6. REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

The OU 3-14 RI/FS includes a variety of tasks related to scoping, implementation, and decision-making under the FFA/CO (DOE-ID 1991). Standard RI/FS tasks have been identified by the EPA (1988a) to provide consistent reporting and allow more effective monitoring of RI/FS projects. Proposed activities in each task that will be performed as part of the OU 3-14 RI/FS are discussed below.

Specific details of proposed field activities are described in the field sampling plan (FSP) (DOE-ID 2003f; see Appendix A), the quality assurance project plan (QAPjP) (DOE-ID 2002e), the health and safety plan (HASP) (INEEL 2003a; see Appendix B), and the waste management plan (INEEL 2003b; see Appendix C). These documents are described in Subsection 6.1, and the remainder of this section is a review of the specific required elements of the RI/FS.

6.1 Project Plan and Scope

This work plan is a part of the project planning and scoping task, which involves activities necessary to initiate the OU 3-14 RI/FS (DOE-ID 2000b). Project planning is intended to identify the proper sequence of site activities to accomplish the investigation. The following subsections describe the plans developed as part of the planning and scoping process. These plans are prepared in accordance with *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988a).

6.1.1 Field Sampling Plans and Quality Assurance Project Plan

The FSP (see Appendix A) directing tank farm field-sampling activities contains detailed procedures for collecting and analyzing data for the tank farm. The procedures include the sampling objectives, sample locations and frequency, sample designation, sampling equipment, and sample handling and analysis for the OU 3-14 field investigation.

The QAPjP (DOE-ID 2002e) includes procedures designed to ensure the integrity of samples collected, the precision and accuracy of the analytical results, and the representativeness and completeness of environmental measurements collected for OU 3-14. The QAPjP, written in accordance with RI/FS guidance, discusses the following elements:

- Idaho Completion Project description
- Project organization and responsibility, including the job titles of individuals responsible for ensuring that the environmental data collected are valid
- Quality assurance objectives for data, including required precision, accuracy, representativeness, and completeness and the allowed use of the data
- Sample custody procedures and documentation
- Calibration procedures and frequency
- Analytical procedures with references to applicable standard operating procedures
- Data reduction, validation, and reporting procedures
- Internal quality control procedure description or reference

- Performance and system audits
- Preventive maintenance procedures
- Specific routine procedures used to assess data accuracy, precision, and completeness
- Corrective action procedures
- Quality assurance reports, including results of system and performance audits and assessments of data accuracy, precision, and completeness.

6.1.2 Health and Safety Plan

The HASP (see Appendix B) establishes the procedures and requirements that will be used to eliminate or minimize health and safety risks to persons performing tasks for the OU 3-14 tank farm soil remedial investigation. The HASP has been prepared in accordance with the Occupational Safety and Health Administration standard (29 CFR 1910.120; 29 CFR 1926.65). The HASP contains information about the hazards involved in performing the work and contains the specific actions and equipment that will be used to protect persons while they are at the task site. Project activities and hazards have been evaluated and are within the INTEC safety authorization basis (DOE-ID 2000b), as defined by DOE O 5480.23, "Nuclear Safety Analysis Reports."

The HASP also contains the safety, health, and radiological hazards assessments for executing all OU 3-14 tank farm soil remedial investigation tasks. The intent of the HASP is to identify known hazards and serve as a plan for mitigating them.

6.1.3 Waste Management Plan

The waste management plan (see Appendix C) identifies the potential waste types and quantities expected to be generated during implementation of the remedial investigation. The plan addresses the various waste stream sources and classifications and provides for waste stream disposition. The waste management plan is written in accordance with federal and state regulations, and it discusses specific requirements for waste characterization, storage, and disposition under those regulations.

6.1.4 Data Management Plan

All data generated as a result of the field investigation will be managed in accordance with the requirements specified in the "Data Management Plan for the Idaho Completion Project Environmental Data Warehouse" (PLN-1387).

6.2 Quality Assurance and Quality Control

The for QAPjP for WAGs 1, 2, 3, 4, 5, 6, 7, and 10 and inactive sites (DOE-ID 2002e) pertains to quality assurance and quality control for all environmental, geotechnical, geophysical, and radiological testing, analysis, and data review. The attached FSP details specific requirements to support the OU 3-14 field investigation, including quality assurance/quality control requirements for all sample and analyte types that may potentially be collected.

6.3 Data Management and Evaluation

This subsection discusses the approach to managing and evaluating field and laboratory data collected for the OU 3-14 field investigation. Field data (e.g., downhole gamma and soil moisture flux data) will be collected electronically, and initially they will be maintained and managed by the OU 3-14 project manager for the specific data set. The Hydrogeologic Data Repository will provide long-term management for all field data. Laboratory data (e.g., soil and pore water analytical results) will be evaluated and validated by INEEL Sample and Analysis Management and managed and maintained by the Integrated Environmental Data Management System (IEDMS). All data management will follow guidelines specified in the "Data Management Plan for the Idaho Completion Project Environmental Data Warehouse" (PLN-1387) and in the following subsections.

6.3.1 Laboratory Analytical Data

Analytical data are managed and maintained in the IEDMS. The components that make up IEDMS provide an efficient and accurate means of sample and data tracking.

The IEDMS performs sample and data tracking throughout all phases of a sampling project beginning with the assignment of unique sample identification numbers using the Sampling and Analysis Plan (SAP) Application Program. The SAP Application Program produces a SAP table that contains a list of sample identification numbers, sample demographics (e.g., area, location, and depth), and the planned analyses. Once the SAP table is finalized, it is used as input to automatically produce sample labels and tags (with or without barcode identification). In addition, sampling guidance forms can be produced for the field sampling team; these forms provide information such as sampling location, requested analysis, container types, and preservative.

When the analytical data package (sample delivery group) is received, it is logged into the IEDMS journaling system, an integrated subsystem of the sample tracking system, which tracks the sample delivery group from data receipt to the Environmental Restoration Information System. Cursory technical reviews on the data packages are performed to assess the completeness and technical compliance with respect to the project's analysis-specific task order statement of work. Any deficiencies, resubmittal actions, or special instructions to the validator are recorded on the Cursory Subcontractual Compliance Review form using the Laboratory Performance Indicator Management System. This form is sent to the validator with the data package (when required).

Errors in the data package are resolved among all pertinent Sample and Analysis Management chemists, the originating laboratory, and the IEDMS staff. Data validity is ensured by the validator through the assignment of method validation flags. The validator generates a limitations and validation report, which gives detailed information on the assignment of data qualifier flags. A copy of the form accompanies the report with the assigned data qualifier flags and any changes to the data, which are entered into the IEDMS database. From this database, a summary table (a result table) is generated. The result table summarizes the sample identification numbers, sample logistics, analytes, and results for each particular type of analysis (e.g., inorganic, radiological, and organic) from the sampling effort.

6.3.2 Field Data

Field data include all data that are nonchemical analytical data generated in support of OU 3-14. These data will be managed in accordance with the requirements specified in the "Data Management Plan for the Idaho Completion Project Environmental Data Warehouse" (PLN-1387). Final field data will reside in the Hydrogeologic Data Repository for long-term management. These data will be analyzed using methods that are appropriate for the data types and specific field conditions. Analysis will include recognized methods and techniques that are used with the specific data types and may include statistical processes.

6.3.3 Data Evaluation

Data evaluation will depend on the type of data (e.g., laboratory or field) and data uses and will follow procedures defined in the workplans for individual tasks.

6.4 Risk Evaluation and Methodology

This subsection summarizes the methodology for the BRA that will be performed for OU 3-14. The risk evaluation approach will in general be consistent with the OU 3-13 RI/BRA (DOE-ID 1997a) approach (with revised future use scenarios, as described in Sections 3 and 5), updates to the CSM, conceptual model, and numerical model.

The purpose of the BRA is to determine potential adverse human health effects posed by COPCs identified at OU 3-14 under the no action alternative (DOE-ID 1991). Typically, BRAs are composed of two parts: a human health evaluation and an ecological evaluation. The OU 3-14 RI/BRA will focus solely on the human health evaluation, because an ecological evaluation has already been performed for the OU 3-13 RI/BRA. The results of the ecological evaluation suggest tank farm soil contamination is unlikely to result in a significant decline in the health or diversity of INEEL-wide ecological communities.

The procedures used in the BRA are consistent with those described in the following guidance documents:

- "Risk Assessment Guidance for Superfund," *Human Health Evaluation Manual (Part A), Volume I* (EPA 1989)

- "Supplemental Guidance for Superfund Risk Assessments in Region 10" (EPA 1991)

- *Guidance Protocol for the Performance of Cumulative Risk Assessments at the INEL* (LMITCO 1995b).

The OU 3-14 RI/BRA will be similar in format to the OU 3-13 RI/BRA (DOE-ID 1997a) and will draw from the results of that evaluation. As a result of the large uncertainty in the tank farm contaminant inventories and the groundwater flow and transport model parameters used in the OU 3-13 RI/BRA, tank farm contaminant inventories will be evaluated as part of the OU 3-14 RI/BRA. The evaluation will be achieved primarily through additional downhole gamma logging and sample collection, the goals of which are to reduce uncertainty related to the nature, extent, and distribution of contamination. The risk assessment will include the cumulative groundwater risk presented by OU 3-14 sources to a residential receptor located at the downgradient ICDF boundary and will update the OU 3-13 RI/BRA calculations and scenarios.

The human health BRA for OU 3-14 will include the following components:

- **Human Health Hazard Identification.** The human health hazard identification process will determine the site environmental conditions (including current and future land use), contaminant sources, contaminant release rates, exposure pathways, exposure routes, and receptor locations, based on the CSM for OU 3-14 presented in Subsection 3.5. The CSM for OU 3-14 will be revised and updated as needed during the BRA to provide a current understanding of the system and provide a basis for identification of the potential exposure scenarios.

- **Data Evaluation and Identification of COPCs.** This step will summarize the data collected for OUs 3-13 and 3-14 and will describe the screening evaluation used to identify and select contaminants that are of the greatest potential health concern at the site.

- **Exposure Assessment.** An exposure assessment is conducted to estimate the magnitude of potential human exposures, the frequency and duration of these exposures, and the pathways through which humans are potentially exposed to COPCs at the site. The exposure assessment involves evaluating the fate and transport of chemical releases from the site, identifying potentially exposed populations and pathways of exposure, estimating exposure point concentrations for specific pathways, and estimating chemical intake rates in humans.

- **Exposure Scenarios.** The OU 3-14 RI/BRA will address both current and future worker exposure scenarios. The future worker scenario will begin 100 yr after the start of the RI/BRA. A future residential groundwater exposure scenario, with the resident located at the downgradient ICDF boundary, will be addressed for the following 900 yr after the 100-yr occupational scenario. This provides a total 1,000-yr exposure timeframe at the tank farm. These assumptions could be modified based on evolving land use plans at the INEEL. In addition to the 1,000-yr total exposure evaluation for risk assessment, the risk for the groundwater pathway will be calculated to the time of the peak predicted risk at the exposure points.

- **Exposure Pathways and Routes.** The exposure pathways to be assessed, as identified in Subsection 3.5, include the subsurface, air, and surface pathways. The exposure routes to be addressed are as follows:

  - Current and Future Workers

    - Soil ingestion

    - Dermal exposure to soil

    - Inhalation of dust

    - Direct exposure to ionizing radiation

  - Future Residents

    - Groundwater ingestion

    - Groundwater inhalation

    - Dermal exposure to groundwater.

- **Toxicity Assessment.** The toxicity assessment will involve the characterization of the toxicological properties of and health effects from COPCs, with special emphasis on defining their dose-response relationships. From these dose-response relationships, toxicity values are derived and can be used to evaluate the potential occurrence of adverse health effects at different levels of exposure.

- **Risk Characterization.** Risk characterization will combine the results of the exposure assessment and toxicity assessment to characterize risk to human health, both in numerical expressions and qualitative statements. Carcinogenic and noncarcinogenic health effects will be addressed. Risks and hazard quotients will be calculated using a 25-yr running average concentration for the occupational scenario and a 30-yr running average for the residential scenario. A time history of risks will be provided for the exposure routes. Time histories of the risk will be presented graphically, and maximum risks will be tabulated for the occupational and residential exposure scenarios.

- **Qualitative Uncertainty Analysis.** The uncertainties in the risk assessment process and how these uncertainties influence the characterization of health risks will be analyzed qualitatively. The qualitative uncertainty analysis will include a discussion of the uncertainty associated with the following components of the system:

  - Physical setting (current land use, future land use, and exposure pathways)

  - Contaminants not included as COPCs in the OU 3-14 RI/BRA

  - Conceptual model uncertainties (key model assumptions and model parameter uncertainty)

  - Toxicity values

  - Exposure parameters.

- **Quantitative Sensitivity and Uncertainty Analysis.** A quantitative sensitivity analysis will evaluate the sensitivity of parameters of the contaminant inventory, source term model, fate and transport model, and risk assessment model. Scenarios to be evaluated will be determined during the RI/BRA process. A Monte Carlo uncertainty analysis will be used to evaluate the precision of the models.

6.5 Additional OU 3-14 Investigations

Additional components of the OU 3-14 remedial investigation beyond the Phase I and II field activities are discussed in more detail below. These components consist of contaminant transport studies, treatability studies, and safety assessments.

6.5.1 Contaminant Transport Study

The INTEC conceptual and numerical models will be updated to support the development of the RI/FS. Although most of the model development work will be conducted under OU 3-13 Groups 4 and 5, several tank farm tasks must be completed under OU 3-14. Three specific data inputs related to the contaminant transport were identified in Subsection 5.2.3.2 including, site-specific infiltration rates, water balance data for the northern INTEC, and site specific geochemical parameters.

6.5.1.1 Infiltration Rates. Subsection 5.2.3.2 identified spatially variable soil-moisture content and soil-moisture tension measurements in tank farm soils as data inputs required to determine infiltration rates. Infiltration rate is a sensitive parameter in the contaminant transport model, because infiltration is the primary mechanism for release and transport of contaminants from the contaminated soils as well as from the grouted tanks and piping. Infiltration is highly dependent on soil type, topography, and surface cover and, in the tank farm, is also affected by aboveground and belowground engineered structures. The consequences of not gathering sufficient data for estimating tank-farm-specific infiltration are that the

OU 3-14 modeling will utilize estimates developed for the Radioactive Waste Management Complex, which has substantially different infiltration characteristics and may overestimate or underestimate actual tank farm rates. However, infiltration rates are typically higher in gravelly sand soils, such as those at INTEC, than silt and loam soils found at the RWMC.

The OU 3-13 RI/BRA (DOE-ID 1997a) developed precipitation recharge estimates from data collected at the Radioactive Waste Management Complex (Martian 1995). Modeling was performed to quantify observations of moisture moving into the soil at 17 NPATs located across the Subsurface Disposal Area of the Radioactive Waste Management Complex (McElroy 1990, 1993; Bishop 1995). The models were calibrated to several years of moisture content data. The data also included companion soil-moisture tension data at two of the NPAT locations. The infiltration behavior varied widely between monitoring locations, and the primary mechanism for recharge was identified as infiltration from melting snow each spring. The fast snowmelt during periods of low evapotranspiration resulted in a large percentage of the annual precipitation becoming recharge even though the total potential evapotranspiration at the Subsurface Disposal Area is several times the annual precipitation. The OU 3-13 RI/BRA recharge rate may not be appropriate for the tank farm, because recharge resulting from precipitation is strongly dependent on soil type, topography, and surface vegetation type, which are very different at the tank farm than at the Radioactive Waste Management Complex. Furthermore, the tank farm soil has been covered by an impermeable liner overlain by gravel. The liner has been breached many times during maintenance operations; however, it reportedly has always been patched afterward. Drainage areas that receive runoff from rooftops and roads could experience significant infiltration, but the tank farm interim action partially addressed these sources. In other areas, the combination of gravel over a compromised impermeable barrier most likely maximizes infiltration by limiting evaporation and focusing recharge through any liner breaches. The liner is also nearing the end of its functional design life and will deteriorate incrementally over time.

Two characteristic infiltration rates are needed for the OU 3-14 RI/FS. The first represents long-term infiltration through INTEC's disturbed alluvial soils without engineered structures (e.g., impermeable liners and buildings). This value will be used for long-term simulation of contaminant transport in the BRA. The second value will be used to represent realistic infiltration through the tank farm soils as has occurred from the time of release to present. This value is needed to evaluate the effects that potential remedial alternatives would have on groundwater risk. The method presented by Martian (1995) will be used to estimate infiltration through the tank farm soil after one or more seasons of moisture content data have been collected in the tank farm.

6.5.1.2 Water Balance. Section 5 identified the need for water balance data for northern INTEC and identification of perched water recharge sources to support the OU 3-14 tank farm modeling. Currently, however, the OU 3-13 Group 4 project is tasked with conducting a series of water balance studies that will provide the necessary data to support OU 3-14 tank farm modeling. These studies include a time-series analysis of perched water and recharge sources (use of spectral analysis to identify common high-energy frequencies in perched water and possible recharge sources), an analysis of the effects of relocation of the percolation ponds and recent Big Lost River cessation (drought) on perched water elevations, estimation of vadose zone hydraulic properties, and development of a comprehensive inventory of anthropogenic recharge sources. The Group 4 study activities and schedule will be coordinated with this project to ensure that OU 3-14 DQOs are addressed.

6.5.1.3 Geochemical Properties. Section 5 identified the need for contaminant-specific K_d for alluvial soils, sedimentary interbeds, and basalt that are representative of tank farm conditions. The consequences of not gathering site-specific data are that sorption processes could be overestimated or underestimated in the contaminant transport modeling, increasing uncertainty in risk predictions. To resolve this uncertainty, OU 3-14 will investigate the chemistry of tank farm alluvial pore water (solution chemistry) and test contaminant-specific soil/water distributions.

6.5.1.3.1 Solution Chemistry. Sorption processes are affected by geochemical reactions between the contaminant species, infiltrating water/dissolved minerals, and the geologic media. At the tank farm, estimating contaminant sorption is complicated by the extremely acidic nature of the aqueous waste solutions released to the alluvium. If low pH conditions persist in localized areas within the release sites, the hydrogen ions would compete with contaminants for ion exchange sites and adsorption sites on minerals. Under low pH conditions, the hydrogen ion initially would prevent retardation of many radionuclides. Due to the carbonate nature of the alluvial soil, however, the existence of low pH areas is unlikely. At CPP-31, for example, all acid would have been quickly neutralized,[a] based on the volume of waste released and volume of soil across which that release would have spread with an estimated field capacity moisture content of 0.11. At other sites, such as CPP-28 or high-contamination areas near borehole 79-1, it is uncertain what volume of soil was contacted and reacted with. In these areas, direct measurement of pore water conditions are needed.

Although acid wastes may have been effectively neutralized, it is likely that competition from natural cations (e.g. Ca^{2+} and Mg^{2+}) would have a greater effect on increasing radionuclide mobility than persistent low pH conditions from the release. High concentrations of Ca^{2+}, Mg^{2+}, and other cations in the INTEC perched water suggest that these would also be present in alluvial pore water. In addition, reactions between the acidic waste solutions and calcite/dolomite in the soil would have significantly increased calcium and magnesium concentrations in solution in the alluvium near the release sites. The presence of these and other similarly sized cations in alluvial pore water may have reduced sorption of radionuclides due to competition for sorption sites.

To help resolve this issue, the buffering capacity of the alluvium will be estimated using mineralogy specific to the tank farm soil and chemical analysis of tank contents. However, because it is uncertain whether the liquid releases spread laterally or channeled downward through narrow conduits, it is difficult to determine how much calcite/dolomite would have been available for the reaction at all release sites and what the resulting solution chemistry would be. Therefore, field measurements of geochemical properties will also be made. Measuring soil pH and cation concentrations at or near known and suspected release sites is critical to selection of an appropriate conceptual model of release. Alluvial pore water will be collected and analyzed from locations within the known release sites using direct-push instruments (cone penetrometer probes with integrated lysimeters). Obtaining actual solution chemistry will not only support the development of a representative release model but is necessary to design follow-on soil/water partitioning tests. If necessary, soil samples may also be collected and analyzed during Phase II of the field investigation.

6.5.1.3.2 Kd. Modeling chemical reactions of waste solute and subsurface media requires parameterization of the reaction model. The model most often used is a linear sorption isotherm where the mass of contaminant sorbed onto the soil (or other geologic media) is a function of the aqueous concentration and the K_d. K_ds are used in computer modeling as a mathematically simple representation of sorption. K_d is a bulk term used to encompass all processes that remove a contaminant from solution and represents the ratio of adsorbed-to-dissolved concentrations, which are typically given in units of mL/g. K_d are a sensitive and uncertain parameter in the tank farm contaminant fate and transport model.

Because field data are often insufficient to determine actual sorption, K_d are typically obtained by fitting a linear isotherm to results of batch or column experiments, neglecting the actual mechanisms

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a. Assuming a 14,000-gal release of 1.4 *M* acid concentration; alluvium contains 6 wt% calcite/dolomite; 0.11 field capacity moisture content; personal communication, P. Martian, Bechtel BWXT Idaho, LLC, 2003.

responsible for contaminant removal. In such tests, the target media are exposed to solutions of water with known concentrations of contaminants (or surrogate compounds) under chemical conditions designed to represent the actual field environment. However, it can be difficult to accurately represent actual field conditions in batch sorption experiments due to spatial or temporal variability in chemical conditions and solubility potentials within a waste release site (Hull and Pace 2000).

Factors that are necessary to include in the design of batch or column tests include the oxidation state of the contaminants, the solution chemistry for the infiltrating water, and the geochemical properties of tank farm alluvium (natural and as altered by the waste releases), interbeds, and basalt. In addition, investigators will need to determine the appropriate mineralogy, contaminant concentration, particle size, temperature, and atmospheric conditions (soil gas) for the test. The approach for developing defensible contaminant-specific sorption properties includes literature studies, bench-scale batch and column tests on actual and surrogate materials, and field calibration data collection. The approach will be documented in a detailed test plan to be developed during the Phase I field investigation period.

Based on previous risk modeling, isotopes of strontium, neptunium, and plutonium are identified as the primary contaminants of interest for sorption studies. For Sr-90, there are a number of existing studies specifically examining sorption to INTEC sediments and basalt (e.g. Liszewski et al. 1997, 1998; Hawkins and Short 1965; Del Debbio and Thomas 1989; Bunde et al. 1997). It is anticipated that once alluvial pore water chemistry is examined, a representative Sr-90 K_d value can be obtained from these and other reports. There is no INTEC specific data for neptunium. From experience at the Radioactive Waste Management Complex, it is expected that neptunium K_d values can be readily derived from a series of batch adsorption experiments per ASTM-D-4319.

Plutonium is a chemically complex element for which derivation of linear isotherm partition coefficients has proven difficult. Plutonium exists in multiple oxidation states and is subject to dissolved transport and particulate transport through the formation of colloids. Literature values for plutonium K_ds are highly variable (Dicke 1997). The approach selected to identify a representative plutonium K_d for OU 3-14 is to first conduct a literature review. Based on the results of the literature review, testing may proceed to bench scale to measure wash-off from contaminated sediments. Sequential extraction of soil samples will be conducted using water, weak acid, an oxidizer, and a strong acid to discern under what conditions, if any, the plutonium may be mobilized. This information will help investigators select appropriate models of release. Finally, if warranted by the results of the literature review and sequential extraction tests, a series of column tests will be conducted.

Because transport and adsorptive characteristics of contaminants, particularly actinides, are strongly affected by their initial oxidation state and by oxidation/reduction reactions within the vadose zone, column studies with filtration of outflow for plutonium at three oxidation states (IV, V, and VI) will be performed. Because traditional batch sorption experiments assume a single physical/chemical form of contaminant, column studies are recommended for investigating actinide mobility (Fjeld et al. 2000). Depending on the results of the tests, multi-mobility models may be used to represent fractions with differing solubility. The tests will also examine the potential for formation of colloids and ligands under tank-farm-specific geochemical conditions. Because the majority of plutonium does not exhibit breakthrough during test periods, the test columns may be sliced and analyzed to determine what distance through the column plutonium may have moved in order to derive an observed retardation factor.

Some tank farm alluvium, interbed, and basalt samples have been archived from past investigations and will be evaluated for possible use in OU 3-14 sorption studies. Depending on the representativeness of these samples, additional soil samples may need to be collected. It is anticipated that high radiation levels will preclude collection and testing soils from some areas.

In addition to laboratory sorption tests, OU 3-14 will also look for direct evidence (field scale) of sorption processes. For example, borehole logging should indicate whether high-contamination zones extend to the basalt or terminate in the alluvium. Termination in the alluvium would support the hypothesis that the waste was neutralized and affected by sorption processes. Borehole logging may also be used to estimate K_ds by comparing the activity of selected radionuclides detected by active and passive gamma spectrometry to concentrations found in collocated pore water samples. Because a number of site-specific factors could influence the quantity and quality of field data, it is anticipated that a combination of field data and laboratory test data will be used to derive conservative, yet realistic, models of contaminant sorption.

In summary, to improve the fate and transport modeling of contaminants from the tank farm, defensible retardation factors and pore-water solution data from the alluvium are needed. Critical data will be obtained by examining pore water chemistry in known release sites and by performing laboratory-scale K_d studies for neptunium and plutonium. By determining the range of K_d values for site-specific materials and water chemistry, investigators will be able to select conservative, yet representative, values; defend the risk assessment; and, ultimately, defend the selection of an appropriate remedial action.

6.5.2 Treatability Study

As discussed in the RI/FS guidance (EPA 1988a), site characterization and treatability investigations are two of the main components of the RI/FS process. As site and technology information is collected and reviewed, additional data needs for evaluating alternatives are identified. Treatability studies may be required to fill some of these data gaps. Pre-ROD treatability studies may be needed when potentially applicable treatment technologies are being considered for which no or limited performance or cost information is available in the literature with regard to the waste types and site conditions of concern. Post-ROD or RD/RA treatability studies can provide the detailed design, cost and performance data needed to optimize treatment processes and to implement full-scale treatment systems. When implementing a remedy, RD/RA treatability studies can be used to select among multiple vendors, implement the most appropriate of the remedies prescribed in a contingency ROD, or support detailed design specifications.

Although certain post-ROD treatability studies are appropriate, conducting treatability studies during the RI/FS can reduce the uncertainties associated with selecting the remedy, provide a sounder basis for the ROD, and possibly facilitate negotiations between the Agencies without lengthening the overall cleanup schedule for the site. Because treatability studies may be expensive, however, careful consideration needs to be given to the decision as to what and when to test. A remedy selection treatability study should be designed to verify whether a process option can meet the OU's cleanup criteria and at what cost. The purpose of a pre-ROD treatability study is to generate the critical performance and cost data necessary for remedy evaluation in the detailed analysis of alternatives during the feasibility study. Investigation of equipment-specific parameters or design-level detail should generally be delayed until post-ROD RD/RA studies. Results of remedy selection treatability studies allow for estimating the costs associated with full-scale implementation of the alternative(s) within an accuracy of +50/-30%, as suggested for the feasibility study by CERCLA guidance (EPA 1988a).

Several remedial technology data gaps were identified in Section 5 and need to be addressed to support selection and implementation of remedial alternatives, including in situ and ex situ treatment, either pre- or post-ROD. If performed, candidate technologies for treatability studies will be reviewed using EPA guidance for selecting treatability studies (EPA 1992). This guidance provides a method to evaluate which treatability studies should be performed to support the feasibility study and the ROD. The evaluation will be based on the significance of feasibility study data gaps associated with each technology and whether bench-, pilot-, or field-scale testing would be necessary. Other factors to be considered are budget and schedule constraints, technology availability, maturity of new technology, and site-specific conditions. It is anticipated that at least one technology, grout/polymer encapsulation, will warrant a remedy-selection treatability study, as described below. This technology may be applied in situ or ex situ, and each has process-specific data requirements that may merit treatability studies. In situ grouting is described below, and many of the specific treatability study elements apply to ex situ grouting as well.

Treatability study work plans will be prepared for any treatability study performed. The work plan will be the key document to define the study objectives and work scope and will be prepared in accordance with CERCLA treatability study guidance (EPA 1992). Treatability study summary evaluation reports will also be prepared, as required. Other project documents that will be prepared specifically for the treatability study include test plans, SAPs, safety assessments, HASPs, and waste management plans.

Grout/polymer encapsulation is an in situ or ex situ treatment technology that would likely require treatability studies before implementation. Grout/polymer encapsulation entails injecting or mixing a slurry-like mixture of cements, chemical polymers, or petroleum-based waxes into contaminated soil or waste. Stabilizing agents are specially formulated to encapsulate contaminants and isolate them from the surrounding environment. In the environmental industry, the process is described as nondisplacement jet grouting, or in situ grouting, where soil and grout are mixed below the surface, forming a large area that is physically and/or chemically stabilized (Loomis et al. 2002). When properly designed and applied, in situ grouting produces a durable waste form resistant to weathering and degradation over long periods. In situ grouting reduces mobility of contaminants by the following mechanisms:

- Reduced permeability. Injecting grout under pressure into the contaminated area fills void space in the soil matrix. The resultant grout monolith has low porosity and hydraulic conductivity. If grout is injected into hot spots before tank farm closure, low-pressure grouts such as waxes would be desirable to protect active waste lines.

- Encapsulation. Energetic mixing of grout and soil encases contaminants in a leach-resistant matrix and minimizes the potential for contaminants to be mobilized by infiltrating water.

- Chemical buffering. An appropriately selected grout can chemically alter infiltrating water to reduce the solubility potential of contaminants. In addition, many grouts exhibit an affinity for specific contaminants and can chemically bind contaminants to reduce leachability.

In situ grouting activities have been performed at a number of DOE sites using a variety of technical approaches. As early as 1985, DOE was evaluating grouting as a viable remedial technology for buried waste and contaminated soil sites. In situ grouting has been selected as a remedial action by DOE and its regulators and has been implemented successfully at several waste sites including the following:

1. Oak Ridge National Laboratory in 1996

2. INEEL Radioactive Waste Management Complex acid pit in 1997

3. Brookhaven National Laboratory in 1999

4. Savannah River Site in 2000.

In addition to these applications, extensive research at the INEEL and other DOE sites has been conducted to evaluate the efficacy of in situ grouting. As a result, the implementability of in situ grouting equipment and processes is well understood. Although specific grouting parameters (e.g., injection pressures, grout viscosities, and injection point spacing) need to be developed on a site-by-site basis, this information is more critical during the remedial design phase than during the feasibility study.

The effectiveness of in situ grouting is also relatively well understood. In situ grouting has been demonstrated to substantially reduce permeability and encapsulate contaminants, thereby minimizing contaminant leaching in a wide variety of soil types and environmental conditions. Though parameters such as hydraulic conductivity, chemical buffering, and monolith cracking have proven difficult to measure in field-scale applications, a limited body of data does exist. In addition, the DOE has conducted a substantial amount of grout waste-form testing. Available laboratory and field-scale data indicate that in situ grouting could be an effective alternative to stabilize contaminants in the tank farm soils.

To provide a defensible basis for the long-term effectiveness evaluation of in situ grouting in the OU 3-14 feasibility study, additional data are needed to better define the expected release rate of contaminants from the treated soils. Because grouted waste forms typically exhibit very low hydraulic conductivity, the dominant mechanism of release is diffusion, where contaminants are dissolved and diffuse through relatively static intergranular water to edges of the grout block. From there, infiltrating water transports the contaminant away from the contamination area. In order to model post-treatment release rates and resulting risk in the feasibility study, investigators need estimates of contaminant specific pore water concentrations and diffusion coefficients.

Typically, diffusion coefficient data are derived from short-term (90-day) bulk leach methods such as the “American National Standard Method for the Measurement of the Leachability of Solidified Low-Level Radioactive Wastes by a Short Term Test Procedure” (ANS/ANSI-16.1). The standard test requires a monolithic sample (cylinder) and demineralized water leachant. The leachant is extracted and replaced at specified time intervals with new water. Given the geometry of the specimen and the leachant composition over time, the diffusion coefficient can be computed and a leachability index assigned. The leachability index is a numerical score used to compare retention of nonvolatile waste components within porous waste-form materials. The leachability index is the negative exponent of the effective diffusion coefficient of the chemical specie of interest. Diffusion is largely dependent on grout type and, to a lesser extent, on chemical species of the contaminant (Weidner et al. 2000).

A substantial body of literature regarding grout performance has been developed by federal reactor waste-disposal research programs. In addition, DOE has conducted several in situ grouting treatability studies and remedial actions where diffusion coefficients were developed for select contaminants and grout types. In general, performance of fission products (e.g. carbon, technetium, strontium, and cesium) in cementitious waste forms are well documented. For example, during tests of grouting underground storage tank sludge at Oak Ridge National Laboratory, Sr-85 and Cs-137 exhibited excellent leach resistance with leachability indexes greater than 10, as measured by the ANS/ANSI-16.1 leach test (Spence and Kauschinger 1997). However, other OU 3-14 contaminants (plutonium and neptunium) and other grout types may not have sufficient leach data available to support the feasibility study detailed analysis.

Though other methods can be used to analyze release (e.g., using the water infiltration rate combined with a retardation factor, as presented by Hull and Pace [2000]), release of contaminants from grout waste forms traditionally has been evaluated using diffusion coefficients derived from ANS/ANSI-16.1 or similar tests. To support the feasibility study, a literature review will be conducted to compile and evaluate available diffusion coefficient data applicable to tank farm contaminants of interest. Then, if insufficient data are available for certain contaminants or candidate grout products, leach tests will be planned and conducted to evaluate the performance of selected grout types with tank farm contaminants of interest.

Leachability of the grout material may be affected by chemical properties of the waste site soils. Most cementitious grouts are alkaline, and though it may be nearly in equilibrium with native INEEL soils, the potential effects of low pH tank farm soils on grout durability have not been investigated. Although it is likely that the buffering capacity of most grouts would far exceed the soil acidity, the potential interactions, given candidate grout types and possible soil pH conditions, have not been investigated or documented. If geochemical calculations indicate potential interferences, additional bench studies will be conducted to quantify the effects of acidic soils on the grout leach index. Preferably, actual soil samples from known release sites will be used in the bench tests. However, if actual samples from the release point prove impractical to retrieve and test due to high levels of radiation, surrogate samples may be chemically altered before testing to represent conditions thought to exist in the release areas.

In regards to standard leach tests, the chair of the ANS/ANSI-16.1 working group recently commented that for purposes of evaluating in situ grouting at the INEEL, the test should be modified to produce data more representative of the waste environment.[b] Using deionized water, in equilibrium with air and with frequent changeout as called for by the procedure, is not representative of actual subsurface conditions. Running a static test to obtain leachability indices and equilibrium distribution with the monolithic sample was recommended. Longer-term leach tests (multiple years) may also provide useful data. In addition, Eh and pH should be measured under an inert gas blanket to discern the actual effect on water chemistry. Finally, simulated water(s) should be tested to evaluate actual solubility potential in the tank farm environment. These recommendations will be considered in the design of the OU 3-14 treatability study.

In addition to leachability of contaminants from specific grouts, the dissolution rate of the grout itself is an important data need, because it helps support the long-term effectiveness evaluation. During the bench tests, the effective diffusion coefficient and leachability index of component elements (e.g., calcium, aluminum, and silicon) will also be measured. Results will indicate durability of the waste form and may allow investigators to evaluate the expected performance life of the waste form.

6.5.2.1 Safety Assessment for High Radiation Soil Excavation and Handling. The presence of contaminated areas with strong radiation fields and a broad range of radiological and chemical contaminants significantly complicates the feasibility study evaluation of remedial alternatives. Past borehole logging identified high radiation areas in the vicinity of the known release sites (e.g., up to 50 R/hr at CPP-31, 25 R/hr at CPP-27, 40 R/hr at CPP-28, and 90 R/hr at CPP-79). To comply with occupational exposure limits, intrusive activities in these areas would undoubtedly require specialized engineering design for remote handling, shielding, and confinement systems. (Handling material with readings greater than 200 mR/hr typically requires special consideration.) Additionally, the presence of significant inventories of radioisotopes at these release sites, as compared to DOE STD-1027-92 (1992) facility hazard categorization guidelines, may also require that intrusive activities at the tank farm be evaluated in light of the facility nuclear safety basis. Although detailed design and final safety analysis and approval would not be required until the remedial design phase, a preliminary assessment of worker protection issues will be performed prior to development of the feasibility study to support the evaluation of cost, implementability, and short-term effectiveness.

To produce a conceptual design and develop a cost estimate for stabilization, retrieval, and disposal alternatives in the feasibility study, a preliminary safety assessment will be performed. The assessment will include a preliminary evaluation of risks associated with grouting, retrieval, packaging, and transportation process, including accidents resulting from natural phenomena and external hazards to the public, the workers, and the environment. Results of the evaluation of accident scenarios will show

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b. Spence, R. D., 2001, "Review and Critique of the OU 7-13/14 Draft Feasibility Study and Engineering Design Files," comments provided to BBWI Operational Review Board, October 31, 2001.

whether significant risk to workers or the public from the operations exist and will be a basis for deciding what level of engineering controls is appropriate to include in the conceptual design and subsequent feasibility study analysis.

The methodology for the preliminary safety assessment involves the identification and screening of common as well as operational specific hazards. The significance of each hazard is evaluated based on its potential for a release of hazardous material. All hazards that are qualitatively determined to be significant in terms of the potential for an unmitigated release are further considered for possible scenarios of release and are then re-evaluated for significance assuming that existing or planned preventive and mitigative measures are in place. High-ranking hazards may be analyzed quantitatively in an accident consequence assessment. In the quantitative assessment, potential doses (and chemical exposures if applicable) to individuals at differing locations (on-site workers, off-site public, etc.) would be calculated for a variety of scenarios that span the range of probable occurrences.

Based on results of the analysis, it will be determined whether unmitigated hazards have the potential to exceed dose evaluation guidelines such as those established in DOE-ID O 420.D, "Requirements and Guidance for Safety Analysis." Depending on the outcome, the retrieval operation could be subject to design and operational requirements of 10 CFR 830, "Nuclear Safety," and DOE O 420.1, "Facility Safety." Depending on how postulated accident consequences compare to the guidelines, important safety components may be identified and safety significant systems, structures, and components to mitigate unacceptable high exposures to workers. Technical safety requirements and other required administrative controls may be identified during the hazard analysis process as well. In addition to nuclear safety issues, the preliminary safety assessment will also address radiological worker protection issues and identify key protective systems that may be required to ensure compliance with 10 CFR 835, "Occupational Radiation Protection."

The results of the preliminary safety assessment will provide a basis for selecting an appropriate conceptual design for retrieval and help to determine whether nuclear facility safety requirements and quality standards would be applicable to this operation. This level of design and cost-estimate information will be necessary to support the detailed analysis of alternatives.

6.6 Remedial Alternatives Development and Screening

The OU 3-14 feasibility study will define RAOs based on results of the BRA, as discussed previously in Subsection 6.4, and identify and analyze alternatives to meet RAOs at OU 3-14 release sites. The overall process to be used to define RAOs and identify, screen, and analyze remedial alternatives for OU 3-14 is described below.

6.6.1 Establish Remedial Action Objectives and General Response Actions

RAOs specify the contaminants, media, exposure routes, receptors, and an acceptable contaminant level or range required to protect human health and the environment and meet ARARs. The RAOs will be based on the results of an initial analysis of ARARs and a thorough evaluation of risks determined in the BRA. The OU 3-14 RAOs will focus on protecting human health and the environment by reducing contaminant concentrations, controlling contaminant release mechanisms, or eliminating exposure pathways.

GRAs will be developed to satisfy the RAOs. GRAs for OU 3-14 include no action, institutional controls, containment, in situ treatment, ex situ treatment, excavation, and disposal. Like RAOs, GRAs are media-specific. GRAs that might be used at specific release sites are initially defined during scoping and are refined throughout the RI/FS as site conditions become better understood and action-specific ARARs are identified.

6.6.2 Preliminary Remedial Process Options

The feasibility study process will include screening of appropriate process options available to address residual contamination that poses unacceptable risks at OU 3-14. Process options are defined for various technology types. The process options are grouped and discussed under the GRAs identified previously and discussed below.

Institutional Controls**—**Institutional controls include actions that prevent or limit access to contaminated areas through the period of time that DOE controls INTEC. Institutional controls also may extend beyond the period in which DOE maintains control at INTEC; however, another agency such as the Bureau of Land Management may take over the administration of institutional controls. Institutional controls may include monitoring, access restriction (fences or other barriers, signs, and security), soil-moisture management, administrative procedures, and deed restrictions. Past INEEL remedial action decisions that employ only institutional controls are referred to as limited action decisions.

Containment**—**Containment, often the preferred method of dealing with sites where treatment is impractical, may reduce the risk to acceptable levels without removing contaminants from the site. Containment includes process options such as capping, grout curtains, or sheet pilings designed to isolate contaminants and prevent their migration beyond the containment boundaries. Experience and data collected from other contaminated sites will help guide the development and evaluation of alternatives that include the GRA of containment.

In Situ Treatment**—**In situ treatment process options include treatment technologies such as grouting. The in situ treatment options would be integrated into alternatives that focus on reducing the toxicity, mobility, or volume of contaminants without removal.

Retrieval- Soil retrieval options include conventional excavation equipment, e.g. trackhoes and backhoes, to less conventional equipment, including microtunneling devices and remote excavators. The Pit 9 Glovebox Excavator and other INEEL projects, as well as other DOE and industry experience, will be used to identify specific process options.

Ex Situ Treatment**—**Ex situ treatment process options require removing contaminants from their current location and treating them to reduce their toxicity, mobility, or volume. Ex situ treatment options could include processes such as soil washing, physical separation, and ex-situ vitrification or grouting. Treated materials can either be returned to their original location or transported to a disposal location.

Disposal On- or Off-Site—This GRA includes process options for removing contaminated media from the tank farm. Once removed, materials would be packaged and transported for disposal in an engineered facility located either on or off the INEEL Site, possibly after the appropriate ex situ treatment.

6.6.3 Screening of Process Options

The preliminary list of process options supporting the selected GRAs for OU 3-14 will be screened to eliminate clearly unsuitable process options. This process option screening will be based on effectiveness, implementability, and cost.

Specific process options will be evaluated with regard to their effectiveness in achieving the RAOs. This evaluation of effectiveness will focus on the following:

- The potential effectiveness of process options in handling the estimated volumes of contaminants in specific environmental media and meeting the remediation goals identified in the RAOs
- The potential impacts to human health and the environment during the construction and implementation phase
- The reliability of the process with respect to remediation of the contaminants and site conditions.

Implementability encompasses both the technical and administrative feasibility of implementing a process option. Technical implementability is used as an initial screen of process options to eliminate those that are clearly ineffective or unworkable at a site. Administrative aspects of implementability are evaluated primarily during the detailed analysis of alternatives. However, factors such as the availability and capacity of treatment, storage, and disposal services are considered. Availability of necessary equipment and skilled workers to implement the process option are also considered.

Cost is a factor in the screening of process options. Relative capital and operating and maintenance costs are used rather than detailed estimates. At this stage of process option screening, cost analysis is based on engineering judgment and past experience, and the cost (high, low, or medium) of each process is evaluated relative to other process options of the same technology type.

Elimination of any process option during screening will be fully documented in the final feasibility study report.

6.6.4 Development of Alternatives

Alternatives will be developed that protect human health and the environment by eliminating, reducing, or controlling risks posed by the site. GRAs and the process options chosen to represent the various technology types are combined to form alternatives for the tank farm soils. The GRA of no action would be considered a baseline against which all other alternatives would be compared.

Each remedial alternative formulated in the feasibility study will specifically address each release site at the tank farm and will cumulatively address all risks for the Tank Farm Group. The design level required for feasibility study remedial alternatives is established somewhat qualitatively, with the overall goal of producing a defensible feasibility study that can (1) adequately compare alternatives and produce a cost estimate within the -30 to +50% range cited in CERCLA guidance and (2) ultimately allow for selection of a remedial alternative. To accomplish this, a design level between conceptual and preliminary should be produced for each alternative passing initial screening.

6.6.5 Screening of Alternatives

Alternatives will be screened on the basis of the short- and long-term aspects of their effectiveness, implementability, and cost. Each screening criterion is discussed below. To the extent practical, a wide range of alternatives will be preserved. Computerized decision analysis tools may be used to document the screening and analysis of alternatives and to facilitate agreement among the multiple parties who will use the results of the feasibility study to select a preferred remedial alternative.

6.6.5.1 Effectiveness. A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment. Each alternative developed will be evaluated for effectiveness in providing protection and reduction of toxicity, mobility, or volume. Both short- and long-term components of effectiveness will be evaluated. Short-term effectiveness refers to the period until the remedial action is complete. Long-term effectiveness refers to controls that may be required to manage the risk posed by treatment residuals, untreated water, and any contamination left at the site. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the radiological or chemical compounds or contaminated media resulting from a treatment that decreases the inherent threats or risks associated with the contamination. Results of treatability studies discussed in Subsections 5.2.3.5 and 6.5 for specific technologies will be included in this evaluation.

6.6.5.2 Implementability. Implementability is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative. Technical feasibility is the ability to construct, reliably operate, and meet technology-specific regulations for process options. Administrative feasibility refers to the ability to obtain approvals from NE-ID, EPA, and IDEQ; availability of treatment, storage, and disposal services (and capacity); and requirements for and availability of specific equipment and technical specialists.

6.6.5.3 Cost. A cost estimate for each alternative will be prepared. Cost estimates at this level of evaluation are typically not accurate at the level desired for the detailed analysis, i.e. +50 to -30%. Parametric estimates or vendor information are often used at this level of estimate. However, cost-sensitive parameters for each process option should be identified and receive the most attention. These data needs are discussed in Subsections 5.2.3 and 6.5 for specific technologies.

Capital and operations and maintenance costs will be considered, where appropriate, during the screening of alternatives. The evaluation will include those operating and maintenance costs that will be incurred for as long as necessary, even after the initial remedial action is complete. In addition, potential future remedial action costs will be considered during alternative screening to the extent that they can be defined. Present worth analyses will be used during alternative screening to evaluate expenditures that occur over different periods.

6.6.5.4 Selection of Alternatives for Detailed Analysis. The output of the alternatives-screening step is a list of candidate alternatives that can reduce risk to human health and the environment and that are technically and administratively feasible. To the extent possible, the range of alternatives originally defined, i.e., no action through limited action and more intensive actions, will be preserved.

The results of the screening process will be reviewed by DOE, EPA, and IDEQ. This review will result in an agreed-upon set of alternatives that will undergo detailed analysis.

6.7 Detailed Analysis of Alternatives

Alternatives remaining after the screening process will first be analyzed in detail individually and then in comparison to each other. A no action alternative will also be analyzed and serve as a baseline against which all other alternatives are compared. The detailed analysis will consist of an assessment of individual alternatives compared to the nine evaluation criteria discussed below. A comparative analysis will then focus on the relative performance of each alternative against the criteria.

The nine evaluation criteria discussed below are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The first two criteria, overall protection of human health and the environment and compliance with ARARs, are the threshold criteria that must be met in order for an alternative to be eligible for selection. The third to seventh criteria are the primary balancing criteria that compare the relative tradeoffs among the alternatives. The last two criteria are the modifying criteria and will be addressed in the ROD after public comment on the comprehensive RI/FS report and proposed plan.

6.7.1 Overall Protection of Human Health and the Environment

Alternatives will be assessed to determine whether they can adequately protect human health and the environment by eliminating, reducing, or controlling risks.

6.7.2 Compliance with ARARs

The alternatives will be assessed to determine whether they meet ARARs. The feasibility study will acknowledge those alternatives that would require an ARARs waiver under 40 CFR 300.430 (f)(1)(ii)(C) to be the proposed remedial alternative.

6.7.3 Long-Term Effectiveness and Permanence

Alternatives will be assessed to determine the long-term effectiveness and permanence that they afford, along with the degree of certainty that each alternative will prove successful. Factors affecting long-term permanence and effectiveness include the following:

- A residual risk assessment for each alternative to evaluate the risks associated with the implementation of the remedial alternative

- The type, degree, and adequacy of long-term management required, including engineering controls, institutional controls, monitoring, operation, and maintenance

- Long-term reliability of controls, including uncertainties associated with land disposal of untreated hazardous waste and treatment residuals

- The potential need for replacement of the remedy.

6.7.4 Reduction of Toxicity, Mobility, and Volume

The degree to which alternatives employ treatments that reduce toxicity, mobility, or volume will be assessed. Results of treatability studies discussed in Subsections 5.2.3 and 6.5 for specific technologies should be included in this evaluation. Factors affecting toxicity, mobility, or volume that will be considered include the following:

- The type of process options employed in an alternative and what materials they will treat

- Amount of contamination that will be destroyed or treated

- The degree of expected reduction in toxicity, mobility, or volume

- The degree to which the treatment is irreversible

- Residuals that will remain and by-products that will be created following treatment.

6.7.5 Short-Term Effectiveness

Assessment of short-term effectiveness of alternatives will consider the following:

- Possible short-term risks to the community during implementation of an alternative
- Potential impacts on workers conducting remedial actions and the effectiveness and reliability of protective measures
- Potential environmental impacts of remedial actions and the effectiveness and reliability of mitigative measures during implementation
- The time until protection is achieved.

6.7.6 Implementability

Assessment of the ease or difficulty of implementing the alternatives will consider the following:

- Degree of difficulty or uncertainty associated with construction and operation of the technology
- Expected operational reliability and the ability to undertake additional action, if required
- Ability and time required to obtain necessary approvals and permits from the Agencies
- Availability of necessary equipment and specialists
- Available capacity and location of needed treatment, storage, and disposal services
- Timing of the availability of prospective technologies that may be under development.

6.7.7 Costs

Costs will be estimated, including capital and operation and maintenance costs based on present value. The costs will be developed with an accuracy of +50 to -30% (EPA 1988a), unless otherwise stated in the feasibility study.

6.7.8 State of Idaho Acceptance

Concerns identified by the IDEQ during its reviews of the comprehensive RI/FS work plan, RI/FS, proposed plan, and ROD will be assessed. The reviews will consider the proposed use of waivers, the selection process used to evaluate alternatives, and other actions. Comments received from the State of Idaho will be incorporated into the remedial evaluation.

6.7.9 Community Acceptance

Community response to the alternatives will be assessed. Similar to the IDEQ acceptance criteria, complete assessment will not be possible until comments on the proposed action have been received. The process for public involvement is discussed in detail in Subsection 6.9.

6.8 Remedial Investigation/Feasibility Study Report

A draft RI/FS report will summarize previous field investigation results, treatability studies, ARAR analyses, comprehensive and cumulative risk assessments, and remedial alternatives. The RI/FS report is defined as a primary document in the FFA/CO Action Plan (DOE-ID 1991). The RI/FS report will serve as a basis for consolidating information that has been obtained and will document the rationale used to screen and develop remedial actions for OU 3-14. The RI/FS report will contain information that the decision-makers need to select an appropriate remedy for OU 3-14. The elements of the RI/FS report will follow the basic format presented in EPA (1988a). Supporting data, information, and calculations will be included in the appendices to the RI/FS report. The report will be revised in accordance with comments received and submitted to NE-ID, EPA, and IDEQ for review. Written comments on the draft RI/FS from EPA and IDEQ will be addressed in the final RI/FS report.

6.9 Proposed Plan and Record of Decision

The OU 3-14 RI/FS activities include preparation of a proposed plan and ROD. The proposed plan, a secondary document, as defined in the FFA/CO Action Plan (DOE-ID 1991), will be prepared to facilitate public participation in the remedy selection process. After the RI/FS report is complete, the proposed plan for OU 3-14 will be presented to the public. This plan will outline the proposed remediation plans developed and supported by the RI/FS activities. The proposed plan will be written in accordance with the format recommended in EPA guidance (EPA 1999). Any issues raised during the public comment period will be addressed in the ROD responsiveness summary.

Public involvement in the decision process is vital to the successful implementation of a remedial alternative. Public participation in the decision process will be conducted according to the Community Relations Plan (INEL 1995) and EPA guidance (EPA 2002b).

After DOE-ID, EPA, IDEQ, and public comments on the RI/FS report and proposed plan are received, a remedy for OU 3-14 will be selected and documented in the ROD, which will be signed by the parties specified in the FFA/CO. The ROD will be prepared in accordance with EPA guidance (EPA 1999). The ROD will serve the following four functions:

- Certify that the remedy selection process was carried out in accordance with the FFA/CO (DOE-ID 1991) and, to the extent practicable, with the NCP (40 CFR 300)

- Describe the technical parameters of the remedy, specifying the treatment, engineering, and institutional components as well as remediation goals

- Provide the public with a consolidated source of information about the site and the chosen remedy, including the rationale behind the selection

- Delineate post-ROD activities, such as scoping the remediation, remedial action plan development, and monitoring.

6.10 Identification of Potentially Applicable or Relevant and Appropriate Requirements (ARARs)

This section identifies initial ARARs for OU 3-14. The list represents a preliminary identification of ARARs based on site characteristics and knowledge of contaminants. Further identification and definition of ARARs will be conducted through a phased process as remedial action alternatives appropriate for the site are identified and will be presented in the OU 3-14 RI/FS, Proposed Plan, and ROD.

The CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (42 USC § 9601), requires the selection of remedial actions that satisfy two threshold criteria: overall protection of human health and the environment and compliance with ARARs. Remedies must address substantive standards, requirements, criteria, or limitations under federal environmental laws and any promulgated state environmental requirements, standards, criteria, or limitations that are more stringent than corresponding federal standards. In addition, the importance of nonpromulgated criteria or other advisory information, called "to be considered" or TBC criteria, is formally recognized in the NCP in the development of remediation goals or cleanup levels.

The EPA has specified that potential ARARs identified for a site should be considered at several points in the remediation planning process (EPA 1988a). These points include the following:

- During scoping of the RI/FS, chemical- and location-specific ARARs may be identified on a preliminary basis.

- During the site characterization phase of the remedial investigation, when the baseline public health evaluation is conducted to assess risk at a given site, chemical-specific ARARs and TBC criteria are identified more comprehensively and are used to help identify preliminary RAOs.

- During the feasibility study, location- and action-specific ARARs are identified for each alternative evaluated in the detailed analysis of alternatives. Changes in regulatory requirements can be assessed through the development of the ROD.

The ARAR identification process for the OU 3-14 comprehensive investigation consists of evaluating sites against the *CERCLA Compliance with Other Laws Manual* (EPA 1988b) to identify preliminary chemical- and location-specific ARARs. Generally, action-specific ARARs are identified in the feasibility study, as appropriate for the remedial alternatives under consideration. However, if an action-specific ARAR contains generic requirements that are deemed appropriate in most remedial scenarios likely to be employed at OU 3-14, it is identified below.

6.10.1 Preliminary ARARs Identification for OU 3-14 Tank Farm Soils

This subsection and Subsection 6.10.2 discuss the preliminary list of ARARs that may apply to OU 3-14 tank farm soils. Section 6.10.2 presents a preliminary list of TBC criteria that may apply to remedial actions under OU 3-14. Tables 6-1 and 6-2 present preliminary lists of potential ARARs and TBC guidance, respectively. This list identifies ARARs that may apply to CERCLA sites located in at an operational facility, have been extensively disturbed from construction activities, and have ongoing work activities in the vicinity.

6.10.1.1 Action-Specific ARARs. Action-specific ARARs are technology- or activity-based requirements for actions taken at a site. Action-specific ARARs generally do not guide the development of remedial action alternatives, but these ARARs indicate how the selected remedy must be implemented. Action-specific ARARs will be refined following alternative development.

Principal action-specific ARARs relate to radioactive material and well construction requirement standards, the management of stormwater and fugitive dust emissions, and management and disposal of radioactive or hazardous waste or residuals, and capping of waste in place.

6.10.1.2 Chemical-Specific ARARs. Chemical-specific ARARs are usually health- or risk-based values that establish the acceptable amounts or concentrations of a chemical that may be found in or discharged to the ambient environment.

Within the context of the effectiveness evaluation, chemical-specific ARARs assume significance, as each alternative is evaluated for its effectiveness in protecting human health and the environment.

Table 6-1. Preliminary list of ARARs for tank farm soil and groundwater.

Statute or Requirement	Citation	Applicable (A), or Relevant and Appropriate (R&A)	Comments
Action-specific			
Remediation Waste Staging Piles	IDAPA 58.01.05.008 (40 CFR 264.554)	A	Applies to management of CERCLA wastes that may be generated and require staging prior to transport to the ICDF or an off-site facility.
Temporary Units	IDAPA 58.01.05.008 (40 CFR 264.553)	A	Applies to temporary management of CERCLA wastes that may be generated and require storage (<1 yr) before transport to the ICDF or an off-site facility.
Procedures for Planning and Implementing Off-Site Response Actions	40 CFR 300.440	A	Applies to CERCLA wastes that are sent off-site for storage, treatment, or disposal.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal facilities	IDAPA 58.01.05.008 (40 CFR 264)	A	Applies to waste treatment performed as part of the remedial action. Specific sections of this ARAR will be reviewed for applicability to feasibility study treatment options.
Closure and Post-Closure Requirements	IDAPA 16.01.05.008 [40 CFR Subpart G]	A	Applies to soils that are capped in place with an engineered barrier.
Land Disposal Restrictions	IDAPA 58.01.05.011 (40 CFR 268)	A	Applies to CERCLA wastes that would otherwise be a RCRA hazardous waste. If these wastes are shipped offsite for disposal. Also applies to soils that have triggered placement.
Alternative LDR Treatment Standards for Contaminated Soils	IDAPA 58.01.05.011 (40 CFR 268.49)	A	Applies to CERCLA soils that would otherwise be a RCRA hazardous waste. If these wastes are shipped offsite for disposal. Also applies to soils that have triggered placement.
Idaho Well Construction Standards	IDAPA 37.03.09.025	A	Applies to drilling of new groundwater monitoring wells, if required.
Chemical-specific			
Hazardous Waste Determination	IDAPA 58.01.05.006 (40 CFR 262.11)	A	Applies to waste generated during remediation activities.
Hazardous Waste Characteristics Identification	IDAPA 58.01.05.005 (40 CFR 261.20 through .24)	A	Applies if soils are excavated and consolidated to facilitate their management or treated or placed in long-term storage awaiting disposal.

Table 6-1. (continued).

Statute or Requirement	Citation	Applicable (A), or Relevant and Appropriate (R&A)	Comments
Idaho Fugitive Dust Emissions	IDAPA 58.01.01.650 et seq.	A	Applies to control of dust during site disturbance and well drilling activities.
Rules for the Control of Air Pollution in Idaho (Air Toxics Rules)	IDAPA 58.01.01.585 and 58.01.01.586	A	Applies to control of emissions during site disturbance and well drilling activities.
Idaho Ground Water Quality Rule	IDAPA 58.01.11.200		Applies to groundwater standards.
National Emission Standards for Hazardous Air Pollutants (NESHAPS)	40 CFR 61.92 40 CFR 61.93	A	Applies to control of radionuclide emissions during earthmoving and well drilling activities.
Location-specific			
Floodplains	10 CFR 1022[40 CFR 270 and 265; 40 CFR 6, Appendix A (Executive Order 11988)]	A	Applies to activities conducted in the 100-yr floodplain. Fill material or structures would be evaluated to ensure that they are able to withstand the 100-yr flood flows.
National Historic Preservation Act	16 USC 470 et seq.	A	An assessment will be performed to determine if the aboveground structures are eligible for designation under the National Historic Preservation Act. If eligible, appropriate follow-on actions would be performed.

Table 6-2. Preliminary list of TBC environmental criteria for OU 3-14.

TBC Criteria	Title
DOE Order 5480.4	Environmental Protection, Safety, and Health Protection Standards
DOE Order 435.1	Radioactive Waste Management:
DOE Order 231.1	Environment, Safety and Health Reporting
DOE Order 5400.5	Radiation Protection of the Public and Environment

The ability to protect human health and the environment is a threshold criterion that CERCLA remedial actions must meet to be considered a preferred remedy. The EPA considers a remedy protective if it “adequately eliminates, reduces, or controls all current and potential risks posed through each [exposure] pathway [at] the site.” In accomplishing protectiveness, a remediation alternative must meet or exceed ARARs or other risk-based levels established when ARARs do not exist or are waived.

In both the NCP and the *CERCLA Compliance with Other Laws Manual* (EPA 1988b), the EPA specifies that when ARARs are not available for a given chemical or when such chemical-specific ARARs are not sufficient to be protective, risk-based levels should be identified or developed to ensure that a remedy is protective. Both carcinogenic and noncarcinogenic effects are considered in determining risk-based levels and evaluating protectiveness. For carcinogenic effects, the health advisory or risk-based levels are selected so that the total lifetime risk to the exposed population of all contaminants falls within the acceptable range of 10^{-4} to 10^{-6}. The 10^{-6} risk level is specified by EPA as a point of departure for levels of exposure, as determined by EPA reference doses, taking into account the effects of other contaminants at the site.

Therefore, chemical-specific ARARs serve three primary purposes:

- To identify requirements that must be met as a minimum by a selected remedial action alternative (unless a waiver is obtained).
- To provide a basis for establishing appropriate cleanup levels.
- To identify chemical-specific ARARs for contaminants at OU 3-14. The National Emission Standards for Hazardous Air Pollutants (40 CFR 61.92) established emission limits for radionuclides other than radon from DOE facilities. The standard limits an entire facility's emissions to ambient air to an amount that would not cause any member of the public to receive an effective dose equivalent of 10 mrem per year. These requirements are considered potentially applicable to possible remedial actions that may be undertaken at OU 3-14.

The State of Idaho's rule governing new sources of toxic air pollutants, located in IDAPA 58.01.01.585 and 58.01.01.586, is a potential ARAR if a remedial option generates regulated toxic air pollutants. If toxic air pollutant emissions exceed relevant screening levels, appropriate air modeling would determine ambient air concentration. Reasonable available control technologies would be employed to control emissions if acceptable ambient air concentrations were exceeded. If remedial action is necessary, air-screening analysis would determine the levels of emissions likely to be associated with the options being proposed. The INEEL is categorized as an attainment or unclassified area for ambient air quality (42 USC 7401 et seq.) and, therefore, is subject to IDAPA 58.01.01.575-77 and 40 CFR 50.

6.10.1.3 Location-Specific ARARs. Location-specific ARARs are regulatory requirements or restrictions on activities in specific locations that a given remedial action must meet. General location-specific regulatory requirements are identified in Table 6-1.

6.10.2 To-Be-Considered Guidance

TBC criteria are advisories, guidelines, or policies that do not meet the definition of ARARs. These criteria may assist in determining protective criteria in the absence of specific ARARs. Preliminary TBC criteria for the OU 3-14 site include the following:

- DOE orders and manuals
- Executive orders
- Federal and state rules pertaining to relevant subjects that are not promulgated criteria, limits, or standards by definition of Section 121[d] of CERCLA (42 USC 9601)
- EPA guidance documents
- Remedial action decisions at similar Superfund sites.

Table 6-2 lists potential TBC criteria for OU 3-14.