



# The Hazard Ranking System (HRS)

- BACKGROUND:** In 1990, the U.S. Environmental Protection Agency (EPA) revised procedures for evaluating uncontrolled releases of hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). These revised procedures include substantial changes to the Hazard Ranking System (HRS), the scoring system EPA uses to assess a site's relative threat to public health and the environment. This information brief provides an overview of the HRS as it applies to DOE facilities and the relationship of the HRS to other site activities under CERCLA and the Resource Conservation and Recovery Act (RCRA).
- STATUTES:** [42 U.S.C. 9601 *et seq.*] CERCLA §105(8)(A), now §105(a)(8)(A), as amended by [Pub. L. 99-499] SARA, which added §105(c)(1) to CERCLA; [Pub. L. 94-580] RCRA.
- REGULATIONS:** *Code of Federal Regulations*, Section 40 (40 CFR), Part 300, as amended, 55 *FR* 8666, March 8, 1990; 40 CFR, Part 300, Appendix A, "Hazard Ranking System; Final Rule," 55 *FR* 51532, December 14, 1990.
- REFERENCES:**
1. *Comprehensive Environmental Response, Compensation, and Liability Act Requirements*, DOE Order 5400.4, October 6, 1989.
  2. "Federal Agency Hazardous Waste Compliance Docket ("docket")," EH-231 Information Brief, EH-231-011/0192 (January 1992).
  3. "Site Inspections (SIs) Under CERCLA," EH-231 Information Brief, EH-231-013/1092 (October 1992).
  4. *Guidance for Performing Preliminary Assessments Under CERCLA*, EPA/540/G-91/013 (September 1991).
  5. *Guidance for Performing Site Inspections Under CERCLA*, EPA 540-R-92-021 (September 1992).
  6. *Hazard Ranking System Guidance Manual*, EPA-R-92-026 (November 1992).
  7. *Executive Order 12580*, January 23, 1987.

## What is the HRS and what is its purpose?

The HRS is a relatively simple scoring system EPA uses to evaluate relative threats to public health and the environment posed by uncontrolled releases or threatened releases of hazardous substances. The HRS uses information obtained from the initial, limited investigations conducted at a site—the Preliminary Assessment (PA) and the Site Inspection (SI). EPA uses the HRS to assign each site a score ranging from 0 to 100 based on the likelihood that contaminants have been or will be released from the site, the physical and toxicological characteristics of the contaminants present at the site, and the human population or sensitive environments actually or potentially exposed to a release from the site. Sites scoring at least 28.50 are eligible

for placement on the National Priorities List (NPL), which designates those sites representing the highest priority for further investigation and possible cleanup under CERCLA.

## What is the statutory/regulatory basis for the HRS?

The HRS is Appendix A to the National Contingency Plan (NCP), the primary regulation developed under CERCLA. Originally adopted in 1982, the HRS was revised in 1990 in response to SARA and now

- places greater scoring weight on "targets" (e.g., human population and sensitive environments) actually exposed to contamination or located near sources of contamination;

- considers threats from contaminated soils, from human food-chain organisms, and to sensitive environments; and
- uses revised toxicity factors that include chronic noncarcinogenic and carcinogenic effects. (The original HRS considered only acute toxicity.)

### What is the structure of the HRS?

While not a risk assessment *per se*, the HRS provides a measure of relative threat among the universe of uncontrolled releases of hazardous substances for the purposes of identifying sites eligible for listing on the NPL. The HRS structure includes *pathways* (i.e., avenues by which people or environmental receptors may be exposed to contaminants), *threats* do potential releases within the pathways, and *factors* (i.e., variables) within each pathway and threat. The algorithm used to calculate the HRS score allows the score to be relatively high even if only one pathway score is high. This is important because some extremely dangerous sites pose threats through only one pathway (e.g., deeply-buried, leaking drums might contaminate nearby drinking water wells but pose no threat via the air, surface water, or soil exposure pathways).

The four HRS pathways are air, ground water, surface water, and soil exposure. The surface water pathway is subdivided into the drinking water pathway, which considers threats from drinking contaminated water; the human food-chain pathway, which considers threats from eating contaminated fish and shellfish; and the environmental pathway, which considers threats to sensitive environments. The soil exposure pathway considers threats to resident populations (i.e., persons living or working on contaminated property) and nearby populations (i.e., persons living near contaminated property).

Within each HRS pathway and threat, multiple individual factors are grouped into three *factor categories* designed to answer three fundamental characteristics of each site.

- *Likelihood of release* addresses the likelihood that a contaminant has been or will be released into the environment.
- *Waste characteristics* addresses the properties of the contaminant and how much is likely to migrate from the site.
- *Targets* addresses how many persons or what sensitive environments are threatened by the release(s).

Numerical values are assigned to factors and used to calculate factor category values for each pathway.

The HRS score for a site is calculated using a root mean square approach: the square root of the sum of the squares of the pathway scores, divided by a factor (Ref. 4). Because the maximum score for each of the pathways is 100, the root mean square approach puts the site score on a scale of 0 to 100.

### What is the relationship of the HRS to the CERCLA pre-remedial process?

The HRS is a fundamental part of the process EPA and DOE use to evaluate sites under CERCLA, and the HRS score is the primary measure of whether or not a site should be placed on the NPL. The HRS also defines specific PA and SI data collection needs and determines how PA and SI data are combined into the site score. For example, as part of the evaluation of likelihood of release in the ground water pathway, the HRS requires an estimate of the depth from the bottom of a source to the top of an aquifer, assigns a value to the factor "depth to aquifer" based on that estimate, and dictates how the factor value for "depth to aquifer" is combined with other factor values to yield a value for likelihood of release. To assist in the site assessment process, a preliminary HRS score is developed during the PA and refined throughout the SI and NPL listing stages, if warranted.

### What is the significance of an HRS score of 28.50 and other HRS scores?

The cutoff score of 28.50 was chosen for the original HRS as a management tool because using that value would yield an initial NPL of at least 400 sites as suggested by CERCLA. The cutoff score has never been a part of the HRS and can be changed without a rulemaking process if EPA determines such a change is warranted. After analyzing data from 110 sites, EPA decided not to change the cutoff score when promulgating the 1990 revisions to the HRS.

The cutoff score of 28.50 is not a strict statement of "significant" versus "nonsignificant" threat or risk at a site. EPA has never equated the HRS score with a level of risk nor attached significance to the cutoff score as an indicator of a specific level of risk from a site. EPA never intended the cutoff to reflect a point below which no threat is present. Moreover, HRS scores above 28.50 should not be used by themselves in setting priorities for further investigation or remedial action. The HRS algorithms include numerous complex, nonlinear relationships which reflect requirements established by SARA and policy decisions by EPA as well as risk assessment principles. As a consequence, the HRS algorithms do not imply, for example, that a score of 70 represents a greater threat than a score of 50, or that two sites with equal scores should have equal priorities for further response.

## **What are PA Score and Pre-Score and how are they used?**

*PA Score* and *Pre-Score* are PC-based programs that assist the user in conducting a site assessment and developing a preliminary HRS score. *PA Score* is used at the PA stage; *Pre-Score* is used at the SI stage. Both programs contain the necessary worksheets, databases, and instructions for completing an HRS score and provide printed outputs suitable for inclusion in a final report. These programs eliminate arithmetical errors in calculating site scores and reduce or eliminate the need to look up factor values that depend on the particular conditions or characteristics of a site (e.g., location-specific factors such as net precipitation and chemical-specific factor values such as toxicity). However, the databases for these programs may not always contain complete factor values for the unique contaminants found at DOE's sites.

Both programs are useful for understanding the data requirements of the PA or SI in general as well as the specific data gaps at a site. For sites with scores close to the 28.50 cutoff, these programs can be used to evaluate "what if" scenarios in order to identify the data most critical for determining whether or not the site score will exceed the cutoff. During the SI, *Pre-Score* also can be used to establish data quality objectives for particular data collection activities (e.g., where and how many samples to collect to most efficiently develop an HRS score and how precisely to delineate the boundaries of a wetland in developing a defensible HRS score).

## **Which factors were changed in or added to the revised HRS?**

Nearly every factor in the original HRS was changed in some way in the revised HRS. Some of the most important changes include adding the soil exposure pathway to address direct contact problems, adding the human food-chain threat to the surface water pathway, placing greater scoring emphasis on sites that have resulted in actual exposure of targets as opposed to potential exposure, revising the toxicity factors to include chronic effects, weighting potentially exposed targets according to their distance from a site or the amount of dilution likely to occur, placing greater emphasis on environmental targets, and allowing the air pathway to be scored for potential releases as well as actual releases.

## **Which HRS factors have a large contribution to HRS scores?**

It is difficult to draw general conclusions on which factors have a large contribution to HRS scores because nearly any factor can be critical at a given site, particularly if the site score is near the cutoff. Establishing an observed release to air, soil, ground water,

or surface water usually is important because the value for likelihood of release for the appropriate pathway(s) is maximized, and it is possible to establish actual contamination at one or more targets, which, in turn, will increase the appropriate pathway score by a factor of 10 to 100 or more. Establishing an observed release to surface water for a substance with a high bioaccumulation potential (e.g., PCBs, dioxins) will often put the site score above the cutoff due to the human food chain and environmental threats. Useful insights into key factors at a given site can be obtained from knowledge of the HRS scoring algorithms and evaluating "what if" scenarios using *PA Score* and/or *Pre-Score*.

## **What are DOE's responsibilities in developing an HRS score and proposing a site for NPL listing?**

At a minimum, DOE must collect and summarize sufficient data to develop and fully document the HRS score for the site. At the PA stage, the emphasis is on collecting information on waste characteristics and targets and on developing defensible hypotheses regarding suspected releases and contamination at targets. At the SI stage, the emphasis is on collecting or using existing analytical sampling data to test hypotheses developed during the PA and collecting complete, updated information on all other specific site parameters required for HRS scoring. Analytical data usually must include full-spectrum chemical analysis; targeted analysis of specific substances may be acceptable but must be justified based on site information (e.g., complete knowledge of wastes present).

EPA (or the authorized state) has final responsibility for defining data collection requirements, making the ultimate determination as to whether data collection is adequate, developing the HRS score, and proposing a site for the NPL.

## **What are special considerations in applying the HRS at DOE sites?**

Although one of the key goals of the HRS is to provide for a consistent evaluation of the relative threat posed by a wide variety of sites nationwide, DOE sites are unique in several ways. DOE's sites range widely in size. The larger sites often encompass many, widely dispersed sources and contaminant releases that may be divided into smaller administrative units, each of which may require a separate PA, SI, and HRS score. DOE's sites often include unique and complex wastes (e.g., radionuclides and mixed waste). Values for substance-specific HRS factors (e.g., toxicity, bioaccumulation potential) for the unique substances found at DOE sites may not be found in the databases associated with *PA Score* and *Pre-Score*.

DOE's sites differ administratively from most sites evaluated under CERCLA. Many active facilities in-

clude inactive hazardous waste sites, and thus are subject to the requirements of both CERCLA and RCRA. States generally have primary authority to enforce site assessment activities under RCRA, while EPA generally has the primary authority to enforce CERCLA site assessment activities. This split may lead to problems over primary enforcement authority and ultimate approval of HRS scores. In addition, DOE facilities are subject to other environmental statutes (e.g., National Environmental Policy Act, Clean Air Act, and Clean Water Act) which may add layers of competing site assessment authorities and requirements. Finally, remedial actions at DOE's sites are not contingent upon NPL listing, pursuant to DOE Order 5400.4.

### **Is the HRS score of any value to the RCRA corrective action process?**

The HRS score, by itself, does not trigger further investigations under RCRA. The trigger under RCRA generally is documenting environmental concentrations exceeding specified "action levels" developed for the protection of public health and the environment. Moreover, lists of target analytes, approved analytical procedures, quantitation limits, and QA/QC requirements and procedures differ significantly between CERCLA and RCRA, making it difficult to utilize data collected under one process for the other.

Given the dual authority that applies to DOE sites, elements of the HRS (e.g., pathway scores) may identify potential releases that pose a sufficient threat to public health and the environment to warrant investigation under RCRA corrective action, even if the HRS score is lower than the cutoff for inclusion on the NPL (i.e., 28.50). However, EPA may consider substantial studies or actions that meet CERCLA requirements and have occurred at the time a RCRA permit is issued to be consistent with RCRA requirements. As a consequence, solid waste management units (SWMUs) that have undergone the CERCLA remedial process may not be subject to RCRA corrective action, although corrective action may still apply at other SWMUs at the same site.

### **What are the potential requirements related to the HRS at RCRA sites?**

Under SARA, EPA established a Federal Agency Hazardous Waste Compliance Docket (the "docket") to identify Federal facilities that must be evaluated to determine whether they pose a risk to public health or the environment. SARA also mandates completion of a PA and, if warranted, an SI and NPL listing, for all sites listed on the docket. Several RCRA activities will trigger a docket listing and thus site assessment under CERCLA:

- application for a permit or interim authority to treat, store, or dispose of hazardous waste under RCRA §3005,
- notification of hazardous waste activity under RCRA §3010, and
- identification of hazardous waste sites as part of the biennial inventory of Federal agency hazardous waste activities under RCRA §3016 (Ref. 2).

In addition, EPA and authorized states may respond under CERCLA to sites subject to RCRA Subtitle C.

### **How may application of the HRS change under SACM and/or SAFER?**

EPA is pilot testing the Superfund Accelerated Cleanup Model (SACM) and is participating in a pilot test of DOE's Streamlined Approach For Environmental Restoration (SAFER) process. Although the initiatives differ somewhat in emphasis, both share the goal of streamlining site assessment and remediation under CERCLA. SACM promotes existing provisions within the NCP that allow initiation and completion of short-term remedies to address immediate threats without HRS evaluation and NPL listing, although HRS evaluation and NPL listing are still required for more long-term, complex, and less time-critical remedies. SAFER focuses on site remediation rather than site assessment, but shares an emphasis on early actions to reduce risk.

Neither SACM nor SAFER should have any effect on formal HRS scoring requirements or how the HRS is used for NPL eligibility. However, early actions to reduce risk prior to HRS evaluation may result in a lower final HRS score. In some cases, the HRS score could be reduced to below the 28.50 cutoff. To be eligible for consideration in HRS scoring, the early action must physically remove hazardous substances or wastes containing hazardous substances from the site and must occur within 18 months after placement of the site on the Federal facilities hazardous waste compliance docket. Also the removed material must be disposed or destroyed at a facility permitted under RCRA or the Toxic Substances Control Act or approved under Atomic Energy Act authorities.

**Questions of policy or questions requiring policy decisions will not be dealt with in EH-231 Information Briefs unless that policy has already been established through appropriate documentation. Please refer any questions concerning the subject material covered in this Information Brief to Kathleen Schmiat, RCRA/CERCLA Division, EH-231, (202) 586-5982.**

