U.S. EPA Superfund Radiation Risk Assessment: A Community Toolkit – 14338

Stuart A. Walker, Melissa Greer Dreyfus, Dain Thorpe (intern)

U.S. Environmental Protection Agency, Washington, DC. 20460

ABSTRACT

This paper discusses tools that EPA has designed to specifically enhance community involvement at radioactively contaminated Superfund sites. The focus of this paper is a toolkit was developed by EPA to help the general public understand more about EPA's risk assessment process used at radioactively contaminated sites being remediated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund sites. Not all of the 22 fact sheets in the toolkit will be useful at all sites. It is recommended that EPA staff working on a site provide only the fact sheets that are useful for the public at that specific site. The fact sheets will also be available on the internet for any interested members of the public.

INTRODUCTION

The Environmental Protection Agency (EPA) implements the Superfund program under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). From the beginning of the Superfund program, Congress envisioned a role for communities. This role has evolved and expanded during the implementation of the Superfund program.

Initially, the CERCLA statute had community involvement requirements designed to inform surrounding communities of the work being done at a site. CERCLA's provisions required 1) development of a community relations plan for each site, 2) establishment of information repositories near each site where all publicly available materials related to the site would be accessible for public inspection, 3) opportunities for the public to comment on the proposed remedy for each site and 4) development of a responsiveness summary responding to all significant comments received on the proposed remedy.

In recognition of the need for people living near Superfund sites to be well-informed and involved with decisions concerning sites in their communities, SARA expanded Superfund's community involvement activities in 1986. SARA provided the authority to award Technical Assistance Grants (TAGs) to local communities enabling them to hire independent technical advisors to assist them in understanding technical issues and data about the site.

To facilitate the meaningful involvement of communities in the Superfund process, EPA has developed tools. While most of these tools are designed to be useful at a wide variety of sites, some tools are focused on particular site types, such as radiation sites.

PREVIOUS TOOLS FOR RADIATION SITES

EPA previously developed two tools to facilitate public involvement at radioactively contaminated Superfund sites which may be found at the following webpage: http://www.epa.gov/superfund/resources/radiation/radcomm.htm. Both of these products were intended to help the general public, site decision-makers, and community involvement coordinators at radioactively contaminated Superfund sites.

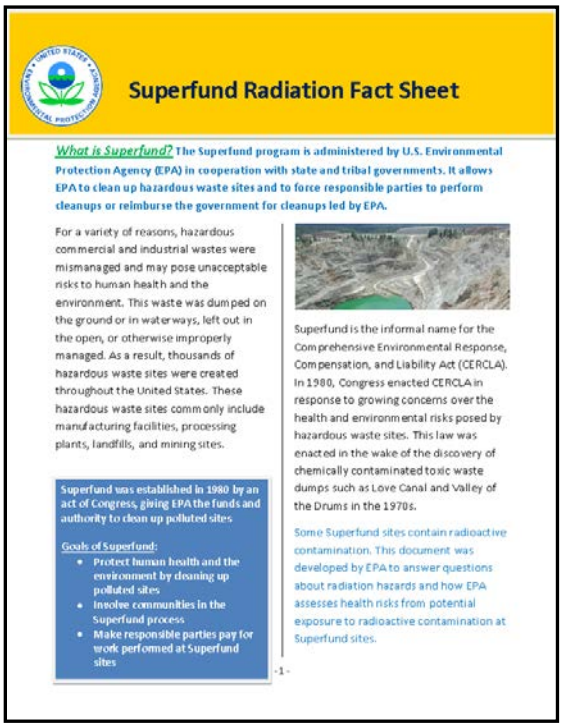
The first is a booklet entitled “Common Radionuclides Found at Superfund Sites.” The information in this booklet is intended to help the general public understand more about the various common radionuclides found at Superfund sites. The booklet contains 12 radionuclide-specific fact sheets that answer questions such as: How can a person be exposed to the radionuclide?, How can it affect human health?, How does it enter and leave the body?, What levels of exposure result in harmful effects?, and What recommendations has EPA made to protect human health from the radionuclide?

The second is a video entitled “Superfund Radiation Risk Assessment and How you can Help, an Overview.” This 19 minute video describes the Superfund risk assessment process for radioactive contamination: what it is, how it works, and most importantly, how members of the public can be involved.

NEW COMMUNITY TOOLKIT FOR RADIATION SITES

EPA continues the development of tools to enhance involvement of communities at radioactively contaminated Superfund sites with the new “Superfund Radiation Risk Assessment: A Community Toolkit.” Below is an overview of the 22 fact sheets that make up the Toolkit.

The first two fact sheets were developed by the EPA to help the general public understand more about the risk assessment process that may be used at Superfund sites to assess and address radioactive contamination. The Superfund Radiation" fact sheet provides an overview of the Superfund remedial program and how and why it addresses radioactive contamination. The "Superfund Radiation Risk Assessment" fact sheet provides an overview of how EPA conducts risk assessments at radioactively contaminated Superfund sites.



Superfund Radiation Fact Sheet

What is Superfund? The Superfund program is administered by U.S. Environmental Protection Agency (EPA) in cooperation with state and tribal governments. It allows EPA to clean up hazardous waste sites and to force responsible parties to perform cleanups or reimburse the government for cleanups led by EPA.

For a variety of reasons, hazardous commercial and industrial wastes were mismanaged and may pose unacceptable risks to human health and the environment. This waste was dumped on the ground or in waterways, left out in the open, or otherwise improperly managed. As a result, thousands of hazardous waste sites were created throughout the United States. These hazardous waste sites commonly include manufacturing facilities, processing plants, landfills, and mining sites.

Superfund was established in 1980 by an act of Congress, giving EPA the funds and authority to clean up polluted sites

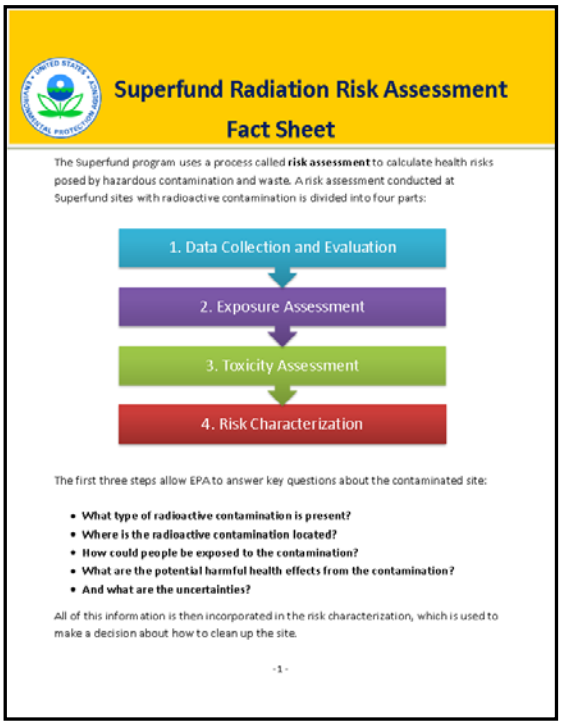
Goals of Superfund:

- Protect human health and the environment by cleaning up polluted sites
- Involve communities in the Superfund process
- Make responsible parties pay for work performed at Superfund sites

Superfund is the informal name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In 1980, Congress enacted CERCLA in response to growing concerns over the health and environmental risks posed by hazardous waste sites. This law was enacted in the wake of the discovery of chemically contaminated toxic waste dumps such as Love Canal and Valley of the Drums in the 1970s.

Some Superfund sites contain radioactive contamination. This document was developed by EPA to answer questions about radiation hazards and how EPA assesses health risks from potential exposure to radioactive contamination at Superfund sites.

-1-



Superfund Radiation Risk Assessment Fact Sheet

The Superfund program uses a process called **risk assessment** to calculate health risks posed by hazardous contamination and waste. A risk assessment conducted at Superfund sites with radioactive contamination is divided into four parts:

1. Data Collection and Evaluation
2. Exposure Assessment
3. Toxicity Assessment
4. Risk Characterization

The first three steps allow EPA to answer key questions about the contaminated site:

- **What type of radioactive contamination is present?**
- **Where is the radioactive contamination located?**
- **How could people be exposed to the contamination?**
- **What are the potential harmful health effects from the contamination?**
- **And what are the uncertainties?**

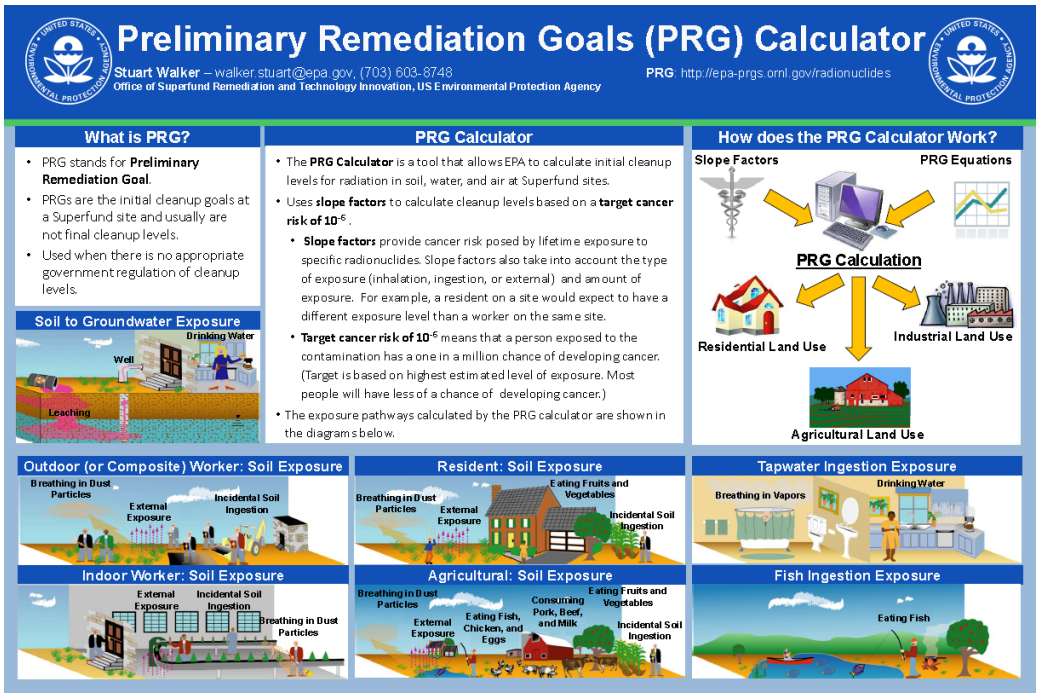
All of this information is then incorporated in the risk characterization, which is used to make a decision about how to clean up the site.

-1-

Attachment A: Compendium of Information on the Preliminary Remediation Goal (PRG) and Dose Compliance Concentration (DCC) Calculators includes fact sheets for 6 calculators that were developed by EPA to assess radioactive contamination in soil, water, air, buildings, sidewalks, and streets at designated Superfund sites. The information in these fact sheets is intended to help the general public understand more about the each of these calculators that may be used at Superfund sites.

These fact sheets answer questions such as:

- What is PRG or DCC?
- How does the calculator work?, and
- What are the types of radioactive exposures does the calculator assess?



In addition to reading the calculator fact sheets, Attachment A includes a “Primer on PRG and DCC Calculators” fact sheet may be helpful for general information about cleanup levels for radioactively contaminated Superfund sites, and for an explanation of some of the terms that appear in each of the calculator fact sheets.

Attachment B: Compendium of Information on Radionuclides Commonly Found at Superfund Sites includes 12 facts sheets on radionuclides are the most frequently encountered at U.S. Environmental Protection Agency (EPA) designated Superfund sites. The information in these fact sheets is intended to help the general public understand more about the various radionuclides commonly found at Superfund sites.

- amercium-241
- cesium-137
- cobalt-60
- iodine
- plutonium
- radium
- radon
- strontium

- technetium-99
- thorium
- tritium
- uranium

These fact sheets answer questions such as:

- How can a person be exposed to the radionuclide?
- How can it affect human health?
- How does a radionuclide enter and leave the body?
- What levels of exposure result in harmful health effects?, and
- What recommendations has EPA made to protect human health from the radionuclide?

EPA Facts about Cesium-137

What is cesium-137?

Radioactive cesium-137 is produced spontaneously when other radioactive materials, such as uranium and plutonium, absorb neutrons and undergo fission. Fission is the process in which the nucleus of a radionuclide splits into smaller parts. Cesium-137 is a common radionuclide produced when nuclear fission of uranium and plutonium occurs in a reactor or atomic bomb.

What are the uses of cesium-137?

Cesium-137 and its decay product, barium-137m, are used in food sterilization, including wheat, spices, flour, and potatoes. Cesium-137 is used in a wide variety of industrial instruments, such as level and thickness gauges and moisture density gauges. Cesium-137 is also commonly used in hospitals for diagnosis and treatment. Large sources can be used to sterilize medical equipment.

How does cesium change in the environment?

Cesium-137 decays in the environment by emitting beta particles. As noted above, cesium-137 decays to a short-lived decay product, barium-137m. The latter isotope emits gamma radiation of moderate energy, which further decays to a stable form of barium. The time required for a radioactive substance to lose 50 percent of its radioactivity by decay is known as the half-life. Cesium-137 is significant because of its prevalence, relatively long half life (30 years), and its potential effects on human health. Barium-137, the daughter product of cesium-137 decay, has a half-life of 2.6 minutes.

How are people exposed to cesium-137?

People may be exposed externally to gamma radiation emitted by cesium-137 decay products. If very high doses are received, skin burns can result. Gamma photons emitted from the barium decay product, barium-137m, can pass through the human body, delivering radiation exposure to internal tissue and organs. People may also be exposed internally if they swallow or inhale cesium-137.

Large amounts of cesium-137 were produced during atmospheric nuclear weapons tests conducted in the 1950s and 1960s. As a result of atmospheric testing and radioactive fallout, this cesium was dispersed and deposited worldwide.

Sources of exposure from cesium-137 include fallout from previous nuclear weapons testing, soils and waste materials at radioactively contaminated sites, radioactive waste associated with operation of nuclear reactors, spent fuel reprocessing plants, and nuclear accidents such as Chernobyl and Fukushima. Cesium-137 is also a component of low-level radioactive waste at hospitals, radioactive source manufacturing, and research facilities.

How does cesium-137 get into the body?

Cesium-137 can enter the body when it is inhaled, ingested, or absorbed through the skin. After radioactive cesium is ingested, it is

- 1 -

distributed fairly uniformly throughout the body's soft tissues. Slightly higher concentrations are found in muscle; slightly lower concentrations are found in bone and fat. Cesium-137 remains in the body for a relatively short time. It is eliminated more rapidly by infants and children than by adults.

Is there a medical test to determine exposure to cesium-137?

Generally, levels of cesium in the body are inferred from measurements of urine samples using direct gamma spectrometry. Because of the presence of the gamma-emitting barium daughter product, a technique called whole-body counting may also be used; this test relies on detection of gamma photon energy. Skin contamination can be measured directly using a variety of portable instruments. Other techniques that may be used include taking blood or fecal samples, then measuring the level of cesium.

How can cesium-137 affect people's health?

Based on experimentation with ionizing radiation and human epidemiology, exposure to radiation from cesium-137 can cause cancer. Great Britain's National Radiological Protection Board (NRPB) predicts that there will be up to 1,000 additional cancers over the next 70 years among the population in Western Europe exposed to fallout from the accident at Chernobyl.

The magnitude of the health risk would depend on exposure conditions for scenarios involving nuclear accidents or waste materials, such as:

- Types of radioactivity encountered,
- Nature of exposure, and
- Length of exposure.

What recommendations has the U.S. Environmental Protection Agency made to protect human health?

Please note that the information in this section is limited to recommendations EPA has made to protect human health from exposure to cesium-137. General recommendations EPA has made to protect human health at Superfund sites (the 10^{-4} to 10^{-6} cancer risk range), which cover all radionuclides including cesium-137, are summarized in the fact sheet "Primer on Radionuclides Commonly Found at Superfund Sites."

EPA has established a Maximum Contaminant Level (MCL) of 4 millirems per year for beta particle and photon radioactivity from man-made radionuclides in drinking water. Cesium-137 would be covered under this MCL. The average concentration of cesium-137, which is assumed to yield 4 millirems per year, is 200 picoCuries per liter (pCi/L). If other radionuclides that emit beta particles and photon radioactivity are present in addition to cesuim-137, the sum of the annual dose from all the radionuclides cannot exceed 4 millirems/year.

For more information about how EPA addresses cesium-137 at Superfund sites

Contact Stuart Walker of EPA:
(703) 603-8748 or walker.stuart@epa.gov,
or visit EPA's Superfund Radiation Webpage:
http://www.epa.gov/superfund/resources/radiation/

- 2 -

In addition to the radionuclide fact sheets, the "Primer on Radionuclides Commonly Found at Superfund Sites"" fact sheet provides general information about cleanup levels for radioactively contaminated Superfund sites, and for an explanation of some of the terms that appear in each of the radionuclide fact sheets.

The fact sheets in Attachment B replace the EPA previously issued the booklet "Common Radionuclides Found at Superfund Sites."

CONCLUSION

The draft is in final signature phase of EPA's internal review and should be finalized prior to the Waste Management 2014 conference. This toolkit should facilitate the cleanup of radioactively contaminated Superfund sites by helping to improve public confidence in the cleanup process by enhancing the involvement of the public in the cleanup process. The toolkit helps the public better understand the risk assessment process and therefore the selection of cleanup levels.