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Alternatives Generation and Analysis Report for Immobilized Low-Level Waste Interim Storage Architecture

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Abstract: The Immobilized Low-Level Waste Interim Storage subproject will provide storage capacity for immobilized low-level waste product sold to the U.S. Department of Energy by the privatization contractor. This report describes alternative Immobilized Low-Level Waste storage system architectures, evaluation criteria, and evaluation results to support the Immobilized Low-Level Waste storage system architecture selection decision process.

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**ALTERNATIVES GENERATION
AND ANALYSIS REPORT FOR
IMMOBILIZED LOW-ACTIVITY
WASTE INTERIM STORAGE
ARCHITECTURE**

September 1996

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Prepared for
U.S. Department of Energy
Richland, Washington

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DECISION ANALYSIS SUMMARY

In July 1995, the U.S. Department of Energy initiated a program to privatize the treatment and immobilization functions of the Hanford Site Tank Waste Remediation System. In the first phase of privatization, vendors will be selected to establish the technical, operational, regulatory, and financial elements of the privatized services program, followed by demonstration scale treatment of 6 percent to 13 percent of the Hanford Site tank waste in facilities that are developed, financed, permitted, constructed, owned, operated, and deactivated by the vendor. The second phase of privatization will treat the remaining tank wastes in fullscale facilities.

The privatization schedule requires the vendor to start production of immobilized low-activity waste (ILAW) in 2002. Based on the 1996 Tank Waste Remediation System Low-Level Waste Disposal subproject multi-year program plan, this study examines alternatives for the ILAW Interim Storage subproject (OOL-EEW-465) that would provide storage capacity for a 7.5-year interim between start of production and disposal availability.

This report presents descriptions and analysis of alternative system architectures considered for performing the ILAW Interim Storage function. The analysis shows that the option of using a combination of the existing waste vaults and new construction has the highest composite rating for those alternatives that meet all of the decision criteria that were established for this study.

As a result of this study, the 1997 Low-Level Waste Disposal subproject multi-year program plan will reflect an accelerated schedule that provides startup of permanent disposal facilities in 2005, about five years sooner than previously planned. These changes are also reflected in proposed Tri-Party Agreement milestone M-90-00 and its subelements. The accelerated disposal schedule will decrease the interim storage operating duration to approximately three years. The shorter interim storage duration will allow the use of the existing vaults while eliminating the need for providing additional storage facilities.

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LIST OF TERMS

AGV	Automatic Guided Vehicle
ALARA	As Low As Reasonably Achievable
AMU	Aqueous Makeup
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOT	Department of Transportation
DRD	Design Requirements Document
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FY	Fiscal Year
HAB	Hanford Advisory Board
ICF KH	ICF Kaiser Hanford Company
ILAW	Immobilized Low-Activity Waste
LLW	Low-Level Waste
MYPP	Multi-Year Program Plan
NRC	U.S. Nuclear Regulatory Commission
PA	Performance Assessment
PUREX	Plutonium-Uranium Extraction
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
REDOX	Reduction and oxidation
RFP	Request for Proposals
ROM	Rough order of magnitude
TRS	Technical Requirements Specification
TWRS	Tank Waste Remediation System
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

ALTERNATIVES GENERATION AND ANALYSIS REPORT FOR IMMOBILIZED LOW-ACTIVITY WASTE INTERIM STORAGE ARCHITECTURE

1.0 INTRODUCTION

This report presents descriptions and analysis of alternative system architectures considered for performing the Immobilized Low-Activity Waste (ILAW) Interim Storage function. Section 1.0 provides introductory and background information about the ILAW Interim Storage subproject. Section 2.0 presents the problem statement in the form of objectives, key issues, scope, and a description of the approach taken in this analysis. Section 3.0 describes the constraints, assumptions, and performance requirements that formed the basis for the generation of alternatives. Section 4.0 describes the decision criteria that were used to evaluate the developed alternatives. A description of each of the developed alternatives is presented in Section 5.0. Section 6.0 summarizes the analysis of the architecture alternatives. A summary of the study findings is presented in Section 7.0 and Section 8.0 provides a list of references used in this study.

1.1 BACKGROUND

In July 1995, the U.S. Department of Energy (DOE) initiated a program to privatize the treatment and immobilization of Hanford Site tank waste. The Tank Waste Remediation System (TWRS) privatization strategy is described in the privatization Request for Proposals (RFP) (Wagoner 1996). In the first phase of privatization, vendors will be selected to establish the technical, operational, regulatory, and financial elements of the privatized services program, and then perform demonstration scale treatment of Hanford Site tank waste in facilities that are developed, financed, permitted, constructed, owned, operated, and deactivated by the vendor. Storage and disposal of ILAW will be provided by DOE.

The current privatization schedule indicates the start of ILAW production in 2002. Completion of minimum order quantities is required by 2007. The Fiscal Year (FY) 1996 TWRS Low-Level Waste (LLW) Disposal subproject multi-year program plan (MYPP) (Murkowski 1995) shows permanent disposal capacity becoming available in 2009. The ILAW Interim Storage subproject (00L-EEW-465) will provide storage capacity during the interim between the start of privatized production and the opening of the permanent ILAW engineered disposal structure.

1.2 OVERVIEW

The Hanford Site presently has several surplus facilities that may be suitable for storage of ILAW. Among these existing facilities are several process canyons (U Plant, B Plant, T Plant, Plutonium-Uranium Extraction [PUREX]) that are either decommissioned or slated for decommissioning in the near future. The former grout program constructed five LLW disposal vaults and filled one vault with grouted waste before the program was terminated, leaving four empty vaults. The design of the vaults is compliant with *Resource Conservation and Recovery Act of 1976* (RCRA) regulations for hazardous waste storage, surface impoundments, and land disposal facilities.

In addition to the possible use of surplus facilities, the option of constructing a new government-owned storage facility was analyzed and evaluated. The option of contracting the storage function out to a private contractor was also considered. The analysis considered other variations of these options, including using only some parts of the canyon buildings and using combinations of the existing vaults with canyon buildings and/or new construction.

This study was performed in accordance with WHC-IP-1231, the implementing procedure for Systems Engineering procedure TSEP-3.0, "Alternatives Generation and Analysis," and TSEP-9.0, "Decision Management." This report provides documentation to support the required analysis for architecture selection decision 4.2.4.2.3.

2.0 PROBLEM STATEMENT

This section describes the problem statement for this analysis, including the objectives of the analysis, key issues identified during the analysis, scope of the analysis, and the approach used in developing the analysis.

2.1 OBJECTIVES

The primary objective of this analysis is to provide the supporting information needed for the decision that will select the ILAW Interim Storage System architecture, element 4.2.4.2 of the TWRS Architecture. The secondary objective is to provide information in support of other decisions (e.g., infrastructure, disposal architecture) for the TWRS LLW Disposal Subproject and to provide input for the development of the Technical Requirements Specifications (TRS) and Design Requirements Document (DRD) for the ILAW Interim Storage Facility.

2.2 KEY ISSUES

During the course of this analysis, some key issues have been identified as major drivers in the direction of the analysis. These issues are described in this section.

2.2.1 Regulatory Status of Immobilized Low-Activity Waste Product

A key uncertainty that impacts the analysis of ILAW Interim Storage alternatives is the regulatory status of the ILAW product. Hanford Site tank waste contains listed waste constituents and, under the RCRA regulations, residue from the treatment of listed waste (e.g., the ILAW product) is itself listed. Therefore, in the absence of any initiative to have the treated ILAW product delisted, it will be assumed that the Interim Storage Facility must comply with the RCRA and Washington State Department of Ecology (Ecology) regulations for management of hazardous and dangerous waste in containers.

A related aspect of this issue concerns the U.S. Environmental Protection Agency's (EPA) proposed changes in the hazardous waste identification and listing rules (60 FR 66344). Under the current proposal, it is possible that the ILAW product would be allowed to exit the RCRA system, to be regulated only under DOE and/or U.S. Nuclear Regulatory Commission (NRC) rules. Comments on the proposal have been received by the EPA and the rulemaking is scheduled to be finalized by December 15, 1996.

2.2.2 Privatization Uncertainties

At the time this analysis was performed, the TWRS Privatization initiative was at the RFP stage. The technical basis for much of this analysis comes from bounding limits specified in the RFP. The basis for the analysis is likely to change after a private vendor is selected and the technical details of the vendor proposal become available. The parameters that will be affected include the waste package geometry, gross volumetric waste loading, daily package throughput, and total package count. However, the results and conclusions of the analysis are not very sensitive to these parameters and would not be likely to change.

The privatization schedule calls for Part A deliverables to be completed 16 months after award of contract. Therefore, the technical details of the vendor plans would become available in the last quarter of calendar year 1997.

2.3 SCOPE AND BASIS

The scope of this analysis is limited to the ILAW Interim Storage, element 4.2.4.2 of the TWRS architecture. Although the analysis considers the flexibility of the Interim Storage system to function as a disposal system, the ILAW Engineered Disposal Structure architecture is not in the scope of this analysis. Analysis of alternatives for the disposal system architecture is planned for FY 1997.

2.4 APPROACH

This section describes the approach that was taken in performing this analysis. The analysis was broken into five primary tasks. A functional analysis was performed to determine the major subfunctions of the ILAW Interim Storage function. From these functional requirements, several alternatives were developed and a preliminary screening performed. Decision criteria were developed to ensure all of the viable alternatives were evaluated to a common set of benchmarks. The alternatives were then ranked against the objective and subjective criteria to differentiate them with respect to the ability to satisfy the decision criteria.

2.4.1 Functional Analysis

The TWRS level 3 and 4 functions and requirements for the Remediate Tank Waste function have been developed and are described in the TWRS Functions and Requirements document (WHC 1996). The level 4 function "Dispose ILAW" (4.2.4.2) is the parent function for the ILAW Interim Storage function. The level 5 functional decomposition is described in Place (1995) and summarized here.

- **Dispose ILAW (4.2.4.2)** Description: The Dispose ILAW Function transports containers of ILAW packages from the LLW Immobilization Facility, places the waste packages in their designated storage locations, monitors the packages for storage containment integrity, and if necessary, eventually retrieves the packages from storage to prepare them for onsite disposal. The Dispose ILAW Function furnishes shipping containers to the LLW Immobilization Facility. The LLW Immobilization Facility loads the shipping containers with packages of ILAW. The Dispose ILAW function collects the loaded shipping containers and transports them to the disposal area or the interim storage area as required.
- **Accept ILAW (4.2.4.2.1)** Description: The Accept ILAW function receives waste certification data from the ILAW function, evaluates the data provided, and either accepts the waste for storage or disposal or determines the disposition of out-of-specification product.
- **Transport ILAW (4.2.4.2.2)** Description: The Transport ILAW function transports containers of ILAW from the LLW Immobilization Facility to the ILAW Interim Storage Facility and/or to the ILAW Engineered Disposal Structure. The Transport ILAW function provides empty shipping containers to the LLW Immobilization Facility and transports the containers loaded with packages of ILAW to the Interim Storage Facility and the ILAW Engineered Disposal Structure.
- **Interim Store Immobilized LLW Wastes (4.2.4.2.3)** Description: The Interim Store Immobilized LLW Wastes function places the accepted ILAW packages in their designated storage locations, monitors packages for storage containment integrity, and if necessary, eventually retrieves the packages from storage to prepare and load them for either shipment to onsite ILAW disposal or return the material for further processing. The ILAW Interim Storage Facility receives the loaded shipping containers, unloads them, and handles and stores the ILAW packages. Material returned to the process for further processing includes out of specification product and solid forms not acceptable for disposal.
- **Dispose of Immobilized LLW Waste (4.2.4.2.4)** Description: The Dispose of Immobilized LLW Waste function receives ILAW packages in shipping containers, unloads the containers, and emplaces the ILAW packages in the Engineered Disposal Structure. This function also performs monitoring, closure and post-closure monitoring of the Engineered Disposal Structure.

During this study, the ILAW Interim Storage function (4.2.4.2.3) was further decomposed into five proposed subfunctions. These subfunctions define the base requirements for any ILAW Interim Storage alternative. Alternatives that are not capable of performing these functions were excluded from further analysis.

- **Ship/Receive ILAW (4.2.4.2.3.1)** The Interim Storage Facility shall have the capability to receive and ship ILAW packages in shipping containers on a transport vehicle.
- **Handle ILAW (4.2.4.2.3.2)** The facility shall be capable of handling ILAW packages for placement and retrieval within the storage area.
- **Monitor ILAW (4.2.4.2.3.3)** The facility shall be capable of monitoring the integrity of the ILAW packages in storage.
- **Load/Unload ILAW (4.2.4.2.3.4)** The facility shall have the capability to load and unload a waste package from its shipping container.
- **Provide Storage Space (4.2.4.2.3.5)** The facility shall provide space suitable for storing the ILAW packages safely.

2.4.2 Generate Alternatives

The second step performed in this study was to generate a set of viable alternative architectures to perform the ILAW Interim Storage function. The methodology used to generate the alternatives consisted of informal brainstorming sessions in conjunction with discussions among the cognizant DOE and WHC representatives of the ILAW Storage and Disposal program. Descriptions of the candidate architectures that were identified are contained in (Burbank 1996) and are summarized below. Detailed descriptions of the alternatives that were developed for this study can be found in Section 5.0.

2.4.2.1 Existing Vaults. The existing vaults could be retrofitted with waste package handling equipment and used for interim storage of ILAW. The vault concepts differed primarily in the method of access to the vault interior. The two options that were considered were access through the roof and access through the wall. The wall concept was further divided to an open excavation case and a retaining wall/tunnel case.

2.4.2.2 Existing Canyon Building. Existing canyon buildings could be used for interim storage of ILAW waste packages. The analysis focused on PUREX and B Plant canyons, but is considered to be generally applicable to other canyon buildings such as T Plant or U Plant, which have the same basic design as the B Plant canyon building.

2.4.2.3 New Government-Owned Facility. The next option identified was to build a new government-owned facility. Optional configurations for such a facility would be abovegrade, belowgrade, or incorporated into an existing disposal facility such as the Environmental Remediation Disposal Facility (ERDF).

2.4.2.4 Offsite/Commercial Facility. The final option that was identified for interim storage of ILAW was to contract with a private firm to build, operate, and decommission the storage facility. The commercial option would use either the TWRS privatization treatment contractor or another commercial vendor. WHC prepared a position paper on the offsite option (Murkowski 1996) for consideration by the TWRS privatization Contract Support Team and Source Evaluation Board. The paper resulted in a policy decision by DOE to provide government-owned ILAW interim storage and disposal. Therefore, the commercial option was not considered further.

2.4.2.5 Options Initially Considered and Rejected. During the course of the engineering analysis, several options were considered and rejected due to an inability to comply with key constraints. Among these were unshielded abovegrade storage (e.g., storage pads, butler buildings), unshielded belowgrade storage (e.g., in the ERDF), individual shielded storage casks, and the WNP-1 and WNP-4 spray ponds. These options were rejected due to excessive radiation exposure (for unshielded facilities) or excessive costs (for storage casks and WNP spray ponds).

2.4.3 Develop Decision Criteria

The third step in the approach to this study was to develop the decision criteria that would be used for the alternatives analysis. The criteria that were agreed upon were documented in the Decision Plan for this activity (Washenfelder 1996). The criteria were selected based on their likelihood of providing some discrimination between the identified alternatives. The criteria encompassed the following general categories: cost, schedule, operability, maintainability, safety, flexibility, risk, and public acceptance. Section 4.0 provides a detailed description of the decision criteria.

2.4.4 Develop Evaluation Data

The next step in performing the study was to develop engineering data to support the evaluation. A description of the key data used in the evaluation of objective decision criteria follows.

2.4.4.1 Capacity. The required capacity of the ILAW Interim Storage Facility is based on the FY 1996 MYPP and the privatization RFP. The planning case assumptions are described in Appendix A. Using the planning case assumptions and the MYPP schedule, the required capacity for the ILAW interim storage project is 10,400 packages. The derivation of this number is presented in Appendix A and Section 3.3.1.

2.4.4.2 Radiation Shielding. Shielding calculations were performed for the average and maximum package as described in the privatization RFP. Shielding requirements are described in Section 3.3.2. The calculations show that the ILAW packages will require remote handling.

2.4.4.3 Capital Cost. Capital cost estimates were developed by ICF Kaiser Hanford (ICF KH) for each option. The ICF KH report is attached in Appendix B. Estimated capital costs for options that provided the required storage capacity ranged from \$11 million to \$18 million.

2.4.4.4 Schedule. Project schedules were developed by WHC and ICF KH for comparison to existing and proposed *Hanford Federal Facility Agreement and Consent Order* (referred to as the Tri-Party Agreement) (Ecology et al. 1996) milestones.

2.4.5 Perform Evaluation

Evaluation of the developed alternatives was performed by project and engineering staff using an evaluation criteria matrix worksheet. Individual evaluations were combined to arrive at a consensus opinion. Objective decision criteria were evaluated by using engineering data developed during the analysis. Subjective decision criteria were evaluated based on the engineering judgment of the technical staff and consultation with subject matter experts. Section 6.0 provides more details on the methodology and results of the analysis.

3.0 CONSTRAINTS AND ASSUMPTIONS

This section describes the constraints and assumptions that define the framework within which the analysis was performed.

3.1 CONSTRAINTS

Requirements that are imposed on the system by outside agencies are considered to be constraints. The key constraints that drive the ILAW interim storage architecture come from the Code of Federal Regulations (CFR), the Washington Administrative Code (WAC), and DOE Orders. Since all viable options must be capable of complying with the constraints, the list was used as a screening tool to eliminate some concepts from consideration. Table 3-1 lists the primary sources of constraints on this project.

Table 3-1. Applicable Constraint Documents. (2 sheets)

Document Identifier	Title
10 CFR 830	Nuclear Safety Management, Subpart A, General Provisions, Section 830.120, Quality Assurance Requirements
10 CFR 835	Occupational Radiation Protection
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 52	Approval and Promulgation of Implementation Plans
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
DOE Order 1540.2	Hazardous Material Packaging for Transportation - Administrative Procedures
DOE Order 5000.3B	Occurrence Reporting and Processing Operations Information
DOE Order 5400.1	General Environmental Protection Program
DOE Order 5400.5 (1990)	Radiation Protection of the Public and the Environment
DOE Order 5480.1B	Environment, Safety, and Health Program for Department of Energy Operations
DOE Order 5480.3	Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Waste
DOE Order 5480.4 (1984)	Environmental Protection, Safety, and Health Protection Standards
DOE Order 5480.6 (1992)	Radiological Control
DOE Order 5480.7A	Fire Protection

Table 3-1. Applicable Constraint Documents. (2 sheets)

Document Identifier	Title
DOE Order 5480.7	Fire Protection
DOE Order 5480.11 (1988)	Radiation Protection for Occupational Workers
DOE Order 5480.19	Conduct of Operations Requirements for DOE Facilities
DOE Order 5480.20 (1991)	Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities
DOE Order 5480.21	Unreviewed Safety Questions
DOE Order 5480.22	Technical Safety Requirements
DOE Order 5480.23	Nuclear Safety Analysis Reports
DOE Order 5483.1A (1983)	Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities
DOE Order 5500.7B	Emergency Operations Records Protection Program
DOE Order 5820.2A (1993)	Radioactive Waste Management
DOE Order 6430.1A (1989)	General Design Criteria
NFPA 70 (1993)	National Electrical Code
NFPA 101 (1993)	Code for Safety of Life from Fire in Buildings and Structures, Vol. 5
UBC (1994)	Uniform Building Code
Tri-Party Agreement (1996)	Hanford Federal Facility Agreement and Consent Order (Amendment 6)
WAC 173-401	Operating Permit Regulation
WAC 173-303	Dangerous Waste Regulations
WAC 246-220	Radiation Protection--General Provisions
WAC 246-290	Public Water Supplies

3.2 ASSUMPTIONS

Assumptions were made for areas where insufficient information existed or a required analysis had not been completed. The five main assumptions used in this analysis and the rationale behind them are described here.

3.2.1 Regulated Dangerous Waste

The first assumption is that the ILAW product will be a regulated dangerous waste. This is a conservative assumption, in that it reflects the currently existing situation, and results in the imposition of the most restrictive constraints. If the situation were to change in

the future due to a successful delisting petition or EPA rule changes, the likely result would be fewer constraints on the facility, resulting in less restrictive design requirements and a potentially lower total project cost.

3.2.2 Transportation Mode

The second assumption is that the transportation mode will be truck or rail. Although a formal analysis of transportation options has not been completed (and may not be necessary), it appears that either a conventional tractor-trailer or a flatbed rail car would be capable of meeting all transportation requirements for the ILAW product. All alternatives include a truck/rail transloading building to allow the flexibility of using either transport mode.

3.2.3 Performance Assessment

The third assumption is that performance assessment issues are not relevant to the storage function. The rationale behind this assumption is that interim storage is a short term condition, and a performance assessment is intended to predict the long term consequences of a permanent disposal action. Although this analysis considers flexibility to perform as disposal to be a desirable feature, the detailed evaluation of performance assessment issues and their impacts on disposal options is outside the scope of this study.

3.2.4 Waste Package Specifications

The fourth assumption is that the waste package will comply with the central case of privatization RFP Specification 2. This specification describes the nominal size and configuration of waste packages, maximum limits on product volume, and maximum average dose rates from waste packages. The rationale for this assumption is that, until the details of the private vendor proposals are known, this is the best available information.

3.2.5 Facility Life Cycle

The last major assumption is that the storage facility life cycle is complete when it has been filled to capacity. This assumption was made to help differentiate the life-cycle costs of the alternatives and to prevent the analysis from being influenced by inequitable comparisons of decommissioning and closure costs. The costs of waste retrieval and storage facility closure would be borne by the ILAW Disposal subproject, if the disposal system analysis determines that the stored wastes must be relocated for final disposal. If the disposal system analysis indicates that the wastes may be left in place, the storage system would be closed as a disposal unit. If not, the storage action should not affect the closure requirements for the facility following removal of the waste packages.

3.3 PERFORMANCE REQUIREMENTS

Performance requirements for the Interim Storage Facility were developed to provide measurable decision criteria to differentiate the options from one another. The requirements that result in a measurable difference between the options are described here.

3.3.1 Storage Capacity

The storage capacity of options that used existing facilities was determined using a standard set of assumptions for waste package size, spacing, and stacking height. Facility-specific constraints such as floor space and crane geometry were used to determine the package layout and the corresponding maximum capacity of the options that used existing facilities.

For the new facility options, the required storage capacity was based on the FY 1996 MYPP interim storage operating life of 7.5 years, and the RFP durations and order quantities. The Phase I minimum order quantity of 2,800 MT of sodium and base contract duration of 5 years gives a production rate of 560 MT sodium per year for each vendor. The additional quantity of 2,300 MT sodium that would be produced during the four year contract extension gives a production rate of 575 MT sodium during the extension period. Thus, for the 7.5-year Interim Storage Facility operating life, assuming two vendors are selected, the production quantity is $[(5 \times 560) + (2.5 \times 575)] \times 2 = 8,475$ MT sodium. Using 20 wt% Na₂O waste loading, 80 vol% fill efficiency, and glass density of 2.65 g/cm³, with a package size of 1.2 m x 1.2 m x 1.8 m, gives the design capacity of the ILAW interim storage project of 10,400 packages (see Appendix A).

3.3.2 Radiation Shielding

Preliminary radiation dose rate calculations based on the average and maximum packages as defined by the privatization RFP were used to determine the thickness requirements for steel and concrete shielding structures. These requirements were compared with the existing facility configurations to differentiate the options from the standpoint of worker radiation exposure. For a new facility concept, the requirement was used as the design basis for shielding.

The results of radiation shielding calculations performed to determine the shielding requirements for waste package transport containers and the storage facility are presented in Tables 3-2 and 3-3. Calculations were performed using Microshield^{®1} Version 3.13 (Grove Engineering 1992). Shielding calculations are considered to be preliminary and will be refined further during conceptual design.

¹Microshield is a trademark of Grove Engineering, Inc., Rockville, MD 20850.

Table 3-2 shows the calculated waste package shielding requirements and the requirements basis for the transportation function. The analysis shows that weight limits for truck transport will allow no more than two waste packages per shipment.

Table 3-2. Shielding for Immobilized Low-Activity Waste Transportation.

Radiation limit	Steel shielding thickness required for waste form/ ¹³⁷ Cs concentration		
	Glass monolith 8 Ci/m ³	Glass marbles 6 Ci/m ³	Glass marbles 8 Ci/m ³
1,000 mrem/h at package surface (RFP/Interface Control Document)	15.9 mm	15.9 mm	22.2 mm
200 mrem/h at surface (Interface Control Document/contact handling/DOT)	43.0 mm	43.0 mm	50.0 mm
10 mrem/h at 2 m (Interface Control Document/DOT)	75.0 mm	75.0 mm	83.0 mm

DOT = Department of Transportation

RFP = Request for Proposal

Note: Transport container at truck cab $\leq$ 2 mrem/h (DOT) requires up to 38-mm (1.5 in.) of additional steel shielding on back of cab.

Key findings:

1. The waste form affects the shielding design.
2. Shipping containers could weigh approximately 7.5 MT each.
3. The weight required for shielding will limit trailer to two waste packages per shipment.

Table 3-3. Shielding for Immobilized Low-Activity Waste Storage.

Zone category	Access time allowed	Maximum dose rate (mrem/h)
Uncontrolled area	Fulltime	0.05
Controlled area		
1	Fulltime	0.25
2	Less than 1 hour per day	2.0
3	Less than 1 hour per week	10
4	Less than 10 hours/year	50
5	No normal access allowed	> 50

Based on 500 mrem/year control guideline.

Results:

Walls

Zone 1	46 cm (18 in.) of solid concrete
Zone 2	38 cm (15 in.) of solid concrete
Zone 3	23 cm (9 in.) of solid concrete

Roof

Zone 3	23 cm (9 in.) of solid concrete
Zone 4	15 cm (6 in.) of solid concrete

Note: Higher dose rate packages may need to be located away from walls.

Calculations were also performed on a large array of waste packages and the results compared to the *Radiological Design Guide* (Evans 1994). Table 3-3 shows the calculated storage facility shielding requirements as a function of adjacent occupancy zones and the thickness of concrete shielding required to achieve a desired dose rate, based on average ^{137}Cs curie content of 3 Ci/m^3 . If packages with higher cesium content are received, they may need to be located away from walls to take advantage of the self-shielding characteristics of the waste form.

4.0 DECISION CRITERIA

This section describes the decision criteria that were used to determine the relative rankings of each alternative. The decision criteria can be grouped into the major categories of cost, schedule, operability, maintainability, safety, flexibility, risk, and public acceptance.

4.1 COST

Consideration of the cost of the options was split into the two subcategories of capital cost and operating cost. For the purpose of this analysis, the life cycle of the storage facility was defined to end when the facility was filled to capacity. It is assumed that costs for waste retrieval from the storage facility (if necessary) would be borne by the ILAW Disposal subproject.

4.1.1 Capital Cost

Capital costs were evaluated objectively based on capital cost estimates that were developed by ICF KH for each alternative. The capital cost estimates were at a rough order-of-magnitude (ROM) level of accuracy, due to the limited amount of detailed design data. Capital cost estimates included engineering, design, construction, contract administration, project management, and project integration. A 35 percent contingency was included in all of the capital cost estimates. Options with lower capital cost received higher scores.

4.1.2 Operating Cost

Relative operating costs were evaluated subjectively based on engineering judgement of which options would require a larger workforce. Consideration of utility costs and maintenance requirements for the existing facility options was also included. Lower operating cost options received higher scores.

4.2 SCHEDULE

The ability of an option to meet critical schedule milestones was considered under this category. The alternatives were objectively evaluated for the ability to meet three key sets of schedule criteria: the privatization schedule, the MYPP schedule, and the Tri-Party Agreement (Ecology et al. 1996) milestones.

4.2.1 Privatization Schedule

The primary schedule driver for this project is the need to have storage capacity available when the private treatment contractor begins production. This criterion was a go/no-go test to determine if it was possible to implement an option by the July 2002 start date.

4.2.2 Multi-Year Program Plan Milestones

The FY 1996 MYPP schedule provides additional milestones to be met by this project. The MYPP schedule provided the basis for the 7.5-year operating life of the ILAW Storage Facility, and consequently, the capacity requirement for the new facility options. For the existing facility options, the available capacity was compared to the MYPP assumptions regarding production rates to determine the operating life of the option. This analysis was used to support the various combination options that were evaluated.

4.2.3 Tri-Party Agreement Milestones

The Tri-Party Agreement provides legally enforceable milestones for the DOE tank waste remediation system. At the time this study was performed, the TWRS Tri-Party Agreement milestones were under negotiation pending approval of the TWRS Environmental Impact Statement (EIS). Until the milestones are changed to reflect the final EIS, the current TWRS Tri-Party Agreement milestones have little relevance to this project, and they were not considered to be discriminators for the evaluation.

When approved, the new M-90 series milestones currently under negotiation will govern this project and will be incorporated into the MYPP update for FY 1997. The proposed M-90 milestones are consistent and compatible with this analysis, and were negotiated with full cognizance of the results of this analysis.

4.3 OPERATION, MAINTENANCE, AND SAFETY

The alternatives were evaluated from a daily operations standpoint under this category. The category was further subdivided into four subcategories of operability, maintainability, safety, and radiation exposure.

4.3.1 Operability

Operability was evaluated subjectively based on the estimated complexity of the procedures that would be used during the daily operations of the facility. All alternatives were developed to include remote handling of waste packages. Options with fewer pieces of equipment and simpler operating procedures scored higher.

4.3.2 Maintainability

Maintainability was evaluated subjectively based on the estimated complexity of the machines and equipment needed to support the storage facility. Equipment accessibility, zone entry, and contact versus remote maintenance were important considerations in this evaluation category. Options with fewer moving parts, easy contact maintenance access, and off-the-shelf equipment scored higher.

4.3.3 Safety

Safety was evaluated subjectively based on the estimated number and severity of potential hazards associated with the facility. The options with the fewest and least hazardous safety risks were scored highest.

4.3.4 Radiation Exposure

Radiation exposure was evaluated subjectively based on the estimated relative ease or difficulty that would be encountered in keeping exposure as low as reasonably achievable (ALARA). Options that minimized the possibility of surface contamination and that had sufficient shielding for personnel were scored highest.

4.4 FLEXIBILITY

The flexibility of an alternative to perform additional functions in addition to the primary interim storage function was evaluated under this category. The options were ranked based on their perceived ability to be converted to a disposal configuration, and on the ease of retrieval of waste packages if necessary.

4.4.1 Waste Retrieval

Retrievability was evaluated subjectively based on the estimated ease of reentering the facility for package retrieval after the storage period is over. Options that provided easy retrievability were scored higher.

4.4.2 Waste Disposal

This criterion was evaluated on the basis of whether the option could serve as a disposal facility in the future. Options that could serve as RCRA compliant disposal scored highest, followed by those that could serve as non-RCRA disposal, then those that could not

serve as disposal. The physical logistics of closure (e.g., backfilling, monitoring) were also considered under this criterion.

4.5 RISK

The relative risks of the alternatives were subjectively ranked based on the perceived degree of programmatic, technical, regulatory, and political uncertainty. Options that were judged to have low risk received higher scores.

4.5.1 Programmatic Risk

Programmatic risk reflects the perceived likelihood that an option may not be able to fulfill programmatic objectives. The primary programmatic objectives are to provide sufficient storage capacity in time to support the privatization contractors operations.

4.5.2 Technical Risk

The technical risk criterion considers the potential technical hurdles that the option must overcome. Technical constraints include the need to develop new technology or to apply existing technology in a new or previously untested manner.

4.5.3 Regulatory Risk

The regulatory risk criterion is a measure of the perceived difficulty of obtaining the necessary regulatory approvals and permits to allow implementation of the option.

4.5.4 Political Risk

Political risks that might impact the ability of an option to fulfill its mission are considered in this evaluation criterion. Political risks include the ability to gain the support of DOE and contractor management, obtain congressional budget authority, and secure stakeholder approval.

4.6 PUBLIC ACCEPTANCE

Significant decisions at Hanford, such as the selection of an ILAW Interim Storage architecture, are subject to considerable scrutiny from the general public and organized stakeholder groups. The level of public acceptance of an option is measured against a

subjective set of values as described in various position papers prepared by the Hanford Advisory Board (HAB) and other stakeholder groups.

4.6.1 Future Site Uses Working Group

The first set of values was formulated in 1992 by the Future Site Uses Working Group (DOE 1992):

- Protect the Columbia River
- Deal realistically and forcefully with groundwater contamination
- Use the Central Plateau wisely for waste management
- Do no harm during cleanup or with new development
- Cleanup of areas with high future use value is important
- Clean up to the level necessary to enable future use options
- Transport wastes safely and be prepared for emergencies
- Capture economic development opportunities locally
- Involve the public in future decisions about the Hanford Site.

4.6.2 Tank Waste Task Force

In 1993, the Tank Waste Task Force reinforced the first set of values by adding the following values (Drummond 1993):

- Get on with cleanup
- Protect the environment
- Protect public and worker health and safety
- Use systems design approach that keeps endpoints in mind as intermediate decisions are made
- Establish management practices that ensure accountability, efficiency, and allocation of funds to high priority items.

4.6.3 Hanford Advisory Board

The first major action taken by the HAB in early 1994 was to endorse and adopt both sets of values from the previous stakeholder groups. In September 1994, acting on a recommendation from its Cultural and Socioeconomic Impacts Committee, the Board adopted these additional values (Gould 1994):

- Historic and cultural resources have value. They should not be degraded or destroyed. Appropriate access to those resources is a part of their value.
- Work force stability and reasonable stability in the demand for public services are important for the affected communities. In decisions on projects and contractors, consideration should be given to affected work force and population shifts.
- Cleanup and waste management decisions should be coordinated with the efforts of the affected communities to shift toward more private business activity and away from dependence on federal projects that have adverse environmental or economic impact.
- The importance of ecological diversity and recreational opportunities should be recognized; those resources should be enhanced as a result of cleanup and waste management decisions.
- These concerns should be considered while promoting the most effective and efficient actions that will protect environmental quality and public health and safety now and for future generations.
- Cleanup activities should protect to the maximum degree possible the integrity of all biological resources, with specific attention to rare, threatened, and endangered species and their related habitat.

These values were used to prepare a subjective ranking of each option based on whether the option substantially met the intent of the statement, was not applicable, or substantially failed to meet the intent of the statement.

5.0 DESCRIPTION OF ALTERNATIVES

The alternatives that were identified were developed to a preconceptual study level by ICF KH. During the study, additional alternatives were discovered and subsets of the identified options became clear. The options are summarized below. Additional details describing maintenance and operating concepts for each of the options can also be found in the ICF KH report, included in Appendix B.

5.1 EXISTING VAULTS

The existing waste vaults were constructed by the former grout program in the late 1980's and early 1990's. The vaults were designed to contain a liquid LLW grout mixture during the curing and solidification period, and to serve as a disposal structure for the resulting grouted waste monolith. Five vaults were constructed; one was filled before termination of the program, leaving four empty vaults available for use.

Each vault is 37.64 m (123.5 ft) long and 15.39 m (50.5 ft) wide, with a roof clearance of 10.36 m (34.0 ft), providing 579 m² (6,236 ft²) of floor space. The vaults are constructed of reinforced concrete, and were designed and constructed in compliance with RCRA requirements for both hazardous waste surface impoundments and land disposal units. The side walls are 1.37 m (4.5 ft) thick at the base, tapering to 0.61 m (2.0 ft) wide at the top. The end walls have a constant thickness of 0.76 m (2.5 ft). The floor slab is 1.37 m (4.5 ft) thick and is flat and level.

The roof is composed of 29 slabs 16.61 m (54.5 ft) long, 1.22 m (4.0 ft) wide, and 0.66 m (2.17 ft) thick, with a 1.90 m (6.25 ft) wide slab at each end. The roof contains numerous piping penetrations for filling, ventilating, and monitoring the interior of the vault. The entire structure of each vault is encased in a bituminous sealant and geotextile system, up to 0.91 m (3.0 ft) thick. The vault construction excavation has been partially backfilled, so that the grade adjacent to the vaults is presently level with the top of the roof.

Each vault is built above a RCRA-compliant leak detection and collection system. The leak detection system consists of a sealed concrete slab sloped to a collection sump fitted with a riser pipe to the surface. The system is capable of collecting, detecting, sampling, and removing any leachate that might escape from the primary vault structure.

5.1.1 Option 1A--Vaults Wall Access Open Excavation

The wall entry concept (illustrated on pages B-47 and B-48) would involve excavation of the soil on the east (or west) side of the vaults to provide access to the top of the end wall. The bituminous sealant would be removed and the top portion of the end wall would be demolished to provide access to the vault interior. Crane rails would be installed in the

vault, supported from the side walls and protruding out of the end wall opening. A steel unloading building would be constructed immediately adjacent to the end wall. An access roadway would be constructed along the east side of the vaults. The remotely operated vault crane would be used for unloading the waste package from the shielded transport container and placing the package in the storage array. The vault wall access options provide a storage capacity of 5,568 packages.

5.1.2 Option 1B--Vaults Wall Access Enclosed Excavation

This concept is (illustrated on pages B-44 to B-46) identical to the open excavation Option 1A, with the exception that the access road excavation would be supported by retaining walls which would serve two purposes. The walls would minimize the shoulder space requirement for the access roadway, and would provide additional shielding for the radiation shine coming through the vault wall opening.

5.1.3 Option 1C--Vaults Roof Access

The roof entry concept (illustrated on pages B-41 to B-43) would involve removal of the bituminous coating and four of the roof slabs from one end of the vault roof, providing access to the interior. A bridge crane would be installed in the vault, supported from the side walls. On the surface, adjacent to and over the vault roof opening, a steel unloading building would be constructed over a concrete unloading bay slab. The remainder of the vault roof opening would be covered by a steel weather enclosure to prevent entry of precipitation, animals, and wind-blown debris.

The waste transport truck would back into the unloading building, where the waste package would be remotely removed from the transport container. The package would be lifted from the truck and placed in the vault using the unloading crane. The vault bridge crane would then be used to position the package in its storage location. In the roof access option, the storage capacity is reduced to 5,376 packages due to the clearance requirements of the bridge crane and the end walls.

5.2 CANYON BUILDING

Existing canyon buildings could be used for interim storage of ILAW waste packages. The analysis focused on three areas of PUREX (illustrated on pages B-39 and B-40) and on B Plant (illustrated on pages B-37 and B-38), which is generally applicable to other similar canyon buildings such as T Plant or U Plant.

5.2.1 Option 2A--PUREX Canyon Deck

The PUREX deck is the large open area above the process cell cover blocks, measuring approximately 8.38 m (27.5 ft) wide by 247.8 m (813 ft) long. In this option, a modular steel floor system about 0.91 m (3.0 ft) high would be installed on the cover blocks to raise the packages above the cover block lifting bails and spread the load evenly across the cover blocks. The transport vehicle could enter the building through the rail tunnel at the east end of the building, or the packages could be offloaded to a rail car for entry into the tunnel. The cost estimates for all PUREX options include a rail/truck transloading building to provide flexibility in selection of the transportation mode.

The overhead clearance above the deck is constrained by the main bridge crane so that packages can only be stacked four high. If the main crane were removed from service, the slave crane could be used for package handling, allowing for a 50 percent increase in storage capacity. The analysis assumed that the main bridge crane would remain in service, limiting the capacity of this option to 4,260 packages.

5.2.2 Option 2B--PUREX Storage Gallery

The storage gallery is a clean area located on the lower level of the PUREX building immediately north of the process cells. The gallery is about 231.6 m (760 ft) long by 5.94 m (19.5 ft) wide, with a ceiling height of 6.75 m (22.17 ft), which limits the package stacking to five high. Accounting for the intrusion of a process cell at the west end and a stairwell at the east end, the storage capacity is 2,700 packages.

Access to the storage gallery would be from the existing annex building loading dock, through the aqueous makeup (AMU) area to the elevator and down to the lower level. The elevator would need to be upgraded or replaced to meet the required load capacity. Package handling would be via remotely operated automatic guided vehicles (AGVs) similar in concept to a forklift. The annex loading dock and AMU area would be modified to allow remote handling of the packages by the AGVs.

5.2.3 Option 2C--PUREX Process Cells

The process cell area of PUREX contains 12 cells with an overall length of about 264 m (867 ft). The cells are 4.26 m (14 ft) wide and 12 m (39.5 ft) deep. In this concept, the cover blocks would be removed and 82 carbon steel liners capable of holding 24 packages each would be fitted into the cells. The ILAW packages would then be placed into the cell liners for storage. The total capacity of this option is 1,968 packages.

This option is only feasible if all process equipment has been removed from the cells, leaving empty cells ready to accept the liners. No provision is made for demolition or

removal of process equipment in this analysis. If the PUREX process equipment has not been removed, this option becomes prohibitively expensive.

5.2.4 Option 2D--T/U/B Plant

These three older canyon buildings are similar in design, and the analysis of one would be applicable to the others. For this study, B Plant was used as the basis for the analysis. The original concept considered using the storage gallery and process cells for ILAW storage, but a simple analysis of the available capacity showed that these areas would not be cost effective. Therefore, the detailed analysis was limited to the canyon deck area.

The B Plant canyon deck is 11.28 m (37 ft) wide by 243.8 m (800 ft) long. The bridge crane limits the overhead clearance so that packages can only be stacked five high. Like the PUREX option, a modular steel floor system about 0.91 m (3.0 ft) high would be installed on the cover blocks to raise the packages above the cover block lifting bails and spread the load evenly across the deck. The transport vehicle could enter the building directly through the rail tunnel, or packages could be transloaded to a rail car for entry into the building. Packages would be handled using the existing canyon crane. The B Plant canyon deck option provides a storage capacity of 4,800 packages.

5.3 NEW FACILITY

Three concepts for new construction were developed. The first two concepts are identical with the exception that one is above grade and one is below grade. The third option provides only the additional storage space required to complement the vault options to provide the full 10,400 package capacity. All options include a truck/rail transloading building for transport mode flexibility. For the purposes of this analysis, it was assumed that the new facility would be located near the existing vaults, but the evaluation would be generally applicable for other locations that are reasonably close to existing site roads and electrical service. Similarly, the orientation of the new facility could be rotated 90 degrees to allow for the privatization site location east of the vaults with negligible impact on the evaluation results.

5.3.1 Option 3A--New Facility Abovegrade

This alternative (illustrated on pages B-49 to B-51) would involve construction of a new facility configured similar to the vault wall access options, but long enough to provide the entire required capacity. The building would be a concrete structure 15.24 m (50 ft) wide by 266.7 m (875 ft) long with an unloading building attached at one end. The walls and roof would be thick enough to provide the required shielding, and walls would be buttressed to provide additional stiffness for earthquake loads.

5.3.2 Option 3B--New Facility Belowgrade

This option (illustrated on pages B-52 to B-54) is similar to the above grade option with the exception that it is below grade and the roof would be thicker to support the added earth load on the walls.

5.3.3 Option 3C--New Facility Complimentary to Vaults

This option would provide a new below grade building adjacent to and east of one of the existing vaults. The new structure would share a common bridge crane with the vault. The building would be similar in construction to the existing vault, but would be about 140 m (460 ft) long, providing storage capacity for an additional 5,000 packages.

5.4 COMBINATIONS

With the exception of the new facility options 3A and 3B, none of the alternatives identified in this study can provide the required capacity by itself. Therefore, combinations of two options were also analyzed.

5.4.1 Option 4A--Vaults Plus New

This option is a combination of Options 1C and 3C. The existing vaults would be modified first, providing storage capacity for about 4 years of production, during which time the new storage building would be constructed. When the vaults are filled, storage operations would begin in the new structure.

5.4.2 Option 4B--Vaults Plus Canyon

This option is a combination of Options 1C, 2A, and 2B. The existing vaults would be modified first, providing an additional 4 years before any packages would have to be stored in PUREX.

5.4.3 Option 4C--PUREX Plus T/U/B Canyon

This option is a combination of Options 2A, 2B, and 2D. In this concept, the PUREX building would be used first, providing 5 years of storage, followed by B, T, or U Plant for the remaining duration.

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6.0 ANALYSIS OF ALTERNATIVES

The alternatives analysis was performed by engineering staff familiar with the project. The evaluation method was based on well established decision analysis techniques (Kepner and Tregoe 1981), to apply the decision criteria to the alternatives. Each option was ranked from 1 to 10 for technical criteria and were ranked yes(+1)/no(-1)/not applicable(0) for the public acceptance criteria. Individual evaluators' rankings were totaled (for public acceptance criteria) and averaged (for technical criteria) to arrive at a composite consensus ranking for the options. The maximum possible score was 210 points. Of this total, 150 points were for technical criteria, while the public acceptance score could range from -60 to +60 points. Table 6-1 presents the composite scores.

The total scores resulting from the evaluation fell roughly into three tiers. The three vault alternatives (1A, 1B, and 1C) were all in the highest scoring tier. The alternative that received the highest total score was option 1C, the roof access concept for the vaults; however, none of these options can provide the desired storage capacity. Of the five concepts that could provide the planning case design basis capacity (3A, 3B, 4A, 4B, 4C), the highest score was for option 4A, vaults plus new construction. The second tier of scores included the remaining new construction options, as well as combination option 4B, vaults plus canyon. The options that employed only the canyon buildings fell into the lowest scoring tier.

From a practical standpoint, there is not enough difference in the scores of the vault options to differentiate between them or eliminate any of them from consideration. Additional study of the vault options during conceptual design would allow a more detailed analysis to determine the preferred method for accessing the interior of the vaults.

6.1 ANALYSIS

For the cost criteria, the vault options scored well because of their low capital cost per capacity and low total capital cost. The canyon options were judged to be costlier both on a capital cost per package and for operating costs associated with the ventilation systems. The new facility capital costs were the highest of all options except the PUREX cells. Table 6-2 presents a summary of the capital costs. All options were found to be capable of meeting all schedule milestones, and the schedule criteria did not differentiate between the alternatives.

For the operability, maintainability, and safety criteria, the new facility options scored highest, with the vault options close behind. Canyon options scored lower because of the constraints imposed by existing contamination in the facilities and the more complex infrastructure support required.

The vault options and the new facility options scored high in the flexibility criteria, on both disposal and retrieval capabilities. The canyon options scored poorly in this category

because of the known deficiencies in RCRA compliance and contamination issues associated with retrieval from a canyon.

The vault options received high ratings in the risk categories. The new construction options scored lower because of the perceived difficulty of obtaining approval for new construction when existing facilities are empty and available. The canyon options scored lowest because of concerns about their permissibility and technical concerns about the structural integrity and load carrying ability of the cover blocks and cell walls.

Many of the public acceptance criteria were found to be not applicable to the alternatives that were generated, and most of the others were generally found to be met by all of the concepts. The only criteria that scored poorly were associated with disruption of habitat and environment for the options involving new construction.

6.2 DISCUSSION

The analysis of alternative architectures for ILAW interim storage reveals that none of the existing surplus facilities has sufficient capacity to store the volume of product that is expected in the first 7.5 years of privatized treatment operations. The surplus facility options with the largest capacity are the vault options, which provide roughly four years of storage capacity at the projected production rates. The B Plant deck and PUREX deck options (2D and 2A) provide about 3.5 and 3 years of capacity respectively.

Of those options that meet the capacity requirement (3A, 3B, 4A, 4B, and 4C), option 4A scored better than the other options in all major criteria categories except the capital cost and operability categories, where it ranked second. All other options have at least three categories where they are ranked either last or next to last. This indicates that there are significant barriers to be overcome by all options except 4A.

Recent Tri-Party Agreement negotiations with Ecology have resulted in a proposed set of new milestones that provide for disposal capacity to be in place three years after the commencement of production. If these milestones are approved and adequately funded, any one of the vault options (1A, 1B, or 1C) alone could provide the required capacity, and additional capacity would not be needed. This provides the opportunity to separate the decision on the initial increment of storage capacity, which can use modified existing facilities, from the decision on the remainder, which may require major new construction or may be found to be unnecessary.

A decision at this time to pursue the use of the vaults for ILAW interim storage would have minimal risk. More detailed study is indicated during conceptual design to select between the roof access or wall access concepts for the vault option.

Table 6-1. Immobilized Low-Level Waste Evaluation Matrix Composite Scores.

	Option 1A: Vault, wall access, open excavation	Option 1B: Vault, wall access, enclosed excavation	Option 1C: Vault, roof access	Option 2A: Canyon building, PUREX deck	Option 2B: Canyon building, PUREX Storage Gallery	Option 2C: Canyon building, PUREX Process Cells	Option 2D: Canyon building, TAU/8 Plant	Option 3A: New facility, above grade	Option 3B: New facility, below grade	Option 3C: New facility, Complementary to Vaults	Option 4A: Combination, Vault + new	Option 4B: Combination, Vault + Canyon	Option 4C: Combination, PUREX + TAU/8 Canyon
TECHNICAL EVALUATION CRITERIA													
A. COST													
A.i. Capital Cost	6	7	10	6	6	2	6	5	4	6	6	9	7
A.ii. Operating Cost	6	10	6	6	4	5	10	6	6	6	10	6	5
B. SCHEDULE													
B.i. Meets TPA milestones	10	10	10	10	10	10	10	10	10	10	10	10	10
B.ii. Meets MYPP milestones	10	10	10	10	10	10	10	10	10	10	10	10	10
B.iii. Supports privatization schedule	10	10	10	10	10	10	10	10	10	10	10	10	10
C. OPERATIONS/MAINTENANCE/SAFETY													
C.i. Operability	6	6	9	7	6	5	6	10	9	9	9	8	6
C.ii. Maintainability	7	7	8	5	4	5	9	9	9	9	9	8	6
C.iii. Safety	6	8	9	6	6	6	10	9	9	9	10	8	6
C.iii. Radiation exposure/ALARA	9	9	9	6	6	5	6	9	9	9	9	8	6
D. FLEXIBILITY													
D.i. Ability to convert to disposal	9	9	10	3	4	4	3	7	10	10	10	7	9
D.ii. Ability to retrieve for disposal	9	9	9	7	7	6	7	10	9	9	10	8	7
E. RISK													
E.i. Programmatic risks	10	10	10	5	5	2	5	6	6	8	9	7	5
E.ii. Technical risks	6	8	9	6	5	4	5	10	10	10	7	7	6
E.iii. Regulatory risks	10	10	10	4	4	4	3	9	9	9	10	7	3
E.iii. Political risks	10	10	10	5	5	5	7	7	8	8	8	8	5
SUBTOTAL - TECHNICAL EVALUATION CRITERIA	137	135	141	94	94	81	91	132	131	137	141	120	94
F. PUBLIC ACCEPTANCE EVALUATION CRITERIA													
F.i. Protect the Columbia river.	2	2	2	2	2	2	2	2	2	2	2	2	2
F.ii. Deal realistically and forcefully with groundwater contamination.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.iii. Use the Central Plateau wisely for waste management.	2	2	2	2	2	2	2	1	1	1	2	2	2
F.iii. Do no harm during cleanup or with new development.	1	1	1	2	2	2	2	-1	-1	0	1	2	2
F.v. Cleanup of areas with high future use value is important.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.vi. Clean up to the level necessary to enable future use options.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.viii. Transport waste safely and be prepared for emergencies.	2	2	2	0	0	0	0	1	1	2	2	1	0
F.viii. Capture economic development opportunities locally.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.ix. Involve the public in future decisions about the Hanford site.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.x. Get on with the cleanup.	1	1	1	0	0	0	1	0	0	0	1	1	1
F.xi. Protect the environment.	1	1	1	0	0	0	0	1	1	1	1	1	0
F.xii. Protect public and worker health and safety.	1	1	1	0	0	0	0	1	1	1	1	1	0
F.xiii. Use systems design approach that keeps endpoints in mind as intermediate decisions are made.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xiv. Establish management practices that ensure accountability, efficiency, and allocation of funds to high priority items.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xv. Historic and cultural resources have value. They should not be degraded or destroyed. Appropriate access to those resources is a part of their value.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xvi. Workforce stability and reasonable stability in the demand for public services are important for the affected communities. In decisions on projects and contractors, consideration should be given to affected workforce and population shifts.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xvii. Cleanup and waste management decisions should be coordinated with the efforts of the affected communities to shift toward more private business activity and away from dependence on federal projects having adverse environmental or economic impacts	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xviii. The importance of ecological diversity and recreational opportunities should be recognized; those resources should be enhanced as a result of cleanup and waste management decisions.	0	0	0	0	0	0	0	0	0	0	0	0	0
F.xix. These concerns should be considered while promoting the most effective and efficient actions that will protect environmental quality and public health and safety now and for future generations.	1	1	1	0	0	-1	0	-1	-1	0	1	1	0
F.x. Cleanup activities should protect to the maximum degree possible the integrity of all biological resources, with specific attention to rare, threatened, and endangered species and their related habitat.	0	0	0	0	0	0	0	-1	-1	-1	-1	0	0
SUBTOTAL - PUBLIC ACCEPTANCE CRITERIA	11	11	11	6	6	5	7	3	3	8	9	9	7
TOTAL SCORE	148	146	152	100	100	86	98	135	134	143	149	129	101
NOTE: ONLY THE SHADED OPTIONS MEET THE PLANNING CASE DESIGN BASIS CAPACITY													

Table 6-2. Capital Cost Summary Immobilized Low-Activity Waste Interim Storage Options.

Option	Description	Capacity, package count	Capital cost (\$1,000)	Cost per package
Grout vaults	1A Wall Access Open Excavation	5,568	\$4,320	\$776
	1B Wall Access Enclosed Excavation	5,568	\$6,560	\$1,178
	1C Roof Access	5,376	\$4,170	\$776
Canyon building	2A PUREX Deck	4,260	\$5,540	\$1,300
	2B PUREX Storage Gallery	2,700	\$2,258	\$836
	2C PUREX Process Cells	1,968	\$10,770	\$5,473
	2D T/U/B Plant Deck	4,800	\$5,055	\$1,053
New facility	3A Above Ground	10,800	\$16,143	\$1,495
	3B Below Ground	10,800	\$18,102	\$1,676
	3C Complimentary to Vaults	5,000	\$6,980	\$1,396
Combinations	4A Vault + New	10,376	\$11,150	\$1,075
	4B Vault + Canyon	12,336	\$11,968	\$970
	4C PUREX + Canyon	11,170	\$12,853	\$1,093

PUREX = Plutonium-Uranium Extraction.

7.0 SUMMARY AND CONCLUSIONS

Thirteen different concepts have been developed and analyzed for the ability to meet the ILAW Interim Storage architecture selection decision criteria. The concepts cover a range of ideas encompassing modifications to existing surplus facilities and newly constructed facilities. The analysis shows that option 4A, using a combination of the existing waste vaults and new construction, has the highest composite rating for those options that meet all of the decision criteria. If the capacity criterion were to be modified due to changes in the interim storage operating duration, then the waste vault concepts 1A, 1B, and 1C become the highest ranking options.

Since the highest ranking option that meets all decision criteria is a combination that includes a vault option, the opportunity exists to consider two separate decisions. The first decision would entail selection of the architecture for the initial storage increment, allowing the decision on the remaining increment of storage capacity to be deferred. There is little risk in pursuing a path forward that includes a waste vault option. If a vault option is implemented first, it would provide almost four years of storage capacity and allow the decision on additional storage capacity to be deferred until a later time.

A decision at this time to pursue the use of the vaults for ILAW interim storage would have minimal risk. More detailed study is indicated during conceptual design to select between the roof access or wall access concepts for the vault option.

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APPENDIX A

PLANNING CASE DESIGN BASIS

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WHC-SD-W465-AGA-001
Revision 0

ILLW INTERIM STORAGE PROJECT W-465 PLANNING CASE DESIGN BASIS				
RFP Specifications (Phase I, each vendor)	Envelope A	Envelope B	Envelope C	Total
1) Base contract quantities, MT Na	2600	100	100	2800
2) Extension contract quantity, MT Na	2300	0	0	2300
3) Maximum product volume, cm ³ /gmol Na	100	250	100	102.94
4) Nominal waste package volume, m ³	2.59	2.59	2.59	2.59
5) Base contract duration, years	5	5	5	5
6) Extension contract duration, years	4	4	4	4
Enabling Assumptions (DOE Direction)				
a) Waste Oxide Loading, wt% Na ₂ O	20	20	20	20
b) Package fill fraction, vol%	80	80	80	80
c) Orme flowsheet total quantity, MT Na				7.80E+04
d) Nominal average product volume, cm ³ /gmol Na	73.11	73.11	73.11	73.11
Derived Design Factors (each vendor)				
A) Base throughput, MT Na/year	520	20	20	560
A1) Extension throughput, MT Na/year	575	0	0	575
B) Base throughput, gmol Na/year	2.26E+07	8.70E+05	8.70E+05	2.44E+07
B1) Extension throughput, gmol Na/year	2.50E+07	0.00E+00	0.00E+00	2.50E+07
C) Base nominal product volume, m ³ /year	1.65E+03	6.36E+01	6.36E+01	1.78E+03
C1) Extension nominal product volume, m ³ /year	1.83E+03	0.00E+00	0.00E+00	1.83E+03
D) Base nominal package count, pkgs/year	638.01	24.54	24.54	687.09
D1) Extension nominal package count, pkgs/year	705.50	0.00	0.00	705.50
E) Base total package count				3435
E1) Extension total package count				2822
F) Phase 1 total package count (each vendor)				6257
ILLW Interim Storage MYPP Basis				
i) Operating life, years	7.5	7.5	7.5	7.5
ii) Vendor TOE	0.6	0.6	0.6	0.6
iii) Number of vendors	2	2	2	2
Derived Design Factors (Interim storage)				
a) Maximum total package count	13551	839	336	14726
b) Nominal total package count	9908	245	245	10398
c) Maximum average package flux, packages/day	4.95	0.31	0.12	5.38
d) Maximum peak package flux, packages/day	8.25	0.51	0.20	8.97
e) Nominal average package flux, packages/day	3.62	0.09	0.09	3.80
f) Nominal peak package flux, packages/day	6.03	0.15	0.15	6.33
Derived Design Factors (Phase I Privatization)				
a) Maximum total package count				17621
b) Nominal total package count				12515
Derived Design Factors (Phase II Privatization)				
a) Nominal total package count				83218
Derived Design Factors (ILLW Disposal)				
a) Total disposal package count				95733

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Author: Neil R Brown at -DOE4
Date: 3/8/96 3:29 PM
Subject: LLW planning case: Waste Loading etc.

----- Message Contents -----

To all:

Re: LLW planning case

After a meeting attended by many of us, the following has been agreed to as the planning basis for cost estimates. We will all use the following:

1. The total amount of sodium to be processed into ILAW is 7.8E4 MT of sodium (Na) -- this is taken from the ORME flowsheet rev 1.
2. The amount of sodium to be processed in Phase 1 shall be broken into two components. The first 5 years of production, each vendor shall process 2800 MT of sodium, resulting in a total of 5600 MT of sodium processed. In the optional 4 years following, each shall process 2300MT or a total of 4600 MT. (This represents the maximum amount of sodium in the contract). The total for phase 1 processing is 10,200 MT of sodium. The remainder of the sodium shall be processed in Phase 2. Linear production rates are to be assumed.
3. The waste loading shall be 73.1 cm3 of package volume per gram mol of sodium processed. The 73.1 cm3 package volume is based upon a waste oxide loading of 20 wt% waste Na2O and the package (external dimensions) filled to 80% full and a glass density of 2.65 g/cm3. The sodium waste oxide loading of 20% is in contrast to the more optimistic 25% used in the Orme flowsheet. Testing data indicates that a 20% loading is more realistic for meeting the required durability. (For clarification, 20% waste sodium loading is approximately 23.3% waste loading on a total waste oxide basis, but since sodium is the key constituent it is easier to think just in terms of sodium loading).

For the total waste sodium (7.8E10g Na) there are a total of 3.39E9 mol of sodium. At 73.1 cm3 of package per mol there are 248E9 cm3 or 248,000 m3 of package for all of the waste. The RFP allows for a maximum of 100 cm3 of package per gram mol of sodium processed, but our best guess is that 73.1 is reasonably achievable and financial incentives are to be negotiated to minimize packaged waste volume.

4. The assumed package volume shall be 2.59 m3. This is in agreement with the central case of the RFP (1.2x1.2x1.8).

5. When all is said and done this results in the following number of packages:

Total:	95,720
Phase 1 first 5 years	6,875
Phase 1 sencond 4 years	5,645
Phase 2 total	83,200

Address all questions to Neil Brown at 372-2323

APPENDIX B

ICF KAISER ENGINEERING REPORT

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W465LR

LETTER REPORT

IMMOBILIZED LOW-LEVEL WASTE
INTERIM STORAGE ALTERNATIVE

PROJECT W-465

Technical Documents

4-26-96

Date

Technical Author

4/26/96

Date

N/A

Quality Engineering

Date

Project Manager

4/26/96

Date

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LETTER REPORT
**IMMOBILIZED LOW-LEVEL WASTE
INTERIM STORAGE ALTERNATIVE**

PROJECT W-465

Prepared for
Westinghouse Hanford Company

April 1996

Subcontract WHC-380393

Prepared by
ICF Kaiser Hanford Company
Richland, Washington

W465LR

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LETTER REPORT

**IMMOBILIZED LOW-LEVEL WASTE
INTERIM STORAGE ALTERNATIVE**

PROJECT W-465

INTRODUCTION

Project W-465, "Low-Level Waste Interim Storage Facility," will provide waste acceptance, storage, and transportation services for immobilized low-level waste (ILLW) products produced by the privatized Tank Waste Remediation System (TWRS) treatment contractors. The ILLW interim storage operating life is 7.5 years and the planning case design basis total waste package count is 10,400 packages.

To provide an ILLW interim storage facility to store a total of 10,400 packages, storage options considered were the existing grout vaults, the 221-B or the Plutonium-Uranium Exchange (PUREX) Canyon Buildings, and a new facility. Several concepts were developed for this study effort. Each concept includes design concepts identifying major construction and modifications required for implementation, rough order magnitude engineering and construction cost estimates, and construction schedules.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A summary of the storage options and concepts, the storage capacity for each concept, and estimated costs are shown in Table 1.

TABLE 1

STORAGE OPTIONS AND CONCEPTS			
Storage Option	Sketches	Storage Capacity (Pkgs)	Cost Estimate (\$1,000)
221-B CANYON BUILDING	ES-465-S1	4,800	5,055
Process Cell Area	ES-465-S2	0	
Canyon Deck Area	ES-465-S2	4,800	5,055
PUREX CANYON BUILDING	ES-465-S3	8,928	18,568
Storage Gallery Area	ES-465-S4	2,700	2,258
Process Cell Area	ES-465-S4	1,968	10,770
Canyon Deck Area	ES-465-S4	4,260	5,540
EXISTING GROUT VAULTS	ES-465-C3		
Roof Access	ES-465-S5,S6	5,376	4,170
Wall Access	ES-465-C4,C5	5,568	
Concrete Enclosure Access	ES-465-C5,S7,S8	5,568	6,560
Open Excavation Road Access	ES-465-C5,S9	5,568	4,320
NEW FACILITY	ES-465-C3-C6		
Complementary Storage Facility	ES-465-C3-C5	5,000	6,980
Independent Storage Facility	ES-465-C6,C7,S12,S13	10,800	
Abovegrade Facility	ES-465-C6,S10,S11	10,800	16,143
Belowgrade Facility	ES-465-C7,S12,S13	10,800	18,102

APPROACH/EVALUATION

The approach and evaluation of the four options are based on the general design criteria and specific assumptions outlined below for each alternative.

- The facilities are designated as nonsafety (Safety Class 3) per U.S. Department of Energy (DOE) Order 6430.1A.
- Required operating life of the facilities is 7.5 years.
- Assume that Westinghouse Hanford Company (WHC) will perform all required environmental assessments.
- Assume that required utilities for the new facilities are readily available within the boundaries of 200-East and/or 200-West Areas.
- None of the existing facilities will require structural modifications for natural phenomenon hazard events (seismic, wind, and tornado missile).
- Canyon cells will be empty to receive the steel liner. No canyon process equipment demolition or modification is considered in this report.
- An engineering analysis was not performed. The assumption is made that the existing facilities will accept the new loads. Future engineering analysis will have to be performed for the new facilities and to qualify the structure of the existing facilities for the new loads.
- An unloading station for receiving ILLW packages will be located at a railroad spur for every option.
- Structural, electrical, and mechanical upgrades to comply with new codes are not considered in this report.

- Waste packages will be transported inside a reusable shielded overpack on a truck or by rail delivery.
- Waste packages will be stored in a horizontal configuration.
- Planning case design basis total package count is 10,400 packages.
- Maximum package weight is 10 metric tons.
- Outside container dimensions are 1.2 m wide by 1.2 m tall by 1.8 m long (4 ft wide by 4 ft tall by 6 ft long).
- Storage array shielding requirement is equivalent to 18-in. thick concrete for the walls and 9-in. thick concrete for the roof.
- Transporting the waste packages to unloading stations may be by truck or rail.
- Waste package handling and storage is performed by remote operation.
- Waste package handling and storage concepts must consider placement and retrieval.
- Retrieval of waste packages will utilize the same handling equipment and will follow a reverse process to placement.

221-B CANYON BUILDING

This option considers the retrofit and utilization of the existing 221-B Canyon Building for the interim storage of approx 4,800 ILLW packages (sketches ES-465-C2, ES-465-S1, and ES-465-S2). (All sketches are shown in Appendix A.) Two areas of the 221-B Canyon Building were evaluated for the storage of the waste packages: the process cells area and the canyon deck area.

Process Cells Area

The process cells area and the storage space the area can provide versus the cost to make the space functionally ready for storing the waste package was reviewed. Upon evaluation, storage in the process cells area was deemed impractical for the following reasons.

- Existing process equipment and process nozzles would have to be removed from 36 of the cells.
- Low pressure blank connectors would have to be installed on process nozzles.
- Space for the installation of prefabricated carbon steel cell liners to protect the waste packages from the process cell environment would have to be allocated. The efforts above would provide space for storing 864 waste packages only. This is approximately 8% of the planning case design basis total waste package count of 10,400 packages.

Canyon Deck Area

Using the space above the canyon deck as storage space was considered. This would be done by placing all cover blocks in their original positions over the hot pipe trench and Process Cells. Modular elevated floor supports would be provided above the protruding cover block bails.

Containers would be received either by truck or rail at a new unloading station at the entrance to the 221-B Canyon Building. The unloading station would consist of an enclosed structure with doors for both truck and rail delivery. A remotely-operated 10-metric ton crane, monitored via closed-circuit television (CCTV), would unload the waste packages from the overpack of the delivery car. The waste packages would then be moved through the 221-B Building tunnel into the canyon, where the existing bridge crane would pick up and store the containers on the floor support array.

PUREX CANYON BUILDING

This option considers the retrofit and utilization of the PUREX Canyon Building (sketch ES-465-S3) for the interim storage of approx 9,000 ILLW packages. Three areas of the building (sketch ES-465-S4) were evaluated for the viability of storing waste

packages: the storage gallery area which is located below the sample and operating galleries, the process cells area, and the canyon deck area.

Waste packages would be received either by truck or rail at a new unloading station (sketch ES-465-C2) at the entrance to the PUREX Building tunnel. The unloading station consists of an enclosed metal framed steel structure with doors for either truck or rail delivery. A remotely-operated 10-metric ton crane, monitored via CCTV, would unload the waste packages from the overpack of the delivery car. The waste packages would then be moved through the tunnel into the PUREX Building where the existing bridge crane would pick up and transport the waste packages according to the following storage sequence.

The Storage Gallery

Two options to transfer containers from the PUREX Annex Loading Dock, through the aqueous makeup unit (AMU) basement area to the storage gallery were evaluated. Both options will require modification of the existing elevator or the installation of a new one.

Bridge Crane

This option evaluated the construction of a bridge crane in the storage gallery to receive and transfer the waste packages to their final location in the gallery. This would require modification to the Annex building to facilitate loading/unloading at the existing Annex loading dock and the addition of two monorail systems: one at the upper level for transferring the waste packages from the Annex loading dock next to the AMU area to the elevator, and the second at the lower level to receive and transfer the packages to a new bridge crane. The transfer points and the bridge cranes would require three separate CCTV monitors. The presence of a bridge crane in the storage gallery would result in the reduction of gallery storage capacity by about 20% due to crane clearance requirements. This option became less desirable and was not considered further.

Automatic Guided Vehicle

This option evaluated the use of an automatic guided vehicle (AGV) to receive the packages at the loading dock next to the AMU area and transport them through the AMU to the service elevator then down to the storage gallery and to their final storage destination in

the gallery. This process will require modification to the Annex Building to facilitate loading/unloading at the existing Annex loading dock and one CCTV camera and monitor. Using the PUREX storage gallery would provide storage space for 2,700 containers.

Process Cells Area

The PUREX process cells area consists of several compartmentalized cells of varied dimensions. For this concept, carbon steel containers (serve as liners) capable of storing 24 waste packages each will be shop fabricated and transported/delivered to the canyon deck area. The steel container are hoisted, via the PUREX canyon crane, and positioned into the process cells areas. The canyon crane optical system would provide visual monitoring of the waste packages during the transporting and storage process. The process cells would provide storage space for 1,968 waste packages.

Canyon Deck Area

This concept considers utilizing the canyon deck floor for the storage of waste packages. To prepare the canyon deck floor for accepting the waste packages, a 3-ft high carbon steel support modular system must be placed on the deck floor to clear the bails of the cover blocks. The steel support modular would be shop fabricated and delivered to the canyon deck area and positioned on the deck floor to accept the waste packages. The PUREX Canyon crane optical system would provide visual monitoring during the transporting and storage of waste packages. The canyon deck area would provide storage space for 4,260 waste packages.

EXISTING GROUT VAULTS

This concept considers the retrofit and utilization of the existing grout vaults for the interim storage of approximately 5,500 ILLW packages. Two options for accessing the vaults were evaluated: accessing the vaults through the roof, and accessing the vaults through the end wall. Both options would require the construction of an approximate 2,000 ft, 24-ft wide paved access road (sketches ES-465-C3, ES-465-C4, and ES-465-C5).

Both options would require an electrical utility extension, lighting fixtures for the roadway, and crane and remotely-operated CCTV cameras on the crane. It is assumed that required utilities are available within 1/2 mile and that the existing 13.8 kV feeder system with a

new 13.8 kV/480 V 75 kVA transformer can be used. Both options would require a control building for the CCTV monitors and controls, radiation monitor alarms, crane controls, and power panels - 480 V and 240/120 V. Both options would require a 7-1/2 hp, and a 480 V exhaust fan and controller for each vault.

Roof Access

This option would involve excavation at the east end of the vault down to the roof level, and removing four 4-ft roof planks via a mobile crane. Crane rails, for a 10-ton bridge crane, extending the full length of the vault would be affixed to the vault walls. A concrete foundation would be constructed between two vaults to support a 16- by 30-ft steel-framed metal structure that would serve as an unloading station (sketches ES-465-S5 and ES-465-S6). The unloading station will house a 10-ton bridge crane that would pick up the waste package from a delivery truck and lower it to the vault floor. The remotely-operated vault crane would pick up the waste package and place it in a final storage location in the vault. When a vault is filled, the unloading station and crane would be removed, and the vault crane would be relocated to an empty vault. The filled vault would receive a metal cover over the roof access opening. The unloading station and crane would be placed over an empty vault and the process would be repeated for the remaining vaults.

Wall Access

This option considers two wall access alternatives: construct a concrete enclosure access to the vault, or have an open excavation road access.

Concrete Enclosure Access

This concept would excavate down 25 ft below grade and construct a concrete floor and retaining walls along the east end of the vaults (sketches ES-465-C4, ES-465-S7, and ES-465-S8). This concrete enclosure would be tied to the 24-ft access road and would serve as the access to the vaults and the unloading station at each vault. The concrete retaining wall at the unloading station would act as a shielding barrier from the stored waste packages. A fence would be constructed on each side of the concrete enclosure for safety. At each unloading station, the upper 10 ft of the existing vault's end wall would be removed to provide access to the vault interior. Crane rails (for a 10-ton bridge crane), extending the full length of the vault, would be affixed to the vault walls and would

protrude beyond the end of the vault over the unloading station (sketch ES-465-S7 and ES-465-S8). The remotely-operated bridge crane would be controlled from a control building adjacent to the vaults. A metal-framed steel structure would be constructed to serve as a reusable weather enclosure cover for the concrete enclosure at each unloading station. Roll-up doors would be installed at the north and south ends of the concrete enclosure for housekeeping during the unloading and storage operation. An expanded metal siding enclosure would be constructed to seal the vault opening after the vault is full and the crane is relocated.

Open Excavation Road Access

This concept is very similar to the concrete enclosure access in that it entails excavating 25 ft below grade and constructing a paved roadway access to the vaults with shoulders sloping at 2:1 (sketches ES-465-C5 and ES-465-S9). At each unloading station, the upper 10 ft of the end wall would be removed to provide access to the vault interior. Crane rails (for a 10-ton bridge crane) extending the full length of the vault would be affixed to the vault walls and would protrude beyond the end of the vault over to a crane beam end column supporting structure. The end wall opening would have a roll-up door that would serve as a barrier against weather and debris. Crane operation would be the same as in the concrete enclosure access concept. An expanded metal siding enclosure would be constructed to seal the vault opening after the vault is full and the crane is relocated.

NEW FACILITY

The new facility option considered two types of structures that are similar in configuration and design. One structure would function as a complementary storage facility to the existing grout vaults. The other structure would be an independent storage facility capable of storing the planning case design basis total of 10,400 waste storage packages.

Complementary Storage Facility

This facility will be constructed adjacent and in line with one of the grout vaults (sketches ES-465-C3, ES-465-C4, and ES-465-C5) and will function as an overflow storage facility. As stated before, the grout vaults are capable of storing approximately 5,500 ILLW packages. A new complementary storage facility capable of storing an additional 5,000 ILLW packages would bring the total storage capacity to 10,500 waste packages.

The new facility will have the same configurations as the existing grout vaults, except that it will be longer and will require buttresses to stiffen the long walls. Ideally, this new structure could be placed directly east of the last grout vault as an extension structure, having the same width and depth and crane rails affixed to the walls extending the full length making it into one long vault. With this configuration, the 10-ton crane used for the grout vaults could travel between the grout vault and the new structure. The new structure will utilize the same roadway access, electric utilities, CCTV cameras and monitors, and all other required controls and the control building for the grout vaults. Additional lighting and HVAC will be required.

Independent Storage Facility

This facility will have a similar configuration as the complementary storage facility, except it will be about twice as long and will be a stand-alone structure (sketches ES-465-C6 and ES-465-C7). The structure may be constructed above or below grade and will have its own access road, an enclosed unloading bay with roll-up doors, control building, electrical utilities, instruments and controls, mechanical systems and components, and remotely-operated bridge crane.

Abovegrade Facility

This facility will be a reinforced concrete vault structure with 18-in. walls stiffened with buttresses and 10-in. prestressed concrete roof planks. The vault structure inside dimensions will be approximately 875 ft long by 50 ft wide. An 18-ft wide concrete unloading structure with a metal roof would span the full width of the end wall. The unloading structure will have a roll-up door at each end.

Belowgrade Facility

This facility will be identical to the abovegrade facility, except that the vault structure and the unloading station will be below grade and the roof planks will be stiffer to support the added earth load.

UNCERTAINTIES AND RECOMMENDATIONS FOR FURTHER STUDY

The 221-B and PUREX Canyon Buildings cover blocks will require qualification for structural integrity due to added loads.

The PUREX Building cover block and wall between pipe trench and process cell will require qualification for structural integrity due to added loads.

The grout vault walls will require qualification for structural integrity due to the added load from the new bridge crane and due to the removal of a 10-ft section of the end wall.

REFERENCES

1. Letter, R. J. Murkowski (Westinghouse Hanford Company) to P. E. LaMont (U.S. Department of Energy, Richland Operations [RL]), "Immobilized Low-Level Waste Interim Storage Alternatives," Document No. 9650431, January 30, 1996.
2. Memorandum, via cc:mail, D. A. Burbank (Westinghouse Hanford Company) to ICF Kaiser Hanford Company Project Team, "Action Items - W-465 ILLW Interim Storage project," March 4, 1996.
3. Memorandum, via cc:mail, D. A. Burbank (Westinghouse Hanford Company) to ICF Kaiser Hanford Company Project Team, "U Plant Crane Condition," March 8, 1996.
4. Memorandum, via cc:mail, D. A. Burbank (Westinghouse Hanford Company) to ICF Kaiser Hanford Company Project Team, "Design concept comments - ILLW Interim Storage project W-465," March 20, 1996.
5. Scope of Work, "Immobilized Low-Level Interim Storage Alternative, Statement of Work - Engineering Support for Cost Estimate," prepared by ICF Kaiser Hanford Company, presented to Westinghouse Hanford Company at status meeting of March 19, 1996.
6. Drawings: Grout Vaults - H-2-79698, H-2-78456, H-2-78457
221-B CANYON - W-70064, W-69565, W-69566
PUREX - H-2-52000, H-2-52168, H-2-52224, H-2-52078-82

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APPENDICES

- Appendix A. Cost Estimate Summary
- Appendix B. Schedule
- Appendix C. Sketches

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APPENDIX A

Cost Estimate Summaries

221 Canyon	A-1
PUREX	A-3
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Grout Wall Access	A-7
Grout Wall Access Alt.	A-9
New Facility Above Grade	A-11
New Facility Below Grade	A-13

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WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAG1/P4H203
FILE NO. W465SAG1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - 221 CANYON -
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 2
DATE 04/24/96 08:25:24
BY KLR/JJM/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY X	TOTAL TOTAL	TOTAL DOLLARS
000	ENGINEERING	630,000	35	220,000	850,000
460	IMPROVEMENTS TO LAND	150,000	35	50,000	200,000
501	BUILDINGS	130,000	35	40,000	170,000
550	OTHER STRUCTURES	2,780,000	35	970,000	3,750,000
600	UTILITIES	60,000	35	20,000	80,000
(ADJUSTED TO MEET DOE 5100.4)					
PROJECT TOTAL		3,750,000	35	1,300,000	5,050,000

CHECK

TYPE OF
ESTIMATE R.O.M. ESTIMATE APRIL 24, 1996

ARCHITECT
ENGINEER *Heit*

OPERATING
CONTRACTOR

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

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WESTINGHOUSE HANFORD COMPANY
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FILE NO. W46SSAG1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - 221 CANYON -
R.O.M. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 08:25:45
BY KLR/JJH/CDL

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN	420000	0	420000	0.00	0	420000	567000
120000	CONSTRUCTION ENG/INSP	210000	0	210000	0.00	0	210000	283500
SUBTOTAL 1	ENGINEERING	630000	0	630000	0.00	0	630000	850500
320001	SITWORK	120900	26598	147498	0.00	0	147498	199122
320005	STRUCTURES	1020000	417160	2245160	0.00	0	2245160	3030966
320025	PUREX UNLOADING FACILITY	350000	77000	427000	0.00	0	427000	576450
320162	221-B Canyon Facility Plan	156141	34350	190491	0.00	0	190491	257164
SUBTOTAL 3201	Electrical - Fixed Price	156141	34350	190491	0.00	0	190491	257164
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	2455041	555108	3010149	0.00	0	3010149	4063702
SUBTOTAL 3	CONSTRUCTION	2455041	555108	3010149	0.00	0	3010149	4063702
400000	PROJECT MANAGEMENT	105000	0	105000	0.00	0	105000	141750
SUBTOTAL 4	PROJECT INTEGRATION	105000	0	105000	0.00	0	105000	141750
PROJECT TOTAL		3,190,041	555,108	3,745,149	0.00	0	3,745,149	5,055,952

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAF1/P4M203
FILE NO. W465SAF1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - PUREX -
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 2
DATE 04/24/96 08:02:09
BY KLR/JJH/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	X CONTINGENCY TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,630,000	35	3,550,000
501	BUILDINGS	10,670,000	35	14,410,000
550	OTHER STRUCTURES	430,000	35	580,000
600	UTILITIES	30,000	35	40,000
(ADJUSTED TO MEET DOE 5100.4)				
PROJECT TOTAL		13,760,000	35	18,580,000

CHECK

TYPE OF ESTIMATE	R.O.M. ESTIMATE	APRIL 24, 1996
ARCHITECT ENGINEER	LCH	
OPERATING CONTRACTOR		

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

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Revision 0

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAF1/P4M203
FILE NO. W465SAF1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - PUREX -
R.O.M. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 08:02:28
BY KLR/JJM/CDL

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN	1750000	0	1750000	0.00	0	1750000	2362500
120000	CONSTRUCTION ENG/INSP	875000	0	875000	0.00	0	875000	1181250
SUBTOTAL 1	ENGINEERING	2625000	0	2625000	0.00	0	2625000	3543750
320005	STRUCTURES	7174000	1593280	8767280	0.00	0	8767280	11835828
320006	CONVEYANCE SYSTEMS	1100000	242000	1342000	0.00	0	1342000	1811700
320025	PUREX UNLOAD FACILITY	350000	77000	427000	0.00	0	427000	576450
3201C1	Purex Unloading Facility Plan	129319	28450	157769	0.00	0	157769	212988
SUBTOTAL 3201	Electrical - Fixed Price	129319	28450	157769	0.00	0	157769	212988
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	8753319	1940730	10694049	0.00	0	10694049	14436966
SUBTOTAL 3	CONSTRUCTION	8753319	1940730	10694049	0.00	0	10694049	14436966
400000	PROJECT MANAGEMENT	435000	0	435000	0.00	0	435000	587250
SUBTOTAL 4	PROJECT INTEGRATION	435000	0	435000	0.00	0	435000	587250
PROJECT TOTAL		11,813,319	1,940,730	13,754,049	0.00	0	13,754,049	18,567,966

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Revision 0

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAA1/P4M203
FILE NO. W465SAA1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - GROUT ROOF ACCESS -
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 2
DATE 04/24/96 07:31:57
BY KLR/JJM/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,500,000	35	530,000	2,030,000
460	IMPROVEMENTS TO LAND	410,000	35	140,000	550,000
501	BUILDINGS	550,000	35	190,000	740,000
550	OTHER STRUCTURES	5,750,000	35	2,010,000	7,760,000
600	UTILITIES	50,000	35	20,000	70,000

(ADJUSTED TO MEET DOE 5100.4)

PROJECT TOTAL

8,260,000 35 2,890,000 11,150,000

CHECK

TYPE OF
ESTIMATE R.O.M. ESTIMATE APRIL 24, 1996
ARCHITECT
ENGINEER LGH
OPERATING
CONTRACTOR

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

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Revision 0

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAAT/P4M203
FILE NO. W465SAAT

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - GROUT ROOF ACCESS -
R.O.M. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 07:32:21
BY KLR/JJH/CDL

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS			
110000	DEFINITIVE DESIGN	1000000	0	1000000	0.00	0	1000000	35	350000	1350000	
	SUBTOTAL 11	DEFINITIVE DESIGN	1000000	0	1000000	0.00	0	1000000	35	350000	1350000
120000	CONSTRUCTION ENGINEERING/INSP	500000	0	500000	0.00	0	500000	35	175000	675000	
	SUBTOTAL 12	ENGINEERING/INSPECTION	500000	0	500000	0.00	0	500000	35	175000	675000
	SUBTOTAL 1	ENGINEERING	1500000	0	1500000	0.00	0	1500000	35	525000	2025000
320001	SITework	93300	20526	113826	0.00	0	113826	35	39839	153665	
320005	STRUCTURES	1047840	245525	1293365	0.00	0	1293365	35	452678	1746043	
320007	NEW VAULT	3328170	747190	4075368	0.00	0	4075368	35	1426379	5501747	
320025	PUREX UNLOADING FACILITY	350000	77000	427000	0.00	0	427000	35	149450	576450	
3201C3	Grout Vault Roof Access Plan	490872	107992	598864	0.00	0	598864	35	209603	808466	
	SUBTOTAL 3201	Electrical - Fixed Price	490872	107992	598864	0.00	0	598864	35	209603	808466
	SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	5310182	1198241	6508423	0.00	0	6508423	35	2277949	8786371
	SUBTOTAL 3	CONSTRUCTION	5310182	1198241	6508423	0.00	0	6508423	35	2277949	8786371
400000	PROJECT INTEGRATION	250000	0	250000	0.00	0	250000	35	87500	337500	
	SUBTOTAL 4	PROJECT INTEGRATION	250000	0	250000	0.00	0	250000	35	87500	337500
PROJECT TOTAL		7,060,102	1,198,241	8,258,423	0.00	0	8,258,423	35	2,890,449	11,148,871	

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAB1/P4M203
FILE NO. W465SAB1

**** IEST - INTERACTIVE ESTIMATING ****
LOW LEVEL WASTE STORAGE - GROUT WALL ACCESS -
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

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DATE 04/24/96 07:33:57
BY KLR/JJM/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY X	TOTAL	TOTAL DOLLARS
000	ENGINEERING	1,860,000	35	650,000	2,510,000
460	IMPROVEMENTS TO LAND	590,000	35	210,000	800,000
501	BUILDINGS	540,000	35	190,000	730,000
550	OTHER STRUCTURES	6,980,000	35	2,440,000	9,420,000
600	UTILITIES	60,000	35	20,000	80,000

(ADJUSTED TO MEET DOE \$100.4)

PROJECT TOTAL

10,030,000 35 3,510,000 13,540,000

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TYPE OF
ESTIMATE R.O.M. ESTIMATE APRIL 24, 1996

ARCHITECT
ENGINEER LGH

OPERATING
CONTRACTOR

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

WHC-SD-W465-AGA-001
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** TEST - INTERACTIVE ESTIMATING **
 LOW LEVEL WASTE STORAGE - GROUT WALL ACCESS -
 R.O.M. ESTIMATE
 DOE-R02 - WORK BREAKDOWN STRUCTURE SUMMARY

ICF KAISER HANFORD
 WESTINGHOUSE HANFORD COMPANY
 JOB NO. W4655AB1/P4M203
 FILE NO. W4655AB1

WBS DESCRIPTION	ESTIMATE	ONSITE	SUB TOTAL	ESCALATION	SUB TOTAL	CONTINGENCY	TOTAL
110000 DEFINITIVE DESIGN	1240000	0	1240000	0.00	0	1240000	434000
120000 CONSTRUCTION ENG/INSP	620000	0	620000	0.00	0	620000	837000
SUBTOTAL 1 ENGINEERING	1860000	0	1860000	0.00	0	1860000	2511000
320001 SITEWORK	236650	52503	291153	0.00	0	291153	393057
320005 STRUCTURES	2111175	479459	2590634	0.00	0	2590634	3497353
320007 NEW VAULT	3236780	712532	3951312	0.00	0	3951312	5134270
320025 PUMEX UNLOAD FACILITY	499090	108800	608890	0.00	0	608890	822001
320104 GROUT VAULT WALL ACCESS PLAN	350000	77000	427000	0.00	0	427000	576450
SUBTOTAL 1201 Electrical - Fixed Price	499090	109800	608890	0.00	0	608890	822001
SUBTOTAL 32 CONSTRUCTION-FIXED PRICE	6437695	1431294	7868989	0.00	0	7868989	10623133
SUBTOTAL 3 CONSTRUCTION	6437695	1431294	7868989	0.00	0	7868989	10623133
400000 PROJECT MANAGEMENT	310000	0	310000	0.00	0	310000	418500
SUBTOTAL 4 PROJECT INTEGRATION	310000	0	310000	0.00	0	310000	418500
PROJECT TOTAL	8,607,695	1,431,294	10,038,989	0.00	0	10,038,989	13,552,633

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 DATE 04/24/96 07:34:16
 BY KLR/JJM/CDL

ICF KAISER HANFORD
VESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAC1/P4W203
FILE NO. W465SAC1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - GROUT WALL ACCESS ALT.-
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

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DATE 04/24/96 07:53:49
BY KLR/JJH/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY X TOTAL	TOTAL DOLLARS	
000	ENGINEERING	1,550,000	35	540,000	2,090,000
460	IMPROVEMENTS TO LAND	1,000,000	35	350,000	1,350,000
501	BUILDINGS	540,000	35	190,000	730,000
550	OTHER STRUCTURES	5,190,000	35	1,820,000	7,010,000
600	UTILITIES	90,000	35	30,000	120,000

(ADJUSTED TO MEET DOE S100.4)

PROJECT TOTAL

8,370,000 35 2,930,000 11,300,000

CHECK

TYPE OF
ESTIMATE R.O.M. ESTIMATE APRIL 24, 1996

ARCHITECT
ENGINEER

OPERATING
CONTRACTOR

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST " 10,000 / 100,000 " - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

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Revision 0

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SACT/P4M203
FILE NO. W465SACT
** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE - GROUT WALL ACCESS ALT.-
R.O.M. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 11:24:55
BY KLR/JJM/CPL

WBS	DESCRIPTION	ESTIMATE	SUBTOTAL	ONSITE	SUB	ESCALATION	SUB	CONTINGENCY	TOTAL
*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
110000	DEFINITIVE DESIGN	1030000	0	0	1030000	0.00	0	360500	1390500
120000	CONSTRUCTION ENG/INSP	515000	0	0	515000	0.00	0	180250	695250
SUBTOTAL 1	ENGINEERING	1545000	0	0	1545000	0.00	0	540750	2085750
320001	SITENWORK	226700	49074	276574	0	0.00	0	276574	373375
320005	STRUCTURES	852000	107440	1039440	0	0.00	0	363804	1403244
320007	NEW VAULT	3417570	766865	4184435	0	0.00	0	4184435	5646808
320025	PUREX UNLOAD FACILITY	350000	77000	427000	0	0.00	0	169450	576450
320105	GROUT VAULT ALT WALL ACCESS PLAN	518841	114145	632986	0	0.00	0	632986	854531
SUBTOTAL 3201	ELECTRICAL - FIXED PRICE	518841	114145	632986	0	0.00	0	632986	854531
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	5365111	1195324	6560435	0	0.00	0	6560435	8856588
SUBTOTAL 3	CONSTRUCTION	5365111	1195324	6560435	0	0.00	0	6560435	8856588
400000	PROJECT MANAGEMENT	260000	0	260000	0	0.00	0	260000	351000
SUBTOTAL 4	PROJECT INTEGRATION	260000	0	260000	0	0.00	0	260000	351000
PROJECT TOTAL		7,170,111	1,195,324	8,365,435	0	0.00	0	2,927,902	11,293,338

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W46SSAE1/P4M203
FILE NO. W46SSAE1

**** TEST - INTERACTIVE ESTIMATING ****
LOW LEVEL WASTE STORAGE-NEW FACILITY ABOVE GRADE
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 2
DATE 04/24/96 07:59:39
BY KLR/JJM/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY X	TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,210,000	35	770,000	2,980,000
460	IMPROVEMENTS TO LAND	140,000	35	50,000	190,000
501	BUILDINGS	290,000	35	100,000	390,000
550	OTHER STRUCTURES	9,270,000	35	3,250,000	12,520,000
600	UTILITIES	50,000	35	20,000	70,000

(ADJUSTED TO MEET DOE \$100.4)

PROJECT TOTAL

11,960,000 35 4,190,000 16,150,000

CHECK

TYPE OF ESTIMATE	R.O.M. ESTIMATE	APRIL 24, 1996	REMARKS: CHECK ISSUE ESTIMATE DOES NOT INCLUDE ANY: ESCALATION : OTHER PROJECT COSTS
ARCHITECT ENGINEER	LGH		
OPERATING CONTRACTOR			

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Revision 0

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W46SSAE1/P4M203
FILE NO. W46SSAE1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE-NEW FACILITY ABOVE GRADE
R.O.N. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 08:00:03
BY KLR/JJH/CDL

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ON-SITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN	1470000	0	1470000	0.00	0	35	1984500
120000	CONSTRUCTION ENGINEERING/INSP	735000	0	735000	0.00	0	35	992250
SUBTOTAL 1	ENGINEERING	2205000	0	2205000	0.00	0	35	2976750
320001	SITework	117400	25020	143228	0.00	0	35	193358
320005	STRUCTURES	6938440	1541457	8479897	0.00	0	35	11447862
320025	PUREX UNLOAD FACILITY	350000	77000	427000	0.00	0	35	576450
320106	New Facility Above Grade Plan	276866	60910	337776	0.00	0	35	455998
SUBTOTAL 3201	Electrical - Fixed Price	276866	60910	337776	0.00	0	35	455998
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	7682706	1705195	9387901	0.00	0	35	12673668
SUBTOTAL 3	CONSTRUCTION	7682706	1705195	9387901	0.00	0	35	12673668
400000	PROJECT MANAGEMENT	365000	0	365000	0.00	0	35	492750
SUBTOTAL 4	PROJECT INTEGRATION	365000	0	365000	0.00	0	35	492750

PROJECT TOTAL		10,252,706	1,705,195	11,957,901	0.00	0	35	16,143,168

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W465SAD1/P4M203
FILE NO. W465SAD1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE-NEW FACILITY BELOW GRADE
R.O.M. ESTIMATE
DOE_R01 - PROJECT COST SUMMARY

PAGE 1 OF 2
DATE 04/24/96 07:57:20
BY KLR/JJM/CDL

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	TOTAL	TOTAL DOLLARS
000	ENGINEERING	2,550,000	35	890,000	3,440,000
460	IMPROVEMENTS TO LAND	440,000	35	160,000	600,000
501	BUILDINGS	290,000	35	100,000	390,000
550	OTHER STRUCTURES	10,000,000	35	3,530,000	13,610,000
600	UTILITIES	50,000	35	20,000	70,000

(ADJUSTED TO MEET DOE 5100.4)

PROJECT TOTAL

13,410,000 35 4,700,000 18,110,000

CHECK

TYPE OF
ESTIMATE R.O.M. ESTIMATE APRIL 24, 1996

ARCHITECT
ENGINEER

OPERATING
CONTRACTOR

REMARKS: CHECK ISSUE

ESTIMATE DOES NOT INCLUDE ANY: ESCALATION
: OTHER PROJECT COSTS

(ROUNDED/ADJUSTED TO THE NEAREST * 10,000 / 100,000 * - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

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ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. W46SSAD1/P4M203
FILE NO. W46SSAD1

** TEST - INTERACTIVE ESTIMATING **
LOW LEVEL WASTE STORAGE-NEW FACILITY BELOW GRADE
R.O.M. ESTIMATE
DOE_R02 - WORK BREAKDOWN STRUCTURE SUMMARY

PAGE 2 OF 2
DATE 04/24/96 07:57:41
BY KLR/JJM/CDL

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSITE INDIRECTS	SUB TOTAL	ESCALATION % TOTAL	SUB TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS
110000	DEFINITIVE DESIGN	1700000	0	1700000	0.00	0	35	2295000
120000	CONSTRUCTION ENG/INSP	850000	0	850000	0.00	0	35	1147500
SUBTOTAL 1	ENGINEERING	2550000	0	2550000	0.00	0	35	3442500
320001	SITWORK	363900	80058	443958	0.00	0	35	599343
320005	STRUCTURES	7549730	1675941	9225671	0.00	0	35	12454656
320025	PUREX UNLOAD FACILITY	350000	77000	427000	0.00	0	35	576450
3201C7	New Facility Below Grade Plan	276866	60910	337776	0.00	0	35	455998
SUBTOTAL 3201	Electrical - Fixed Price	276866	60910	337776	0.00	0	35	455998
SUBTOTAL 32	CONSTRUCTION-FIXED PRICE	8540496	1893909	10434405	0.00	0	35	14086447
SUBTOTAL 3	CONSTRUCTION	8540496	1893909	10434405	0.00	0	35	14086447
400000	PROJECT MANAGEMENT	425000	0	425000	0.00	0	35	573750
SUBTOTAL 4	PROJECT INTEGRATION	425000	0	425000	0.00	0	35	573750
PROJECT TOTAL		11,515,496	1,893,909	13,409,405	0.00	0	35	18,102,697

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APPENDIX B

Schedule

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(c) Delmarva Systems, Inc.

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APPENDIX C

Sketches

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ICF KAISER HANFORD

ENGINEERING SKETCH
IMMOBILIZATION LOW-LEVEL WASTE

PROJECT SITE PLAN
FACILITY LOCATIONS

Prepared by: P. LATING	Sh. of 1	Sheet no. ES-465-C1	Rev. 0
Checked by: T465C1

PROJECT SITE PLAN

ENGINEERING SKETCH LIST

CIVIL SKETCHES

- 1-465-C1 PROJECT SITE PLAN
- 1-465-C2 TYPICAL CANYON FACILITY SITE PLAN
- 1-465-C3 GROUT VAULT ROOF ACCESS SITE PLAN
- 1-465-C4 GROUT VAULT WALL ACCESS SITE PLAN
- 1-465-C5 GROUT VAULT ALT WALL ACCESS SITE PLAN
- 1-465-C6 NEW FACILITY ABOVE GRADE SITE PLAN
- 1-465-C7 NEW FACILITY BELOW GRADE SITE PLAN

STRUCTURAL SKETCHES

- 1-465-S1 TYPICAL CANYON FLOOR PLAN
- 1-465-S2 TYPICAL CANYON SECTIONS
- 1-465-S3 PURCH CANYON FLOOR PLANS
- 1-465-S4 PURCH CANYON SECTION
- 1-465-S5 GROUT VAULT ROOF ACCESS LOGIC SECTION
- 1-465-S6 GROUT VAULT ROOF ACCESS CROSS SECTION
- 1-465-S7 GROUT VAULT WALL ACCESS LOGIC SECTION
- 1-465-S8 GROUT VAULT WALL ACCESS CROSS SECTION

STRUCTURAL SKETCHES (CONT)

- 1-465-S9 GROUT VAULT ALT WALL ACCESS LOGIC SECTION
- 1-465-S10 GROUT VAULT ALT WALL ACCESS CROSS SECTION
- 1-465-S11 NEW FACILITY ABOVE GRADE LOGIC SECTION
- 1-465-S12 NEW FACILITY ABOVE GRADE CROSS SECTION
- 1-465-S13 NEW FACILITY BELOW GRADE CROSS SECTION

GROUT FACILITY STORAGE ARRAY SCHEMES

- 1-465-A1 GROUT FACILITY STORAGE ARRAY SCHEME 11
- 1-465-A2 GROUT FACILITY STORAGE ARRAY SCHEME 12

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ICF KAISER HANFORD	ENGINEERING SKETCH			
	IMMOBILIZATION LOW-LEVEL WASTE			
TYPICAL CANYON FACILITY FLOOR PLAN	Project No.	Sheet No.	Rev.	
	P-4510	ES-465-S1	0	
	Scale			
	1/4" = 1'-0"

TYPICAL CANYON FLOOR PLAN

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ICF KAISER HANFORD

ENGINEERING SKETCH
W-465, IMMOBILIZATION LOW-LEVEL WASTE

TYPICAL 221 CANYON
SECTIONS

Prepared by
P. LAING

Checked by
F46552

Sheet No.
ES-465-S2

Rev.
0

TYPICAL 221 CANYON

ADDITIONAL MATERIALS
SUPPORT SYSTEM
WIDTH 8'
HEIGHT 3'
LENGTH 10'
UNITS 288

LAYERS: 5
COLUMNS: 8
ROWS: 120
TOTAL 4,800

JCF KAISER HANFORD	ENGINEERING SKETCH			
	W-465, IMMOBILIZATION LOW-LEVEL WASTE			
PUREX CANYON STORAGE PLANS	Project No.	Sheet No.	Scale	Date
	ES-465-S3	146553	1" = 10'	0

07

PUREX CANYON FACILITY

ICF KAISER HANFORD		ENGINEERING SKETCH	
PURE CANYON SECTIONS		W-465, IMMOBILIZATION LOW-LEVEL WASTE	
Drawn by: [blank]	Checked by: [blank]	Scale: 1" = 10' - 0"	Sheet No. ES-465-S4
Project No. 146556	Revision No. 0		

STORAGE BY AREA FILLED

DECK		CELL	
LAYERS:	4	LAYERS:	6
COLUMNS:	5	COLUMNS:	5
ROWS:	213	ROWS:	3
SUBTOTAL	4260	SUBTOTAL	180
TOTAL	8,928	SUBTOTAL	2700

STG. GALLERY	
LAYERS:	5
COLUMNS:	3
ROWS:	180
SUBTOTAL	2700

ADDITIONAL MATERIALS

SUPPORT SYSTEM		CSTL LINER	
WIDTH	8'	WIDTH	12'-6"
HEIGHT	3'	HEIGHT	25'
LENGTH	10'	LENGTH	9'
UNITS	321	UNITS	82

PUREX CROSS SECTION

PUREX CANYON FACILITY

ICF KAISER HANFORD		ENGINEERING SKETCH IMMOBILIZED LOW-LEVEL WASTE		
Title: GROUT VAULT ROOF ACCESS LOGIT SECT	Prepared by: P. LAING	Sh. of: 1	Sketch no.: ES-465-SS	Rev: 0
	Checked by:	Crane: 146555

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ICF KAISER HANFORD		ENGINEERING SKETCH IMMOBILIZED LOW-LEVEL WASTE			
Title GROUT VAULT ROOF ACCESS CROSS SECT	Prepared by J. L. KING	Sh. of 1	Sketch no. ES-465-S6	Rev. 0	
	Checked by L. J. W. 146556

ICF KAISER HANFORD

ENGINEERING SKETCH
IMMOBILIZED LOW-LEVEL WASTE

Date: GROUT VAULT
WALL ACCESS LOGIT SECT

Prepared by: P. L. AING
Checked by:

Sh of
14557

Sheet no.
ES-465-S7

Rev.
0

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ICF KAISER HANFORD

ENGINEERING SKETCH
IMMOBILIZED LOW-LEVEL WASTE

NAME: GROUT VAULT
WALL ACCESS CROSS SECT

Prepared for
P. EATING
Contract No.

Sh. of
1
Scale
1:46558

Sketch no.
ES-465-SB

Rev.
0

GROUT VAULT

UNLOADING BAY

CROSS SECTION LOOKING WEST

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WHC-SD-W465-AGA-001
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ICF KAISER HANFORD		ENGINEERING SKETCH IMMOBILIZED LOW-LEVEL WASTE			
NAME NEW FACILITY ABOVE GRADE LOGIT SECT	Prepared by H. LATING	Date 11/11/80	Sheet No. ES-465-S10	Rev. 0	Drawn by 1465510

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WHC-SD-W465-AGA-001
Revision 0

ICF KAISER HANFORD		ENGINEERING SKETCH		IMMOBILIZED LOW-LEVEL WASTE	
Drawn by	NEW FACILITY	Checked by	ES-TLLW-S11	Scale	0
Project No.	ABOVE GRADE CROSS SECTS	Project No.	ES-TLLW-S11	Scale	0

UNLOADING BAY

CROSS SECTION LOOKING EAST

TYPICAL SECTION

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ICF KAISER HANFORD

ENGINEERING SKETCH
IMMODILIZED LOW-LEVEL WASTE

NEW FACILITY
BELOW GRADE SITE PLAN

Prepared by
P. LAING
Checked by

Sheet No.
1
146567

Sketch No.
ES-465-C7

Rev.
0

100 0 100 200

SCALE IN FEET

17

24' ACCESS ROAD

CONTROL BLDG
40' DBL WIDE
& PARKING

VAULT
218-E-16-10

VAULT
218-E-16-02

VAULT
218-E-16-03

VAULT
218-E-16-04

VAULT
218-E-16-05

RETAINING WALL

NEW VAULT

N40000

WHC-SD-W465-AGA-001
Revision 0

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I C-18

ICF KAISER HANFORD		ENGINEERING SKETCH IMMOBILIZED LOW-LEVEL WASTE			
Title: NEW FACILITY BELOW GRADE LOGIT SECT	Prepared by: P. LAING	Dr. of: 1	Sheet no.: ES-465-S12	Rev: 0	
	Checked by:	1465512

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WHC-SD-W465-AGA-001
Revision 0

ICF KAISER HANFORD		ENGINEERING SKETCH IMMOBILIZED LOW-LEVEL WASTE		
Name: NEW FACILITY BCLOW GRADE CROSS SECTS	Prepared by: P. LAING	Sheet of: 1	Sketch no.: ES-ILLW-S13	Rev: 0
	Checked by: J465513

TYPICAL SECTION

UNLOADING BAY

SCALE IN FEET

CROSS SECTION LOOKING EAST

THIS ROW CAN NOT BE FILLED IN
THE ROOF ACCESS STUDY CASE

ARRAY #1
LAYERS: 6 MAX
COLUMNS: 8
ROWS: 28
TOTAL 1344 PER VAULT

ARRAY #1A
LAYERS: 6
COLUMNS: 8
ROWS: 28
TOTAL 1392 PER VAULT

ROWS

ENGINEERING SKETCH		IMMOBILIZED LOW-LEVEL WASTE	
Project No.	1	Sheet No.	0
Drawing No.	ES-465-A1	Scale	0
STORAGE ARRAY SCHEME #1		GROUT FACILITY

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ICF KAISER HANFORD

ENGINEERING SKETCH
IMMOBILIZED LOW-LEVEL WASTE

GROUT FACILITY
STORAGE ARRAY SCHEME #2

Prepared by
J. L. KING

Rev.
1465A2

Sketch no.
ES-465-A2

Rev.
0

ARRAY #2
LAYERS: 6 MAX
COLUMNS: 12
ROWS: 18
TOTAL 1296 PER VAULT

ARRAY #2A
LAYERS: 6
COLUMNS: 12
ROWS: 19
TOTAL 1368 PER VAULT

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Revision 0

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	D. A. Burbank	Date 8/20/96
Project Title/Work Order		EDT No. 617626
Alternatives Generation and Analysis Report for Immobilized Low-Level Waste Interim Storage Architecture, Rev. 0		ECN No. --

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