov>; Hernandez-Quinones, Samuel

<Hernandez.Samuel@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: PAG Webpages Ready for Your Review--the words "trigger level" have been replaced.

Dear Christina, Jerry, Sam and Sara:

The webpage language for the proposed drinking water is ready for your review. Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

All changes are highlighted on the web page so that you can find them easily. Links are below. You will need to log-in with your LAN ID and password to view them. Lately there have been some problems with the Drupal system. If you get a "page not found" error, you will need to log into Drupal first. If you don't have access to Drupal, I can come over there and log in for you.

-

PAG Webpage:

https://wcms.epa.gov/node/150755/revisions/380891/view

-

Fact Sheet:

https://wcms.epa.gov/radiation/fact-sheet-proposed-drinking-water-protective-action-guide-pag-radiological-emergencies

-

Fact Sheet for Public Water Systems

https://wcms.epa.gov/radiation/proposed-epa-drinking-water-protective-action-guide-pag-radiological-emergencies

-

Please let me know ASAP if you approve these changes or if you need any edits. Please call me if you have questions or need help with Drupal.

Tony Nesky

Center for Radiation Information and Outreach

Tel: 202-343-9597

nesky.tony@epa.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hill, Glynis
Sent: Mon 5/23/2016 3:30:30 PM
Subject: RE: full PAG Manual

It just means its out…the agencies will then contact OMB for meetings if they want a 12866 meeting

---

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Monday, May 23, 2016 10:15 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: OMB: full PAG Manual

Link below is the full Manual, rec'd on 5/19. The link doesn't tell us much about the Interagency review. I can ask Trish at NRC if they've seen it go out from Vlad.

S.

From: Hill, Glynis
Sent: Monday, May 23, 2016 10:00 AM
To: DeCair, Sara
Subject: RE: Briefing on full PAG Manual

http://www.reginfo.gov/public/do/eoDetails?rrid=126354 This is the link to the document that appears; however Im not sure if this the DW one or the Full Manual.

Pending EO 12866 Regulatory Review - reginfo.gov

www.reginfo.gov

RIN: 2060-ZA19 View EO 12866 Meetings: Received Date: 05/19/2016 Title: Protective Action Guidance for Radiological ...

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Monday, May 23, 2016 9:52 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Re: Briefing on full PAG Manual

Help? I'm not sure where to look.

From: Hill, Glynis
Sent: Monday, May 23, 2016 9:48 AM
To: Veal, Lee; DeCair, Sara
Cc: Perrin, Alan
Subject: RE: Briefing on full PAG Manual

You can check the OMB website to see if the documents were sent out to Federal agencies.

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Veal, Lee

Sent: Monday, May 23, 2016 9:37 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>; Hill, Glynis <Hill.Glynis@epa.gov>
Cc: Perrin, Alan <Perrin.Alan@epa.gov>
Subject: RE: Briefing on full PAG Manual

Good morning,

Do we know if OMB got the PAGs out to the interagency last week? I think that Vlad might have been shooting for that given his training this week.

Lee

Lee Ann B. Veal

Acting Deputy Director, Radiation Protection Division

Office of Radiation and Indoor Air

Office: 202-343-9448; Cell: 202-617-4322

www.epa.gov/radiation

From: DeCair, Sara
Sent: Thursday, May 19, 2016 5:03 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

That seems odd, here is a copy.

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 4:51 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>

Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

It doesn't look like the FRN was uploaded to ROCIS.

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 4:30 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Vlad, here is a brief summary:

To the extent possible, we (the PAGs Subcommittee of the FRPCC) addressed comments by adding clarifications while keeping most of the Manual the same. The biggest change from 2013 would be the addition of drinking water guidance, but that is just a placeholder in this version.

Other notable additions are language on the Basis for Early Phase PAGs and Basis for Intermediate Phase PAGs. This language is excerpted from the 1992 PAG Manual appendices, at the request of commenters. We added explanations of why we did away with the thyroid-based evacuation footnote and the 50-year Relocation PAG in the 2013 revision, for transparency.

To help address questions about how protective the PAGs are in general, and of young children in particular, we added more information about the conservatism built into the setting and the implementation of the PAGs. Then in the sections on long term remediation and waste management, we made no wording changes since these parts we negotiated at the Deputy Secretary level, and we didn't get many specific comments on those parts at all.

Lastly, we made many editorial and cosmetic improvements, including adjusting section and chapter divisions to improve readability. I will emphasize, though, that the PAGs themselves

didn't change from the 2013 revision. You'll see we also discuss what we heard in the public comments within the FR Notice, too.

Thanks,

Sara

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 3:10 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual
Importance: High

Sara,

I confirm receipt of the draft PAG Manal. I want to send it out interagency reviewers but thought it would be helpful if I could focus their attention on specific chapters or sections that may have changed significantly relative to the proposed version. I know that you will brief us on the manual in greater detail in a couple weeks but are there any bullets that you think would benefit reviewers?

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 2:21 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Vlad,

No worries. We have availability between 8:30 and 11:00 am, or between 3:30 and 5:30 pm on Tuesday, May 31st. Just let us know,

Sara

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 12:13 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Sara,

Thanks for agreeing to provide a briefing. I imagine that it would not only be very informative but also yield a much more efficient review. Unfortunately, I'll be out of town on training all of next week (an EPA NPDES Permit Writing Workshop) so would prefer to push the briefing to the following week. Could you let me know if any days and times work that week?

Thanks,

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 11:48 AM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>

Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: Briefing on full PAG Manual

Vlad,

Glynis tells me that you'd like a briefing on the full PAG Manual, since you weren't involved with the process of getting it out for comment in 2013. We would suggest a phone briefing where I can walk through the changes we made based on public comments, and show you how much of the Manual has stayed the same. It can be organized as a front to back walk through of the chapters as we have them laid out now.

I can set up a conference line for us once you let us know which of the dates/times here might work best. I anticipate that my Division Director, Alan, and also Glynis would want to participate as well. Will you let me know if any of the times below would work for you? Thank you!

May 24th, Tuesday: 9 am, 10 am or 4 pm.

May 25th, Wednesday: 8 or 9 am.

May 26th, Thursday: 4 pm.

Sara D. DeCair

>>>http://www.epa.gov/radiation/rert/pags.html<<<;;

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hill, Glynis
Sent: Wed 5/18/2016 8:34:18 PM
Subject: FW: OMB Review Concluded of Drinking Water PAG

FYI, just received the email below!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Wednesday, May 18, 2016 4:33 PM
To: Grevatt, Peter <Grevatt.Peter@epa.gov>
Cc: Christ, Lisa <Christ.Lisa@epa.gov>; Greene, Ashley <Greene.Ashley@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>; Hill, Glynis <Hill.Glynis@epa.gov>; Owens, Nicole <Owens.Nicole@epa.gov>
Subject: OMB Review Concluded of Drinking Water PAG

Peter,

OMB has just concluded its review of the proposed Drinking Water PAGs. Big thanks to you and your staff for addressing the comments submitted by OMB and interagency reviewers.

Vlad

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Perrin, Alan
Sent: Fri 5/6/2016 2:05:06 PM
Subject: FW: OMB Comments on DW PAG Passback
EPA Drinking Water PAG FR Notice (OMB Comments 05-04-16).docx
ATT00001.htm
EPA Drinking Water PAG (OMB Comments 05-04-16).docx
ATT00002.htm

FYI

~~~~~~~~~~~~~~~

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: Edwards, Jonathan
Sent: Friday, May 06, 2016 7:25 AM
To: Perrin, Alan <Perrin.Alan@epa.gov>
Subject: Fw: OMB Comments on DW PAG Passback

With attachments. --Jon

From: Burneson, Eric
Sent: Thursday, May 5, 2016 5:36 PM
To: Edwards, Jonathan
Cc: Christ, Lisa; Hernandez-Quinones, Samuel
Subject: FW: OMB Comments on DW PAG Passback

Jonathon:

Just a heads up that folks here have been checking with your folks about the OMB passback on the DW PAG. We think that most of OMB's edits in the attached can be accommodated. However we want to speak with your folks about their request to include more information in the FRN about risk basis for our PAG and a discussion of economic analysis.
~~~~~~~~~~~~~~~

Eric Burneson, P.E.

Director of Standards and Risk Management

Office of Ground Water and Drinking Water

US Environmental Protection Agency

Phone: 202-564-5250

Fax: 202 564 3760

From: Grevatt, Peter
Sent: Wednesday, May 04, 2016 9:02 PM
To: Christ, Lisa <Christ.Lisa@epa.gov>
Cc: Burneson, Eric <Burneson.Eric@epa.gov>; Greene, Ashley <Greene.Ashley@epa.gov>
Subject: Fwd: OMB Comments on DW PAG Passback

Please take a look. Let's see if we can get a few min to discuss tomorrow.

Sent from my iPhone

Begin forwarded message:

From: "Dorjets, Vlad" <Vladik_Dorjets@omb.eop.gov>
Date: May 4, 2016 at 7:26:42 PM EDT
To: "Rennert, Kevin" <Rennert.Kevin@epa.gov>
Cc: "Grevatt, Peter" <Grevatt.Peter@epa.gov>, "Burneson, Eric" <Burneson.Eric@epa.gov>, "Laity, Jim" <James_A._Laity@omb.eop.gov>
Subject: OMB Comments on DW PAG Passback

Kevin,

Please find attached, updated comments from OMB on the intermediate Drinking Water PAG and the related FRN. As you will see, in many cases, our edits and comments take the form of efforts (or requests to EPA) to incorporate into the preamble some of the language EPA provided in response to OMB comments (i.e. in comment bubbles rather than in actual text) and increase the level of transparency and clarity for the public. In most of these cases, it is the gist that OMB cares about so please feel free to propose alternate language that gets at the same effect.

Please note that we received substantive comments from DHS, NRC, and DOE. While the attached comments reflect our best effort to address their – and OMB's – concerns, we have not had an opportunity to discuss them with all three agencies yet. Specifically, we believe that the attached documents address the concerns of DHS and NRC but we do not know whether DOE will find them acceptable. Given both of our interests to conclude this review as soon as possible, we are transmitting these comments to DOE at the same time as EPA as a time saving measure. We will let you know as soon as we can if they have different ideas on how to best address their concerns.

Let me know if you have any questions.

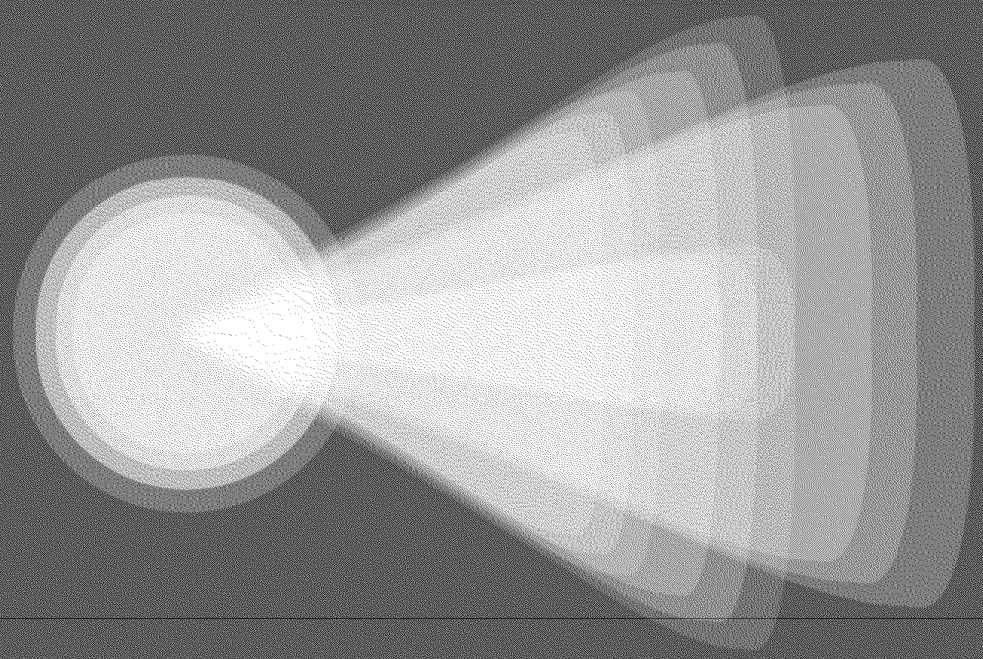
Vlad

United States
Environmental Protection
Agency

EPA-XXX/X-XX/XXX | Month YYYY | www.epa.gov/xxxxxx

Protective Action Questions & Answers for Radiological and Nuclear Emergencies:

A companion document to the U.S. Environmental Protection Agency Protective Action Guide (PAG) Manual



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Protective Action Questions and Answers for Radiological and Nuclear Emergencies: Companion document to the U.S. Environmental Protection Agency Protective Action Guide (PAG) Manual

FOREWORD

One of the most critical factors in the success of a radiological response is the effectiveness of public communication. "The timely and effective flow of information between agencies and the public is vital for facilitating and encouraging appropriate protective actions, reducing rumors and fear, maintaining public trust and confidence and reducing morbidity and mortality." (Becker, 2004)

Planning radiation emergency public safety messages will improve timeliness of information, increase consistency of the information and, ultimately, enhance effectiveness of the communication. Social media and the 24-hour news cycle bring information about emergencies and emergency response actions to the public on a much quicker timeframe than in the past. Members of the public and media expect answers to queries on an accelerated schedule and further expect that they can access updated information on responses several times daily via multiple information platforms.

This document is intended to help emergency planners prepare public communications prior to and during a radiological emergency. The messages in this document should be worked into emergency response plans and standard operating procedures. All radiological emergencies are different therefore the messages need to be adapted for the specifics for the emergency at hand.

Based on the safety measures in EPA's Protective Action Guide (PAG) Manual, this document is written generically to be applicable to all types of radiological emergencies. It complements the planning considerations presented in the PAG Manual and Federal Emergency Management Agency's incident-specific messaging documents *Improvised Nuclear Device Response and Recovery: Communicating in the Immediate Aftermath* and *Communicating During and After a Nuclear Power Plant Incident.*

The comprehensive questions and answers represents some of the best of the previous work produced through other government emergency radiological communications efforts. This document includes new messages addressing potassium iodide (KI) consumption and populations that require special consideration, including pregnant and breastfeeding women, children and those with disabilities.

Ideally, there will never be a need for these messages, but we have a responsibility to be prepared to empower the public with information on how to protect themselves and their families in the case of a radiological or nuclear emergency.

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Protective Action Guidance

1. What is a Protective Action?

Protective actions are the urgent steps that people can take to protect their health and the health of loved ones in a radiation emergency.

The main protective actions that the public might be asked to take are evacuation or sheltering (staying inside).

2. How do people know which steps to take?

Health and emergency management officials will tell the public if protective actions are needed and whether evacuation or staying inside would be more effective for avoiding radiation dose.

Officials make these decisions about how to protect public health by using information about local conditions and by using the recommendations in the “PAGs” or Protective Action Guides.

3. What are the PAGs?

PAGs, or Protective Action Guides, are radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to safeguard health after a radiation emergency has occurred. The U.S. Environmental Protection Agency developed the PAGs to help responders plan for and respond to radiation emergencies.

Every emergency situation is different, and the best action or set of actions in one situation may not be appropriate at another time or in another situation.

Knowing *when* emergency steps need to be taken, and *which* steps are warranted, is important for protecting the health of the public. The PAGs provide general guidance to officials, which they can use in combination with their knowledge of local conditions, to make these important decisions.

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4. What kinds of steps are included in the PAGs?

The PAGs include actions that government agencies and members of the public can take to protect people's health in a radiation emergency.

In the beginning of a radiation emergency, there are two main protective actions that the public might be asked to take to avoid exposure to radiation: evacuation or sheltering (staying inside). The PAGs also provide guidance on food safety and administration of potassium iodide (KI).

5. What is evacuation? What is sheltering? What is the difference?

Evacuation involves urgently moving people from an area expected to be in the path of radioactive releases.

Sheltering, on the other hand, involves having people stay indoors in their homes, offices, schools, or other buildings while radioactive materials pass over.

6. Are there other steps officials might ask people to take?

Depending on the situation, evacuation or sheltering may be supplemented by other measures.

Limit Access: One step is to keep people out of the affected area.

Decontamination: Another step involves decontamination, which means to remove any radioactive particles that may have fallen onto people's clothes, skin, or hair. Decontamination is done by having people change clothes and, possibly, wash or shower.

Food: Sometimes officials may also take steps to stop certain foods from being consumed if the foods are suspected of being contaminated. Authorities may also act to prevent livestock from grazing in potentially-contaminated areas, and instead have the animals drink water and eat feed that has been previously stored.

Potassium Iodide: Potassium iodide, or KI, is a non-radioactive form of iodine. KI can be useful in situations where radioactive iodine has been released into the environment. It works by filling a person's thyroid gland with safe iodine so that harmful radioactive iodine is not absorbed. KI is not an "anti-radiation" drug, and it can be harmful to take it when it is not needed.

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7. How do officials know when it is time to carry out protective actions?

The PAGs provide radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to safeguard health after a radiation emergency has occurred.

When a radiation emergency occurs, officials will use available information and computer models to quickly predict how much radiation people could *potentially* receive from the incident.

Officials then use the PAGs to determine what general actions can be taken to *avoid* that potential exposure from taking place.

In other words, PAGs are trigger levels for deciding when specific steps are needed to *prevent* people from being exposed to a level of radiation that might be hazardous to health.

8. Wouldn't it make more sense to carry out all of the protective actions right away, as soon as a radiation emergency occurs?

No. Different safety measures are used for different situations.

Taking all of the safety measures at once is not possible. For example, people cannot stay inside and evacuate at the same time. Officials need to see what kind of threat the emergency poses to people so they can provide the best advice on how to protect health.

9. Why don't officials just automatically advise everyone to evacuate when a radiation emergency occurs?

There are situations when sheltering may be a better choice for preventing or reducing radiation exposure.

For example, if a cloud containing radioactive particles is expected to pass over an area very soon and then leave quickly, evacuation could actually expose people to more radiation than staying indoors.

This is because evacuation takes time, and many people might be caught outside or in their cars when the cloud passed over. So people staying indoors while the cloud passed by would be more protected than those caught outside trying to evacuate.

Also, in some situations, evacuation may not be practical. Blocked highways or power outages, for example, could make evacuation difficult. So, too, could severe weather.

Officials using the PAGs and information about local conditions will tell the public

whether evacuation, sheltering or other steps are needed in a radiation emergency. Follow the instructions so that you take the right steps to protect yourself and your loved ones.

10. What about controls on food?

In some situations, officials may determine that it is necessary to take actions to prevent radioactive contamination from entering the food supply.

Steps might involve preventing livestock from grazing in potentially-contaminated pastures or fields and ensuring that animals only eat feed and drink water that has been previously stored.

When necessary, officials may also act to stop certain foods from coming to market or limit consumption of certain foods if they are suspected of being contaminated.

11. What about taking Potassium Iodide?

Never take potassium iodide (also known as KI) and never give to your children unless you have been specifically advised to do so by the health department, emergency management officials, or your doctor.

Potassium iodide, or KI, is a non-radioactive form of iodine. KI can be useful in situations where radioactive iodine has been released into the environment. It works by filling a person's thyroid gland with safe iodine so that harmful radioactive iodine is not absorbed.

But KI is only useful in situations involving radioactive iodine, and it only protects the thyroid gland; it does not help in other situations involving radioactive releases.

KI is not an "anti-radiation" drug, and it can be harmful to take it when it is not needed.

12. Who uses the PAGs?

States and local governments have the main responsibility for taking measures to protect life and health.

In a radiation emergency, state and local emergency response agencies use the PAGs to decide when special actions are needed to avoid radiation exposure and protect people's health.

13. Do PAGs play a role in protecting people after the immediate

emergency is over?

Yes, it is possible that protective actions, including food safety measures, will stay in place to protect people until the area is cleaned up.

One such cleanup measure is *decontamination of land and property*, which involves cleaning radioactive contamination from an area so that people can reoccupy it. When this is not possible, another measure – *relocation* – may be required. Relocation involves moving people from an area and continuing to keep them from returning. An additional protective action may involve placing continuing *controls on food and water*.

14. What is the basis for the PAGs?

The PAGs are radiation dose guidelines, or "trigger levels," designed to prevent immediate health effects from radiation while balancing the risks of long-term health effects against the risks of protective actions, such as accidents from evacuation or risks from sheltering-in-place.

Balancing the risks between radiation exposure and protective actions is important. During the 2011 Fukushima nuclear power accident, no one died as a result of radiation exposure. However, over 1,000 people died from the evacuation, primarily elderly hospital patients who had to be moved from areas without power. The 2013 PAG Manual makes use of the lessons learned in Fukushima.

15. Where can I find out more about protective actions?

We are strongly committed to keeping the public informed and to answering people's questions. If you want to learn more about the PAGs, please go to http://www.epa.gov/radiation/protective-action-guides-pags. For information about the response, please contact us on the web at www.agency.etc or by telephone: [INSERT AGENCY CONTACT NUMBER HERE]

Impacted Community: Immediate Actions

16. If I am outside, what steps should I take to protect myself and my loved ones?

There are a few simple steps — recommended by doctors, scientists, and health experts — that will help protect you and your loved ones.

IF YOU ARE OUTSIDE:

Cover your nose and mouth. Covering your nose and mouth with a cloth reduces the risk of breathing in radioactive dust or smoke. You may also use a disposable mask, such as a dusk mask, if one is immediately available.

Don't touch objects or pieces related to the release — they could be radioactive.

Go inside and stay inside. Quickly go into a building where the walls and windows have not been broken. This will help shield you from any radiation that might be outside.

Remove your outer clothes. Once you are inside, carefully take off your outer layer of clothing. This is done in case any radioactive dust has fallen onto your clothes while you were outside.

Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.

Wash off. If available, take a warm shower with lots of soap. Do not scald or scratch your skin.

Wash your hair only with shampoo or soap and water. Don't use conditioner because it can cause the radioactive dust to stick to your hair.

Children should be given a shower or washed under supervision of a parent or other adult.

If you cannot shower, use a wipe or clean wet cloth to wipe skin that was not covered by clothing (such as your hands and face).

Gently blow your nose and gently wipe your eyelids, eyelashes, and ears with a clean wet cloth.

Put on clean clothes. Clothing stored in a closet or away from radioactive material is clean. If you do not have clean clothes, carefully brush off your outer layer of clothing and get dressed again.

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Tune in. Tune to local radio or television news or government emergency management websites for more instructions.

17. If I am inside a building, what steps should I take to protect myself and my loved ones?

There are a few simple steps — recommended by doctors, scientists, and health experts — that will help protect you and your loved ones.

IF YOU ARE IN A BUILDING:

Stay inside. If the walls and windows of the building are not broken, stay in the building and do not leave.

If the walls and windows of the building are broken, go to an inside room and do not leave. If the building has been heavily damaged, quickly go into another building where the walls and windows have not been broken.

Close doors and windows. To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. It is not necessary to put duct tape or plastic sheets around doors or windows.

Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate. In-room fans (for example, ceiling fans) that only recirculate air are okay to use. Air conditioning systems in large buildings can be used if they are set on recirculate.

If you have to go outside, follow the "if you are outside" instructions.

Be sure to cover your nose and mouth with a cloth. Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.

Shower or wash with soap and water, removing any remaining dust. Be sure to wash your hair with shampoo or soap, but remember not to use conditioner, since it can cause radioactive dust to stick to your hair.

Tune in. Tune to local radio or television news or government emergency management websites for more instructions.

18. If I am in a car or truck, what steps should I take to protect myself and my loved ones?

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IF YOU ARE IN A CAR OR TRUCK:

Shut the windows and vents. Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate.

Cover your nose and mouth. Cover your nose and mouth with a cloth to avoid breathing radioactive dust or smoke.

Get Inside. If you are close to your home, office, or a public building, go there immediately and go inside quickly.

If you cannot get to your home or another building safely, pull over to the side of the road and stop in the safest place possible. Turn off the engine and stay in the car until you are told it is safe to get back on the road.

If it is a hot or sunny day, try to stop under a bridge or in a shady spot so you and your passengers don't overheat.

Tune in. Listen to the car radio for more instructions.

19. If I am in a potentially-affected community, what steps should I take to protect myself and my loved ones?

IF YOU ARE IN A POTENTIALLY-AFFECTED COMMUNITY:

Go inside and stay inside. Go inside your home, office, school or other building.

The wind can sometimes carry radioactive dust from the site of the release. As a precaution, people should stay indoors for their personal safety until authorities say it is okay to leave.

Tune in. Tune to the local radio or television station, or check government emergency management websites, for more instructions.

20. What should people do if they are on a boat near the affected area?

Like cars, boats do not provide adequate protection from radioactive material. Tune in

to the radio for more information about the location of the radioactive material. If you are in a boat, you have two choices:

- Return to a marina or boat landing and find a building and go inside
- Get information on the location of the radioactive material and navigate to a distance far enough away from the incident.

21. What should people do if they're told to evacuate?

If you are told to evacuate, leave the area immediately

When the public evacuates, they are moved to safer areas depending on levels of radiation and radioactive material in order to keep exposures as low as possible, and under most conditions evacuation is preferred.

If you are told to evacuate:

- Pay close attention to what officials are telling you.
- Take the designated routes to reception centers where you will be registered and checked for contamination.
- If easily accessible, bring identification cards and medications with you.
- Follow the instructions of law enforcement personnel.

Transportation will be provided to those who need it, including physically accessible transportation for people with disabilities.

Limit calls to emergencies only, so those who need immediate help can be addressed in a timely manner. Text messaging may work during high volume periods because it does not require as much bandwidth.

22. Are care shelters available for people who are evacuating?

Yes, designated shelters have been opened.

You should first go to the reception center to be checked for contamination, and then to a shelter, or you can stay at a hotel or with family or friends.

Potassium Iodide (KI): Important Information

23. Should my family take potassium iodide?

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Never take potassium iodide (also known as KI) and never give it to your children unless you have been specifically advised to do so by the health department, emergency management officials, or your doctor.

Potassium iodide only reduces risk from radioactive iodine if taken very close to the time of exposure. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

24. What is potassium iodide? How does it work?

Potassium iodide is a non-radioactive form of iodine.

KI is only useful in situations where hazardous radioactive iodine has been released into the environment. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

KI works by filling a person’s thyroid gland with safe iodine so that the harmful radioactive iodine in the environment is not absorbed.

You should only take potassium iodide if you have been specifically advised to do so by local public health officials, emergency management officials, or your doctor. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

25. Do dirty bombs release radioactive iodine?

It is unlikely that a “dirty bomb” will release radioactive iodine. For various technical reasons, particularly the short amount of time it stays radioactive, radioactive iodine is not considered something terrorists are likely to use in a dirty bomb.

26. What types of incidents release radioactive iodine?

Radioactive iodine *may* be released during a nuclear power plant incident or a nuclear detonation. In the case of a nuclear power plant release, the plant operators will know if radioactive iodine has been released into the environment and will inform local officials so that decisions on potential KI distribution can be made quickly.

27. Will potassium iodide protect me from radiation?

Potassium iodide only protects the thyroid gland from radioactive iodine. It does not provide protection from any other kind of radiation exposure.

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Potassium iodide pills are not “radiation antidotes.” Potassium iodide should *only* be taken if there is a specific public health recommendation to do so.

28. Are over-the-counter medicines that contain iodine, such as disinfectants or throat sprays, a good substitute for potassium iodide?

No. Doing so will not protect your thyroid and could even be dangerous to your health. It is true that many over-the-counter medicines contain iodine in some form. Examples include iodine liquid for cuts and sores, disinfectants, and throat sprays.

These should never be taken as a substitute for potassium iodide.

These over-the-counter medicines and products are not intended for internal use. They may contain other ingredients that can be harmful.

Also, the amount of iodine contained in most of these products is small and would have no protective effect against radioactive iodine.

29. What about taking household disinfectants or antiseptics that contain iodine? Are these a good substitute for potassium iodide?

No. Doing so will not protect your thyroid drinking or consuming them could poison you.

30. Is taking large amounts of iodized salt a good substitute for potassium iodide?

No. Doing so will not protect your thyroid. Furthermore, although most people don’t realize this, it could even be dangerous.

It is true that iodized salt contains small quantities of iodine. But the iodine content in iodized salt is too low to prevent uptake of radioactive iodine.

Furthermore, it is actually dangerous to consume large amounts of iodized salt.

The main ingredient in salt -- sodium chloride -- can make people very ill if taken in large amounts.

Even tablespoons of salt taken repeatedly over a short period of time can cause poisoning. Eating large amounts of salt can also cause high blood pressure and other medical problems.

31. Are herbs or herbal products a good substitute for potassium iodide?

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No. Doing so will not protect your thyroid and could even be dangerous to your health. It is true that some herbs and herbal products may contain iodine.

But the amount of iodine is not regulated, so it is not possible to know how much iodine you will be getting.

Taking large amounts of herbs or herbal products could endanger your health.

32. Do people need a prescription to obtain potassium iodide?

The government stockpiles potassium iodide for emergency uses.

If public health and emergency management officials determine that taking potassium iodide would be helpful, the pills will be provided to people at no charge.

Additional Information: Situation Specifics

33. Where should I go for information about the situation?

Tune in your local radio or television station, or check government emergency management websites for the latest information.

Public health and emergency management officials will be providing regular updates. You can also go to the following website or toll-free hotline for information:

- [www.agency.etc]
- 1-8XX-XXX-XXXX

34. I am seeing a lot of information and instructions about what to do on internet blogs. Should I follow it?

Check official sources first. You can find the latest information at [www.agency.etc].

Blogs, social media, and the internet more generally can be a useful source of information, but only if the source is known and trustworthy.

Unfortunately, we know from past disasters and emergencies that small numbers of individuals may use the situation to distribute false information. And even well-intentioned individuals can pass on incorrect information or rumors.

Therefore, it is advisable to double-check what you are reading with the information and instructions being provided by the official website listed above, the official toll-free hotline, or local radio and television broadcasts.

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In an emergency, get information from reliable sources so that you can protect your health and the health of loved ones.

35. I received a text message giving me instructions on what to do. How do I tell if it is an official message or a fake?

If the government has issued an emergency text message, it will clearly identified as coming from [INSERT INFORMATION]. That is, the sender will read [INSERT INFORMATION].

Unfortunately, we know from past disasters and emergencies that small numbers of individuals may use the situation to send out official-looking false information. And, as noted earlier, even well-intentioned individuals can pass on incorrect information or rumors.

If you are unsure about a message, double check what you are reading with the information and instructions being provided by the official website or the official toll-free hotline.

[www.agency.etc]

1-8XX-XXX-XXXX

36. How many people have been injured or killed?

At this time, we do not yet know the specific number of casualties. An update will be provided as soon as reliable information becomes available.

Right now, we are focused on getting help to people in the affected area as quickly and safely as possible.

37. Where is the radioactive material located?

Radiation and environmental health experts are checking air, water, and ground conditions in and around the release site to locate the hazardous areas. Stay tuned to radio, television or visit [www.agency.gov] for the latest information.

38. Where is the radioactive dust and smoke going?

According to current weather predictions, the areas [DIRECTION] of [CITY] could be in the path of the cloud containing the radioactive dust and smoke.

Until advised otherwise, people in neighborhoods and communities that could potentially be

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in this path should stay indoors.

39. What is a plume?

Officials sometimes call the cloud of smoke and radioactive dust moving away from the explosion a plume.

40. What are emergency responders doing at this time?

Emergency responders, radiation experts, scientists, and representatives from all levels of government are working together to protect the public and save lives.

If terrorism: Law enforcement is working to apprehend those responsible.

41. How can people learn about the safety of their family members?

Use text messages instead to try and reach your family members.

If phone lines or other communication infrastructure has been damaged in the bombing, or if the lines are clogged, you may not be able to complete a phone call.

If you have access to a computer or a web-enabled device, use e-mail, social media websites like Facebook and Twitter, or online registries such as the Red Cross Safe and Well website.

Emergency responders are gathering and organizing all vital information available. If you are separated from your children or loved ones, search online for registries where people can identify themselves and their location.

Bear in mind that it may take time for registries to put in the latest information. You can seek additional information and counseling services at [LIST ORGANIZATIONS or LOCATIONS].

42. What will happen to people in the affected neighborhoods?

While it is too early to know the specific impacts, we know that this is a serious incident.

As appropriate: Lives have been lost, people have been injured, and homes and businesses have been destroyed.

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All levels of government are coordinating their efforts to do everything possible to help the people affected by this emergency.

As life-saving activities continue, follow the instruction of emergency responders. These instructions are for your safety and the well-being of your loved ones.

These instructions are based on the best information we have right now. These instructions may be updated as more information is available.

43. How can the public help?

Your help is vital in this situation.

Here are six important steps you can take to help:

1. Do not abandon your car on the road. Instead, park your car without impeding traffic. This will allow responders to help people in need of assistance.

2. Do not go near the release site. It could put you in danger and also stop emergency responders from doing their jobs.

3. Use text messaging rather than phone calls to communicate with friends and family. This will help to keep the phone lines from overloading.

4. Don't go to the hospital, police stations, or fire stations unless you were injured, or have another medical emergency requiring immediate treatment. These facilities need to be available for victims in serious need of assistance.

5. Stay alert: If you see anything suspicious, contact your local police or the FBI right away.

6. Stay tuned to television, radio, and government emergency management websites for updates.

44. What should I do if I come across an object that might be radioactive?

Do not approach, pick up, or touch debris or other objects that may be contaminated with radioactive material. These objects could be radioactive, especially in the immediate vicinity of the incident.

45. When will it be safe for people to return to their homes and businesses?

Federal, State, local, and tribal partners are collecting information about the dangers in the impacted areas. Until this is done we cannot predict when people can begin returning to the area.

If you have been evacuated, do not return until you are told it is acceptable to do so by authorities. Please do not put yourself or your family in danger by attempting to return early. Attempting to return early could divert responders' efforts away from those who need immediate assistance.

46. Will this affect air travel?

Until we have more information, expect air travel in and near the affected area to be restricted.

This is to keep air crews and passengers safe. It also keeps the airspace free for response and recovery activities.

47. Will this affect travel on waterways, both at home and abroad?

Until we have more information, expect the use of navigable waterways in the affected area to be restricted.

This is to keep mariners, other waterway users, and passengers safe. It also keeps the waterways free for response and recovery activities.

Radiation Health Effects

48. What is radiation?

Radiation is energy. Radiation travels from its source in the form of energy waves or energized particles.

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Radiation has so much energy it can pose a health risk by damaging tissue and DNA in genes.

For a radiological emergency, we trying to keep exposure to radiation as low as possible.

49. What is a rem, millirem (mrem), gray (Gy) or sievert (Sv)?

These units measure radiation exposure or dose, which for all practical purposes are the same thing. In the United States, dose and exposure are sometimes measured in units called rem or roentgen (R). Dose is often reported in millirem (mrem), which is a fraction of a rem; 1/1000. The international community uses units called gray or sieverts to measure the same thing.

According to radiation safety experts, radiation exposure below 10 rem (10,000 mrem or 0.01 Sv) usually results in little to no harmful health effects.

[Put in context of radiation incident doses]

50. What is a curie (Ci) or a bequerel (Bq)?

These units measure the amount of radioactive material in a sample, such as in a sample of water, soil or air. This is sometimes referred to as the sample's radioactivity (or simply its activity). In the United States, we measure this amount of radioactive material in curies (Ci) and the international community uses becquerels (Bq). Typically results will be in picocuries (pCi), which is one trillionth (or one million millionth) of a curie. EPA suggests that people fix their homes if radon levels in an air sample are more than 4 picocuries per liter (pCi/L).

[Put in context of radiation incident radioactivity findings]

51. Will people who have been exposed to the radiation get cancer?

Just because a person is near a radioactive source for a short time or gets a small amount of radioactive dust on himself or herself does not mean he or she will get cancer later in life, especially if it is removed quickly.

Scientists and health experts are working now to gather information on the radiation risks posed by the attack.

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Meanwhile, health agencies will be establishing screening centers to check people for radioactive contamination and to arrange for any longer-term follow-up should it be needed.

Further information on this will be provided soon by health and emergency management officials.

52. How much radiation is safe? How much is considered low risk?

According to radiation safety experts, radiation exposure between 5–10 rem usually results in little to no harmful health effects. Safety recommendations are designed to keep your dose below these levels.

It takes a large dose of radiation—more than 75 rem—in a short amount of time (usually minutes) to cause immediate health effects like acute radiation sickness.

[Put incident dose in context to radiation sickness doses]

Infants, the elderly and pregnant women are more sensitive to radiation exposure than healthy adults. Differences like age, gender and even previous exposure are factors that might influence a body's reaction to radiation exposure.

You can lower your risk of developing health effects by limiting your exposure to radiation by following these three steps:

- Get inside a building or to a basement to protect yourself.
- Get clean.
- Listen to officials and emergency responders for further safety instructions.

53. Is radiation contagious?

Unlike some biological agents, radiological effects are not contagious and cannot result in an epidemic.

It is true that people who have radioactive dust on their clothes or their bodies can leave some of that contamination on things or people they come into contact with.

But there is a simple solution: to have them clean up or decontaminate.

People who might have radioactive dust on them can remove their outer layer of clothing, shower, and put on new clothes.

54. Are people at risk for radiation poisoning or sickness?

Radiation sickness an illness from short-term exposure to a large amount of radiation. It takes a large dose of radiation—more than 75 rem—in a short amount of time (usually minutes) to cause immediate health effects like acute radiation sickness.

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[Put incident dose in context to radiation sickness doses]

Signs of radiation sickness include: injury like a burn or rash, nausea, and/or vomiting. If you have been exposed to high levels of radiation and are experiencing these symptoms–even days after exposure–seek medical attention immediately.

If you are not experiencing these or other life threatening symptoms, stay away from hospitals. Hospitals are caring for those most critically injured.

Food, Water and Air Safety

55. Is the food safe to eat?

Food in sealed containers and any unspoiled food in your refrigerator or freezer are safe to eat.

Use a damp towel or cloth to wipe off cans, bottles, packaged foods, counters, plates, pots and utensils before using them.

Seal these towels or cleaning cloths in a plastic bag and place them away from people and pets.

However, any unpackaged food that was out in the open and close to the incident may have radioactive dust on it. Therefore, do not consume food that was out in the open.

Food that was outdoors from [*time*] today, within a few miles of [*explosion site*] should be avoided.

56. Can people eat food from their gardens or locally caught fish and game?

Do not eat food from your garden if you suspect that radioactive material has settled on it. It is possible that the radioactive fallout has contaminated the ground and any crops that were planted.

Locally caught fish and game should be tested for radioactive contamination before it is eaten.

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Responders will be monitoring the area and will notify you when it is safe to eat local fish, game and food from your garden.

Listen for instructions from State and local officials and responders regarding food safety.

57. Is the water safe to use?

Bottled water and sealed juice or soda containers will be free of radioactive contamination. Wipe or rinse the outside of bottles or cans before opening them.

Water from the tap is probably safe. But until we have drinking water test results, only bottled water is certain to be free of contamination.

Tap or well water can be used for cleaning yourself and your food.

Boiling tap water does not get rid of radioactive material.

58. What should farmers do with their crops?

We are asking farmers in [AREA] not to tend, harvest, eat, or distribute their crops until radiation monitoring and sampling results are analyzed, unless otherwise directed.

We recognize that your crops are your livelihood. State, local, and tribal officials will keep you informed as radiation monitoring and sampling results come in.

59. What should farmers and ranch owners do with livestock?

If you are being asked to stay inside (shelter-in-place) or evacuate, follow the instructions of State, local, and tribal officials. These instructions are for your safety.

We are asking farmers and ranchers in [AREA] not to transport their livestock and to not consume or distribute milk from dairy animals until radiation monitoring and sampling results are analyzed, unless otherwise directed. If you have milk producing animals, contact state, local, or tribal officials for guidance.

Take these simple steps to protect your livestock from eating feed or drinking water contaminated with radioactive material:

- Move your livestock indoors, away from more highly contaminated areas outside.
- Use only stored feed and covered water. If possible, avoid using hay or alfalfa kept outside.

60. Is the air safe to breathe?

Federal, State, and local partners are monitoring to determine the location and levels of

radioactive material on the ground and in the air.

If there are radioactive particles in the air there are simple steps you can take to reduce your exposure:

- Cover your mouth and nose with a protective layer – like a mask, cloth, or towel.
- If you have been instructed to stay inside, remain inside. Walls provide protection from the radioactive material outside.
- Close doors and windows. To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. It is not necessary to put duct tape or plastic sheets around doors or windows.

Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate. In-room fans (for example, ceiling fans) that only recirculate air are okay to use. Air conditioning systems in large buildings can be used if they are set on recirculate.

We are tracking the radiation levels and authorities will instruct you to leave the area when it is in your best interest to do so.

Decontamination

61. If people are told by health and emergency management officials to self- decontaminate, what does this mean?

It means that people are being told to take several easy steps to remove any radioactive material that might have fallen onto clothes, skin, or hair.

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To self-decontaminate:

- Remove your outer clothes;
- Place the clothes in a plastic bag, seal the bag, and put it someplace away from children and pets;
- Take a warm shower with lots of soap; do not scald or scratch your skin;
- Wash your hair with shampoo or soap and water. Do not use conditioner because it can cause radioactive dust to stick to your hair;
- If you cannot shower, use a wipe or clean wet cloth to wipe skin that was not covered by clothing (such as your hands and face);
- Put on clean clothes.

62. How long does an exposed person have to remove contamination from their body?

There is no set time. People should remove contamination as soon as possible to reduce their radiation dose by using the six steps listed above.

63. Is it safe for me to let someone who might have been affected by the radiological incident into my home?

Even if someone has radioactive dust on their clothes or body, a few simple steps can clean up or decontaminate the person so that he or she can safely visit your home.

First, ask your visitor to remove the outer layer of clothing and place it in a plastic bag. Place the bag away from people and pets.

Second, have your visitor shower with soap and warm water to remove any remaining radioactive material. A warm shower with lots of soap is sufficient. There is no need to use very hot water or to scratch the skin.

Hair may be washed with shampoo or soap and water. But don't use conditioner because it can cause the radioactive dust to stick to your hair.

Finally, put on clean clothes.

64. How should people decontaminate their homes and their possessions?

Do not decontaminate your home until you get information from emergency responders or local officials.

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You may not need to decontaminate your home OR there may be special instructions for how to clean your home. For example, you may receive special instructions on wearing protective clothing, methods for keeping dust to a minimum and washing the outside of your home. You can find more information on steps you can take at [INSERT web address].

Exposure vs. Contamination

65. How do I know if I've been exposed to radiation or contaminated by radioactive materials?

People cannot see, smell, feel, or taste radiation; so you may not know whether you have been exposed.

In addition, low levels of radiation exposure do not cause any symptoms.

People who were in areas of concern may be instructed to go to a screening center—sometimes called a community reception center. At this location, responders will quickly check for radiation by using special equipment to determine how much radiation is present and whether it poses any danger in your area.

If you think you have been contaminated, simply removing the outside layer of clothing and washing exposed skin will significantly reduce any contamination you may have on your body.

66. What is the difference between radiation exposure and radioactive contamination?

Exposure occurs when radiation interacts with the body. You can be exposed to radiation without having radioactive material on your body (contamination). For example, a chest x-ray or CT scan a person is exposed but they are not contaminated and they are not radioactive.

Contamination is when a radioactive material is physically on or inside of a person or object. If you are contaminated with radioactive material, you are being exposed to radiation. Contamination can occur two ways:

1. External contamination occurs when radioactive material settles on a surface or outside of an object.

2. Internal contamination occurs when radioactive material enters the body. This can occur after radioactive material is swallowed, inhaled, injected, or absorbed through the skin or wounds.

Special Issues and Concerns: Pregnancy and Breastfeeding

67. I am pregnant. Is my baby in danger?

After any radiation incident, expectant mothers who have concerns should seek advice from their physicians working in consultation with radiation professionals.

It is true that the fetus is extremely sensitive to radiation, with the unborn child at greatest risk during the first trimester of the pregnancy. After some radiation accidents in other countries, pregnant women reportedly terminated their pregnancies because they feared that the radiation would harm the developing embryo or fetus. Tragically, these terminations turned out to be totally unnecessary.

According to the Centers for Disease Control and Prevention (CDC) and as history has shown, most radiation exposure events will not expose the fetus to levels likely to cause health effects.

However, before any potential health risk to the embryo/fetus can be assessed, healthcare professionals and radiation experts would determine what external or internal doses the mother might have received as a result of being very close to the incident.

Once dose levels to the mother and fetus have been determined, your physician working in conjunction with other medical and radiation professionals can discuss potential risks (if any) and provide appropriate counseling.

68. Is it safe to breastfeed?

Breastfeeding is very important for the well-being of a baby, providing vital nutrients and a sense of security.

For mothers far from the release site, breastfeeding can continue.

However, if a mother was close to the release site and was either injured or is believed to have inhaled significant quantities of radioactive dust or smoke, there is a small possibility that some radioactivity could be passed through breast milk.

Public health and medical officials may advise the mother to temporarily stop breastfeeding and switch to either breast milk that was pumped and stored before the incident or baby formula until she is able to contact her doctor or public health and medical officials for further instructions or advice.

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Formula containers and feeding supplies should be cleaned with a damp cloth or clean towel before use.

If possible, continue pumping and disposing of breast milk to maintain supply while additional information is gathered. Clean pumping supplies as indicated by the manufacturer.

If no other source of food is available, continue to breastfeed. This remains an excellent source of nutrition for your baby.

69. Can pregnant women take potassium iodide pills?

As with the rest of the population, pregnant women should take potassium iodide only when specifically advised to by public health authorities.

Potassium iodide will cross the placenta and protect the thyroid of the growing fetus, as well as the mother, from radioactive iodine only.

70. Can breastfeeding women take potassium iodide?

As with the rest of the population, breastfeeding women should take potassium iodide tablets only when specifically advised by public health authorities.

However, this will not be sufficient to fully protect the breastfed child. The child will also need potassium iodide in special doses adapted for newborns and infants.

Listen to your community health officials for specific guidance on taking potassium iodide pills. For the latest information go to [www.agency.etc].

71. I am trying to get pregnant. Should I worry that my future children will be affected?

There is no evidence that your future children will be at a greater risk for birth defects or other problems.

Over many years, extensive studies of the children of atomic bomb survivors have been conducted by scientists. There has been no indication of genetic effects in the offspring of people who survived the atomic bombings and later had children.

Special Issues and Concerns: Children

72. What should I do about my children and family? Should I leave to find my children?

If your children or family are with you, stay together. Take the same actions to protect your whole family.

If your children or family are in another home or building, they should stay there until you are told it is safe to travel. You should also stay where you are. You cannot help them if you are injured.

Schools have emergency plans and shelters. If your children are at school, they should stay there until it is safe to travel.

Do not go to the school until public officials say it is safe to travel.

73. What is being done to protect children in school?

Schools have emergency plans in place to protect the children. These plans include keeping everyone inside and providing assistance for those with special needs.

Children in schools will be cared for by teachers and staff until such time as it is safe for them to leave. Children will not be released to go outside until instructed to do so by health officials and emergency responders.

74. If some of the radioactive dust got on my clothes or skin, will I contaminate my child? Is it safe for me to be around my child?

Radioactive dust can be removed by taking off and bagging your outer layer of clothing, showering with soap and warm water, and putting on clean clothes.

People who have cleaned up pose no contamination risk to you, your property, or the members of your household.

75. If people need to be decontaminated at a reception center or other location, will I be able to stay with my children when they are decontaminated?

Parents should be able to stay with their children during decontamination and other processes.

Children and their families (parents or caregivers) should not be separated unless there are critical medical issues that need to be addressed.

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76. Does my child need to have his/her thyroid scanned?

Thyroid scans are only needed in situations where there is a possibility that radioactive iodine has entered the body.

Health experts are actively gathering information and determining potential health threats. You will be notified if thyroid scans are needed.

77. What kind of emotional impact can a radiological terrorism incident have on children? What should I look out for?

Children are among the most vulnerable of those affected by a radiological emergency because they lack the maturity, skills, and experience to fully understand and process what is going on.

Family members and caregivers should gently try to find out what the child thinks and feels about the disaster.

If the child is scared because she/he has misunderstood what has happened, then simple explanations should be provided while avoiding alarming details.

Children who exhibit signs of stress such as difficulty sleeping, loss of appetite, or bedwetting should receive extra time and attention from family members and other caregivers.

It is important to remember that children also need a chance to play and relax. Encourage older children to be helpful and maintain regular routines.

78. Are children at higher risk of harm if exposed to radiation?

Children exposed to radiation may be at greater risk than adults.

Children have higher breathing rates, are growing, and have physical proximity to the ground—where radiation may be more concentrated—which makes them more vulnerable. Young children are also very sensitive to radioactive iodine.

Health experts are actively gathering information and determining potential health threats—specifically looking at effects on children. Instructions issued by health officials are based on these findings.

79. Will my child and I get cancer from the radiation exposure?

There are many causes of cancer, some genetic and some from the environment.

For some people, it is possible that the low levels of radiation expected from the incident could slightly increase the risk of cancer over what occurs naturally in a

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person's lifetime.

Just because a person is near a radioactive source for short time, inhales a small amount of radioactive dust, or gets a small amount of radioactive material on clothing or skin, it does not automatically mean he or she will get cancer later in life.

Scientists, doctors, and other health experts are working now to check people and gather information on any potential radiation risks posed by the attack. Once exposure information has been gathered, health officials and your doctor will be able to discuss possible risks (if any) and the practical steps you can take to reduce them.

80. Should my children take potassium iodide?

If health authorities do advise that potassium iodide needs to be taken by the public in an affected area, children can do so unless they have known allergies to iodine.

However, the doses and procedures for giving KI to children are not the same as for an adult.

If potassium iodide is needed, health authorities will provide specific guidance on dosages and procedures for giving KI to children.

Special Issues and Concerns: People with Disabilities or Special Medical Needs

81. If I go through decontamination at a reception center or other facility, will my eyeglasses have to be taken away?

Your glasses should not be taken away.

Eye glasses may be washed in the shower with the person who wears them.

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82. I have a prosthetic limb. If I have to be decontaminated to remove radioactive dust, will by prosthetic limb have to be taken away?

There is no reason for a prosthetic limb to be taken away.

Most prosthetic limbs can get wet. So they can be removed, thoroughly cleaned along with the person, and put back on.

83. Is there a general list of the kinds of devices, adaptive equipment, prostheses, and mobility aids that can be decontaminated?

Unfortunately, there is no single guide currently available that covers all situations.

However, a general list was published in 2006 by the New York Center for Terrorism Planning and Preparedness (NYCTP) in a document on hospital decontamination protocols.

The list identifies the following items that can be decontaminated: non-electric wheelchairs, prosthetic limbs (w/o leather components), walkers, crutches (w/o foam cushions/parts), canes (w/o foam cushions/parts), eyeglasses, and prosthetic eyes.

Items that cannot be decontaminated, or that pose special challenges, include mechanical ventilators, electric wheelchairs, hearing aids, contact lenses, and any leather attachments/components of items.

For such items, discuss options with emergency responders and health officials.

84. What if my service animal is found to be contaminated?

If your service animal is known or suspected to be contaminated it will be decontaminated.

In 2006, the PETS Act (Pets Evacuation and Transportation Standards Act) was created to ensure that state and local emergency management partners address the specific needs of individuals with service animals. Provisions for decontamination of service animals are included in the law.

85. How are service animals decontaminated?

Most animals can be decontaminated by simply using a soap and water solution. For sensitive areas around the animal's eyes, nose, mouth, and in ears, where traditional washing methods may be more difficult, moist towelettes may be utilized.

In some situations, emergency responders may also place a muzzle on the animal to prevent it from licking or drinking contaminated water.

86. What should people do if they do not have access to their life-sustaining medications?

If you are in the affected area and your life is in danger because you are running out of life-sustaining medication, such as insulin or heart medicine, take the following steps to get medication:

- Call 911 if possible.
- Seek help from a neighbor.
- As a last resort, you can go to the closest medical facility.
- If you must go outside, remember to clean yourself thoroughly when you come back inside.
- Remove the outer layer of clothes, shower and wash with soap and warm water, and put on clean clothes.

87. I have been having radiation treatments for medical reasons. Should I stop my treatments because I might have been exposed to radiation from the emergency?

As a general rule, there is no reason for a radiation incident to cause people to stop or take a break from potentially life-saving medical treatments.

However, it is possible the dislocation or emotional stress from the incident could leave some people very tired and less able to deal with the side effects of medical radiation therapy.

If this is the case, you should discuss this with your doctor to jointly decide the best

course of action.

Special Issues and Concerns: Pets

88. If people have been told to stay inside and self-decontaminate during a radiation emergency, what should be done about pets? How do I decontaminate my pet?

If your pet was outside at the time of the incident, the pet can be brought inside and decontaminated.

Start by putting on waterproof gloves and a dust mask (or other material to cover your mouth).

Also, keep cuts and scrapes (yours and on your pet) covered to keep radioactive material out of any wounds.

Then wash your pet carefully in a shower or bath using shampoo or soap and water. Rinse the pet completely.

To make sure you have not picked up any contaminants, be sure to shower, and wash your hands and face, after you have washed the pet.

89. Is pet food safe for my pet?

As with other foods, sealed pet food is safe for animals to consume.

As with other foods, rinse or wipe off any debris from a closed can or package with tap water and put the washcloth in a plastic bag away from people and animals.

ED_001057_00008882

To: Wieder, Jessica[Wieder.Jessica@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
Cc: White, Rick[White.Rick@epa.gov]
From: Nesky, Anthony
Sent: Wed 2/24/2016 7:15:26 PM
Subject: Re: PAG Comm Plan
PAG Comms Plan draft 2-24-2016-jessfinal+tn.docx

Here is my markup. It looks great-there are only two little grammarly things, and one optional addition.

From: Wieder, Jessica
Sent: Wednesday, February 24, 2016 2:06 PM
To: DeCair, Sara
Cc: Nesky, Anthony; White, Rick
Subject: RE: PAG Comm Plan

Here is the final Comm Plan. It meets OAR Comm Standard format. I will incorporate your edits and Tony's edits to the Q&A as soon as I receive them

Jess

Jessica Wieder
U.S. EPA
Radiation Protection Program
Center for Radiation Information and Outreach
w: 202-343-9201
c: Ex. 6 - Personal Privacy

From: DeCair, Sara
Sent: Wednesday, February 24, 2016 1:55 PM
To: Wieder, Jessica
Subject: Re: Comm Plan

Gotcha -- I am reviewing QA s now Thx!!!

Sent from my iPhone

> On Feb 24, 2016, at 1:32 PM, Wieder, Jessica <Wieder.Jessica@epa.gov> wrote:
>
> Sara - After talking with OAR Comm, I am streamlining the Comm Plan (making it shorter) and will be integrating the desk statement where the key messages are as soon as I get them back from Tony.
>
> Jess
>
>
> Jessica Wieder
> U.S. EPA
> Radiation Protection Program
> Center for Radiation Information and Outreach
> w: 202-343-9201
> c: Ex. 6 - Personal Privacy

Conference of Radiation Control Program Directors, Inc.

Office of Executive Director ❖ 1030 Burlington Lane, Suite 4B ❖ Frankfort, KY 40601
Phone: 502/227-4543 ❖ Fax: 502/227-7862 ❖ Web Site: www.crcpd.org

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jared.thompson@arkansas.gov
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rmcburney@crcpd.org

July 25, 2016

Air and Radiation Docket and Information Center
Environmental Protection Agency
Mail Code 6102 T
Pennsylvania Ave
NW Washington DC, 20460

Attn: Docket ID No EPA-HQ-OAR2007-0268

The Conference of Radiation Control Program Directors, Inc. (CRCPD) is a professional organization dedicated to radiation protection. The mission of CRCPD is to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education. CRCPD's primary goal is to make sure radiation exposure to individuals is kept to the lowest practical level, while not restricting its beneficial uses. CRCPD's membership includes the directors and members of State radiation control programs across the nation as well as other individuals interested in radiation protection issues. Many of our member States have nuclear power plants within their jurisdictions, and many of them also have actual long-term contaminated site clean-up experience.

CRCPD believes the efforts of the EPA to revise the draft 2013 PAG Manual to provide additional guidance for drinking water Protective Action Guideline (PAG) is a positive and necessary step. The CRCPD previously commented on the draft 2013 PAG Manual in 2013 and in those comments we strongly encouraged the EPA to develop a drinking water PAG. In particular, we suggested a PAG of 500 mrem per year.

EPA states that the two tiered approach, 100 mrem projected dose in the first year for infants, children and pregnant or nursing women and 500 mrem projected dose in the first year for the general population, is consistent with other guidance developed for consideration during the intermediate phase of a radiological incident. The FDA PAGs for food are developed based on the application of the PAG limit to the most sensitive population and the most sensitive organ for the radionuclide of concern. At 500 mrem, this effectively makes the FDA PAG for food less conservative than the EPA's proposed drinking water PAG. This may cause public messaging issues and difficult questions to address from the public.

CRCPD appreciates the efforts of the EPA to provide clear and technically sound guidance in implementing the new drinking water PAG. In particular, recognizing that strontium, cesium and iodine can provide a quick screening tool for determining a default derived reference level (DRL) for drinking water concentrations is a useful technique. Also CRCPD agrees that the technical basis used for determining water PAGs is technically sound and conservative.

On a final note the CRCPD would like to recommend that the new EPA PAGs eventually be adopted as Presidential Guidance. As this will take additional time we also recommend that the new EPA PAGs are not held up while this Presidential Guidance is sought.

Thank you for considering these comments and requests. The CRCPD stands ready to assist our Federal partners and are available to provide additional details on any of these issues should you desire. I look forward to your response.

Sincerely,

Jared W. Thompson
Chairperson

Conference of Radiation Control Program Directors, Inc.
Office of Executive Director ❖ 1030 Burlington Lane, Suite 4B ❖ Frankfort, KY 40601
Phone: 502/227-4543 ❖ Fax: 502/227-7862 ❖ Web site: www.crcpd.org

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Desai, Lisa
Sent: Thur 7/28/2016 7:31:35 PM
Subject: FW: Drinking Water PAG Comments
Draft Comments on Drinking Water PAG.docx

Sara,

I have received the attached information and it has been reviewed by Asst Director Klinger. I understand the agency missed the deadline but Kay Foster indicated that you would still like for us to submit. I trust you will get it in the appropriate hands. Please find attached .

Should you have any questions please let me know.

Thanks in advance.

Lisa M. Desai, Office of the Director

Assistant to the Director

2200 South Dirksen Parkway

Springfield, Illinois 62703

Office: 217-557-6225

Fax: 217-524-7967

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hernandez-Quinones, Samuel[Hernandez.Samuel@epa.gov]; Amber Brewer[abrewer@endyna.com]; siddhanti@endyna.com[siddhanti@endyna.com]
From: Amy Doll
Sent: Mon 7/25/2016 8:53:07 PM
Subject: Water PAG Comment Matrix and Docket List (posted thru 7/20)
Water PAG Docket List_072016.xlsx
Water PAG_Comment Matrix_072516#2.xlsx

Hi Sara

Until late this afternoon, the docket had not posted any more comments since 7/20, when I sent the "docket list" last week (attached again). The attached Water PAG Comment Matrix Spreadsheet includes all those comments posted through 7/20, which as noted below in the docket list were in:

-- S category -- means "substantive" and those will be included in appropriate Tabs in the Comment Matrix Spreadsheet

-- G category -- means "general" and those will be included only in the General Tab in the Comment Matrix Spreadsheet

EnDyna anticipates that you might move some of those "substantive" comments into General Tab, but if there was any doubt we've put those "substantive" comments in the most relevant Tabs in the Comment Matrix Spreadsheet.

The docket posted only two more comments today (7/25), one of which from Food & Water Watch is "substantive" and the other is a request for extension from Sierra Club. EnDyna will begin including additional comments in the matrix tomorrow, as they get posted by the docket.

I will give you a call tomorrow, when you are back in office, to discuss version control and plan ahead.

Hope you had a good trip,

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: Amy Doll
Sent: Wednesday, July 20, 2016 3:05 PM
To: DeCair, Sara (DeCair.Sara@epa.gov) (DeCair.Sara@epa.gov)
Cc: Hernandez-Quinones, Samuel (Hernandez.Samuel@epa.gov); Amber Brewer; 'Smita Siddhanti (siddhanti@endyna.com)'
Subject: Water PAG Docket List (posted thru 7/20)

Hi Sara

The attached Water PAG Docket List will provide a "snapshot" of what has been posted in the Water PAG Docket through 7/20 (today).

At the top, I show the "categories" that EnDyna is using to track the comments, please note in particular:

-- S category -- means "substantive" and those will be included in appropriate Tabs in the

Comment Matrix Spreadsheet

-- G category -- means “general” and those will be included only in the General Tab in the Comment Matrix Spreadsheet

The others are: general opposition and not relevant to any tabs in the comment matrix (D category), and not relevant to Water PAG Docket (B category).

EnDyna will prioritize entering the “S category” comments into the Comment Matrix Spreadsheet by COB Monday.

Is there any decision yet about whether or not to extend the comment period?

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Mon 7/25/2016 6:45:43 PM
Subject: Supplemental OMB Comments on PAG Manual
EPA PAG Manual (Supplemental OMB Comments 07-25-16).docx

Glynis,

Attached please find additional comments from OMB on the PAG Manual. Almost all of these comments can be found in Section 5.2 but there are is a suggested edit earlier in the document as well. Please note that these comments were submitted to us by the National Security Council who, I understand, was heavily involved in the original drafting of Section 5.2 following Fukushima. Please address these comments together with the other comments you have received from OMB and interagency reviewers in your passback. You should now have all of our comments. I look forward to seeing EPA's passback.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Perrin, Alan
Sent: Fri 7/22/2016 7:17:28 PM
Subject: RE: OMB Comments on PAG Manual

Hmmm. Skimmed this and the manual comments. Ex. 5 - Deliberative Process
Ex. 5 - Deliberative Process

Alan Perrin, Deputy Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Friday, July 22, 2016 2:59 PM
To: Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: Fw: OMB Comments on PAG Manual

FYI, cmts on the FR. I have plenty to keep me busy for a few days!

S.

From: Dorjets, Vlad <Ex. 6 - Personal Privacy @omb.eop.gov>
Sent: Friday, July 22, 2016 12:55 PM
To: Hill, Glynis
Cc: DeCair, Sara
Subject: RE: OMB Comments on PAG Manual

Attached please find OMB's comments on the FRN.

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]

Sent: Thursday, July 21, 2016 12:14 PM
To: Dorjets, Vlad Ex. 6 - Personal Privacy @omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Vlad,

Thanks again; do you have an idea when we will receive the additional Section 5.2 and FRN comments?

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto: Ex. 6 - Personal Privacy @omb.eop.gov]
Sent: Thursday, July 21, 2016 12:09 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Glynis,

DOL/OSHA consulted with CDC/NIOSH about NIOSH's comment that workers who perform tasks in which they are expected to receive dose in excess of 5 rem should only undertake those activities voluntarily. The two agencies agreed that the language proposed by DOL on page 43 of their comments should take precedence over NIOSH's comments because it brings the document in line with other forthcoming federal guidance on radiation emergency response. I'll share your passback with CDC to confirm this matter but you should disregard their comment and refer to DOL's comments instead.

Also, DOL noticed that there was a typo in one of their comments. The suggested language included in the second comment on page 43 should read "complete a particular mission," not "complete a particular mention."

Vlad

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Wednesday, July 20, 2016 12:53 PM
To: Dorjets, Vlad <Ex. 6 - Personal Privacy @omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Thanks Vlad!!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto: Ex. 6 - Personal Privacy @omb.eop.gov]
Sent: Wednesday, July 20, 2016 12:16 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: OMB Comments on PAG Manual

Glynis,

Attached please find OMB's comments on EPA's draft final PAG Manual. Please note that we will have additional comments on Section 5.2 and on the FRN but did not want to delay getting you our other comments.

I have also attached comments we received from DOL. Due to an oversight, OMB failed to

include DOL on the original interagency distribution. Given their equity in this rule, OMB gave DOL some extra time to review the rulemakings documents and provide comments. Please review DOL's comments and address them in the passback as you would the comments OMB received from other interagency reviewers (shared with EPA earlier).

In regards to those comments from interagency reviewers, please note that OMB fully supports the comments made by NRC, DHS, and DOE. With respect to DHS comment, you will see recommended changes in the Manual suggesting that EPA use some of the language we agreed upon for the proposed water PAGs.

In regards to the comment we received from CDC/NIOSH, we are in the process of checking with DOL/OSHA to see if they support it. We defer to EPA (and FDA) on how to address the NIH comments. In regards to the FDA comments, OMB is particularly interested in EPA's response to the request that the document include references to other FDA-approved medical counter-measures since due to their potential use in mitigating effects associated with radiation emergencies (e.g. radioisotope de-corporation agents calcium-DTPA, zinc-DTPA, Prussian blue, leukocyte growth factors filgrastim and pegfilgrastim, etc.).

I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | Ex. 6 - Personal Privacy @omb.eop.gov

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Fri 7/22/2016 4:55:29 PM
Subject: RE: OMB Comments on PAG Manual
EPA PAG Manual FRN (OMB Comments 07-22-16).docx

Attached please find OMB's comments on the FRN.

From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Thursday, July 21, 2016 12:14 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

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Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, July 21, 2016 12:09 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

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From: Hill, Glynis [mailto:Hill.Glynis@epa.gov]
Sent: Wednesday, July 20, 2016 12:53 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: OMB Comments on PAG Manual

Thanks Vlad!!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Wednesday, July 20, 2016 12:16 PM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: OMB Comments on PAG Manual

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I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hooper, Charles A.
Sent: Thur 7/21/2016 2:29:33 PM
Subject: RE: PAG Manual Update

Good idea, I'll send a copy to George. I'm getting input from our R7 FEMA folks too before sending out to the larger group.

Btw, I think drinking water for special populations at 100 mrem is pretty solid. I can't imagine that we'd ever use it anyway with all the bottled water that's available.

Chuck Hooper, CHP

Radiation Safety Officer

EPA Region 7

11201 Renner Boulevard

Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

From: DeCair, Sara
Sent: Thursday, July 21, 2016 9:24 AM
To: Hooper, Charles A. <Hooper.CharlesA@epa.gov>
Subject: RE: PAG Manual Update

That is fab. I hope you'll share with other Regions to use, too, before or after you get the feedback on the note (it's always interesting to hear what questions people have…) I'm at HPS and got two Qs from HPS-ers about how I can live with how low the PAGs are. Typical!

From: Hooper, Charles A.
Sent: Thursday, July 21, 2016 10:14 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: PAG Manual Update

Sara; I'm planning on sending the following message out to our local Region 7 REP community and just wanted to make sure this sounds okay and is accurate. Thanks!

I just wanted to give everybody a status update on the long-awaited PAG Manual. As most folks know the Drinking Water portion of the PAG cleared OMB back in June which began a 45-day public comment period that will be ending on July 25th. I recently received a briefing from EPA's PAG coordinator in HQ, Sara DeCair. Pending any unforeseen issues and a timely OMB review of the response to comments on the Drinking Water proposal, the Drinking Water section will be inserted into the larger PAG Manual **and will likely be finalized this year**. Please understand that anything can happen at the end of an administration and things could get held up, but if this goes final as planned there will be a **one-year training and adoption period to allow emergency management officials to update their response plans**. Since the larger PAG Manual has been on hold for a while to work out the drinking water proposal I didn't want this to come as a complete surprise to our local REP community.

https://www.epa.gov/radiation/protective-action-guides-pags

From the EPA PAG website ("PAG Manual" tab):

In 2013, EPA sought public comment on a revision to the 1992 PAG manual, to update dose calculations based on current science. EPA believes that guidance based on the best available science can help local authorities save lives and minimize the impact of a radiological emergency.

EPA is assessing public comments received and ***plans to issue a final PAG Manual in 2016****. There will then be a* ***one-year training and adoption period to allow emergency management officials to update their response plans****.*

Significant changes from the 1992 PAG Manual include:

- *Applying the PAG Manual to incidents other than just nuclear power plant accidents.*
- *Referring users to current food guidance from the Food and Drug Administration (FDA).*
- *Providing guidance for potassium iodide (KI) based the latest FDA guidance.*
- *Providing basic planning guidance on reentry, cleanup and waste disposal.*
- *Incorporating late phase (cleanup) guidance from the Department of Homeland Security's Radiological Dispersal Device/Improvised Nuclear Device Planning Guidance.*
- *Incorporating the new Drinking Water PAG.*

The 2013 PAG Manual provides a list of considerations for planning and initiating a cleanup process as the emergency is brought under control. The PAG Manual does not set cleanup levels. One of the recommendations in the Manual is a community involvement process for setting cleanup levels.

From the EPA PAG website ("Drinking Water Proposal" tab):

EPA is proposing non-regulatory guidance that authorities can use to protect residents from experiencing the harmful effects from radiation in drinking water following an emergency. EPA is seeking public comment on the proposed drinking water Protective Action Guide (PAG) for Radiological Incidents for up to 45 days following publication in the Federal Register.

The proposed PAG does not affect EPA's drinking water standards for radionuclides.

Background

EPA is proposing a two-tiered approach for drinking water to address the people at the most sensitive life stage and to address the general population The tiered approach may help officials prioritize potentially scarce water resources for those most at risk in a disaster response.

The proposed PAGs are developed for up to one year of exposure. In comparison, the Maximum Contaminant Levels (MCL) were developed assuming 70 years of continuous exposure. The PAGs are intended to 1) prevent short-term health effects, 2) balance protection with other important factors that may arise during an emergency (ensuring the actions result in more benefit than harm), and 3) reduce the potential for longer term health effects. In considering these key principles, EPA is proposing drinking water PAGs of:

•500 mrem projected dose, for one year, to the general population.

•100 mrem projected dose, for one year, to the most sensitive populations (e.g. infants, children, pregnant women and nursing women).

Chuck Hooper, CHP

Radiation Safety Officer

EPA Region 7

11201 Renner Boulevard

Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hooper, Charles A.
Sent: Thur 7/21/2016 2:14:01 PM
Subject: PAG Manual Update

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https://www.epa.gov/radiation/protective-action-guides-pags

-

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Lenexa, Kansas 66219

(913) 551-7271 office

Hooper.CharlesA@epa.gov

To: Hill, Glynis[Hill.Glynis@epa.gov]
Cc: DeCair, Sara[DeCair.Sara@epa.gov]
From: Dorjets, Vlad
Sent: Wed 7/20/2016 4:15:52 PM
Subject: OMB Comments on PAG Manual
EPA PAG Manual (OMB Comments 07-20-16).docx
EPA PAG Manual (DOL Comments).docx

Glynis,

Attached please find OMB's comments on EPA's draft final PAG Manual. Please note that we will have additional comments on Section 5.2 and on the FRN but did not want to delay getting you our other comments.

I have also attached comments we received from DOL. Due to an oversight, OMB failed to include DOL on the original interagency distribution. Given their equity in this rule, OMB gave DOL some extra time to review the rulemakings documents and provide comments. Please review DOL's comments and address them in the passback as you would the comments OMB received from other interagency reviewers (shared with EPA earlier).

In regards to those comments from interagency reviewers, please note that OMB fully supports the comments made by NRC, DHS, and DOE. With respect to DHS comment, you will see recommended changes in the Manual suggesting that EPA use some of the language we agreed upon for the proposed water PAGs.

In regards to the comment we received from CDC/NIOSH, we are in the process of checking with DOL/OSHA to see if they support it. We defer to EPA (and FDA) on how to address the NIH comments. In regards to the FDA comments, OMB is particularly interested in EPA's response to the request that the document include references to other FDA-approved medical counter-measures since due to their potential use in mitigating effects associated with radiation emergencies (e.g. radioisotope de-corporation agents calcium-DTPA, zinc-DTPA, Prussian blue, leukocyte growth factors filgrastim and pegfilgrastim, etc.).

I'll get you the final comments as soon as possible. Please do not hesitate to let me know if you have any questions.

Vlad

Vlad Dorjets

Natural Resources and Environment Branch

Office of Information and Regulatory Affairs

White House Office of Management and Budget

(202) 395-7315 | vdorjets@omb.eop.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Kraus, Terrence D[tdkraus@sandia.gov]; Hunt, Brian[bhunt@sandia.gov]
From: Kraus, Terrence D
Sent: Fri 7/15/2016 12:44:48 PM
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

Sara,

If you are in the office today, please give me a call.

No hurries; we can also talk next week.

Ex. 5 - Deliberative Process

We have been holding off to see if the Water DRL method is approved and then once it is approved we planned to get our software team working to implement the method this FYI.

We are hesitant to start the software team working until we are confident of the form of the final method.

I wanted to get you thoughts on what you think is the appropriate course of action.

I'm thinking the proposed Water DRL that we have seen is very likely going to be the final, approved method.

If this is the case, we can try to get with our software team to start implementing the method before we run out of time this FY.

Let's talk when you get a chance.

Have a great weekend.

Terry Kraus, CHP

Nuclear Incident Response Programs

Sandia National Laboratories

(505) 284-9708

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 3:11 PM
To: Kraus, Terrence D
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

I thought it would be fun to discuss :D **Ex. 6 - Personal Privacy**
Ex. 6 - Personal Privacy

I'm off tomorrow but if I do come in, shall I call you?

From: Kraus, Terrence D [mailto:tdkraus@sandia.gov]
Sent: Thursday, July 14, 2016 5:00 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

Hi Sara,

Sorry to cause you trouble, but that was my comment which was submitted through Dan Blumenthal.

I think your proposed revision will help clarify and minimize my concerns, so I would be happy with the proposed revision.

Will you be in the office on Friday 7/15?

Thank you.

Terry Kraus, CHP

Nuclear Incident Response Programs

Sandia National Laboratories

(505) 284-9708

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 12:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.mackinney@dhs.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; michael.howe@fema.dhs.gov; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; paul.ward@fema.dhs.gov; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; Kraus, Terrence D; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
Subject: [EXTERNAL] Interesting PAG question: 'except nuclear war'

PAG Subcommittee;

Hopefully you've had a chance to provide input on the PAG Manual (the rest of the Manual,

minus drinking water which is out for comment) which is in OMB review now. An interesting suggestion came up and I wanted to find out if anyone has strong feelings about the caveat, or knowledge of why it's there.

The PAG Manual states, "This Manual provides radiological protection criteria for application to all incidents that would require consideration of protective actions, with the exception of nuclear war."

Ex. 5 - Deliberative Process

Recommend adding a sentence similar to, "The PAGs in this Manual may not be appropriate for protecting the public following a nuclear detonation because of the magnitude of the impacts. EPA will work with decision-makers on a case-by-case basis to develop appropriate PAGs following a nuclear detonation."

I might suggest just cutting 'with the exception of nuclear war' and/or adding only the first of two sentences suggested above. This echoes the point that separate guidance for INDs is available, and that in addition to military actions in the case of war, PAGs might indeed be used to inform protective actions. As always, I'm open to suggestions here and the no-action path would be to just leave the language how it is.

Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Kraus, Terrence D
Sent: Thur 7/14/2016 9:00:10 PM
Subject: RE: [EXTERNAL] Interesting PAG question: 'except nuclear war'

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202-343-9108

Room 1416 B in WJC West

To: 'Howe, Michael'[Michael.Howe@fema.dhs.gov]; MacKinney, John A[john.mackinney@HQ.DHS.GOV]; DeCair, Sara[DeCair.Sara@epa.gov]; Amy Doll[adoll@endyna.com]; Andrew.Wallo@eh.doe.gov[Andrew.Wallo@eh.doe.gov]; ben.cacioppo@dtra.mil[ben.cacioppo@dtra.mil]; derek.favret@hq.doe.gov[derek.favret@hq.doe.gov]; Edward.Regnier@hq.doe.gov[Edward.Regnier@hq.doe.gov]; John.Jensen@dm.usda.gov[John.Jensen@dm.usda.gov]; john.madrid@dtra.mil[john.madrid@dtra.mil]; lee.a.nickel1@navy.mil[lee.a.nickel1@navy.mil]; lodwick.jeffrey@dol.gov[lodwick.jeffrey@dol.gov]; Noska, Michael A (FDA/OC)[Michael.Noska@fda.hhs.gov]; Patricia.Milligan@nrc.gov[Patricia.Milligan@nrc.gov]; Ward, Paul[Paul.Ward@fema.dhs.gov]; ricardo.a.reyes@us.army.mil[ricardo.a.reyes@us.army.mil]; siddhanti@endyna.com[siddhanti@endyna.com]; tdkraus@sandia.gov[tdkraus@sandia.gov]; Veal, Lee[Veal.Lee@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; william.cunningham@nist.gov[william.cunningham@nist.gov]
From: Ansari, Armin (CDC/ONDIEH/NCEH)
Sent: Thur 7/14/2016 8:52:19 PM
Subject: RE: Interesting PAG question: 'except nuclear war'

Hi everybody,

I too think deleting the sentence is the better option to avoid confusion.

I think Andy's assessment is correct that the sentence was there to address DoD issues. But deleting the sentence doesn't harm that. DoD still has the authority to do what they need to do in any area they designate as National Defense Area (NDA). This is obviously not my area of expertise, but I think the concept of NDA is still applicable, not just to nuclear war but also to IND incident:

"E2.1.20. National Defense Area (NDA). An area established on non-Federal lands located within the United States, its possessions or territories for safeguarding classified defense information or protecting DoD equipment and/or material. Establishment of an NDA temporarily places such non-Federal lands under the effective control of the Department of Defense and results only from an emergency event. The OSC or DSR at the scene shall define the boundary, mark it with a physical barrier, and post warning signs. The landowner's consent and cooperation shall be obtained whenever possible; however, military necessity will dictate the final decision regarding location, shape, and size of the NDA."

Above definition comes from this document

http://www.au.af.mil/au/awc/awcgate/dod/d523016p.pdf

Armin

From: Howe, Michael [mailto:Michael.Howe@fema.dhs.gov]
Sent: Thursday, July 14, 2016 3:13 PM
To: MacKinney, John A <john.mackinney@HQ.DHS.GOV>; DeCair, Sara <DeCair.Sara@epa.gov>; Amy Doll <adoll@endyna.com>; Andrew.Wallo@eh.doe.gov; Ansari, Armin (CDC/ONDIEH/NCEH) <asa4@cdc.gov>; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Noska, Michael A (FDA/OC) <Michael.Noska@fda.hhs.gov>; Patricia.Milligan@nrc.gov; Ward, Paul <Paul.Ward@fema.dhs.gov>; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee <Veal.Lee@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; william.cunningham@nist.gov
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The course of action will be the same whether the wording stays or goes. Delete the phrase if it helps avoid confusion.

Michael Howe

M. F. Howe, MS CHP

Health Physicist

Radiological Emergency Preparedness Program

Technological Hazards Division

FEMA/DHS

michael.howe@fema.dhs.gov

202 306 5750 (cell)

From: MacKinney, John A
Sent: Thursday, July 14, 2016 2:33 PM
To: DeCair, Sara; Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
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I recommend deleting the phrase. It is an historic carve out from another circumstance. Truth is, we would use the PAGs in the downwind areas where implementation is feasible. Also, war is no longer defined as all out nuclear holocaust the way we saw it 20+ years ago. It could be limited. The only question about the use of PAGs following a nuclear strike, whether one or multiple, is feasibility of implementation.

John MacKinney

Director, Nuclear and Radiological Policy

US Department of Homeland Security

(202) 254-6030

SIPR john.mackinney@dhs.sgov.gov

JWICS jamackinney@dhs.ic.gov

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To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; MacKinney, John A; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
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The PAG Manual states, "This Manual provides radiological protection criteria for application to all incidents that would require consideration of protective actions, with the exception of nuclear war."

Comment: In the absence of EPA guidance specific to "nuclear war" it is likely that the PAGs in this Manual would be implemented because there is no other guidance. Recommend adding a sentence similar to, "The PAGs in this Manual may not be appropriate for protecting the public following a nuclear detonation because of the magnitude of the impacts. EPA will work with decision-makers on a case-by-case basis to develop appropriate PAGs following a nuclear detonation."

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To: MacKinney, John A[john.mackinney@HQ.DHS.GOV]; DeCair, Sara[DeCair.Sara@epa.gov]; Amy Doll[adoll@endyna.com]; Andrew.Wallo@eh.doe.gov[Andrew.Wallo@eh.doe.gov]; asa4@cdc.gov[asa4@cdc.gov]; ben.cacioppo@dtra.mil[ben.cacioppo@dtra.mil]; derek.favret@hq.doe.gov[derek.favret@hq.doe.gov]; Edward.Regnier@hq.doe.gov[Edward.Regnier@hq.doe.gov]; John.Jensen@dm.usda.gov[John.Jensen@dm.usda.gov]; john.madrid@dtra.mil[john.madrid@dtra.mil]; lee.a.nickel1@navy.mil[lee.a.nickel1@navy.mil]; lodwick.jeffrey@dol.gov[lodwick.jeffrey@dol.gov]; Michael.Noska@fda.hhs.gov[Michael.Noska@fda.hhs.gov]; Patricia.Milligan@nrc.gov[Patricia.Milligan@nrc.gov]; Ward, Paul[Paul.Ward@fema.dhs.gov]; ricardo.a.reyes@us.army.mil[ricardo.a.reyes@us.army.mil]; siddhanti@endyna.com[siddhanti@endyna.com]; tdkraus@sandia.gov[tdkraus@sandia.gov]; Veal, Lee[Veal.Lee@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; william.cunningham@nist.gov[william.cunningham@nist.gov]
From: Howe, Michael
Sent: Thur 7/14/2016 7:13:08 PM
Subject: RE: Interesting PAG question: 'except nuclear war'

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SIPR john.mackinney@dhs.sgov.gov

JWICS jamackinney@dhs.ic.gov

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 2:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; MacKinney, John A; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
Subject: Interesting PAG question: 'except nuclear war'

PAG Subcommittee;

Hopefully you've had a chance to provide input on the PAG Manual (the rest of the Manual, minus drinking water which is out for comment) which is in OMB review now. An interesting suggestion came up and I wanted to find out if anyone has strong feelings about the caveat, or knowledge of why it's there.

The PAG Manual states, "This Manual provides radiological protection criteria for application to all incidents that would require consideration of protective actions, with the exception of nuclear war."

Comment: In the absence of EPA guidance specific to "nuclear war" it is likely that the PAGs in this Manual would be implemented because there is no other guidance. Recommend adding a sentence similar to, "The PAGs in this Manual may not be appropriate for protecting the public following a nuclear detonation because of the magnitude of the impacts. EPA will work with decision-makers on a case-by-case basis to develop appropriate PAGs following a nuclear detonation."

I might suggest just cutting 'with the exception of nuclear war' and/or adding only the first of two sentences suggested above. This echoes the point that separate guidance for INDs is available, and that in addition to military actions in the case of war, PAGs might indeed be used to inform protective actions. As always, I'm open to suggestions here and the no-action path would be to just leave the language how it is.

Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: MacKinney, John A[john.mackinney@HQ.DHS.GOV]; DeCair, Sara[DeCair.Sara@epa.gov]; Amy Doll[adoll@endyna.com]; asa4@cdc.gov[asa4@cdc.gov]; ben.cacioppo@dtra.mil[ben.cacioppo@dtra.mil]; Favret, Derek[Derek.Favret@Hq.Doe.Gov]; Regnier, Edward[Edward.Regnier@hq.doe.gov]; John.Jensen@dm.usda.gov[John.Jensen@dm.usda.gov]; john.madrid@dtra.mil[john.madrid@dtra.mil]; lee.a.nickel1@navy.mil[lee.a.nickel1@navy.mil]; lodwick.jeffrey@dol.gov[lodwick.jeffrey@dol.gov]; Howe, Michael[Michael.Howe@fema.dhs.gov]; Michael.Noska@fda.hhs.gov[Michael.Noska@fda.hhs.gov]; Patricia.Milligan@nrc.gov[Patricia.Milligan@nrc.gov]; Ward, Paul[Paul.Ward@fema.dhs.gov]; ricardo.a.reyes@us.army.mil[ricardo.a.reyes@us.army.mil]; siddhanti@endyna.com[siddhanti@endyna.com]; tdkraus@sandia.gov[tdkraus@sandia.gov]; Veal, Lee[Veal.Lee@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; william.cunningham@nist.gov[william.cunningham@nist.gov]
From: Wallo, Andrew
Sent: Thur 7/14/2016 7:05:55 PM
Subject: RE: Interesting PAG question: 'except nuclear war'

While I generally agree with John's suggestion that if feasible the PAGs would be used, I have a vague recollection this may be a DOD issue, they had their own wartime criteria and wanted it clear they would not be obligated to use the PAGs. Wjho would be in charge in a war? Would we be under marshal law? But that was a longtime ago I could be wrong or DOD may have different perspectives.

Andy

From: MacKinney, John A [mailto:john.mackinney@HQ.DHS.GOV]
Sent: Thursday, July 14, 2016 2:33 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>; Amy Doll <adoll@endyna.com>; Wallo, Andrew <Andrew.Wallo@hq.doe.gov>; asa4@cdc.gov; ben.cacioppo@dtra.mil; Favret, Derek <Derek.Favret@Hq.Doe.Gov>; Regnier, Edward <Edward.Regnier@hq.doe.gov>; John.Jensen@dm.usda.gov; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael <Michael.Howe@fema.dhs.gov>; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul <Paul.Ward@fema.dhs.gov>; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee <Veal.Lee@epa.gov>; Wieder, Jessica <Wieder.Jessica@epa.gov>; william.cunningham@nist.gov
Subject: RE: Interesting PAG question: 'except nuclear war'

I recommend deleting the phrase. It is an historic carve out from another circumstance. Truth is, we would use the PAGs in the downwind areas where implementation is feasible. Also, war is no longer defined as all out nuclear holocaust the way we saw it 20+ years ago. It could be limited. The only question about the use of PAGs following a nuclear strike, whether one or multiple, is feasibility of implementation.

John MacKinney

Director, Nuclear and Radiological Policy

US Department of Homeland Security

(202) 254-6030

SIPR john.mackinney@dhs.sgov.gov

JWICS jamackinney@dhs.ic.gov

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 2:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; MacKinney, John A; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
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Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]; Amy Doll[adoll@endyna.com]; Andrew.Wallo@eh.doe.gov[Andrew.Wallo@eh.doe.gov]; asa4@cdc.gov[asa4@cdc.gov]; ben.cacioppo@dtra.mil[ben.cacioppo@dtra.mil]; derek.favret@hq.doe.gov[derek.favret@hq.doe.gov]; Edward.Regnier@hq.doe.gov[Edward.Regnier@hq.doe.gov]; John.Jensen@dm.usda.gov[John.Jensen@dm.usda.gov]; john.madrid@dtra.mil[john.madrid@dtra.mil]; lee.a.nickel1@navy.mil[lee.a.nickel1@navy.mil]; lodwick.jeffrey@dol.gov[lodwick.jeffrey@dol.gov]; Howe, Michael[Michael.Howe@fema.dhs.gov]; Michael.Noska@fda.hhs.gov[Michael.Noska@fda.hhs.gov]; Patricia.Milligan@nrc.gov[Patricia.Milligan@nrc.gov]; Ward, Paul[Paul.Ward@fema.dhs.gov]; ricardo.a.reyes@us.army.mil[ricardo.a.reyes@us.army.mil]; siddhanti@endyna.com[siddhanti@endyna.com]; tdkraus@sandia.gov[tdkraus@sandia.gov]; Veal, Lee[Veal.Lee@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; william.cunningham@nist.gov[william.cunningham@nist.gov]
From: MacKinney, John A
Sent: Thur 7/14/2016 6:33:08 PM
Subject: RE: Interesting PAG question: 'except nuclear war'

I recommend deleting the phrase. It is an historic carve out from another circumstance. Truth is, we would use the PAGs in the downwind areas where implementation is feasible. Also, war is no longer defined as all out nuclear holocaust the way we saw it 20+ years ago. It could be limited. The only question about the use of PAGs following a nuclear strike, whether one or multiple, is feasibility of implementation.

John MacKinney

Director, Nuclear and Radiological Policy

US Department of Homeland Security

(202) 254-6030

SIPR john.mackinney@dhs.sgov.gov

JWICS jamackinney@dhs.ic.gov

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, July 14, 2016 2:24 PM
To: Amy Doll; Andrew.Wallo@eh.doe.gov; asa4@cdc.gov; ben.cacioppo@dtra.mil; derek.favret@hq.doe.gov; Edward.Regnier@hq.doe.gov; John.Jensen@dm.usda.gov; MacKinney, John A; john.madrid@dtra.mil; lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; Howe, Michael; Michael.Noska@fda.hhs.gov; Patricia.Milligan@nrc.gov; Ward, Paul; ricardo.a.reyes@us.army.mil; siddhanti@endyna.com; tdkraus@sandia.gov; Veal, Lee; Wieder, Jessica; william.cunningham@nist.gov
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Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: siddhanti@endyna.com[siddhanti@endyna.com]
From: Amy Doll
Sent: Fri 7/8/2016 3:19:56 PM
Subject: RE: Mockup of Water PAG comment spreadsheet/matrix
Water PAG docket_export 070816ad.pdf

Great! Attached is a snapshot of what was posted in the Water PAG docket through yesterday.

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Friday, July 08, 2016 10:54 AM
To: Amy Doll
Subject: RE: Mockup of Water PAG comment spreadsheet/matrix

Amy, I think we're in good shape to go into Monday's call. Thank you and have a good weekend!

From: Amy Doll [mailto:adoll@endyna.com]
Sent: Friday, July 08, 2016 10:23 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: siddhanti@endyna.com
Subject: FW: Mockup of Water PAG comment spreadsheet/matrix

Hi Sara

Just checking whether there is anything we need to discuss about the mockup before the 11am

call you scheduled for Monday with OW staff?

After we get any feedback/comments on the draft mockup of the comment spreadsheet/matrix, EnDyna could begin reviewing the Water PAG comments.

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

From: Amy Doll
Sent: Thursday, June 23, 2016 2:24 PM
To: DeCair, Sara (DeCair.Sara@epa.gov) (DeCair.Sara@epa.gov)
Cc: 'Smita Siddhanti (siddhanti@endyna.com)'
Subject: Mockup of Water PAG comment spreadsheet/matrix

Hi Sara

Attached is a draft mockup of the comment spreadsheet/matrix to get the thinking/discussion process started for how to organize the Water PAG comments.

- The yellow tabs relate to the specific questions in the FR notice (where a specific section of Water PAG document also seemed related, I've noted that)

- The blue tabs relate to other info in the FR notice that I thought commenters might comment on.

- The green tabs relate to comments on "EPA Draft Protective Action Guide (PAG) for Drinking Water" document

One question that I have is – what is the difference between "the guidance for advance planning" in the first question in the FR notice (which in reading the Water PAG document, I interpreted to be related to most of Section 6) and the final question in the FR notice (which I interpreted as a more general/broad question about the whole Water PAG document)?

Please let me know if you have any questions, or if you want any revisions to the spreadsheet/matrix prior the proposed conference call next week.

Finally, of the comments currently posted in your docket, the substantive ones are #214, #218, #226, and #229. Two of those (#214, #218) mention BIER VII a part of their rationale and that's why I thought they should be considered substantive instead of general opposition – it might be worth talking to the EPA/OW staffers about how any comments referencing BIER VII should be handled.

The remainder of comments currently posted in the docket are either general opposition to Water PAG (16 total) or simply general comments about radiation and/or cancer, etc. (3 total).

Thanks,

Amy

Amy Doll

Senior Associate

EnDyna, Inc.
7926 Jones Branch Drive, Suite 620
McLean, VA 22102

adoll@endyna.com
Tel: 703-848-8842 ext. 111

To: DeCair, Sara[DeCair.Sara@epa.gov]
Cc: Hill, Glynis[Hill.Glynis@epa.gov]
From: Dorjets, Vlad
Sent: Tue 6/14/2016 7:31:13 PM
Subject: RE: Any news from interagency on PAG Manual review?
EPA PAG Manual (DOE Comments).docx
EPA PAG Manual (HHS-CDC Comments).docx
EPA PAG Manual (HHS-FDA Comments).docx
EPA PAG Manual (HHS-NIH Comments).docx
EPA PAG Manual (NRC Comments).docx

Sara,

Attached please find comments from DOE, DHS (CDC, FDA, and NIH) and NRC. OMB comments are still forthcoming. Once I have finished those comments we can discuss next steps but, in the meantime, you may want to look through these to see what Agencies are saying.

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Tuesday, June 14, 2016 3:09 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Re: Any news from interagency on PAG Manual review?

Vlad,

It would be very helpful to have some of the feedback sooner to get a start on digesting it, with the knowledge that there is more coming. I appreciate the idea!

Let me know if there is anything I can do to be helpful.

Sara

From: Dorjets, Vlad [Ex. 6 - Personal Privacy]@omb.eop.gov>
Sent: Tuesday, June 14, 2016 3:03 PM
To: DeCair, Sara
Cc: Hill, Glynis
Subject: RE: Any news from interagency on PAG Manual review?

Sara,

Thanks for checking in. Comments were due at the end of last week and I am currently working through them and finalizing OMB's comments. So you know, I received substantive comments from DOE, NRC and HHS. What I can do is send you those comments as-is so that you can start reviewing them and then send you OMB's comments (which may include some of the comments received from other agencies) once they're ready.

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Tuesday, June 14, 2016 2:59 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Any news from interagency on PAG Manual review?

Vlad,

I'm just wondering if there is any update on the interagency review of the PAG Manual. I think it's been a couple weeks and I am hopeful that you're getting some good input. My management would love to have any hints on where it stands and when to expect feedback that we can work on. Thanks so much!

Sara

202-343-9108

To: Brozowski, George[brozowski.george@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
From: Ferguson, Rafaela
Sent: Mon 6/13/2016 4:32:16 PM
Subject: RE: Handling Press Response Regarding New Water PAG

George,

Looks fine to me. Thanks for sending it out to the regions.

Rafie

From: Brozowski, George
Sent: Wednesday, June 08, 2016 10:14 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>; Ferguson, Rafaela <Ferguson.Rafaela@epa.gov>
Subject: Handling Press Response Regarding New Water PAG

Good evening ladies and I got an email from a reporter from the Santa Fe New Mexican regarding the new water PAGs. I got in touch with Tony Nesky and let me know what you think on the following to go out to the regions:

The Office of Water is the lead office for the new water PAGs. Reporters should go through your regional press office or HQ Press Office and they can arrange a discussion with a senior drinking water official.

The HQ Press Office Contact for drinking water issues is Julia Valentine:

Desk: (202) 564-2663

Cell: (202) 740-1336

valentine.julia@epa.gov

George P. Brozowski

Regional Health Physicist/Radon Coordinator

US EPA – R6

1445 Ross Avenue

Mail Stop - 6MM-XU

Dallas, TX 75202

214-665-8541 o

214-755-1530 c

To: DeCair, Sara[DeCair.Sara@epa.gov]; Nesky, Anthony[Nesky.Tony@epa.gov]
From: Perrin, Alan
Sent: Fri 6/10/2016 7:17:51 PM
Subject: RE: Water PAG rollout - contacts we need to make

Done, done and done. Mr. White sent out emails earlier this week. I'll forward what went out to you.

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: DeCair, Sara
Sent: Friday, June 10, 2016 3:06 PM
To: Perrin, Alan <Perrin.Alan@epa.gov>; Nesky, Anthony <Nesky.Tony@epa.gov>
Subject: Water PAG rollout - contacts we need to make

According to the attached Rollout plan, we are to make contact with the Nuclear Energy Institute, Committee to Bridge the Gap, and the National Alliance for Radiation Readiness.

It might be simplest if we have Alan place phone calls to key people at each of these orgs on Monday. Or we can do an email with the Regs.gov link:

https://www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2007-0268-0210

What is your preference? I can supply contact information for all of these. Meantime, today I'm sending the link above to key people in HPS, FRMAC, A Team, the PAG Subcommittee and encouraging them to share so we get plenty of input.

Thanks!

Sara

From: Wadlington, Christina
Sent: Monday, June 06, 2016 7:46 AM
To: Nesky, Anthony <Nesky.Tony@epa.gov>; Ellis, Jerry <Ellis.Jerry@epa.gov>; Hernandez-Quinones, Samuel <Hernandez.Samuel@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: RE: PAG Webpages Ready for Your Review--the words "trigger level" have been replaced.

Anthony,

I apologize, but I don't think you were provided with the OPA approved language for the PAGS release.

It might be easier if we set up a quick meeting to chat?

Christina Wadlington

Communications Director

Office of Ground Water and Drinking Water

U.S. Environmental Protection Agency

Tel: 202.566.1859

Email: wadlington.christina@epa.gov

From: Nesky, Anthony
Sent: Friday, June 03, 2016 8:44 PM
To: Ellis, Jerry <Ellis.Jerry@epa.gov>; Wadlington, Christina <Wadlington.Christina@epa.gov>; Hernandez-Quinones, Samuel

<Hernandez.Samuel@epa.gov>; DeCair, Sara <DeCair.Sara@epa.gov>
Cc: White, Rick <White.Rick@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: PAG Webpages Ready for Your Review--the words "trigger level" have been replaced.

Dear Christina, Jerry, Sam and Sara:

The webpage language for the proposed drinking water is ready for your review. Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

Ex. 5 - Deliberative Process

All changes are highlighted on the web page so that you can find them easily. Links are below. You will need to log-in with your LAN ID and password to view them. Lately there have been some problems with the Drupal system. If you get a "page not found" error, you will need to log into Drupal first. If you don't have access to Drupal, I can come over there and log in for you.

-

PAG Webpage:

https://wcms.epa.gov/node/150755/revisions/380891/view

-

Fact Sheet:

https://wcms.epa.gov/radiation/fact-sheet-proposed-drinking-water-protective-action-guide-pag-radiological-emergencies

-

Fact Sheet for Public Water Systems

https://wcms.epa.gov/radiation/proposed-epa-drinking-water-protective-action-guide-pag-radiological-emergencies

-

Please let me know ASAP if you approve these changes or if you need any edits. Please call me if you have questions or need help with Drupal.

Tony Nesky

Center for Radiation Information and Outreach

Tel: 202-343-9597

nesky.tony@epa.gov

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hill, Glynis
Sent: Mon 5/23/2016 3:30:30 PM
Subject: RE: full PAG Manual

It just means its out…the agencies will then contact OMB for meetings if they want a 12866 meeting

---

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Monday, May 23, 2016 10:15 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Cc: Veal, Lee <Veal.Lee@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>
Subject: OMB: full PAG Manual

Link below is the full Manual, rec'd on 5/19. The link doesn't tell us much about the Interagency review. I can ask Trish at NRC if they've seen it go out from Vlad.

S.

From: Hill, Glynis
Sent: Monday, May 23, 2016 10:00 AM
To: DeCair, Sara
Subject: RE: Briefing on full PAG Manual

http://www.reginfo.gov/public/do/eoDetails?rrid=126354 This is the link to the document that appears; however Im not sure if this the DW one or the Full Manual.

Pending EO 12866 Regulatory Review - reginfo.gov

www.reginfo.gov

RIN: 2060-ZA19 View EO 12866 Meetings: Received Date: 05/19/2016 Title: Protective Action Guidance for Radiological ...

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: DeCair, Sara
Sent: Monday, May 23, 2016 9:52 AM
To: Hill, Glynis <Hill.Glynis@epa.gov>
Subject: Re: Briefing on full PAG Manual

Help? I'm not sure where to look.

From: Hill, Glynis
Sent: Monday, May 23, 2016 9:48 AM
To: Veal, Lee; DeCair, Sara
Cc: Perrin, Alan
Subject: RE: Briefing on full PAG Manual

You can check the OMB website to see if the documents were sent out to Federal agencies.

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Veal, Lee

Sent: Monday, May 23, 2016 9:37 AM
To: DeCair, Sara <DeCair.Sara@epa.gov>; Hill, Glynis <Hill.Glynis@epa.gov>
Cc: Perrin, Alan <Perrin.Alan@epa.gov>
Subject: RE: Briefing on full PAG Manual

Good morning,

Do we know if OMB got the PAGs out to the interagency last week? I think that Vlad might have been shooting for that given his training this week.

Lee

Lee Ann B. Veal

Acting Deputy Director, Radiation Protection Division

Office of Radiation and Indoor Air

Office: 202-343-9448; Cell: 202-617-4322

www.epa.gov/radiation

From: DeCair, Sara
Sent: Thursday, May 19, 2016 5:03 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

That seems odd, here is a copy.

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 4:51 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>

Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

It doesn't look like the FRN was uploaded to ROCIS.

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 4:30 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Vlad, here is a brief summary:

To the extent possible, we (the PAGs Subcommittee of the FRPCC) addressed comments by adding clarifications while keeping most of the Manual the same. The biggest change from 2013 would be the addition of drinking water guidance, but that is just a placeholder in this version.

Other notable additions are language on the Basis for Early Phase PAGs and Basis for Intermediate Phase PAGs. This language is excerpted from the 1992 PAG Manual appendices, at the request of commenters. We added explanations of why we did away with the thyroid-based evacuation footnote and the 50-year Relocation PAG in the 2013 revision, for transparency.

To help address questions about how protective the PAGs are in general, and of young children in particular, we added more information about the conservatism built into the setting and the implementation of the PAGs. Then in the sections on long term remediation and waste management, we made no wording changes since these parts we negotiated at the Deputy Secretary level, and we didn't get many specific comments on those parts at all.

Lastly, we made many editorial and cosmetic improvements, including adjusting section and chapter divisions to improve readability. I will emphasize, though, that the PAGs themselves

didn't change from the 2013 revision. You'll see we also discuss what we heard in the public comments within the FR Notice, too.

Thanks,

Sara

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 3:10 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual
Importance: High

Sara,

I confirm receipt of the draft PAG Manal. I want to send it out interagency reviewers but thought it would be helpful if I could focus their attention on specific chapters or sections that may have changed significantly relative to the proposed version. I know that you will brief us on the manual in greater detail in a couple weeks but are there any bullets that you think would benefit reviewers?

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 2:21 PM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Vlad,

No worries. We have availability between 8:30 and 11:00 am, or between 3:30 and 5:30 pm on Tuesday, May 31st. Just let us know,

Sara

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Thursday, May 19, 2016 12:13 PM
To: DeCair, Sara <DeCair.Sara@epa.gov>
Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: RE: Briefing on full PAG Manual

Sara,

Thanks for agreeing to provide a briefing. I imagine that it would not only be very informative but also yield a much more efficient review. Unfortunately, I'll be out of town on training all of next week (an EPA NPDES Permit Writing Workshop) so would prefer to push the briefing to the following week. Could you let me know if any days and times work that week?

Thanks,

Vlad

From: DeCair, Sara [mailto:DeCair.Sara@epa.gov]
Sent: Thursday, May 19, 2016 11:48 AM
To: Dorjets, Vlad <Vladik_Dorjets@omb.eop.gov>

Cc: Hill, Glynis <Hill.Glynis@epa.gov>; Perrin, Alan <Perrin.Alan@epa.gov>; Veal, Lee <Veal.Lee@epa.gov>
Subject: Briefing on full PAG Manual

Vlad,

Glynis tells me that you'd like a briefing on the full PAG Manual, since you weren't involved with the process of getting it out for comment in 2013. We would suggest a phone briefing where I can walk through the changes we made based on public comments, and show you how much of the Manual has stayed the same. It can be organized as a front to back walk through of the chapters as we have them laid out now.

I can set up a conference line for us once you let us know which of the dates/times here might work best. I anticipate that my Division Director, Alan, and also Glynis would want to participate as well. Will you let me know if any of the times below would work for you? Thank you!

May 24th, Tuesday: 9 am, 10 am or 4 pm.

May 25th, Wednesday: 8 or 9 am.

May 26th, Thursday: 4 pm.

Sara D. DeCair

>>>http://www.epa.gov/radiation/rert/pags.html<<<;;

202-343-9108

Room 1416 B in WJC West

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hill, Glynis
Sent: Wed 5/18/2016 8:34:18 PM
Subject: FW: OMB Review Concluded of Drinking Water PAG

FYI, just received the email below!

Glynis Hill – Environmental Scientist | Office of the Administrator | Office of Policy | Office of Regulatory Policy & Management

(202) 564-1139 | 3512V WJC North | Mail Code 1803 | 1200 Pennsylvania Avenue, NW | Washington, DC 20460

From: Dorjets, Vlad [mailto:Vladik_Dorjets@omb.eop.gov]
Sent: Wednesday, May 18, 2016 4:33 PM
To: Grevatt, Peter <Grevatt.Peter@epa.gov>
Cc: Christ, Lisa <Christ.Lisa@epa.gov>; Greene, Ashley <Greene.Ashley@epa.gov>; Burneson, Eric <Burneson.Eric@epa.gov>; Hill, Glynis <Hill.Glynis@epa.gov>; Owens, Nicole <Owens.Nicole@epa.gov>
Subject: OMB Review Concluded of Drinking Water PAG

Peter,

OMB has just concluded its review of the proposed Drinking Water PAGs. Big thanks to you and your staff for addressing the comments submitted by OMB and interagency reviewers.

Vlad

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Perrin, Alan
Sent: Fri 5/6/2016 2:05:06 PM
Subject: FW: OMB Comments on DW PAG Passback
EPA Drinking Water PAG FR Notice (OMB Comments 05-04-16).docx
ATT00001.htm
EPA Drinking Water PAG (OMB Comments 05-04-16).docx
ATT00002.htm

FYI

~~~~~~~~~~~~~~~

Alan Perrin, Acting Director
Radiation Protection Division, USEPA
ofc (202) 343-9775 | mbl (202) 279-0376

From: Edwards, Jonathan
Sent: Friday, May 06, 2016 7:25 AM
To: Perrin, Alan <Perrin.Alan@epa.gov>
Subject: Fw: OMB Comments on DW PAG Passback

With attachments. --Jon

From: Burneson, Eric
Sent: Thursday, May 5, 2016 5:36 PM
To: Edwards, Jonathan
Cc: Christ, Lisa; Hernandez-Quinones, Samuel
Subject: FW: OMB Comments on DW PAG Passback

Jonathon:

Just a heads up that folks here have been checking with your folks about the OMB passback on the DW PAG. We think that most of OMB's edits in the attached can be accommodated. However we want to speak with your folks about their request to include more information in the FRN about risk basis for our PAG and a discussion of economic analysis.
~~~~~~~~~~~~~~~

Eric Burneson, P.E.

Director of Standards and Risk Management

Office of Ground Water and Drinking Water

US Environmental Protection Agency

Phone: 202-564-5250

Fax: 202 564 3760

From: Grevatt, Peter
Sent: Wednesday, May 04, 2016 9:02 PM
To: Christ, Lisa <Christ.Lisa@epa.gov>
Cc: Burneson, Eric <Burneson.Eric@epa.gov>; Greene, Ashley <Greene.Ashley@epa.gov>
Subject: Fwd: OMB Comments on DW PAG Passback

Please take a look. Let's see if we can get a few min to discuss tomorrow.

Sent from my iPhone

Begin forwarded message:

From: "Dorjets, Vlad" <Vladik_Dorjets@omb.eop.gov>
Date: May 4, 2016 at 7:26:42 PM EDT
To: "Rennert, Kevin" <Rennert.Kevin@epa.gov>
Cc: "Grevatt, Peter" <Grevatt.Peter@epa.gov>, "Burneson, Eric" <Burneson.Eric@epa.gov>, "Laity, Jim" <James_A._Laity@omb.eop.gov>
Subject: OMB Comments on DW PAG Passback

Kevin,

Please find attached, updated comments from OMB on the intermediate Drinking Water PAG and the related FRN. As you will see, in many cases, our edits and comments take the form of efforts (or requests to EPA) to incorporate into the preamble some of the language EPA provided in response to OMB comments (i.e. in comment bubbles rather than in actual text) and increase the level of transparency and clarity for the public. In most of these cases, it is the gist that OMB cares about so please feel free to propose alternate language that gets at the same effect.

Please note that we received substantive comments from DHS, NRC, and DOE. While the attached comments reflect our best effort to address their – and OMB's – concerns, we have not had an opportunity to discuss them with all three agencies yet. Specifically, we believe that the attached documents address the concerns of DHS and NRC but we do not know whether DOE will find them acceptable. Given both of our interests to conclude this review as soon as possible, we are transmitting these comments to DOE at the same time as EPA as a time saving measure. We will let you know as soon as we can if they have different ideas on how to best address their concerns.

Let me know if you have any questions.

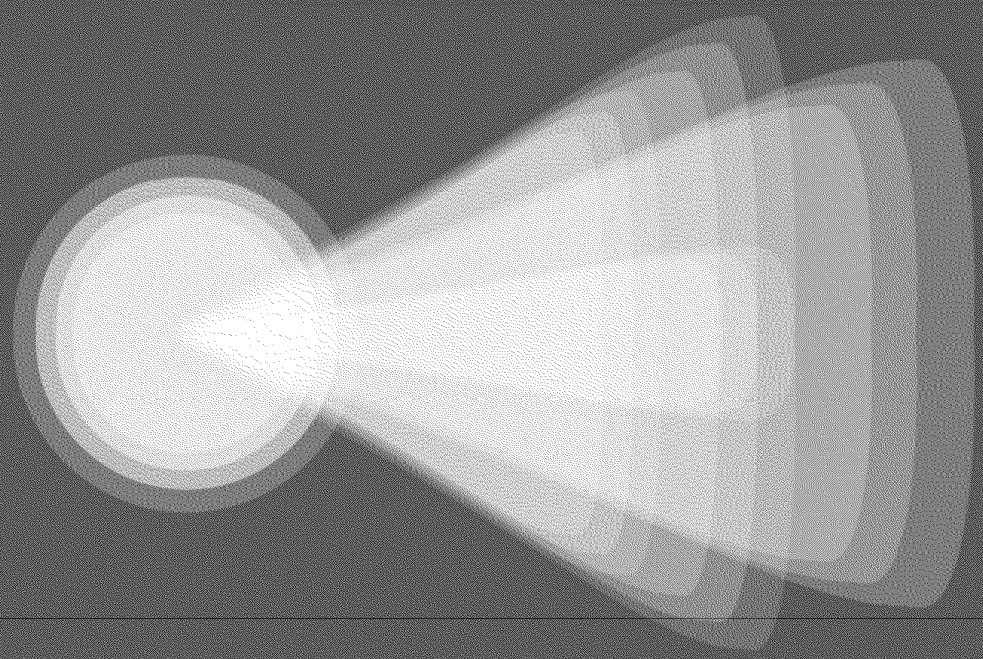
Vlad

United States
Environmental Protection
Agency

EPA-XXX/X-XX/XXX | Month YYYY | www.epa.gov/xxxxxx

Protective Action Questions & Answers for Radiological and Nuclear Emergencies:

A companion document to the U.S. Environmental Protection Agency Protective Action Guide (PAG) Manual



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Protective Action Questions and Answers for Radiological and Nuclear Emergencies: Companion document to the U.S. Environmental Protection Agency Protective Action Guide (PAG) Manual

FOREWORD

One of the most critical factors in the success of a radiological response is the effectiveness of public communication. "The timely and effective flow of information between agencies and the public is vital for facilitating and encouraging appropriate protective actions, reducing rumors and fear, maintaining public trust and confidence and reducing morbidity and mortality." (Becker, 2004)

Planning radiation emergency public safety messages will improve timeliness of information, increase consistency of the information and, ultimately, enhance effectiveness of the communication. Social media and the 24-hour news cycle bring information about emergencies and emergency response actions to the public on a much quicker timeframe than in the past. Members of the public and media expect answers to queries on an accelerated schedule and further expect that they can access updated information on responses several times daily via multiple information platforms.

This document is intended to help emergency planners prepare public communications prior to and during a radiological emergency. The messages in this document should be worked into emergency response plans and standard operating procedures. All radiological emergencies are different therefore the messages need to be adapted for the specifics for the emergency at hand.

Based on the safety measures in EPA's Protective Action Guide (PAG) Manual, this document is written generically to be applicable to all types of radiological emergencies. It complements the planning considerations presented in the PAG Manual and Federal Emergency Management Agency's incident-specific messaging documents *Improvised Nuclear Device Response and Recovery: Communicating in the Immediate Aftermath* and *Communicating During and After a Nuclear Power Plant Incident.*

The comprehensive questions and answers represents some of the best of the previous work produced through other government emergency radiological communications efforts. This document includes new messages addressing potassium iodide (KI) consumption and populations that require special consideration, including pregnant and breastfeeding women, children and those with disabilities.

Ideally, there will never be a need for these messages, but we have a responsibility to be prepared to empower the public with information on how to protect themselves and their families in the case of a radiological or nuclear emergency.

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Protective Action Guidance

1. What is a Protective Action?

Protective actions are the urgent steps that people can take to protect their health and the health of loved ones in a radiation emergency.

The main protective actions that the public might be asked to take are evacuation or sheltering (staying inside).

2. How do people know which steps to take?

Health and emergency management officials will tell the public if protective actions are needed and whether evacuation or staying inside would be more effective for avoiding radiation dose.

Officials make these decisions about how to protect public health by using information about local conditions and by using the recommendations in the “PAGs” or Protective Action Guides.

3. What are the PAGs?

PAGs, or Protective Action Guides, are radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to safeguard health after a radiation emergency has occurred. The U.S. Environmental Protection Agency developed the PAGs to help responders plan for and respond to radiation emergencies.

Every emergency situation is different, and the best action or set of actions in one situation may not be appropriate at another time or in another situation.

Knowing *when* emergency steps need to be taken, and *which* steps are warranted, is important for protecting the health of the public. The PAGs provide general guidance to officials, which they can use in combination with their knowledge of local conditions, to make these important decisions.

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4. What kinds of steps are included in the PAGs?

The PAGs include actions that government agencies and members of the public can take to protect people's health in a radiation emergency.

In the beginning of a radiation emergency, there are two main protective actions that the public might be asked to take to avoid exposure to radiation: evacuation or sheltering (staying inside). The PAGs also provide guidance on food safety and administration of potassium iodide (KI).

5. What is evacuation? What is sheltering? What is the difference?

Evacuation involves urgently moving people from an area expected to be in the path of radioactive releases.

Sheltering, on the other hand, involves having people stay indoors in their homes, offices, schools, or other buildings while radioactive materials pass over.

6. Are there other steps officials might ask people to take?

Depending on the situation, evacuation or sheltering may be supplemented by other measures.

Limit Access: One step is to keep people out of the affected area.

Decontamination: Another step involves decontamination, which means to remove any radioactive particles that may have fallen onto people's clothes, skin, or hair. Decontamination is done by having people change clothes and, possibly, wash or shower.

Food: Sometimes officials may also take steps to stop certain foods from being consumed if the foods are suspected of being contaminated. Authorities may also act to prevent livestock from grazing in potentially-contaminated areas, and instead have the animals drink water and eat feed that has been previously stored.

Potassium Iodide: Potassium iodide, or KI, is a non-radioactive form of iodine. KI can be useful in situations where radioactive iodine has been released into the environment. It works by filling a person's thyroid gland with safe iodine so that harmful radioactive iodine is not absorbed. KI is not an "anti-radiation" drug, and it can be harmful to take it when it is not needed.

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7. How do officials know when it is time to carry out protective actions?

The PAGs provide radiation dose guidelines that would trigger public safety measures, such as evacuation or staying indoors, to safeguard health after a radiation emergency has occurred.

When a radiation emergency occurs, officials will use available information and computer models to quickly predict how much radiation people could *potentially* receive from the incident.

Officials then use the PAGs to determine what general actions can be taken to *avoid* that potential exposure from taking place.

In other words, PAGs are trigger levels for deciding when specific steps are needed to *prevent* people from being exposed to a level of radiation that might be hazardous to health.

8. Wouldn't it make more sense to carry out all of the protective actions right away, as soon as a radiation emergency occurs?

No. Different safety measures are used for different situations.

Taking all of the safety measures at once is not possible. For example, people cannot stay inside and evacuate at the same time. Officials need to see what kind of threat the emergency poses to people so they can provide the best advice on how to protect health.

9. Why don't officials just automatically advise everyone to evacuate when a radiation emergency occurs?

There are situations when sheltering may be a better choice for preventing or reducing radiation exposure.

For example, if a cloud containing radioactive particles is expected to pass over an area very soon and then leave quickly, evacuation could actually expose people to more radiation than staying indoors.

This is because evacuation takes time, and many people might be caught outside or in their cars when the cloud passed over. So people staying indoors while the cloud passed by would be more protected than those caught outside trying to evacuate.

Also, in some situations, evacuation may not be practical. Blocked highways or power outages, for example, could make evacuation difficult. So, too, could severe weather.

Officials using the PAGs and information about local conditions will tell the public

whether evacuation, sheltering or other steps are needed in a radiation emergency. Follow the instructions so that you take the right steps to protect yourself and your loved ones.

10. What about controls on food?

In some situations, officials may determine that it is necessary to take actions to prevent radioactive contamination from entering the food supply.

Steps might involve preventing livestock from grazing in potentially-contaminated pastures or fields and ensuring that animals only eat feed and drink water that has been previously stored.

When necessary, officials may also act to stop certain foods from coming to market or limit consumption of certain foods if they are suspected of being contaminated.

11. What about taking Potassium Iodide?

Never take potassium iodide (also known as KI) and never give to your children unless you have been specifically advised to do so by the health department, emergency management officials, or your doctor.

Potassium iodide, or KI, is a non-radioactive form of iodine. KI can be useful in situations where radioactive iodine has been released into the environment. It works by filling a person's thyroid gland with safe iodine so that harmful radioactive iodine is not absorbed.

But KI is only useful in situations involving radioactive iodine, and it only protects the thyroid gland; it does not help in other situations involving radioactive releases.

KI is not an "anti-radiation" drug, and it can be harmful to take it when it is not needed.

12. Who uses the PAGs?

States and local governments have the main responsibility for taking measures to protect life and health.

In a radiation emergency, state and local emergency response agencies use the PAGs to decide when special actions are needed to avoid radiation exposure and protect people's health.

13. Do PAGs play a role in protecting people after the immediate

emergency is over?

Yes, it is possible that protective actions, including food safety measures, will stay in place to protect people until the area is cleaned up.

One such cleanup measure is *decontamination of land and property*, which involves cleaning radioactive contamination from an area so that people can reoccupy it. When this is not possible, another measure – *relocation* – may be required. Relocation involves moving people from an area and continuing to keep them from returning. An additional protective action may involve placing continuing *controls on food and water*.

14. What is the basis for the PAGs?

The PAGs are radiation dose guidelines, or "trigger levels," designed to prevent immediate health effects from radiation while balancing the risks of long-term health effects against the risks of protective actions, such as accidents from evacuation or risks from sheltering-in-place.

Balancing the risks between radiation exposure and protective actions is important. During the 2011 Fukushima nuclear power accident, no one died as a result of radiation exposure. However, over 1,000 people died from the evacuation, primarily elderly hospital patients who had to be moved from areas without power. The 2013 PAG Manual makes use of the lessons learned in Fukushima.

15. Where can I find out more about protective actions?

We are strongly committed to keeping the public informed and to answering people's questions. If you want to learn more about the PAGs, please go to http://www.epa.gov/radiation/protective-action-guides-pags. For information about the response, please contact us on the web at www.agency.etc or by telephone: [INSERT AGENCY CONTACT NUMBER HERE]

Impacted Community: Immediate Actions

16. If I am outside, what steps should I take to protect myself and my loved ones?

There are a few simple steps — recommended by doctors, scientists, and health experts — that will help protect you and your loved ones.

IF YOU ARE OUTSIDE:

Cover your nose and mouth. Covering your nose and mouth with a cloth reduces the risk of breathing in radioactive dust or smoke. You may also use a disposable mask, such as a dusk mask, if one is immediately available.

Don't touch objects or pieces related to the release — they could be radioactive.

Go inside and stay inside. Quickly go into a building where the walls and windows have not been broken. This will help shield you from any radiation that might be outside.

Remove your outer clothes. Once you are inside, carefully take off your outer layer of clothing. This is done in case any radioactive dust has fallen onto your clothes while you were outside.

Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.

Wash off. If available, take a warm shower with lots of soap. Do not scald or scratch your skin.

Wash your hair only with shampoo or soap and water. Don't use conditioner because it can cause the radioactive dust to stick to your hair.

Children should be given a shower or washed under supervision of a parent or other adult.

If you cannot shower, use a wipe or clean wet cloth to wipe skin that was not covered by clothing (such as your hands and face).

Gently blow your nose and gently wipe your eyelids, eyelashes, and ears with a clean wet cloth.

Put on clean clothes. Clothing stored in a closet or away from radioactive material is clean. If you do not have clean clothes, carefully brush off your outer layer of clothing and get dressed again.

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Tune in. Tune to local radio or television news or government emergency management websites for more instructions.

17. If I am inside a building, what steps should I take to protect myself and my loved ones?

There are a few simple steps — recommended by doctors, scientists, and health experts — that will help protect you and your loved ones.

IF YOU ARE IN A BUILDING:

Stay inside. If the walls and windows of the building are not broken, stay in the building and do not leave.

If the walls and windows of the building are broken, go to an inside room and do not leave. If the building has been heavily damaged, quickly go into another building where the walls and windows have not been broken.

Close doors and windows. To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. It is not necessary to put duct tape or plastic sheets around doors or windows.

Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate. In-room fans (for example, ceiling fans) that only recirculate air are okay to use. Air conditioning systems in large buildings can be used if they are set on recirculate.

If you have to go outside, follow the "if you are outside" instructions.

Be sure to cover your nose and mouth with a cloth. Once you are inside, take off your outer layer of clothing and seal it in a plastic bag if available. Store the bag where others will not touch it.

Shower or wash with soap and water, removing any remaining dust. Be sure to wash your hair with shampoo or soap, but remember not to use conditioner, since it can cause radioactive dust to stick to your hair.

Tune in. Tune to local radio or television news or government emergency management websites for more instructions.

18. If I am in a car or truck, what steps should I take to protect myself and my loved ones?

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IF YOU ARE IN A CAR OR TRUCK:

Shut the windows and vents. Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate.

Cover your nose and mouth. Cover your nose and mouth with a cloth to avoid breathing radioactive dust or smoke.

Get Inside. If you are close to your home, office, or a public building, go there immediately and go inside quickly.

If you cannot get to your home or another building safely, pull over to the side of the road and stop in the safest place possible. Turn off the engine and stay in the car until you are told it is safe to get back on the road.

If it is a hot or sunny day, try to stop under a bridge or in a shady spot so you and your passengers don't overheat.

Tune in. Listen to the car radio for more instructions.

19. If I am in a potentially-affected community, what steps should I take to protect myself and my loved ones?

IF YOU ARE IN A POTENTIALLY-AFFECTED COMMUNITY:

Go inside and stay inside. Go inside your home, office, school or other building.

The wind can sometimes carry radioactive dust from the site of the release. As a precaution, people should stay indoors for their personal safety until authorities say it is okay to leave.

Tune in. Tune to the local radio or television station, or check government emergency management websites, for more instructions.

20. What should people do if they are on a boat near the affected area?

Like cars, boats do not provide adequate protection from radioactive material. Tune in

to the radio for more information about the location of the radioactive material. If you are in a boat, you have two choices:

- Return to a marina or boat landing and find a building and go inside
- Get information on the location of the radioactive material and navigate to a distance far enough away from the incident.

21. What should people do if they're told to evacuate?

If you are told to evacuate, leave the area immediately

When the public evacuates, they are moved to safer areas depending on levels of radiation and radioactive material in order to keep exposures as low as possible, and under most conditions evacuation is preferred.

If you are told to evacuate:

- Pay close attention to what officials are telling you.
- Take the designated routes to reception centers where you will be registered and checked for contamination.
- If easily accessible, bring identification cards and medications with you.
- Follow the instructions of law enforcement personnel.

Transportation will be provided to those who need it, including physically accessible transportation for people with disabilities.

Limit calls to emergencies only, so those who need immediate help can be addressed in a timely manner. Text messaging may work during high volume periods because it does not require as much bandwidth.

22. Are care shelters available for people who are evacuating?

Yes, designated shelters have been opened.

You should first go to the reception center to be checked for contamination, and then to a shelter, or you can stay at a hotel or with family or friends.

Potassium Iodide (KI): Important Information

23. Should my family take potassium iodide?

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Never take potassium iodide (also known as KI) and never give it to your children unless you have been specifically advised to do so by the health department, emergency management officials, or your doctor.

Potassium iodide only reduces risk from radioactive iodine if taken very close to the time of exposure. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

24. What is potassium iodide? How does it work?

Potassium iodide is a non-radioactive form of iodine.

KI is only useful in situations where hazardous radioactive iodine has been released into the environment. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

KI works by filling a person’s thyroid gland with safe iodine so that the harmful radioactive iodine in the environment is not absorbed.

You should only take potassium iodide if you have been specifically advised to do so by local public health officials, emergency management officials, or your doctor. It is not an “anti-radiation” drug, and it can be harmful to take when it is not needed.

25. Do dirty bombs release radioactive iodine?

It is unlikely that a “dirty bomb” will release radioactive iodine. For various technical reasons, particularly the short amount of time it stays radioactive, radioactive iodine is not considered something terrorists are likely to use in a dirty bomb.

26. What types of incidents release radioactive iodine?

Radioactive iodine *may* be released during a nuclear power plant incident or a nuclear detonation. In the case of a nuclear power plant release, the plant operators will know if radioactive iodine has been released into the environment and will inform local officials so that decisions on potential KI distribution can be made quickly.

27. Will potassium iodide protect me from radiation?

Potassium iodide only protects the thyroid gland from radioactive iodine. It does not provide protection from any other kind of radiation exposure.

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Potassium iodide pills are not “radiation antidotes.” Potassium iodide should *only* be taken if there is a specific public health recommendation to do so.

28. Are over-the-counter medicines that contain iodine, such as disinfectants or throat sprays, a good substitute for potassium iodide?

No. Doing so will not protect your thyroid and could even be dangerous to your health. It is true that many over-the-counter medicines contain iodine in some form. Examples include iodine liquid for cuts and sores, disinfectants, and throat sprays.

These should never be taken as a substitute for potassium iodide.

These over-the-counter medicines and products are not intended for internal use. They may contain other ingredients that can be harmful.

Also, the amount of iodine contained in most of these products is small and would have no protective effect against radioactive iodine.

29. What about taking household disinfectants or antiseptics that contain iodine? Are these a good substitute for potassium iodide?

No. Doing so will not protect your thyroid drinking or consuming them could poison you.

30. Is taking large amounts of iodized salt a good substitute for potassium iodide?

No. Doing so will not protect your thyroid. Furthermore, although most people don’t realize this, it could even be dangerous.

It is true that iodized salt contains small quantities of iodine. But the iodine content in iodized salt is too low to prevent uptake of radioactive iodine.

Furthermore, it is actually dangerous to consume large amounts of iodized salt.

The main ingredient in salt -- sodium chloride -- can make people very ill if taken in large amounts.

Even tablespoons of salt taken repeatedly over a short period of time can cause poisoning. Eating large amounts of salt can also cause high blood pressure and other medical problems.

31. Are herbs or herbal products a good substitute for potassium iodide?

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No. Doing so will not protect your thyroid and could even be dangerous to your health. It is true that some herbs and herbal products may contain iodine.

But the amount of iodine is not regulated, so it is not possible to know how much iodine you will be getting.

Taking large amounts of herbs or herbal products could endanger your health.

32. Do people need a prescription to obtain potassium iodide?

The government stockpiles potassium iodide for emergency uses.

If public health and emergency management officials determine that taking potassium iodide would be helpful, the pills will be provided to people at no charge.

Additional Information: Situation Specifics

33. Where should I go for information about the situation?

Tune in your local radio or television station, or check government emergency management websites for the latest information.

Public health and emergency management officials will be providing regular updates. You can also go to the following website or toll-free hotline for information:

- [www.agency.etc]
- 1-8XX-XXX-XXXX

34. I am seeing a lot of information and instructions about what to do on internet blogs. Should I follow it?

Check official sources first. You can find the latest information at [www.agency.etc].

Blogs, social media, and the internet more generally can be a useful source of information, but only if the source is known and trustworthy.

Unfortunately, we know from past disasters and emergencies that small numbers of individuals may use the situation to distribute false information. And even well-intentioned individuals can pass on incorrect information or rumors.

Therefore, it is advisable to double-check what you are reading with the information and instructions being provided by the official website listed above, the official toll-free hotline, or local radio and television broadcasts.

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In an emergency, get information from reliable sources so that you can protect your health and the health of loved ones.

35. I received a text message giving me instructions on what to do. How do I tell if it is an official message or a fake?

If the government has issued an emergency text message, it will clearly identified as coming from [INSERT INFORMATION]. That is, the sender will read [INSERT INFORMATION].

Unfortunately, we know from past disasters and emergencies that small numbers of individuals may use the situation to send out official-looking false information. And, as noted earlier, even well-intentioned individuals can pass on incorrect information or rumors.

If you are unsure about a message, double check what you are reading with the information and instructions being provided by the official website or the official toll-free hotline.

[www.agency.etc]

1-8XX-XXX-XXXX

36. How many people have been injured or killed?

At this time, we do not yet know the specific number of casualties. An update will be provided as soon as reliable information becomes available.

Right now, we are focused on getting help to people in the affected area as quickly and safely as possible.

37. Where is the radioactive material located?

Radiation and environmental health experts are checking air, water, and ground conditions in and around the release site to locate the hazardous areas. Stay tuned to radio, television or visit [www.agency.gov] for the latest information.

38. Where is the radioactive dust and smoke going?

According to current weather predictions, the areas [DIRECTION] of [CITY] could be in the path of the cloud containing the radioactive dust and smoke.

Until advised otherwise, people in neighborhoods and communities that could potentially be

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in this path should stay indoors.

39. What is a plume?

Officials sometimes call the cloud of smoke and radioactive dust moving away from the explosion a plume.

40. What are emergency responders doing at this time?

Emergency responders, radiation experts, scientists, and representatives from all levels of government are working together to protect the public and save lives.

If terrorism: Law enforcement is working to apprehend those responsible.

41. How can people learn about the safety of their family members?

Use text messages instead to try and reach your family members.

If phone lines or other communication infrastructure has been damaged in the bombing, or if the lines are clogged, you may not be able to complete a phone call.

If you have access to a computer or a web-enabled device, use e-mail, social media websites like Facebook and Twitter, or online registries such as the Red Cross Safe and Well website.

Emergency responders are gathering and organizing all vital information available. If you are separated from your children or loved ones, search online for registries where people can identify themselves and their location.

Bear in mind that it may take time for registries to put in the latest information. You can seek additional information and counseling services at [LIST ORGANIZATIONS or LOCATIONS].

42. What will happen to people in the affected neighborhoods?

While it is too early to know the specific impacts, we know that this is a serious incident.

As appropriate: Lives have been lost, people have been injured, and homes and businesses have been destroyed.

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All levels of government are coordinating their efforts to do everything possible to help the people affected by this emergency.

As life-saving activities continue, follow the instruction of emergency responders. These instructions are for your safety and the well-being of your loved ones.

These instructions are based on the best information we have right now. These instructions may be updated as more information is available.

43. How can the public help?

Your help is vital in this situation.

Here are six important steps you can take to help:

1. Do not abandon your car on the road. Instead, park your car without impeding traffic. This will allow responders to help people in need of assistance.

2. Do not go near the release site. It could put you in danger and also stop emergency responders from doing their jobs.

3. Use text messaging rather than phone calls to communicate with friends and family. This will help to keep the phone lines from overloading.

4. Don't go to the hospital, police stations, or fire stations unless you were injured, or have another medical emergency requiring immediate treatment. These facilities need to be available for victims in serious need of assistance.

5. Stay alert: If you see anything suspicious, contact your local police or the FBI right away.

6. Stay tuned to television, radio, and government emergency management websites for updates.

44. What should I do if I come across an object that might be radioactive?

Do not approach, pick up, or touch debris or other objects that may be contaminated with radioactive material. These objects could be radioactive, especially in the immediate vicinity of the incident.

45. When will it be safe for people to return to their homes and businesses?

Federal, State, local, and tribal partners are collecting information about the dangers in the impacted areas. Until this is done we cannot predict when people can begin returning to the area.

If you have been evacuated, do not return until you are told it is acceptable to do so by authorities. Please do not put yourself or your family in danger by attempting to return early. Attempting to return early could divert responders' efforts away from those who need immediate assistance.

46. Will this affect air travel?

Until we have more information, expect air travel in and near the affected area to be restricted.

This is to keep air crews and passengers safe. It also keeps the airspace free for response and recovery activities.

47. Will this affect travel on waterways, both at home and abroad?

Until we have more information, expect the use of navigable waterways in the affected area to be restricted.

This is to keep mariners, other waterway users, and passengers safe. It also keeps the waterways free for response and recovery activities.

Radiation Health Effects

48. What is radiation?

Radiation is energy. Radiation travels from its source in the form of energy waves or energized particles.

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Radiation has so much energy it can pose a health risk by damaging tissue and DNA in genes.

For a radiological emergency, we trying to keep exposure to radiation as low as possible.

49. What is a rem, millirem (mrem), gray (Gy) or sievert (Sv)?

These units measure radiation exposure or dose, which for all practical purposes are the same thing. In the United States, dose and exposure are sometimes measured in units called rem or roentgen (R). Dose is often reported in millirem (mrem), which is a fraction of a rem; 1/1000. The international community uses units called gray or sieverts to measure the same thing.

According to radiation safety experts, radiation exposure below 10 rem (10,000 mrem or 0.01 Sv) usually results in little to no harmful health effects.

[Put in context of radiation incident doses]

50. What is a curie (Ci) or a bequerel (Bq)?

These units measure the amount of radioactive material in a sample, such as in a sample of water, soil or air. This is sometimes referred to as the sample's radioactivity (or simply its activity). In the United States, we measure this amount of radioactive material in curies (Ci) and the international community uses becquerels (Bq). Typically results will be in picocuries (pCi), which is one trillionth (or one million millionth) of a curie. EPA suggests that people fix their homes if radon levels in an air sample are more than 4 picocuries per liter (pCi/L).

[Put in context of radiation incident radioactivity findings]

51. Will people who have been exposed to the radiation get cancer?

Just because a person is near a radioactive source for a short time or gets a small amount of radioactive dust on himself or herself does not mean he or she will get cancer later in life, especially if it is removed quickly.

Scientists and health experts are working now to gather information on the radiation risks posed by the attack.

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Meanwhile, health agencies will be establishing screening centers to check people for radioactive contamination and to arrange for any longer-term follow-up should it be needed.

Further information on this will be provided soon by health and emergency management officials.

52. How much radiation is safe? How much is considered low risk?

According to radiation safety experts, radiation exposure between 5–10 rem usually results in little to no harmful health effects. Safety recommendations are designed to keep your dose below these levels.

It takes a large dose of radiation—more than 75 rem—in a short amount of time (usually minutes) to cause immediate health effects like acute radiation sickness.

[Put incident dose in context to radiation sickness doses]

Infants, the elderly and pregnant women are more sensitive to radiation exposure than healthy adults. Differences like age, gender and even previous exposure are factors that might influence a body's reaction to radiation exposure.

You can lower your risk of developing health effects by limiting your exposure to radiation by following these three steps:

- Get inside a building or to a basement to protect yourself.
- Get clean.
- Listen to officials and emergency responders for further safety instructions.

53. Is radiation contagious?

Unlike some biological agents, radiological effects are not contagious and cannot result in an epidemic.

It is true that people who have radioactive dust on their clothes or their bodies can leave some of that contamination on things or people they come into contact with.

But there is a simple solution: to have them clean up or decontaminate.

People who might have radioactive dust on them can remove their outer layer of clothing, shower, and put on new clothes.

54. Are people at risk for radiation poisoning or sickness?

Radiation sickness an illness from short-term exposure to a large amount of radiation. It takes a large dose of radiation—more than 75 rem—in a short amount of time (usually minutes) to cause immediate health effects like acute radiation sickness.

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[Put incident dose in context to radiation sickness doses]

Signs of radiation sickness include: injury like a burn or rash, nausea, and/or vomiting. If you have been exposed to high levels of radiation and are experiencing these symptoms–even days after exposure–seek medical attention immediately.

If you are not experiencing these or other life threatening symptoms, stay away from hospitals. Hospitals are caring for those most critically injured.

Food, Water and Air Safety

55. Is the food safe to eat?

Food in sealed containers and any unspoiled food in your refrigerator or freezer are safe to eat.

Use a damp towel or cloth to wipe off cans, bottles, packaged foods, counters, plates, pots and utensils before using them.

Seal these towels or cleaning cloths in a plastic bag and place them away from people and pets.

However, any unpackaged food that was out in the open and close to the incident may have radioactive dust on it. Therefore, do not consume food that was out in the open.

Food that was outdoors from [*time*] today, within a few miles of [*explosion site*] should be avoided.

56. Can people eat food from their gardens or locally caught fish and game?

Do not eat food from your garden if you suspect that radioactive material has settled on it. It is possible that the radioactive fallout has contaminated the ground and any crops that were planted.

Locally caught fish and game should be tested for radioactive contamination before it is eaten.

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Responders will be monitoring the area and will notify you when it is safe to eat local fish, game and food from your garden.

Listen for instructions from State and local officials and responders regarding food safety.

57. Is the water safe to use?

Bottled water and sealed juice or soda containers will be free of radioactive contamination. Wipe or rinse the outside of bottles or cans before opening them.

Water from the tap is probably safe. But until we have drinking water test results, only bottled water is certain to be free of contamination.

Tap or well water can be used for cleaning yourself and your food.

Boiling tap water does not get rid of radioactive material.

58. What should farmers do with their crops?

We are asking farmers in [AREA] not to tend, harvest, eat, or distribute their crops until radiation monitoring and sampling results are analyzed, unless otherwise directed.

We recognize that your crops are your livelihood. State, local, and tribal officials will keep you informed as radiation monitoring and sampling results come in.

59. What should farmers and ranch owners do with livestock?

If you are being asked to stay inside (shelter-in-place) or evacuate, follow the instructions of State, local, and tribal officials. These instructions are for your safety.

We are asking farmers and ranchers in [AREA] not to transport their livestock and to not consume or distribute milk from dairy animals until radiation monitoring and sampling results are analyzed, unless otherwise directed. If you have milk producing animals, contact state, local, or tribal officials for guidance.

Take these simple steps to protect your livestock from eating feed or drinking water contaminated with radioactive material:

- Move your livestock indoors, away from more highly contaminated areas outside.
- Use only stored feed and covered water. If possible, avoid using hay or alfalfa kept outside.

60. Is the air safe to breathe?

Federal, State, and local partners are monitoring to determine the location and levels of

radioactive material on the ground and in the air.

If there are radioactive particles in the air there are simple steps you can take to reduce your exposure:

- Cover your mouth and nose with a protective layer – like a mask, cloth, or towel.
- If you have been instructed to stay inside, remain inside. Walls provide protection from the radioactive material outside.
- Close doors and windows. To keep radioactive dust or powder from getting inside, shut all windows, outside doors, and fireplace dampers. It is not necessary to put duct tape or plastic sheets around doors or windows.

Close the windows and turn off the fan, air conditioner or heater if weather conditions permit. Otherwise, set the fan, air conditioner or heater on recirculate. In-room fans (for example, ceiling fans) that only recirculate air are okay to use. Air conditioning systems in large buildings can be used if they are set on recirculate.

We are tracking the radiation levels and authorities will instruct you to leave the area when it is in your best interest to do so.

Decontamination

61. If people are told by health and emergency management officials to self- decontaminate, what does this mean?

It means that people are being told to take several easy steps to remove any radioactive material that might have fallen onto clothes, skin, or hair.

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To self-decontaminate:

- Remove your outer clothes;
- Place the clothes in a plastic bag, seal the bag, and put it someplace away from children and pets;
- Take a warm shower with lots of soap; do not scald or scratch your skin;
- Wash your hair with shampoo or soap and water. Do not use conditioner because it can cause radioactive dust to stick to your hair;
- If you cannot shower, use a wipe or clean wet cloth to wipe skin that was not covered by clothing (such as your hands and face);
- Put on clean clothes.

62. How long does an exposed person have to remove contamination from their body?

There is no set time. People should remove contamination as soon as possible to reduce their radiation dose by using the six steps listed above.

63. Is it safe for me to let someone who might have been affected by the radiological incident into my home?

Even if someone has radioactive dust on their clothes or body, a few simple steps can clean up or decontaminate the person so that he or she can safely visit your home.

First, ask your visitor to remove the outer layer of clothing and place it in a plastic bag. Place the bag away from people and pets.

Second, have your visitor shower with soap and warm water to remove any remaining radioactive material. A warm shower with lots of soap is sufficient. There is no need to use very hot water or to scratch the skin.

Hair may be washed with shampoo or soap and water. But don't use conditioner because it can cause the radioactive dust to stick to your hair.

Finally, put on clean clothes.

64. How should people decontaminate their homes and their possessions?

Do not decontaminate your home until you get information from emergency responders or local officials.

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You may not need to decontaminate your home OR there may be special instructions for how to clean your home. For example, you may receive special instructions on wearing protective clothing, methods for keeping dust to a minimum and washing the outside of your home. You can find more information on steps you can take at [INSERT web address].

Exposure vs. Contamination

65. How do I know if I've been exposed to radiation or contaminated by radioactive materials?

People cannot see, smell, feel, or taste radiation; so you may not know whether you have been exposed.

In addition, low levels of radiation exposure do not cause any symptoms.

People who were in areas of concern may be instructed to go to a screening center—sometimes called a community reception center. At this location, responders will quickly check for radiation by using special equipment to determine how much radiation is present and whether it poses any danger in your area.

If you think you have been contaminated, simply removing the outside layer of clothing and washing exposed skin will significantly reduce any contamination you may have on your body.

66. What is the difference between radiation exposure and radioactive contamination?

Exposure occurs when radiation interacts with the body. You can be exposed to radiation without having radioactive material on your body (contamination). For example, a chest x-ray or CT scan a person is exposed but they are not contaminated and they are not radioactive.

Contamination is when a radioactive material is physically on or inside of a person or object. If you are contaminated with radioactive material, you are being exposed to radiation. Contamination can occur two ways:

1. External contamination occurs when radioactive material settles on a surface or outside of an object.

2. Internal contamination occurs when radioactive material enters the body. This can occur after radioactive material is swallowed, inhaled, injected, or absorbed through the skin or wounds.

Special Issues and Concerns: Pregnancy and Breastfeeding

67. I am pregnant. Is my baby in danger?

After any radiation incident, expectant mothers who have concerns should seek advice from their physicians working in consultation with radiation professionals.

It is true that the fetus is extremely sensitive to radiation, with the unborn child at greatest risk during the first trimester of the pregnancy. After some radiation accidents in other countries, pregnant women reportedly terminated their pregnancies because they feared that the radiation would harm the developing embryo or fetus. Tragically, these terminations turned out to be totally unnecessary.

According to the Centers for Disease Control and Prevention (CDC) and as history has shown, most radiation exposure events will not expose the fetus to levels likely to cause health effects.

However, before any potential health risk to the embryo/fetus can be assessed, healthcare professionals and radiation experts would determine what external or internal doses the mother might have received as a result of being very close to the incident.

Once dose levels to the mother and fetus have been determined, your physician working in conjunction with other medical and radiation professionals can discuss potential risks (if any) and provide appropriate counseling.

68. Is it safe to breastfeed?

Breastfeeding is very important for the well-being of a baby, providing vital nutrients and a sense of security.

For mothers far from the release site, breastfeeding can continue.

However, if a mother was close to the release site and was either injured or is believed to have inhaled significant quantities of radioactive dust or smoke, there is a small possibility that some radioactivity could be passed through breast milk.

Public health and medical officials may advise the mother to temporarily stop breastfeeding and switch to either breast milk that was pumped and stored before the incident or baby formula until she is able to contact her doctor or public health and medical officials for further instructions or advice.

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Formula containers and feeding supplies should be cleaned with a damp cloth or clean towel before use.

If possible, continue pumping and disposing of breast milk to maintain supply while additional information is gathered. Clean pumping supplies as indicated by the manufacturer.

If no other source of food is available, continue to breastfeed. This remains an excellent source of nutrition for your baby.

69. Can pregnant women take potassium iodide pills?

As with the rest of the population, pregnant women should take potassium iodide only when specifically advised to by public health authorities.

Potassium iodide will cross the placenta and protect the thyroid of the growing fetus, as well as the mother, from radioactive iodine only.

70. Can breastfeeding women take potassium iodide?

As with the rest of the population, breastfeeding women should take potassium iodide tablets only when specifically advised by public health authorities.

However, this will not be sufficient to fully protect the breastfed child. The child will also need potassium iodide in special doses adapted for newborns and infants.

Listen to your community health officials for specific guidance on taking potassium iodide pills. For the latest information go to [www.agency.etc].

71. I am trying to get pregnant. Should I worry that my future children will be affected?

There is no evidence that your future children will be at a greater risk for birth defects or other problems.

Over many years, extensive studies of the children of atomic bomb survivors have been conducted by scientists. There has been no indication of genetic effects in the offspring of people who survived the atomic bombings and later had children.

Special Issues and Concerns: Children

72. What should I do about my children and family? Should I leave to find my children?

If your children or family are with you, stay together. Take the same actions to protect your whole family.

If your children or family are in another home or building, they should stay there until you are told it is safe to travel. You should also stay where you are. You cannot help them if you are injured.

Schools have emergency plans and shelters. If your children are at school, they should stay there until it is safe to travel.

Do not go to the school until public officials say it is safe to travel.

73. What is being done to protect children in school?

Schools have emergency plans in place to protect the children. These plans include keeping everyone inside and providing assistance for those with special needs.

Children in schools will be cared for by teachers and staff until such time as it is safe for them to leave. Children will not be released to go outside until instructed to do so by health officials and emergency responders.

74. If some of the radioactive dust got on my clothes or skin, will I contaminate my child? Is it safe for me to be around my child?

Radioactive dust can be removed by taking off and bagging your outer layer of clothing, showering with soap and warm water, and putting on clean clothes.

People who have cleaned up pose no contamination risk to you, your property, or the members of your household.

75. If people need to be decontaminated at a reception center or other location, will I be able to stay with my children when they are decontaminated?

Parents should be able to stay with their children during decontamination and other processes.

Children and their families (parents or caregivers) should not be separated unless there are critical medical issues that need to be addressed.

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76. Does my child need to have his/her thyroid scanned?

Thyroid scans are only needed in situations where there is a possibility that radioactive iodine has entered the body.

Health experts are actively gathering information and determining potential health threats. You will be notified if thyroid scans are needed.

77. What kind of emotional impact can a radiological terrorism incident have on children? What should I look out for?

Children are among the most vulnerable of those affected by a radiological emergency because they lack the maturity, skills, and experience to fully understand and process what is going on.

Family members and caregivers should gently try to find out what the child thinks and feels about the disaster.

If the child is scared because she/he has misunderstood what has happened, then simple explanations should be provided while avoiding alarming details.

Children who exhibit signs of stress such as difficulty sleeping, loss of appetite, or bedwetting should receive extra time and attention from family members and other caregivers.

It is important to remember that children also need a chance to play and relax. Encourage older children to be helpful and maintain regular routines.

78. Are children at higher risk of harm if exposed to radiation?

Children exposed to radiation may be at greater risk than adults.

Children have higher breathing rates, are growing, and have physical proximity to the ground—where radiation may be more concentrated—which makes them more vulnerable. Young children are also very sensitive to radioactive iodine.

Health experts are actively gathering information and determining potential health threats—specifically looking at effects on children. Instructions issued by health officials are based on these findings.

79. Will my child and I get cancer from the radiation exposure?

There are many causes of cancer, some genetic and some from the environment.

For some people, it is possible that the low levels of radiation expected from the incident could slightly increase the risk of cancer over what occurs naturally in a

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person's lifetime.

Just because a person is near a radioactive source for short time, inhales a small amount of radioactive dust, or gets a small amount of radioactive material on clothing or skin, it does not automatically mean he or she will get cancer later in life.

Scientists, doctors, and other health experts are working now to check people and gather information on any potential radiation risks posed by the attack. Once exposure information has been gathered, health officials and your doctor will be able to discuss possible risks (if any) and the practical steps you can take to reduce them.

80. Should my children take potassium iodide?

If health authorities do advise that potassium iodide needs to be taken by the public in an affected area, children can do so unless they have known allergies to iodine.

However, the doses and procedures for giving KI to children are not the same as for an adult.

If potassium iodide is needed, health authorities will provide specific guidance on dosages and procedures for giving KI to children.

Special Issues and Concerns: People with Disabilities or Special Medical Needs

81. If I go through decontamination at a reception center or other facility, will my eyeglasses have to be taken away?

Your glasses should not be taken away.

Eye glasses may be washed in the shower with the person who wears them.

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82. I have a prosthetic limb. If I have to be decontaminated to remove radioactive dust, will by prosthetic limb have to be taken away?

There is no reason for a prosthetic limb to be taken away.

Most prosthetic limbs can get wet. So they can be removed, thoroughly cleaned along with the person, and put back on.

83. Is there a general list of the kinds of devices, adaptive equipment, prostheses, and mobility aids that can be decontaminated?

Unfortunately, there is no single guide currently available that covers all situations.

However, a general list was published in 2006 by the New York Center for Terrorism Planning and Preparedness (NYCTP) in a document on hospital decontamination protocols.

The list identifies the following items that can be decontaminated: non-electric wheelchairs, prosthetic limbs (w/o leather components), walkers, crutches (w/o foam cushions/parts), canes (w/o foam cushions/parts), eyeglasses, and prosthetic eyes.

Items that cannot be decontaminated, or that pose special challenges, include mechanical ventilators, electric wheelchairs, hearing aids, contact lenses, and any leather attachments/components of items.

For such items, discuss options with emergency responders and health officials.

84. What if my service animal is found to be contaminated?

If your service animal is known or suspected to be contaminated it will be decontaminated.

In 2006, the PETS Act (Pets Evacuation and Transportation Standards Act) was created to ensure that state and local emergency management partners address the specific needs of individuals with service animals. Provisions for decontamination of service animals are included in the law.

85. How are service animals decontaminated?

Most animals can be decontaminated by simply using a soap and water solution. For sensitive areas around the animal's eyes, nose, mouth, and in ears, where traditional washing methods may be more difficult, moist towelettes may be utilized.

In some situations, emergency responders may also place a muzzle on the animal to prevent it from licking or drinking contaminated water.

86. What should people do if they do not have access to their life-sustaining medications?

If you are in the affected area and your life is in danger because you are running out of life-sustaining medication, such as insulin or heart medicine, take the following steps to get medication:

- Call 911 if possible.
- Seek help from a neighbor.
- As a last resort, you can go to the closest medical facility.
- If you must go outside, remember to clean yourself thoroughly when you come back inside.
- Remove the outer layer of clothes, shower and wash with soap and warm water, and put on clean clothes.

87. I have been having radiation treatments for medical reasons. Should I stop my treatments because I might have been exposed to radiation from the emergency?

As a general rule, there is no reason for a radiation incident to cause people to stop or take a break from potentially life-saving medical treatments.

However, it is possible the dislocation or emotional stress from the incident could leave some people very tired and less able to deal with the side effects of medical radiation therapy.

If this is the case, you should discuss this with your doctor to jointly decide the best

course of action.

Special Issues and Concerns: Pets

88. If people have been told to stay inside and self-decontaminate during a radiation emergency, what should be done about pets? How do I decontaminate my pet?

If your pet was outside at the time of the incident, the pet can be brought inside and decontaminated.

Start by putting on waterproof gloves and a dust mask (or other material to cover your mouth).

Also, keep cuts and scrapes (yours and on your pet) covered to keep radioactive material out of any wounds.

Then wash your pet carefully in a shower or bath using shampoo or soap and water. Rinse the pet completely.

To make sure you have not picked up any contaminants, be sure to shower, and wash your hands and face, after you have washed the pet.

89. Is pet food safe for my pet?

As with other foods, sealed pet food is safe for animals to consume.

As with other foods, rinse or wipe off any debris from a closed can or package with tap water and put the washcloth in a plastic bag away from people and animals.

ED_001057_00008882

To: Wieder, Jessica[Wieder.Jessica@epa.gov]; DeCair, Sara[DeCair.Sara@epa.gov]
Cc: White, Rick[White.Rick@epa.gov]
From: Nesky, Anthony
Sent: Wed 2/24/2016 7:15:26 PM
Subject: Re: PAG Comm Plan
PAG Comms Plan draft 2-24-2016-jessfinal+tn.docx

Here is my markup. It looks great-there are only two little grammarly things, and one optional addition.

From: Wieder, Jessica
Sent: Wednesday, February 24, 2016 2:06 PM
To: DeCair, Sara
Cc: Nesky, Anthony; White, Rick
Subject: RE: PAG Comm Plan

Here is the final Comm Plan. It meets OAR Comm Standard format. I will incorporate your edits and Tony's edits to the Q&A as soon as I receive them

Jess

Jessica Wieder
U.S. EPA
Radiation Protection Program
Center for Radiation Information and Outreach
w: 202-343-9201
c: Ex. 6 - Personal Privacy

From: DeCair, Sara
Sent: Wednesday, February 24, 2016 1:55 PM
To: Wieder, Jessica
Subject: Re: Comm Plan

Gotcha -- I am reviewing QA s now Thx!!!

Sent from my iPhone

> On Feb 24, 2016, at 1:32 PM, Wieder, Jessica <Wieder.Jessica@epa.gov> wrote:
>
> Sara - After talking with OAR Comm, I am streamlining the Comm Plan (making it shorter) and will be integrating the desk statement where the key messages are as soon as I get them back from Tony.
>
> Jess
>
>
> Jessica Wieder
> U.S. EPA
> Radiation Protection Program
> Center for Radiation Information and Outreach
> w: 202-343-9201
> c: Ex. 6 - Personal Privacy

To: DeCair, Sara[DeCair.Sara@epa.gov]
From: Hale, Olin
Sent: Mon 2/22/2016 12:47:15 PM
Subject: FW: Draft EPA PAG Manual for Review and Comment: Due Friday, February 19.
PAG Manual draft Final 2-5-2016_FBI.docx

FYSA.

Olin Hale

DHS-FEMA-NPD-THD-PSI

Mobile: (202) 341-8643

email: olin.hale@fema.dhs.gov

From: Hale, Olin
Sent: Friday, February 19, 2016 12:32 PM
To: DeCair, Sara (DeCair.Sara@epa.gov)
Subject: FW: Draft EPA PAG Manual for Review and Comment: Due Friday, February 19.

Good Afternoon Sara,

Please find below FBI WMD's comments.

Per those comments I used to co-chair the DHS Source Security Task Force and we did develop a DHS definition for INDs, RDDs and REDs.

Also, if we are going to be device-specific, often overlooked are radiological exposure devices. REDs pose a greater threat for casualties or injuries than RDDs, are more likely to be employed,

and have been used as weapons in the past. For example, were an adversary to acquire a large, high-energy gamma source (such as a teletherapy source or irradiation slug) we hope the adversary will use an explosive to disperse it, reducing the threat to a contamination-control incident rather than the prospect of injures and/or fatalities that could result from concealing in near large groups of people.

Best Regards,

Olin

Olin Hale

DHS-FEMA-NPD-THD-PSI

Mobile: (202) 341-8643

email: olin.hale@fema.dhs.gov

From: Bogdan, Bernard P. (WMD) (FBI) [mailto:Bernard.Bogdan@ic.fbi.gov]
Sent: Friday, February 19, 2016 12:10 PM
To: Hale, Olin
Subject: RE: Draft EPA PAG Manual for Review and Comment: Due Friday, February 19.

Olin:

I provided this to one of our shops in our Laboratory Division as they have much more technical background than I do. Attached is the response received as well as the general comments below. I am simply passing along verbatim as I received them.

I did not have any comments from my perspective in this regard.

Please pass along as needed.

"Also, below are some general comments:

1) Definitions and terminology – wherever possible, terms and definitions should align with those already established or codified across the government. Some simplifications are needed for the audience intended. Also the IND and RDD definitions may need to be checked against any official USG definition, and others with FEMA. The glossary section needs some additional work.

2) Scope – Consider breaking this up a bit and focusing on that which is needed for decision-makers in the early and intermediate stages of an event. The document should point to other references when discussing established structures such as NIMS (except maybe where PAG-specific functions fall into NIMS) and avoid re-stating what may be in other documents. I would suggest EPA making the late stage, or post event remediation and cleanup guidelines/considerations into a separate document.

3) Presentation of data – If the audience is for planners and decision-makers, I would suggest presenting the material in more user-friendly, bite-sized pieces into what they need to know to make a decision, and provide more visual aids and comparative risk tools, with less emphasis on the specific numbers and rational. (Technical basis could go in a separate justification document).

4) Emphasis – I would suggest not specifically calling out any one type of incident (RDD, IND, Reactor, ect.) and change the approach to generic guidance on small, medium, and large-scale radiological incidents. I think this would better serve planners and decision makers than trying to assume what an RDD (or other originator of the radiological material) may be composed of.

Thanks for the opportunity to take a look.

Bernie

From: Hale, Olin [mailto:olin.hale@fema.dhs.gov]
Sent: Monday, February 08, 2016 4:29 PM
To: Hutter, Adam; Remick, Alan; Scott, Andrew; Armin Ansari; Barbara Stunder; Ben Cacioppo; Stevenson, Benjamin; Bogdan, Bernard P. (WMD) (FBI); Webb, Bill; Blizzard, Jeffrey; Blumenthal, Daniel; Bob Stephan (robertbstephan@aol.com); Bruce Young; byw3@cdc.gov; Carla Boyce; Celia, Matthew; Gorman, Chad; Wood, Chad; Christine Martin; Gregg, Chuck; Burnside, Conrad; Crawford, Sean; Cullen, William R; Dean McCauley; Dennis Emmert (dennis.j.emmert.mil@mail.mil); Eberst, William; Elaine Bond; Feighert, Dan; FladeboeJP@state.gov; Foreman, Bruce; Fox, Kathleen (Katie) M; Garcia, Luis; Gardner, Patricia; Gordon Cleveland; Greten, Timothy; Hammond, Lisa; Sherwood, Harry; Heath, Stanley; Hoyes, Jonathan; Jacqueline.mann@nist.gov; James Williams; Kish, James; Jeffery Albanus; Jeffrey Sincek; 'Jensen, John (USDA)'; Patterson, James L; Jim Stahlman (James.e.stahlman.civ@mail.mil); John F. Koerner (John.Koerner@hhs.gov); John Madrid; MacKinney, John A; John.Sokich@noaa.gov; Brinsfield, Kathryn; Kennedy, Beth D CTR OSD OUSD POLICY (US); McDaniel, Kenneth L CIV; Kgeiss@ostp.eop.gov; Lee Veal (Veal.Lee@epa.gov); Lee.a.nickel1@navy.mil; lodwick.jeffrey@dol.gov; McCarroll, Janis; Collins, Michael (FD) (FBI); michael.noska@fda.hhs.gov; Mike.Wangler@em.doe.gov; Monchek, Rafaela; Monchek, Rafaela; Musick, David; OLeary, Sean; Hale, Olin; pxm@nrc.gov; Grundstrom, Richard; Robert Stephan; Robert Whitcomb; Lewis, Robert; Washington, Russell; Sally Billings; Sara DeCair; Scardino, Thomas; Overby, Stacey; Colman, Steve; steven.fine@noaa.gov; Quinn, Vanessa; Wieder.Jessica@epa.gov; Billado, William; Alvin Morris; Andrew Wallo; Bennett, Gerilee; Blunt, Kenyetta; Bobbitt, Sharon; Brian Schlieger; Carrington, Jessica; Chacko, Betsie; Chase, Stephen; Coleman-Hansberry, Brenda; Collins, Richard; Coons, Albert; DeFelice, Anthony; Dozor, Joshua; Echevarria, Sharon; Gearing, Alexis; Alexis; Glenn-Graves, Precilla (CTR); Harris III, Timothy; Hart, Hampton; Howe, Michael; Jackson, Liz; Kozal, Jason; Kathryn Snead; Ken Lauziere; Kenneth Inn; Laurence Broun; Lisa Karam; Lisa Nanko; Mark Russo; Ward, Paul; Perry, April; Pesapane, Robert; Phillips, Marlene; Ricardo Reyes; Collins, Richard; Robert Prins; Sabata, Andrew; Schafer, John; Stewart-Smith, Mart A (Stewart-SmithMA@state.gov); Tagliento, Marc
Cc: THD-Action-Office
Subject: Draft EPA PAG Manual for Review and Comment: Due Friday, February 19.

Good Afternoon FRPCC Members and Colleagues,

On behalf of Ms. Sara DeCair, please find attached for review and comment the draft **EPA Protective Action Guide (PAG) Manual**.

Comments are due **Friday, February 19th** by close-of-business.

Ms. DeCair has provided the following discussion and instructions for documenting comments as well as her contact information.

Attached you will find our proposed public-comments-in version of the PAG Manual. This includes work we've done together on clarifying and explaining what we meant as a PAGs Subcommittee, and you'll see other tweaks and improvements to make the guidance more complete. This version does contain placeholders for the drinking water guidance to drop in, once public review of that is done. You'll also note, with relief I'm sure, that the changes in total are very minor. All changes from the PAG Manual issued for comment in 2013 are highlighted for you.

Since the changes are minor, we're looking for your comments within two weeks (due date: Feb. 19, 2016). Comments in the form of Page Number, Paragraph Number, Suggestion & Rationale are preferred to making a redline strikeout of the Manual document itself, but whatever works for you will work for us. Also know that formatting is still underway on this document, so if you see ways that could improve, do let me know. Please call or email anytime with questions or issues. Our next steps will be to finalize the document and prepare a proposed Federal Register Notice for OMB review.

Thank you for your help,

Sara

Sara D. DeCair

http://www.epa.gov/radiation/rert/pags.html

202-343-9108

Room 1416 B in WJC West

Thank you kindly for your attention, and please let me know if there are any persons you would recommend for additional distribution.

Best Regards,

Olin

Olin T. Hale, PPS

FRPCC Section Chief

Professional Services and Integration
Technological Hazards Division
Federal Emergency Management Agency
U.S. Department of Homeland Security
202.341.8643

email: olin.hale@fema.dhs.gov

To: Amy Doll[adoll@endyna.com]; Andrew.Wallo@eh.doe.gov[Andrew.Wallo@eh.doe.gov]; asa4@cdc.gov[asa4@cdc.gov]; ben.cacioppo@dtra.mil[ben.cacioppo@dtra.mil]; Carlos.Corredor@Hq.Doe.Gov[Carlos.Corredor@Hq.Doe.Gov]; Edward.Regnier@hq.doe.gov[Edward.Regnier@hq.doe.gov]; John.Jensen@dm.usda.gov[John.Jensen@dm.usda.gov]; john.mackinney@dhs.gov[john.mackinney@dhs.gov]; john.madrid@dtra.mil[john.madrid@dtra.mil]; lee.a.nickel1@navy.mil[lee.a.nickel1@navy.mil]; lodwick.jeffrey@dol.gov[lodwick.jeffrey@dol.gov]; michael.howe@fema.dhs.gov[michael.howe@fema.dhs.gov]; Michael.Noska@fda.hhs.gov[Michael.Noska@fda.hhs.gov]; Patricia.Milligan@nrc.gov[Patricia.Milligan@nrc.gov]; paul.ward@fema.dhs.gov[paul.ward@fema.dhs.gov]; ricardo.a.reyes@us.army.mil[ricardo.a.reyes@us.army.mil]; siddhanti@endyna.com[siddhanti@endyna.com]; tdkraus@sandia.gov[tdkraus@sandia.gov]; Veal, Lee[Veal.Lee@epa.gov]; Wieder, Jessica[Wieder.Jessica@epa.gov]; william.cunningham@nist.gov[william.cunningham@nist.gov]
Cc: olin.hale@fema.dhs.gov[olin.hale@fema.dhs.gov]
From: DeCair, Sara
Sent: Mon 2/8/2016 8:27:07 PM
Subject: PAG Manual for FRPCC review - cmts due 2/19
PAG Manual draft Final 2-5-2016.docx

FRPCC Colleagues;

Attached you will find (finally!) our proposed public-comments-in version of the PAG Manual. This includes work we've done together on clarifying and explaining what we meant as a PAGs Subcommittee, and you'll see other tweaks and improvements to make the guidance more complete. This version does contain placeholders for the drinking water guidance to drop in, once public review of that is done. You'll also note, with relief I'm sure, that the changes in total are very minor. All changes from the PAG Manual issued for comment in 2013 are highlighted for you.

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Thank you for your help,

Sara
Sara D. DeCair
http://www.epa.gov/radiation/rert/pags.html
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