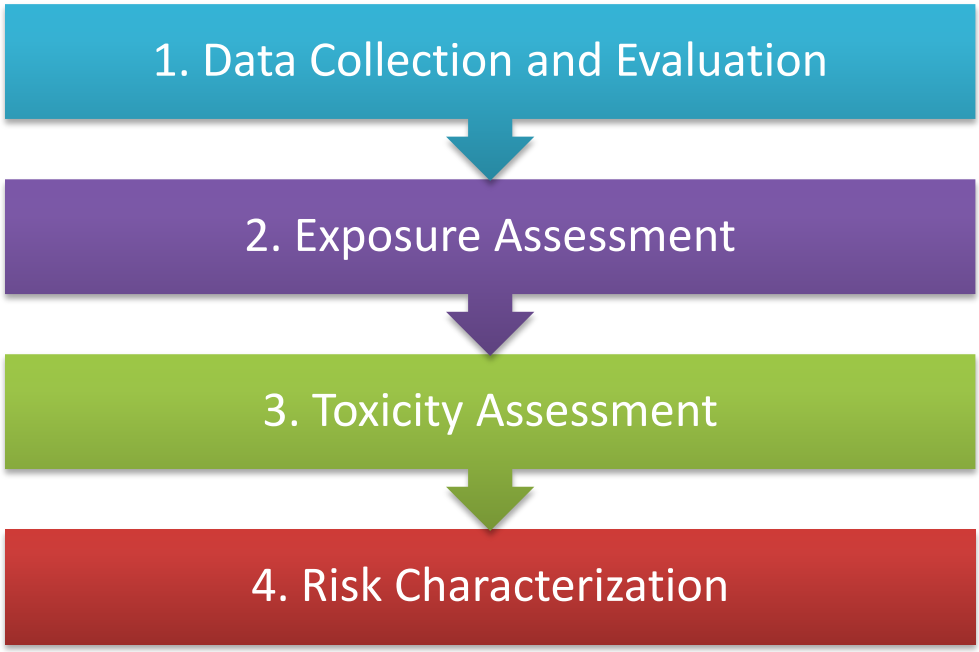
Superfund Radiation Risk Assessment Fact Sheet

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:



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.

Step 1: Data Collection and Evaluation

During Data Collection and Evaluation, EPA has to find out how the site became contaminated and what radionuclides are present. This step is a four-part process.

1. Information Gathering

In the first step, EPA collects information about the site. Information can be collected in many ways, including:

- Looking at old photographs of the site
- Studying maps of the site and surrounding areas
- Reading documents related to the site
- Interviewing community members who are knowledgeable about the site.

By gathering this information, EPA can gain a better understanding of the history and geography of the site and what activities may have taken place there.

Community Involvement

Community involvement is important in the EPA risk assessment process. By engaging the community in the process, we are able to gain local information and insight into the site and its history. This information can allow us to better understand risks to the public near the site.

2. Field Survey

Next, EPA uses special equipment to find areas that may be contaminated. Hand-held instruments are used for smaller areas, but larger sites may require equipment mounted on a van, tractor, or aircraft.

3. Sample Collection

Samples are collected from contaminated areas identified in the field survey. It is important that samples are collected in the right places so that no radionuclides are missed. For example, samples may be collected

from soil, air, water, fish, and vegetation in multiple locations.

4. Determining list of radionuclides

Samples collected are then sent to a laboratory to be analyzed.

The result of all the sampling and laboratory work is a list of radionuclides found at the site and the concentration (or amount) of those radionuclides.

Understanding Background Radiation

Many of the same radionuclides that contaminate a Superfund site also occur naturally. As a result, samples are also collected in uncontaminated areas surrounding the site. These samples allow EPA to determine local background concentrations. Understanding background concentration allows EPA to decide which radionuclides will require the most focus during the investigation.

At this point, it is not known if the levels of these radioactive contaminants could be harmful. The next step of the risk assessment process evaluates whether the contamination from the site may pose a risk to human health.

Step 2: Exposure Assessment

Exposure assessments are used to calculate the amount of exposure to radionuclides on a site that is likely to occur for people near the site (such as residents, workers, and visitors). This assessment is important because radiation that cannot reach you cannot hurt you.

Once it is known which radionuclides are on the site, their concentrations, and where they are, calculations are made to estimate the amount of radiation people may be exposed to. Many factors are included in making these calculations, such as:

- How much air people breathe.
- How much water they drink and use for other purposes.
- How much time people spend near the contaminated site. (Someone who lives near the site, for example, would have a different exposure level than someone working at or visiting the site.)

All of this information is then used to determine how much contact people have with the radioactive contamination.

Community Involvement

The public can be exposed to radiation at Superfund sites through many daily activities. By working with the public, EPA can learn how people in the area could come into contact with the radionuclides from a Superfund site.

Unique community interaction with the environment, such as eating wild fish and game or locally grown foods, is also considered to account for other potential routes of exposure.

Now that the types of radionuclides and the extent of exposure to them have been determined, the next step is to understand harmful health effects from this exposure.

Step 3: Toxicity Assessment

The toxicity assessment phase answers two key questions: what potential harmful health effects can the radionuclide cause, and how much exposure to the radionuclide does it take to pose a significant risk to people?

The toxicity assessment is concerned with the potential for radionuclides to cause cancer. All radionuclides can cause cancer and are assumed to be potentially harmful even at low doses. The risk of cancer from radiation increases as the exposure increases. Uranium radionuclides are the only radionuclides where the noncancer effects are also considered during Superfund site cleanup.

In estimating the toxicity of a radionuclide, EPA must take into account the type of radiation it emits and how the radiation affects different organs in the body. Alpha particles, for example, inflict about 20 times more damage to living tissue than beta particles or gamma rays. In addition, different organs in the body have different cancer rates even when exposed to the same level of radiation. As a result, EPA must consider both whole body radiation exposure as well as specific organ exposure for certain radionuclides.

Understanding Radiation Toxicity

At much higher radiation exposures than would be expected at a Superfund site, harmful effects can be produced in a relatively short time. An example of this is the sickness seen in atomic bomb survivors. Since exposure at Superfund sites is usually much lower, EPA focuses primarily on the cancer risk from exposure to radionuclides.

EPA has developed two methods to assess the harmful effects of exposure to specific radionuclides:

- **Slope factors** provide cancer risk posed by lifetime exposure to specific

radionuclides. Slope factors also take into account the type of exposure (inhalation, ingestion, or external).

- **Dose conversion factors (DCFs)** convert concentration of specific radionuclides (in air, soil, water, or food) to a radiation dose based on a person's type of exposure.

EPA uses this information, combined with the exposure assessment, to calculate how toxic the radionuclides are at the Superfund site.

Step 4: Risk Characterization

Risk characterization is the final phase in a Superfund radiation risk assessment. From the data collection and evaluation phase, we developed a list of radionuclides, and the concentrations of those radionuclides, found at the site. We learned from the exposure assessment phase who is exposed, how they are exposed, and how much of the radioactive contaminants they are exposed to. And from the toxicity assessment, we found out how toxic these contaminants could be based on the exposure. During the risk characterization, we use all of this information to calculate the risk of potential health effects from exposure to radionuclides at the site.

Health risk is based on the excess risk of cancer from exposure to radioactive contamination. This risk is described in terms of the probability that an exposed individual will develop cancer over a lifetime as a result of that exposure.

EPA generally considers excess cancer risk in the range of 1 out of ten thousand people to 1 out of one million people, or 10^{-4} to 10^{-6}, as a protective range for both chemical and radioactive contaminants. If a site is contaminated with radionuclides and cancer-causing chemicals, cancer risk is combined for both. Most people will have less chance of getting cancer than these numbers indicate because EPA uses assumptions about exposure to contaminants that are designed to ensure that everyone at a site is protected, including vulnerable populations such as children.

Once the health risks from the site are understood, the list of radionuclides found at the site is reviewed and a determination is made as to which radionuclides pose a significant risk. This information, as well as information about risks to the environment, can now be used to develop a cleanup plan that will make the site safe for both current and future uses, protecting human health and the environment.

What if I want More Information?

If you would like to learn more about EPA's risk assessment process for radiation at Superfund sites, you may want to watch the video "Superfund Radiation Risk Assessment and How You Can Help: An Overview" available online at: http://www.epa.gov/superfund/health/contaminants/radiation/radvideo.htm.

You may also read documents that EPA has written to help its own staff in conducting risk assessments for radiation at Superfund sites. The "Radiation Risk Assessment at CERCLA Sites: Q & A" is a good place to start since it provides an overview for EPA staff of the material available for them to use. This document is available online at: http://www.epa.gov/superfund/health/contaminants/radiation/pdfs/riskqa-second.pdf.

If you would like to learn more about EPA's Superfund program, you may wish to read "This is Superfund: A Community Guide to EPA's Superfund Program." This guide is available online at: http://www.epa.gov/superfund/community/today/pdfs/TIS%20FINAL%209.13.11.pdf.

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