

Publ by Air & Waste Management Assoc, Pittsburgh, PA. Abstract- This conference proceedings contain 69 papers presented at the Air and Waste Management Annual Meeting in June 1989. Topics covered include: Handling, Licencing, Minimizing, siting and development of hazardous and mixed waste, Atmospheric Emissions from accidental releases and their modelling and health hazards, emergency response, public awareness, risk communication programs and issues related to these communications, Risk Assessment and uncertainty analysis, Health risk assessment for specific chemicals, Transportation of Toxic and hazardous materials, Environmental Impairment Liability Insurance and issues related to it, Alternative fuels, and then impact on the environment, Air Pollution Analysis, measurement techniques and instrumentation.

GENERAL/Commercial

CDM. 1985. Title: Application of Quantitative Risk Assessment to Remedial Measures Evaluation at Abandoned Sites. Corporate Author: Camp, Dresser and McGee, Boston, MA. Publication: Hazardous Wastes and Environmental Emergencies, Proceedings of a National Conference, Cincinnati, OH, May 14-16, 1985. (pp 234-238).

GENERAL/EPA

ICF, Inc. 1986. Risk Assessment Information Directory. EPA Contract No. 69-01-7090.

GENERAL/Other

FCCSET. 1992. Risk Assessment: A survey of characteristics, applications, and methods used by federal agencies for engineered systems. Federal Coordinating Council for Science, Engineering, and Technology. Ad Hoc Working Group on Risk Assessment. Nov. 1992.

METHODOLOGY/Commercial

Dove, F.H.; Marshall, T.C.; Seiler, F.A. Date: 1991, September. Title: Baseline Risk Assessment Methodology for Mixed Waste. Corporate Author: International Technology Corporation, Albuquerque, NM. Pub: CONF-910981; Environmental Remediation '91: Cleaning Up the Environment for the 21st Century, D.E. Wood (ed.),

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Proceedings of a Conference, Pasco, WA, September 8-11, 1991, 970 pp.; (pp. 295-299) Abstract: The presence of mixed chemical and radioactive waste introduces several complex issues into a baseline risk assessment. A five-stage, serial methodology consistent with Department of Energy orders and Environmental Protection Agency regulations is available for the evaluation of risk at these disposal sites. The five stages are: (1) release scenario, (2) source term definition, (3) constituent transport, (4) exposure assessment, and (5) risk characterization. The model considers a variable level of detail (simple to complex) when determining risk, depending on the constituent concentration and exposure levels found. This approach minimizes the effort needed to determine constituent exposure by avoiding complicated models requiring detailed input and complex computation when that level of sophistication is not necessary. While many questions remain concerning the combined effects of radiation and chemicals on cancer, this paper proposes preliminary guidelines for the assessment of combined radiological and nonradiological risk.

METHODOLOGY/Commercial

Niemczyk, S.J. Date: 1987. Title: Estimation of the Risk from Residual Radioactivity. Corporate Author: Gull Associates, Washington, DC. Pub: CONF-871018; Decommissioning, G.A. Tarcza (ed.), Proceedings of the 1987 International Symposium, Pittsburgh, PA, October 4-8, 1987, Vol. 2, 705 pp.; (pp. V.89-V.103) Abstract: A new approach for estimating the potential radiation hazard from residual radioactivity at decontaminated sites and facilities has recently been developed to aid the U.S. Environmental Protection Agency's selection of decommissioning criteria for regulatory purposes. The approach is intended to generate conservatively realistic estimates of radiation doses to on-site residents from radioactivity both in the environment and in buildings. It does so using a comprehensive yet relatively simple set of physically-based, state-of-the-art risk-level environmental transport and exposure pathway models. The transport models have been interfaced to permit time-dependent, mechanistic consideration of radioactive transfers within and among the various environmental media. Radioactive decay and in-growth are explicitly accounted for. Doses in contaminated multiroom buildings are estimated using a set of unique transport and exposure models. The overall approach has been encoded in a computer code REUSEIT which runs on a personal computer.

METHODOLOGY/DOE

Blaylock, B.G.; Frank, M.L.; Hoffman, F.O.; Miller, P.D.; White, R.K.; Purucker, S.T.; Redfearn, A. Date: 1992, October. Title: Human Health Risk Assessment Screening Approach for Evaluating Contaminants at Source Control and Integrator Operable Units. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN; University of Tennessee, Knoxville, TN. Pub: CONF-930165; How Clean is Clean, Proceedings of the 1992 Water Federation Environment Specialty Conference, Washington, DC, January 13, 1993; (15 pp.) Abstract: A more streamlined approach is proposed for executing the remedial investigation/feasibility study process. This approach recognizes the uncertainties associated with the process, particularly regarding the derivation of human health risk estimates. The approach is tailored for early identification of sites and contaminants of immediate concern, early remediation of such sites, and early identification of low-risk sites that can be eliminated from further investigations. The purpose is to hasten the clean-up process, and do so in a cost-effective manner.

METHODOLOGY/DOE

Chu, M. S. Y. ; Rodricks, J. V. ; St. Hilaire, C. ; Bras, R. L. 1986. Risk Assessment and Ranking Methodologies for Hazardous Chemical Defense Waste: A State-of-the-ART Review and Evaluation. Task 1 Report. Sandia National Labs., Albuquerque, NM. U.S. Department of Energy, Washington, DC. Abstract- This report summarizes the work performed under Task 1 of the Risk Assessment Evaluation Task under the Hazardous Chemical Defense Waste Management Program of the Department of Energy (DOE). The objective of Task 1 was to identify, review, and evaluate the state-of-the-art tools and techniques available for ranking and evaluating disposal facilities. These tools were evaluated for their applicability to DOE's mixed hazardous chemical and radioactive waste sites. Various ranking methodologies were reviewed and three were evaluated in detail. Areas that were found to be deficient in each ranking methodology were presented in the report. Recommendations were given for the development of an improved ranking methodology for use on DOE's sites. A literature review was then performed on the various components of a risk assessment methodology. They include source term evaluation, geosphere transport models, exposure pathways models, dose effects models, and sensitivity/uncertainty techniques. A number of recommendations have been made in the report based on the review and evaluation for the development of a comprehensive risk assessment methodology in evaluating mixed waste disposal sites.

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Davis, M.; Avci, H.I.; Picel, K.; Janke, R.J. Date: 1993. Title: Strategy for Assessing Risks Associated with Remediation of the Former Production Area at Fernald. Corporate Author: Argonne National Laboratory, Argonne, IL; U.S. Department of Energy, Fernald Area Office, Cincinnati, OH. Pub: ANL/EAIS/CP-79748; CONF-931095 (Vol. 1); ER '93: Meeting the Challenge, Proceedings of the U.S. Department of Energy Environmental Remediation Conference, Augusta, GA, October 24-28, 1993, Vol. 1, 727 pp.; (pp. 489-492) Abstract: The strategy for assessing the risks associated with the remediation of the former Production Area at the Fernald Environmental Management Project is discussed. The general approach to risk assessment is strongly influenced by a number of factors related to the nature of the site and to management proposals that have been made concerning the site. How these factors affect the approach to assessing baseline risks, to assessing risks associated with remedial activity, and to establishing cleanup criteria are examined.

METHODOLOGY/DOE

Devgun, J.S. Date: 1991. Title: Role of Risk Assessment in Remediation of Contaminated Sites. Corporate Author: Argonne National Laboratory, Chemical Technology Division, Argonne, IL. Pub: ANL/CP-72892; CONF-9106239; Proceedings of the Eleventh International Association for Impact Assessment Annual Meeting, Champaign, IL, June 7-11, 1991; (8 pp.) Abstract: Even though risk assessment is an essential consideration in remediation projects involving radioactive or hazardous waste sites, its role is often unclear and it is not fully utilized in the decision-making process. Risk assessment is an integral part of the remediation process and should play an important role from beginning to end, i.e., from planning stages to verification survey after the cleanup. A conceptual model with complete pathways of exposure and based on site-specific conditions is key to a successful risk assessment. A baseline comparison with existing standards determines, along with other factors, whether a site requires remediation. Risk assessment plays a role in setting priorities between sites and in setting cleanup standards for certain contaminants at a site. Matching the extensiveness and effectiveness of remediation to the degree of risk is important in the decision-making process. Often, the applicable technologies can be screened through risk assessment, and the potential remedial alternatives evaluated in terms of risk reduction. After a remedial

action is complete, its effectiveness can be judged via verification surveys, and any predicted future risk from residual concentrations of contaminants can be left at the site. This paper provides an overview of the risk-assessment process, its role in remediation projects, and the generic methodology for risk assessment.

METHODOLOGY/DOE

Droppo Jr., J.G.; Strenge, D.L.; Buck, J.W. Date: 1991, September. Title: A Risk Computation Model for Environmental Restoration Activities. Corporate Author: Pacific Northwest Laboratory, Richland, WA. Pub: CONF-910981; Environmental Remediation '91: Cleaning Up the Environment for the 21st Century, D.E. Wood (ed.), Proceedings of a Conference, Pasco, WA, September 8-11, 1991, 970 pp.; (pp. 261-264) Abstract: A risk computation model useful in environmental restoration activities was developed for the U.S. Department of Energy. This model, the Multimedia Environmental Pollutant Assessment System (MEPAS), can be used to evaluate effects of potential exposures over a broad range of regulatory issues, including radioactive carcinogenic, nonradioactive carcinogenic, and noncarcinogenic effects. MEPAS integrates risk computation components. Release, transport, dispersion, deposition, exposure, and uptake computations are linked in a single system for evaluation of air, surface water, ground water, and overland flow transport. MEPAS uses standard computation approaches. Whenever available and appropriate, U.S. Environmental Protection Agency guidance and models were used to facilitate compatibility and acceptance. MEPAS is a computational tool that can be used at several phases of an environmental restoration effort. At a preliminary phase in problem characterization, potential problems can be prioritized. As more data become available, MEPAS can provide an estimate of baseline risks or evaluate environmental monitoring data. In the feasibility phase, MEPAS can compute risk from alternative remedies. However, MEPAS is not designed to replace a detailed risk assessment of the selected remedy. For major problems, it is appropriate to use a more detailed risk computation tool for a detailed, site-specific evaluation of the selected remedy.

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Dunning Jr., D.E.; Peterson, J.M. Date: 1993. Title: Comparison of Radiological Risk Assessment Methods for Environmental Restoration. Corporate Author: Argonne National Laboratory, Argonne, IL. Pub: ANL/EA/CP-78779; CONF-930746; Proceedings of the Health Physics Society 38th Annual Meeting, Atlanta, GA, July 11-15, 1993; (10 pp.) Abstract: Evaluation of risks to human health from exposure to ionizing radiation at radioactively contaminated sites is an integral part of the decision-making process for determining the need for remediation and selecting remedial actions that may be required. At sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a target risk range of $10(E-4)$ to $10(E-6)$ incremental cancer incidence over a lifetime is specified by the U.S. Environmental Protection Agency (EPA) as generally acceptable, based on the reasonable maximum exposure to any individual under current and future land use scenarios. Two primary methods currently being used in conducting radiological risk assessments at CERCLA sites are compared in this analysis. Under the first method, the radiation dose equivalent (i.e., Sv or rem) to the receptors of interest over the appropriate period of exposure is estimated and multiplied by a risk factor (cancer risk/Sv). Alternatively, incremental cancer risk can be estimated by combining the EPA's cancer slope factors (previously termed potency factors) for radionuclides with estimates of radionuclide intake by ingestion and inhalation, as well as radionuclide concentrations in soil that contribute to external dose. The comparison of the two methods has demonstrated that resulting estimates of lifetime incremental cancer risk under these different methods may differ significantly, even when all other exposure assumptions are held constant, with the magnitude of the discrepancy depending upon the dominant radionuclides and exposure pathways for the site. The basis for these discrepancies, the advantages and disadvantages of each method, and the significance of the discrepant results for environmental restoration decisions are presented.

METHODOLOGY/DOE

Dwyer, R.L.; Starmer, R.J. Date: 1991, October. Title: Integration of Superfund Risk Concepts into Setting Cleanup Criteria at Mixed Waste Sites. Corporate Author: Environmental Resources Management, Inc., Annapolis, MD; ERM Program Management Company, McLean, VA. Pub: CONF-9110168; Waste Management and Environmental Restoration, Proceedings of the Seventh Annual DOE Model Conference, Oak Ridge,

TN, October 14-17, 1991; (18 pp.) Abstract: As U.S. Department of Energy facility remedial activities evolve to comply with the additional requirements of the National Contingency Plan under CERCLA, some obvious methodological conflicts have arisen. A major instance has to do with the disposition of mixed waste. Difficulties in integrating the differing dose-response methods of radiation health physics and conventional hazardous waste toxicology into mixed waste risk assessment, the current inability to identify and deal with synergistic effects among hazardous and radioactive contaminants, and the lack of defined cleanup standards for many contaminants, or even a simple and straightforward method to calculate them, all hinder the timely and comprehensive definition of cleanup levels for mixed waste wastes at numerous sites. This paper presents several approaches developed for chemical waste risk assessment under the Superfund program that can be adapted to address these mixed waste problems.

METHODOLOGY/DOE

Fields, D.E. Date: 1986, February. Title: Evaluation of Doses and Risks from Different Decontamination and Decommissioning Strategies Using the PRESTO-2 Methodology. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN. Pub: CONF-860203; Health Physics Considerations in Decontamination and Decommissioning, Proceedings of the Health Physics Society 19th Midyear Topical Symposium, Knoxville, TN, February 2-6, 1986, 594 pp.; (pp. 115-124) Abstract: The PRESTO-2 methodology may be applied to evaluate doses and health risks from a variety of decontamination and decommissioning activities. This methodology has been implemented in the form of a computer code that has been applied to several sites, and that has been extensively documented. Radionuclide inventories are specified as separate contamination sources either present on the ground surface, covered by non-radioactive soils but lying above the water table, suspended in the atmosphere, or dissolved in surface waters. Hydrologic transport mechanisms considered in the PRESTO-2 methodology include chemical exchange, ponding and overflow, surface water transport, groundwater transport, and pumping contaminated groundwater from wells. Varied scenarios of water usage are treated. Atmospheric inputs are based on both resuspension factor and resuspension rate approaches, with inhalation and immersion doses based on a Gaussian

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plume transport calculation. Site activities that are considered include land clearing, farming, and residing on the site. Exposure and dose calculations are derived from the U.S. Nuclear Regulatory Commission Regulatory Guide 1.109 approach, while risk calculations use a life-table approach developed for the U.S. Environmental Protection Agency (EPA). Internal dose conversion factors are taken from ICRP 26 and 30, while risk conversion factors are values suggested by EPA.

METHODOLOGY/DOE

Gregory, P.O.; Jones, G.A. Date: 1986. Title: Risk Assessment and Reliability for Low-Level Radioactive Waste Disposal. Corporate Author: Morrison-Knudsen Engineers, Inc., San Francisco, CA. Pub: CONF-860317; Waste Management '86, Volume 3 - Low-Level Waste, R.G. Post (ed.), Proceedings of the Symposium on Waste Management, Tucson, AZ, March 2-6, 1986; (pp. 139-146) Abstract: The reliability of critical design features at low-level radioactive waste disposal facilities is a major concern in the licensing of these structures. To date, no systematic methodology has been adopted to evaluate the geotechnical reliability of Uranium Mill Tailings Remedial Action (UMTRA) disposal facilities currently being designed and/or constructed. This paper discusses and critiques the deterministic methods currently used to evaluate UMTRA reliability. Because deterministic methods may not be applicable in some cases because of the unusually long design life of UMTRA facilities, it is proposed that a probabilistic risk assessment-based methodology be used as a secondary method to aid in the evaluating of geotechnical reliability of critical items. Similar methodologies have proven successful in evaluating the reliability of a variety of conventional earth structures. In this paper, an "acceptable" level of risk for UMTRA facilities is developed, an evaluation method is presented, and two example applications of the proposed methodology are provided for a generic UMTRA disposal facility. The proposed technique is shown to be a simple method which might be used to aid in reliability evaluations on a selective basis. Finally, other possible applications and the limitations of the proposed methodology are discussed.

METHODOLOGY/DOE

Hamilton, L.D.; Medeiros, W.H.; Meinhold, A.; Morris, S.C.; Moskowitz, P.D.; Nagy, J. Date: 1988, Sept. Title: Health Risk Analysis for Ingestion of Contaminants from Existing Groundwater Contamination at Selected UMTRA Project Sites. Corporate Author:

Brookhaven National Laboratory, Upton, NY. Pub: BNL-44772; 84 pp. Abstract: This study examines potential hazards to human health from the ingestion of chemicals in groundwater beneath and adjacent to four abandoned uranium mill tailings sites: Gunnison, Colorado; Lakeview, Oregon; Monument Valley, Arizona; and Riverton, Wyoming. Chemicals of concern in the groundwater near these sites include arsenic, cadmium, chromium, lead-210, molybdenum, nitrate, polonium-210, radium-226 and radium-228, selenium, sulfate, thorium-230, uranium, and vanadium. Hazards to health were evaluated by implementing the method outlined in the Environmental Protection Agency (EPA) Superfund Public Health Evaluation Manual. Conservative assumptions in the method and the effect of these on the risk estimates and EPA's indexes of harm are discussed. Because the method has a number of built-in conservatisms, the estimated risks and indexes only indicate sites and chemicals requiring further analysis. The chemicals and sites identified as presenting risk in this first screening step should be investigated in more detail. Necessary steps are given. Sites and chemicals identified as harmless in this initial screening can be eliminated from further consideration.

METHODOLOGY/DOE

Hassig, N.L.; Gilbert, R.O.; Pulsipher, B.A. Date: 1991, September. Title: A Framework for Evaluating Innovative Statistical and Risk Assessment Tools to Solve Environmental Restoration Problems. Corporate Author: Pacific Northwest Laboratory, Richland, WA. Pub: CONF-910981; Environmental Remediation '91: Cleaning Up the Environment for the 21st Century, D.E. Wood (ed.), Proceedings of a Conference, Pasco, WA, September 8-11, 1991, 970 pp.; (pp. 271-275) Abstract: Environmental restoration activities at the U.S. Department of Energy (DOE) Hanford Site face complex problems due to a history of varied past contaminant disposal practices. Data collection and analysis required for site characterization, pathway modeling, and remediation-method selection decisions must deal with inherent uncertainties and unique problems associated with the restoration. This paper presents a framework for selecting appropriate statistical and risk assessment methods that can be applied to the restoration problem. Using an example, it follows the selection process from option identification to statistical tools identification and selection. The paper makes several points. Pathway modelers and risk assessors often refer to statistical methods but do not include tools selection in the early planning phases of a project. Statistical tools selection and development are problem-specific and often site-specific. The right tool,

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applied correctly, can minimize sampling costs, get as much information as possible out of existing data, provide consistency and defensibility for the results, and give structure and quantitative measures to decision risks and uncertainties. A framework for selecting and applying the right tools consists of developing an options matrix for evaluating a set of potential remediation options. Knowing these options and setting objectives for the quality of the data to be collected, a statistical tools matrix for tools selection can be developed. Applying the tools and iterating through the steps in the framework allows the remediation project manager to make a decision, at a quantifiable risk level, and be able to statistically defend the decision.

METHODOLOGY/DOE

Hoffman, F.O.; Hammonds, J.S. Date: 1992, October. Title: Introductory Guide to Uncertainty Analysis in Environmental and Health Risk Assessment. Environmental Restoration Program. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN. Pub: ES/ER/TM-35; 34 pp. Abstract: To compensate for the potential for overly conservative estimates of risk using standard U.S. Environmental Protection Agency methods, an uncertainty analysis should be performed as an integral part of each risk assessment. Uncertainty analyses allow one to obtain quantitative results in the form of confidence intervals which will aid in decision making and will provide guidance for the acquisition of additional data. To perform an uncertainty analysis, one must frequently rely on subjective judgment in the absence of data to estimate the range and a probability distribution describing the extent of uncertainty about a true but unknown value for each parameter of interest. This information is formulated from professional judgment based on an extensive review of literature, analysis of the data, and interviews with experts. Various analytical and numerical techniques are available to allow statistical propagation of the uncertainty in the model parameters to a statement of uncertainty in the risk to a potentially exposed individual. Although analytical methods may be straightforward for relatively simple models, they rapidly become complicated for more involved risk assessments. Because of the tedious efforts required to mathematically derive analytical approaches to propagate uncertainty in complicated risk assessments, numerical methods such as Monte Carlo simulation should be employed. The primary objective of this report is to provide an introductory guide for performing uncertainty analysis in risk assessments being performed for Superfund sites.

METHODOLOGY/DOE

JEG. 1988, October. Title: Weldon Spring Site Remedial Action Project: Baseline Risk Assessment Protocol Document. Corporate Author: Jacobs Engineering Group, Inc., St. Charles, MO. Pub: DOE/OR/21548-047; 22 pp. Abstract: The Weldon Spring Site (WSS) is a former explosives manufacture and uranium feed materials processing plant, currently controlled by the U.S. Department of Energy (DOE). The Weldon Spring Site comprises two separate areas: (1) the raffinate pits and chemical plant (approximately 220 acres), and (2) the quarry. Although the two areas are considered to be one site for compliance purposes, a separate risk evaluation is being prepared for the quarry. This document does not address the quarry. The U.S. Environmental Protection Agency (EPA) has placed the Weldon Spring Site on the National Priorities List. A Baseline Risk Assessment is required for compliance with the Comprehensive Environmental Response, Compensation, and Liability Act. The purpose the Baseline Risk Assessment is to assess the potential risks to public health and the environment in the absence of remedial action. This Protocol document explains how the Baseline Risk Assessment for the raffinate pits and chemical plant area will be conducted. Specifically, the Protocol document: (1) provides EPA risk assessment guidelines appropriate for the Weldon Spring Site; (2) identifies the site-specific data to be used in the analysis; (3) provides a preliminary list of indicator contaminants; (4) identifies populations near the site; (5) identifies general exposure pathways; (6) describes how Applicable or Relevant and Appropriate Requirements (ARARs) will be identified; and (7) provides the framework for presenting the potential risks due to radiological and chemical contaminant exposures.

METHODOLOGY/DOE

Joseph, T.J. Date: 1992, October. Title: Components and Complexity of an Ecorisk Paradigm. Corporate Author: U.S. Department of Energy, Oak Ridge Operations Office, Oak Ridge, TN. Pub: CONF-921029; Waste Management and Environmental Restoration, Proceedings of the Eighth Annual DOE Model Conference, Oak Ridge, TN, October 18-22, 1992, 228 pp.; (5 pp.) Abstract: This paper is an overview of ecological risk assessment that is intended to open the conference session on ecological risk with a look at the initial thought process. The subject of risk assessment began with the worker and moved gradually to include the public, only recently moving into ecology. The specific assessment variables and

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endpoints for worker risk assessment are more or less straightforward; those for public health risk assessment required new and more complex science and technology because the variables became more difficult to identify, track, and quantify. The continuum of assessment variables is an inverted pyramid which expands in all directions from the very specific point stressor and on to the worker, the public, or the environment or ecosystem (nonhuman species); the temporal and spatial scales within it widen greatly. The ecological risk "paradigm" should show clearly the architecture of risk imposed or inflicted upon all physical and biological components of an ecosystem. The paradigm should establish the most efficient architecture of risk to develop a roadmap to ecological risk that moves the assessor by the most direct route and results in quality science.

METHODOLOGY/DOE

Kennedy, W. E. ; Aaberg, R. L. 1991. Dose and risk assessment for intrusion into mixed waste disposal sites. Battelle Pacific Northwest Labs., Richland, WA. Conference proceeding - Hanford symposium on health and the environment: current topics in occupational health (30th), Richland, WA (United States), 29 Oct - 1 Nov 1991. Sponsored by Department of Energy, Washington, DC. Abstract: Sites previously used for disposal of radioactive and hazardous chemical materials have resulted in situations that pose a potential threat to humans from inadvertent intrusion. An example generic scenario analysis was developed to demonstrate the evaluation of potential exposure to either cleanup workers or members of the public who intrude into buried waste containing both radioactive and hazardous chemical contaminants. The example scenarios consist of a collection of exposure routes (or pathways) with specific modeling assumptions for well-drilling and for excavation to construct buildings. These scenarios are used to describe conceptually some potential patterns of activity by non-protected human beings during intrusion into mixed-waste disposal sites. The dose from exposure to radioactive materials is calculated using the GENII software system and converted to risk by using factors from ICRP Publication 60. The hazard assessment for nonradioactive materials is performed using recent guidelines from the US Environmental Protection Agency (EPA). The example results are in the form of cancer risk for carcinogens and radiation exposure.

METHODOLOGY/DOE

Labieniec, P.A.; Dzombak, D.A.; Siegrist, R.L. Date: 1993. Title: Risk Implications of Approaches to Setting Soil Remediation Goals. Corporate Author: Carnegie-Mellon University, Pittsburgh, PA; Oak Ridge National Laboratory, Oak Ridge, TN. Pub: CONF-930165; How Clean Is Clean, Proceedings of the 1992 Water Federation Environment Specialty Conference, Washington, DC, January 10-13, 1993; (11 pp.) Abstract: A framework has been developed to evaluate and compare the carcinogenic risk implications of two approaches to establishing soil remediation goals at hazardous waste contaminated sites. The approaches considered are: (1) site-specific risk assessment to achieve a specified level of carcinogenic risk; and (2) the use of uniform, concentration-based soil quality guidelines. Uncertainty in site-specific risk assessments and variability in site conditions when a uniform approach is used are taken into account. For each approach, cumulative distribution functions representing the regional variability in risk across sites are developed using a soil risk model. The two approaches are then compared based on these distributions. This paper describes the evaluation framework and presents some preliminary results of ongoing research to apply the framework to sites contaminated with trichloroethylene. Preliminary work in applying the framework to sites contaminated with polychlorinated biphenyls is also described.

METHODOLOGY/DOE

MacDonell, M.M.; Haroun, L.A.; Peterson, J.M.; Blunt, D.A.; Fingleton, D.J.; Picel, M.H. Date: 1991, September. Title: Strategy for Integrated CERCLA/NEPA Risk Assessments. Corporate Author: Argonne National Laboratory, Environmental Assessment and Information Sciences Division, Argonne, IL. Pub: CONF-910981; Environmental Remediation '91: Cleaning Up the Environment for the 21st Century, D.E. Wood (ed.), Proceedings of a Conference, Pasco, WA, September 8-11, 1991, 970 pp.; (pp. 853-860) Abstract: The U.S. Department of Energy (DOE) has established a policy whereby, for remedial actions, the procedural and documentational requirements of the National Environmental Policy Act (NEPA) are integrated with those of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. However, the objectives of risk assessment under NEPA and CERCLA differ somewhat. Until its recent application to contaminated sites, NEPA analysis has typically been applied to impacts from actions at clean sites (e.g., for construction activities), and a somewhat loosely

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structured process has historically been used to estimate relative risks for NEPA. Decisions such as cleanup levels were not made on the basis of risk estimates, and therefore tended to be conservative and not detailed. In contrast, risk estimates for Superfund (CERCLA) sites are used to focus the decision-making process for those sites and support national prioritization for cleanup. The U.S. EPA has developed a detailed framework for preparing baseline health-risk assessments for these sites. The purpose of this paper is to discuss the issues relating to integrating CERCLA and NEPA approaches into the risk assessments prepared for a DOE remedial action project at the Weldon Spring Site near St. Charles, Missouri. These issues are grouped into three basic categories: general assumptions for the impact evaluation, data management, and presentation of the methodology and results. This paper is not intended to represent DOE policy and guidance, nor does it represent the only approach that can be used for integrated risk assessments. It discusses the process that was used for the Weldon Springs project, articulating the issues that were encountered and how they were addressed.

METHODOLOGY/DOE

Mahaffey, J.A.; Doctor, P.G.; Buschbom, R.L.; Glantz, C.S.; Daling, P.M.; Sever, L.E.; Vargo Jr., G.J.; Strachan, D.M.; Pajunen, A.L.; Hoyt, R.C.; Ludowise, J.D. Date: 1993, June. Title: Strategic Analysis Study-Based Approach to Integrated Risk Assessment: Occupational Health Risks from Environmental Restoration and Waste Management Activities at Hanford. Corporate Author: Pacific Northwest Laboratory, Richland, WA; Westinghouse Hanford Company, Richland, WA. Pub: PNL-8598; 86 pp. Abstract: The goal of environmental restoration and waste management activities is to reduce public health risks or to delay risks to the future when new technology will be available for improved cleanup solutions. Actions to remediate the wastes on the Hanford Site will entail risks to workers, the public, and the environment that do not currently exist. In some circumstances, remediation activities will create new exposure pathways that are not present without cleanup activities. In addition, cleanup actions will redistribute existing health risks over time and space, and will likely shift health risks to cleanup workers in the short term. This report describes an approach to occupational risk assessment based on the Hanford Strategic Analysis Study and illustrates the approach by comparing worker risks for two options for remediation of N/K fuels, a subcategory of unprocessed irradiated fuels at Hanford.

METHODOLOGY/DOE

Marron, B.; Johnson, J. 1993. A method for comparative assessment of chemical and radionuclide risks. Transactions of the American Nuclear Society Vol. 68 Jun 1993 pp. 32-33. Abstract- A single, equivalent method has been developed for estimating the radiological and the chemical risks via the air pathway for the operational phase management of transuranic mixed waste at the Waste Isolation Pilot Plant (WIPP) facility. Although the proposed method uses the standard four-step risk assessment process developed by the U.S. EPA, the method is unique because it permits the direct comparison of radiological and chemical risks. Typically, such comparisons are unreasonable because of the differences in the risk assessment methodologies. The proposed method establishes data requirements, source terms, exposure scenarios, dispersion models, and risk characterizations that are equivalent for both radionuclides and chemicals. Variables are defined by probability density functions, and stochastic modeling is used to estimate the overall uncertainty in the risk characterization.

METHODOLOGY/DOE

Miller, P.D.; McGinn, C.W.; Purucker, S.T.; White, R.K. Date: 1994, August. Title: Defining the Role of Risk Assessment in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR. Corporate Author: Oak Ridge National Laboratory, Health and Safety Research Division, Oak Ridge, TN. Pub: ES/ER/TM-58; 45 pp. Abstract: The risk assessment that will be implemented on the Oak Ridge Reservation has been standardized to ensure consistency and technical defensibility in all risk assessment activities and is presented in this document. The strategy emphasizes using existing environmental data in screening risk analyses to aid in identifying chemicals of potential concern, operable units that could pursue a no further investigation determination, and operable units that may warrant early response actions. The screening risk analyses include a comparison of measured chemical concentrations to preliminary remediation goals, performing a most likely exposure and integration point assessment, and performing a screening ecological risk assessment. This document focuses heavily on the screening risk analyses and relies on existing EPA risk assessment guidance to provide specific details on conducting baseline risk assessments. However, the document does contain a section on the

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baseline risk assessment process that details the exposure pathways to be evaluated on the Oak Ridge Reservation.

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Nix, D.W.; Immel, J.W. Date: 1992, March. Title: Development of Exposure Scenarios for CERCLA Risk Assessments at the Savannah River Site. Corporate Author: Westinghouse Savannah River Company, Aiken, SC; University of Tennessee, Knoxville, TN. Pub: CONF-920307 (Vol. 1); Waste Management '92: Working Towards a Cleaner Environment, R.G. Post (ed.), Proceedings of a Symposium, Tucson, AZ, March 1-5, 1992, Vol. 1, 994 pp.; (pp. 515-518) Abstract: Environmental restoration (ER) activities at the Savannah River Site (SRS) begin with the characterization of inactive hazardous, radioactive and mixed waste disposal areas by a combined Resource Conservation and Recovery Act (RCRA) facility investigation (RFI)/Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial investigation (RI) followed by evaluation of remedial alternatives in a RCRA corrective measures study (CMS)/CERCLA feasibility study (FS). A CERCLA baseline risk assessment (BRA) is performed during the RFI/RI characterization to determine if there are any potential risks to human health or the environment from the waste unit. If it is determined that there is need for remedial action, a risk evaluation of remedial alternatives (RERA) is performed as part of the CMS/FS to provide a basis for selecting a remedy that is protective of human health and the environment. The SRS has numerous waste units to evaluate in the RFI/RI and CMS/FS programs and, in order to provide a consistent approach, four standard exposure scenarios were developed for exposure assessments to be used in human health risk assessments. The standard exposure scenarios are divided into two temporal categories: (a) current land use in the BRA, and (b) future land use in the RERA. The current land use scenarios consist of the evaluation of human health risk for industrial exposure (of a worker not involved in waste unit characterization or remediation), a trespasser, a hypothetical current on-site resident, and an off-site resident. The future land use scenario considers exposure to an on-site resident following termination of institutional control in the absence of any remedial action (no action alternative), as well as evaluating potential remedial alternatives against the four scenarios from the BRA. A critical facet in the development of a BRA or RERA is the scoping of exposure scenarios that reflect actual conditions of a waste unit, rather than using factors such as the U.S. Environmental Protection Agency standard default exposure scenarios (OSWER Directive

9285.6-03) that are based on upper-bound exposures that tend to reflect worst case conditions. The use of site-specific information for developing risk assessment exposure scenarios will result in a realistic estimate of reasonable maximum exposure for SRS waste units.

METHODOLOGY/DOE

Pavlou, S.; Waite, D.; Maheras, S.; Robinson, S. 1990. Finding a compromise between chemical and radiological risk assessment methods for mixed waste sites. Paper 5 In: Proceedings of DOE model conference on waste management and environmental restoration. 6th Annual Department of Energy model conference on waste management and environmental restoration. Oak Ridge, TN. 29 Oct - 2 Nov 1990. Abstract- The purpose of this paper is to (1) outline the fundamental similarities and differences between the presently accepted radiological and chemical risk assessment methods, (2) examine the significant differences in analytical results and decision making that can result if either is used to the exclusion of the other and (3) to suggest a hybrid method that utilizes the strong points of each to arrive at a balanced contaminant impact data base for decision making. The approach taken to facilitate these comparisons is to quantitatively assess the collective risk at a simplified site, contaminated with a short list of chemicals and radionuclides. The site is assessed first using exclusively the suggested Superfund toxic chemical methodology for both chemicals and radionuclides, followed by the same analysis using accepted radiological methods for both contaminant categories. Both the methods and the results of these calculations are compared and contrasted. Logical mitigation decisions that might result from each set of calculations are examined. The same site is finally analyzed using a method that incorporates the best of both of the previously used methods and the results are analyzed on the basis of the decision-making utility of the results. Conclusions are drawn relative to several topics of prime importance. These are: acceptable risk bases, key assumptions, statistical inputs, prioritizing contaminants, environmental models, cumulative risk, and risk assessments for non-human receptors.

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Picel, M.H.; Peterson, J.M. Date: 1990, April. Title: Strategies for Conducting Baseline Risk Assessments at FUSRAP Sites. Corporate Author: Argonne National Laboratory, Argonne, IL. Pub: CONF-9004181 (Vol. 1); Remedial Action Under the Environmental Restoration and Waste Management Five-Year Plan, Proceedings of the Department of Energy Remedial Action Program Conference, Albuquerque, NM, April 16-19, 1990, Vol. 1, 656 pp.; (pp. 367-391) Abstract: The main objectives of the Formerly Utilized Sites Remedial Action Program (FUSRAP) are to identify and evaluate radiological conditions at sites formerly utilized by Manhattan District/Atomic Energy Commission programs and to control and manage this contamination so that these sites can be certified for use without radiological restrictions to the extent practicable. There are currently 31 FUSRAP sites, several of which are on the National Priorities List (NPL). A remedial investigation/feasibility study (RI/FS) will be prepared for each of the NPL sites. FUSRAP risk assessments will address both human health and ecological risks and will carry out separate but parallel assessments for both chemical and radiological risks. The risk assessments activities within the RI/FS process consist of two components: (1) the Baseline Risk Assessment (BRA), which occurs during the RI, and (2) the risk assessment, which is performed during the FS to compare risk associated with each remedial alternative being considered. BRAs for FUSRAP sites will be prepared as stand-alone documents or will be folded into the RI report as a chapter, depending on the complexity of the assessment. BRAs at FUSRAP sites serve to analyze potential current and future adverse health effects caused by hazardous substance releases from a given site in the absence of actions to control or mitigate such releases. In addition, BRAs may aid in the prioritization of remedial actions and the development of cleanup criteria. As delineated by the Environmental Protection Agency, there are four basic steps to conducting risk assessment for a site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): (a) identification of the contaminants of concern, (b) exposure assessment, (c) toxicity assessment, and (d) risk characterization. This presentation explores FUSRAP guidelines for compliance with CERCLA BRAs.

METHODOLOGY/DOE

Ramsey, B.A.; Thatcher, B.K. Date: 1993, March. Title: Use of Risk Assessment/Management Methodologies in Natural Resource Trusteeship. Corporate Author: Systematic Management Services,

Germantown, MD; U.S. Department of Energy, Rocky Flats Field Office, Golden, CO. Pub: CONF-930205 (Vol. 1); Waste Management '93: Working Towards a Cleaner Environment, R.G. Post (ed.), Proceedings of a Symposium, Tucson, AZ, February 28-March 4, 1993, Vol. 1, 967 pp.; (pp. 629-632) Abstract: Under section 107(f)(2) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Executive Order 12580, the Department of Energy (DOE) is taking the responsibilities of Natural Resource Trustee at DOE sites throughout the United States. CERCLA and the National Contingency Plan (NCP), Subpart G, authorize the designated trustees to assess damages for injury to, destruction of, or loss of natural resources on lands managed or protected by the trustees. DOE therefore has a dual role to act as Primary Natural Resource Trustee for its lands and facilities and to act as CERCLA lead response agency for cleanups on its lands. Damages assessed by other trustees, such as the Department of Interior and U.S. Fish and Wildlife Service, for damage to threatened and endangered species are enforceable against the DOE. Since the Environmental Protection Agency (EPA) in March 1989 issued guidance for the preparation of ecological risk assessments at CERCLA sites, several regulatory developments have occurred which indicate that ecological risks increasingly may drive decisions on environmental protection and remediation. The developments include (1) revision of the NCP to explicitly require ecological evaluations; (2) the July 1989 court order requiring the scope be expanded of the damages that can be recovered under a Natural Resource Damage Assessment (NRDA); (3) the Resource Conservation and Recovery Act (RCRA) corrective action proposed requirement for ecological risk considerations; and (4) EPA publication of the "Framework for Ecological Risk Assessment" in February 1992. DOE must conduct risk assessments in a cost-effective manner and must be proactive in meeting its responsibilities as a resource trustee. In addition, monies budgeted for remedial and corrective actions must be at least partially based on risk management principles. To meet these needs, the DOE Rocky Flats Office has developed a concept for a comprehensive, site-wide risk assessment (CSWRA) that will be a primary tool. The purpose of the CSWRA is to provide the Rocky Flats Office with a fundamental management tool to support its continuing efforts at the Rocky Flats Plant. The CSWRA will be a living document, updated from its initial descriptive analysis to be increasingly quantitative as data from monitoring, the Rocky Flats Interagency Agreement, and other projects become available.

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SAI. 1979, September. Title: Draft Preliminary Risk Assessment of the Weldon Spring Rock Quarry. Corporate Author: Science Applications, Inc., Oak Ridge, TN. Pub: SAI-OR-79-135-01; 92 pp. Abstract: The Weldon Spring quarry is an abandoned rock quarry located between Missouri State Route 94 and Femme Osage Creek, about 25 miles west of St. Louis, Missouri. For over twenty years the quarry has been utilized as a dump site, first for TNT contaminated rubble and low level radioactive material. The first usage for disposal of radioactive waste occurred in 1959 under the auspices of the U.S. Atomic Energy Commission. The site and the characterization of the drummed and uncontained waste are discussed in detail in Chapter 2 of this report. The ultimate objective of risk assessment activities for the Weldon Spring quarry is to develop an estimate of the public risk and the attendant uncertainties in that estimate. These parameters provide one of the major inputs to decision making. The study reported in this document supports this objective but it is not intended to meet this total objective. Rather the present effort provides a preliminary and scoping evaluation of this risk. This allows a preliminary "ball-park" estimation of risk and establishes the basis for a definitive risk assessment of the Weldon Spring quarry. The specific results of the project necessary to support the objectives include the following items: (1) Risk Estimation - An estimate of the range of risk to the public of the Weldon Spring quarry in its current configuration results from this analysis. This estimate is only representative of the general range in which the hazard could be expected to occur, and is in no way a definitive risk assessment; (2) Methodology - A major result of the project is the development of the preliminary methodology for performance of a complete risk assessment; and (3) Identification of Areas for Further Work. Synthesis of available data and methodology identify areas in which limiting ignorance exists. This includes identification of the areas in which more specific data are needed, and those areas in which methodology developments are necessary.

METHODOLOGY/DOE

Shevenell, L.A.; Hoffman, F.O.; MacIntosh, D.L. Date: 1992, March. Title: Risk Assessment Calculations Using MEPAS, an Accepted Screening Methodology, and an Uncertainty Analysis for the Reranking of Waste Area Groupings at Oak Ridge National Laboratory, Oak Ridge, Tennessee. Environmental Restoration Program. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN. Pub: ORNL/ER-53; 70 pp. Abstract: The Waste Area Groupings (WAGs) at the

Oak Ridge National Laboratory (ORNL) were reranked with respect to on- and off-site human health risks using two different methods. Risks associated with selected contaminants from each WAG for occupants of WAG 2 or an off-site area were calculated using a modified formulation of the Multimedia Environmental Pollutant Assessment System (MEPAS) and a method suitable for screening, referred to as the ORNL/ESD method (the method developed by the Environmental Sciences Division at ORNL) in this report. Each method resulted in a different ranking of the WAGs. Rankings from the two methods are compared in this report. All risk assessment calculations, except the original MEPAS calculations, indicated that three Waste Area Groupings - WAG 1; WAGs 2, 6, and 7 (combined as one WAG); and WAG 4 - pose the greatest potential threat to human health. However, the overall rankings of the WAGs using constant parameter values in the different methods were inconclusive because uncertainty in parameter values can change the calculated risk associated with particular pathways, and hence, the final rankings. Uncertainty analysis using uncertainties about all model parameters were used to reduce biases associated with parameter selection and to more reliably rank waste sites according to potential risks associated with site contaminants. Uncertainty analysis indicates that the WAGs should be considered for further investigation, or remediation, in the following order: (1) WAG 1; (2) WAGs 2, 6, and 7 (combined) and WAG 4; (3) WAGs 3, 5, and 9; and (4) WAG 8.

METHODOLOGY/DOE

Sims, L.M.; Temeshy, A.; Leidle, J.M. Date: 1991. Title: Chemical and Radiological Risk Assessment Techniques. Corporate Author: Bechtel Environmental, Inc., Oak Ridge, TN. Pub: CONF-910270 (Vol. 2); Waste Management '91: Working Towards a Cleaner Environment, R.G. Post (ed.), Proceedings of the Symposium, Tucson, AZ, February 24-28, 1991, Vol. 2, 815 pp.; (pp. 137-142) Abstract: This paper presents techniques for conducting an exposure assessment at a Superfund site. The exposure assessment is potentially the most controversial aspect of risk assessment, requiring decision-making that is based on subjective assumptions, which invites closer scrutiny by regulators. The exposure assessment receives this scrutiny because it is used to identify exposure pathways and to estimate contaminant concentrations to which potential receptors could be exposed. The exposure assessment has three parts: (1) characterizing the exposure setting; (2) identifying exposure pathways; and (3) quantifying the exposure. The first component of the assessment includes analyses of contaminant and receptor

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characteristics that are used to identify potential exposure pathways for three periods of institutional control. Exposure concentrations are determined from a combination of characterization data, disposal inventory data, and environmental fate and transport modeling data. Specific intake values are then calculated for each of the identified pathways using the exposure concentrations and other pathway-specific intake variables.

METHODOLOGY/DOE

Stephenson, D.E.; King, C.M.; Looney, B.B.; Holmes, W.G.; Gordon, D.E. Date: 1985. Title: Factors for Assessment of Human Health Risk Associated with Remedial Action at Hazardous Waste Sites. Corporate Author: Savannah River Laboratory, Aiken, SC; Anderson Hospital and Tumor Institute, Houston, TX. Pub: DP-MS-85-129; CONF-851235; Proceedings of an American Geophysical Union Fall Meeting, San Francisco, CA, December 9, 1985; (17 pp.) Abstract: A risk assessment strategy that is cost effective and minimized human health risks was developed for closure of hazardous waste sites at the Savannah River Plant. The strategy consists of (1) site characterization, (2) contaminant transport modeling, and (3) determination of relative merits of alternative remedial actions according to the degree of health protection they provide.

METHODOLOGY/DOE

Suter II, G.W.; Redfearn, A.; White, R.K.; Shaw, R.A. Date: 1992, July. Title: Approach and Strategy for Performing Ecological Risk Assessments for the Department of Energy Oak Ridge Field Office Environmental Restoration Program. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN. Pub: ES/ER/TM-33; 24 pp. Abstract: This document is intended to supplement existing U.S. Environmental Protection Agency (EPA) guidance for ecological risk assessment at hazardous waste sites by providing guidance that is more specific and more tailored to U.S. Department of Energy sites than the guidance available from the EPA. However, it is a conceptual strategy document and does not include specific guidance on data, assumptions, and models. That detailed guidance is under development and will be presented in subsequent documents. Ecological risk assessments are equal to human health risk assessments in regulatory importance and can use many of the same data and some of the same estimation methods. However, they also have peculiar data needs and methods. Ecological risk assessments begin with an initial scoping phase, termed hazard definition, that characterizes the sources, the potential environment, and the

assessment endpoints. In the subsequent measurement and estimation phase, in which data are obtained concerning source of the endpoint biota to the contaminants and the effects of those exposures, assumptions and models are used to relate the data to the desired exposure and effects parameters. Finally, in an integration phase, termed risk characterization, the various exposure and effects estimates are combined to infer the existence, cause, magnitude, and extent of effects of contaminants on the ecological endpoints. This phase is much more complicated for ecological risk assessments than for human health assessments because more types of data are available. Ecological risk assessments estimate effects using laboratory toxicity test results, like human health assessments, but also use results of ambient toxicity tests and biological surveys.

METHODOLOGY/DOE

Temeshy, A.; Liedle, J.M.; Sims, L.M.; Eford, C.R. Date: 1992. Title: Estimating Risk at a Superfund Site Contaminated with Radiological and Chemical Wastes. Corporate Author: Bechtel National, Inc., Oak Ridge, TN. Pub: Superfund Risk Assessment in Soil Contamination Studies, Proceedings of a Symposium, New Orleans, LA, January 30-31, 1991; ASTM Special Technical Publication 1158:231-244 Abstract: This paper describes the methods and results for estimating carcinogenic and noncarcinogenic effects at a Superfund site that is radiologically and chemically contaminated. Risk to receptors from disposal of waste in soil and resulting contamination of groundwater, air, surface water, and sediment is quantified. Specific risk assessment components which are addressed are the exposure assessment, toxicity assessment, and the resulting risk characterization. In the exposure assessment, potential exposure pathways are identified using waste disposal inventory information for soil and modeled information for other media. Models are used to calculate future radionuclide concentrations in groundwater, soil, surface water and air. Chemical exposure concentrations are quantified using site characterization data. Models are used to determine concentrations of chemicals in surface water and in air. Toxicity parameters used to quantify the dose-response relationship associated with the carcinogenic contaminants are slope factors, and with noncarcinogenic contaminants are reference doses. In the risk characterization step, results from the exposure assessment and toxicity assessment are summarized and integrated into quantitative risk estimates for carcinogens and hazard indices for noncarcinogens. Calculated risks for carcinogenic contaminants are

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compared with EPA's target risk range. At Waste Area Grouping 6, the risk from radionuclides and chemicals for an on-WAG homesteader exceeds EPA's target risk range. Hazard indices are compared to unity for noncarcinogenic contaminants. At WAG 6, the total pathway hazard index for the on-WAG homesteader exceeds unity.

METHODOLOGY/DOE

USDOE. 1992, May. Title: Risk Assessment Guidance Document for the UMTRA Project Groundwater Remediation Phase. Corporate Author: U.S. Department of Energy, Albuquerque Operations Office, Uranium Mill Tailings Remedial Action Project Office, Albuquerque, NM. Pub: DOE/UMTRA-400680-0000; 50 pp. Abstract: The purpose of the groundwater remedial activities at the Uranium Mill Tailings Remedial Action (UMTRA) sites is to reduce, control, or eliminate risks to human health and the environment. This is in accordance with Subpart B of 40 CFR 192. According to this regulation, the need for groundwater restoration is based upon U.S. Environmental Protection Agency (EPA)-defined groundwater cleanup standards and must be consistent with the National Environmental Policy Act process. Risk assessments will be used in the UMTRA Groundwater Program to aid in the evaluation of sites. Risk assessments are conducted for four purposes: (1) preliminary risk assessments are used in prioritizing sites, scope data collection, and determine if a site presents immediate health risks; (2) baseline risk assessments provide a comprehensive integration and interpretation of demographic, geographic, physical, chemical, and biological factors at a site to determine the extent of actual or potential harm; (3) risk evaluation of remedial alternatives is performed to evaluate risks to humans or the environment associated with the various remedial strategies; and (4) after remediation, an evaluation of residual risks is conducted. The information gathered for each of these risk evaluations is used to determine the need for subsequent evaluation. Several sites may be eliminated after a preliminary risk assessment if there is no current or future threat to humans or the environment. Likewise, much of the data from a baseline risk assessment can be used to support alternate concentration limits or supplemental standards demonstrations, or identify sensitive habitats or receptors that may be of concern in selecting a remedy.

METHODOLOGY/DOE

Whelan, G.; Steelman, B. L. 1984. Development of Improved Risk Assessment Tools for Prioritizing Hazardous and Radioactive-Mixed Waste Disposal Sites. Battelle Pacific Northwest Labs., Richland, WA. Conference proceeding - DOE environmental protection information meeting, Albuquerque, NM, USA, 6 Nov 1984. U.S. Department of Energy, Washington, DC. Abstract: It is the intent of all environmental regulations to minimize the risks to man and his environment that arise from a regulated activity. Because lower levels of risk are generally accompanied by higher environmental control costs, optimum management is achieved by balancing risks and costs. Currently, the US Environmental Protection Agency employs the Hazard Ranking System (HRS) to evaluate the environmental risks associated with inactive hazardous waste sites for the purpose of establishing the National Priorities List. Recently, investigators modified the HRS to more realistically evaluate the risks posed by radioactive waste constituents. Although results from applying the modified HRS will be useful for comparing the priority of DOE sites to non-DOE sites, the methodology is still overly subjective. To provide DOE with a better management tool for prioritizing funding allocations for further site investigations and possible remediations, Pacific Northwest Laboratory is developing a more objective, scientifically based, risk assessment methodology called the Remedial Action Priority System (RAPS). This methodology will be developed using empirically, analytically, and semianalytically based mathematical algorithms to predict the potential for contaminant migration from a site to receptors of concern using pathways analyses. Four major pathways for contaminant migration will be considered in the RAPS methodology: groundwater, overland, surface water, and atmospheric. Using the predictions of contaminant transport, simplified exposure assessments will be performed for receptors of interest. The risks associated with the sites will then be calculated relative to other sites for each pathway and for all pathways together. The RAPS methodology will require minimum user knowledge of risk assessment and the least possible amount of input data, and is being designed to operate on a personal computer. 17 refs, 3 figs, 1 table.

METHODOLOGY/DOE

Whelan, G.; Strenge, D.L.; Steelman, B.L.; Hawley, K.A. Date: 1985. Title: Development of the Remedial Action Priority System: An Improved Risk Assessment Tool for Prioritizing Hazardous and Radioactive-Mixed Waste Disposal Sites. Corporate Author: Pacific Northwest Laboratory, Richland, WA. Pub: Management of Uncontrolled Hazardous Waste Sites, Proceedings of the Sixth National

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Conference, Washington, DC, November 4, 1985. Hazardous Materials Control Research Institute, Silver Spring, MD; (pp. 432-437) Abstract: The Remedial Action Priority System (RAPS) represents a methodology that prioritizes inactive hazardous and radioactive mixed-waste disposal sites in a scientific and objective manner based on limited site information. This methodology is intended to bridge the technology gap that exists between the initial site evaluation using the Hazard Ranking System (HRS) and the time-consuming process of actual field site characterization, assessment and remediation efforts. The HRS was designed as an initial screening tool to discriminate between hazardous waste sites that do not and those that are likely to pose significant problems to human health, safety and/or the environment. The HRS is used by the U.S. Environmental Protection Agency to identify sites for nomination to the National Priorities List (NPL). Because the HRS is not designed to evaluate sites containing radionuclides, a modified Hazard Ranking System (mHRS) addressing both hazardous and radioactive mixed wastes was developed by Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE). Neither the HRS nor the mHRS was designed to prioritize sites that are nominated to the NPL according to their potential risks. To provide DOE with a better management tool for prioritizing funding and human resource allocations for further investigations and possible remediations at its inactive waste sites, PNL is developing the risk assessment methodology called RAPS. Use of RAPS will help DOE ensure that those sites posing the highest potential risk are addressed first.

METHODOLOGY/DOE

White, R.K.; Redfearn, A.; Shaw, R.A.; King, A.D.; Swindle Jr., D.W. Date: 1992. Title: Impacts of the Use of Institutional Controls on Risk Assessments for Department of Energy Facilities. Corporate Author: Oak Ridge National Laboratory, Oak Ridge, TN. Pub: CONF-920851 (Vol. 1); Spectrum '92: Nuclear and Hazardous Waste Management, Proceedings of an International Topical Meeting, Boise, ID, August 23-27, 1992, Vol. 1, 848 pp.; (pp. 37-43); CONF-9209165; Proceedings of the 65th Annual Conference of the Water Environment Federation, New Orleans, LA, September 23, 1992; (10 pp.) Abstract: This paper summarizes some of the major issues related to the use of institutional controls at hazardous waste sites that are now under the auspices of the Department of Energy Field Office, Oak Ridge/Environmental Restoration Division (DOE-OR/ERD). The impacts that assumptions regarding institutional controls have on the results and interpretation of the risk

assessment, both in the Remedial Investigation (RI) and the Feasibility Study (FS), are addressed. The approaches and assumptions relating to institutional controls focus on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), since it is the regulatory driver for hazardous waste sites at DOE facilities. In order to provide a contrast to approaches adopted under CERCLA, the Resource Conservation and Recovery Act and radiation regulatory authorities are briefly outlined. To demonstrate the implications of the use of institutional controls at DOE facilities, the approaches and results of a recent baseline risk assessment for Solid Waste Storage Area 6 at Oak Ridge National Laboratory are summarized.

METHODOLOGY/DOE

Zentner, M.D. Date: 1992, November. Title: Comparison of Reactor and Nonreactor Risk Assessment Approaches. Corporate Author: Westinghouse Hanford Company, Richland, WA. Pub: WHC-SA-1560; CONF-930116; Probabilistic Safety Assessment, Proceedings of an International Topical Meeting, Clearwater Beach, FL, January 27-29, 1993; (8 pp.) Abstract: The Risk Assessment Technology Group, Westinghouse Hanford Company (WHC), has participated in a number of full and partial reactor risk assessments of facilities such as the N Reactor, Fast Flux Test Facility, Washington Public Power Supply System No. 1, SP-100 Ground Test Facility, and the Savannah River K Reactor. As the mission of the Hanford Site has changed from special nuclear material production to environmental cleanup, the emphasis for performing risk assessments has shifted from evaluating the risk from operation of reactors to that from nonreactor facilities such as: waste storage tanks; waste treatment facilities such as Grout and the Hanford Waste Vitrification Plant; and waste processing facilities such as the 242-A evaporator. Additionally, risk assessment techniques are being used to support transportation safety studies, engineering design studies, safety analysis report development, and environmental remediation efforts. There are many opportunities for constructive use of risk assessment methodology in a wide variety of areas. This paper describes the state-of-the-art risk assessment at the Hanford Site, shows how the techniques are evolving, and compares reactor and nonreactor approaches.

METHODOLOGY/EPA

Bascietto, J.J. Date: 1992, October. Title: Development of Ecological Risk Assessment - An Historical Perspective. Corporate

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Author: U.S. Department of Energy, Office of Environmental Guidance, Washington, DC. Pub: CONF-921029; Waste Management and Environmental Restoration, Proceedings of the Eighth Annual DOE Model Conference, Oak Ridge, TN, October 18-22, 1992, 228 pp.; (8 pp.) Abstract: This paper gives the history of the U.S. Environmental Protection Agency's (EPA's) effort to develop a regulatory framework for ecological risk, beginning in the 1980s. This effort arose from the EPA's difficulty in establishing the proper level of ecological risk for the cancellation of two pesticides (diazinon and carbamate carbofuran). Diazinon, which was canceled first in 1990 after a six-year special review by the EPA, was less widely used and less toxic than carbamate carbofuran, which was canceled in 1991 after another six-year special review. EPA's 1992 framework for ecologic risk was the first published consensus document on generic ecological risk assessment principles, and is expected to form the basis for all future EPA ecological risk assessments. The current EPA regulatory framework, which is based on these early ecological risk assessment efforts, is given in another paper in this same conference session.

METHODOLOGY/EPA

Hamilton, L.D.; Medeiros, W.H.; Meinhold, A.; Morris, S.C.; Moskowitz, P.D.; Nagy, J. Date: 1988, Sept. Title: Health Risk Analysis for Ingestion of Contaminants from Existing Groundwater Contamination at Selected UMTRA Project Sites. Corporate Author: Brookhaven National Laboratory, Upton, NY. Pub: BNL-44772; 84 pp. Abstract: This study examines potential hazards to human health from ingestion of chemicals in groundwater beneath and adjacent to four abandoned uranium mill tailings sites: Gunnison, CO; Lakeview, OR; Monument Valley, AZ; and Riverton, WY. Chemicals of concern in groundwater near the sites include arsenic, cadmium, chromium, lead-210, molybdenum, nitrate, polonium-210, radium-226 and radium-228, selenium, sulfate, thorium-230, uranium, and vanadium. Hazards to health were evaluated by implementing the method outlined in the EPA Superfund Public Health Evaluation Manual. Because the method has a number of built-in conservatisms, the estimated risks and indexes only indicate sites and chemicals requiring further analysis. The chemicals and sites identified as presenting risk in this first screening step should be investigated in more detail. Necessary steps are given. Sites and chemicals identified as harmless in this initial screening can be eliminated from further consideration.

METHODOLOGY/EPA

MacDonell, M.M.; Haroun, L.A.; Peterson, J.M.; Blunt, D.A.; Fingleton, D.J.; Picel, M.H. Date: 1991, September. Title: Strategy for Integrated CERCLA/NEPA Risk Assessments. Corporate Author: Argonne National Laboratory, Environmental Assessment and Information Sciences Division, Argonne, IL. Pub: CONF-910981; Environmental Remediation '91: Cleaning Up the Environment for the 21st Century, D.E. Wood (ed.), Proceedings of a Conference, Pasco, WA, September 8-11, 1991, 970 pp.; (pp. 853-860) Abstract: The U.S. Department of Energy (DOE) has established a policy whereby, for remedial actions, the procedural and documentational requirements of the National Environmental Policy Act (NEPA) are integrated with those of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended. However, the objectives of risk assessment under NEPA and CERCLA differ somewhat. Until its recent application to contaminated sites, NEPA analysis has typically been applied to impacts from actions at clean sites (e.g., for construction activities), and a somewhat loosely structured process has historically been used to estimate relative risks for NEPA. Decisions such as cleanup levels were not made on the basis of risk estimates, and therefore tended to be conservative and not detailed. In contrast, risk estimates for Superfund (CERCLA) sites are used to focus the decision-making process for those sites and support national prioritization for cleanup. The U.S. Environmental Protection Agency (EPA) has developed a detailed framework for preparing baseline health-risk assessments for these sites. The purpose of this paper is to discuss the issues relating to integrating the CERCLA and NEPA approaches into the risk assessments that have been prepared for a DOE remedial action project at the Weldon Spring Site near St. Charles, Missouri. These issues are grouped into three basic categories: general assumptions for the impact evaluation, data management, and presentation of the methodology and results. This paper is not intended to represent DOE policy and guidance, nor does it represent the only approach that can be used for integrated risk assessments. It merely discusses the process that was used for the Weldon Springs project, articulating the issues that were encountered and how they were addressed.

METHODOLOGY/EPA

Niemczyk, S.J. Date: 1988. Title: A New Approach for Estimating the Risk from Residual Radioactivity. Corporate Author: Gull Associates, Washington, DC. Pub: Proceedings of the Health Physics Society 33rd Annual Meeting, Boston, MA, July 4-8, 1988; (p. S7); Health Physics 54(Suppl. 1):S7 Abstract: To aid the U.S.

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Environmental Protection Agency's selection of decommissioning criteria for unrestricted release of cleaned-up sites and facilities, a new approach has been developed for estimating the potential hazard from residual radioactivity. That approach, intended to provide conservatively realistic estimates of radiation doses to individual residents from such radioactivity in the environment and in buildings, uses a comprehensive yet relatively simple set of physically-based, risk-level environmental transport and exposure pathway models. Doses are estimated for up to 10,000 years. Compared to other approaches which might be used for residual radioactivity, the new approach has several outstanding features. First, some of its models are less conservative than the comparable models in other approaches, thus reducing the likelihood of unwarranted over-estimation of certain doses. Second, the new approach includes models for estimating certain doses due to the neglect of contributions from "other" rooms (as happens in the one-room models typically used). Third, the approach's integrated set of transport and behavior models permits straightforward consideration of situations with significant movement of radioactivity within the environment and/or significant radioactive in-growth, thus helping to prevent overlooking of situations in which the largest potential doses occur at times long after the site's release. Fourth, the approach's extremely efficient solution techniques, combined with its comprehensive set of transport and behavior models, make consideration of a large variety of situations practical. And fifth, the approach has been implemented in a computer code which runs on a personal computer, making the approach accessible to a wide number of users. The new approach constitutes a significant first step toward a set of comprehensive relationships for providing radiation dose estimates for residual radioactivity at a variety of sites and facilities. As such it serves to fill a significant gap in the spectrum of available approaches.

METHODOLOGY/EPA

Norton, S.B.; Rodier, D.J.; Gentile, J.H.; van der Schalie, W. Date: 1992, October. Title: EPA's Framework for Ecological Risk Assessment. Corporate Author: U.S. Environmental Protection Agency, Washington, DC. Pub: CONF-921029; Waste Management and Environmental Restoration, Proceedings of the Eighth Annual DOE Model Conference, Oak Ridge, TN, October 18-22, 1992, 228 pp.; (6 pp.) Abstract: The U.S. Environmental Protection Agency (EPA) has an increasing interest in using ecological risk assessments as a basis for environmental decisions. This increased emphasis is

illustrated by a recent report by the EPA Science Advisory Board. Among their recommendations, the board suggested that EPA (1) target its environmental protection efforts on the basis of opportunities for the greatest risk reduction; (2) attach as much importance to reducing ecological risk as it does to reducing human health risk; and (3) improve the data and analytical methodologies that support the assessment, comparison, and reduction of different environmental risks. This article summarizes the recently published EPA Framework for Ecological Risk Assessment (1992) that describes the basic elements of ecological risk assessment. In addition, the article discusses several of the scientific issues that have been highlighted through the development of the framework report.

METHODOLOGY/EPA

USEPA. 1986. The risk assessment guidelines of 1986. EPA/600/8-87/045. U.S. Environmental Protection Agency. August, 1987.

METHODOLOGY/EPA

USEPA. 1989a. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual. EPA/540/1-89/002. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. OSWER Directive 9285.7-01A; 340 pp. Abstract: This document is part of the two-manual set titled Risk Assessment Guidance for Superfund. Volume I, the Human Health Evaluation Manual, provides guidance for health risk assessment at Superfund sites; Volume 2, the Environmental Evaluation Manual, provides guidance for ecological assessment at Superfund sites. The Environmental Protection Agency (EPA) Office of Emergency and Remedial Response developed a human health evaluation process as part of its remedial response program. The process of gathering and assessing human health risk information described in this manual is adapted from well-established chemical risk assessment principles and procedures (NAS 1983; CRS 1983; OSTP 1985). It is designed to be consistent with EPA's published risk assessment guidelines (EPA 1984; EPA 1986a-e; EPA 1988a; EPA 1989a) and other EPA-wide risk assessment policy. The Human Health Evaluation Manual replaces the Superfund Public Health Evaluation Manual (EPA 1986f). It incorporates new information and builds on several years of Superfund program experience in conducting risk assessments at hazardous waste sites. In addition, this manual and its companion Environmental Evaluation Manual (EPA 1989b) replace the EPA 1985 Endangerment Assessment Handbook, which is no longer to be used. The goal of the Superfund human health evaluation process is to

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provide a framework for developing the risk information necessary to decision making at remedial sites. Specific objectives are to (1) provide an analysis of baseline risks and help determine the need for action at sites; (2) provide a basis for determining levels of chemicals that can remain onsite and still be adequately protective of public health; (3) provide a basis for comparing potential health impacts of various remedial alternatives; and (4) provide a constituent process for evaluating and documenting public health threats at sites.

METHODOLOGY/EPA

USEPA. 1989b. Risk Assessment Guidance for Superfund. Vol. 2: Environmental Evaluation Manual. EPA/540/1-89/001. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. 70 pp. Abstract: This document is part of the two-manual set titled Risk Assessment Guidance for Superfund. Volume I, the Human Health Evaluation Manual, provides guidance for health risk assessment at Superfund sites; Volume 2, the Environmental Evaluation Manual, provides guidance for ecological assessment at Superfund sites. Volume 2 primarily addresses remedial project managers and on-scene coordinators, who are responsible for ensuring a thorough evaluation of potential environmental effects at sites. It is not a detailed "how-to" guidance and does not provide "cookbook" approaches for evaluation. Instead, it identifies the kinds of help that on-scene coordinators and project managers are likely to need and where to find this help. Then it describes an overall framework for considering environmental effects. A detailed discussion of environmental evaluation methods can be found in Ecological Assessments of Hazardous Waste Sites: A Field and Laboratory Reference Document (EPA/600/3-89/013).

METHODOLOGY/EPA

USEPA. 1991, December. Title: Risk Assessment Guidance for Superfund - Volume 1: Human Health Evaluation Manual - Part B, Development of Risk-Based Preliminary Remediation Goals - Interim Report. Corporate Author: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. Pub: OSWER Directive 9285.7-01B; 66 pp. Abstract: The document is one of a three-part series. Part B provides guidance on using U.S. Environmental Protection Agency toxicity values and exposure information to derive risk-based preliminary remedial goals (PRG) for a Comprehensive Environmental Response, Compensation and

Liability Act (CERCLA) site. Initially developed at the scoping phase using readily available information, risk-based PRGs generally are modified based on site-specific data gathered during the remedial investigation/feasibility study. The guidance does not discuss the risk management decisions that are necessary at a CERCLA site. The potential users of Part B are those involved in the remedy selection and implementation process, including risk assessors, risk assessment reviewers, remedial project managers, and other decision-makers.

METHODOLOGY/EPA

USEPA. 1992, May. Title: Guidance for Data Useability in Risk Assessment (Part B): Final Report. Corporate Author: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. Pub: PB-92-963362/XAB; OSWER Directive 9285.7-09B; 85 pp. Abstract: Part B of this report, Guidance for Data Useability in Risk Assessment, provides supplemental information regarding the useability of analytical data for performing a baseline risk assessment at sites with radioactivity. While Part A focuses primarily on chemical contamination, much of the information presented also applies to the risk assessment process for radioactive contamination. The guidance offered in Part B is intended as an overview of the key differences between chemical and radionuclide risk assessments, and not as a comprehensive, stand-alone document to assess the risks posed by radionuclide exposures. Part A of the guidance should be used side-by-side with this document.

METHODOLOGY/ICRP

Devgun, J.S.; Devgun, M.E. Date: 1992. Title: Implications of Recent ICRP Recommendations for Risk Assessments for Radioactive Waste Disposal and Cleanup. Corporate Author: Argonne National Laboratory, Argonne, IL. Pub: ANL/CP-74093; CONF-920307; Waste Management '92, R.G. Post (ed.), Proceedings of a Conference, Tucson, AZ, March 1-5, 1992, Vol. 1, 994 pp.; (pp. 499-503) Abstract: The International Commission on Radiological Protection (ICRP) adopted a new set of recommendations in November 1990 which were issued as ICRP Publication No. 60 in March 1991. These recommendations incorporate new radiobiological information and outline a comprehensive system of radiological protection. This paper evaluates the implications of these new recommendations regarding risk assessments for radioactive waste disposal and remediation of radioactively contaminated sites.

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METHODOLOGY/International

Murray, M.L.; Chambers, D.B.; Knapp, R.A.; Kaplan, S. Date: 1987, September. Title: Estimation of Long-Term Risk from Canadian Uranium Mill Tailings. Corporate Author: Senes Consultants Limited, Willowdale, Ontario, Canada. Pub: Risk Analysis 7(3):287-298
Abstract: A methodology is presented for assessing the risk from Canadian uranium mill tailings piles. The methodology is based on the set of triplets concept and uses an event tree to identify various scenarios representing the performance of a pile over its 1,000-year design life. Compartment-type mathematical models are used to quantify the movement of hazardous substances through the environment. Numerical examples are given of both level 1 (straight probabilistic) and level 2 (probability of frequency) type analyses.

METHODOLOGY/International

Murray, M.L.; Chambers, D.B.; Knapp, R.A.; Holmes, R.W. Date: 1986. Title: An Approach to Risk Assessment for Canadian Uranium Mill Tailings. Corporate Author: Senes Consultants, Willowdale, Ontario, Canada; Department of Energy, Mines and Resources, Ottawa, Ontario, Canada. Pub: CONF-8609486; Radioactive Waste Management, Proceedings of the Second International Conference, Winnipeg, Ontario, Canada, September 7-11, 1986, 821 pp.; (pp. 273-280)
Abstract: Quantitative risk analysis provides a framework for considering the consequences of sequences of events (scenarios) in proportion to their likelihoods of occurrence. This paper considers risk as a "set of triplets" consisting of scenarios, the likelihoods of those scenarios occurring, and their consequences should they occur. Both the likelihood of an event (or scenario) occurring and its consequence may be uncertain quantities. The risk quantification method presented allows incorporation of these uncertainties. This paper discusses the concept of risk and demonstrates how the consequences of a number of scenarios involving naturally occurring events can be combined to estimate the overall risk arising from uranium mill tailings.

METHODOLOGY/NCRP

NCRPM. 1989. Comparative carcinogenicity of ionizing radiation and chemicals. National Council on Radiation Protection and Measurements. Report No. 96.

METHODOLOGY/NRC

USNRC. 1986a. Title: Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings. Corporate Author: National Research Council, Uranium Mill Tailings Study Panel, Washington, DC. Pub: DOE/DP-93032-T1; 260 pp. Abstract: Uranium mill tailings are the finely ground sand-like material that is left after uranium is extracted from ore. As of early 1983, approximately 200 million metric tons of uranium mill tailings covering 1300 ha at 51 sites had accumulated in the United States. Most of these sites are in the arid Southwest. Uranium mill tailings present health and environmental concerns because of the residual radioactivity that they contain and because of a variety of other potential pollutants, such as chlorides, sulfates, and heavy metals. The milling process makes the radioactive and nonradioactive materials contained in the ore when it was mined much more mobile and also adds several potential contaminants to the tailings material during the milling process. Exposure routes of concern are release of the gas, Rn-222, airborne dust, and surface and groundwater contamination. In addition, the use of tailings as construction material or fill can lead to dangerously high levels of radon in associated buildings. At the request of the Department of Energy, a National Research Council study panel, convened by the Board on Radioactive Waste Management, has examined the scientific basis for risk assessment and management of uranium mill tailings and issued this final report containing a number of recommendations. Chapter 1 provides a brief introduction to the problem. Chapter 2 examines the processes of uranium extraction and the mechanisms by which radionuclides and toxic chemicals contained in the ore can enter the environment. Chapter 3 is largely devoted to a review of the evidence on health risks associated with radon and its decay products. Chapter 4 provides a consideration of conventional and possible new technical alternatives for tailings management. Chapter 5 explores a number of issues of comparative risk, provides a brief history of uranium mill tailings regulation, and concludes with a discussion of choices that must be made in mill tailing risk management.

METHODOLOGY/NRC

USNRC. 1986b. Title: Scientific Basis for Risk Assessment and Management of Uranium Mill Tailings. Corporate Author: National Research Council, Uranium Mill Tailings Study Panel, Washington, DC. Pub: DOE/DP-93032-T2; 262 pp. Abstract: A National Research Council study panel, convened by the Board on Radioactive Waste

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Management, has examined the scientific basis for risk assessment and management of uranium mill tailings and issued this final report containing a number of recommendations. Chapter 1 provides a brief introduction to the problem. Chapter 2 examines the processes of uranium extraction and the mechanisms by which radionuclides and toxic chemicals contained in the ore can enter the environment. Chapter 3 is devoted to a review of the evidence on health risks associated with radon and its decay products. Chapter 4 provides a consideration of conventional and possible new technical alternatives for tailings management. Chapter 5 explores a number of issues of comparative risk, provides a brief history of uranium mill tailings regulation, and concludes with a discussion of choices that must be made in mill tailing risk management.

METHODOLOGY/Other

Wartenberg, D., and R. Simon. 1995. Comment: Integrating epidemiologic data into risk assessment. American Journal of Public Health. 85(4):491-493. April, 1995.

UNCERTAINTY/Commercial

Mendez Jr., W.M. Date: 1990. Title: Recent Developments in Health Risks Modeling Techniques Applied to Hazardous Waste Site Assessment and Remediation. Corporate Author: Ebasco Environmental, Inc., Arlington, VA. Pub: CONF-9010166; Waste Management and Environmental Restoration, Proceedings of the 1990 DOE Model Conference, Oak Ridge, TN, October 29-November 2, 1990, 343 pp.; (1 p.) Abstract: Remediation of hazardous and mixed-waste sites is often driven by assessments of human health risks posed by exposures to the hazardous substances released from these sites. The methods used to assess potential health risk involve, either implicitly or explicitly, models for pollutant releases, transport, human exposure and intake, and characterizing health effects. Because knowledge about pollutant fate and transport processes at most waste sites is quite limited and data costs are quite high, most of the models currently used to assess risk that are endorsed by regulatory agencies are quite simple. The models employ many simplifying assumptions about pollutant fate and distribution in the environment, human pollutant intake, and toxicologic responses to pollutant exposures. An important consequence of data scarcity and model simplification is that risk estimates are quite uncertain. Estimates of the magnitude uncertainty associated with risk assessment has been very difficult. A number of methods have been developed to address the issue of uncertainty in risk