CONF-9011141--1

CONF-9011141--1

DE91 002886

DISCLAIMER

LEARNING EXPERIENCES AT OAK RIDGE

Robin K. White
Office of Risk Analysis
Health and Safety Research Division
Oak Ridge National Laboratories
Oak Ridge, Tennessee

The submitted manuscript has been authorized by a contractor of the U.S. Government under contract No. DE-ACO5-84-OB21400. Accordingly, the U.S. Government retains a nonexclusive royalty free license to publish or reproduce the published form of this contribution, or allow others to do so, for U.S. Government purposes.

The Oak Ridge Operations (ORO) of DOE has organized an Environmental Restoration Program to handle environmental cleanup activities for the Oak Ridge Reservation (ORR) following General Watkins' reorganization at DOE Headquarters. ORO's Environmental Restoration Program began October 1, 1989, taking up where RCRA-3004(u) authority ends. Based on the major facilities and locations of contamination sites, the Environmental Restoration Program is divided into five subprograms:

- Oak Ridge National Laboratory (ORNL) sites,
- Y-12 Plant sites,
- Oak Ridge Gaseous Diffusion Plant (ORGDPA) sites,
- Oak Ridge Associated Universities (ORAU) sites, and
- Off-site areas.

The Office of Risk Analysis at ORNL was established under the auspices of the Environmental Restoration Program to implement Superfund legislation in the five subprograms of DOE-ORO. Risk assessment must examine potential human health and ecological impacts from contaminant sources that range from highly radioactive materials to toxic chemicals and mixed wastes. The Office of Risk Analysis, therefore, has a good vantage point from which to view risk assessment needs because of its broad-based responsibility and wide-ranged experience in the DOE-ORO Environmental Restoration Program. The office operates from each of the five ORO facilities: ORNL, ORGDP, and Y-12 Weapons Complex on the Oak Ridge Reservation; Paducah Gaseous Diffusion Plant in Paducah, Kentucky; and Portsmouth Gaseous Diffusion Plant in Portsmouth, Ohio. There have been approximately 700-750 Solid Waste Management Units (SWMUs) and remedial action sites identified on the five facilities. In undertaking this tremendous task, the Office of Risk

Analysis deals daily with the challenges associated with determining potential risk and appropriate remedial alternatives.

There are many aspects of risk assessment which make it a complex and difficult task. Regulatory complexities, limitations in technology, and risk communication and public expectation all play roles in adding intricacy to the process of evaluating risk. As we set out to fulfill Superfund mandates, there are many sources of authority to which we must respond. Risk assessors must follow the regulations of a vast number of agencies leading to questions of primacy and competing jurisdictions. When attempting to accomodate these various regulatory demands, the problem of matching analytical chemistry capabilities with risk data needs arises. What are we able to do, in terms of presenting realistic risk predictions and methods of achieving CERCLA's mandated risk range? The remedial alternatives we are evaluating need to reach acceptable levels of risk effectively while also being cost-efficient. The purpose of this paper is to highlight areas of particular interest and concern at Oak Ridge and to discuss, where possible, solutions implemented by the Oak Ridge Environmental Restoration Program.

In order to keep risk assessment evolving toward its most effective end, the Environmental Restoration Risk Assessment Program established a committee of experts to put risk assessment problems in perspective and develop methodologies and techniques to handle these problems. The Central Risk Assessment Council (CRAC) also functions to ensure consistency among risk assessments at ORO sites, and develop guidance on risk assessment implementation. The CRAC, while acting as a trouble-shooter as well as problem solver, is a first step in solving quality assurance problems that risk assessors face.

In order to meet RCRA's clean closure requirements, one potential difficulty in evaluating a site is in determining the source term. Common problems with source term estimation are that records of the treatment, storage, and disposal of hazardous materials are incomplete and inadequate when maintained at all. The few records that are available tend to focus on the materials essential to Oak Ridge Manhattan Project mission--radioactive substances. Chemicals and other hazardous materials did not become a focus of management concern until the 1970's. At that time, it was discovered that the land disposal areas contained radioactive and hazardous materials freely intermixed. Hence, it is dangerous to sample these disposal areas directly, due to uncertainty. Risk assessors, therefore, use environmental measurements around the site as a surrogate.

At the K-770 Scrapyard site, a preliminary risk assessment was underway when a forty-year-old photograph of the site was discovered which revealed a previously unmentioned township development that formerly existed on the site. This discovery was a fortunate help in choosing the surrogate sampling method since it became apparent that the source term estimate could not easily be made. Even though environmental measurements around the site provide an alternative to direct sampling, there are potential problems with the surrogate method as well: if materials are buried in containers, measurements aurrounding the site may not reveal any contamination as long as the containers retain their integrity. As a result, the measurements could seriously underestimate future release potential and future risks.

At the Clinch River site, regulatory, technological, and expectational difficulties all factor into the risk assessment. In the preliminary screening phase of this off-site assessment, it was determined that research, industrial, and waste disposal activities at the Y-12 plant at ORNL and the ORGDP had introduced a variety of airborne, liquid, and solid wastes into the environment of the river. The contaminants released from these facilities include a varitey of radionuclides, metals, and organic compounds. Some liquid wastes are discharged to streams on the ORR, which drain into the Clinch River. However, much of the water contamination is derived from seepage into the shallow groundwater from old waste storage pits and trenches. The contaminated groundwater drains into Oak Ridge Reservation streams and ultimately into the Clinch river.

This site demonstrates how technology capabilities do not measure up to risk assessment data needs. Because the CERCLA and RCRA mandated 10^{-4} to 10^{-6} risk range cannot be measured by current methods, two screening approaches were used to assess risk which would present conservative and non-conservative estimates: risk based on lowest detection limits for non-detected organics and risk based on mean concentration of detected organics. The conservative approach is based on the maximum reported concentration for a given contaminant and medium within a given reach of the off-site surface water environment. This extreme value is used in accordance with EPA guidance because existing data are not adequate for estimating an average concentration representative of possible lifetime exposure. The conservative approach also assumes that individuals are exposed continuously to this maximum concentration for 70 years. In addition, contaminants that are below the limits of detection are assumed to equal the lowest reported limits of detection.

The non-conservative approach uses average values of concentrations of contaminants in sediment, water and fish. These concentrations are averaged only among values reported above the limits of detection. By comparing the two methods, the non-conservative method showed that using the lowest detection limit would give a less realistic estimate.

Because the Clinch River site has a high level of public interest, public policy issues become increasingly important in communicating with the public constituent. Risk assessment agencies have begun to develop risk communication practices and policies to help the public to be made aware of what a 10^{-6} risk level means, what costs are involved in achieving this level of risk, and what problems with handling, storage, and disposal occur in implementing remediation.

An interesting example of how problems with regulatory demands, technical demands, and public demands can mesh is the Y-12 S-3 ponds. Over a period of years, liquid and solid wastes were disposed of in a number of waste management units at the Y-12 facility. The ponds are evaporation/percolation units built in 1951 to receive waste water from operations at Y-12. The liquid waste the ponds received was composed primarily of nitrate salts, nitric acid solutions, and cleanup solutions containing various organic solvents. Treatment of the pond water began in 1983, and disposal ended in 1984.

In order for management to have a clean closure of the site, the S-3 ponds were slated for groundwater remediation. Preliminary considerations targeted groundwater recovery and treatment in addition to installation of an approved cap as the intervention method of choice. A risk assessment was conducted to evaluate whether additional remediation measures would significantly improve the environmental and human health impacts which might be posed by the site contamination.

Three possible post-closure strategies were evaluated: 1) no-action, or baseline conditions; 2) isolation of the contaminant source (capping), and 3) reduction of groundwater contamination (groundwater recovery and treatment). The results of groundwater modeling indicated that implementation of the groundwater recovery and treatment option does not reduce the noncarcinogenic risk more quickly than do the other options and none of the alternatives significantly affect carcinogenic risk at the site.

In a cost-benefit analysis, the costs and benefits associated with each of the proposed alternatives compared the benefits produced by the alternatives in reducing the noncarcinogenic toxicity and lifetime excess cancer risks at the end of a 30-year post-closure period. Of the engineered options, capping was least expensive, with total lifetime costs estimated at $3.55 million. Costs escalated as groundwater recovery and treatment modules were added, beginning at $25 million for installation and operation of one treatment module.

Relative change in excess cancer risk is expressed as the number of lives saved (per 100,000 people exposed) for a given alternative over the post-closure period. Exposure to tetrachloroethylene (PCE) and uranium at the beginning of the post-closure period was estimated to produce a risk of

11×10^{-5} (11 cancer deaths per 100,000 people exposed). The cost-benefit analysis showed that implementation of any of the alternatives would only reduce this risk to about 4×10^{-5} (four cancer deaths per 100,000 people exposed).

Thus, all of the alternatives are estimated to "save" seven lives per 100,000 people exposed and reduce the noncarcinogenic toxicity by at least 95 percent. Under the conditions of this analysis, the no-action alternative would be the option of choice. Regulatory realities, however, eliminate this alternative as a viable option and make installation of an engineered cap the option against which the more aggressive treatment measures should be compared. For virtually equally protective results, groundwater recovery and treatment options escalate costs at least 7-fold.

In the case of the S-3 ponds, regulatory requirements that grew out of public protection demands necessitated remedial alternatives which were not especially effective and yet cost exorbitant amounts. The limitations of current technology do not offer "quick fix" remedial options that will curb human health risks at the publicly desired range in a cost-effective manner.

It is likely that the risk assessment process, though continual efforts to tackle its multi-faceted problems are being made, could profit from a national re-thinking of the problem of hazardous waste and environmental pollution.

- How bad is it, in realistic terms?
- How much of our national resources in people, money, and time is it worth investing?
- What meaningful solutions can we effect now?
- What science must be expedited in order to effect meaningful solutions for the future?

END

DATE FILMED

12 / 17 / 90