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INNOVATIVE TECHNOLOGIES FOR THE REMEDIATION OF TRANSURANIC-CONTAMINATED LANDFILLS

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Abstract

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The complexity and heterogeneity of buried waste associated with the U.S. Department of Energy (DOE) Complex has required considerable effort to identify appropriate remediation schemes. Preliminary evaluations indicate that significant technological advancements are required to safely and cost-effectively complete the remediation of these buried waste sites within the defined time-frame.

The TRU-contaminated Arid Landfill Stabilization (TALS) Program, formerly the Buried Waste Integrated Demonstration (BWID) program, was organized by the U. S. Department of Energy (DOE), Office of Technology Development (OTD), to develop advanced technologies to solve problems associated with the environmental remediation of DOE buried transuranic waste located in arid environments. The specific mission of the TALS Program is to manage the development of emerging technology systems and promote their use to improve the DOE environmental remediation and waste management operations for TRU-contaminated landfills in arid environments.

Implementation of the TALS Program involves five key strategies. (1.) A systems engineering approach is used to advance technological solutions which satisfy the needs of our customers. (2.) The best science and technology is used, this involves engineers and scientific expertise from throughout the U.S. government, universities, private industry, and international communities. (3.) Technology development is managed to performance-based requirements. (4.) Integrated product teams are formed which include technology end-users as well as industry partners. (5.) On-going work sponsored by the former BWID will be leveraged and supported to obtain early successes for the TALS Program.

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The TALS Program is focusing its resources on four technology systems. These systems are the Site Characterization System, the Containerized Waste Assay System, the Buried Waste Removal System, and the In Situ Stabilization System.

The Site Characterization System provides physical, chemical, and radiological information and interpretation of near-subsurface waste and other objects, and associated containment structures. Non-intrusive technologies that characterize the size, shape, depth, physical orientation, and constituent makeup of near-subsurface (<10m) waste objects are supported through this system.

The Containerized Waste Assay System provides improved accuracy and shorter count times to nonintrusively characterize waste containers. This system is capable of determining the container's waste matrix, fissile material quantity, specific nuclide concentration, free liquid quantity, and additional spatial information.

The Buried Waste Removal System provides advanced waste handling, retrieval, and conveyance techniques. Using remote operations, operators can safely and efficiently remove buried waste contaminated with radioactive and hazardous constituents. This system is designed to reduce the risks to human health and the environment.

The In Situ Stabilization System is focusing on providing technology systems that support in situ disposal of wastes. These techniques prevent migration of contaminants from the buried waste as well as prevent subsidence of the waste. Interim as well as long-term stabilization materials are being developed.

The TALS Program supports these buried waste remediation efforts by seeking out the best talent to solve these technology challenges as identified in baseline remediation strategies. Experts from throughout the DOE complex, universities, private sector, and the international community are being included in this program to solve these challenges and ensure implementation and commercialization of innovative technologies.

Introduction

The U.S. Department of Energy (DOE) has initiated a comprehensive research, development, demonstration, testing and evaluation program to provide innovative technology systems to achieve its environmental management responsibilities. The Office of Technology Development (OTD) is responsible for this research in support of the Offices of Environmental Restoration and Waste Management efforts.

In fiscal year (FY) 1992 the OTD established the Buried Waste Integrated Demonstration (BWID). The BWID mission was to support the development of emerging technologies for their application to the remediation of DOE buried waste site.

During FY95, the BWID program was transitioned into a larger program which will focus its attention to DOE Landfills and Contaminated Soils. The research and activities formerly referred to as the BWID will now be associated with the Transuranic-contaminated Arid Landfill Stabilization Program (TALS).

Background

The amount of buried waste located throughout the DOE complex as of 1990 is estimated at approximately 3.1 million cubic meters (DOE Complex Buried Waste Assessment, PNL-8390). This waste is predominantly located at the Hanford Site, Savannah River Site, Idaho National Engineering Laboratory (INEL), Oak Ridge National Laboratory, and Rocky Flats Plant. The waste at these various DOE sites has been buried or stored in trenches, pits, storage pads, or other special structures. Much of this buried waste is believed to be contaminated with hazardous and radioactive materials. Significant remediation challenges are presented for buried waste, particularly the pre-1970 buried transuranic (TRU) contaminated waste.

Approach

A system engineering analysis was performed based on the strategic planning, technical requirements and programmatic assumptions of various DOE Environmental Restoration/Waste Management (ER/WM) programs. Several high-level systems are presently being supported by the TALS. These systems are illustrated in figures 1, 2, and 3. Figure 1 illustrates the Retrieval and Ex Situ Treatment System. Figure 2 illustrates the In Situ Stabilization, Treatment, and Monitoring System. And Figure 3 illustrates the Containment System. Individual technologies supported by the TALS Program are listed within each subelement of each system.

Remediation Technologies

Technologies are being developed through the TALS Program to satisfy specific performance objectives. Key technologies within the TALS include: the Selective Retrieval System, the Containerized Waste Assay System, the Site Characterization System, and the In Situ Stabilization System.

The Selective Retrieval System is being demonstrated at the INEL in 1995. This System is an advanced cooperative telerobotic retrieval unit. It is based off of an overhead gantry platform which can deploy multiple remediation tools in support of retrieval operations. Two robotic manipulators, a crane, a vacuuming tool, contamination control devices, and various characterization sensors are all being integrated into the system. The System is being designed and tested to perform careful retrieval of selected contaminants located within a larger burial site.

The Containerized Waste Assay System is being designed to nonintrusively characterize waste containers. Emphasis has been on qualitatively and quantitatively determining the waste constituents of 55 gallon drums. This System supports the shipment of waste to either treatment and/or disposal facilities. Precision, accuracy and throughput rates are being improved

versus the comparable rates for conventional assay techniques.

Specific waste characterization technology goals are to (a) determine the waste matrix, (b) obtain spatial information, (c) determine fissile material quantity, (d) determine the specific nuclide concentration, and (e) determine the quantity of any free liquids.

The Site Characterization System provides physical, chemical, and radiological information and interpretation of near-surface waste, other objects, and containment features. Nonintrusive technology which characterizes the size, shape, depth, physical orientation, and constituent makeup of near-surface waste objects are being developed.

The In Situ Stabilization System involves stabilizing hazardous and radioactive buried wastes in place. This concept could be used as an interim solution that is followed by retrieval for later treatment and disposal or as a long-term final solution. For both approaches jet grouting equipment is used to inject grout material into the buried waste matrix. The grouting process stabilizes and immobilizes waste forms and contaminants in place. Various materials are being investigated for their application to this remediation scheme. Results from a 1994 grouting and fracturing demonstration at the INEL showed this technique has promise for stabilizing DOE buried waste sites.

Industry/University Partners

The TALS Program has obtained the support of universities, private industry, and national laboratories in the development of these innovative technologies. During FY-94 there were 23 industry/university partners and six national laboratories involved. In FY-95, there were 38 industry/university partners, 12 national laboratories, and 7 U.S. Government Agencies involved in our technology development process.

The TALS Program emphasizes the transfer of technology to private industry so that they can respond to requests to remediate DOE waste sites in the future. Several technologies have been commercialized since the last Cooperative Research Program Meeting.

The Rapid Transuranic Monitoring Laboratory has been licensed to Thermo Analytical. The system is supporting remediation operations at the Savannah River Site. Significant cost savings are being obtained through the use of this system and its analytical capabilities.

The Rapid Geophysical Surveyor has been commercialized by the spin-up company Sage Earth Sciences. Sage Earth has provided surveys to a variety of

customers including the U.S. National Park Service, the U.S. Department of Defense, the U.S. Environmental Protection Agency, and private industry.

The Contamination Control Unit has been transferred to the INEL Waste Management organization. This Unit is being used as an Emergency Response support unit. It also has supported contaminated soil remediation efforts at the INEL and the DOE Hanford site.

Summary

Considerable efforts are under way to resolve this nations environmental challenges. To achieve these goals significant technological advancements are required to safely and cost-effectively complete the remediation of these contaminated waste sites. The TALS Program has resulted in the development of multiple advanced technology systems. These systems not only support problems associated with the environmental remediation of DOE buried transuranic waste located in arid environments but Landfill remediation in general.

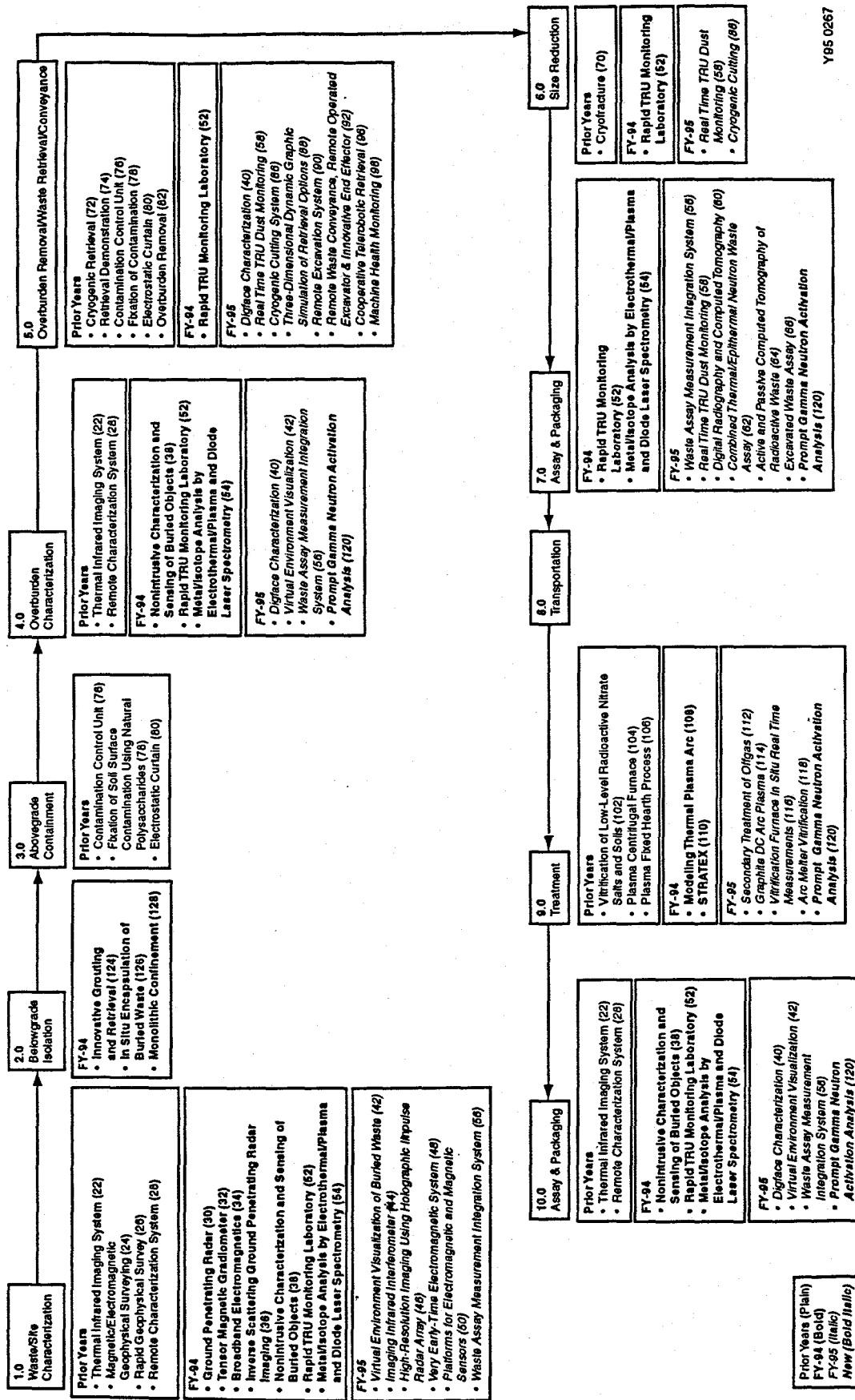
Four technology systems have been the focus of this Program's research. These systems are the Site Characterization System, the Containerized Waste Assay System, the Buried Waste Removal System, and the In Situ Stabilization System. Specific technology performance objectives have been established and tested against. The results of this research has been documented.

The approach to technology development is to use the best science and people. Therefore considerable technical collaboration has been required to achieve this research.

The final results of this research is the commercialization and implementation of advanced technologies. TALS-sponsored technologies are being implemented across the DOE Complex. These implementation efforts have reduced both remediation costs and worker's risk to exposure while satisfying remediation schedules.

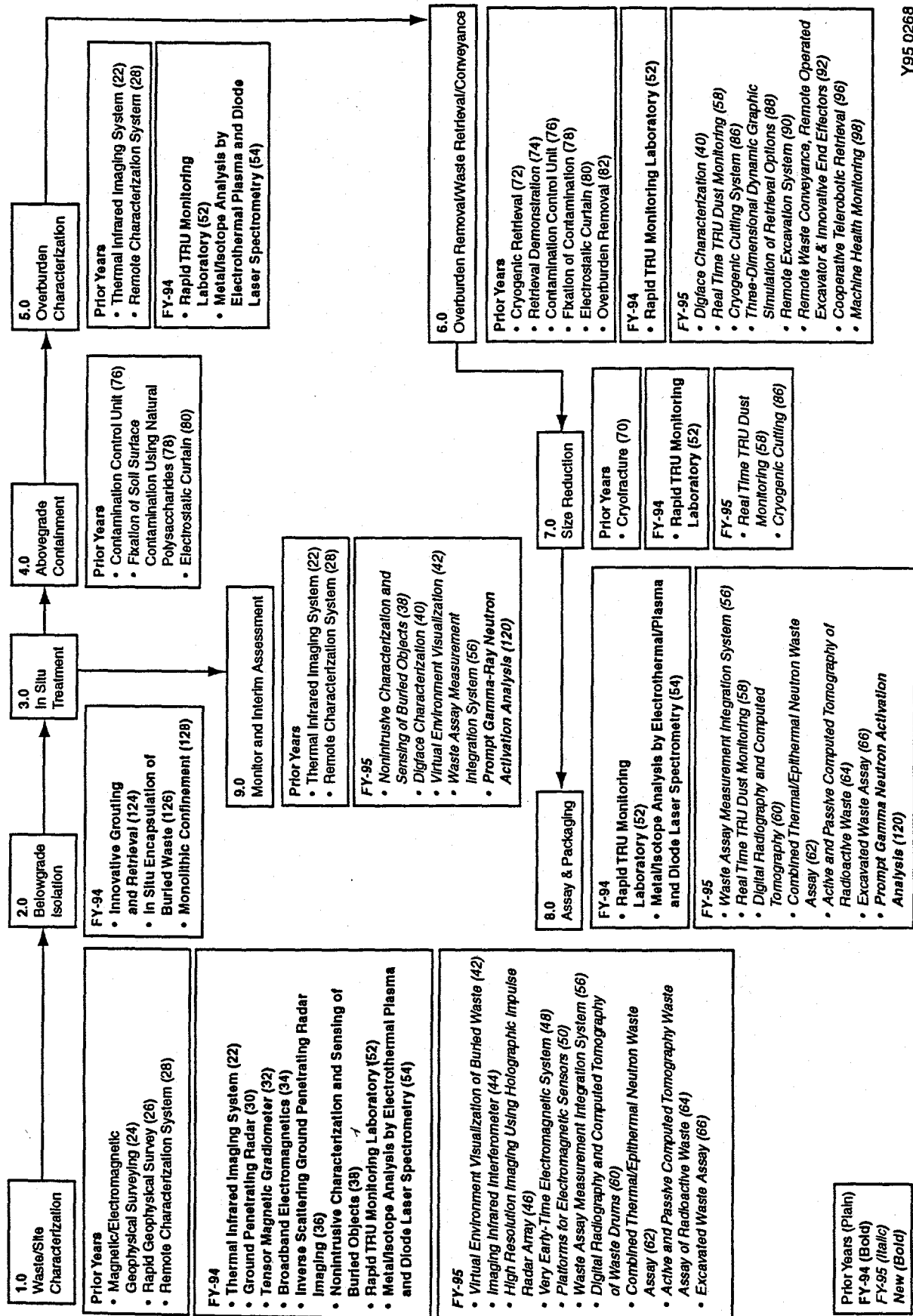
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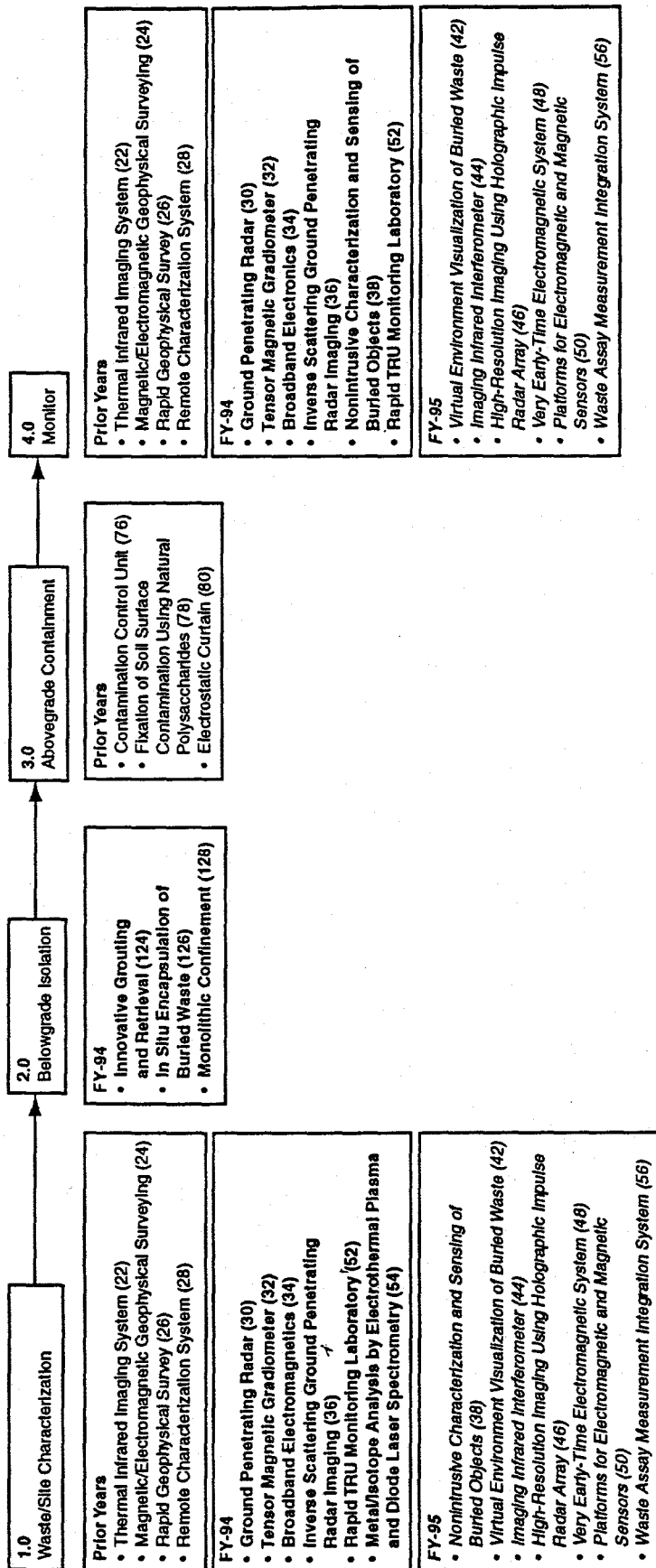
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Figure 1. Retrieval and Ex Situ Treatment



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Figure 2. In Situ Stabilization, Treatment, and Monitoring



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Prior Years (Plain)
FY-94 (Bold)
FY-95 (Italic)
New (Bold)

Figure 3. Containment