**Idaho National Engineering Laboratory
Waste Area Groups 1-7 and 10
Technology Logic Diagram
(Volume I)**

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ABSTRACT

The Technology Logic Diagram was developed to provide technical alternatives for environmental restoration projects at the Idaho National Engineering Laboratory. The diagram (three volumes) documents suggested solutions to the characterization, retrieval, and treatment phases of cleanup activities at contaminated sites within 8 of the laboratory's 10 waste area groups. Contaminated sites at the laboratory's Naval Reactor Facility and Argonne National Laboratory-West are not included in this diagram.

SUMMARY

The Technology Logic Diagram (TLD) was developed to help waste area group (WAG) managers at the Idaho National Engineering Laboratory (INEL) select suitable technologies to remediate their waste sites. The TLD can also assist managers at other locations in selecting appropriate technologies for effective environmental restoration.

Data were gathered on the type, form, and amount of contamination at each WAG by (a) reviewing the INEL environmental restoration road map documentation, (b) studying the INEL waste stream data base, (c) reading descriptive documentation relative to WAGs, (d) interviewing WAG managers, and (e) inspecting waste sites. Technical teams and WAG managers then identified potential technologies for characterization, retrieval, treatment, and capping of these sites. Transportation and disposal other than capping were not addressed. Technologies were evaluated based on current science and technology needs and on implementation requirements. Information on some technologies was obtained directly from the Oak Ridge National Laboratory K-25 Site TLD, where K-25 Site problems are similar to INEL problems.

Compiling problems and technical solutions into WAG environmental restoration activities was then documented in a three-volume TLD. Volume I contains a description of the INEL's waste sites, type of wastes, and reference requirements for waste cleanup and handling, plus a general description of the TLD and how to use it. Volume I also ranks the identified technologies. Volume II contains the actual logic diagram, identifying applicable technologies for each contaminated site. Volume III contains detailed descriptions of the technologies, their current status, and a list of contaminated sites where the technologies may be used.

Table A-1 in Appendix A of Volume I summarizes technologies identified to remediate the INEL and includes the (a) technology status, (b) number of times the technology was recommended as an option at INEL sites, (c) number of times the technology was identified as the preferred option, (d) estimated volume of waste the technology would potentially remediate, and (e) technology ranking.

Technology status is defined as either (a) accepted, (b) demonstration, testing, and evaluation needed, or (c) research and development needed. Accepted technologies are those supported by industry or regulators and available at the INEL. Technologies that require demonstration, testing, and evaluation are those available but not demonstrated or accepted for the specific INEL problem. Additional demonstration, testing, and evaluation are required prior to implementing this technology. Technologies that require research and development are those under laboratory-, bench-, or pilot-scale testing or at a conceptual stage of development. Further development of these technologies is required for utilization at the INEL.

Teams of technical experts identified and evaluated technologies applicable to each environmental restoration activity or subelement, e.g., characterization, retrieval, etc. Many technologies were identified as "preferred," based on the technology's availability, effectiveness, and waste minimization capabilities. In many cases, the preferred technology was the one selected by the WAG manager.

Waste volumes listed in Table A-1 indicate the total volume of waste at a certain site. This volume identifies the technology's usefulness. The larger the volume, the higher the technology ranking.

Technologies were ranked high, medium, or low according to the (a) number of times the technology was applicable to INEL sites, (b) volume of waste that the technology would be used to remediate, and (c) number of times the technology was designated as preferred. Technologies were ranked low if they were applicable less than four times, were less than 50,000 m³ of waste, or were not designated as preferred. Technologies were given a medium ranking if they were applicable at 4 through 20 sites, treated 50,000 to 200,000 m³ of waste, or were designated as preferred for 1 to 20 times. Technologies were ranked as high if they were applicable more than 20 times, treated more than 200,000 m³ of waste, or preferred more than 20 times. As a result, 6 research and development technologies were ranked high, 7 medium, and 18 low.

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The ORNL K-25 Site TLD was used as the guide for the INEL effort, and many ORNL employees contributed to this TLD, particularly R. L. Kibbe and R. L. Fellows.

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Albert Nelson Tardiff, Jr. (DOE-HQ) and Edwin Martinez (DOE-ID) provided technical guidance and program leadership.

WAG managers provided waste area descriptions as well as technical input and detailed reviews.

The highly complex and seemingly endless job of collecting, reviewing, resolving, and incorporating reviewer comments into the final report fell to a group of hard-working, motivated people including S. D. Dunstan, B. S. McCullogh, and K. J. Pour of MSE, Inc., and L. C. Rounds, D. S. Vandel, L. D. Schlenker, A. A. Reyes, and N. Reynolds of EG&G Idaho.

The task of inputting the enormous amount of data into the computer and then providing changes to accommodate the many revisions and review comments was accomplished by C. A. Martin, G. W. Serr, and S. Stacey of Manpower, Inc.

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ACRONYMS

ACC	accepted
ADS	Activity Data Sheet
ARA	Auxiliary Reactor Area
COCA	Consent Order and Compliance Agreement
D&D	decontamination and decommissioning
DT&E	Demonstration, Testing, and Evaluation
DOD	Department of Defense
DOE	Department of Energy
EM	Environmental Restoration and Waste Management
EPA	Environmental Protection Agency
FFA/CO	Federal Facilities Agreement/Compliance Order
ICPP	Idaho Chemical Processing Plant
INEL	Idaho National Engineering Laboratory
LDR	land disposal restriction
LLW	low-level waste
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
OU	operable unit
PBF	Power Burst Facility
PCB	polychlorinated biphenyl
R&D	research and development
RA	remedial action
RCRA	Resource Conservation and Recovery Act

RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
S&T	Science and Technology
SDA	subsurface disposal area
TAN	Test Area North
TCLP	toxicity characteristic leachate procedure
TD	technology development
TEDS	Technology Evaluation Data Sheets
TLD	Technology Logic Diagram
TRA	Test Reactor Area
TRU	transuranic waste
TTP	Technical Task Plan
USLE	Universal Soil Loss Equation
WAG	waste area group

Idaho National Engineering Laboratory Waste Area Groups 1-7 and 10 Technology Logic Diagram

1. INTRODUCTION

1.1 Purpose and Scope

The purpose of the Technology Logic Diagram (TLD) is to provide a planning document for the U.S. Department of Energy (DOE), DOE operating contractors, and private industry that relates the environmental restoration and associated waste management problems at the Idaho National Engineering Laboratory (INEL) to the technologies available to remediate the problems. In preparing the TLD, the status of each potential remediation technology was evaluated considering waste area groups (WAGs) 1-7 and 10 (see Figure 1). Criteria included (a) technology effectiveness when applied to site problems, (b) level of technology maturity, and (c) wastes generated when utilizing the technology.

The Hanford Site wiring diagram and the Oak Ridge National Laboratory's K-25 TLD were used as guides. Other TLDs will be developed to address waste management and decontamination and decommissioning (D&D) problems.

1.2 Overview of TLD

The TLD links DOE environmental cleanup goals, specific INEL environmental cleanup problems, and potential technological solutions. Using flow-chart arrows, the TLD relates the environmental restoration and waste management (EM) problems at the INEL to technologies suitable for remediating them. The TLD also identifies appropriate remedial technologies and indicates the status of these technologies in terms of maturity, implementation requirements, and demonstrated performance. Finally, the TLD aids environmental restoration managers by identifying preferred remediation technologies appropriate to their specific problems.

1.2.1 Volume I

Volume I of the TLD consists of the following sections:

- Introduction
- A brief history of WAGs
- A description of the TLD
- A summary of INEL science and technology needs
- Reference requirements presenting issues relative to the cleanup of contaminated sites

Figure 1. Waste area groups (WAGs) at the INEL.

- Appendix B (contains WAG descriptions and the environmental problems they present)

1.2.2 Volume II

Volume II describes the TLD's overall layout and development. The logic diagram flows from left to right and consists of 11 columns of input data or information called logic elements. The progression flows through the logic elements, beginning with the EM goals and ending with the implementation needs.

- *EM Goals* have three components: (a) cleanup legacy, (b) prevent future insult, and (c) develop environmental stewardship. These problems are shared by all elements of the DOE complex to varying extents. Technologies that do not contribute to these goals are not evaluated in the TLD.
- *EM Problem* contains problem areas agreed upon by EM/DOE for D&D, remedial action (RA), and waste management. These EM problems are used to organize the diagrams and will be discussed. The problems found in WAGs 1–7 are all RAs. Therefore, all technologies evaluated will contribute to corrective RA problems.
- *INEL Problem* describes the problem areas identified at the INEL for WAGs 1–7 and 10 (e.g., landfills and ponds) by specific operable unit (OU). These problem areas have been defined by Environmental Restoration and Technology Development (TD) staff.
- *Problem Area/Contaminants* identify (a) the waste types, (b) specific contaminants, and (c) forms and volumes. For example, OU 1-05, the Test Area North (TAN) soil area, is described as low-level radioactive material, consisting of ^{137}Cs , ^{60}Co , and ^{90}Sr found in 570 m³ concrete and metal debris.
- *Reference Requirements* identify the point containment levels accepted by the Environmental Protection Agency (EPA), DOE, and other Federal agencies. Windows of opportunity for technology development, release criteria, or minimum contamination levels are also shown in this column.
- *Subelements* are classifications of environmental restoration activities under which technologies are grouped. All environmental restoration activities have been categorized into the following subelement groups: characterization, retrieval, biological and chemical treatment, thermal and physical treatment, and caps and barriers.
- *Alternatives* define the general technology approaches that may be applied to the problem. The various alternatives for completing the previous logic element are listed. For example, alternatives for the subelement, "Thermal and Physical Treatment," might be physical separation or incineration.
- *Technologies* identify specific technologies that may be applied to remediate the problem.

- *Status* provides information on the status of the technologies identified in the previous column. The status includes the availability and historical performance information of these technologies.

The following categories have been used to describe the availability of technologies.

- *Accepted (A)*: Technology is accepted by industry or regulators, and the demonstrated technology is available at the INEL.
- *Demonstration, Testing, and Evaluation (DTE) Needed*: Technology is available but not demonstrated or accepted for the specific problem at the INEL. Additional demonstration, testing, and evaluation is required prior to implementing the technology.
- *Research and Development (R&D) Needed*: Technology is under laboratory-, bench-, or pilot-scale testing or at a conceptual stage. Significant development is required for technology utilization.

These classifications should provide the status of the technology.

- *Science and Technology (S&T) Needs* are perceived needs in S&T where support should be applied to develop an accepted or "immature" technology. Science needs are related to the fundamental understanding of the scientific phenomena, which form the basis for the technology. These needs are typically for laboratory- or bench-scale experiments; and when possible, experiments addressing specific areas of uncertainty are suggested. Technology needs relate to improvements that make a current technology more economical to apply and safer and more efficient. The demonstration of a technology on a site-specific problem is classified as a technology improvement need.

If scientific needs are specified, it should be understood that the needs of technology development or improvement are necessary to implement newly developed scientific understanding. Likewise, testing a technology development opportunity implies that technology improvements are also likely to be needed.

- *Implementation Needs* or specialized needs were evaluated for both development of a technology and deployment of a mature technology. These needs were evaluated in areas of (a) resources such as financial or personnel, (b) hardware such as process equipment, development equipment, and computers, (c) software such as models, procedures, and computer programs, (d) facilities such as laboratories, shops, and buildings, and (e) education such as training classes or degreed personnel. An estimate of the process cost is given. Only extraordinary needs are highlighted, i.e., those needs that require long lead time or unusual procurements such as line items for facility construction.

When standard laboratory facilities are sufficient, facility needs are not identified. Since INEL facilities to implement the technology are relatively extensive, the TLD focuses only on unique facility needs.

Because of the large number of remedial action sites, additional facilities may be needed to meet technology needs.

1.2.3 Volume III

Volume III of the TLD provides the Technology Evaluation Data Sheets (TEDS) for EM activities (characterization, retrieval, biological and chemical treatment, thermal and physical treatment, and caps and barriers) referenced by a TEDS code number in Volume II. These sheets describe and evaluate technologies in more detail than Volume II. The TEDS are arranged by activity and alphanumerically by the TEDS code number in the upper right corner of the data sheet.

1.3 History of the WAGs

Nuclear operations at the INEL (formerly the National Reactor Testing Station) began in the 1950s. A total of 52 reactors were built and tested. Operating these reactors and their associated support facilities resulted in several contaminated areas. With the exception of the facility structures themselves, most contaminated areas consist of soil contamination, with various radioactive isotopes, a variety of organic solvents, and heavy metals. Some areas are contaminated with only hazardous materials or radioactive isotopes, while others contain both.

Contaminated sites were identified using historical information. Additional information was obtained through radiological surveys, visual evidence, and interviews with past and present INEL employees. This effort resulted in the identification of approximately 300 contaminated or potentially contaminated sites.

During the mid-1980s, concern developed over the cleanup of the contaminated sites. Negotiation between the DOE, the State of Idaho, and the EPA (Region X) resulted in the development and approval of a Consent Order and Compliance Agreement (COCA) for the cleanup of the INEL contamination sites.

Each of the contaminated sites was assigned a unique COCA number, and signs containing these identifying numbers were placed at the sites. Photographs were taken of each site, and preliminary radiological survey data were collected. A limited amount of sampling for hazardous materials was also performed. A data base of INEL COCA site information was established, and plans were initiated to undertake the thorough characterization of each identified site.

Although most contaminated sites are small in size, a few do contain enough contaminants that the INEL was placed on the EPA National Priorities List.

By the end of the 1980s, it was necessary to establish new agreements with the regulatory agencies. Federal Facility Agreements (FFAs) were selected as the mechanism for formalizing the new agreements. A Federal Facilities Agreement/Consent Order (FFA/CO) was developed for the INEL contaminated sites. These sites are currently being governed by this agreement. When COCA changed to an FFA/CO, the manner in which the sites were identified and numbered also changed.

Geographic areas at the INEL such as Test Area North (TAN), Test Reactor Area (TRA), and the Idaho Chemical Processing Plant (ICPP) were designated as waste area groups (WAGs) and assigned a numeric value. TAN became WAG-1, TRA became WAG-2, etc. Similar problem areas or sites within each WAG were combined and designated as Operable Units (OUs), then assigned a numeric designator, e.g., each WAG would contain a series of OUs consisting of a number of similar contaminated sites or areas. It is intended that all sites in a given OU will be characterized and cleaned up as a single project. This will make the remediation of these sites more efficient.

Currently, most OUs at the INEL have been characterized to some extent. Many have been thoroughly characterized. Some have had interim actions performed to remove or stabilize contamination and prevent the spread of contamination. As a result of finding little or no contamination during characterization of some of the sites, no cleanup of those sites will be required. These sites/OUs are designated as no action sites. Areas that still contain contamination in amounts requiring cleanup will be included in appropriate environmental and safety documentation. Cleanup of these sites will be planned and scheduled as specified in the FFA/CO.

1.4 INEL Site Specific Conditions

The INEL is located on the Snake River Plain at an elevation of approximately 1,500 m. Elevations across the INEL range from 1,450 to 1,580 m. The subsurface geology of the INEL consists of basalts deposited as lava flows with interbedded sediments. Thicknesses and depths of sediment layers, and properties of basalts and other geologic formations have been found to vary across the INEL.

The Big Lost River, an intermittent stream at the INEL, is approximately three km northwest of the Radioactive Waste Management Complex (RWMC) at its closest point. A flood control system constructed in 1958 diverts part of the flow to four spreading areas near the southwest corner of the INEL. During the winter, nearly all flow is diverted from the river channel to avoid accumulation of ice.

Beneath the Snake River Plain lies the Snake River Plain Aquifer (SRPA). The SRA, which is designated as a sole source aquifer, is approximately 320 km long, 48 to 97 km wide, with a total estimated volume of 2,500 billion m³ of water. The depth to the SRPA from ground surface is approximately 177 m. The direction of flow is roughly northeast to southwest, at measured rates ranging from 1.5 to 6.1 m/day with an average of 3 m/day. Evidence of perched groundwater has been found at depths from 9.1 to 70 m.

Temperature extremes recorded at the INEL range from a low of -42°C in January to 39°C in July. The average winter temperature varies from -16 to -3°C. The average summer temperature varies from 10 to 31°C.

Prevailing winds are from the southwest. The average hourly wind speed varies from 9 km/hr in December to 14 km/hr in April and May. The highest hourly average recorded wind

speed was 82 km/hr from the west-southwest. The highest instantaneous recorded wind speed was 126 km/hr, from the west southwest. Calm conditions occur 11% of the time.

The INEL climate is semiarid, with an average annual total precipitation of 22 cm. Maximum monthly precipitation occurs during May and June, and the minimum occurs during July. The largest recorded rainfall within a 24-hour period was 4.4 cm in June 1954. The maximum hourly recorded rainfall was 3 cm on June 10, 1969. Average recorded snowfall is 72 cm and falls primarily from November through April.

The average soil moisture zero flux plane depth at the INEL generally varies seasonally from 1.2 to 2.3 m. However, positive and negative gradients indicating upward and downward water movement, respectively, may be found for depths to 3.3 m at various times of the year. Below 3.3 m, gradients are primarily negative (downward) throughout the year.

1.5 INEL Road Map and Waste Stream Tracking System Interface

The INEL Road Map Program, which provides regulatory drivers for environmental restoration projects, was the basis for the initial input to the TLD. Additional information was also obtained from the environmental restoration waste stream tracking system, which provided the 10-year waste form and volume generation forecasts for all INEL waste streams.

1.6 Description of Appropriate Technology Identification

The process used to evaluate environmental restoration technologies involved identifying the characteristics of the site and appropriate technologies or processes for each contaminated site or area. An engineering evaluation of each identified technology was then performed.

Team leaders were identified and asked to assemble a team of technical experts for their particular subelement (e.g., characterization and retrieval) of the environmental restoration process. A series of facilitated meetings was held with the team leaders and appropriate personnel with expertise in these technologies. The purpose of the meetings was to discuss the history, contaminants, current status, and plans for each site covered by the FFA/CO. These discussions used brainstorming sessions to identify appropriate technologies or techniques for each subelement or phase of contaminated site cleanup. At the conclusion of the discussion about a particular site, lists were prepared of appropriate technologies for characterization of that site, for retrieval of the contaminants, treatment of the contaminated materials, and any regulatory issues that would affect the project. Other applicable technologies such as stabilization, decontamination, or capping of the sites were also listed, if appropriate.

Technologies that simply involve removal and land disposal of contaminated media and debris are not considered for discussion herein. Due to the limited land disposal capacity at the INEL, only treatment technologies that provide some form of waste reduction could be considered.

2. CHARACTERIZATION

The purpose of the characterization portion of this TLD is to review the characterization requirements for INEL environmental restoration activities and to identify and evaluate applicable characterization technologies. In addition, areas where characterization needs are not fully met, or where improvements will result in technical or economic gains, new technology requirements were identified.

Characterization is broken into several components, each of which contain several technology options. These individual options are evaluated as part of the TLD process and are shown for each characterization component (Table A-1 of Appendix A). In addition to listing characterization technologies, this table also presents need assessments. It indicates whether the technology needs basic research and development or further demonstration, testing, and evaluation before being used at the INEL.

Following research and development, demonstration, testing, and evaluation, certain implementation needs must be met to successfully utilize a given technology. Fortunately, implementation needs for most characterization technologies are relatively minor. Other than procurement of the necessary equipment, most implementation needs consist of installing equipment, preparing procedures, and training operators. Although adequate funding and scheduling must be provided, implementation of characterization technologies is not viewed as a particularly difficult item.

Characterization is used in identifying and quantifying contamination. Characterization technologies are used to locate buried wastes and contaminated groundwater seeps and to define contaminant migration boundaries in soils and sediments in burial grounds and outside tanks, pipelines, buildings, and other structures. Characterization is required to meet regulatory requirements, permit risk assessment, and guide remedial treatments. For the most part, the technologies involve the analysis of soils, sediments, sludges, water, and air in the field and laboratory. The main contaminant groups of concern are radioactive elements, heavy metals (e.g., lead, mercury, and chromium) and organic compounds or mixtures of organic compounds (e.g., PCBs or fuels).

Although characterization technologies are identified as preferred or applicable to a particular site, it is important to consider EPA sampling and analysis requirements in the process of selection and application of any technology to be used for final characterization phases.

3. RETRIEVAL

The purpose of the retrieval portion of the TLD is to review the retrieval requirements for the INEL environmental restorations activities, identify applicable retrieval technologies, and then evaluate those technologies. Wastes to be retrieved include debris, (e.g. concrete, metal) soil, and sludge. Options for retrieval processes have been divided into two basic types, manual and remote, each of which contains several technology options. These individual options are evaluated as part of the TLD process and are shown for each retrieval component (see Table A-1 of Appendix A). In addition to listing retrieval technologies, this table also presents need assessments. It indicates if the technology needs basic research and development of further demonstration, testing, and evaluation before it is used at the INEL.

The manual retrieval equipment listed are commercially available and fully proven technologies applied to excavation and demolition operations. No pressing technology needs exist for this type of equipment. However, there may be some project specific implementation needs that will require additional minor modifications to the equipment (e.g., a dust suppression system that would consist of a water spray system mounted on the equipment). In general, implementation needs fall into categories such as (a) space requirements, (b) personnel training, or (c) resources that are needed to fully implement the technology.

The remote retrieval equipment listed requires demonstration, testing, and evaluation as it requires modification to meet site-specific conditions.

4. BIOLOGICAL AND CHEMICAL TREATMENT

The purpose of the biological and chemical treatment portion of the TLD is to identify biological and chemical technologies as options for treating wastes at INEL environmental restoration sites and then to evaluate those technologies. In addition, areas where biological and chemical treatment needs are not fully met or where improvements will result in technical or economic gains, new technology requirements were identified.

Biological and chemical treatment is broken into several components, each of which contain several technology options. These individual options are evaluated as part of the TLD process, and are shown for each biological and chemical component (see Table A-1 of Appendix A). In addition to listing biological and chemical treatment technologies, this table also presents need assessments. It indicates if the technology needs basic research and development or further demonstration, testing, and evaluation (DT&E) before being used at the INEL.

Many of these technologies require further DT&E. For example, soil washing such chemical washing or biological leaching is specified as applicable to numerous sites and uses a variety of processes and formulas. These are not immediately available for use on a large scale due to either the expense or unavailability of the large quantities of chemical solutions required for the process or because there is not enough data on the successful use of these technologies as applied to various soils and contaminants. Additionally, more information regarding the secondary wastes generated from the use of these technologies is needed to ensure that adequate volume reduction and treatment technologies exist.

5. THERMAL AND PHYSICAL TREATMENT

The purpose of the thermal and physical treatment portion of the TLD is to review the thermal and physical treatment technologies for treating waste sites at the INEL.

Because of the wide scope of activities under thermal and physical treatment processes, the science and technology needs for these processes have been summarized and are presented below. These needs are divided into three categories: (a) laboratory development, (b) full-scale demonstration, testing, and evaluation, and (c) operating data from successful operations. Many technologies show great promise but need further proof-of-principle testing in the laboratory. Others have been through this phase and need to progress on to full-scale demonstration testing of the concept on simulated waste. Some technologies have been adequately demonstrated, and actual performance data are available. These data must be analyzed and applied to specific INEL treatment processes. It is believed that the technologies shown in the TLD fall into these "demonstration" categories. It is not anticipated that new materials or processes will have to be developed to support thermal and physical treatment of most contaminants identified in INEL wastes. The specific science and technology needs for each technology identified are presented in the TLD.

Each thermal and physical technology identified will present a specific set of implementation needs. In general, implementation needs fall into categories such as facility modifications, space requirements, training, or resources needed to fully implement the technology. Implementation needs are also presented for individual technologies in the TLD.

Many of the technologies listed in the TLD are not fully proven and are still under development. Although the status of all technologies presented in the TLD are specified, some general conclusions can be drawn from that information. Thermal processes relying on vitrification, desorption, and degradation should be considered as still in the development stage as far as INEL wastes are concerned.

Physical treatment processes such as amalgamation, centrifugal separations, solvent extraction, and soil washing should also be considered developmental at this time. Further work must be done with each of these processes to demonstrate their applicability and performance on INEL waste problems.

A study was completed as part of a Thermal Processing Technology project conducted by the Waste Technology Development Department of EG&G Idaho, Inc. It was conducted as a followup to a separate study conducted by EG&G Idaho, referred to as the Preliminary Systems Design Study (SDS). The SDS provided an overall evaluation of a variety of remediation systems strategies for treatment of buried waste at the Radioactive Waste Management Complex (RWMC) of the INEL. Many of the SDS higher rated process systems strategies were based on retrieving the waste material and processing it into a more stable and acceptable state through some form of thermal treatment.

The SDS study identified an ex situ process strategy that would provide for separation of retrieved waste into a bulk soil waste stream, a bulk metals waste stream, a combustible waste stream, and a noncombustible waste stream. The SDS postulates that the combustible stream

would be best treated by an incinerator technology and the noncombustible waste stream (and possibly the bulk soil stream) by a high temperature melter/vitrifier technology. The SDS further determined that this process is one of the more desirable of the potential ex situ treatment options.

For the purpose of this document, the study identifies, describes, evaluates, and ranks the potential thermal treatment technologies that could be employed in either the incineration of the INEL combustible wastes or the melt processing of noncombustible wastes as separate waste streams. An earlier thermal technology identification and screening study was used as a starting point. The study identified and ranked available thermal technologies against application to bulk average mixed waste and soil streams representative of the INEL buried wastes.

This study provides additional consideration of the likely composition of the separated combustible and noncombustible waste streams against which to separately rank the incinerators and melters, respectively. A technology evaluation (scoring) approach was used, similar to that in the earlier study, to score each technology on a list of attributes, then rank the technologies by total score. Although the same list of attributes was used for both incinerators and melters, each attribute was made up of criteria (subattributes or contributing features) which were somewhat different for incinerators and melters.

It should be noted that the ranking results simply indicate which types of incinerators and melters are likely best suited for INEL waste applications. It is quite possible that any of these technologies could be made to satisfactorily perform the required combustion and melting stabilization functions to some degree, given sufficient engineering investment. It is also true that none of the technologies have been demonstrated fully on the transuranic (TRU)-contaminated wastes and soils that make up the remediation problem.

In general, it can be stated that commercial incineration technologies for combustible wastes have been well developed over the last two decades. Incinerators are well understood for the type of combustible waste materials applications being considered, with the recognition that incineration of TRU-contaminated wastes will require special features to ensure proper contamination and criticality control. Many incineration systems have been constructed and are now operating in hazardous and low-level radioactive waste treatment applications throughout the world.

Melting technologies can be operated such that they pyrolyze or oxidize (combust) an organic waste fraction. However, incinerators have been designed and developed specifically for this purpose and will function much more effectively than a melter in this regard. There are also other benefits to preprocessing organics in an incineration step and processing the residual inorganics in the melter process to achieve the final waste form. Such a strategy will maintain a minimum offgas volume from the melter process, thus allowing melter afterburners and offgas trains to be small and compact systems. This creates advantages in equipment and facility design, process complexity and controllability, and perhaps even in perception. These advantages disappear rapidly with increasing organic loading in the waste, as offgas system design will then be driven by the offgas products from the processing of the organics. In addition, elimination of organics allows a greater flexibility of operation of the melter process to control chemistry (redox conditions) in the melt.

The melter technology rankings are largely driven by the operating temperature capability, robustness to feedstock variations, limitations of offgas generators, and related industrial applications experience base. The melter technologies have a considerable experience base within the pyrometallurgical industry and the glass industry, which indicate they are generally time-proven technologies for related materials applications. The specific application of the melter technologies for stabilization of radioactive wastes has, however, largely been limited to a few well-defined high-level waste glass compositions (using lower temperature joule-heated melters). There are, therefore, many more open questions regarding the applications of melter technologies to the processing of TRU contaminated wastes and soils. Other studies have been conducted by EG&G Idaho to more thoroughly evaluate the leading melter technologies (Table 1).

Table 1. Technology rankings for incinerators and melters.

Incinerators	Ranking	Melters	Ranking
Rotary kiln			
Controlled air	74	Plasma torch hearth	75
Slagging kiln	73	Graphite electrode hearth	73
Fluidized bed	66	Joule-heated	68
Multiple hearth	62	Molten metal	60
Cyclone incinerator	53	Fossil fueled hearth	59
Cyclone melter	43	Graphite electrode shaft	45
Molten salt	33	Slagging kiln	41
	24	Microwave	40
		Plasma torch shaft	38
		Cyclone melter	36
		Fossil fueled shaft	24

6. CAPS AND BARRIERS

The purpose of the caps and barriers portion of the TLD is to review the containment and isolation of INEL wastes. Capping limits the transport of waste by water, wind, and human/animal/plant intrusion. A cap can be as simple as a sheet of plastic or as complex as a multi-layer engineered system.

The term "capping," when generally applied to existing waste sites, may include (a) covering the top of the waste area with a protective layer, (b) placing vertical barriers around the boundaries of the waste or at selected locations around the waste, (c) placing barriers under the waste, and (d) implementing groundwater control measures. Waste form modification may also be included under the broad heading of capping when a waste is structurally stabilized in order to support a cap.

Two fundamentally different capping technologies have been applied across the country to minimize infiltration to waste, based on climatic conditions.

- One approach maximizes runoff by sealing the surface with an impermeable material, such as geomembranes, concrete or asphalt (sealed cover) and lateral drainage using the three-layer EPA design (Resource Conservation and Recovery Act [RCRA] cover). This method has been used in climates ranging from arid to humid to maximize evapotranspiration and storage using a thick soil cover with a vegetated surface (ET-storage cover). This cover has been widely used at arid climate Uranium Mill Tailings Remedial Action and low-level waste (LLW) sites.
- A second approach uses a water balance cap (capillary barrier) with a vegetated surface cover. These are typically preferred over impermeable surface covers if vegetation can survive and control erosion (EPA 1989a)?. Previous studies at the INEL and other arid sites suggest that a relatively thick vegetated soil cover may provide adequate water storage to control infiltration to the waste and support vegetation.

Studies indicate that a 2-m thick vegetated soil cover can store and remove by evapotranspiration nearly all of the precipitation that may fall under normal conditions. Soil-only covers can prevent significant infiltration to waste, but cannot ensure zero infiltration. The optimum soil cover thickness for maintenance of vegetation, storage of infiltration and control of infiltration is therefore between 1.2 to 3.3 m. A soil cover thicker than 3.3 m may not result in increased storage capacity of water that can be removed by evapotranspiration. Any water that infiltrates to a depth of greater than 3.3 m is likely to contact waste eventually. EPA guidance states that closure cover soil layers should be designed with the capacity to store or drain infiltration resulting from the maximum probable precipitation event. This scenario should be redefined for each site, and adequate soil moisture storage capacity determined.

More accurate infiltration modeling requires additional model development and testing, and study of input variables.

6.1 Technology Options

Porous gravel or cobble capillary barriers may reduce infiltration to underlying layers. As soil water contents fall below field capacity, water moves in response to capillary gradients, in the direction of greater capillary suction. Capillary suction is inversely proportional to both size of pore space and soil water content. Coarse-grained gravel and cobble layers therefore inhibit capillary flow. When overlying fine-grained soils approach saturation, moisture potential values increase to greater than zero as gravity head develops that allows water to drain into and through the capillary barrier.

While storage and evapotranspiration may reduce or eliminate infiltration at various test sites, additional protection may be provided by low-permeability layers including free-standing covers, water balance caps, and compacted soil or geomembranes. Previous studies indicate that soils can be compacted to a hydraulic conductivity of $1.0\text{E-}6$ cm/sec, which can significantly retard percolation.

Wind and water erosion are significant problems at arid sites. EPA requires that soil loss from the surface cover be less than 2 tons/acre/year, as calculated using the Universal Soil Loss Equation (USLE), which accounts only for water erosion.

Studies performed at the INEL indicate that:

- Wind erosion of a surface covering is not likely to be significant, given that historically the area is subject to aggregation of soil.
- A more site-specific estimate of erosion can be established by using the USLE (as recommended by EPA) for capping design alternatives.

EPA guidance suggests that vegetation should be the first choice for surface covering for erosion control, if it can be demonstrated that a vegetated cover can meet the EPA recommended maximum loss rate of 2 tons/acre/year. If not, alternative surface covers should be evaluated. Gravel or cobble surface covers have been used with vegetation at arid sites to improve vegetation success and reduce erosion.

6.2 Radiological Performance Assessment

Any proposed design must meet the quantitative radiological performance objectives. Performance assessment modeling is required to determine the soil cover thickness needed to reduce radiological exposure to less than the prescribed levels.

Closure cover performance objectives and design guidance are provided by DOE, EPA, and the Nuclear Regulatory Commission (NRC). EPA offers performance objectives and design guidance for LLW and hazardous waste closure covers, while DOE and NRC offer performance objectives for LLW. Some INEL sites contain LLW mixed with transuranic waste (TRU) and RCRA-hazardous wastes.

Mixed waste closures are subject to RCRA authority for the hazardous waste component and to DOE orders for the LLW component. RCRA and DOE guidance do not conflict significantly. Where there is ambiguity, the more stringent guidance should be followed. NRC and joint NRC-EPA performance objectives and design guidance are included for comparison and to address topics not covered in detail by EPA or DOE.

EPA performance objectives for closure covers for hazardous waste landfills are given in 40 CFR 264.310 (permitted facilities) and 265.310 (interim status facilities). Other EPA guidance concerning radionuclide exposure include 40 CFR 61 (air) 40 CFR 141 (drinking water).

DOE performance objectives for LLW disposal units are defined in DOE Order 5820.2A, Chapter III, "Management of Low-Level Waste" and in DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

NRC requirements for land disposal of LLW are given in 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." These regulations are not binding on DOE. However, they are potentially useful for purposes of comparison. NRC LLW land disposal facilities must be sited, designed, operated, closed, and controlled to meet the specified objectives.

7. REFERENCE REQUIREMENTS

7.1 Purpose and Scope

The purpose of reference requirements is to provide general requirements DOE should consider when developing or evaluating technologies for INEL remediation problems. These requirements include specific RCRA waste stream classifications, identification of hazardous constituents in waste regulated under RCRA, and concentrations at which waste must be managed as hazardous.

Best Demonstrated and Available Technologies (BDATs) for waste treatment are provided in this document and are intended to be used as reference only. There is no de minimus criteria established for the release of radiologically contaminated media or debris. However, release levels and concentrations are discussed in EGG-2400 listed below. This information is necessary to determine the applicability of certain treatment technologies and disposal options.

7.2 Derivation of Reference Requirements

Reference requirements include Federal regulations, State statutes, and DOE/State agreements, DOE Orders and INEL documents. Generally, reference requirements are derived from the following standards:

- DOE/State agreements (e.g., Federal Facility Agreement and Consent Order (FFA/CO)) which establishes the schedule and provides criteria for the identification of Applicable or Relevant and Appropriate Requirements (ARARs) for cleanup activities at the INEL under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- 40 CFR, Parts 262 and 268, "Resource Conservation and Recovery Act" (RCRA) which will likely be identified as ARARs for hazardous waste identification requirements and the minimum, concentration based, technology expressed treatment standards and best demonstrated available technologies for treatment of hazardous and mixed wastes (radioactive-hazardous).
- 10 CFR radiological control requirements, which drive the handling and disposal standards for nonhazardous radioactive wastes.
- DOE Orders and INEL documents, (e.g., DOE 5400.5, "Radiation Protection of the Public and Environment," EGG-2400, "The development of Criteria for Release of Idaho National Engineering Laboratory Sites Following Decontamination and Decommissioning) which establish the methodology used by the INEL and other DOE facilities to protect members of the public and the environment against undue risk from radiation.

7.3 FFA/CO Schedule and Release Requirements

7.3.1 Window of Opportunity

The window of opportunity was derived to establish the relative timeframe for each identified problem that could be used for technology development. The FFA/CO identifies dates that the summary reports will be completed for each OU.

For the purpose of this document, references to ARARs is limited to RCRA Subtitle C requirements for characterization, treatment, and disposal of hazardous/mixed waste. It is not intended to imply that other ARARs (e.g., Clean Water Act, Safe Drinking Water Act, Toxic Substances Control Act, Clean Air Act, TBCs, etc.) do not apply to the cleanup activities identified in this document. Reference requirements are provided as a general application to each operating unit and are intended for use as a limited measure of guidance.

7.3.2 Regulatory Level

The specific conditions of each site (e.g., sampling and analysis data, characterization reports, etc.) are required to ascertain a comprehensive applicability to all of the regulatory requirements (ARARs). Note that agency/facility agreements under the Record of Decision (ROD) establish cleanup levels and certain applicability of ARARs.

Once the specific characteristics of the waste being generated have been identified, and the waste is found to meet the LDR waste criteria, there are options provided in the regulations allowing, under certain conditions, relief from specified treatment standards or technologies. This relief may be obtained through treatability variances (40 CFR 268.44) or through the delisting process (40 CFR 260.22).

7.3.3 Identification of ARARs Pertaining to RCRA

Other than being useful in ROD development, the importance of initially identifying the ARARs pertaining to RCRA in regard to technology development is to establish to what degree a treatment technology must mandate that specific technology-based or concentration-based treatment standards are to be met prior to land disposing of CERCLA generated hazardous/mixed hazardous wastes. If waste generated from remediation activities is not treated to meet these specific standards, the disposal options for that waste may become very limited (if radiological components are involved in a RCRA waste stream, disposal options are significantly diminished). In many cases, a hazardous waste may be treated in such a manner that it exits RCRA Subtitle C regulation, making disposal simple even where waste is radiologically contaminated. In other cases, even though treated, a RCRA listed waste (e.g., incinerator ash) may meet the treatment standards, however, it typically keeps the listed hazardous waste code and must be land disposed at a RCRA Subtitle C facility.

8. Evaluation of Identified Technologies

8.1 Introduction

The purpose of this section is to evaluate the technologies identified as applicable at the INEL. This summarization of technology application and status is shown in Tables A-1 and A-2 of Appendix A. These tables include (a) the number of times a technology was identified as applicable and the location at the INEL, (b) the volume of media/waste in m³ that the technology would address at the INEL, (c) the status of the technology, (d) the technology ranking, and (e) the number of times that the technology was identified as the preferred technology.

8.2 Technology Ranking

A relative ranking has been assigned to each technology identified. The methodology used is based on three criteria: (a) the total number of times that the technology was identified as applicable, (b) the total volume of waste that the technology was applicable to, and (c) the number of times that the technology was identified as a preferred technology. The development status of the technology was not considered in establishing its rank. However, status information for each technology is provided in Table A-1 of Appendix A.

Each technology is designated as either high (H), medium (M), or low (L) and is presented in Table 2. The rank of the technology is based upon meeting any one of the three criteria provided. (Note: There are 10 technologies identified in the "general" section of characterization only, although these technologies are not included in the ranking process but are identified in Table A-1 with a ranking of N/A.)

A technology which has a demonstration, testing, and evaluation (DT&E) need or research and development (R&D) need may also be found to have a high ranking. This provides a basis for establishing which technologies to consider for further development.

Table 2. Technology rankings.

Rank	Times applicable	Media volume (M ³)	Times preferred
High (H)	>20	>200,000	>20
Medium (M)	4 to 20	>50,000–<200,000	1 to 20
Low (L)	<4	<50,000	0

Appendix A

Technology Application Tables

TECHNOLOGY RANKING SUMMARY

INEL TLD TABLE 1

Table A-1. Technology ranking summary.

TECHNOLOGY CATEGORY	TEDS CODE	*STATUS	OPTION APPLIED	OPTION PREFERRED	**MEDIA VOLUME	RANK (H M L)
CHARACTERIZATION						
ANNULAR DENUDER TECHNOLOGY	CHAR 64A-IN	A	GEN	GEN	N/A	
ARTIFICIAL INTELLIGENCE/NEURAL NETWORK	CHAR 22-IN	DTE	GEN	GEN	N/A	
ATOMIC ADSORPTION SPECTROSCOPY (AA,AE)	CHAR 76-IN	A	9	1	100890	M
AUGER ELECTRON SPECTROSCOPY (AES)	CHAR 2-IN	A	14	0	350048	H
AUTOCORRELATION OPTIMIZED ANALYSIS	CHAR 29-IN	DTE	0	0	0	L
COLD VAPOR (MERCURY)	CHAR 24-IN	A	8	0	99388	M
CONTINUOUS AIR MONITORING	CHAR 59-IN	A	GEN	GEN	N/A	
COLLECTIONS	CHAR 72-IN	A	GEN	GEN	N/A	
DIRECT SAMPLING ION TRAP MASS SPECTROMETRY	CHAR 90-IN	DTE	7	0	439455	H
METHODS	CHAR 125-IN	DTE	32	10	642334	H
ELECTRON DIFFRACTION (ED, SAED, LEED)	CHAR 37-IN	A	15	0	350048	H
ELECTRON SPECTROSCOPY/CHEMICAL ANALYSIS	CHAR 1-IN	A	17	0	350573	H
FIBER OPTIC CAMERA SYSTEMS	CHAR 122-IN	A	0	0	0	L
FIBER OPTIC CHEMICAL SENSORS	CHAR 25-IN	DTE	0	0	0	L
FLUORESCENCE	CHAR 92-IN	RD	14	0	350048	H
GAS CHROMATOGRAPHY (GID, IC, TC)	CHAR 100-IN	A	1	0	76	L
GAS CHROMATOGRAPHY-MASS SPECTROMETRY	CHAR 88-IN	A	11	0	447395	H
GROUND PENETRATING RADAR	CHAR 124-IN	A	33	6	642939	H
HADAMARD MASKING FOR SPATIAL RESOLUTION	CHAR 28-IN	DTE	GEN	GEN	N/A	
IMMUNOASSAY (PCB)	CHAR 99-IN	DTE	1	0	76	L
EMITTERS	CHAR 51-IN	A	39	26	528220	H
IN SITU PASSIVE MONITORS	CHAR 102-IN	DTE	35	3	530120	H
SPECTROMETRY	CHAR 78-IN	A	8	0	99458	M
(ICP)	CHAR 77-IN	A	8	1	99466	M
INFRARED ANALYSIS OF WASTES	CHAR 136-IN	DTE	1	0	1424	L
ION CHROMATOGRAPHY (IC)	CHAR 50-IN	A	6	0	620	L
ISOTOPE DILUTION MASS SPECTROMETRY (IDMS)	CHAR 48-IN	A	5	0	99316	M
LASER ABLATION-DIAGNOSING	CHAR 86-IN	DTE	27	0	190125	H
LASER ABLATION-INDUCTIVELY COUPLED PLASMA	CHAR 111-IN	DTE	6	0	99388	M
LASER SCATTERING PARTICLE SIZE ANALYSIS	CHAR 26-IN	A	GEN	GEN	N/A	
LIQUID SCINTILLATION COUNTING	CHAR 129-IN	A	38	0	530089	H
MAGNETICS	CHAR 128-IN	A	32	0	642334	H
CONCENTRATION	CHAR 55-IN	DTE	0	0	0	L

*A-ACCEPTED; DTE-DEMONSTRATION/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED;

**CONCRETE, SOIL, DEBRIS, LIQUID, SLUDGE;

#-RANK CONTAMINANT SPECIFIC; GEN-GENERAL APPLICATION

TECHNOLOGY RANKING SUMMARY

INEL TLD TABLE 1

Table A-1. (continued).

TECHNOLOGY CATEGORY	TEDS CODE	*STATUS	OPTION APPLIED	OPTION PREFERRED	**MEDIA VOLUME	RANK (H M L)
METALLOGRAPHIC SAMPLE PREPARATION	CHAR 67-IN	A	33	1	529015	H
MICROGRAVITY METHODS	CHAR 127-IN	DTE	2	0	121424	M
MICROWAVE DIGESTION	CHAR 19-IN	A	51	2	631066	H
MULTI-ANGLE DRILLING	CHAR 64-IN	DTE	2	0	0	L
NaI GAMMA SPECTROSCOPY	CHAR 106-IN	A	37	4	530121	H
NaI GAMMA SPECTROSCOPY	CHAR 112-IN	A	37	4	530121	H
NEUTRON ACTIVATION	CHAR 107-IN	A	GEN	GEN	N/A	
OPTIMIZATION OF SAMPLING DESIGNS	CHAR 71-IN	DTE	50	0	300881	H
ORGANIC VAPOR MONITORING	CHAR 5-IN	A	5	0	439427	H
PROPORTIONAL COUNTING	CHAR 108-IN	A	39	0	530915	H
PUNCH CORES	CHAR 83-IN	A	34	23	528225	H
SAMPLING AND MIXING METHODS	CHAR 81-IN	A	61	11	639612	H
SECONDARY ION MASS SPECTROMETRY (SIMS)	CHAR 135-IN	DTE	1	0	0	L
SEISMIC METHODS	CHAR 126-IN	DTE	2	0	121424	M
SMALL LONG-RANGE ALPHA DETECTION (LRAD)	CHAR 65-IN	DTE	GEN	GEN	N/A	
STATISTICAL METHODS/CORRELATED DATA	CHAR 75-IN	A	2	0	112	L
SUBSURFACE COMPLEXATION	CHAR 45-IN	DTE	35	0	530089	H
SUPERCRITICAL FLUID EXTRACTION-MGS	CHAR 115-IN	RD	5	0	7934	M
EXTRACTION	CHAR 62-IN	RD	35	0	529015	H
VISUAL DISPLAY OF STATISTICAL INFORMATION	CHAR 73-IN	DTE	GEN	GEN	N/A	
WASTE CURIE MONITORING (SEMI-LAB)	CHAR 109-IN	A	GEN	GEN	N/A	
WAVELENGTH DISPERSIVE X-RAY SPECTROSCOPY	CHAR 66-IN	A	3	0	350048	L
X-RAY DIFFRACTION	CHAR 31-IN	A	15	0	100808	H
X-RAY FLUORESCENCE	CHAR 6-IN	A	7	0	100808	M
X-RAY FLUORESCENCE	CHAR 98-IN	A	7	0	529630	M
RETRIEVAL						
CONTAINMENT STRUCTURES	RETR CNT-001	A	41	0	27783	H
HYDRAULIC-POWERED SHEAR ATTACHMENT	RETR SR-001	A	19	2	34	M
MANUAL VAPOR VACUUM	RETR VAC-001	A	1	0	542135	L
MANUALLY OPERATED BACKHOE	RETR ME-003	A	62	50	27068	H
MANUALLY OPERATED CONCRETE SAW	RETR SR-002	A	16	0	25548	M
MANUALLY OPERATED DOZER	RETR ME-005	A	20	0	25548	M
MANUALLY OPERATED EXCAVATOR	RETR ME-001	A	52	3	543515	H
MANUALLY OPERATED HYDRAULIC RAM	RETR SR-003	A	18	0	27749	M

*A-ACCEPTED; DTE-DEMONSTRATION/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED;

**CONCRETE, SOIL, DEBRIS, LIQUID, SLUDGE;

#-RANK CONTAMINANT SPECIFIC; GEN-GENERAL APPLICATION

TECHNOLOGY RANKING SUMMARY

INEL TLD TABLE 1

Table A-1. (continued).

TECHNOLOGY CATEGORY	TEDS CODE	*STATUS	OPTION APPLIED	OPTION PREFERRED	**MEDIA VOLUME	RANK (H M L)
MANUALLY OPERATED MOTOR GRADER	RETR ME-004	A	17	0	24377	M
MANUALLY OPERATED SCABBLER	RETR SCA-001	A	18	0	27749	M
MANUALLY OPERATED TRENCHER	RETR ME-006	A	1	0	2294	L
TELEOPERATED EXCAVATION EQUIPMENT	RETR RE-001	DTE	35	3	529029	H
BIOLOGICAL AND CHEMICAL						
BIOACCUMULATION	BICH IL-BA	DTE	0	0	1	L
BIOACCUMULATION	BICH IL-BA2	DTE	1	0	22	L
BIOPRECIPITATION	BICH IL-BP	DTE	1	0	7	L
BIOPRECIPITATION	BICH IL-BP2	DTE	0	0	0	L
CHEMICAL PRECIPITATION	BICH I-CP	RD#	7	0	664	L
CHEMICAL WASHING	BICH I-CW	RD#	16	0	152955	M
CHEMICAL WASHING	BICH I-CW2	RD#	18	0	367682	H
CHEMICAL WASHING	BICH I-CW2B	RD#	4	0	11516	M
DIRECT BIOLOGICAL LEACHING	BICH I-DBL	DTE#	18	0	152991	M
DIRECT BIOLOGICAL LEACHING	BICH I-DBL2	DTE	16	0	367646	H
DIRECT BIOLOGICAL LEACHING	BICH I-DBL2B	DTE	4	0	11516	M
INDIRECT BIOLOGICAL LEACHING	BICH I-IBL	DTE#	16	0	152955	M
INDIRECT BIOLOGICAL LEACHING	BICH I-IBL2	DTE	18	0	367682	H
INDIRECT BIOLOGICAL LEACHING	BICH I-IBL2B	DTE	4	0	11516	M
LANDFARMING	BICH O-LFM	DTE	6	0	9542	M
PLANT UPTAKE OF METALS/RADIONUCLIDES	BICH I-PUC	DTE	14	0	152587	M
PLANT UPTAKE OF METALS/RADIONUCLIDES	BICH I-PUC2	DTE	10	0	27152	M
PLANT UPTAKE OF METALS/RADIONUCLIDES	BICH I-PUC2B	DTE	4	0	11516	M
SLURRY/LIQUID BIODENTRIFICATION	BICH NO3-B	DTE	1	0	451	L
SLURRY/LIQUID BIOREMEDIATION	BICH O-SB	DTE	11	0	9734	M
SLURRY/LIQUID BIOREMEDIATION	BICH O-SB2	DTE	6	0	341348	H
SUBSURFACE BIOREMEDIATION	BICH O-SSB	DTE	7	0	9483	M
CHEMICAL WASHING	BICH-016	RD	2	0	7820	L
CHEMICAL WASHING (Cs & Sr)	BICH-012	RD	7	0	3306	M
CHEMICAL WASHING (Cs)	BICH-011	RD	11	0	173709	M
CHEMICAL WASHING (Cs, Sr, & Pu)	BICH-004	RD	1	0	0	L
CHEMICAL WASHING (Cr)	BICH-005	RD	2	0	494	L
CHEMICAL WASHING (Cr, Hg, & Beryllium)	BICH-013	RD	2	0	10	L
CHEMICAL WASHING (Cr, Hg, & Beryllium)	BICH-014	RD	1	0	5	L

*A-ACCEPTED; DTE-DEMONSTRATION/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED;

**CONCRETE, SOIL, DEBRIS, LIQUID, SLUDGE;

#-RANK CONTAMINANT SPECIFIC; GEN-GENERAL APPLICATION

TECHNOLOGY RANKING SUMMARY

INEL TLD TABLE 1

Table A-1. (continued).

TECHNOLOGY CATEGORY	TEDS CODE	*STATUS	OPTION APPLIED	OPTION PREFERRED	**MEDIA VOLUME	RANK (H M L)
CHEMICAL WASHING (Co & Cs)	BICH-009	RD	1	0	5	L
CHEMICAL WASHING (Co, Cs, & Hg)	BICH-025	DTE	1	0	9175	L
CHEMICAL WASHING (Co, Cs, & Hg))	BICH-026	RD	1	0	74	L
CHEMICAL WASHING (Co, Cs, & Sr))	BICH-001	RD	2	0	1923	L
CHEMICAL WASHING (Hg)	BICH-007	RD	2	0	111	L
CHEMICAL WASHING - PCB'S	BICH-030	DTE	1	0	76	L
COLD DILUTE POTASSIUM HYDROXIDE	BICH-032	RD	1	0	0	L
DILUTE NITRIC ACID WASH	BICH-020	RD	5	0	5	M
DILUTE NITRIC ACID WASH - LEAD	BICH-035	RD	1	0	30	L
HOT NITROGEN STRIPPING	BICH-031	RD	1	0	270000	H
AMALGAM ELECTROWINNING	BICH-017	RD	1	0	111	L
NITRIC ACID/EDTA WASH	BICH-017A	RD	1	0	111	L
SODIUM BICARBONATE WASH	BICH-023	DTE	1	0	2339	L
SURFACTANT WASH	BICH-024	RD	1	0	38	L
SURFACTANT WASH/DILUTE NITRIC ACID	BICH-034	RD	3	0	368	L
THERMAL/PHYSICAL TREATMENT						
AMALGAMATION	T/P PA-01	DTE	10	1	232187	H
ANAEROBIC THERMAL PROCESSOR	T/P TD-07	A	7	0	342696	H
CEMENTITIOUS	T/P PSS-01	A#	17	6	562800	H
CENTRIFUGAL SEPARATION	T/P PG-01	A	1	0	4	L
CO2 BLASTING	T/P PB-01	A	14	0	2470	M
CONTROLLED AIR INCINERATION	T/P TI-01	A	4	0	405	L
CRUSHER PLANT	T/P CR-001	A	1	0	24	L
EVAPORATION	T/P PE-01	A	3	1	7	L
EXTERNALLY FIRED ROASTER (XTRAX)	T/P TD-04	A#	15	2	232780	H
IN SITU AUGER INJECTION	T/P PSS-03	DTE	2	0	9249	L
INDIRECT HEAT SCREW CONVEYOR	T/P TD-06	A	7	0	342696	H
INDUSTRIAL BOILER	T/P TI-05	A	2	0	212	L
LIQUID INJECTION COMBUSTOR	T/P TI-04	A#	7	0	219562	H
MINIMUM ADDITIVE WASTE STABILIZATION	T/P PF-02	RD	4	0	147	M
POLYMER SOLIDIFICATION	T/P PSS-02	A	3	0	340106	H
ROTARY KILN INCINERATION	T/P TI-02	A	3	0	340312	H
ROTARY KILN-DIRECT	T/P TD-02	A	8	2	1276	M
ROTARY KILN-INDIRECT	T/P TD-03	A	4	1	1729	M

*A-ACCEPTED; DTE-DEMONSTRATION/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED;

**CONCRETE, SOIL, DEBRIS, LIQUID, SLUDGE;

#-RANK CONTAMINANT SPECIFIC; GEN-GENERAL APPLICATION

A-6

TECHNOLOGY RANKING SUMMARY

INEL TLD TABLE 1

Table A-1. (continued).

TECHNOLOGY CATEGORY	TEDS CODE	*STATUS	OPTION APPLIED	OPTION PREFERRED	**MEDIA VOLUME	RANK (H M L)
SAND BLASTING	T/P PB-03	A	13	0	2470	M
SCREENING AND SORTING METHODS	T/P PSR-01	A#	4	2	340146	H
SOIL WASHING	T/P PSW-01	RD#	41	35	540124	H
SUPER CRITICAL WATER OXIDATION	T/P TO-02	RD	10	0	559683	H
VAPOR VACUUM EXTRACTION	T/P PVV-01	A	4	1	9391	M
WATER BASED REACTIVE PLASMA	T/P PF-01	RD	3	0	480	L
WATER CRYSTAL (ICE) BLASTING	T/P PB-02	A	13	0	2470	M
WET AIR OXIDATION	T/P TO-01	RD	1	0	95	L
CAPS AND BARRIERS						
CAPS	CAPS CB-01	A	20	0	248832	H
WATER BALANCE CAPS	CAPS CB-02	DTE	20	0	248832	H

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*A-ACCEPTED; DTE-DEMONSTRATION/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED;
 **CONCRETE, SOIL, DEBRIS, LIQUID, SLUDGE;
 #-RANK CONTAMINANT SPECIFIC; GEN-GENERAL APPLICATION

Table A-2. INEL technology application data sheet.

Table 2.		STATUS*	OPTION APPLIED	OPTION PREFERRED	OU 1-03									
TEDS CODE	TECHNOLOGY OPTION				TSF-03	TSF 38	WRRTE-01	LOFT-02	TSF-46	TSF 21	TAN V-1	TAN V-2	TAN V-3	TSF 26
	CHARACTERIZATION													
CHAR 64A-IN	ANNULAR DENUDER TECHNOLOGY (GENERAL)	A	N/A	N/A										
CHAR 22-IN	ARTIFICIAL INTELLIGENCE/NEURAL NETWORK (GENERAL)	DTE	N/A	N/A										
CHAR 76-IN	ATOMIC ADSORPTION SPECTROSCOPY (AA-AE)	A	9	1		P	X							
CHAR 2-IN	AUGER ELECTRON SPECTROSCOPY (AES)	A	14	0							X	X	X	
CHAR 29-IN	AUTOCORRELATION OPTIMIZED MULTIVARIANT ANALYSIS	DTE	1	0										
CHAR 24-IN	COLD VAPOR (MERCURY)	A	8	0		X	X							
CHAR 59-IN	CONTINUOUS AIR MONITORING (GENERAL)	A	N/A	N/A										
CHAR 72-IN	DATABASE MANAGEMENT FOR LARGE DATA COLLECTIONS (GENERAL)	A	N/A	N/A										
CHAR 90-IN	DIRECT SAMPLING ION TRAP MASS SPECTROMETRY (DSITMS)	DTE	7	0		X	X							
CHAR 125-IN	ELECTRICAL AND ELECTROMAGNETIC (EM) METHODS	DTE	32	0					P	X	P	P	P	P
CHAR 37-IN	ELECTRON DIFFRACTION (ED, SAED, I EED)	A	15	0							X	X	X	X
CHAR 1-IN	ELECTRON SPECTROSCOPY FOR CHEMICAL ANALYSIS (ESCA)	A	17	0							X	X	X	X
CHAR 122-IN	FIBER OPTIC CAMERA SYSTEMS	A	1	0										
CHAR 25-IN	FIBER OPTIC CHEMICAL SENSORS	DTE	1	0										
CHAR 92-IN	FLUORESCENCE	RD	14	0							X	X	X	X
CHAR 100-IN	GAS CHROMATOGRAPHY (GID, IC, TC)	A	1	0										
CHAR 88-IN	GAS CHROMATOGRAPHY-MASS SPECTROMETRY (GC-MS)	A	11	0		X	X							
CHAR 124-IN	GROUND PENETRATING RADAR	A	31	6					X	X	X	X	X	X
CHAR 28-IN	HADAMARD MASKING FOR SPATIAL RESOLUTION (GENERAL)	DTE	N/A	N/A										
CHAR 99-IN	IMMUNOASSAY (PCB)	DTE	1	0										
CHAR 51-IN	IN SITU MEASUREMENT OF BETA/GAMMA EMITTERS	A	19	26					X	X	X	X	X	X
CHAR 102-IN	IN SITU PASSIVE MONITORS-SURFACE CONTAMINATION BY WEAK BETA RADIONUCLIDES	DTE	15	3					P	X	X	X	X	P
CHAR 78-IN	INDUCTIVELY-COUPLED PLASMA MASS SPECTROMETRY (ICP-MS)	A	8	0		X	X							
CHAR 77-IN	INDUCTIVELY-COUPLED PLASMA SPECTROSCOPY (ICP)	A	8	1		X	P							
CHAR 136-IN	INFRARED ANALYSIS OF WASTES	DTE	1	0										
CHAR 50-IN	ION CHROMATOGRAPHY (IC)	A	6	0		X	X							
CHAR 46-IN	ISOTOPIC DILUTION MASS SPECTROMETRY (IDMS)	A	5	0		X								
CHAR 86-IN	LASER ABLATION-DIAGNOSING METALS AND RADIONUCLIDES	DTE	27	0					X	X				
CHAR 111-IN	LASER ABLATION-INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROSCOPY	DTE	6	0		X	X							
CHAR 24-IN	LASER SCATTERING PARTICLE SIZE ANALYSIS (GENERAL)	A	N/A	N/A										
CHAR 129-IN	LIQUID SCINTILLATION COUNTING	A	38	0					X	X	X	X	X	X
CHAR 128-IN	MAGNETICS	A	12	0					X	X	X	X	X	X
CHAR 55-IN	MEMBRANE TECHNOLOGY FOR SAMPLE COLLECTION AND CONCENTRATION	DTE	1	0										
CHAR 67-IN	METALLOGRAPHIC SAMPLE PREPARATION	A	33	1					P	X				
CHAR 127-IN	MICROGRAVITY METHODS	DTE	2	0										
CHAR 19-IN	MICROWAVE DIGESTION	A	51	2		X	X	X	X	X	X	X	X	X
CHAR 64-IN	MULTI-ANGLE DRILLING	DTE	2	0										
CHAR 106-IN	NaI GAMMA SPECTROSCOPY	A	17	4					X	X	P	P	P	P
CHAR 112-IN	NaI GAMMA SPECTROSCOPY	A	37	4					X	X	P	P	P	P
CHAR 107-IN	NEUTRON ACTIVATION (SEMI-LAB) (GENERAL)	A	N/A	N/A										
CHAR 71-IN	OPTIMIZATION OF SAMPLING DESIGNS	DTE	50	0		X	X	X	X	X	X	X	X	X
CHAR 5-IN	ORGANIC VAPOR MONITORING	A	5	0										
CHAR 108-IN	PROPORTIONAL COUNTING	A	39	0					X	X	X	X	X	X
CHAR 83-IN	PUNCH CORES	A	34	21					X	X				
CHAR 81-IN	SAMPLING AND MIXING METHODS	DTE	61	11		X	X	P	X	X	X	X	X	X
CHAR 135-IN	SECONDARY ION MASS SPECTROMETRY (SIMS)	DTE	1	0										
CHAR 126-IN	SEISMIC METHODS (REFRACTION, PROFILING, REFLECTION)	DTE	2	0										
CHAR 65-IN	SMALL LONG-RANGE ALPHA DETECTION (LRAD) (GENERAL)	DTE	N/A	N/A										
CHAR 75-IN	STATISTICAL METHODS FOR SPATIALLY CORRELATED DATA	A	2	0										
CHAR 45-IN	SUBSURFACE COMPLEXATION	DTE	35	0					X	X	X	X	X	X
CHAR 115-IN	SUPERCritical FLUID EXTRACTION-MULTIDETECTOR GAS CHROMATOGRAPHY (SFE-GC)	RD	5	0		X								
CHAR 62-IN	VACUUM ASSISTED REVERSE FLOW SOLVENT EXTRACTION METHODS	RD	35	0					X	X				
CHAR 73-IN	VISUAL DISPLAY OF STATISTICAL INFORMATION (GENERAL)	DTE	N/A	N/A										
CHAR 109-IN	WASTE CURIE MONITORING (SEMI-LAB) (GENERAL)	A	N/A	N/A										
CHAR 66-IN	WAVELENGTH DISPERSIVE X-RAY SPECTROSCOPY (WDS WDX)	A	1	0		X	X							
CHAR 31-IN	X-RAY DIFFRACTION	A	15	0							X	X	X	X
CHAR 6-IN	X-RAY FLUORESCENCE	A	7	0		X	X							
CHAR 98-IN	X-RAY FLUORESCENCE	A	7	0		X	X							

A=ACCEPTED, DTE=DEMONSTRATED/TESTING/EVALUATION NEEDED, RD=RESEARCH/DEVELOPMENT NEEDED, #RANK VARIES WITH CONTAMINANT, X=TECHNOLOGY IDENTIFIED AS APPLICABLE TO REMEDIATION SITE, P=PREFERRED TECHNOLOGY

Table A-2. (continued).

Table 2.								OU 1-03		OU 1-04	OU 1-05				OU 1-06	
TEDS CODE	TECHNOLOGY OPTION	STATUS*	OPTION APPLIED	OPTION PREFERRED	TSF-03	TSF-38	WRTF-01	LOFT-02	TSF-06	TSF-21	TAN V-1	TAN V-2	TAN V-3	TSF-26	LOFT-01	TSF-07
RETRIEVAL																
RETR CTMNT-001	CONTAINMENT STRUCTURES	A	41	0				X		X						X
RETR SR-001	HYDRAULIC POWERED SHEAR ATTACHMENT (UTILIZED WITH BACKHOE)	A	19	2					P	X						
RETR VAC-001	MANUAL VAPOR VACUUM	A	1	0		X										
RETR ME-003	MANUALLY OPERATED BACKHOE	A	62	50	P	X	P	P	X	P	X	X	X	X	P	X
RETR SR-002	MANUALLY OPERATED CONCRETE SAW	A	16	0					X							
RETR ME-005	MANUALLY OPERATED DOZER	A	20	0				X	X							X
RETR ME-001	MANUALLY OPERATED EXCAVATOR	A	52	1	X	X	X	X	P	X						P
RETR SR-003	MANUALLY OPERATED HYDRAULIC RAM	A	18	0					X	X						
RETR ME-004	MANUALLY OPERATED MOTOR GRADER	A	17	0				X	X							X
RETR SCA-001	MANUALLY OPERATED SCABBLER	A	18	0					X	X						
RETR ME-006	MANUALLY OPERATED TRENCHER	A	1	0												
RETR RE-001	TELEOPERATED EXCAVATION EQUIPMENT	DTE	35	1	X	P			X	X						X
BIOLOGICAL AND CHEMICAL																
BICH IL-BA	BIOACCUMULATION	DTE	2	0												
BICH IL-BA2	BIOACCUMULATION	DTE	1	0												
BICH IL-BP	BIOPRECIPITATION	DTE	1	0												
BICH IL-BP2	BIOPRECIPITATION	DTE	1	0												
BICH I-CP	CHEMICAL PRECIPITATION	RD#	7	0							X	X	X			
BICH I-CW	CHEMICAL WASHING	RD#	16	0	X		X		X							
BICH I-CW2	CHEMICAL WASHING	RD#	18	0												
BICH I-CW2B	CHEMICAL WASHING	RD#	4	0				X								
BICH I-DBL	DIRECT BIOLOGICAL LEACHING	DTE#	18	0	X		X		X							
BICH I-DBL2	DIRECT BIOLOGICAL LEACHING	DTE	16	0												
BICH I-DBL2B	DIRECT BIOLOGICAL LEACHING	DTE	4	0				X								
BICH I-IBL	INDIRECT BIOLOGICAL LEACHING	DTE#	16	0	X		X		X							
BICH I-IBL2	INDIRECT BIOLOGICAL LEACHING	DTE	18	0												
BICH I-IBL2B	INDIRECT BIOLOGICAL LEACHING	DTE	4	0				X								
BICH I-O-LFM	LANDFARMING	DTE	6	0		X										X
BICH I-PUC	PLANT UPTAKE OF METALS/RADIONUCLIDES	DTE	14	0					X							
BICH I-PUC2	PLANT UPTAKE OF METALS/RADIONUCLIDES	DTE	10	0												
BICH I-PUC2B	PLANT UPTAKE OF METALS/RADIONUCLIDES	DTE	4	0					X							
BICH NO3-B	SLURRY/LIQUID BIODENTRIFICATION	DTE	1	0												
BICH O-SB	SLURRY/LIQUID BIOREMEDIATION	DTE	11	0		X										X
BICH O-SB2	SLURRY/LIQUID BIOREMEDIATION	DTE	6	0	X		X									
BICH O-SSB	SUBSURFACE BIOREMEDIATION	DTE	7	0		X										X
BICH-001	CHEMICAL WASHING (COBALT, CESIUM, & STRONTIUM)	RD	2	0					X	X						
BICH-004	CHEMICAL WASHING (CESIUM, STRONTIUM, & PLUTONIUM)	RD	1	0												
BICH-005	CHEMICAL WASHING (CHROMIUM)	RD	2	0												
BICH-007	CHEMICAL WASHING (MERCURY)	RD	2	0												
BICH-009	CHEMICAL WASHING (COBALT & CESIUM)	RD	1	0												
BICH-011	CHEMICAL WASHING (CESIUM)	RD	11	0												
BICH-012	CHEMICAL WASHING (CESIUM & STRONTIUM)	RD	7	0												
BICH-013	CHEMICAL WASHING (CHROMIUM, MERCURY, & BERYLLIUM)	RD	2	0												
BICH-014	CHEMICAL WASHING (CHROMIUM, MERCURY, & BERYLLIUM)	RD	1	0												
BICH-016	CHEMICAL WASHING - ORGANICS	RD	2	0												X
BICH-017	AMALGAM ELECTROWINNING	RD	1	0												
BICH-017A	NITRIC ACID/EDTA WASH	RD	1	0												
BICH-020	DILUTE NITRIC ACID WASH	RD	5	0					X							
BICH-023	SODIUM BICARBONATE WASH	DTE	1	0												
BICH-024	SURFACTANT WASH	RD	1	0												
BICH-025	CHEMICAL WASHING (COBALT, CESIUM, & MERCURY)	DTE	1	0												
BICH-026	CHEMICAL WASHING (COBALT, CESIUM, & MERCURY)	RD	1	0												
BICH-030	CHEMICAL WASHING - PCB'S	DTE	1	0												
BICH-031	HOT NITROGEN STRIPPING	RD	1	0												
BICH-032	COLD DILUTE POTASSIUM HYDROXIDE	RD	1	0												
BICH-034	SURFACTANT WASH/DILUTE NITRIC ACID	RD	3	0	X		X									
BICH-035	DILUTE NITRIC ACID WASH - LEAD	RD	1	0												

A ACCEPTED DTE DEMONSTRATED/TESTING/EVALUATION NEEDED RD RESEARCH/DEVELOPMENT NEEDED * RANK VARIES WITH CONTAMINANT
 X TECHNOLOGY IDENTIFIED AS APPLICABLE TO REMEDIATION SITE P PREFERRED TECHNOLOGY

INEL TLD Table 2

3-12		OU 2-05																								OU 2-07																								OU 2-09																								OU 3-06																								OU 3-09																								OU 3-11																								OU 3-12																								OU 3-13																								OU 4-05																								OU 4-06																								OU 4-09																								OU 4-12																								OU 5-12																								OU 7-08																								OU 7-13																								OU 10-03																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
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X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																																																											

Table A-2. (continued).

Table 2.					OU 1-01	OU 1-04	OU 1-05	OU 1-06								
TEDS CODE	TECHNOLOGY OPTION	STATUS*	OPTION APPLIED	OPTION PREFERRED	TSF-03	TSF 38	WRRTI-01	LOFT-02	TSF-06	TSF 21	TAN V-1	TAN V-2	TAN V-3	TSF-26	LOFT-01	TSF-07
	THERMAL AND PHYSICAL															
T/P PA-01	AMALGAMATION	DTE	10	1				X							X	
T/P TD-07	ANAEROBIC THERMAL PROCESSOR	A	7	0	X	X	X	X								
T/P PSS-01	CEMENTITIOUS	A	17	6	X	P	X	X			P	P	P	P		
T/P PG-01	CENTRIFUGAL SEPARATION	A	1	0												
T/P PB-01	CO2 BLASTING	A	14	0					X						X	
T/P TI-01	CONTROLLED AIR INCINERATION	A	4	0												
T/P CR-001	CRUSHER PLANT	A	1	0						X						
T/P PE-01	EVAPORATION	A	3	1												
T/P TD-04	EXTERNALLY FIRED ROASTER (XTRAX)	A	15	2	X	X	X	X							X	X
T/P PSS-03	IN SITU AUGER INJECTION	DTE	2	0												X
T/P TD-06	INDIRECT HEAT SCREW CONVEYOR	A	7	0	X	X	X	X								
T/P TI-05	INDUSTRIAL BOILER	A	2	0												
T/P TI-04	LIQUID INJECTION COMBUSTOR	A	7	0												
T/P PF-02	MINIMUM ADDITIVE WASTE STABILIZATION (MAWS)	RD	4	0												
T/P PSS-02	POLYMER SOLIDIFICATION	A	3	0												
T/P TI-02	ROTARY KILN INCINERATION	A	3	0												
T/P TD-02	ROTARY KILN-DIRECT	A	8	2												
T/P TD-03	ROTARY KILN-INDIRECT	A	4	1												
T/P PB-03	SAND BLASTING	A	13	0					X							
T/P PSR-01	SCREENING AND SORTING METHODS	A	4	2		P										
T/P PSW-01	SOIL WASHING	RD	41	35	P		X	X	P	X					P	P
T/P TO-02	SUPER CRITICAL WATER OXIDATION	RD	10	0							X	X	X			
T/P PVV-01	VAPOR VACUUM EXTRACTION	A	4	1											X	
T/P PF-01	WATER BASED REACTIVE PLASMA	RD	3	0												
T/P PB-02	WATER CRYSTAL (ICE) BLASTING	A	13	0					X							
T/P TO-01	WET AIR OXIDATION	RD	1	0												
	CAPS AND BARRIERS															
CAPS CB-01	CAPS	A	20	0			X	X	X						X	X
CAPS CB-02	WATER BALANCE CAPS	DTE	20	0			X	X	X						X	X

A-ACCEPTED; DTE-DEMONSTRATED/TESTING/EVALUATION NEEDED; RD-RESEARCH/DEVELOPMENT NEEDED; #RANK VARIES WITH CONTAMINANT;
X-TECHNOLOGY IDENTIFIED AS APPLICABLE TO REMEDIATION SITE; P-PREFERRED TECHNOLOGY

INEL TLD Table 2

[illegible]

Appendix B
Description of INEL Problem Sites

Appendix B

Description of INEL Problem Sites

B-1. Description of WAG 1

This section provides a description of the Waste Area Group (WAG) 1 problem sites that have the potential to benefit from technology development and assessment. WAG 1 encompasses Test Area North (TAN), located at the Idaho National Engineering Laboratory (INEL). It includes the Technical Support Facility (TSF), Water Reactor Research Test Facility (WRRTF), Cask Testing Project, Loss-of-Fluid Test Facility (LOFT), Initial Engine Test Facility (IET), and Specific Manufacturing Capabilities Facility. WAG 1 is divided into 10 Operable Units (OUs) that consist of approximately 1,230,000 yd² of potentially contaminated soil over 125 acres, including Underground Storage Tanks (USTs), pits, ponds, and a railroad turntable. Hazardous, radioactive, and mixed wastes exist at WAG 1. In general, contaminant concentrations are in trace or very low levels for contaminated soils. Much higher concentrations are encountered in tank sludges.

OUs 1-01, 1-02, 1-08, and 1-09 are not being considered in this discussion because they have resulted in or are expected to result in a no further action recommendation and are not expected to benefit from technology development or evaluation. Likewise, OU 1-07A is not being considered because the Record of Decision (ROD) has been negotiated before the Technology Logic Diagram (TLD) publication date.

OU 1-03 has been designated a Track 2 OU in the Federal Facility Agreement/Consent Order (FFA/CO). It consists of two burn pits, gasoline spill from the TSF service station, and bottle site. Soil in the burn pits is contaminated with metals and organics, resulting from trash and waste solvent burning that occurred through the mid-1960s. Lead is the only metal detected and organics consist of heavy hydrocarbons.

The TSF bottle site consists of buried laboratory bottles. A few bottles have been excavated and were found to contain some metals and standard laboratory chemicals. The boundary of the burial area has not yet been determined.

TSF bottle site (TSF 38) has been transferred to OU 1-10.

Waste Type: Hazardous—organics (any metal or laboratory chemical)

Waste Form: Debris (glass and plastics)

Source Volume: 4.2 m³

Waste Type: Hazardous—organics (any metal or laboratory chemical)

Waste Form: Soil

Source Volume: 30 m³

TSF burn pit (TSF-03) has been transferred to OU 1-10.

Waste Type: Hazardous—metals, organics (heavy hydrocarbons)

Waste Form: Soil
Source Volume: 76 m³

WRRTF burn pit (WRRTF-01) has been transferred to OU 1-10.

Waste Type: Hazardous—metals, organics (heavy hydrocarbons)
Waste Form: Soil
Source Volume: 210 m³

OU 1-04 has been designated a Track 2 OU in the FFA/CO. It consists of a total of seven sumps, ponds, pits, and tanks that were used for storage or disposal of acids or caustics.

The TSF acid neutralization sump north of TAN-602, TSF neutralization pits (2) north of TAN-649, TSF caustics tank V-4 south of TAN-616, TSF neutralization pits (2) north of TAN-607, TSF acid pond at TAN-735, and TSF acid pit west of TAN-647 will not be discussed further because they are expected to result in no further action recommendations.

LOFT disposal pond (LOFT-02) site has been transferred to OU 1-10.

Waste Type: Hazardous—metals (lead and mercury)
Waste Form: Soil
Source Volume: 2294 m³

OU 1-05 has been designated a Track 2 OU in the FFA/CO. It consists of nine radioactively contaminated sites. Five sites consist of tanks or piping systems that will be closed within the next 3 years. Two sites contain buried radioactive rubble and metal. Two additional sites include a surface drainage pond and valve pit containing contaminated metal. Three radioactively contaminated tanks, V-1, V-2, and V-3, were recently added to this OU. Liquid and sludge samples from each of these partially filled tanks were collected and analyzed during 1990. These analyses were performed only for radioactive constituents.

The TSF TAN/TSF-1 area (soil area) (TSF-06) has been transferred to OU 1-10. It contains trace amounts of barium, lead, mercury, cadmium, chrome, and silver. It is also contaminated with low levels of ¹³⁷Cs, ⁶⁰Co, and ⁹⁰Sr. Source contamination is estimated to be concentrated in the top 6 in. of soil, but some may be as deep as 6 ft. The contamination is contained on a 28 acre site. There may a number of buried vaults in the area. A soil vault was retrieved during a previous excavation in the area. The soil vault was approximately 6 ft long × 3 ft wide × 6 ft deep with a concrete bottom and metal sides. Any remaining vaults are expected to be of similar construction but could also be made with concrete sides.

Waste Type: Low-level radioactive
Contaminant: ¹³⁷Cs, ⁶⁰Co, and ⁹⁰Sr
Waste Form: Debris (concrete and metal)
Source Volume: 570 m³

Waste Type: Low-level radioactive—noncompactible
Contaminant: ¹³⁷Cs, ⁶⁰Co, and ⁹⁰Sr
Waste Form: Soil
Source Volume: 1900 m³

TSF IET valve pit (TSF-21)

Waste Type: Low-level radioactive—compactible
Contaminant: ^{137}Cs , ^{60}Co , ^{90}Sr
Waste Form: Debris (concrete and metal pipe)
Source Volume: 2.8 m^3

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs , ^{60}Co , and ^{90}Sr
Waste Form: Soil
Source Volume: 20 m^3

TAN V-1, V-2, and V-3 tanks (Source volumes have been combined)

Waste Type: Mixed low-level radioactive—liquid
Contaminant: ^{57}Co , ^{60}Co , ^{134}Cs , ^{137}Cs , ^{152}Eu , ^{154}Eu , ^{155}Eu , ^{54}Mn , ^{226}Ra , ^{90}Sr , ^{234}U , ^{235}U , ^{236}U , ^{238}U , ^{239}Pu (trace), and ^{134}Am (Samples were as high as 750 mrem/h). Trichlorethylene, methyl chloroform, fluorides, sulfates, organic carbon, carbon tetrachloride, acetone, hydraulic fluid, Stoddard Solvent, Oc9 Pump Oil, Texal-40, Tap Magic, bromides, mineral oil, lead, mercury, chromium 3 and 4.
Waste Form: Liquid
Source Volume: 5950 gal

Waste Type: Mixed low-level radioactive—noncompactible
Contaminant: ^{57}Co , ^{60}Co , ^{134}Cs , ^{137}Cs , ^{152}Eu , ^{154}Eu , ^{155}Eu , ^{54}Mn , ^{226}Ra , ^{90}Sr , ^{234}U , ^{235}U , ^{236}U , ^{238}U , ^{239}Pu (trace), and ^{134}Am (Samples were as high as 750 mrem/h). Trichlorethylene, methyl chloroform, fluorides, sulfates, organic carbon, carbon tetrachloride, acetone, hydraulic fluid, Stoddard Solvent, Oc9 Pump Oil, Texal-40, Tap Magic, bromides, mineral oil, lead, mercury, chromium III and IV.
Waste Form: Sludge
Source Volume: 23 to 60 in.

TSF-PM2A (TSF-26)

Waste Type: Mixed radioactive
Contaminant: ^{60}Co , ^{134}Cs , ^{137}Cs , ^{152}Eu , ^{90}Sr , heavy metals, and organics.
Waste Form: Sludge
Source Volume: 5 m^3 .

Waste Form: Metals Tanks
Volume: Two, 50,000-gals./each, underground tanks

Waste Form: Soil
Volume: 700 m^3 .

OU 1-06 has been designated a Track 1 OU in the FFA/CO. It consists of four old spill and disposal sites: a 5000-gal diesel spill, 10-gal sulfuric acid spill, 1-gal mercury spill, and disposal pond for TSF sanitary and process wastes. The LOFT sulfuric acid spill at TAN-771 will not be discussed further because it is expected to result in a no further action recommendation.

LOFT diesel fuel spills (TAN-629) (LOFT-01) site has been transferred to OU 1-10.

Waste Type: Hazardous—organics (diesel fuel)

Waste Form: Soil

Source Volume: 7646 m³

TSF disposal pond (TSF-07)

Waste Type: Mixed low-level radioactive ¹³⁷Cs and ⁶⁰Co

Waste Form: Soil

Source Volume: 9175 m³

TSF High Temperature Reactor Experiment (HTRE) III mercury spill area (TSF-08) has been transferred to OU 1-10.

Waste Type: Hazardous—metals (mercury)

Waste Form: Soil

Source Volume: 4 m³

OU 1-07B has been designated as a Remedial Investigation/Feasibility Study (RI/FS) in the FFA/CO. It is the original RI/FS for the TAN groundwater under the FFA/CO. During initial scoping meetings on the RI/FS, the U. S. Department of Energy (DOE) and regulators decided to start an Interim Action (IA) to begin source remediation while the RI/FS was being completed. This site is contaminated with DCE, TCE, PCE, and the radioisotope ⁹⁰Sr.

The draft RI/FS is due on September 1993; therefore, technology development is not beneficial to OU 1-07B.

OU1-10 has been designated as an RI/FS in the FFA/CO. It is the overall OU that coordinates all cleanup work requiring characterization at the other WAG 1 OUs. This OU includes the TSF paint shop floor drain leach field west of TAN-636. The leach field will not be discussed further because it is expected to result in a no further action recommendation. All sites remaining in this OU have been described above.

B-2. Description of WAG 2

This section provides a description of the WAG 2 FFA/CO sites that have the potential to benefit from technology development and assessment. WAG 2 encompasses the Test Reactor Area (TRA) at the INEL. Potential release sites associated with various facilities at TRA include a leaching pond, USTs, rubble piles, cooling towers, injection well, french drains, and assorted spills where hazardous and mixed wastes may exist. WAG 2 is divided into 13 OUs.

OUs 2-01, 2-02, 2-03, 2-04 2-06, 2-07, 2-08, 2-11, and 2-12 are not being considered in this discussion because they have resulted in or are expected to result in no further action recommendations and, thus, are not expected to benefit from technology development or

evaluation. Likewise OU 2-10 is not being considered because the ROD has been negotiated before the TLD publication date.

OU 2-05 has been designated a Track 2 OU in the FFA/CO; however, it is expected to result in a no action recommendation. It includes seven radioactive waste tanks. One unit consists of three underground hot-waste catch tanks and the area where a fourth leaking tank was removed in the 1960s. Additionally, there is an underground hot-waste storage tank and a site where two hot waste tanks were removed and replaced with four new tanks in 1986. Although not part of OU 2-05, these four tanks are still at TRA, stored aboveground, and need to be emptied and discarded. Another site includes a TRA inactive radioactive contaminated tank located underground (TRA-614).

WAG 2 will be removed, stored or treated, and disposed of the TRA-614 tank and tank contents by the TLD publication date. The contamination remaining after the tank removal activities are being addressed in this document. The TRA inactive radioactive contaminated tank at TRA-614 and TRA radioactive tanks 1 and 4 at TRA-630 are not considered in this discussion because they are expected to result in no further action recommendations after the tank removal activities are complete.

TRA hot waste tanks 2, 3, and 4 at TRA-613 (TRA-15)

Waste Type: Low-level radioactive—noncompactible
Contaminants: ^{54}Mn , ^{97}Nb , ^{60}Co , ^{134}Cs , ^{144}Cs , ^{137}Cs , ^{90}Sr , ^{154}Eu , and ^{110}Ag
Waste Form: Soil, concrete
Source Volume: 100 m³

Waste Type: Mixed low-level radioactive
Contaminants: Silver and mercury and the following radioisotopes: ^{54}Mn , ^{97}Nb , ^{60}Co , ^{134}Cs , ^{144}Cs , ^{137}Cs , ^{90}Sr , ^{154}Eu , and ^{110}Ag
Waste Form: Laboratory waste
Source Volume: Unknown m³

Waste Type: Mixed low-level radioactive
Contaminants: Silver and mercury and the following radioisotopes: ^{54}Mn , ^{97}Nb , ^{60}Co , ^{134}Cs , ^{144}Cs , ^{137}Cs , ^{90}Sr , ^{154}U , and ^{110}Ag
Waste Form: Laboratory waste—liquid
Source Volume: Unknown m³

OU 2-07 Track 2 consists of the Engineering Test Reactor Basin, Material Test Reactor Areas, ATR Cooling Tower Basins and Cooling Towers, and soil contaminated with chromium. The Cooling Towers are suspected of being contaminated with chromium because chromates were used as a corrosion inhibitor in cooling water at TRA until 1972.

TRA ETR Cooling Tower Basin (TRA-36)

Waste Type: Hazardous-Metals
Contaminants: Chromium
Waste Form: Soil and concrete
Source Volume: 247 m³

TRA MTR Cooling Tower N of TRA-607 (TRA-39)

Waste Type: Hazardous-Metals
Contaminants: Chromium
Waste Form: Soil
Source Volume: 106.7 m³

OU 2-09 Track 2 consists of the cold waste pond and sewage treatment system at TRA. The cold waste pond was constructed in 1982 and primarily receives cooling tower blowdown water. The sewage treatment system has been in use since the 1950s. While neither unit was ever intended for the disposal of hazardous or radioactive wastes, it is suspected that they both may contain either hazardous or radioactive wastes.

TRA sewage treatment plant (TRA-624) and sludge pit (TRA-732) (TRA-07)

Waste Type: Low-level radioactive—noncompactible
Waste Form: Concrete
Source Volume: 11.1 m³
Waste Form: Soil
Source Volume: 11.1 m³

Waste Type: Mixed low-level radioactive
Waste Form: Liquid waste
Source Volume: Unknown m³
Waste Form: Laboratory waste—liquid
Source Volume: Unknown m³

OU 2-13 has been designated a RI/FS in the FFA/CO. It is the overall OU that coordinates remediation work at the smaller units within TRA that require cleanup following characterization. This OU also contains the chemical waste pond, which will not be discussed because it is expected to result in a no further action recommendation.

B-3. Description of WAG 3

This section provides a description of the WAG 3 problem sites that have the potential to benefit from technology development and assessment. WAG 3 encompasses the Idaho Chemical Processing Plant (ICPP) at INEL and provides the assessment and cleanup of the ICPP sites where releases of hazardous or radioactive substances have occurred. Contamination includes substances such as organics (including PCBs), asbestos, radionuclides, metals, corrosives, petroleum wastes, and mixed wastes. WAG 3 is divided into 13 OUs.

OUs 3-01, 3-02, 3-03, 3-04, 3-05, 3-06, and 3-10 are not being considered in this discussion because they have resulted in or are expected to result in no further action recommendations, and thus are not expected to benefit from technology development or evaluation.

OU 3-07 has been designated a Track 2 OU in the FFA/CO. It includes 12 sites; one site resulted from an air release during a steam flushing operation and eight sites contain contaminated soil from spills and pipe leaks in the tank farm. The other sites are ⁹⁰Sr in the perched water at Well 55-06, soil contaminated from the pressurization of the solid storage

cyclone, and a decontamination spill. Radionuclides, mercuric nitrate, and nitric acid are the major contaminants suspected.

The contaminated soil from the leak in the ICPP WM-181 to the process equipment waste (PEW) line, ICPP-604 radioactive waste unloading area, ICPP contaminated soil in the tank farm area, contaminated soil in the tank farm area north of ICPP-604, contaminated soil in the tank farm area near valve box B-9, and contaminated soil in the tank farm area southwest and northwest of valve box B-4 will not be discussed further because they are expected to result in no further action recommendations.

Well 55-06 (Strontium Contamination in Perched Water) (ICPP-83).

Site 55-06 is the perched water body associated with monitoring well ICPP 55-06. The well was constructed with 2-in. stainless steel casing and screen to a depth of 113 ft. The screened interval is 92 to 113 ft. Perched water was encountered at 104 ft. Sampling results indicate the presence of ^{90}Sr and tritium. ICPP-55 is not considered the source of the radionuclides. This site will be added to the comprehensive RI/FS study of the perched water zone.

Waste Type:	Indeterminate (question to OU manager pending)
Contaminant:	^{90}Sr and tritium
Waste Form:	Indeterminate (question to OU manager pending)
Source Volume:	Unknown m^3

Contaminated Soil in Tank Farm Area from Steam Flushing Operation (ICPP-26).

A leak developed in a line during a steam flushing operation on May 10, 1964. Contaminated fluid and steam was dispersed over an area of approximately 3 to 4 acres. The majority of this site has been excavated because of construction activities that have taken place since the time of the incident. It is unclear whether the contaminants were completely excavated.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{90}Sr and ^{137}Cs and low levels of plutonium
Waste Form:	Soil
Source Volume:	Unknown m^3

Contaminated Soil in Tank Farm Area South of WM-181 by Valve Box A-6 (ICPP-28).

Radioactively contaminated soil was discovered on October 1, 1974. The leak occurred because of a hole in a pipe wall. The hole may have been drilled in the pipe during installation in 1955. Eleven test pipes were placed to a depth of 20 ft to determine the extent of contamination. Fifty-six cubic yards of the contaminated soil containing approximately 3000 Ci of radionuclide were removed. Approximately 5 yd^3 of contaminated soil remain. The failed line was removed from service.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{90}Sr and ^{137}Cs
Waste Form:	Concrete

Source Volume:	Unknown m ³
Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Soil
Source Volume:	5.4 m ³

Contaminated Soil in Tank Farm Area South of Tank WM-183 (ICPP-31).

On September 18, 1975, contaminated soil, apparently from a corroded carbon steel line in the radioactive liquid waste transfer system, was discovered. Soil was left in place because of the quantity (800 yd³) of contaminated soil and is monitored by "observation wells" (probes) that extend 25 ft deep. Maximum readings of 10 rem/h have been recorded between 13 and 20 ft belowgrade.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Soil
Source Volume:	605 m ³

Tank Farm Release Near Valve Box A-2 (ICPP-79).

Twice in 1986 decontamination solutions backed up into valve box A-2 and exited along the secondary containment of the lines leaving the valve box. The site includes the soil around the lines exiting valve box A-2. The exact location of the contamination has not been determined but is somewhere west of valve box A-2.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Soil
Source Volume:	Unknown m ³

OU 3-08 has been designated a Track 2 OU in the FFA/CO. It consists of seven sites that include a solvent burner, contaminated soil in the tank farm, contaminated soil north and west of the main stack, transfer line leak from the old Waste Calcining Facility to WL-102, decontamination solution leak, and blowout of contaminated dolomite. Radionuclides, mercuric nitrate, and nitric acid are the major contaminants suspected.

The contaminated soil north and west of the main stack will not be discussed further because it is expected to result in a no further action recommendation.

Pressurization of the Solid Cyclone Northeast of ICPP-633 (ICPP-13).

A cyclone at the Waste Calcining Facility pressurized and released dolomite solids in October 1976. Most or all of the contaminated soil was removed. A layer of clean soil was used as a cover to fix any remaining contamination in place.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{90}Sr , ^{137}Cs , and ^{106}Ru
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{90}Sr , ^{137}Cs , and ^{106}Ru
Waste Form:	Soil
Source Volume:	Unknown m ³

Solvent Burner East of ICPP-605 (ICPP-15).

Contaminated soil was detected in 1974. The contamination was the result of a leaking flange on top of a solvent burner holding tank. Radiation levels ranged up to 3 rem/h. The contaminated soil was removed. Additional contamination resulted from a continual leakage of combustion products from the solvent burner flue when the system was in operation. The solvent burner and holdup tank were removed in 1985. Investigations are underway to determine the amount of contamination that remains.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	Plutonium at low levels, kerosene, and tributyl phosphates
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	Plutonium at low levels, kerosene, and tributyl phosphates
Waste Form:	Soil
Source Volume:	Unknown m ³

Contaminated Soil in the Tank Farm Area East of ICPP-604 (ICPP-27).

Excavation work uncovered radioactively contaminated soil in 1974. The leak was determined to have started as early as the 1960s. Most of the contaminated soil was removed. It is estimated that 25 mCi of activity remains in the soil at this site. Sampling done in 1991 indicated hot spots at several depths throughout the site.

Waste Type:	Mixed low-level radioactive—noncompactible corrosive metals
Contaminant:	^{90}Sr , ^{137}Cs , mercuric nitrate, and nitric acid
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Mixed low-level radioactive—noncompactible corrosive metals
Contaminant:	⁹⁰ Sr, ¹³⁷ Cs, mercuric nitrate, and nitric acid
Waste Form:	Soil
Source Volume:	13.5 m ³

Contaminated Soils N and W of the Main Stack (ICPP-29)

Waste Type:	Low-level radioactive - noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Soil
Source Volume:	Unknown m ³

ICPP-633 Decontamination Spill (ICPP-35).

Radioactive decontamination solution leaked through an open valve on a line that was connected to a transport air line from the Waste Calcining Facility to solids storage in 1972. About 10 tons of contaminated gravel were removed. Approximately 2.5 Ci of activity remain in the ground spread over an area of several thousand square feet. Remaining radiation levels are about 100 to 200 mrem/h at the points of highest radiation and 5 to 25 mrem/h in the area surrounding the location directly affected by the spill.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	⁹⁰ Sr and ¹³⁷ Cs
Waste Form:	Soil
Source Volume:	0.45 m ³

Transfer Line Leak from ICPP-633 to WL-102 (ICPP-36)

Waste Type:	Mixed low-level radioactive—noncompactible corrosive metals
Contaminant:	⁹⁰ Sr, ¹³⁷ Cs, ¹³⁴ Cs, ¹⁵⁴ Eu, nitric acid, and mercuric nitrate
Waste Form:	Soil
Source Volume:	33.8 m ³

OU 3-09 has been designated a Track 2 OU in the FFA/CO. It consists of 15 sites, 13 of which are in the ICPP-603 area. The contaminated areas around ICPP-603 include contaminated soils resulting from settling basins, vault and dry wells, soil storage areas, temporary storage area, pipeline break, sludge and water release, transfer line leak, contaminated soil east of the dry fuel storage area, and abandoned radioactive storage tank. One of the sites had a radioactive particulate air release resulting from the failure of a cell ventilation filter.

Concrete Settling Basin, Vault, and Dry Walls East of ICPP-603 (ICPP-01).

The concrete settling basin/vault and dry wells were used for the discharge of radioactively contaminated fuel storage basin water. The settling basin was taken out of service and covered with dirt in 1966. The use of the remaining settling facilities was terminated in 1977.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	117 m ³

French Drain West of ICPP-603 (ICPP-02).

The french drain was used in the 1960s to dispose of basin "bleed-off" water. The drain was removed in the late 1960s when the graphite fuel storage building was constructed. The graphite fuel storage building is now directly above the abandoned disposal site.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	Unknown m ³

Temporary Storage Area Southeast of ICPP-603 (ICPP-03).

This area was used to store old abandoned equipment most of which was radiologically contaminated. The area was decommissioned in the late 1970s. The extreme eastern 20% of the area continues to be significantly above background, averaging approximately 6 mrem/h.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{90}Sr
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{90}Sr
Waste Form:	Soil
Source Volume:	1100 m ³

Contaminated Soil Around ICPP-603 Settling Tank (ICPP-04).

In 1953, soil around the ICPP-603 settling tank was found to be radiologically contaminated. The contaminated soil was removed.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{90}Sr
Waste Form:	Soil
Source Volume:	1100 m ³

Contaminated Soil Around ICPP-603 Settling Basin (ICPP-05).

In 1954, soil around the ICPP-603 settling basin was found to be radiologically contaminated. The contaminated soil was removed.

Waste Type:	Low-level radioactive—noncompactible
Contaminate:	^{137}Cs and ^{90}Sr
Waste Form:	Soil
Source Volume:	1100 m ³

Trench East of ICPP-603 Fuel Storage Basin (ICPP-06).

This trench was used in the 1960s to discharge basin water while maintenance was being conducted on the fuel storage basin. Nearly 500,000 gal of basin water containing up to 50 ppm chloride ion was sent to this trench.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	22,546 m ³

ICPP-603 Basin Filter System Line Failure (ICPP-08).

An underground line from the basin system failed in April 1973. Radiologically contaminated soil was left in place. The leaking pipe was blind flanged and left in place.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	947 m ³

Soil Contamination Near the Northeast Corner of ICPP-603 S Basin (ICPP-09).

An underground leak was found during construction activities. Water was sampled and found to have an activity level of 6000 d/m/mL. Radiation levels in the trench and activity as high as 2 rem/h beta and gamma were detected. Investigations revealed that the water source was a

fire water line, and the contamination was caused by this water flowing through previously contaminated soil. Surface soil was sent to the burial ground.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	75.6 m ³

ICPP-603 Plastic Pipeline Break (ICPP-10).

Contamination resulted from a break in a 3/4-in. polyvinyl chloride (PVC) line in 1976. Some of the water drained through a personnel access door and contaminated a small area of asphalt and dirt. Radiation levels in the contaminated area were as high as 200 mrem/h.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Floor, soil, asphalt
Source Volume:	36 m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	Unknown m ³

ICPP-603 Sludge and Water Release (ICPP-11).

On February 8, 1978, waste containing sludge and basin water was released to the ground during basin cleanup activities.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	^{137}Cs and ^{134}Cs
Waste Form:	Soil
Source Volume:	22.5 m ³

Soil Storage Area South of ICPP Peach Bottom Fuel Storage Area (ICPP-17).

About 1200 yd³ of 2 mCi/g soil is stored east of ICPP-603. Sampling was conducted on the soil in 1991 for TCLP metals. The results indicate metals concentrations below RCRA concerns. Some of this soil is now stored in about 620 boxes, and the remaining soil has been graded to match the surrounding ground elevation.

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Concrete
Source Volume: Unknown m^3

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Soil
Source Volume: 907 m^3

ICPP-603 to ICPP-604 Line Leak (ICPP-19).

On March 9, 1978, a leak developed in the waste transfer line between ICPP-603 and WL-102 in ICPP-604. Radioactively contaminated liquid leaked from the underground line to the soil. Some contaminated soil was removed.

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Concrete
Source Volume: Unknown m^3

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Soil
Source Volume: 90 m^3

Particulate Air Release South of ICPP-603 (ICPP-22).

In October 1958, cell ventilation filters failed, and a radioactive particulate release occurred. Land adjacent to the building was contaminated. Most of the contamination was cleaned up.

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Concrete m^3
Source Volume: Unknown

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Soil
Source Volume: Unknown m^3

Abandoned Liquid Radioactive Waste Storage Tank ICPP VES-SFE-20 (ICPP-69).

The tank was taken out of service in 1977. The tank contains about 400 gal of low-level radioactive liquid waste.

Waste Type:	Low-level radioactive—liquid
Contaminant:	¹³⁷ Cs and ¹³⁴ Cs
Waste Form:	Liquid
Source Volume:	1.403 m ³

Contaminated Soil West of ICPP-693, East of Dry Fuel Storage Area (ICPP-78).

Radioactively contaminated soil was encountered during excavation for a trench by the dry fuel storage area in May 1987. The trench was filled back in with contaminated soil, and access to area was restricted.

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	Has not been sampled
Waste Form:	Concrete m ³
Source Volume:	Unknown

Waste Type:	Low-level radioactive—noncompactible
Contaminant:	Has not been sampled
Waste Form:	Soil
Source Volume:	7 m ³

OU 3-11 has been designated a Track 2 OU in the FFA/CO. It consists of two sites: chemical storage area and evaporator overhead pipeline. The major contaminants of concern are radionuclides, nitric and hydrofluoric acid, and heavy metals.

ICPP-621 Chemical Storage Area Spills (ICPP-45).

The chemical storage area consists of eight tanks. There are two nitric acid tanks, two acid tanks, one hydrofluoric acid tank, and three aluminum nitrate tanks. Each of these tanks have separate french drains except the two acid tanks, which share a limestone-pit containment area.

Waste Type:	Hazardous—corrosives
Contaminant:	Nitric acid, hydrofluoric acid, and aluminum nitrate
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Hazardous—corrosives
Contaminant:	Nitric acid, hydrofluoric acid, and aluminum nitrate
Waste Form:	Soil
Source Volume:	451 m ³

ICPP PEW Evaporator Overhead Pipeline Spills (ICPP-58).

The line from the PEW evaporator to the monitoring station developed leaks in 1954 and 1976. Both leaks were underground pipe leaks. The release contained a 0.2 m nitric acid solution contaminated with cesium, strontium, cerium, ruthenium, and tritium. The 1976 site was buried with several feet of clean soil, and a building has been placed over the 1954 leak location.

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Concrete
Source Volume: Unknown m^3

Waste Type: Low-level radioactive—noncompactible
Contaminant: ^{137}Cs and ^{134}Cs
Waste Form: Soil
Source Volume: 902 m^3

OU 3-12 has been designated a Track 1 OU in the FFA/CO. It consists of units recently added to the FFA/CO. Currently, this OU contains three sites: a vent tunnel drain leak, an abandoned vessel off-gas (VOG) line and an abandoned transfer line.

ICPP-601 Vent Tunnel Drain Leak (VT-300) (ICPP-80).

This is a new unit added to the FFA/CO in December 1991. Descriptions of events, waste types, and release dates will be forth coming with the Track 1 investigation conducted in 1992.

Waste Type: Low-level radioactive (question pending)
Contaminant: ^{90}Sr and tritium
Waste Form: Soil
Source Volume: Unknown m^3

Abandoned ICPP-637/ICPP-601 VOG Line (ICPP-81).

This is a new unit added to the FFA/CO in December 1991. Descriptions of events, waste types, and release dates will be forth coming with the Track 1 investigation conducted in 1992.

Waste Type: Low-level radioactive—noncompactible
Contaminant: Has not been sampled
Waste Form: Soil
Source Volume: Unknown m^3

Abandoned Line 1.5 in., PLA, 776 West of Beach Street (ICPP-82).

This is a new unit added to the FFA/CO in December 1991. Descriptions of events, waste types, and release dates will be forth coming with the Track 1 investigation conducted in 1992.

Waste Type: Low-level radioactive—noncompactible
Contaminant: Has not been sampled
Waste Form: Soil
Source Volume: Unknown m^3

OU 3-13 has been designated a RI/FS in the FFA/CO. It is the overall OU that includes the comprehensive RI/FS for WAG 3, perched water zones at ICPP, and other miscellaneous units

requiring investigation. This OU also includes the hydrofluoric acid storage tank and dry well and a french drain used for disposal of specific acids.

ICPP Hydrofluoric Storage Tank (YDB-105) and Dry Well (ICPP-39).

YDB-105 was a hydrofluoric storage tank that has been removed. Overflow from the tank drained to a limestone neutralization pit beneath the tank. The neutralized solution drained to a dry well about 175 ft to the southwest. The site was characterized before the FFA/CO, and no RCRA hazardous wastes were detected.

Waste Type:	Hazardous corrosive—chemical
Contaminant:	Hydrofluoric acid
Waste Form:	Soil
Source Volume:	Unknown m ³

French Drain South of ICPP-633 (ICPP-48).

The french drain was used for the disposal of nitric acid and other chemicals consisting primarily of aluminum nitrate and calcium nitrate. Use of the drain has been discontinued. Sampling of the soil was conducted around the french drain in 1986, and no hazardous wastes/constituents were detected.

Waste Type:	Hazardous—corrosives
Contaminant:	Nitric acid
Waste Form:	Concrete
Source Volume:	Unknown m ³

Waste Type:	Hazardous—corrosives
Contaminant:	Nitric acid
Waste Form:	Soil
Source Volume:	45 m ³

B-4. Description of WAG 4

This section provides a description of the WAG 4 problem sites that have the potential to benefit from technology development and assessment. WAG 4 encompasses CFA, which includes spills, USTs, landfill, ponds, leach fields, and leach pits. This WAG is divided into 13 OUs.

OUs 4-01, 4-02, 4-03, 4-04, 4-07, and 4-11 are not being considered in this discussion because they have resulted in or are expected to result in a no further action recommendation, and thus are not expected to benefit from technology development or evaluation. Likewise, OUs 4-06, 4-08, and 4-10 are not being considered because the RODs will have been negotiated before the TLD publication date.

OU 4-05 has been designated a Track 2 OU in the FFA/CO. It consists of a pond used to collect liquids that drained from building CFA-674 between 1954 and 1965 and a bermed area used by the fire department for fire fighter training. There is a concern that the pond may

contain mercury. The bermed area is saturated with oil and will require remedial action. It is believed that the oil may have penetrated more than 6 ft.

CFA Pond (CFA-674) (CFA-04)

Waste Type: Hazardous—mercury
Waste Form: Soil
Source Volume: 106.7 m³

CFA Fire Department Training Area, Bermed (CFA-17)

Waste Type: Hazardous—organics (fuel oil spills)
Waste Form: Sludge
Source Volume: 230 m³

OU 4-06 has been designated a Track 2 and includes two areas that may contain lead contamination. Between 1953 and 1980, CFA-06 was used as a lead shop where lead shot, bricks, and scraps were stored and a spray paint booth drained. Smoke and fumes from pouring lead may have settled on the ground outside this building. CFA-43 stored lead materials and scrap. Areas contain lead will be sampled and decision will be made whether further action is required.

CFA Lead Shop (CFA-06)

Waste Type: Hazardous-metals
Contaminants: Lead and lead oxide
Waste Form: Soil and lead chunks
Source Volume: 30 m³

CFA Lead Storage Area (CFA-43)

Waste Type: Hazardous-recyclable metals
Contaminants: Metal and lead
Waste Form: Lead shot, bricks, and batteries
Source Volume: 76 m³

CFA Spray Paint Booth Drain (CFA-44)

Waste Type: Hazardous-metals, organics
Contaminants: Lead and paint thinner
Waste Form: Soil
Source Volume: 82 m³

OU 4-09 has been designated a Track 2 OU in the FFA/CO. This OU consists of three areas: a transformer yard where transformer oil, which may contain PCBs, may have leaked and two locations where fuel oil was spilled or leaked onto the ground. Any cleanup required will be completed as an IA or with the comprehensive WAG 4 RI/FS.

CFA Transformer Yard Oil Spills (CFA-10).

Sampling of this area is scheduled to begin in FY-95. Transformers containing PCBs were stored in this area for about 1.5 years. There are no known incidents of leaks or spill from these transformers.

Waste Type: Hazardous-organics (PCB spill)
Waste Form: Soil and gravel
Source Volume: 76 m³

CFA 760 pump station fuel spill (CFA-26)

Waste Type: Petroleum (No. 2 diesel fuel)
Waste Form: Soil
Source Volume: 174 m³

CFA Tank Farm Pump Station Spills (CFA-42)

Waste Type: Hazardous-organics (fuel oil)
Waste Form: Soil
Source Volume: 38 m³

OU 4-12 has been designated an RI/FS in the FFA/CO. The site includes two municipal-type landfills (Landfills II and III). These landfills received cafeteria waste, construction debris, paint thinners, solvents, asbestos, some chemicals, and other miscellaneous wastes from site operations.

Results from the risk assessment propose that no further action is necessary; however, public concerns may require the landfills to be capped.

CFA Landfill II (CFA-02)

Waste Type: Municipal sanitary
Waste Form: Liquid (paint thinner)
Source Volume: 5 m³

Waste Type: Municipal sanitary
Waste Form: Solid (chromium, mercury, beryllium, and trichlorethane)
Source Volume: 98,000 m³

Waste Type: Municipal sanitary
Waste Form: Sludge (chromium, mercury, beryllium, and trichlorethane)
Source Volume: 980 m³

CFA Landfill III (CFA-03)

Waste Type: Municipal sanitary
Waste Form: Debris
Source Volume: 120,000 m³

Waste Type: Municipal sanitary
Waste Form: Liquid (paint thinner)
Source Volume: 5 m³

Waste Type: Municipal sanitary
Waste Form: Sludge (chromium, mercury, beryllium, and trichlorethane)
Source Volume: 260 m³

OU 4-13 (RI/FS) is the OU that covers the overall CFA and coordinates remedial work at waste units requiring cleanup following characterization. Information and decisions from WAG 4 Track 1 and 2 activities and intermediate RODs will be integrated. Any IAs will support the comprehensive RI/FS.

B-5. Description of WAG 5

This section provides a description of the WAG 5 problem sites that have the potential to benefit from technology development and assessment. WAG 5 encompasses the Power Burst Facility (PBF) and the Advanced Reactor Areas (ARA). WAG 5 is divided into 13 OUs, which consist of evaporation ponds, sanitary sewers, waste sumps, radioactive debris burial ground, and storage pads. An example of a WAG-5 rubble site is shown in Figure B-1.

OUs 5-01, 5-02, 5-03, 5-04, 5-06, 5-07, 5-08, 5-09, 5-10, and 5-11 are not being considered in this discussion because they have resulted in or are expected to result in no further action recommendations and, thus, are not expected to benefit from technology development or evaluation. Likewise, OUs 5-05, 5-10, and 5-13 are not being considered because the RODs will have been negotiated before or within 6 months of the TLD publication date.

OU 5-12, was designated the comprehensive RI/FS in the FFA/CO. This OU covers all the sites at PBF/ARA. The comprehensive RI/FS will evaluate all risks and cumulative effects of all OUs within WAG 5.

Information and decisions from WAG 5 (Track 1) and 2 activities as well as intermediate RODs will be integrated. Any IAs will support the comprehensive RI/FS.

PBF reactor area corrosive waste disposal sump brine tank PBF-731 (PBF-08)

Waste Type:	Low-level radioactive—noncompactible
Contaminants:	^{60}Co and ^{137}Cs
Waste Form:	Sludge
Source Volume:	5.139 m ³

PBF reactor area evaporation pond PBF-733 (PBF-10)

Waste Type:	Mixed low-level radioactive—metal
Contaminant:	^{60}Co , ^{137}Cs , and chromium
Waste Form:	Soil
Source Volume:	74.1 m ³

B-6. Description of WAG 6

This section provides a description of the WAG 6 problem sites that have the potential to benefit from technology development and assessment. This WAG consists of the Experimental Breeder Reactor-I (EBR-I) and Boiling Water Reactor Experiment (BORAX) areas. Both of these areas were originally constructed to accommodate test reactors and have since been decommissioned. EBR-I is now a National Historic Landmark open to the public. Historically, the BORAX area housed five reactors, but many of the facilities have been dismantled or moved,

Figure B-1. Rubble pile near the PBF reactor in OU 5-03.

and no operations (other than monitoring) take place in the area. The boundaries of the WAG are directly related to the facility locations and areas immediately adjacent to them. WAG 6 consists of five OUs that include the BORAX-I burial site, trash dump, fuel oil tanks, septic tanks, and leach pond. Sites to be investigated are primarily old tanks but also include a small spill area and several liquid and solid waste disposal locations.

No WAG 6 OUs are being considered in this TLD because they have resulted in or are expected to result in no further action recommendations and, thus, are not expected to benefit from technology development or evaluation.

B-7. Description of WAG 7

This section provides a description of the WAG 7 problem sites that have the potential to benefit from technology development and assessment. WAG 7 encompasses the RWMC, which was established in 1952 and is a controlled area for the disposal of solid radioactive wastes generated by DOE operations at the INEL and other DOE sites. Fourteen OUs have been identified at RWMC including the Transuranic Storage Area (TSA) and Subsurface Disposal Area (SDA). Photographs and a drawing of these areas are shown in Figures B-2 through B-4. TSA photos taken during operation and as it appears today are shown in Figures B-2 and B-3, respectively. A drawing of an SDA (Pit 9) is shown in Figure B-4. The SDA, which is the location of the largest remediation activity at the INEL, is a confirmed release site. Findings from environmental monitoring activities have determined that migration of transuranic (TRU) radionuclides has occurred to the 110-ft sedimentary interbed beneath RWMC. The aquifer is located 600 ft below the surface at this location. In addition, organic constituents have been detected in the aquifer and vadose zone underlying RWMC.

OUs 7-02, 7-04, 7-05, 7-06, 7-07, 7-09, and 7-11 are not being considered in this discussion because they have resulted in or are expected to result in no further action recommendations and, thus, are not expected to benefit from technology development or evaluation. Likewise, OUs 7-10, and 7-12 are not being considered because the draft RI/FS ROD will have been submitted to the state and EPA before the TLD publication date. OUs 7-01 and 7-03 are addressed under OU 7-13 because it is expected that any remedial action required for these OUs will be performed under OU 7-13 remedial activities.

OU 7-08 is described as volatile organic compounds (VOCs) in the vadose zone beneath and within the immediate vicinity of RWMC. The vadose zone is described as the subsurface region that begins at the surface and extends down to the top of the Snake River Plain Aquifer.

This OU is assumed to require an RI/FS and remedial action to mitigate release of VOCs to the aquifer and atmosphere and to validate and calibrate the organic transport model. A treatability study is being undertaken to develop a process and attendant cost data for site-specific vapor vacuum extraction technology.

Vadose zone organics RI/FS

Waste Type:

Hazardous—organics (chloroform, TCE, toluene, and carbon tetrachloride)

Figure B-2. Pad A at the RWMC during operations in 1975.

Figure B-3. Pad A as it looks today.

Cross Section of Pit 9

Figure B-4. Pit 9 at the RWMC.

Waste Form:	Unknown
Source Volume:	Unknown m ³
Waste Type:	Hazardous—organics (chloroform, TCE, toluene, and carbon tetrachloride)
Waste Form:	Sludge
Source Volume:	94.75 m ³
Waste Type:	Hazardous—organics (chloroform, TCE, toluene, and carbon tetrachloride)
Waste Form:	Soil
Source Volume:	Unknown m ³

Vadose Zone Organics RI/FS.

OU 7-13 is defined as the pits and trenches containing TRU contaminated waste at the RWMC SDA. These wastes include TRU, low-level, and mixed waste in solid and liquid form. Disposal of TRU contaminated wastes at SDA ceased in 1970. Soils around or beneath the pits and trenches contaminated by TRU and hazardous wastes are also included in this OU. A photo of a vapor vacuum extraction process to remediate this area is shown in Figure B-5.

This OU will be investigated in several phases. A preliminary scoping study and Track 2 investigation will be performed to evaluate the exposure potential. The OU will then be investigated as an RI/FS process. It is assumed that the decision process will specify remedial action for some or all of the pits and trenches to mitigate release of contaminants to the environment. The remedial actions may include retrieval, treatment, and disposal action for waste from TRU contaminated pits, trenches, and soils.

TRU pits and trenches RI/FS (RWMC-04)

Waste Type:	Radioactive, mixed radioactive, hazardous-organic, TRU [Rocky Flats Plant fire waste (plutonium), fuel end boxes (⁶⁰ Co), TCE, toluene, and carbon tetrachloride]
Waste Form:	Debris (paper, rags, sweepings, vehicles, diatomaceous earth, wood, metal, and glass)
Source Volume:	566.37 m ³
Waste Type:	Radioactive, mixed radioactive, hazardous-organic, TRU [Rocky Flats Plant fire waste (plutonium), fuel end boxes (⁶⁰ Co), TCE, toluene, and carbon tetrachloride]
Waste Form:	Soil
Source Volume:	5097.5 m ³

OU 7-14 is the comprehensive RI/FS for WAG 7 and will incorporate the cumulative impact at the RWMC. Information and decisions from WAG 7 Track 1 and 2 activities as well as intermediate RODs will be integrated. Any IAs will support the comprehensive RI/FS.

Figure B-5. Vapor vacuum extraction equipment at the RWMC.

B-8. Description of WAG 10

This section provides a description of the WAG 10 problem sites that have the potential to benefit from technology development and assessment. WAG 10 includes regional Snake River Plain Aquifer concerns related to the INEL that cannot otherwise be addressed on a WAG-specific basis and other surface disposal sites and ponds identified at the INEL that are not included in specific areas. The boundaries of WAG 10 are the INEL boundaries, or beyond, as necessary to encompass real or potential impact from INEL activities. WAG 10 includes any areas within the INEL not covered by other WAGs. The WAG consists of 12 specifically identified and two generally identified sites divided into four OUs. Specific sites currently recognized as part of the WAG include the liquid corrosive chemical disposal area located between WAGs 6 and 7, organic moderated reactor experiment located between WAGs 4 and 5, and former ordnance areas (including the old Naval Ordnance Disposal Area) located at numerous sites within the INEL.

OUs 10-01 and 10-02 are not being considered in this discussion because they have resulted in or are expected to result in no further action recommendations and, thus, are not expected to benefit from technology development or evaluation. Likewise OU 10-05, which includes two sites transferred from OU 4-01, is not being considered because the ROD will have been negotiated before the TLD publication date.

OU 10-03 identified as a Track 2 investigation in the FFA/CO consists of areas containing ordnance that have not been inventoried. These areas are poorly defined at the INEL and include a bombing range and an area to test large caliber guns. A Track 2 investigation will be conducted to evaluate this OU. Figure B-6 shows electromagnetic geophysical survey equipment being used to characterize these areas. IA may be required to perform detonation of unexploded ordnance and cleanup of debris.

Ordnance areas (including the naval ordnance disposal area)

Waste Type:	Hazardous—unexploded ordnance
Waste Form:	Soil
Source Volume:	1420 m ³

Waste Type:	Nonhazardous—metal
Waste Form:	Ordnance
Source Volume:	4.0 m ³

OU 10-04 has been identified as the comprehensive RI/FS in the FFA/CO. This OU includes the overall INEL site investigation of the Snake River Plain Aquifer.

Five wells will be drilled during site characterization. The WAG 6 comprehensive RI/FS will also be incorporated into the WAG 10 RI/FS. Upon completion, all WAG comprehensive RI/FSs will roll into the overall RI/FS for the INEL.

Figure B-6. Electromagnetic geophysical survey equipment is used to characterize INEL sites.

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