Lecture 4b-Exposure Assessment for EPA Superfund Sites

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Tuesdays & Thursdays
3-4:25 pm, Room A719 Crabtree Hall, GSPH
What is CERCLA?

• The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Over five years, $1.6 billion was collected and the tax went to a trust fund for cleaning up abandoned or uncontrolled hazardous waste sites.
What Does CERCLA DO?

• established prohibitions and requirements concerning closed and abandoned hazardous waste sites;
• provided for liability of persons responsible for releases of hazardous waste at these sites; and
• established a trust fund to provide for cleanup when no responsible party could be identified.
Response Types Under CERCLA

• Short-term removals, where actions may be taken to address releases or threatened releases requiring prompt response. Generally these are Immediately Dangerous to Life and Health (IDLH).

• Long-term remedial response actions, that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious, but not immediately life threatening. These actions can be conducted only at sites listed on EPA's National Priorities List (NPL).
What Does SARA DO?

• The Superfund Amendments and Reauthorization Act (SARA) amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on October 17, 1986. SARA reflected EPA's experience in administering the complex Superfund program during its first six years and made several important changes and additions to the program. SARA:
  • stressed the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites;
  • required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations;
  • provided new enforcement authorities and settlement tools;
  • increased State involvement in every phase of the Superfund program;
  • increased the focus on human health problems posed by hazardous waste sites;
  • encouraged greater citizen participation in making decisions on how sites should be cleaned up; and
  • increased the size of the trust fund to $8.5 billion.
• SARA also required EPA to revise the Hazard Ranking System (HRS) to ensure that it accurately assessed the relative degree of risk to human health and the environment posed by uncontrolled hazardous waste sites that may be placed on the National Priorities List (NPL).
Chapter 6—Risk Assessment Guidelines, Exposure Assessment Procedure

- The objective of the exposure assessment is to estimate the type and magnitude of exposures to the chemicals of potential concern that are present at or migrating from a site.
- The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.
Step 1-Characterization of the Exposure Setting

- In this step, the assessor characterizes the exposure setting with respect to the general physical characteristics of the site and the characteristics of the populations on and near the site.

- Basic site characteristics such as climate, vegetation, ground-water hydrology, and the presence and location of surface water are identified in this step.

- Populations also are identified and are described with respect to those characteristics that influence exposure, such as location relative to the site, activity patterns, and the presence of sensitive subpopulations. This step considers the characteristics of the current population, as well as those of any potential future populations that may differ under an alternate land use.
Step 2—Exposure Pathway Analysis

• In this step, the exposure assessor identifies those pathways by which the previously identified populations may be exposed.
• Each exposure pathway describes a unique mechanism by which a population may be exposed to the chemicals at or originating from the site.
• Exposure pathways are identified based on consideration of the sources, releases, types, and locations of chemicals at the site; the likely environmental fate (including persistence, partitioning, transport, and intermedia transfer) of these chemicals; and the location and activities of the potentially exposed populations.
• Exposure points (points of potential contact with the chemical) and routes of exposure (e.g., ingestion, inhalation) are identified for each exposure pathway.
Step 3 -- Quantification of exposure

- In this step, the assessor quantifies the magnitude, frequency and duration of exposure for each pathway identified in Step 2.
- This step is most often conducted in two stages: estimation of exposure concentrations and calculation of intakes.
Estimation of exposure concentrations

• In this part of step 3, the exposure assessor determines the concentration of chemicals that will be contacted over the exposure period.
• Exposure concentrations are estimated using monitoring data and/or chemical transport and environmental fate models.
• Modeling may be used to estimate future chemical concentrations in media that are currently contaminated or that may become contaminated, and current concentrations in media and/or at locations for which there are no monitoring data.
Calculation of intakes

• In this part of step 3, the exposure assessor calculates chemical specific exposures for each exposure pathway identified in Step 2. Exposure estimates are expressed in terms of the mass of substance in contact with the body per unit body weight per unit time (e.g., mg chemical per kg body weight per day, also expressed as mg/kg-day).

• These exposure estimates are termed "intakes" and represent then normalized exposure rate.

• Chemical intakes are calculated using equations that include variables for exposure concentration, contact rate, exposure frequency, exposure duration, body weight, and exposure averaging time.

• The values of some of these variables depend on site conditions and the characteristics of the potentially exposed population.

• After intakes have been estimated, they are organized by population, as appropriate.

• Then, the sources of uncertainty (e.g., variability in analytical data, modeling results, parameter assumptions) and their effect on the exposure estimates are evaluated and summarized.

• This information on uncertainty is important to site decision-makers who must evaluate the results of the exposure and risk assessment and make decisions regarding the degree of remediation required at a site.

• The exposure assessment concludes with a summary of the estimated intakes for each pathway evaluated.