



**US Army Corps
of Engineers®**

Fact Sheet

Risk Assessment

U.S. Army Corps of Engineers

This is one in a series of fact sheets that provides information about regulatory, technical, and other issues related to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This fact sheet discusses risk assessment: what it is and how it is used in making cleanup decisions.

What is Risk?

Risk is the chance that some harmful event will occur. In the case of environmental cleanups, we think of risk as the potential for a negative health impact as a result of exposure to contamination.

What is Risk Assessment?

Risk assessment is the process used to determine the potential for a negative health effect to occur as a result of exposure to hazardous materials. A risk assessment should be able to answer the questions: "*What is the problem, and how bad is it?*" Under DERP-FUDS and FUSRAP, risk assessment information helps determine what actions should be taken to clean up the site. Risk assessments are one type of information considered in risk management.

How is Risk Calculated in the Risk Assessment?

Risk is a function of how much of a contaminant enters a person's body (exposure), and how dangerous a contaminant is to humans (toxicity). If there is no exposure, then there is no risk. The calculation for determining risk may be expressed as:

$$\text{Risk} = \text{Exposure} \times \text{Toxicity}$$

Exposure. Exposure to contamination may occur from many routes, including drinking contaminated water, breathing contaminated air, eating contaminated foods, or accidentally inhaling or ingesting contaminated soil particles. Exposure can also occur through direct contact between contaminants and skin.

The concentration of the contaminant in the water, air, sediment, or soil that is contacted at the point of exposure is one factor that will determine level of exposure. Another factor that will determine the level of exposure is the type of activity and land-use taking place at the point of exposure. For example, a person that lives directly on a contaminated site will most likely obtain a greater exposure to the contamination than a person who works at or only occasionally visits a contaminated site.

Toxicity. The U.S. Environmental Protection Agency and other government agencies have compiled the toxicity of many hazardous compounds in readily available, standardized data-bases. Not all compounds have well understood toxicity values. Special consideration is given to populations such as pregnant women and children that may be especially susceptible to a contaminant's toxic effects.

Uncertainty. Although risk assessment is a science, it is not a perfect one. Most scientists agree that there is a great deal of uncertainty associated with risk assessment; however, to compensate for this uncertainty, the risk assessment process is deliberately conservative. That is, it errs on the side of safety when calculating potential risks to people.

Characterization of Risks in the Risk Assessment

Health impacts are generally characterized as carcinogenic or non-carcinogenic. For a non-cancer illness, the risk calculation (shown above) will result in a "hazard quotient". When a risk calculation results in a hazard quotient less than 1, it is assumed there will be no adverse health effects from that exposure to that contaminant. A hazard quotient above 1 is considered hazardous.

Carcinogenic risks (which include risks from radioactive compounds) are characterized as the risk or probability of developing cancer over a lifetime. Because it is a probability, carcinogenic risk is expressed as a fraction, without units. This takes values from 0 to 1.

What is Risk Management?

The term "risk management" describes a type of decision making. First, a decision must be made as to whether an assessed risk needs to be reduced to protect public health and the environment. Second, a decision must be made about the means to reduce that risk, should action be deemed necessary.

Risk management is the process of weighing policy alternatives and selecting the most appropriate regulatory action. Risk management is not a science; rather it combines information about risk with economic, political, legal, ethical, and value judgments to reach decisions.

Legal Requirements

For environmental cleanups at Superfund sites, risk management decisions are primarily driven by legal requirements. The U.S. Environmental Protection Agency is responsible for developing risk assessment guidelines for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which is more commonly known as Superfund.

For carcinogenic contaminants, current Superfund regulations consider the range of 1 in 10,000 (0.0001 or 10^{-4}) to 1 in 1,000,000 (0.000001 or 10^{-6}) excess lifetime risk of cancer to be acceptable. An excess lifetime risk of cancer is the probability above the 1 in 3 risk of developing cancer in the United States (American Cancer Society). If the excess cancer risk is above 1 in 10,000, then an action must be taken to reduce the cancer risk from exposure to this contaminant.

For contaminants which cause non-cancer illnesses, if the hazard quotient is above 1, then an action must be taken to reduce the risk of adverse health effect from exposure to this contaminant.

References and Further Reading:

- *Risk Assessment Guidance in Superfund, U.S. Environmental Protection Agency*
http://www.epa.gov/oswer/riskassessment/risk_superfund.htm
- *Risk Assessment in the Federal Government: Managing the Process, National Research Council*
- *Scientific Notation Fact Sheet, U.S. Army Corps of Engineers, Buffalo District*

How Do I Get More Information?

To get more information about risk assessment or other related issues, contact:

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The USACE-Buffalo District also maintains a WebPage with additional information and links to related sites at: <http://www.lrb.usace.army.mil/fusrap>