Using EPA's Risk Assessment Tools for Superfund When Addressing Removal Actions and Late-Phase Response to Terrorist Attacks - 11568

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ABSTRACT

EPA's Office of Superfund Remediation and Technology Innovation (OSRTI) has three internet based calculators, or risk assessment models, for developing risk based Preliminary Remediation Goals (PRGs) for radioactively contaminated CECLA sites. These PRG calculators are EPA's recommended methodology for developing risk-based concentrations for remedial actions for soil and water (PRG), inside buildings (BPRG), and outside hard surfaces (SPRG). EPA has three equivalent calculators for dose assessment, which are the Dose Compliance Concentration (DCC) calculator for soil and water, inside buildings (BDCC), and outside hard surfaces (SDCC). The three PRG calculators also include default PRG tables provided for each of the calculators showing concentrations corresponding to 1×10^{-6} when the calculators are run using all of their default parameters. However, if an On Scene Coordinator (OSC) is developing removal action levels (RALs) at $1 \times l0^{-4}$ at their site using one of these calculator, or is developing risk-based cleanup goals during the late-phase portion of an actual response after an Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND) terrorist attack, or a simulation during an exercise, they may want to run the calculator using more site-specific data. This presentation will provide information on how users may employ these tools beyond their original intended uses in the remedial program, and focus on some of the more conservative default parameters that are likely candidates for replacement by site-specific information.

INTRODUCTION

EPA has developed its human heath and dose assessment models for use at its long-term site cleanup program. These tools may also be used effectively at EPA's more short-term response actions, and also for selecting cleanup levels in response to terrorist attacks.

CERCLA REMEDIAL PROGRAM AND RISK MODELS

The Comprehensive Environmental Response, Compensation and Liability Act, CERCLA, nicknamed "Superfund" protects human health and the environment over the long term from releases or potential releases of hazardous substances from abandoned or uncontrolled hazardous waste sites. Within the Superfund remediation framework, radioactive contamination is dealt with in a consistent manner as with chemical contamination, except to account for the technical differences between radionuclides and chemicals. This consistency is important since at every radioactively contaminated site being addressed under Superfund's primary program for long-term cleanup, the National Priorities List (NPL), chemical contamination is also present. Compliance with the requirements of other Federal environmental laws, more stringent State environmental laws, or State facility-siting laws is often the determining factor in establishing cleanup levels at CERCLA sites. These requirements are known as Applicable or Relevant and Appropriate Requirements (ARARs).

However, where ARARs are not available or are not sufficiently protective, EPA generally sets site-specific remediation levels for: 1) carcinogens at a level that represents an upper-bound lifetime cancer risk to an individual of between 10^{-4} to 10^{-6}; and for 2) non-carcinogens such that the cumulative risks from exposure will not result in adverse effects to human populations (including sensitive sub-populations) that may be exposed during a lifetime or part of a lifetime, incorporating an adequate margin of safety. The specified cleanup levels account for exposures from all potential pathways, and through all media (e.g., soil, ground water, surface water, sediment, air, structures, biota).

The 10^{-4} to 10^{-6} cancer risk range can be interpreted to mean that a highly exposed individual may have a one in 10,000 to one in 1,000,000 increased chance of developing cancer because of exposure to a site-related carcinogen. Once a decision has been made to take an action under the Superfund remedial program for longer term site cleanups, EPA prefers cleanups achieving the more protective end of the range (i.e., 10^{-6}). EPA uses 10^{-6} as a point of departure and establishes Preliminary Remediation Goals (PRGs) at 1×10^{-6}.

EPA has developed a PRG for Radionuclides electronic calculator, known as the Rad PRG calculator. This electronic calculator presents risk-based standardized exposure parameters and equations that should be used for calculating radionuclide PRGs for residential, commercial/industrial, and agricultural land use exposures, tap water and fish ingestion exposures. The calculator also presents PRGs to protect groundwater which are determined by calculating the concentration of radioactively contaminated soil leaching from soil to groundwater that will meet MCLs or risk-based concentrations. The Rad PRG calculator may be found at: http://epa-prgs.ornl.gov/radionuclides/.

EPA developed the Preliminary Remediation Goals for Radionuclides in Buildings (BPRG) electronic calculator to help standardize the evaluation and cleanup of radiologically contaminated buildings at which risk is being assessed for occupancy. BPRGs are radionuclide concentrations in dust, air and building materials that correspond to a specified level of human cancer risk. The BPRG calculator may be found at: http://epa-bprg.ornl.gov/.

EPA developed the Preliminary Remediation Goals for Radionuclides in Outside Surface SPRG calculator to address hard outside surfaces such as building slabs, outside building walls, sidewalks and roads. SPRGs are radionuclide concentrations in dust and hard outside surface materials. The SPRG calculator may be found at: http://epa-sprg.ornl.gov/.

To demonstrate compliance with dose based ARARs, EPA developed three dose assessment models that are similar to its PRG calculators except they establish concentrations that correspond to a year of peak dose, and use dose conversion factors instead of slope factors in their equations. The Dose Compliance Concentration (DCC) calculator addresses the same exposure pathways as the PRG calculator, and it may be found at: http://epa-dccs.ornl.gov/. The Dose Compliance Concentration in Buildings (BDCC) calculator addresses the same exposure pathways as the BPRG calculator and may be found at: http://epa-bdcc.ornl.gov/. The Dose Compliance Concentration in Surfaces (SDCC) calculator addresses the same exposure pathways as the SPRG calculator and may be found at: http://epa-sdcc.ornl.gov/.

CERCLA REMOVAL PROGRAM AND RALS

Removal actions are generally short-term response actions taken to abate or mitigate imminent substantial threats to human health and the environment and are generally surface cleanups. EPA categorizes removal actions in three ways, emergency, time-critical, and non-time-critical, based on the type of situation, the urgency and threat of the release or potential release, and the subsequent time frame in which the action must be initiated. Emergency and time-critical removals are in response to releases requiring action within six months; non-time-critical removals are in response to releases requiring action that can start later than six months.

Emergency removal actions are necessary when there is a release that requires on-site activities within hours of the determination that a removal action is appropriate. Time-critical removal actions are those where the lead agency determines, based on the site evaluation, that a removal action is appropriate and must be initiated within six months.

When conducting emergency and time-critical removal actions that are not based on an ARAR, the removal program may use Removal Action Levels (RALs) to determine if an action is necessary. Risk-based RALs for carcinogens generally are based on a 1×10^{-4} cancer risk. RALs typically are used to help define areas, contaminants and conditions that may warrant an emergency or a time-critical removal action at a site. To develop RALs based one of the three PRG calculators, EPA recommends either (1) multiply the PRG results from either the tables on the PRG "Download" page or the default option for the PRG "Search" page by 100; or, (2) select the site-specific on the PRG "Search" page and change the TR (target cancer risk) to 1.0E-4.

DHS APPROACH FOR RDD/IND FINAL CLEANUP LEVELS

Homeland Security Presidential Directive #5 (HSPD-5), Management of Domestic Incidents, states,

> “to prevent, prepare for, respond to and recover from terrorist attacks, major disasters, and other emergencies, the United States Government shall establish a single, comprehensive approach to domestic incident management.”

It also assigns the Secretary of the Department of Homeland Security (DHS) the role of Principal Federal Official for domestic incident management.

DHS coordinated the development of “Planning Guidance for Protection and Recovery Following (RDD) and Improvised Nuclear Device (IND) Incidents” which was issued in the *Federal Register* (71 FR 174) on August 1, 2008. This document addresses the critical issues of protective actions and protective action guides (PAGs) to mitigate the effects caused by terrorist use of a Radiological Dispersal Device (RDD) or Improvised Nuclear Device (IND). This document was developed to provide guidance for site cleanup and recovery following an RDD or IND incident and affirms the applicability of existing PAGs for radiological emergencies. ***These guides are not intended for use at site cleanups occurring under other statutory authorities such as the Environmental Protection Agency (EPA) Superfund program***, the Nuclear Regulatory Commission’s decommissioning program, or other Federal and state cleanup programs.

DHS recommends that an optimization process should be used to determine the societal objectives for expected land uses and the options and approaches available, in order to select the most acceptable criteria.

Optimization is an approach in which one identifies a variety of dose and/or risk benchmarks from state, Federal, or other sources. These benchmarks may be used for analysis of remediation options and final selected levels may move up or down depending on the site-specific circumstances and balancing of other relevant factors. If the benchmark one chooses has an optimization process built into it, then the optimization process associated with the benchmarks chosen to determine final cleanup levels could be used. For example if the CERCLA criteria is used as a benchmark, then the 9 remedy selection criteria could be used as the optimization process. If the NRC or DOE dose criteria is used as a benchmark, then the ALARA process could be used as the optimization process. Additionally, various Federal and state agencies, and other organizations have existing guidance and tools that may be used to establish recovery levels as part of the optimization process during the late phase. For example, EPA, NRC, DoD, DOE, and state programs dealing with site restoration, decommissioning and waste management have guidance and tools that may be used as part of the optimization process and to implement the recovery process. The DHS PAGs state:

> “Various Federal, and State agencies, along with other organizations (e.g., national and international advisory organizations), already have guidance and tools that may be used to help establish cleanup levels. The optimization process allows local decision makers to draw on the thought processes used to develop the dose and/or risk benchmarks used by these State, Federal, or other sources. These benchmarks, though developed within different contexts, may be useful for analysis of cleanup options. Decision makers might reasonably determine that it is appropriate to move up or down from these benchmarks, depending on the site-specific circumstances and balancing of other relevant factors. In developing this Guidance, the Federal Government recognized that experience from existing programs, such as the EPA’s Superfund program, the NRC’s standards for

> decommissioning and decontamination to terminate a plant license, and other national and international recommendations, may be useful in planning the cleanup and recovery efforts following an RDD or IND incident. This Guidance allows the consideration and incorporation, as appropriate, of any or all of the existing environmental program elements. To prevent, prepare for, respond to and recover from terrorist attacks, major disasters, and other emergencies, the United States Government shall establish a single, comprehensive approach to domestic incident management."

USING EPA TOOLS FOR RDD/IND FINAL CLEANUP LEVELS

Normally, the three EPA CERCLA radiation risk assessment modes (PRG, BPRG, and SPRG calculators) would be used only if at a particular RDD/IND site, the optimization process ended up choosing to use a CERCLA approach for the late-phase. As at a CERCLA site, the user at an RDD or IND site can choose to modify the standard default PRG exposure parameters to calculate site-specific PRGs. The characteristics of an RDD or IND site may warrant the use of site-specific assumptions, which differ from the PRG defaults. The site manager should weigh the cost of collecting the data necessary to develop site-specific PRGs with the potential for deriving a higher PRG that provides an appropriate level of protection.

For both for an actual RDD or IND incident, and an exercise simulating such an incident, there are several fairly simple changes generally should be made from the default input parameters. With the PRG and SPRG calculators, the correct region of the country should be picked for purposes of windblown soil and dust resuspension, rather than the default area of Minneapolis. Also when using the SPRG calculator, users should pick the correct state and roadway class for calculating mechanical resuspension of dust from roadways rather than the California urban highway default. There is a link to an online map from the U.S. Department of Transportation for showing the roadway classification for any domestic roadway.

For simulating the amount of radioactive material that will enter inside buildings, EPA has used in an exercise an assumption of 50% of the level of contamination outside would appear inside, for areas where the public was expected to be relocated, based on data for metals at the World Trade Center incident. [1] In the same exercise EPA assumed a level of 200% indoors for areas where the public would not be relocated based on a study of contamination inside at legacy sites.[2] For contaminated dust indoors, EPA 1×10^{-4} m^{-1} based on a Los Alamos report [3] that the National Academy of Science [4] has used for other analyzing other terrorist incidents. When providing concentrations to develop risk based contours in plume maps such as those from NARAC, a user should also use similar weathering assumptions that are made for other plume maps used in the exercise, such as those for the early and intermediate phase. The user would need to factor in the amount of weathering that would take place to reach the risk-based contour, the plot would be for the initial deposition that would result in the risk-based cleanup level for whatever will be the date (e.g., plus 60 days after detonation) for the exercise.

INDs pose an additional complication because of the large number of radionuclides involved. The initial IND detonation results in the release of over 900 radionuclides. However, after one year almost all risk is posed by 38 radionuclides. The mix of the radionuclides depends on whether U-235 or U-238 is the fissionable material and if the debris is unfractionated, or percent of refractory elements present. [5] Users should then develop a ratio of the concentration of Cs-137 to the other radionuclides, since NARAC can model concentrations of deposited Cs-137 from an IND. Users should then use the PRG calculators to determine what percentage of total risk is Cs-137 for a given land use. If Cs-137 is 5% of total cancer risk from IND mix at year 1 after IND detonation, and 100 pCi/cm2 of Cs-137 = 1×10^{-4}, then the 1×10^{-4} plume contour line will be based on 5 pCi/cm2 of Cs-137.

CONCLUSIONS

EPA's risk assessment tools for addressing radioactively contaminated CERCLA remedial sites may be effectively used for CERCLA removal response actions and for selecting final cleanup levels for response actions for actual events or exercises simulating RDDs or INDs. Users should be aware of which default input parameters would be most easily adjusted with little site-specific information. Also users at RDD/IND exercises should understand how to model processes that for actual events EPA would measure not model.

CONCLUSIONS

1. Yiin, et al., "Comparisons of the Dust/Smoke Particulate that Settled Inside the Surrounding Buildings and Outside on the Streets of Southern New York City after the Collapse of the World Trade Center" Journal of the Air & Waste Management Association, (2004) see pages 518 and 522 http://cfpub.epa.gov/ordpubs/nerlpubs/recordisplay.cfm?deid=85615
2. Paustenbach, Finley and Long, "The Critical Role of House Dust in Understanding the Hazards Posed by Contaminated Soils" International Journal of Toxicology (1997) see page 353 http://ijt.sagepub.com/content/16/4-5/339.full.pdf+html
3. "Surface Contamination: Decision Levels", Healy, Los Alamos Scientific Library, (1971), see page 32 http://library.lanl.gov/cgi-bin/getfile?00399244.pdf
4. "Reopening Public Facilities After a Biological Attack", National Academy of Science, (2005) see pages 97 to 99 http://www.nap.edu/catalog.php?record_id=11324
5. H. Hicks, "Results of Calculations of External Gamma Radiation Exposure Rates from Local Fallout and the Relation Radionuclide Compositions of Two Hypothetical 1-MT Nuclear Bursts. Final Report" (1984) http://www.osti.gov/bridge/purl.cover.jsp;jsessionid=DE57C46AEE5C3B38D753ECBF1ED9C5CF?purl=/6103869-Wl2IMw/

6. H. Hicks, "Nevada Test Site Fallout Atom Ratios: 240Pu/239Pu and 241Pu/239Pu" (1984) http://www.osti.gov/bridge/purl.cover.jsp?purl=/5303010-nQWend/