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Defining the Role of Risk Assessment in the Comprehensive Environmental Response, Compensation, and Liability Act Remedial Investigation Process at the DOE-OR

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EXECUTIVE SUMMARY

The risk assessment strategy 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 within 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 U.S. Environmental Protection Agency risk assessment guidance to provide specific details on conducting baseline risk assessments. However, the document does contain a section on the baseline risk assessment process that details the exposure pathways to be evaluated on the Oak Ridge Reservation.

This document will be used in conjunction with existing Martin Marietta Energy Systems, Inc. Environmental Restoration risk assessment standards, policies, procedures, and technical memoranda. The material contained herein will be periodically updated as the strategy is tried and tested and as the risk assessment methodology is revised. The primary purpose for this document is to present the proposed strategy to the Tennessee Department of Environment and Conservation and the U.S. Environmental Protection Agency, Region IV and receive concurrence or additional comments on the material presented herein.

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1. INTRODUCTION

Cleanup of hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is a complicated and painstaking process, particularly at facilities with a multitude of individual hazardous waste sites, each having a large number of chemicals and radionuclides.[1] The U.S. Department of Energy-Oak Ridge, Environmental Restoration Division (DOE-OR/ERD) administers five such facilities which are undergoing environmental cleanup under the CERCLA Remedial Investigation and Feasibility Study (RI/FS) process or the Resource Conservation and Recovery Act (RCRA) investigation process. The nature of the wastes treated, stored, or disposed of at the U.S. DOE-OR sites is heterogeneous and often unknown. The amount of environmental sampling, chemical analysis, and document preparation and review required to support a baseline risk assessment alone at each facility often requires years before arriving at a final Record of Decision (ROD)[2, 3]. Therefore, there is clearly a need to streamline the investigative and decision processes to realize the U.S. Environmental Protection Agency's (EPA's) goal of reducing contaminant levels to those protective of human health and the environment in a timely and cost-effective manner.[4]

The goal of an RI/FS is to gather information sufficient to support an informed risk management decision regarding which remedy appears to be most appropriate for a given site.[2] Risk assessment is one of many tools used to support the decision-making process. The goal of human health risk assessment is:

> *"to focus on providing information necessary to justify action at a site and to select the best remedy for the site. This should include characterizing the contaminants, the potential exposures, and the potentially exposed population sufficiently to determine what risks need to be reduced or eliminated and what exposures need to be prevented. It is important to recognize that information should be developed only to help EPA determine what actions are necessary to reduce risks, and not to fully characterize site risks or eliminate all uncertainty from the analysis."*[2]

The purpose of this document is to present the proposed risk assessment strategy for the Oak Ridge Reservation with respect to each of the phases of the RI process. By documenting not only the goals and objectives of the risk assessment strategy but also the level/rigor of assessment to be performed at each phase of the process, this document will provide the U.S. DOE-OR, the Tennessee Department of Environment and Conservation (TDEC), and the EPA with a point of reference from which the strategy can be implemented. This strategy was previously submitted to the U.S. DOE-OR, the TDEC, and the EPA, Region IV, for review and comment. A comment review meeting was held on May 17, 1994, to discuss the strategy and receive informal comments on the document. The document was revised based on the verbal comments received during the meeting and formal comments subsequently submitted by the TDEC and the EPA, Region IV. The comments as well as the responses to individual comments are contained in the Appendix.

The information contained in this document is not intended to supersede the requirements called for in the existing regulations and risk assessment guidance documents. Rather, this information has been documented to provide risk assessors with guidance concerning the level/rigor of risk assessment necessary for each phase of the RI process. In addition, the document proposes

evaluating a limited set of pathways and land uses for certain sites and performing a limited quantitative evaluation for areas where early response actions are to be performed.

The information contained herein is specific only to human health risk assessment. The document entitled *Approach and Strategy for Performing Ecological Risk Assessments for the Department of Energy Oak Ridge Field Office Environmental Restoration Program*, ES/ER/TM-33 (Suter, 1992) addresses implementation of ecological risk assessments for U.S. DOE-OR.[5]

Of the facilities administered by the U.S. DOE-OR, only those located on the Oak Ridge Reservation (Oak Ridge National Laboratory, Oak Ridge Y-12 Plant, and Oak Ridge K-25 Site) have been listed on CERCLA's National Priorities List. As such, this strategy has been tailored for application to those facilities only.

2. CURRENT CONDITIONS ON THE OAK RIDGE RESERVATION

The three major U.S. DOE-OR installations (Oak Ridge National Laboratory, the Oak Ridge Y-12 Plant, and the Oak Ridge K-25 Site) comprising the Oak Ridge Reservation were constructed in the early to mid 1940s as research, development, and process facilities in support of the Manhattan Project. In addition to the three installations, the Oak Ridge Reservation Superfund Site also includes areas outside the installations, land used by the Oak Ridge Associated Universities, and waterways that have been contaminated by releases from the U.S. DOE-OR installations. In 1989, the Oak Ridge Reservation was evaluated by the EPA using the Hazard Ranking System. As a result of this evaluation, the Oak Ridge Reservation was placed on the National Priorities List and, as such, was required to comply with the requirements of CERCLA. To date, 59 areas requiring evaluation have been identified and categorized as operable units and 151 as study areas (i.e., areas that have a small probability of contributing to environmental contamination or for which there was insufficient information to determine the environmental damage). [6]

Under CERCLA, the DOE was required to enter into an Interagency Agreement with EPA and the TDEC, hereafter referred to as "the Parties." This Agreement is titled the *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014.[7] The primary purpose of the agreement is to coordinate remediation activities undertaken on the Oak Ridge Reservation pursuant to CERCLA, RCRA, and the National Environmental Policy Act (NEPA).

The Parties have a common goal to ensure that releases of hazardous substances to the environment associated with past waste management and operational activities at the Oak Ridge Reservation are adequately investigated and that appropriate remedial action is taken to protect human health and the environment.

The general purposes of the Agreement are to:

- establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the Oak Ridge Reservation in accordance with CERCLA, RCRA, and NEPA; appropriate DOE and EPA guidance and policy; and Tennessee laws;

- coordinate response actions under CERCLA, with RCRA closure, postclosure care, and corrective measures under way or planned under any applicable state laws, in such a manner as to maximize flexibility and preclude redundant activity;

- minimize the duplication of investigative and analytical work and documentation and ensure the quality of data management; and

- expedite response actions with a minimum of delay.[7]

2.1 DEFINITIONS

Facility—as defined by Section 101(9) of CERCLA, means any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, aircraft, or any site or area where a hazardous substance has been deposited, stored, disposed of, placed, or otherwise come to be located but does not include any consumer product in consumer use or any vessel.[4]

Groundwater—as defined by Section 101(12) of CERCLA means water in a saturated zone or stratum beneath the surface of land or water.[4]

Integrator—a groundwater or surface water system that serves as collectors or basins for multiple contaminants that have been released, are currently being released, or have the potential to be released from a variety of sources. Once contaminants have reached these groundwater or surface water systems, they are integrated and transported in the flow paths of these systems.

Integration point assessment—a screening risk analysis that uses monitoring, surveillance, compliance, and RI data to evaluate the off-operable unit risk from a variety of sources that input into the surface water integrators. The integration point assessment is a flux-based risk analysis. Actions taken to control sources that have high fluxes of integrator contaminants of concern are the quickest means of reducing off-operable unit exposure to levels that are as low as reasonably achievable.

Most likely exposure assessment—a screening risk analysis developed to support early response actions at operable units and serve as an indicator of current on-operable unit risk.

On-site—the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.[4,7]

Operable Unit—a discrete action that comprises an incremental step toward comprehensively addressing site problems. This discrete portion of a remedial response manages migration, or eliminates or mitigates a release, threat of a release, or pathway of exposure. The cleanup of a site can be divided into a number of operable units, depending on the complexity of the problems associated with the site. Operable units may address geographical portions of a site, specific site problems, or initial phases of an action, or may consist of any set of actions performed over time or any actions that are concurrent but located in different parts of a site.[4,7]

Remedial Investigation—shall mean an investigation conducted to fully assess the nature and extent of the release or threat of release of hazardous substances, pollutants, or contaminants and to gather necessary data to support the corresponding feasibility study.[7]

Removal—as defined by Section 101(23) of CERCLA, remove or removal means the cleanup or removal of released hazardous substances from the environment; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment: such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, that may otherwise result from a release or threat of release. The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for action taken under section 104(b) of CERCLA, post-removal site control, where appropriate, and any emergency assistance that may be provided under the Disaster Relief Act of 1974. For the purpose of the NCP, the term also includes enforcement activities related thereto.[4,7]

Site—shall mean facility as defined by Section 101(9) of CERCLA 42 U.S.C. 9601(9) [7]

Site Inspection—means an on-site investigation to determine whether there is a release or potential release and the nature of the associated threats. The purpose is to augment the data collected in the preliminary assessment and to generate, if necessary, sampling and other field data to determine if further action or investigation is appropriate.[4]

Solid Waste Management Units—shall mean those units subject to applicable RCRA corrective action requirements, identified by EPA and TDEC, either presently or in the future, as requiring further investigation, and specifically identified as SWMUs in Appendix C.[7]

Sources—environmental media or wastes (e.g., buried, containerized, exposed, etc.) that have released, are currently releasing, or have the potential to release contaminants.

Source control action—is the construction or installation and start-up of those actions necessary to prevent the continued release of hazardous substances or pollutants or contaminants (primarily from a source on top of or within the ground, or in buildings or other structures) into the environment.[4]

Study areas—areas that have a small probability of contributing to environmental contamination or the information on these areas was insufficient to determine the environmental damage. These

areas will be assessed further under the preremedial investigation phase and designated for potential inclusion into new or existing operable units. The Parties will use data from preremedial investigations to determine the status (no further investigation, removal action, or operable unit) and the prioritization for those sites that require further action.[6]

Waste Area Groupings—shall mean a group of solid waste management units and/or other areas of contamination that are geographically contiguous or are located within defined hydrologic units. The DOE may consolidate solid waste management units, waste area groupings, and/or other areas into single groupings for purposes of conducting any work under this Agreement.[7]

2.2 DESCRIPTION OF THE RI PROCESS ON THE OAK RIDGE RESERVATION[6]

Implementation of the CERCLA process on the Oak Ridge Reservation will generally follow the process described in the document *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* , EPA/540/G-89/004.[1] The Oak Ridge Reservation CERCLA strategy contains all of the elements required by the EPA guidance plus additional preremedial investigation activities and interaction (i.e., scoping workshop and status meetings) between the Parties. The strategy emphasizes using early response actions (e.g., removal actions, some routine maintenance actions, and interim remedial actions) to address contaminated areas or selected releases of contaminants to the environment to ensure immediate attention is paid to areas where risk to the public, workers, and/or the environment is unacceptable. The strategy also emphasizes using risk assessment for identifying operable units where early response actions are warranted, prioritizing early and final response actions, and providing a baseline against which alternatives can be compared, clean-up criteria can be established, and alternative performance can be assessed.

Areas of concern at the Oak Ridge Reservation are grouped as either 1) study areas subject to preremedial investigation or 2) operable units for remedial action. As additional areas are identified, they will be reviewed for removal action classification or placed in a study area group for preremedial investigation. If a removal action is determined appropriate, an empowered removal action task team will meet to determine the appropriate approach for the area, the prioritization, and the resources and schedule necessary to support those activities.[6]

Preremedial investigation activities are currently limited to the traditional preliminary assessment/site inspection activities. This document proposes that the preremedial investigation activities be broadened to include performing screening risk analyses.[a] These additional activities would provide the RI team with information concerning:

- chemicals of potential concern,
- data gaps/limitations associated with the historical data base,

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[a]Screening risk analyses on the Oak Ridge Reservation include, at a minimum, comparing available environmental data with preliminary remediation goals (see Sect. 5.1), conducting a most likely exposure and/or integration point assessment (see Sects. 5.2 and 5.3, respectively), and performing the appropriate level of ecological screening assessment.

- detection limits for subsequent environmental sample analysis,
- quantitative risk information on which to base subsequent prioritization efforts,
- risk information on which to base early action if necessary, and
- risk information on which to baseline risk reduction resulting from early action.

Areas of concern that have already undergone preremedial investigation have been grouped into operable units or waste area groupings. These operable units/waste area groupings will undergo the RI process beginning with the development of an RI workplan, including the development of data quality objectives. Subsequent to implementation of the workplan but prior to the development of the RI report, the need for early response actions (removal actions or interim actions) will be evaluated. The decision to conduct some type of early response action will be decided at a status meeting that will include all the Parties. Based on input from the risk assessors, the site characterization specialists, and other technical specialists, the Parties will decide whether an early response action, final action, or a combination of both is feasible and/or appropriate.

The remedial action steps identified in the *Oak Ridge Reservation Site Management Plan for the Environmental Restoration Program*, DOE/OR-1001/R3 that help plan and manage the activities executed to achieve final cleanup actions follow. [6] These activities support the comprehensive and coordinated OU strategy that guides the implementation of remedial actions at the Oak Ridge Reservation.

Step 1: Conduct scoping workshops for each potential remediation project. The purposes of the scoping workshops are to 1) review available historical information and existing data on the operable unit; 2) identify the potential contamination problems and associated potential risks to human health and the environment; 3) identify the likely remediation alternatives; and 4) reach agreement on the need for additional data and the data quality objectives (DQOs) for decisions on remedial action.

Step 2: Identify and conduct early response actions focused on key areas to minimize additional environmental contamination and contaminant release/transport to surface water and local groundwater. Early response actions can be taken under the CERCLA process as removal actions, routine maintenance actions, and interim remedial actions that may then be linked with additional actions for a contaminated study area or operable unit.

Conduct monitoring at key locations to quantify and track contaminant releases from the Oak Ridge Reservation and identify the major source areas contributing to contaminant transport. Monitoring also supports the investigations of the key pathways and processes for contaminant release.

Perform screening risk analyses to prioritize specific areas for early response actions.

Step 3: Conduct RIs for operable units (in parallel with Step 2) to provide the information needed to formulate and implement approaches resulting in RODs for either interim or final remedial solutions for those operable units.

Work with public participation to establish land use objectives for each contaminated area to be consistent with current and future uses for adjacent and downgradient areas and allow cost-effective remedial actions.

Conduct technology development and demonstration efforts as required, based on anticipated remedial decisions, to provide effective tools for remediation.

Step 4: Conduct an FS, and with public involvement, select among the technological alternatives for achieving final remedies. Examples of the selection criteria are ease of implementation, worker risk, cost, public health risk, and environmental risk in the context of future land use.

Step 5: Conduct remediation to achieve the risk reduction commensurate with planned or potential future land use in compliance with environmental regulations.

Step 6: Conduct monitoring at key locations to track the effectiveness of interim and final remedial actions, evaluate the need for contingent actions, and identify remaining or new areas of concern. Conduct additional actions, as needed, prior to final remediation or as contingencies following final actions.

Step 7: Prepare documentation necessary to remove the Oak Ridge Reservation from the National Priorities List following the completion of all remediation response activities.

3. RISK ASSESSMENT STRATEGY

The proposed risk assessment strategy for the Oak Ridge Reservation is graphically displayed in Fig. 1. The strategy follows the guidelines provided by the EPA in the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004[1] and the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A, B, & C)*, EPA/540/1-89/002.[2] In addition to the baseline risk assessment that will be prepared for all final actions, the risk assessment strategy incorporates screening risk analyses into the RI process. These screening analyses will help focus attention on exposure pathways and chemicals of potential concern early in the process, identify sites where no further action may be feasible, and identify sites that warrant early response actions. Figure 2 illustrates the integration of the various risk assessment activities with the RI process on the Oak Ridge Reservation by singling out those steps/activities in the overall process where risk information is generated or used in decision-making. The following text describes in detail the information displayed in Figs. 1 and 2.

3.1 ORR RISK ASSESSMENT OVERVIEW

The human health risk assessment activities that will be conducted during an RI on the Oak Ridge Reservation will begin with a compilation of existing environmental data collected at or near the operable unit under investigation. This dataset may consist of the results of preremedial sampling and analysis, environmental compliance monitoring, biological monitoring, and/or

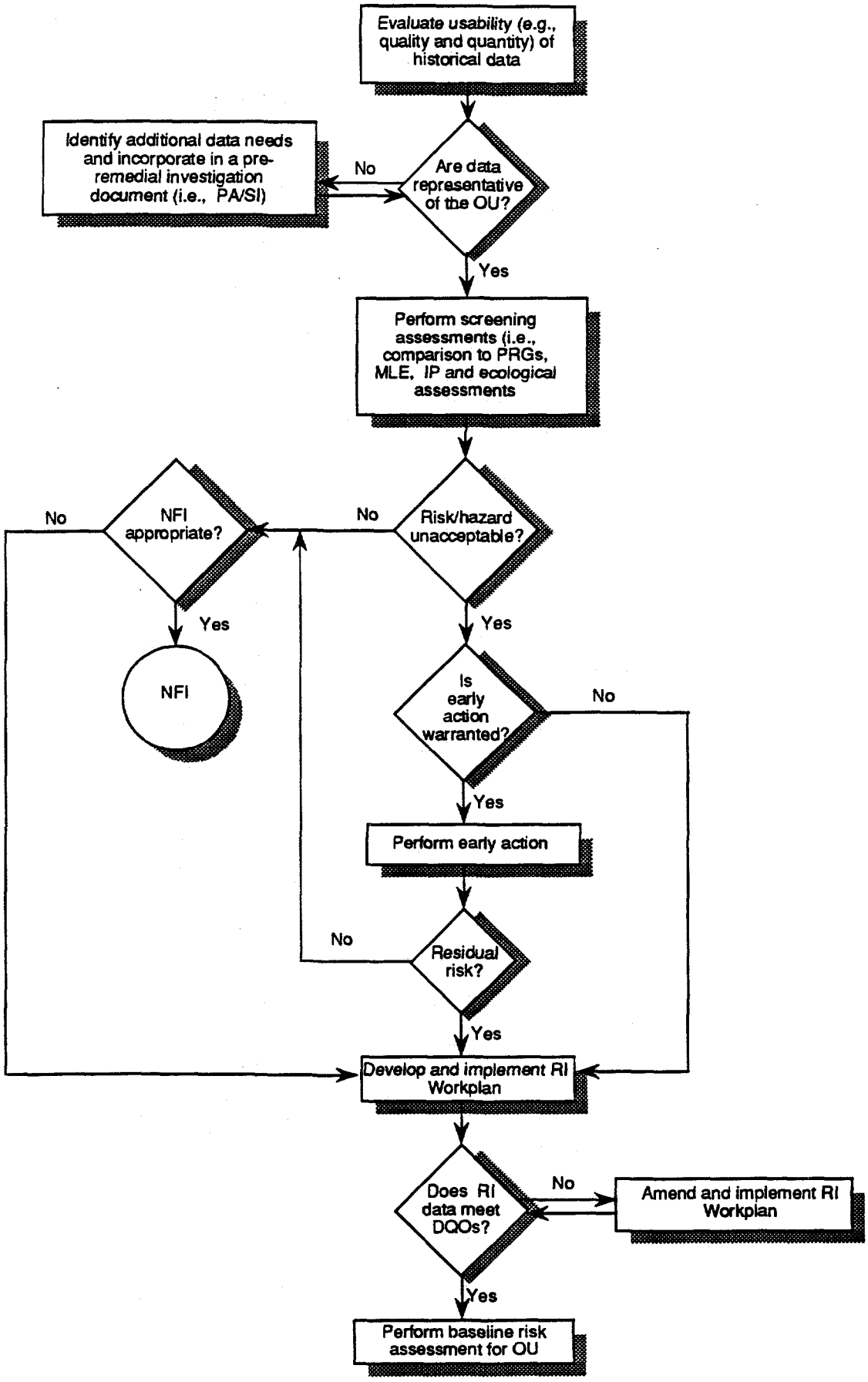

Fig. 1. The Role of Risk Assessment in the Remedial Investigation Process on the DOE-OR.

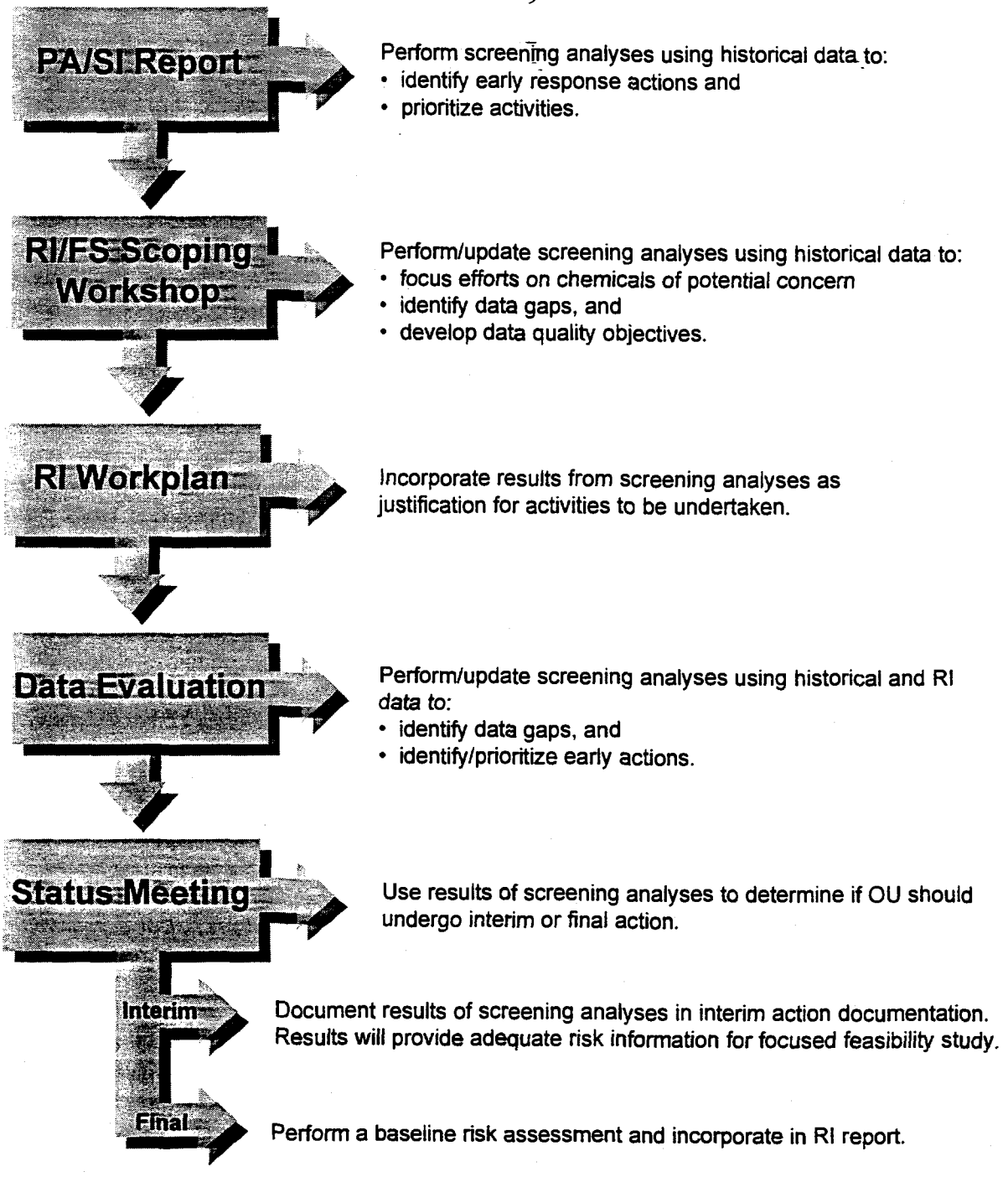

Fig. 2 Integration of risk assessment activities with the RI process.

physical or chemical characterization activities performed as part of a research program. The data must be evaluated to determine if the manner in which they were collected and analyzed is consistent with the data quality requirements necessary to support remedial decisions. The possible results of the data evaluation are 1) data are not useable for any purposes, 2) data have limited uses (i.e., suitable for a screening risk analysis), or 3) data are sufficient to perform a baseline risk assessment.

If the data are determined to be of inadequate quality or are not considered to be representative of the operable unit, additional data needs should be determined and a Preliminary Assessment Report/Site Inspection Workplan (PA/SI) should be prepared. This PA/SI document will incorporate the results of the data evaluation as justification for the site inspection activities to be undertaken. Once the site inspection activities have been conducted, the data set will be recompiled and evaluated to determine the next course of action. Once again the conclusions of the data evaluation may result in performing 1) additional sampling and analyses, 2) performing screening risk analyses, or 3) performing a baseline risk assessment.

At any point in the RI process prior to the development of a baseline risk assessment, screening risk analyses may be performed provided the data are of an appropriate quality and are representative of source conditions. The results of these screening risk analyses can be used to justify the need for performing an early action to mitigate exposure to contaminants either at the sources or within the integrators. No baseline risk assessment will be performed for emergency or early response actions as is stated in OSWER Directive 9355.0-30:

> *"Early and interim action RODs do not require a completed baseline risk assessment, although enough information must be available to demonstrate the potential for risk and the need to take action. Data sufficient to support the interim action decision can be extracted from the ongoing RI/FS for the site and set out in a focused feasibility study or other appropriate document that includes a short analysis of a limited number of alternatives. These data should include a summary of contaminants of concern, concentrations and relevant exposure information. A discussion should accompany these data explaining the need for immediate remedial action based on the presence of contamination that, if left unaddressed in the short-term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. The early and interim action RODs should note that some exposure pathways at the site may not be addressed by the action."*[3]

The results of the screening risk analyses that are used to justify the need for early action will be incorporated into the early action documentation (e.g., Engineering Evaluation/Cost Analysis Report, Record of Decision for Interim Action). If an early action is not determined to be warranted, the results of the screening risk analyses will be presented to the Parties at the scoping meeting and will be used during the development of operable unit-specific DQOs for those operable units proceeding to an RI. If the operable unit will pursue a no further investigation determination, the results of the screening risk analyses will be documented in a technical memorandum, numbered, and referenced on the No Further Investigation Determination Form.[6] The details associated with each of the screening risk analyses are included in the subsequent sections of this document.

If an early action is performed for an operable unit or a portion thereof, environmental data obtained during or subsequent to the implementation of the early action should be incorporated into

the existing operable unit dataset. These additional data will allow the risk assessor to determine if a residual risk is present. In some cases, the early action may reduce the risk below a level of concern from either a human health or ecological perspective. In this case, a no further investigation determination may be pursued for the operable unit or a portion thereof. If a residual risk is present, the operable unit must proceed through the remainder of the RI/FS process.

As previously stated, the results of the screening risk analyses will be presented to the Parties during the scoping meeting and will be used to support the development of DQOs for data to be obtained during the RI. Depending on the complexity of the operable units, more than one round of sampling and analyses may be necessary to adequately characterize the physical and chemical characteristics of the operable unit. Subsequent to the completion of each phase of sampling and analyses, the dataset for the operable unit will be appended, and the screening risk analyses updated. As such, the screening risk analyses can identify data gaps and focus attention and efforts on chemicals of potential concern.

For all operable units proceeding to final action, a baseline risk assessment will be performed. The Parties have agreed to a general set of exposure pathways to be evaluated for all baseline risk assessments. Additional pathways or even a more limited set of pathways will be evaluated only if an activity or land use for the operable unit under investigation is not adequately represented by the predetermined pathways. In addition, operable-unit specific exposure parameters will be used, where possible, so that remedial decisions are based on the best available information. The baseline risk assessment will be submitted as part of the RI report for the operable unit.

3.2 ISSUES AND CONCERNS

At present, there are still two outstanding issues related to the Oak Ridge Reservation risk assessment strategy. The first is related to the development of a screening risk analysis method for evaluating groundwater to identify the need for early response actions. The Risk Assessment Program is working in conjunction with the Groundwater Project Office to develop such a strategy and intends to present the methodology in the next revision of this document. The second outstanding issue is related to the integration of the risk assessment strategy for Decontamination and Decommissioning activities into the Environmental Restoration risk assessment strategy and vice versa. Again, this issue is currently being addressed and will be discussed in a later version of this document.

3.3 SCHEDULE FOR UPDATING THE RISK ASSESSMENT STRATEGY

The risk assessment strategy will be revisited and revised based on comments received both from the regulators and from personnel internal to Martin Marietta Energy Systems, Inc. as the strategy continues to be implemented. It is the goal of the Risk Assessment Program that this document be finalized and that concurrence on the content of the document is formally received from the U.S. DOE-OR, the TDEC, and the EPA, Region IV. Once the document is final, it will be revised on an as-needed basis only.

4. DATA EVALUATION

Past as well as current activities on the Oak Ridge Reservation result in the generation of various types (radioactive, nonradioactive, and mixed) of waste streams. Wastes treated, stored, or disposed of on the Oak Ridge Reservation range from sanitary waste and construction debris to highly radioactive materials. Therefore, DOE Orders, as well as state and federal regulations, require a certain level of environmental surveillance and monitoring; this has been especially true within the past 10 years.

The result of these monitoring activities is a large environmental sampling data base. A problem with using these data for risk assessments is that the environmental monitoring and waste sampling activities were not performed as a comprehensive program. Rather, environmental compliance, environmental safety and health, and various biological monitoring departments conducted sampling and analysis to meet various permit, environmental, and programmatic requirements. Therefore, the data resulting from these programs are of varying quality relative to the sampling and analysis methods used and the corresponding detection limits. Although the data quality was sufficient to meet the project requirements for which it was gathered, the data quality requirements under CERCLA are generally more stringent; therefore, a determination of the useability of these data for risk assessment purposes must be made. This decision on data worth must be based on project-specific DQOs.

Prior to development of a RI workplan for an operable unit, all relevant existing/historical data will be obtained and subjected to a data useability evaluation. This evaluation will follow the guidelines outlined in both the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002,[2] and the *Guidance for Data Useability in Risk Assessment*, EPA/540/G-90/008.[8] In general, the data evaluation process has eight components:

- Combining data available from operable unit investigation and/or other data collection efforts
- Evaluating analytical methods
- Evaluating quantitation limits
- Evaluating qualified and coded data
- Evaluating blanks
- Evaluating tentatively identified compounds
- Comparing operable unit data with background
- Identifying chemicals of potential concern

The purposes of performing such an evaluation are to 1) identify any data gaps that may exist (i.e., lack of data for certain environmental media or time periods), 2) focus any additional sampling efforts on the chemicals of potential concern, and 3) ensure that future analytical methods are sensitive enough to be protective of human health and the environment. The results of the data useability evaluation will result in one of three possible situations:

Situation 1: If the results of the data useability evaluation indicate that the data are of sufficient quality and quantity to be used in a baseline risk assessment, then:

- compare the existing/historical data with chemical-specific preliminary remediation goals (if the contaminants concentrations are less than the preliminary remediation goals, pursue a no further investigation determination);

- perform a most likely exposure assessment;
- perform or update the integration point assessment for the surface water body associated with the operable unit under consideration;
- based on the results of previous steps, determine if an early action is warranted at the operable unit; and
- use the existing/historical data to summarize the nature and extent of contamination and proceed with the development of an RI report and baseline risk assessment.

Situation 2: If the results of the data useability evaluation indicate that the data are not of sufficient quality and quantity to be used in a baseline risk assessment but could be used to support most likely exposure and/or integration point assessments, then:

- identify data gaps and limitations;
- recommend types and quantities of additional samples necessary to meet the baseline risk assessment criteria;
- compare proposed analytical detection limits with preliminary remediation goals to ensure that the detection limits are sensitive enough to be protective of human health and the environment;
- perform a most likely exposure assessment;
- perform or update the integration point assessment for the surface water body associated with the operable unit under consideration;
- based on the results of previous steps, determine if an early action is warranted at the operable unit; and
- incorporate baseline risk assessment requirements into the RI workplan.

Situation 3: If the results of the data useability evaluation indicate that the data are not of sufficient quality and quantity to be used in a baseline risk assessment or a most likely exposure and/or integration point assessment, then:

- identify data gaps and limitations;
- recommend sample types/quantities necessary to meet the risk assessment criteria;
- compare proposed analytical detection limits with preliminary remediation goals to ensure that the detection limits are sensitive enough to be protective of human health and the environment; and
- incorporate baseline risk assessment requirements into the RI workplan.

5. SCREENING RISK ANALYSES

Human health screening risk analyses as presented in this document include comparing available environmental data with preliminary remediation goals and conducting a most likely exposure and/or integration point assessment. These analyses were developed and designed to further the RI process in a more timely and cost-effective manner by identifying sources that are of highest priority to the program. As previously mentioned, the screening risk analyses are valuable tools in identifying and providing justification to support early response actions. Lastly, these analyses can be used to focus efforts on chemicals of potential concern or to identify data gaps.

The nature of the screening risk analyses described in this document was based on the known physiographic, hydrologic, and geographic characteristics of the Oak Ridge Reservation and existing contaminant data. This information indicated that the surface water and groundwater systems on the Reservation serve as collectors or basins for multiple contaminants from a variety of sources. These contaminants are mixed together within these water bodies and integrated into their flow system. As such, the surface water and groundwater systems are referred to as **integrators**. Most importantly, these integrators along with the air pathway are the primary means of contaminant transport to areas outside the boundaries of the Reservation where public exposure becomes more probable. A screening risk analysis methodology has been developed to evaluate the surface water integrators, but no screening methodology has been developed for the groundwater integrators.

A flux-based risk analysis methodology (referred to as an integration point assessment) was developed to evaluate the surface water integrators. The integration point assessment actively uses monitoring, surveillance, compliance, and RI data to evaluate relative contribution to the off-operable unit risk from the various sources that input into the surface water integrators. Once the sources that are contributing significantly to the risks in the integrator are identified, source control actions can be prioritized and undertaken to reduce exposure to levels that are as low as reasonably achievable. The integration point assessment is discussed in detail in Sect. 5.3.

In summary, the goals of the screening risk analyses are:

- to identify contaminant sources (may be previously defined operable units or study areas) that are contributing significantly to the surface water integrators and prioritize activities so that these sources are addressed as quickly as possible,

- to identify contaminant sources for which an early action is necessary from a human health and/or an ecological perspective, and

- to identify operable units or study areas for which all or a portion thereof may pursue a no further investigation determination.

5.1 COMPARISON TO PRELIMINARY REMEDIATION GOALS

Chemical-specific preliminary remediation goals are concentration goals for individual chemicals for specific medium and land use combinations. The preliminary remediation goal is a concentration that is derived from a specific excess cancer risk level or hazard index. Because preliminary remediation goals do not take into account operable unit-specific pathways, they do not represent clean-up criteria. The Risk Analysis Section of the ORNL Health Sciences Research Division has developed chemical-specific preliminary remediation goals for the pathways and routes of exposure listed in the following text.

The preliminary remediation goals were derived in accordance with the methodology outlined in the *Risk Assessment Guidance for Superfund Vol. 1 - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)*, EPA/54011-89/002B OSWER

Directive 9285.7-01B, June 1991.[9] Preliminary remediation goals for agricultural and recreational land use scenarios are currently under development.

Residential	Industrial
Groundwater/Surface Water	**Groundwater/Surface Water**
Ingestion	Defaults to residential per guidance.
Inhalation of vapor-phase chemicals	
Ingestion & Inhalation	**Soil**
Soil	Ingestion
Ingestion	Inhalation
External Exposure	Ingestion & Inhalation
Ingestion and External Exposure	External Exposure
Inhalation of volatiles	Ingestion, Inhalation, & External Exposure

The preliminary remediation goals are initial guidelines that are protective of human health and the environment, based on readily available information, and comply with applicable, relevant, and appropriate requirements. As part of the risk assessment strategy for the Oak Ridge Reservation, existing/historical data will be compared to preliminary remediation goals as an initial screening analysis to aid in identifying:

1) chemicals of potential concern,
2) transport and exposure pathways that need to be adequately characterized in subsequent sampling and analysis activities,
3) data gaps/limitations,
4) appropriate detection limits for subsequent sampling efforts, and
5) operable units for which a no further investigation determination may be appropriate.

If the chemical data exceed the preliminary remediation goals for the industrial scenario, then an early response action (removal or interim measure) may be warranted for the operable unit. The results of the comparison of the data to preliminary remediation goals should be used in conjunction with other technical information regarding feasibility and cost to determine if an early action is warranted.

If the data points are all less than the preliminary remediation goals, then a determination of no further investigation may be appropriate for the operable unit. In this case, because the preliminary remediation goals are the most conservative estimate of risk associated with a particular concentration, the comparison of operable unit-specific data with the preliminary remediation goals would be adequate for justifying no further investigation.

5.2 MOST LIKELY EXPOSURE ASSESSMENTS

The most likely exposure assessment was developed to support early response actions at operable units and serve as an indicator of current on-operable unit risk. The degree of rigor

associated with the baseline risk assessment process is not and has never been deemed necessary or appropriate for supporting interim actions. As stated in the CFR, March 8, 1990, Vol. 55, No. 46:

> *"To implement an early action under remedial authority, an operable unit for which an interim action is appropriate is identified. Data sufficient to support the interim action decision is extracted from the ongoing Remedial Investigation/Feasibility Study that is underway for the site or final operable unit and an appropriate set of alternatives is evaluated. Few alternatives, and in some cases perhaps only one, should be developed for interim actions. A completed baseline risk assessment generally will not be available or necessary to justify an interim action. Qualitative risk information should be organized that demonstrates that the action is necessary to stabilize the site, prevent further degradation, or achieve significant risk reduction quickly. Supporting data, including risk information, and the alternatives analysis can be documented in a focused Remedial Investigation/Feasibility Study. However, in cases where the relevant data can be summarized briefly and the alternatives are few and straightforward, it may be adequate and more appropriate to document this supporting information in the proposed plan that is issued for public comment."*

The most likely exposure assessment was developed for use in conjunction with the results of the integration point assessment to identify those operable units of highest priority relative to both off- and on-operable unit risk. The most likely exposure assessment provides the risk manager with information concerning the relative on-operable unit risk to workers, while the integration point assessment provides the manager with information concerning the relative contribution of the operable unit under investigation to off-operable unit contaminant transport and migration. Therefore, the results of the most likely exposure, the integration point, or a combination of both provide the risk manager with the risk information needed to demonstrate that the proposed interim action *"is necessary to stabilize the site, prevent further degradation, or achieve significant risk reduction quickly."* In addition, the results of these assessments can be used to prioritize the operable units with respect to risk.

Most likely exposure and integration point assessments may be performed for 1) operable units and study areas on the Oak Ridge Reservation that are undergoing development of an RI workplan, 2) operable units for which RI workplans have been developed but not yet implemented, and 3) operable units that warrant early action (removal or interim action). The most likely exposure and integration point assessments are not meant to replace or substitute for the performance of a baseline risk assessment for operable units proceeding to final action; instead, the most likely exposure and integration point assessments are intended to 1) use the existing/historical data in a manner that will result in the identification of operable units where early action is warranted, 2) focus attention on the contaminants that will be "risk-drivers" to ensure that the sampling and analytical methods used in the RI are appropriate, and 3) provide the assessor with an indication of the risk/hazard to on-operable unit receptors as well as an indication of the relative contribution of that operable unit to off-operable unit risk.

The exposure pathways evaluated in the most likely exposure assessment include the ingestion of and dermal contact with contaminated soil or sediment, inhalation of wind-generated particulates, and external exposure to radioactive contaminants. Ingestion of, inhalation of, or dermal contact with surface water or groundwater contaminants and the resulting risk/hazard associated with such

exposures will not be evaluated as part of the most likely exposure assessment. In the case of exposure to surface water, the risk/hazard associated with the various types/magnitudes of exposure will be evaluated as part of the integration point assessment. Exposure to groundwater contaminants will be evaluated in the integrator groundwater operable unit risk assessments. The purpose/goal of the most likely exposure assessment is to identify, expedite, and support interim actions at the operable units that are high-risk with respect to current on-operable unit exposures.

5.2.1 Derivation of the Exposure Concentration

The derivation of the exposure concentrations used in the most likely exposure assessment will depend on the analytical quality control level of the available data. If the data are of limited quality then the exposure concentration will be estimated by deriving the geometric mean of the dataset. The geometric mean is used as an estimate of the exposure concentration because it is often less conservative than the arithmetic mean (which is usually driven by the highest values in a distribution). For historical data that are of limited quality, the geometric mean is considered to be less likely to overestimate the calculated exposure concentrations due to the outliers that are contained within the dataset.

For a dataset composed of quality data, the upper 95% confidence limit of the arithmetic mean of the operable unit data will be used as the exposure concentration. As the quantity and degree of analytical rigor of the data increases, the upper 95% confidence limit of the arithmetic mean should become less likely to significantly overestimate the actual mean. Therefore, a more accurate representation of actual operable unit concentrations will be obtained while recognizing the natural variation in environmental data.

5.2.2 Performing the Most Likely Exposure Assessment

The most likely exposure assessment is performed using the methodology outlined in the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A).* EPA/540/1-89/002. However, the most likely exposure assessment is limited to evaluation of four exposure pathways: 1) external exposure to radiation in soil/sediment, 2) ingestion of soil/sediment, 3) inhalation of volatile compounds and wind-generated dust, and 4) dermal contact with soil/sediment. In addition, the intake and exposure duration parameters have been modified to reflect the "most likely exposure" that would occur on-operable unit.

Intake and exposure parameters for the four exposure pathways are provided in Table 1. The parameters were derived based on the assumption that a general plant employee enters the facility 8 hours per day, 5 days per week, 50 weeks per year for 25 years. Because general plant employees are typically exposed to remedial action sites only by happenstance, parameter values are industrial default occupational values provided as EPA guidance[2, 10] that have been adjusted by a factor of 10%. The subjective assumption that the receptor spends only 10% of the day (48 minutes) within the boundaries of the individual operable unit under investigation is considered appropriate for the purposes of the most likely exposure. For example, for use in the most likely exposure assessment, the default air intake (20 m^3/day) is multiplied by 10% resulting in an intake of 2 m^3/day. These parameters are considered to be conservative in representing actual exposure of the general plant

workers. If operable unit-specific exposure parameters are available, they will be used in the most likely exposure assessment instead of the parameters listed in Table 1.

5.3 INTEGRATION POINT ASSESSMENTS

For Oak Ridge Reservation operable units, the majority of any off-operable unit public exposure to contaminants results from surface water which is the major transport mechanism for contaminant fluxes to off-operable unit receptors. Other potential transport mechanisms such as the food chain, the air pathway, and direct groundwater transport are not currently primary sources of off-operable unit fluxes. The integration point assessment discussed in this section is designed to actively use monitoring, surveillance, compliance, and RI data to evaluate the off-operable unit risk from a variety of sources that input into the surface water integrator operable unit. The data will be used to establish a baseline for evaluating the risk at different points within the integrators, identify and prioritize source areas within the context of the integrator, and establish the degree of risk reduction an action to control contaminant sources can potentially achieve.

The integration point assessment is a flux-based risk assessment. Flux is defined as the mass of chemical that migrates through a cross-sectional area in a given time. Flux is an important concept for controlling contaminant sources because of the number of actual and potential sources of contaminants that exist on the Oak Ridge Reservation and the variability in flow rates of the different surface water systems that transport these contaminants to the surface water integrator operable units and eventually to the Clinch River. Actions to control sources of contamination that are taken at areas having high fluxes of integrator contaminants of concern are the quickest means of reducing off-operable unit exposure to levels that are as low as reasonably achievable.

One of the more important objectives during early phases of an integrator operable unit investigation is to assimilate available information from existing programs to estimate fluxes and mass balances of contaminants within the integrator system. The information is then used to assess fluxes within the watershed and compare them to fluxes that input into public access areas to differentiate between various contaminant sources at the Oak Ridge Reservation. Mass balance information is important to describe the accumulation and discharge of contaminants within a system where inputs and outputs are known. The integration point assessment provides a means for communicating this information in terms of risk to the public and risk managers. It also provides an important risk link between the source operable units and integrator operable units so that the effects of actions to control contaminant sources can be evaluated in the integrator.

5.3.1 Integration Point Assessment Method

The first step in performing the integration point assessment is selecting the actual point of assessment. In general, an integration point assessment should be performed at systems that drain catchment areas at the boundaries of the Oak Ridge Reservation. Examples include White Oak Lake, East Fork Poplar Creek, Bear Creek, Poplar Creek, and the Clinch River. These large-scale

Table 1. Most Likely Exposure Intake and Exposure Parameters

Exposure Pathway	EPA Default Parameters[a]	most likely exposure Parameters[d]
External exposure	2000 hours/year	200 hours/year
Ingestion of soil/sediment	50 mg/day	0.005 g/day
Inhalation of wind-generated dust	20 m^3 air/day	2 m^3 air/day
Dermal contact with soil/sediment	Surface area[b] Hands: 0.082 m^2 Arms: 0.23 m^2 Adherence Factor: 1.0 mg/cm^2[c] Absorption Factor[c] Organics: 1% Inorganics: 0.1% 8 hours/day	Surface area[b] Hands: 0.082 m^2 Arms: 0.23 m^2 Adherence Factor: 1.0 mg/cm^2[c] Absorption Factor[c] Organics: 1% Inorganics: 0.1% 0.8 hours/day (48 minutes/day)

a Exposure parameters are based on occupational values provided by EPA.[2]

b 50th percentile adult body-part surface area.[2]

c Adherence Factor and Absorption Factors based on EPA Region IV guidance.[2]

d Exposure parameters are based on occupational values provided by the EPA with the added assumption that the worker spends one-tenth of his or her working day at the operable unit under investigation.[2]

integration point assessments can assist in prioritizing sources. Other points can be selected as needed to support activities taken to control contaminant sources. Integration point assessments can be used to support RIs and may assess only a portion of the larger integrator watershed to ensure that smaller subsystems of the watershed are cleaned to safe risk levels.

The integration point assessment is then performed at the chosen point using the 95% upper confidence limit on the arithmetic average for yearly concentration data. Surface water pathways are assessed at this point with the assumption of residential land use of the water. This would entail using standard risk assessment parameters that are available in *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002 for these pathways.[2] Primary pathways to be assessed include ingestion of surface water, dermal contact while showering, and indoor inhalation of contaminants resulting from water use. The cumulative risk across all pathways for all chemicals at this point is then compared with action levels of an excess cancer risk of 1E-4 and to the noncarcinogenic hazard index of 1. Action under CERCLA is generally warranted if either of these action levels are exceeded. The next step is to use contaminant fluxes and risk to identify the primary contributors to the risk at the integration point.

Generally, the results generated by a risk assessment are driven by a few high priority contaminants only. Determination of high priority contaminants can be achieved by selecting those comprising 90% of the total risk at the integration point. For those identified contaminants that drive the risk, the annual fluxes for each should be quantified to the degree possible at the integration point and at the major sources. The spatial resolution of the sources is dependent upon the amount of source data available.

The flux data for each of the sources are then used with the integration point flux data to rank the relative importance of the different sources within the context of the integration point. Given the generalized cancer risk equation for multiple substances:

$$Risk_T = \sum Risk_i$$

where:

$Risk_T$ = the total cancer risk, expressed as a unitless probability; and
$Risk_i$ = the risk estimate for the i^{th} substance.

The equation for calculation of carcinogenic effects for the flux-based risk assessment at each of the sources is:

$$Risk_{sf}(\%) = \{\sum [\, Risk_i \; (Flux_{is} / Flux_{ip})]\} / Risk_T$$

where:

$Risk_{sf}$ = percentage of risk at the integration point that originates at the identified source;
$Flux_{is}$ = flux of the i^{th} substance originating at the identified source; and
$Flux_{ip}$ = flux of the i^{th} substance identified at the integration point.

Similarly, the standard equation for calculation of noncarcinogenic effects is:

$$\text{Hazard Index}_t = \sum E_i/\text{RfD}_i$$

where:

E_i = exposure level (or intake) for the i^{th} toxicant;
RfD_i = reference dose for the i^{th} toxicant; where
E and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or shorter term).

The calculation for the flux-based risk assessment of noncarcinogenic effects is:

$$\text{Hazard}_{sf}(\%) = \sum[\, E_i\text{Flux}_{is}/\text{RfD}_i\text{Flux}_{ip}]/\text{Hazard Index}_t$$

where:

Hazard_{sf} = percentage of the hazard index at the integration point that originates at the identified source.

The reader should note that carcinogenic and noncarcinogenic effects cannot be combined if the integration point assessment indicates that both are of concern.

5.3.2 Modeling

Specific source areas that pose a threat of major release or operable units that are situated in exceedingly complex groundwater regimes where numerous source terms cannot be differentiated may have to be modeled. The modeling results can be used to show the need to mitigate a potential off-operable unit risk or to confirm the role they are suspected to play in releases to the environment. The modeling results should be within the context of the larger scale integration point assessment, and its impact on selected integration points should be compared with other releases for which more information is known.

5.3.3 Uncertainty

Because of the dynamic nature of the Oak Ridge Reservation watershed systems and fiscal restraints in data collection, it is recognized that significant amounts of uncertainty are necessarily present in performance of these integration point assessments, especially if modeled results are used. Uncertainties are inherent in the flux determination process because of difficulties in actually measuring the flux and the temporal variability of fluxes in both short- and long-term time frames. Temporal variability is caused by the effects of climate and human actions at the sources as well as the relationships between mass balances and hydrologic conditions.

However, given a bias for action at operable units on the Oak Ridge Reservation, the uncertainty present in the process should not preclude activities to control contaminant sources. The integration point assessment is designed to use risk to identify sources that are clearly off-operable

unit contributors of high priority contaminants. These operable units can then be addressed in an expedited manner with actions that are interim or final in nature. Consistent implementation of this process can assist in meeting short-term goals of reducing off-operable unit exposures to levels that are as low as reasonably achievable and in meeting long-term goals of cleaning the watershed systems within the plant boundaries to safe risk levels.

6. BASELINE RISK ASSESSMENTS

The baseline risk assessment is an analysis of the potential adverse health effects (current or future) caused by hazardous substance releases from an operable unit in the absence of any actions to control or mitigate these releases (i.e., under an assumption of no action). The baseline risk assessment contributes to the characterization and subsequent development, evaluation, and selection of appropriate response alternatives. The results of the baseline risk assessment are used to:

- help determine whether additional response action is necessary at the operable unit;
- modify preliminary remediation goals;
- help support the selection of the "no-action" remedial alternative, where appropriate; and
- document the magnitude of risk at an operable unit and the primary causes of that risk.

As previously stated, a baseline risk assessment will be performed for all operable units on the Oak Ridge Reservation proceeding to final action. The exposure pathways and associated exposure parameters to be used in these baseline risk assessments will depend on:

- the sources, releases, types, and locations of chemicals at the operable unit;
- the likely environmental fate of the chemicals; and
- the potentially exposed populations.

The baseline risk assessment process on the Oak Ridge Reservation will follow the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A, B, & C)*, EPA/540/1-89/002.[2] However, an agreement between the Parties has been reached that limits the exposure pathways to be evaluated to those illustrated in Figs. 3 and 4. As is evidenced in the aforementioned figures, current land use scenarios include evaluation of an on-operable unit industrial receptor, and if applicable a fisherman, while future land use scenarios include a residential scenario (including the ingestion of homegrown produce), an on-operable unit industrial

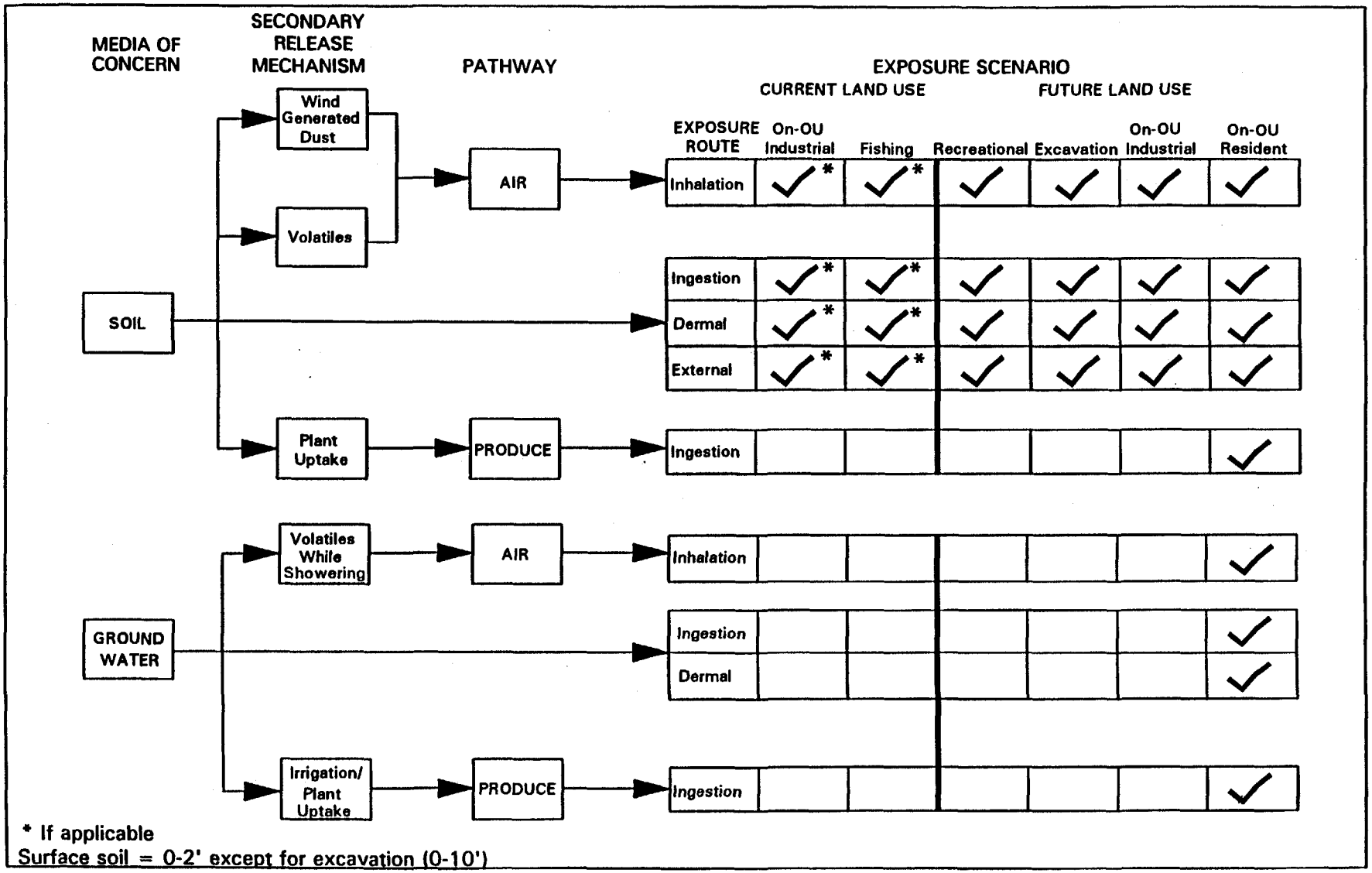

Fig. 3 Human health BRA land use assumptions and exposure pathways.

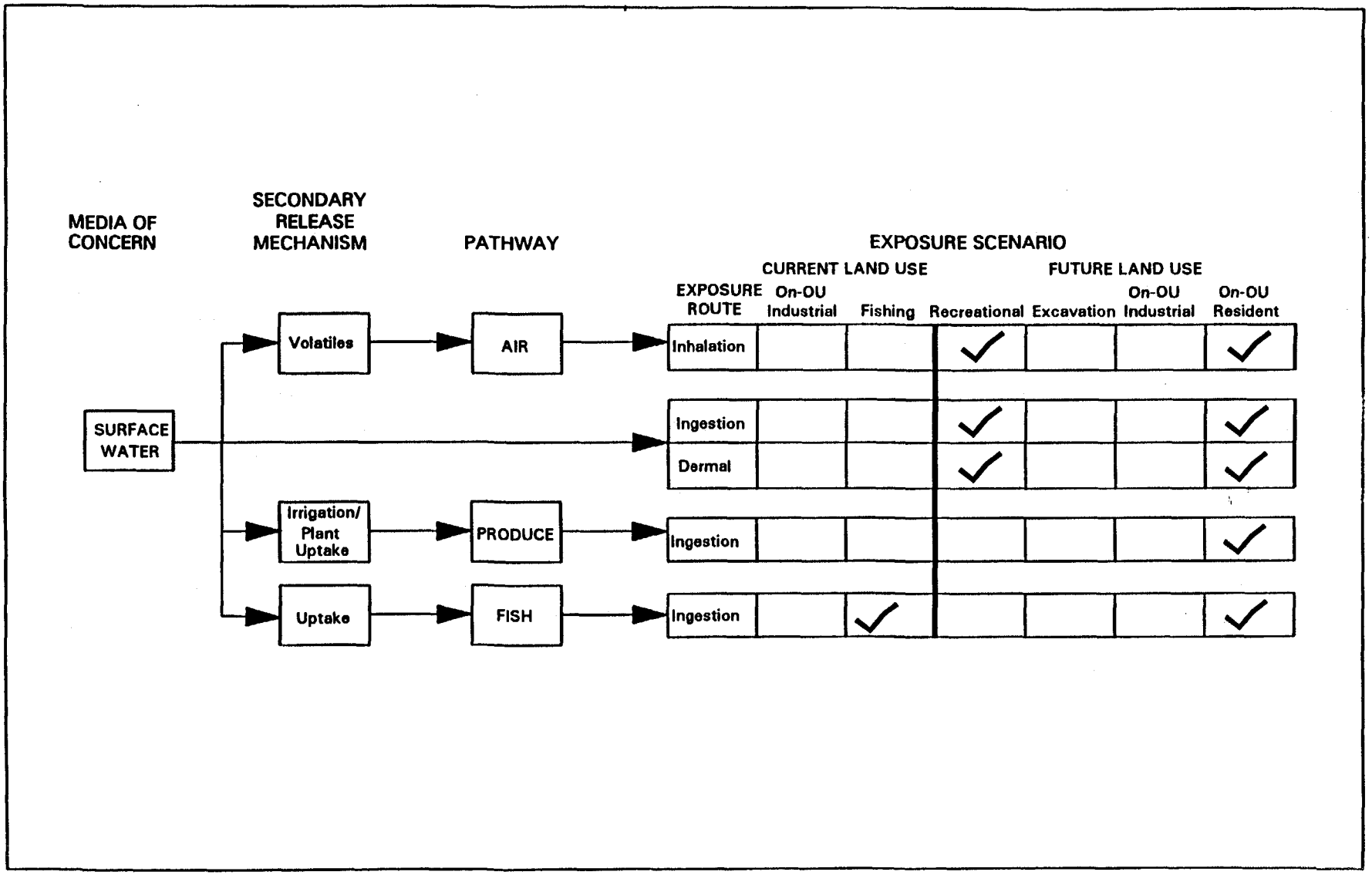

Fig. 4 Human health BRA land use assumptions and exposure pathways.

scenario, an excavation scenario, and a recreational scenario. The exposure parameters to be used in the baseline risk assessments in the absence of any operable-unit-specific values will be the standard default exposure parameters found in either the *Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A, B,&C)*, EPA/540/1-89/002 or *Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors*, OSWER Directive 9285.6-03.[2] The following subsections of this report briefly describe the primary steps in performing a baseline risk assessment.

6.1 COMPILE AND EVALUATE THE OPERABLE UNIT DATASET

As discussed in Chapter 4 of this document, it is imperative that the operable unit dataset be constantly updated with all available environmental data. The dataset must also be evaluated to ensure that the data to be used in the baseline risk assessment are of the quality level necessary to make remedial decisions as determined during the development of DQOs for the operable unit. The outcome of the data evaluation is a list of chemicals of potential concern. A Martin Marietta Energy Systems, Inc., Environmental Restoration procedure entitled "Data Evaluation for the Selection of Chemicals of Potential Concern for Risk Assessment" is currently under development. This procedure will contain a detailed description of the data evaluation process. In general, the data evaluation of the operable unit dataset for risk assessment purposes will consist of the following steps:

- **Evaluate analytical methods, quantitation limits, qualifiers and codes, and blanks**

  Regardless of whether the data have or have not been validated by an independent party, the risk assessor will:

  1) evaluate the dataset to ensure that the analytical methods were appropriate for the chemical analyzed and the sample matrix,
  2) evaluate the quantitation limits to ensure that the detection limits were not unusually high,
  3) evaluate the qualifiers and codes to ensure that the data are valid, and
  4) evaluate and perform a comparison of blank concentrations to actual sample concentrations to ensure that the concentrations were not biased by either the laboratory preparation methods or the actual analysis.

- **Determine if tentatively identified compounds (TICs) are significant**

  Tentatively identified compounds will be retained as chemicals of potential concern only if they are detected frequently and are known to have been associated with operable unit operations.

- **Compare dataset to background and reference samples**

  A comprehensive effort was undertaken on the Oak Ridge Reservation to obtain background soils data. The soils data obtained have been evaluated and are presented in the *Final Report on the Background Soil Characterization Project at the Oak Ridge*

Reservation, Oak Ridge, Tennessee, Volumes 1-3, DOE/OR/01-1175/V1-3.[11] *Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge, Tennessee, Volumes 1-3,* DOE/OR/01-1175/V1-3. These data will be used to screen environmental datasets and eliminate contaminants determined to be at or below background concentrations. A procedure that will discuss the uses and limitations of the background data and other reference data for all media is scheduled to be complete in September of 1994.

An effort is currently underway within the Environmental Restoration Groundwater Program to develop a methodology for establishing background groundwater chemical concentrations. Until this methodology is in place, groundwater data will be compared with reference samples obtained from uncontaminated groundwater wells that are screened in the same lithology (if available) as operable unit wells.

Constituents eliminated as a result of background or reference sample comparisons will be discussed in the text of the baseline risk assessment report and will be listed in an appendix with all other eliminated constituents.

- **Perform a toxicity screening**

  Subsequent to the comparison to background/reference samples, the data will be subjected to a toxicity screening. The maximum detected value for each contaminant will be compared to all available toxicity information (ingestion and inhalation reference doses and slope factors, and external radiation slope factors, if applicable). If a contaminant contributes <1% of the total risk/hazard for every pathway that can be evaluated, the contaminant will be eliminated and so noted in the text of the report and in the appropriate appendix. However, if a contaminant contributes ≥1% of the total risk/hazard for any given pathway, that contaminant will be retained and evaluated quantitatively.

  In addition, this screening activity results in the compilation of a list of contaminants for which no toxicity values are available and that can only be evaluated qualitatively. A table of the contaminants to be evaluated qualitatively will be included in the text of the baseline risk assessment report.

- **Eliminate essential nutrients**

  Those contaminants that are considered to be essential nutrients will be eliminated from the quantitative evaluation if they are not considered to be significantly elevated and/or if no toxicity information is available.

- **Compare nondetected contaminants quantitation limits to preliminary remediation goals**

  The reported detection limits for all nondetected contaminants (i.e., analytes that are not detected in any/all samples) will be compared to preliminary remediation goals to ensure that the detection limits were appropriate. A table will be generated as a result of this comparison, and the results will be discussed in the text of the report.

- **Compile the list of contaminants of potential concern**

  All contaminants that remain after the previous steps have been performed will be compiled in a list of chemicals of potential concern. These are the chemicals of potential concern that will be carried through the baseline risk assessment and upon which remedy selection will be based.

6.2 EXPOSURE ASSESSMENT

The exposure pathways evaluated in all baseline risk assessments on the Oak Ridge Reservation will be limited to the pathways indicated and discussed within this document. The purpose for delineating the pathways to be evaluated is to ensure that the risk assessments produced are both technically defensible and consistent in their approach and methodology. The pathways that have been identified to be included in the baseline risk assessments are those pathways that the Parties have agreed are necessary to support remedial decisions.

In addition to the agreed upon exposure scenarios, the EPA and TDEC requested that a table presenting a comparison of operable unit data with agricultural preliminary remediation goals be included in each baseline risk assessment. These agricultural preliminary remediation goals are currently under development and will be distributed for use once they are reviewed. Although the agricultural scenario will not be used to make remedial decisions, the Parties believe that the agricultural scenario provides the most conservative estimate of exposure and, therefore, will circumvent questions that may arise concerning whether or not the property could be used for agricultural purposes in the future.

An Environmental Restoration standard is currently being developed and is entitled *Requirements for Conducting Human Health Risk Assessments*. In this standard, the exposure equations to be used for the pathways to be evaluated will be set-forth. Once this standard is in place, any deviation in the exposure equations must be identified and approved by the Risk Assessment Program. The purpose of standardizing the equations is to ensure technical defensibility and consistency in all baseline risk assessments.

The exposure scenarios that have been identified by the Parties as necessary for making remedial action decisions and are to be evaluated in the baseline risk assessments conducted on the Oak Ridge Reservation are illustrated in Figs. 3 and 4 and are discussed in Subsects. 6.2.1–6.2.6. The applicability of those scenarios marked with an asterisk on the figures must be determined during the scoping meeting for the operable unit. If the pathways are determined applicable, they will be included. The exposure scenarios and issues and points of note related to each of the exposure scenarios are discussed in the following subsections. The exposure scenarios evaluated in the baseline risk assessment are crucial to the future development of remedial goal objectives. These scenarios serve as the foundation upon which the remedial goal objectives are based and must, therefore, be representative of both current and future land use considerations.

The exposure parameters for the variables of the exposure equations associated with each of the pathways listed in Figs. 3 and 4 will be taken directly from the *Risk Assessment Guidance for*

Superfund: Volume I, Human Health Evaluation Manual (Part A),[2] and the *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*, OSWER Directive 9285.6-03.[10] In general, the exposure parameters are those that comprise the 90th-95th percentile for all variables. Concentration terms will be based on the measured environmental concentrations for both current and future land use considerations.

6.2.1 Current Land Use: Industrial Scenario

The industrial scenario evaluates the risk/hazard to a general plant employee (not a remedial action worker) exposed to on-operable unit contaminant concentrations using standard industrial default exposure parameters. Exposure may occur via the inhalation of wind generated dust or volatiles, or via ingestion, dermal contact, or external exposure.

Exposure to remedial action workers will not be evaluated as part of the baseline risk assessment. Remedial action workers operate in accordance with established health and safety protocols as defined by the Occupational Safety and Health Administration. These protocols are set-forth in regulatory guidance and have been incorporated in the operable unit-specific health and safety plans developed for the remedial activities to be undertaken. In addition, quality assurance measures such as real-time health and safety monitoring, self-assessment activities, and audits and surveillances are performed during site characterization activities. These quality assurance measures are performed to ensure that health and safety procedures are implemented correctly, adequate for the activities being undertaken, and protective considering the contaminants present.

6.2.2 Current Land Use: Fishing Scenario

During the scoping and/or DQOs workshop for an operable unit, a determination as to the appropriateness of this scenario will be made. If the operable unit is not located within proximity to a fishable water body, the scenario will not be evaluated. If the scenario is determined to be applicable, exposure to near-shore contamination via the soil pathways and ingestion of fish via the surface water pathway will be evaluated Again, the standard default exposure parameters will be used unless operable unit-specific information is available.

6.2.3 Future Land Use: Recreational

This exposure scenario evaluates the risk/hazard to a receptor who is swimming in contaminated surface water, has short-term exposure to contaminated soil/sediment, and/or catches and eats contaminated fish. It is to be noted that because the concentration and exposure terms are equivalent, fish ingestion and exposure to contaminated soil/sediment in the recreational scenario is equivalent to that in the current land use fishing scenario. Therefore, when evaluating the future use recreational scenario, the only additional routes of exposure to be evaluated are inhalation of volatiles, incidental ingestion of surface water, and dermal contact with surface water while swimming.

6.2.4 Future Land Use: Excavation

This exposure scenario evaluates the risk/hazard to a receptor who purposefully disturbs both surface and subsurface soil. This scenario encompasses activities such as building a house with a basement and excavating for a surface impoundment or pond. Routes of exposure evaluated in this scenario include inhalation of wind generated dust, inhalation of volatiles, and ingestion, dermal contact and external exposure to subsurface (0–10 ft) soil.

6.2.5 Future Land Use: On-Operable Unit Industrial

The industrial scenario is defined as one in which a general plant employee (not a remedial action worker) is exposed to on-operable unit contaminant concentrations using standard industrial default exposure parameters. This scenario will differ only from the current land use on-operable unit industrial scenario in the parameter value for duration of exposure.

6.2.6 Future Land Use: On-Operable Unit Resident

This exposure scenario evaluates the risk/hazard to a receptor who lives on the operable unit, uses either contaminated surface water or groundwater as a potable water source, grows produce in a garden that is both cultivated in contaminated soil and irrigated by contaminated groundwater or surface water, and is a recreational fisherman (if applicable). The on-operable unit resident is considered to be the maximally exposed receptor.

The on-operable unit resident may be exposed to contaminants found in the surface soil (0–2 ft) via direct ingestion, dermal or external exposure, inhalation of wind-generated dust or volatiles, and/or ingestion of produce that was grown in contaminated soil/sediment. In addition, the on-operable unit resident may be exposure to contaminants found in surface water or groundwater via inhalation of volatile contaminants during showering, direct ingestion, dermal exposure, and ingestion of homegrown produce irrigated with contaminated surface water or groundwater. Lastly, exposure via ingestion of contaminated fish will also be evaluated if the operable unit is located near a fishable water body.

6.3 TOXICITY ASSESSMENT

The Risk Assessment Program for Martin Marietta Energy Systems, Inc., supported by the Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, provides updated toxicity values to all risk assessment personnel (including subcontractors) on a regularly scheduled basis. These updates are distributed as the controlled document *Toxicity Values for Use in Hazardous Waste Risk Assessment and Remediation*, ES/ER/TM-76.[12] The updates are obtained from the EPA's *Health Effects Assessment Summary Tables*[13] and the Integrated Risk Information System. The purpose of providing these updates is to ensure that all risk assessment personnel (including subcontractors) use the most current information and reduce the cost incurred in redundant on-line database searches. A procedure entitled *Incorporating Biomedical and Environmental Information Analysis Data in Toxicity Assessment for Environmental Restoration*

Risk Assessments, ER/C-P2004[14], details how this information is to be used and identifies the appropriate channels to follow to obtain additional toxicity information.

The Risk Assessment Program supported by the Biomedical and Environmental Information Analysis Section, Health Sciences Research Division, also provides toxicity profiles for chemicals of potential concern for the Oak Ridge Reservation to all risk assessment personnel (including subcontractors) on a regularly scheduled basis. The chemicals of potential concern were selected and prioritized based on their frequency of detection in the surface water bodies (namely, East Fork Poplar Creek and the Clinch River) that serve as exit pathways from the reservation . The toxicity profiles are also submitted as a controlled document entitled *Toxicity Profiles for Use in Hazardous Waste Risk Assessment and Remediation*, ES/ER/TM-77[15]. Profiles are currently available for more than 30 compounds that are found on the Oak Ridge Reservation.

6.4 RISK CHARACTERIZATION

The risk characterization section of a baseline risk assessment incorporates the outcome of the previous activities (data evaluation, exposure assessment, and toxicity assessment) and calculates the risk or hazard resulting from exposure to contaminants via the pathways and routes of exposure determined appropriate for the operable unit in question. The aforementioned standard, *Requirements for Conducting Human Health Risk Assessments*, that is under development will standardize the tables to be used to present the output of the risk characterization.

6.5 DEVELOP REMEDIAL GOAL OPTIONS

Remedial Goal Options (RGOs) will be developed for the contaminants and pathways of concern as identified in the risk characterization. In general, RGOs will be developed on a chemical-specific basis and will use operable unit-specific exposure parameter values, if available.

7. REFERENCES

1. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, EPA/540/G-89/004. Office of Emergency and Remedial Response, U. S. Environmental Protection Agency, 1988.

2. *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual (Part A),* EPA/540/1-89/002. Office of Emergency and Remedial Response, U. S. Environmental Protection Agency, 1989.

3. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Process*, OSWER Directive 9355.0-30. Office of Solid Waste and Emergency Response, U. S. Environmental Protection Agency, 1990.

4. *National Oil and Hazardous Substance Pollution Contingency Plan*, The Federal Register 55, No. 46, 1990. U. S. Environmental Protection Agency, 1990.

5. Suter, G. W., A. Redfearn, R. K. White, and R. Shaw, *Approach and Strategy for Performing Ecological Risk Assessments for the Department of Energy Oak Ridge Field Office Environmental Restoration Program*, ES/ER/TM-33, July, 1992.

6. *Oak Ridge Reservation Site Management Plan for the Environmental Restoration Program*, DOE/OR-1001/R3, U. S. Department of Energy, Office of Environmental Restoration and Waste Management, Oak Ridge, Tennessee, June 1994.

7. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, U. S. Department of Energy, January, 1992.

8. *Guidance for Data Useability in Risk Assessment, Interim Final*, EPA/540/G-90008. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., October 1990.

9. *Risk Assessment Guidance for Superfund Vol. 1 - Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)*, EPA/540/R-2/003 OSWER Directive 9285.7-01B, December 1991.

10. *Human Health Evaluation Manual Supplemental Guidance: Standard Default Exposure Factors*, OSWER Directive 9285.6-03. Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D. C., 1991.

11. *Final Report on the Background Soil Characterization Project at the Oak Ridge Reservation, Oak Ridge, Tennessee, Volumes 1-3*, DOE/OR/01-1175/V1-3.

12. *Toxicity Values for Use in Hazardous Waste Risk Assessment and Remediation*, ES/ER/TM-76, Martin Marietta Energy Systems, Inc., Oak Ridge, TN, June, 1994.

13. *Health Effects Assessment Summary Tables*, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH. (Updated Quarterly)

13. *Incorporating Biomedical and Environmental Information Analysis Data in Toxicity Assessment for Environmental Restoration Risk Assessments*, ER/C-P2004, Martin Marietta Energy Systems, Inc., Oak Ridge, TN, October, 1992.

14. *Toxicity Profiles for Use in Hazardous Waste Risk Assessment and Remediation*, ES/ER/TM-77, Martin Marietta Energy Systems, Inc., February, 1994.

APPENDIX

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DOE OVERSIGHT DIVISION
761 EMORY VALLEY ROAD
OAK RIDGE, TENNESSEE 37830-7072

July 25, 1994

Mr. Nelson Lingle
Environmental Restoration Division
U.S. Department of Energy
P.O. Box 2001
Oak Ridge, TN 37831-8541

Dear Mr. Lingle

TDEC Comment Letter
Defining the Role of Risk Assessment in the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR (ES/ER/TM-58)

The Tennessee Department of Environment and Conservation, DOE Oversight Division (TDEC/DOE-O) has reviewed the above referenced document. The following are comments relevant to that review.

1. Page 8-9, Section 2.2

   Comment: This section uses a scenario to describe how an operable unit progresses through the CERCLA process, leaving the reviewer unclear as to the type of risk assessment which will support a record of decision. It is the Division's opinion that a baseline risk assessment (BRA) is prudent when progressing toward a record of decision. This baseline should account for the cumulative impacts associated with the operable unit under consideration for action. This perspective should help insure that any early or removal actions on a unit are consistent with a final action on that unit.

2. Page 10, Section 3, Paragraph 2

"However, the rigor of the risk evaluation that is associated with activities in the stream lined process ..."

Comment: This section should give a clear description of what DOE considers as the standard risk assessment process on the ORR. The process to reach a BRA as presented appears very convoluted and burdensome. From a regulatory perspective it seems adequate to present a diagram showing the basic CERCLA process. This would include data evaluation, data quality objectives workshop, remedial investigation (RI) work plan (if needed), RI Report including baseline risk assessment, and so on. The bulk of the diagram presented may be necessary for DOE to determine the need for a removal action but should not be considered to be a functional part of the BRA on each operable unit.

3. Page 16, Section 4, Paragraph 2

"Risk scores will be derived for activities by multiplying a numerical weight representing the severity of an impact by the likelihood of occurrence of the impact."

Comment: Clarify what type of "numerical weight". Also clarify how the "numerical weight and the "likelihood of occurrence" are derived.

4. Page 18, Section 5.2, Paragraph 2

"Parameter values are generally industrial default occupational values provided as U.S. EPA guidance but are adjusted based on the assumption that the receptor spends only 10% of the day within the boundaries of the individual operable unit under investigation."

Comment: What evidence was used to support the adjustment to 10% for the receptor?

Any questions or comments concerning this letter should be addressed to Jacque Van Audenhove at (615) 481-0163.

Sincerely

R. Doug McCoy, Manager
Environmental Restoration Program

cc Mr. Victor Weeks, EPA
Ms. Pat Halsey, MMES

er0408.10

Document Review Record
Risk Assessment Program/Environmental Restoration Division
Martin Marietta Energy Systems, Inc.

Title: Defining the Role of Risk Assessment in the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR (ES/ER/TM-58)

Author(s): P. D. Miller, C. W. McGinn, S. T. Purucker, A. Redfearn, and R. K. White

Document Number: ES/ER/TM-58

Technical Reviewer: (Print) Jacque Van Audenhove and Ana Gonzalez

Technical Reviewer: (Signature) See attachment

Review Deadline: Date Sent: Date Reviewed: Date Complete: 7/27/94

Sections Reviewed: (Circle)
* All
* Specific Section(s):(List)_____
* All With Emphasis On:

Comment Number	Locator	Comment	Response	Check if Mandatory Comment
1.	Page 8-9, Section 2.2	This section uses a scenario to describe how an operable unit progresses through the CERCLA process, leaving the reviewer unclear as to the type of risk assessment which will support a record of decision. It is the Division's opinion that a baseline risk assessment (BRA) is prudent when progressing toward a record of decision. This baseline should account for the cumulative impacts associated with the operable unit under consideration for action. This perspective should help insure that any early or removal actions on a unit are consistent with a final action on that unit.	The phrase "risk assessment" will be changed to read "baseline risk assessment".	

Document Review Record
Risk Assessment Program/Environmental Restoration Division
Martin Marietta Energy Systems, Inc.

Title: Defining the Role of Risk Assessment in the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR (ES/ER/TM-58)

2.	Page 10, Section 3, ¶ 2	**"However, the rigor of the risk evaluation that is associated with activities in the streamlined process..."** This section should give a clear description of what DOE considers as the standard risk assessment process on the ORR. The process to reach a BRA as presented appears very convoluted and burdensome. From a regulatory perspective it seems adequate to present a diagram showing the basic CERCLA process. This would include data evaluation, data quality objectives workshop, remedial investigation (RI) work plan (if needed), RI Report including baseline risk assessment, and so on. The bulk of the diagram presented may be necessary for DOE to determine the need for a removal action but should not be considered to be a functional part of the BRA on each operable unit.	An effort will be made to further clarify the role of risk assessment in the RI process on the ORR. The diagram referred to in this comment will be revised to incorporate all written and verbal comments received. A diagram depicting the overall RI process on the reservation may also be included to further clarify the concepts described in the text.	
3.	Page 16, Section 4, ¶ 2	**"Risk scores will be derived for activities by multiplying a numerical weight representing the severity of an impact by the likelihood of occurrence of the impact."** Clarify what type of "numerical weight". Also clarify how the "numerical weight and the "likelihood of occurrence" are derived.	During the review meeting held with the Tennessee Department of Environment and Conservation and the U. S. Environmental Protection Agency Region IV, the decision was made to delete Section 4 in its entirety. As such, no response is necessary for this comment.	
4.	Page 18, Section 5.2, ¶ 2	**"Parameter values are generally industrial default occupational values provided as U. S. EPA guidance but are adjusted based on the assumption that the receptor spends only 10% of the day within the boundaries of the individual operable unit under investigation."** What evidence was used to support the adjustment to 10% for the receptor?	As will be indicated in the text of the report, the 10% adjustment factor was a subjective assumption. It is to be noted that since the scenario is designed to evaluate a general plant employee and not a remedial action worker, the assumption could still be considered conservative.	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

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Mr. W. Nelson Lingle, Chief
Oak Ridge Remediation Branch
Environmental Restoration Division
U.S. Department of Energy
Oak Ridge Operations
P.O. Box 2001
Oak Ridge, Tennessee 37831-8541

SUBJ: ROLE OF RISK ASSESSMENT
OAK RIDGE RESERVATION, OAK RIDGE, TENNESSEE

Dear Mr Lingle:

The purpose of this letter is to provide you with the Environmental Protection Agency's (EPA's) comments on the draft document entitled "Defining the Role of Risk Assessment in the CERCLA Remedial Investigation Process at the DOE-OR" dated January 23, 1994. The attached comments supplement EPA's verbal comments expressed at the May 17, 1994, meeting concerning this issue. It is EPA's expectation that DOE will incorporate our verbal comments and the enclosed comments, and submit a revised version for review/approval.

If you have any questions regarding this matter, please contact me directly at (404) 347-3016 or by voice mail at (404) 347-3555 Box # 6461.

Sincerely,

Victor L. Weeks
FFA Project Manager
Federal Facilities Branch

cc: Mr. Doug McCoy, TDEC
Ms. Pat Halsey, MMES

Review Comments on the Draft Version of
"Defining the Role of Risk Assessment in the
CERCLA Remedial Investigation Process at the DOE-OR"

1. Page 7, Paragraph 3

   The first discussion here of most-likely-exposure and integration-point assessments (words should be hyphenated as shown) are unique concepts to this document and the reader needs a definition here rather than waiting till pages 17 and 20 for any discussion of the concept. Also, the first bullet just below this paragraph should be corrected to read "chemicals of potential concern" for consistency with EPA terminology.

2. Page 11, Figure 1

   This figure should be changed as follows:

   - move "compare data to PRGs" up to an earlier and independent step;
   - change the term "removal action" to "early action";
   - add line for Ecological Risk input to NFI step; and
   - identify process as being operable unit related in the title.

3. Page 12, Last Paragraph

   The preliminary remediation goals as discussed in the first bullet are apparently to be derived per EPA RAGs Vol I, Part B guidance (so stated on Page 14). A clarifying statement to that effect and a reference to the guidance should be added here.

4. Page 13

   In the last bullets under situations 2 and 3, the word should be risk assessment "requirements" rather than "recommendations" since the baseline risk assessment would not have been completed at this time in the process.

5. Page 14

   PRGs are to be developed for four land use scenarios. In the second paragraph from bottom of page, the land use PRGs to be compared to the site data points need to be specified.

Also, to be consistent with EPA guidance, bullet number 1 should be chemicals (not contaminants) of potential concern. Bullet number 5 should only apply if the contamination is adequately characterized by appropriate sampling and analyses.

6. Page 16

Delete Section 4.

7. Page 18, First Paragraph

Modify sentence to read "... high-risk with respect to current on-site exposures." Also, reference number 8 cites a pre-final EPA guidance document that should be changed to document EPA/540/R-92/003, December 1991. The language should be modified to be consistent with the guidance of the final document.

8. Page 21, Second Paragraph

A discussion on ground water pathways should be included here. Also, the reference to a risk of 1E-4 should specify whether the risk level is pathway or chemical specific.

Document Review Record
Risk Assessment Program/Environmental Restoration Division
Martin Marietta Energy Systems, Inc.

Title: Defining the Role of Risk Assessment in the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR

Author(s): P. D. Miller, C. W. McGinn, S. T. Purucker, A. Redfearn, and R. K. White

Document Number: ES/ER/TM-58

Technical Reviewer: (Print) Victor Weeks and Elmer Aiken, U. S. E. P. A, Region IV

Technical Reviewer: (Signature) See Attachment

Review Deadline: Date Sent: Date Reviewed: Date Complete: 06/29/94

Sections Reviewed: * All
(Circle) * Specific Section(s):(List)_____
* All With Emphasis On:

Comment Number	Locator	Comment	Response	Check if Mandatory Comment
1.	Page 7, ¶ 3	The first discussion here of most-likely-exposure and integration-point assessments (words should be hyphenated as shown) are unique concepts to this document and the reader needs a definition here rather than waiting till pages 17 and 20 for any discussion of the concept. Also, the first bullet just below this paragraph should be corrected to read "chemicals of potential concern" for consistency with EPA terminology.	The text will be modified to include a discussion of these concepts earlier within the document. All references to chemicals of potential concern will be worded as such.	
2.	Page 11, Figure 1	This figure should be changes as follows: - move "compare data to PRGs" up to an earlier and independent step; - change the term "removal action " to "early action"; - add line for Ecological Risk input to NFI step; and - identify process as being operable unit related in the title.	The figure will be modified to incorporate all written and verbal comments received.	
3.	Page 12, last ¶	The preliminary remediation goals as discussed in the first bullet are apparently to be derived per EPA RAGs Vol. I, Part B guidance (so stated on Page 14). A clarifying statement to that effect and a reference to the guidance should be added here.	A clarifying statement and a reference to the appropriate guidance document will be incorporated.	
4.	Page 13	In the last bullets under situations 2 and 3, the word should be risk assessment "requirements" rather than recommendations" since the baseline risk assessment would not have been completed at this time in the process.	The word recommendations will be changed to requirements.	

Document Review Record Risk Assessment Program/Environmental Restoration Division Martin Marietta Energy Systems, Inc.				
Title: Defining the Role of Risk Assessment in the Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) Remedial Investigation Process at the DOE-OR				
5.	Page 14	PRGs are to be developed for four land use scenarios. In the second paragraph from bottom of page, the land use PRGs to be compared to the site data points need to be specified. Also, to be consistent with EPA guidance, bullet number 1 should be chemicals (not contaminants) of potential concern. Bullet number 5 should only apply if the contamination is adequately characterized by appropriate sampling and analyses.	These changes will be incorporated.	
6.	Page 16	Delete Section 4.	Section 4 will be deleted.	
7.	Page 18, First ¶	Modify sentence to read "...high-risk with respect to current on-site exposures." Also, reference number 8 cites a pre-final EPA guidance document that should be changed to document EPA/540/R-92/003, December 1991. The language should be modified to be consistent with the guidance of the final document.	These changes will be incorporated.	
8.	Page 21, Second ¶	A discussion on ground water pathways should be included here. Also, the reference to a risk of 1E-4 should specify whether the risk level is pathway or chemical specific.	The groundwater pathway was identified as an issue to be addressed in the revised document. The words "cumulative risk for all chemicals across all pathways" have been incorporated.	