Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

CERTIFIED MAIL

June 2, 2009

Mr. Richard Smith

Dear Mr. Smith:

FREEDOM OF INFORMATION ACT REQUEST (FOI 2009-0042)

Pursuant to the Freedom of Information Act (FOIA), you requested a copy of a document entitled, "Hanford Shipping Facility Feasibility Study" RPP-21852.

A copy of the document is enclosed with deletions of detailed facility drawings, sketches for storage arrays, quantities within the canisters, and other physical security information pursuant to Exemption 2 of the FOIA. Exemption 2 protects information on matters that are "related solely to the internal personnel rules and practices of an agency." This Exemption has been interpreted to encompass two categories of information that may be protected from disclosure. One of the categories is information of "more substantial internal matters, the disclosure of which would risk circumvention of a legal requirement." Information within this category would principally be of use to persons seeking to violate the law and avoid detection. Information of this nature is referred to as "High 2" information.

The High 2 information that has been deleted from the document could provide potentially sensitive insight into the operations of the Hanford Site Canister Storage Building. If this information was released, it could be used to educate terrorists (and other individuals or entities seeking to harm the national security) about the sensitive operations of the facility. For this reason, the information has been deleted.

All releasable information in the documents has been segregated and is being provided to you. The undersigned individual is responsible for this determination. You have the right to appeal to the Office of Hearings and Appeals, as provided in 10 CFR 1004.8, for any information denied to you in this letter. Any such appeal shall be made in writing to the following address: Director, Office of Hearings and Appeals (HG-1), U.S. Department of Energy, L'Enfant Plaza Building, 1000 Independence Avenue SW, Washington, D.C. 20585-1615, and shall be filed within 30 days after receipt of this letter. Should you choose to appeal, please provide this office with a copy of your letter.

In addition, you requested a waiver of fees for any information provided to you. Since costs associated with your request fell under $15.00, a determination on your request for a waiver was not made.

If you have any questions regarding your request, please contact me at our address above or on (509) 376-6288.

Sincerely,

Dorothy Riehle
Freedom of Information Act Officer
Office of Communications
and External Affairs

OCE:DCR

Enclosure

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ENGINEERING DATA TRANSMITTAL

1. EDT 821295
1A. Page 1 of 1

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Hanford Shipping Facility Feasibility Study

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for CH2M HILL Hanford Group, Inc.
Richland, WA 99352

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Abstract: This document provides results of a feasibility study for a proposed Hanford Shipping Facility. The shipping facility will receive, prepare for shipment and ship IHLW and SNF from Hanford to the Monitored Geologic Repository. The study evaluated sites for the facility as well as concepts for material handling. Concepts for storage of 2000 canisters of IHLW were also evaluated.

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HANFORD SHIPPING FACILITY FEASIBILITY STUDY

September 30, 2004

Prepared By
CH2M HILL Hanford Group, Inc.
Richland, Washington

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EXECUTIVE SUMMARY

The primary function of the Hanford Shipping Facility is to receive canisters, alternatively provide interim storage, and load them into rail shipping casks for shipment to the monitored geologic repository. The following are the types of canisters to be received:

- Immobilized high-level waste canisters containing immobilized high-level waste from the Waste Treatment Plant

- Multi-canister overpacks containing spent nuclear fuel

- U.S. Department of Energy standard canisters containing slightly irradiated spent nuclear fuel.

This feasibility study evaluates alternatives for the Hanford Shipping Facility regarding facility location, shipping, and receiving facility configuration, storage facility configuration, and material handling approaches. The preferred alternatives are as follows:

- The preferred site for the Hanford Shipping Facility with or without storage capability is adjacent to the southeast corner of the Canister Storage Building. This site is within the old Hanford Waste Vitrification Plant site and is near storage and the planned packaging facilities of the slightly irradiated nuclear fuel at Hanford. The Hanford Shipping Facility at this site could receive canisters from the Canister Storage Building or the planned fuel preparation facility through transfer passage instead of onsite cask transportation. Immobilized high-level waste canisters from the high-level waste vitrification building would be transported 4.9 miles to the Hanford Shipping Facility via onsite road transportation cask.

- The preferred immobilized high-level waste canister storage facility configuration consists of an open rack in a shielded building with canisters stacked two high. This configuration is similar to that used in the high-level waste vitrification building. This configuration facilitates efficient canister handling operations as the bare canister is handled remotely, and allows efficient canister storage through minimum required spacing between canisters. This storage alternative was evaluated assuming that an active ventilation system would be required because the cooling air is in direct contact with the stored canisters.

- The preferred canister handling approach is to remotely handle bare canisters within a shielded structure. Immobilized high-level waste canisters from the high-level waste vitirification building would be received via an onsite road transportation cask. The cask would be removed from the transporter and placed in a hot cell for removal of the canister. Canisters stored at the Canister Storage Building may be received by either an onsite road transportation cask or a transfer passage from the Canister Storage Building directly to the Hanford Shipping Facility hot cell. Similarly, canisters would be loaded into the MGR rail cask within the Hanford Shipping Facility hot cell. The following major material handling capabilities are recommended to support facility throughput requirements of two immobilized high-level waste canisters per day:

- One truck bay for receipt of canisters and onsite cask handling
- Two rail bays for shipment of canisters and monitored geologic repository cask handling
- One crane in the truck bay
- One dedicated crane servicing both rail bays
- One high-integrity crane in the load-in/load-out cell (hot cell)
- One high-integrity crane in the immobilized high-level waste canister storage area.

CONTENTS

APPENDICES

TABLES

LIST OF TERMS

CSB	Canister Storage Building
DOE	U.S. Department of Energy
HSF	Hanford Shipping Facility
IHLW	immobilized high-level waste
MCO	multi-canister overpack
MGR	monitored geologic repository
ROM	rough-order-of-magnitude
SNF	spent nuclear fuel
WTP	Waste Treatment Plant

1.0 OBJECTIVE

The Hanford Shipping Facility (HSF) is required to load canisters of immobilized high-level waste (IHLW) and spent nuclear fuel (SNF) from the Hanford Site into shipping casks for transport to the monitored geologic repository (MGR) at Yucca Mountain. The objective of this feasibility study is to refine the scope of the HSF for use in future conceptual design activities.

Specifically, this feasibility study provides evaluations of the following items:

- Technically feasible and cost effective concepts for shipping and receiving of IHLW and SNF including shipping and receiving functions, lag storage, decontamination, overpacking, and cask and canister handling.
- Technically feasible and cost effective concepts for storage of up to 2000 IHLW canisters including evaluation of storage concepts (Canister Storage Building [CSB], Savannah River Site and racks in a vault storage concepts) and canister handling equipment concepts (multi-canister overpack [MCO] handling machine, shielded cask transporter [similar to Savannah River Site], and remote handling equipment).
- HSF site evaluation and recommendation of a preferred site.
- A preferred HSF layout based on the above evaluation results.
- A rough-order-of-magnitude (ROM) cost for the preferred HSF alternatives (HSF without storage and HSF with storage).

The rationale for storage capacity of 2000 IHLW canisters for this study is based on the current projection for when shipping to the MGR will commence versus the baseline schedule for start of shipping. The baseline start of shipping is early in 2013, whereas the current projection for the start of shipping is late in 2015. The production rate of IHLW canisters at the Waste Treatment Plant (WTP) is 480 per year. Storage of 2,000 canisters would allow adequate capacity for the 3 years of WTP production with an additional year of float. This study also looks at the feasibility of expansion of the storage area to 4,000 canisters in case the start of shipping is delayed beyond the current projection.

2.0 BACKGROUND

The Hanford Site has 177 large underground storage tanks that contain approximately 55.5 million gallons of radioactive dangerous waste that was generated over several decades of nuclear weapons production. The highly radioactive waste is comprised of liquid, sludge, and salt cake. The storage tanks are located in an area of the Hanford Site called the 200 Areas Plateau.

The WTP is currently under construction on the east edge of the 200 Areas Plateau. The WTP will convert most of the Hanford Site radioactive waste into glass and seal it in large stainless steel canisters. The canisters containing the highly radioactive portion of the treated waste, the

IHLW, are to be shipped to an MGR via rail for final disposal. The WTP is scheduled to begin producing IHLW canisters in May 2010. IHLW canister production is anticipated to be about 56 during the first year, and will increase to 240 in 2011, 360 in 2012, and 480 in 2013. Total production is estimated at 9,400 canisters. *Integrated Mission Acceleration Plan* (RPP-13678) requires the HSF to package approximately 9,400 IHLW canisters, 418 SNF MCOs, and 71 SNF U.S. Department of Energy (DOE) standard canisters into MGR casks for transport to the MGR for permanent disposal.

The two remaining incomplete vaults in the existing CSB will be prepared to store canisters by Project W-464 to accommodate temporary storage of 880 IHLW canisters from the WTP (*Conceptual Design Report for Immobilized High-Level Waste Interim Storage Facility (Phase 1), Project W-464* [HNF-2298]). Project W-464 construction is currently scheduled for completion by May 2010. However, the MGR is not scheduled to receive nuclear waste until 2013. Under the current Hanford Site schedule, the CSB will be nearing capacity by the end of 2012. The CSB will run out of storage space in mid 2013.

3.0 ALTERNATIVES CONSIDERED

This section includes a summary of the alternatives considered and evaluated for each of the studies presented in the appendices.

3.1 SITE SELECTION EVALUTION ALTERNATIVES

The site selection evaluation considered the five alternatives shown in Table 1. The five alternative sites were evaluated for (1) HSF without storage and (2) HSF with 2,000 IHLW canister storage (with possible expansion to 4,000 IHLW canister storage). Alternative 5 is actually broken down into two sub-alternatives due to physical constraints imposed by the WTP site. Alternative 5A is applicable to the HSF without storage evaluation and Alternative 5B is applicable to the HSF with storage evaluation.

Table 1. Hanford Shipping Facility Site Alternatives Evaluated

Alternatives	Description
[redacted]	New facility located 1,800 feet north of the CSB site
[redacted]	New facility adjoining the northeast border of the ETF site
[redacted]	Expansion of the CSB facility (Assumes W-464 has been completed)
4	New facility adjoining the southeast border of the WTP complex
5A	The first WTP Alternative 5 sub-site is immediately east of the High-Level Waste Vitrification Building and conjoined to it by a canister transfer tunnel
5B	The second WTP Alternative 5 sub-site is north and slightly east of the High-Level Waste Vitrification Building

[redacted]

CSB = Canister Storage Building.
ETF = Effluent Treatment Facility.
WTP = Waste Treatment Plant.

3.2 INTERIM STORAGE AND STAGING EVALUATION ALTERNATIVES

The storage and staging evaluation considered seven groups of alternatives. The groups and the associated alternatives are shown in Table 2.

3.3 HANFORD SHIPPING FACILITY MATERIAL HANDLING EVALUATION ALTERNATIVES

The material handling evaluation considered four groups of alternatives representing the four primary material handling functions. The groups and the associated alternatives are shown in Table 3.

4.0 EVALUATION CRITERIA

A summary explanation of the evaluation criteria is provided in Table 4. Not all evaluation criteria are applicable to each evaluation. The evaluation criteria is tailored to the study as described in the appendices for each evaluation.

5.0 ALTERNATIVES EVALUATIONS

Both the siting and storage/staging evaluations used a weighted scoring of evaluation criteria to determine the preferred alternatives. The evaluation criteria are weighted according to their relative degree of importance. The weighting factors used in this study were established with consideration of weighting factors used in other alternative analyses and comments received during the preparation of this evaluation. The rankings of the alternatives for both raw scores and weighted scores are compared to assess the sensitivity of the final alternative rankings to the selected weighting factors.

The material handling evaluation was driven by a time and motion study and the configuration of the facilities.

6.0 DECISION ANALYSIS SUMMARY

This section provides a summary of the results from the individual studies presented in the appendices of this document.

6.1 SITE SELECTION EVALUTION RESULTS

Refer to Appendix A for the complete site selection evaluations. HSF site evaluation study drawing number CEES-04-044-C-001 shows the location of all the alternatives within the 200 East Area. Drawings are provided in Appendix A.

The preferred HSF site selected for the HSF without canister storage is Alternative 3 a site adjacent to the CSB; refer to Drawing CEES-04-044-C-004, sheet 1 (included in the Appendix A attachment).

Table 2. Storage Concepts, Alternatives, and Variations Evaluated

Concepts	Concept A: Open Rack Vault (similar to WTP & West Valley)	Concept B: Closed Tube Vault (similar to CSB)	Concept C: SRS Vault (similar to DWPF)	Concept D: Dry Cask Storage (similar to commercial nuclear power plants)
Alternatives	1. Single Vault, Single Stack	1. Single Bank of Vaults, Single Stack	1. Single Stack	1. Single Canister, Horizontally Loaded/Stored
	2. Single Vault, Double Stack	2. Single Bank of Vaults, Double Stack		
	3. Dual Vault, Single Stack	3. Dual Bank of Vaults, Single Stack	2. Double Stack	2. Five Canisters, Vertically Loaded/Stored
	4. Dual Vault, Double Stack	4. Dual Bank of Vaults, Double Stack		
Variations on Alternatives	i. Rack/Canister Clearance Options	i. Combining Storage and Load-In/Load-Out Equipment	N/A	N/A
	ii. Location of Load-In/Load-Out Cell	ii. Location of Load-In/Load-Out Cell		
	iii. Other Storage Arrays			

CSB = Canister Storage Building.
DWPF = Defense Waste Processing Facility.
N/A = not applicable.
SRS = Savannah River Site.
WTP = Waste Treatment Plant.

Table 3. Material Handling Alternatives Evaluated

Group	Alternatives
Receiving and Shipping	a. A single bay used for import and export of canisters b. Two bays: one dedicated for receipt and one dedicated for the export of canisters c. Receipt of IHLW canisters via a transfer passage from the WTP High-Level Waste Vitrification Building and a bay for export of canisters in the MGR cask d. Receipt of MCOs and DOE standard canisters via a transfer passage from the CSB and a bay for export of canisters in the MGR cask
Canister Handling	a. Bare canister handling within a shielded cell b. Locally shielded canister handling similar to CSB
Cask Handling	a. 1 common crane for MGR and onsite casks b. 2 cranes, one for MGR casks and one for onsite casks
Canister Decontamination and Overpacking	a. Obtain a waiver for out of specification canisters b. Use decontamination and overpacking capabilities at other Hanford facilities c. Store out of specification canisters at CSB d. Provide decontamination and overpacking capabilities at the HSF

CSB = Canister Storage Building.
DOE = U.S. Department of Energy.
HSF = Hanford Shipping Facility.
IHLW = immobilized high-level waste.
MCO = multi-canister overpack.
MGR = monitored geologic repository.
WTP = Waste Treatment Plant.

Table 4. Summary of Evaluation Criteria

Evaluation Criteria	Description
Operability	Qualitative measure of inherent complexity determined by the following factors: • Physical complexity • Operator interfaces • System responsiveness
Space Utilization	Quantitative measure of the efficient use of space
Availability	Qualitative measure of the following: • Maintainability • Reliability • Inspectability
Technology Maturity	Measure of the relative maturity of the concept applied on a production scale in the nuclear industry
Expandability – Storage	Qualitative measure of the ease with which each concept can be expanded to add additional storage modules
Environmental Considerations	Measurement of the following factors: • Airborne effluent generation and associated cleanup equipment • Secondary solid and liquid waste generation and disposal • Permitting requirements
Safety	Assessment of the following factors: • Radiological protection and criticality safety • Industrial safety • ALARA
Decontamination/Decommissioning	Qualitative measure of features incorporated into design to facilitate future decontamination for decommissioning
Constructability	Qualitative measure of ease of construction assessing complexity, ability to use standard construction methods and materials
Capital Cost	Comparison of the capital cost for each option
Operating Cost	Comparison of the O&M costs for each option

ALARA = as low as reasonably achievable.
O&M = operations and maintenance.

The preferred HSF site selected for the HSF with canister storage (2,000 IHLW canisters expandable to 4,000 canisters) is Alternative 3, at the CSB site; refer to Drawing CEES-04-044-C-004, sheet 1.

6.2 INTERIM STORAGE AND STAGING EVALUATION RESULTS

Refer to Appendix B for the evaluations leading to this recommendation.

The recommendation from the interim storage and staging evaluation is to pursue an open rack vault concept. This is based on using a single vault and double stacking the canisters, with a separate load-in/load-out cell containing a small staging area.

6.3 HANFORD SHIPPING FACILITY MATERIAL HANDLING EVALUATION RESULTS

Refer to Appendix C for the evaluations leading to these recommendations.

The HSF material handling evaluation recommended the following material handling approaches:

- Separate receiving and shipping bays are required:
  - One truck bay for receipt of canisters by onsite truck casks
  - One dedicated shipping bay for two MGR rail casks. Two MGR casks need to be in process to meet throughput requirements, but a single in-cell MGR cask loading station is adequate.
- A transfer passage for receipt of canisters should be incorporated in the Alternative 5A HSF (sited adjacent to the WTP high-level waste vitrification building). Up to 9,400 IHLW canisters would be directly transferred to the shipping facility through this passage. The number and configuration of HSF receiving and shipping bays is not affected by the addition of a transfer passage. Although facility throughput is not affected, incorporation of a transfer passage would increase operability, availability, and safety while reducing life-cycle costs.
- Incorporation of a transfer passage for receipt of canisters should be further evaluated during the design phase because of potential impact to CSB operations during construction of a transfer passage for the Alternative 3 HSF (sited adjacent to the CSB). The 418 MCOs, 71 DOE standard canisters, and up to 880 IHLW canisters to be stored at the CSB would be received at the HSF through the transfer passage instead of by onsite transportation cask. Although, facility throughput may not be affected, incorporation of a transfer passage may increase operability, availability, and safety while reducing life-cycle costs.
- The preferred canister handling method is to remotely handle bare canisters in a shielded structure (in-cell canister handling).

- Separate receiving and shipping cranes are required:
  - One crane for operation of onsite transportation casks in the receiving bay
  - One dedicated crane for operation of the two MGR casks in the shipping bay.
- Because several existing or planned facilities provide capabilities for canister decontamination or overpacking, canister decontamination and overpacking capabilities do not need to be provided in the HSF. These other facilities include the following:
  - The WTP high-level waste vitrification building may be used for IHLW canister decontamination
  - The planned fuel preparation facility will provide capability for decontamination and repackaging of SNF canisters and may provide decontamination and overpacking capability of IHLW canisters
  - The MGR will have the capability to overpack canisters.

6.4 ROUGH-ORDER-OF-MAGNITUDE COST ESTIMATE

The ROM cost estimate incorporating the preferred sites and facility configurations recommended in Sections 6.1 through 6.3, is provided in Appendix D.

The ROM cost estimate for the HSF without storage is $102.5 million in unescalated 2004 dollars.

The ROM cost estimate for the HSF with storage is $170.0 million in unescalated 2004 dollars. These cost estimates exclude operations costs, facility protection measures, and decontamination and decommissioning costs. A security requirements analysis must be completed to determine facility protection measures. Upon completion of the security requirements analysis, the cost for security protection measures will be established.

6.5 FACILITY LAYOUT

The preferred facility layouts incorporating site and facility configurations recommended in Sections 6.1 through 6.3, are provided in Appendix E.

The preferred alternative HSF without storage facility layout is shown on drawing CEES-04-044-C-004, sheet 2. The preferred alternative HSF with storage facility layout is shown on drawing CEES-04-044-C-004, sheet 1. These drawing are included in Appendix E.

6.6 SKETCHES

The sketches in Appendix F are used to clarify the cask and canister mechanical handling processes used in the HSF and illustrate the canister path through the HSF.

7.0 QUALIFYING CRITERIA AND RISKS

The major enabling assumptions, constraints, and the associated risks documented in the appendix evaluations are summarized below.

7.1 CONSTRAINTS AND ASSUMPTIONS

This section summarizes the major constraints and assumptions used in the evaluations contained in the appendices of this document. These include:

- The initial need date for the HSF with or without storage is 2013.
- The storage and staging alternatives shall comply with all relevant requirements in the *Hanford Shipping Facility System Specification* (RPP-20270).
- The HSF throughput shall be based on a just-in-time philosophy (RPP-20270)
- The HSF shall be designed to receive 2 IHLW canisters per day (RPP-20270).
- The allowable shipment rates of canisters from the Hanford Site to the MGR are 655 IHLW canisters per year concurrent with either 78 MCOs or 36 DOE standard canisters (RPP-20270).
- Receipt rate of SNF canisters is 78 MCOs per year or 36 DOE standard canisters per year. Based on the small percentage of these canisters, the assumption is that they will be 'worked in' to the overall shipping operations or will be accommodated by additional operating shifts. The flexibility to campaign these canister types has clear benefits, especially as the requirement is that the facility is 'just-in-time' and only staging (no storage) provisions are required for SNF canisters.
- The storage area shall be sized for interim storage of up to 2,000 IHLW canisters ("Solicitation No. 109427 For Hanford Shipping Facility (W-QQQ) Feasibility Study, Statement of Work" [CHG 2004]).
- The design shall allow for expansion for long-term storage of up to 4,000 IHLW canisters without negatively affecting the ability of the HSF to receive, store, and ship canisters (RPP-20270).
- 9,400 IHLW canisters, 418 MCOs, and 71 DOE standard canisters are to be processed through the HSF (CHG 2004).
- A staging area shall be provided for IHLW, MCO, and DOE standard canisters (CHG 2004).
- Peak HSF throughput rates will be accommodated by additional shift operations. Based on initial time and motion studies, operations to achieve the required throughput requires more than one operating shift. This study assumes two 8-hour shifts, 5 days per week as the normal shift operations.

- The functional requirements for storage and staging are defined as 'interim'; however, the assumption is that the HSF storage and staging equipment is designed for a 40-year operational life.
- The HSF will receive one design of MGR rail cask with baskets/internals as required to accept the various canisters produced at the Hanford Site (IHLW, MCO, and DOE standard canister).
- The MGR rail casks will be provided by the MGR to support HSF planned canister export rates (availability of 100% is assumed).
- Each repository cask railcar will have a dedicated cask, personnel barrier, and impact limiters.
- The MGR cask without impact limiters will maintain containment after a drop from 6 feet onto the floor of all MGR cask handling areas. The MGR has preliminarily identified this MGR cask design requirement as a need for handling the MGR cask within their receiving facilities.
- Canisters will be processed through the HSF in campaigns according to canister type.
- Rail service, via the Hanford Site railroad, will be available throughout the life of the HSF.
- Implementation of the following security constraints is assumed to be similar among the facility configuration alternatives:
  - A facility may not possess, receive, process, transport, or store special nuclear material until the facility has been cleared in accordance with *Safeguards and Security Program* (DOE O 470.1)
  - A security requirements analysis risk assessment must be completed to ensure any additional protection measures are incorporated into the design of the facility.
  - A security concept and design criteria document will be completed for integration of the physical security, protective force, operations security requirements, and administrative controls for the HSF.
  - [redacted]

7.2 RISKS

This section summarizes the major uncertainties or risk identified in the evaluations contained in the appendices of this document. These include:

- Delays to the MGR canister acceptance date could impact both WTP operations and the need date for HSF storage and/or additional storage capacity.

(b2)

- Potential WTP site construction and operational activities could impact the construction schedule and cost for both Alternatives 5A and 5B. For this reason, backup alternatives should be selected for these two alternatives and the interfaces with WTP should be well defined if either alternative site 5A or 5B are selected.

- This study assumes that empty MGR casks are continuously available for introduction into the HSF (100% availability). The assumed operation is that empty MGR casks would be staged in the HSF marshalling yard providing 100% availability to the HSF while the loaded MGR casks are transported to the MGR, unloaded, and transported back to the Hanford Site. If empty MGR casks are not available to the HSF during the time for transport to and from MGR and cask unloading at MGR, significant changes to the HSF would be required to maintain IHLW canister receipt and average facility throughput. HSF load-out operations would cease during periods when empty MGR casks are not available but receipt of IHLW canisters at the HSF would continue, resulting in the need for a significantly larger IHLW staging capacity. Also, to maintain an average throughput of two canisters per day, additional MGR cask load-out stations and MGR cask bays would be required.

- This study recommends that canister decontamination and overpacking is not needed in the HSF because of the low out-of-specification incident rate, availability or planned availability of other Hanford Site facilities that can provide this capability, and possible acceptance at MGR under a waiver. If incorporation of canister decontamination and overpacking capabilities at the HSF are desired, significant changes to the HSF design concept and capital cost would result.

- This study is based on an MGR cask operational time of 24 hours for opening and closing the cask. Because MGR cask operations are the limiting factor on facility throughput, cask operation times should be verified and impacts to the design concept analyzed.

- The contamination levels on canisters are assumed to be verified to be consistent with the HSF and MGR acceptance criteria prior to shipment or transfer to the HSF. If the contamination level of canisters is not verified upon receipt and canisters are subsequently identified as having unacceptable contamination levels, the HSF may become contaminated and other canisters may be cross-contaminated, resulting in the need for costly and time consuming facility and canister decontamination operations. This risk is particularly applicable to storage concepts in which the canisters are stored in a single airspace with the cooling air in direct contact with the canisters.

8.0 REFERENCES

CHG, 2004, "Solicitation No. 109427 For Hanford Shipping Facility (W-QQQ) Feasibility Study, Statement of Work," CH2M HILL Hanford Group, Inc., Richland, Washington.

DOE O 470.1, 1995, *Safeguards and Security Program*, Change 1, U.S. Department of Energy, Washington, D.C.

HNF-2298, 1998, *Conceptual Design Report for Immobilized High-Level Waste Interim Storage Facility (Phase 1), Project W-464*, Rev. 0, Lockheed Martin Hanford Corporation, Richland, Washington.

RPP-13678, 2003, *Integrated Mission Acceleration Plan*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-20270, 2004, *Hanford Shipping Facility System Specification*, DRAFT, CH2M HILL Hanford Group, Inc., Richland, Washington.

APPENDIX A
HANFORD SHIPPING FACILITY SITE SELECTION

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CONTENTS

ATTACHMENT

FIGURES

TABLES

LIST OF TERMS

CSB	Canister Storage Building
DOE	U.S. Department of Energy
ETF	Effluent Treatment Facility
EUZ	exclusive use zone
FPF	fuel preparation facility
HLW	high-level waste
HSF	Hanford Shipping Facility
HWVP	Hanford Waste Vitrification Plant
IHLW	immobilized high-level waste
MCO	multi-canister overpack
MGR	monitored geologic repository
SNF	spent nuclear fuel
WTP	Waste Treatment Plant

A1.0 INTRODUCTION

The purpose of this appendix is to present a high-level evaluation of alternatives for selection of the preferred sites for the Hanford Shipping Facility (HSF) as either a shipping facility only, or as a combined storage and shipping facility. The HSF provides for shipping and receiving of immobilized high-level waste (IHLW) and spent nuclear fuel (SNF) canisters and in the case of the combined facility, provides interim storage of 2,000 IHLW canisters. The site evaluation also includes consideration of capabilities for potential expansion to accommodate storage of 4,000 IHLW canisters.

A prior site evaluation report, *Alternatives Generation and Analysis (AGA) Report, IHLW Shipping Facility and Storage Module One Site Selection* (RPP-13712), considered sites for storage of 11,320 IHLW canisters and a total of 12,200 canisters of all types. The site evaluation presented in this appendix considers five site alternatives, including the three highest ranked sites from RPP-13712. The other two sites considered in this evaluation are near the Canister Storage Building (CSB) and within the Waste Treatment Plant (WTP) complex. Except for the WTP alternative site, all alternative sites can accommodate the HSF with or without storage capability. The WTP alternative site encompasses two sub-sites, one with storage capability and the other without. All five of the alternatives were developed with enough detail to perform a comparative analysis. A 'do nothing' alternative would not support the basic qualification of expansion to interim storage of 4,000 canisters and was therefore not considered in this analysis.
The alternatives are summarized as follows:

- **Alternative 1** – New facility located 1,800 feet north of the CSB site
- **Alternative 2** – New facility adjoining the northeast border of the Effluent Treatment Facility (ETF) site
- **Alternative 3** – New facility adjacent to the CSB facility
- **Alternative 4** – New facility adjoining the southeast border of the WTP complex
- **Alternative 5** – Includes two sub-sites within the WTP complex: the Alternative 5A sub-site is for the HSF without storage and would be a new building east of the high-level waste (HLW) vitrification building and would include an IHLW canister transfer passage from the HLW vitrification building; and the Alternative 5B sub-site is for the HSF with storage and would be located in the northwest quadrant of the WTP site (at site previously identified for the phase 2 immobilized low active waste vitrification building).

A2.0 BACKGROUND

The Hanford Site has 177 large underground storage tanks that contain approximately 55.5 million gallons of radioactive dangerous waste that was generated over several decades of nuclear weapons production. The highly radioactive waste is comprised of liquid, sludge, and salt cake. The storage tanks are located in an area of the Hanford Site called the 200 Areas Plateau.

The WTP is currently under construction on the east edge of the 200 Areas Plateau. The WTP will convert most of the Hanford Site radioactive waste into glass and seal it in large stainless steel canisters. The canisters containing the highly radioactive portion of the treated waste, the IHLW, are to be shipped to a monitored geologic repository (MGR) via rail for final disposal. The WTP is scheduled to begin producing IHLW canisters in May 2010. IHLW canister production is anticipated to be about 56 during the first year, and will increase to 240 in 2011, 360 in 2012, and 480 in 2013. Total production is estimated at 9,400 canisters. *Integrated Mission Acceleration Plan* (RPP-13678) requires the HSF to package approximately 9,400 IHLW canisters, 418 SNF multi-canister overpacks (MCOs), and 71 SNF U.S. Department of Energy (DOE) standard canisters into MGR casks for transport to the MGR for permanent disposal.

The two remaining incomplete vaults in the existing CSB will be prepared to store canisters by Project W-464 to accommodate interim storage of 880 IHLW canisters from the WTP (*Conceptual Design Report for Immobilized High-Level Waste Interim Storage Facility (Phase I), Project W-464* [HNF-2298]). Project W-464 construction is currently scheduled for completion by May 2010. However, the MGR is not scheduled to receive nuclear waste until 2013. Under the current Hanford schedule, the CSB will be nearing capacity by the end of 2012. The CSB will run out of storage space in mid 2013. This leaves no room for schedule delays at the MGR, in the HSF Project or in Project W-464.

A3.0 FUNCTIONS AND REQUIREMENTS

To support the selection of a preferred site, the attributes or functions and requirements applicable to the facilities (e.g., rail access, road access, utilities) that affect its siting have to be identified. The below functions and requirements are extracted from *Hanford Shipping Facility Functional Analysis* (RPP-20269), from the prior site selection document (RPP-13712), or from the statement of work for this task. These functions and requirements are incorporated into the site evaluation criteria included in Section A7.2.

A3.1 FUNCTIONS

The HSF will provide the following basic functions:

- Receive canisters of IHLW and SNF
- Interim store canisters pending shipment offsite
- Load canisters into transportation casks for shipment offsite to the MGR
- Receive empty shipping casks on railcars and stage them pending loading with canisters
- Dispatch loaded shipping casks to the MGR
- Perform supporting functions required to operate and maintain the HSF and protect the health and safety of workers, the public, and the environment (e.g., maintain nuclear safety, security, and accountability; waste management)

- Maintain security of SNF
- Manage and dispose of facility waste
- Provide utilities required for facility operations
- Maintain safe operations
- Maintain environmental controls
- Provide and maintain facility access to site railway.

A3.2 REQUIREMENTS

For the HSF with or without storage to perform these functions, the site selected for construction must provide the following:

- Maximum throughput shall support the WTP production rate of 2 IHLW canisters per day or one MGR shipping cask every 2½ days
- Safe interim storage for 2,000 IHLW canisters (applicable to the HSF with storage evaluation only)
- Capacity shall be expandable to a total storage capacity of 4,000 IHLW canisters (applicable to the HSF with storage evaluation only)
- Capability to load and unload the following types of canisters and the associated shipping casks: IHLW canisters, MCOs, and DOE standard canisters and the associated overpacks. SNF is assumed to be packaged in DOE standard canisters at the planned fuel preparation facility (FPF) prior to receipt at HSF
- Capability to receive deliveries of four railcars with empty casks and store up to 10 railcars with loaded or empty shipping casks (i.e., provide a railcar marshalling yard with the capacity for the above number of railcars including the switch capabilities to support staging of railcars loading and unloading at a rate to support the required facility throughput)
- Support facilities for 25 to 30 full-time personnel
- Enough land to support construction of the HSF
- Connection to a water distribution system with two independent sources of water
- Road access
- Access to the Hanford Site railway system for transport of MGR casks to the MGR
- A source of potable water for facility personnel

- A source for sewage treatment
- A source of electrical power of 250 kW at 480 VAC
- A connection point for communications systems including the Hanford Local Area Network (HLAN)
- A source for railcar wash water treatment and disposal (non-hazardous and non-radioactive)

Security fencing will be installed around the facility at a minimum 20-feet from the facility. If this distance cannot be accommodated because of property lines, building locations, safety or other site-specific considerations, and unacceptable risk is created, then supplementary protective measures will be provided.

Exterior lighting shall be provided around the fence line with a minimum 0.2 foot-candles illumination for 150 feet in all directions. If safety requirements are more stringent than those required for security, the level required for safety will take precedence.

[redacted]

A4.0 LAND USE PLAN AND MITIGATION

A4.1 LAND USE

The HSF sites (with and without storage) must conform to *Final Hanford Comprehensive Land Use Plan Environmental Impact Statements* (DOE/EIS-0222-F) and its related Record of Decision. The purpose of DOE/EIS-0222-F and its implementing policies and procedures is to facilitate decision-making about Hanford Site uses and facilities until at least 2050.

The preferred alternative described in DOE/EIS-0222-F was implemented by the Record of Decision and anticipates multiple uses of the Hanford Site, including future DOE missions, non-DOE federal missions, and other public and private sector land uses.

DOE/EIS-0222-F contains several key elements applicable to this evaluation. Those elements define the following:

- Five geographic areas of the Hanford Site (Figure A.1)
- Planned future uses for each geographic area

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- Nine land-use designations and permissible uses for each geographic area
- Planning and implementing policies and procedures governing review and approval of future land uses.

Of the nine DOE/EIS-0222-F land-use designations, one is suitable for HSF construction and operation without requiring an amendment to DOE/EIS-0222-F:

- **Industrial-Exclusive** – An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, non-radioactive wastes; includes related activities consistent with Industrial-Exclusive uses.

Allowable use is defined in DOE/EIS-0222-F as "Any reservation of land for a physical development or land-use activity that is consistent with the land-use designation..." Because the HSF will store radioactive dangerous waste, it fits within the definition of Industrial-Exclusive use.

The 200 Areas Plateau is the only Industrial-Exclusive use area shown in Figure A.1 as an elongated rectangle in the center of the Hanford Site.

DOE/EIS-0222-F also establishes a number of DOE policies regarding land use at Hanford. One of the more pertinent policies related to this evaluation is the one to "Reduce exclusive use zone (EUZ) areas to maximize the amount of land available for alternate uses..." (DOE/EIS-0222-F, Section 6.3.1, Overall Policy, Item 5). An EUZ is the safety buffer zone that surrounds DOE activities to protect the public from potential accidents. The size of an EUZ varies with the facility and is based on the distance for which special emergency planning and preparedness efforts are no longer required in the event of an operational emergency. Expansion of an existing or addition of a new EUZ would be counter to DOE/EIS-0222-F policy even if the facility is in the proper designated use area. Figure A.2 shows the Site EUZs. To conform with DOE/EIS-0222-F policies, all candidate sites are to lie well within existing EUZs.

Finally, of note to HSF site selection is that the DOE/EIS-0222-F Record of Decision states that the DOE preferred alternative will "Consolidate waste management operations on 50.1 km^2 (20 mi^2) in the Central Plateau...."

A4.2 HABITAT MITIGATION

The extent of mitigation required at Hanford for an action that disturbs or destroys habitat is variable based on a number of factors. Guidance in establishing the requirements for a given action is provided in *Hanford Site Biological Resources Management Plan (BRMaP)* (DOE/RL-96-32). However, none of the preferred sites identified by this evaluation impact any habitat areas. Therefore, no mitigation will be required for the HSF.

Figure A.1. Comprehensive Land Use Plan Preferred Alternative Map

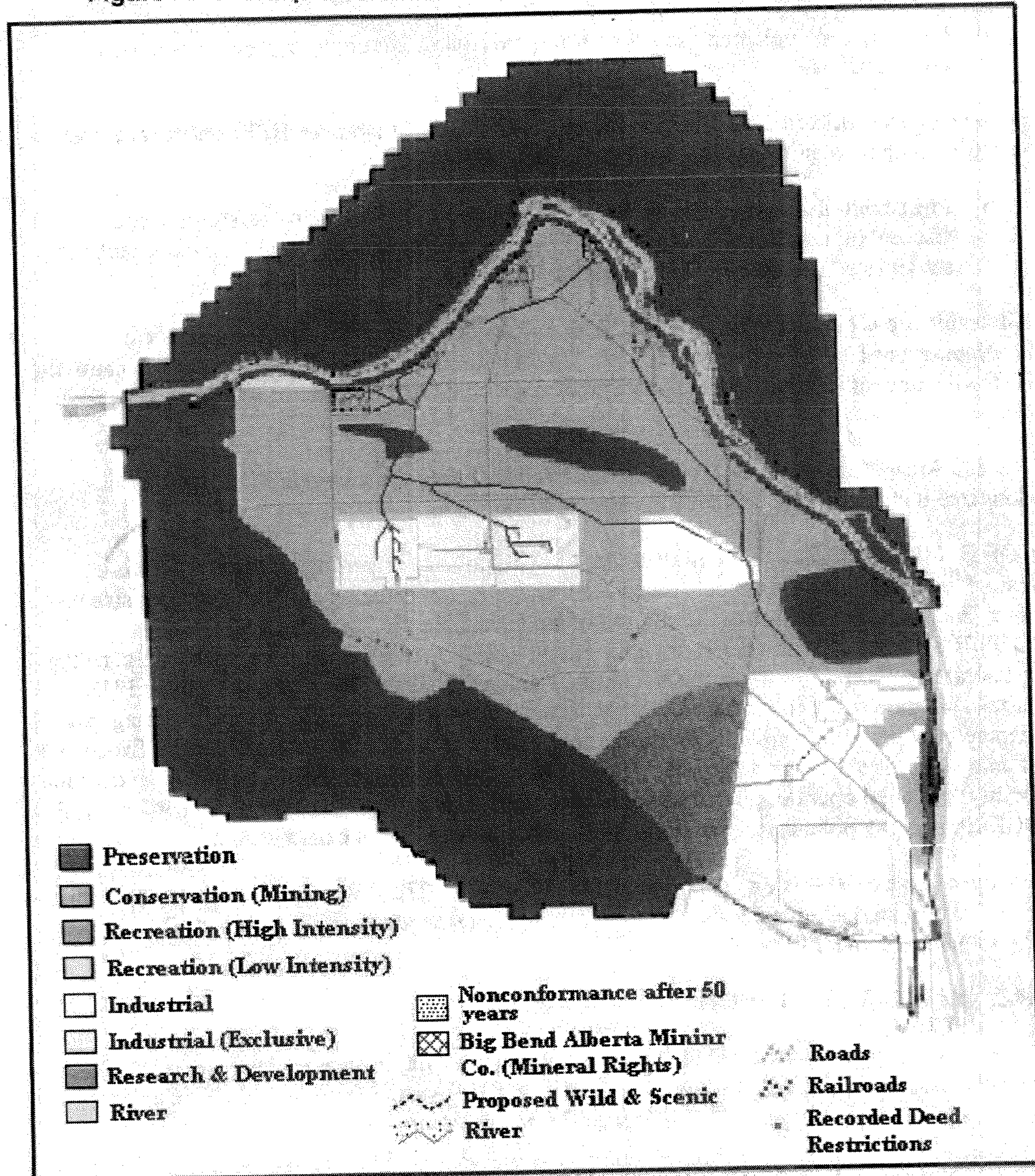
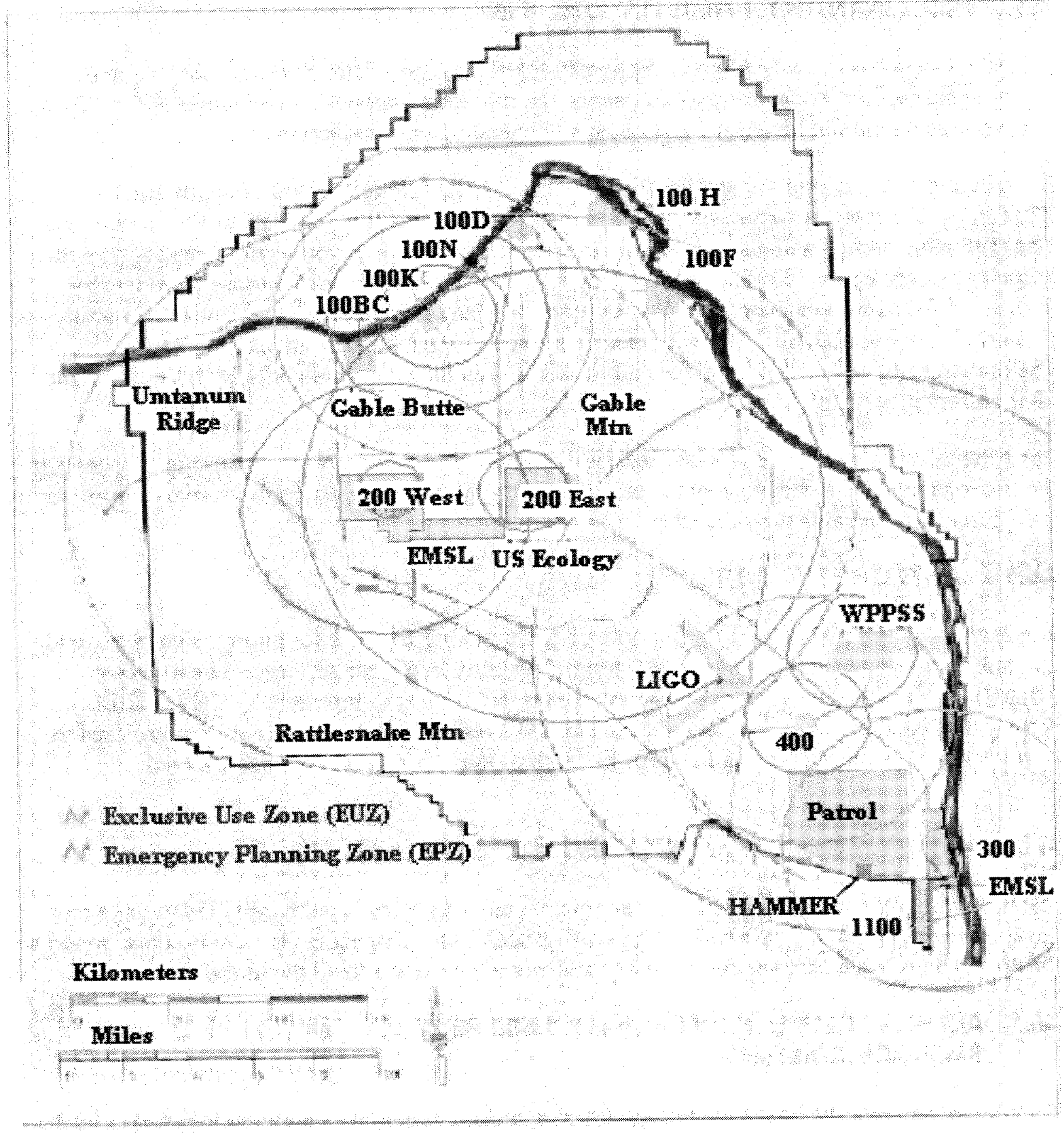


Figure A.2. Comprehensive Land Use Plan Exclusive Use Zones



A5.0 PRELIMINARY FACILITY DESIGN

A HSF concept has been developed. Appendix B of this report details these facility layouts. Considering facility size and supporting areas, the minimum amount of land required for a HSF with storage would fall between 7 and 18 acres depending on the selected site.

For Alternatives 1, 2, and 4, the HSF without storage will have a footprint of approximately 320 feet by 230 feet with a railcar marshalling yard extending1,200 feet outward from one side. The HSF with storage will also fit within this same footprint. The storage module design, with capacity to store up to 2,000 IHLW canisters, will have a rectangular footprint of 230 feet by 70 feet. If the storage capacity has to be expanded to hold 4,000 canisters, the basic footprint will grow to approximately 140 by 230 feet (not including the railcar marshalling yard). The drawings in the attachment at the end of this Appendix show the facility layout designs for all the alternatives considered.

For Alternatives 3, 5A, and 5B, modified facility layouts are used to fit the restrictions present at the site locations. The drawings in the attachment to this appendix also provide diagrams of the configurations used at these three sites.

A5.1 BASIS OF ESTIMATES

The estimates used in this siting evaluation are per unit length values for piping, electrical, road and rail system extensions required to tie the new facility into these services. The unit cost values were derived from vendor data available on the internet or provided by CH2M HILL. These values and the estimated length of the tie-ins from the attachment drawings were used to develop costs for the supporting facilities for each of the alternatives being considered.

A6.0 ANALYSIS OF ALTERNATIVES

The following sections describe the five alternative sites, the associated facility layout, and how the sites meet the evaluation criteria. The HSF concepts (see Appendix B) were used as the basis for the layout of each site, and most facility features are common to all the alternatives.

A6.1 ALTERNATIVE 1: NEW FACILITY 1,800 FEET NORTH OF THE CANISTER STORAGE BUILDING

The CSB lies in the 200 East Area in the southern portion of a large compound that was created in the early 1990s for construction of the Hanford Waste Vitrification Plant (HWVP). The HWVP project was cancelled shortly after the construction of the CSB began and the balance of the HWVP compound has seen little use. The compound is fairly level, with storm water run-on control measures provided and all necessary utilities readily available (see Attachment, Drawing CEES-04-044-C-002). In the northern area of this compound, about 1,800 feet north of the CSB, approximately 85 acres of cleared land are sparsely used as a fenced-in, gravel-stabilized, open storage area.

The Alternative 1 site is more than large enough to support construction of HSF with storage plus the potential future 4,000 IHLW canister expansion. At this location the HSF will required approximately 6.9 acres of land.

The main railroad spur into the 200 East Area runs along the north and east boundaries of the HWVP compound. To provide rail service to a railcar marshalling yard for the HSF, a switch would be added to the 200 East Area spur just inside the 200 East Area gate and rail-extended approximately 1,450 feet into the compound to the marshalling yard. Because the site is relatively flat, the marshalling yard would be constructed mostly at grade.

Paved roads already service the HWVP compound; however, slight modifications to the 2704HV Building parking lot would be required to allow cask transporters direct access to the HSF. Cask transporters would be routed from the WTP via the South WTP Road to Canton Avenue, south to Route 4S, west then north along Route 4S to the entrance to the 2704HV Building parking lot, past the parking lot to Akron Avenue, and then north to the HSF. The total driving distance from the WTP would be 4.9 miles. Road access for delivery of SNF from the CSB can be accomplished completely within the existing HWVP site area with virtually no use of frequently used roads. Again there would be no need for road modifications to support this activity. Onsite cask transporters would be routed from the CSB to the Alternative 1 site with a total driving distance of 0.5 mile.

Potable water would be available 1,180 feet south of the site and sanitary sewer would be available 1,250 feet south of the HSF service bay. Raw water for fire suppression equipment encircles the site; an extension to the HSF for a fire riser would be approximately 160 feet. The HWVP compound is already fenced and, aside from the additional entry gates and any temporary removal required for construction, no additional fencing will be required. Electrical power is available from distribution circuit C8L8 that runs parallel to Route 4S about 1,000 feet west of the site. Communication networks are available near the 2704HV Building, about 1,000 feet southwest of the site.

There would be no habitat mitigation efforts required to use this site. The site lies in the 200 Areas Plateau and is designated for Industrial-Exclusive use in DOE/EIS-0222-F. All habitat in the HWVP compound was previously removed and replaced with a gravel surface.

A6.2 ALTERNATIVE 2: NEW FACILITY ADJOINING THE NORTHEAST SIDE OF THE 200 AREA EFFLUENT TREATMENT FACILITY SITE

Adjoining the northeast edge of the 200 Area ETF site is a large, undeveloped parcel to the north with a gentle downward slope of a little more than 1%. The parcel is bounded on the north by Route 11A, the west by Canton Avenue, the south by the ETF, and the east/northeast by a steep downward slope. The main track of the Hanford railroad system climbs southeast to northwest along this steep slope and reaches the crest of the hill just before crossing Route 11A.

The Alternative 2 site is more than large enough to support the HSF with and without storage plus any future expansion to a 4,000 IHLW canister storage capacity (see Attachment, Drawing CEES-04-044-C-003). At this location the facilities will required approximately 16.8 acres of land.

The main rail spur to 200 East Area enters the plateau northwest of the Alternative 2 site. To provide rail service to a railcar marshalling yard for this site, a switch would be added just after the rail line crests the slope onto the 200 Areas Plateau and rail line would be extended approximately 2,750 feet to the site railcar marshalling yard. The gentle northward slope of the site would allow the yard to be constructed at, or close to, grade level. The large open areas in and around the site would provide more than adequate lay-down, storage, and spoil area for construction.

Road access for delivery of IHLW canisters from the HLW vitrification building would be available off Canton Avenue. Because Canton Avenue is an intra-area road, no special turn or deceleration/acceleration lanes would be required. IHLW cask transporters would be routed from the WTP via the North WTP Road to Canton Avenue, and then north along Canton Avenue to the HSF entrance. Total driving distance from the WTP would be 2.4 miles. Road access for delivery of SNF from the CSB could be provided by Akron Avenue, 12th Street, and the ETF access road. These are also intra-area roads, so no special modifications would be required. Onsite cask transporters would be routed from the CSB to the Alternative 2 site with a total driving distance of 3.1 miles.

Potable water is available from a main approximately 1,000 feet to the south. There are no sanitary sewage treatment complexes of adequate capacity within a reasonable distance; therefore, a standalone sub-surface absorption system would be constructed northwest of the HSF. Approximately 3,700 feet of raw water main would be required to extend the fire suppression water loop from the ETF to around the HSF. Electrical power is available from a distribution circuit that runs along Canton Avenue about 1,000 feet southwest of the site. Communication networks are available near the ETF about 1,200 feet southeast of the site. The site lies outside the 200 East Area fence; therefore, approximately 1,750 feet of security fence will be required to enclose the HSF.

The site is currently covered mostly by cheat grass with very few small sagebrush or rabbit brush plants. Mitigation of the loss of this habitat may be required, but because of the poor quality of habitat it is anticipated that the mitigation effort will be minimal. A small portion of the HSF site and all of the railcar marshalling yard would lie outside 200 Areas Plateau. The plateau boundary is loosely defined in DOE/EIS-0222-F was having a northern boundary just north of the northern fence line of the 200 East and 200 West Areas that extends as a straight line to about 0.5 mile east of the ETF. If the plateau boundary is to be strictly interpreted as an easterly extension of the most northern 200 East Area fence, at least the marshalling yard will lie mostly within an area designated for conservation and a special use permit will be required to construct the HSF at this location (see Attachment, Drawing CEES-04-044-C-003).

A6.3 ALTERNATIVE 3: EXPANSION OF THE CANISTER STORAGE BUILDING

See Section A6.1 for a description of the CSB site. Because of the CSB configuration, an addition will only be made at the south end of the CSB structure. The weld station for seal-welding SNF canisters is housed in this end of the building, and the foundation is basically a 5-foot-thick slab on grade. The following evaluation of the CSB site assumes that the Project W-464 modifications to the existing CSB will have been completed before the HSF construction begins.

The Alternative 3 site is large enough to support construction of the HSF with and without storage and the future potential expansion to 4,000 canisters capacity. A modified layout for the HSF is proposed for this site to allow for a direct canister transfer interface with the CSB and to fit within the constraints of the site (see Attachment, Drawing CEES-04-044-C-004). At this location the HSF will require approximately 10.2 acres of land.

The small amount of excavated material from the HSF construction may have to be hauled to a separate site because there is limited space nearby for the stockpiling/disposal of soil. Because of space constraints, construction laydown and staging areas would have to be more than 1,200 feet from the building site in the area northeast of the 2704-HV Building, which is currently used for temporary storage.

CSB expansion would allow for shared use of some existing support facilities (e.g., office space and electrical power supply equipment). The CSB includes a load-in bay for the MCO and IHLW casks area that could be used to supplement the one planned for the HSF. Also, an FPF is planned for construction adjacent to the CSB. The FPF will provide capability to package SNF into DOE standard canisters and obtain gas samples from MCOs. The FPF will also provide capability to decontaminate and overpack or repackage canisters. Conceptually, the SNF and IHLW canisters stored in the CSB could be transferred into the HSF canister handling hot cell using a belowgrade canister transfer passage for loading directly into an MGR cask. Alternatively, the canisters could be transferred from the CSB to the HSF via the FPF. Both of these concepts would eliminate the need to load the canisters into onsite casks for road shipment to the HSF unloading bay and should be evaluated as part of design optimization during subsequent design phases of the HSF.

The main railroad spur into 200 East Area runs along the north and east boundaries of the HWVP compound. To provide rail service to a railcar marshalling yard for this site, a switch would be added to the 200 East Area spur just after that line turns south, and tracks would be extended approximately 2,000 feet into the compound to the marshalling yard. This would require some of the HWVP perimeter fence road, compound fence, and perimeter lighting to be modified. Minor modifications to the storm water run-on control berm and ditch may also be required.

Road access would be provided by an extension to the roadway serving the CSB. MCO cask transporters would be routed from the south WTP Road to Canton Avenue, south to Route 4S, west then north along Route 4S to the entrance to the CSB, and then east and south to the HSF. The total driving distance from the WTP would be 4.8 miles. No road shipment for SNF canisters is required in this alternative.

Potable water and sanitary sewer would be available 1,280 feet north of the HSF service bay. Raw water for fire suppression equipment encircles the site, and an extension to the HSF for a fire riser would be approximately 160 feet. The HWVP compound is already fenced and no additional fencing would be required, aside from the additional entry gates, relocation of the fence displaced by the railcar marshalling yard, and any temporary removal required for construction. Electrical power would be available from the CSB with a 300-foot-long tie-in line required. Communication networks would be available from the CSB with a 500-foot-long tie-in line required. A security fencing upgrade, by others, is also planned for the CSB. Modifications to the security fencing to accommodate HSF construction and final security fencing inclusive of HSF is assumed to be comparable in cost with the security fencing that would be required at the other alternative sites.

There would be no habitat mitigation efforts required to use this site. The site lies in the 200 Areas Plateau and is designated for Industrial-Exclusive use in DOE/EIS-0222-F. All habitat in the HWVP compound was previously removed and replaced with a gravel surface.

A6.4 ALTERNATIVE 4: NEW FACILITY ADJOINING THE SOUTHEAST EDGE OF WASTE TREATMENT PLANT COMPLEX

South of the compound set aside for the construction of the WTP complex is a very large, undeveloped parcel of land. The terrain is generally flat with localized hummock and swale features that are covered with a dense mature sage-steppe habitat. The parcel is bounded on the north by South WTP Road and the WTP perimeter fence, the west by the 200 East Area perimeter fence, the south by Route 4S, and on the east it extends for more than 0.5 mile before the terrain falls off rapidly. There are a number of open areas in the parcel where excavated soil and excess spoil could be stockpiled.

The Alternative 4 site is large enough to support construction of the HSF with and without storage and the potential 4,000 canister future expansion (see Attachment, Drawing CEES-04-044-C-005, Sheets 1 and 2). At this location the facilities would require approximately 17.6 acres of land.

Approximately 5,550 feet of new rail line would be needed to extend the existing railroad service to the railcar marshalling yard. The PUREX/204-AR Waste Unloading Facility spur would be extended south and east to a crossing over Canton Avenue, then east, passing through several small hills or inactive sand dunes, to a relatively level area where the marshalling yard would be constructed. The elevation where the railroad will cross Canton Avenue is approximately 30 feet above the 'at grade' elevation where the railcar marshalling yard would be constructed. The yard is to be built flat (with no slope). The distance between Canton Avenue and the entrance to the marshalling yard is 1,800 feet, which produces a grade of approximately 1.7% from Canton Avenue to the yard.

Road access would be provided off South WTP Road. Because WTP Road is an intra-area road, no special turn or deceleration/acceleration lanes would be required. The entrance to the HSF would be located just outside the existing gate to the WTP complex. The total driving distance from the WTP would be less than 0.5 mile. Road access for [redacted] from the CSB would be provided using the same roads used to deliver IHLW canisters to Alternative 1. There would be no need for road modifications to support this activity. MCO cask transporters would be routed from the CSB to the Alternative 4 site with a total driving distance of 4.4 miles.

[redacted] Transportation of the IHLW canisters could then be performed using a short distance transporter (e.g., omni-directional transporter) instead of a highway-qualified transporter (e.g., cask transporter).

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Potable water would be provided to the HSF by extending a pipeline 1,000 feet north to the WTP Service Building just inside the WTP complex. Fire suppression water would be provided by extending a 3,700-foot-long loop-off of the new water main that runs along the south side of South WTP Road. There are no sanitary sewage treatment complexes of adequate capacity within a reasonable distance (approximately 1,000 feet); therefore, a stand-alone subsurface absorption system would be constructed northeast of the HSF. Electricity would be provided to the HSF by extending a pole line from distribution circuit C8L5 located west-northwest of the WTP. Approximately 6,000 feet of 13.8 kV distribution line and about 1,000 feet of 480 VAC power cable would be required. Communication networks are expected to be available in the WTP, approximately 1,200 feet north of the site.

[redacted] The site lies in the Industrial-Exclusive use area defined in DOE/EIS-0222-F. The area is currently covered by a fairly dense mature sage-steppe habitat. Mitigation of the loss of this habitat would be required and is anticipated to be extensive.

A6.5 ALTERNATIVE 5: SUB-SITES IN WASTE TREATMENT PLANT COMPLEX

There are two sub-sites being considered in the WTP complex under Alternative 5. The reason for two sub-sites within the WTP site is that the best site for the HSF without storage does not provide any space for storage. Therefore, a second site within the WTP site was selected for the HSF with storage. The first sub-site, the HSF without storage site, is immediately east of the HLW vitrification building. The second, the HSF with storage site, is located northeast of the HLW vitrification building. Both sites are already developed and are basically flat.

A potential for interferences between HSF construction and WTP construction and/or operational activities exists but could not be quantified at this time because of lack of inputs from the WTP project. Because these potential interferences could have significant schedule and/or cost impacts on the HSF construction, they are considered risks and are addressed in Section A8.2.

A6.5.1 Alternative 5A – Hanford Shipping Facility Without Storage at the Waste Treatment Plant Site

The Alternative 5A sub-site is bounded on the north by a line running east from the north edge of the HLW vitrification building, on the south by a line running east from the south edge of the HLW vitrification building, on the west by the HLW vitrification building, and on the east by the low-activity waste vitrification building. There is open area in the WTP complex that could be used for storage, lay down, and spoils piles. The Alternative 5A sub-site is large enough to support construction of the HSF only (see Attachment, Drawing CEES-04-044-C-006, sheets 1 and 3). The HSF would require approximately 7.5 acres of land at this location.

Approximately 5,400 feet of new rail line would be needed to extend the existing railroad service to the railcar marshalling yard and then into the WTP complex to the Alternative 5A sub-site. The marshalling yard would be located west of the WTP site. The PUREX/204-AR Waste Unloading Facility spur would be extended south and east to a crossing over Canton Avenue, then north and east, passing through the old Grout Plant site where the railcar marshalling yard

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would be constructed. The elevation where the railroad would cross Canton Avenue is approximately 30 feet above the 'at grade' elevation where the marshalling yard will be constructed. The rail line would then continue east into the WTP site and then south to the Alternative 5A sub-site.

Road access exists in the WTP complex. A short section of new road would be required to the west of the new HSF to replace the access road that would routinely have railcars parked on it for loading and unloading during HSF operations. The road distance from the HLW vitrification building would not be an issue for Alternative 5A because the IHLW canisters would be delivered from the HLW vitrification building using an underground tunnel. The distance from the Alternative 5A sub-site to the CSB is approximately 4.8 miles.

Potable water would be available within 500 feet of the Alternative 5A sub-site. Fire suppression water is available within the WTP complex and would require a 500-foot extension to the Alternative 5A sub-site. There is adequate sanitary sewage treatment capacity in the WTP complex. The tie-in line lengths for the Alternative 5A sub-site would be 500 feet. Adequate electrical power is also available in the WTP complex. The tie-in line lengths for the Alternative 5A sub-site would be 500 feet. Communication networks are available in the WTP complex, within approximately 500 feet of the sub-site.

The Alternative 5A sub-site, including the associated railcar marshalling yard, lies completely within the existing WTP complex and old Grout Plant site. Therefore, no mitigation of lost habitat would be required.

A6.5.2 Alternative 5B – Hanford Shipping Facility With Storage at the Waste Treatment Plant Site

The Alternative 5B sub-site is bounded on the north by the existing PC Loop Road, on the south by Road C, on the west by Road B, and on the east by Road I. There is open area in the WTP complex that could be used for storage, lay down, and spoils piles. The Alternative 5B sub-site is large enough to support construction of the HSF with and without storage and the potential future 4,000-canister expansion (see Attachment, Drawing CEES-04-044-C-006, sheets 1 and 2). The HSF would require approximately 8.9 acres of land at this location.

As in the case of Alternative 5A, approximately 4,550 feet of new rail line would be needed to extend the existing railroad service to the marshalling yard and then into the WTP complex to the Alternative 5B sub-site. The only difference from the Alternative 5A extension is that the south run inside the WTP complex would not be required for Alternative 5B.

Road access exists in the WTP complex. A short extension into the parking lot and truck load-in/load-out bay would be required for Alternative 5B. The road distance from the HLW vitrification building to the Alternative 5B site is 0.2 miles. The distance from the Alternative 5B sub-site to the CSB is approximately 4.7 miles.

Potable water would be available within 500 feet of the Alternative 5B sub-site. Fire suppression water is available within the WTP complex and would require a 500-foot extension to the Alternative 5B sub-site. There is adequate sanitary sewage treatment capacity in the WTP complex. The tie-in line lengths for the Alternative 5B sub-site would be 500 feet. Adequate electrical power is also available in the WTP complex. The tie-in line lengths for the Alternative 5B sub-site would be 500 feet. Communication networks are available in the WTP complex, within approximately 500 feet of the sub-site.

The Alternative 5B sub-site, including the railcar marshalling yard, lies completely within the existing WTP complex and old Grout Plant site. Therefore, no mitigation of lost habitat would be required.

A7.0 EVALUATION OF ALTERNATIVES

Evaluation criteria are used to compare and further evaluate viable alternatives and provide the mechanisms for selecting a preferred alterative. Development of the evaluation criteria included (1) the constraints dealing with regulations, (2) agreements, (3) required features, and (4) established guidelines. These criteria were then refined to establish a complete set applicable to the specific alternatives being analyzed for this evaluation:

- Operability
- Expandability
- Environmental
- Stakeholder values
- Safety
- Capital cost
- Operating cost
- Security.

Each alternative was evaluated to determine how well it satisfies the evaluation criteria. In the absence of an objective means of comparison, engineering judgment was used to assign the performance ratings, or rankings. The performance rating is multiplied by the weighting factor of each criterion, and the products for each alternative are totaled for comparison.

Section A7.1 defines the assumptions and constraints that underlie decisions made in the evaluation. Section A7.2 defines the evaluation criteria, and Section A7.3 describes the weighting factors. The evaluation results are summarized in Section A7.12.

A7.1 CONSTRAINTS AND ASSUMPTIONS

The following sections identify the constraints that apply to the decisions being made in this analysis and the assumptions used to support the siting evaluations.

A7.1.1 Constraints

The following constraints apply to the decisions being made in this analysis:

- The initial need date for the HSF without storage is 2013, based on the planned WTP start date and production rate, and the storage capacity of the CSB. See related discussion in Section A8.1.

- The initial need date for the HSF with storage is 2013, based on the planned WTP start date and production rate, and the storage capacity of the CSB. See related discussion in Section A8.1.
- The following are the security constraints associated with the SNF canisters.
  - A facility may not possess, receive, process, transport, or store special nuclear material until the facility has been cleared in accordance with *Safeguards and Security Program* (DOE O 470.1).
  - An SRA risk assessment must be completed to ensure any additional protection measures are incorporated into the design of the facility.
  - A security concept and design criteria document will be completed for integration of the physical security, protective force, operations security requirements, and administrative controls for the HSF.
  - [redacted]

A7.1.2 Assumptions

The following assumptions were used to support the siting evaluations:

- Rail service, via the Hanford railroad, will be available throughout the life of the HSF.
- Project W-464 will modify the CSB to prepare the remaining two canister storage vaults for receipt of IHLW canisters before HSF project construction begins.
- [redacted] Coordination of the HSF project with security upgrades activities will be required if the CSB site is selected for the HSF. It is assumed [redacted]
- The maximum IHLW production rate will be 2 canisters per day with a total annual production of 480 canisters a year. The receiving, and material handling capacity of the HSF will be based on this assumption for establishing a basic footprint or building size.
- IHLW and SNF will be shipped by rail to the MGR in large casks that will hold five IHLW canisters, or four MCO canisters, or two IHLW and two MCO canisters, or seven DOE standard canisters.
- All shipping casks will arrive at the HSF without contamination. Any cask found to be contaminated will be considered an off-normal event and, depending on the level of contamination, will be manually decontaminated or transported to another location for decontamination.

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- All canisters received by the HSF and the IHLW interim storage facility will be sealed (welded) and the exterior surfaces will not require decontamination (i.e., be less than 22,000 dpm/100 cm^2).
- Each repository cask railcar will have a dedicated cask, personnel barrier, and impact limiters.
- The railcars will collect enough grime and road dirt as they move between Hanford and the MGR to require cleaning at the HSF before unloading.
- The railcar wash station must be capable of operating during periods of freezing weather.
- [redacted]

A7.2 EVALUATION CRITERIA

Development of the evaluation criteria for the HSF included the constraints dealing with regulations, agreements, required features, and established guidelines. These criteria were then refined to establish a complete set applicable to the specific alternatives being analyzed. The evaluation criteria are defined in Table A.1.

A7.3 WEIGHTING OF EVALUATION CRITERIA

The evaluation criteria are weighted according to their relative degree of importance. The weighting factors used in this study are as identified in Table A.2 and were established with consideration of weighting factors used in other alternative analyses and comments received during the preparation of this evaluation. The rankings of the alternatives for both raw scores and weighted scores are compared to assess the sensitivity of the final alternative rankings to the selected weighting factors.

An assigned numerical value quantifies the criteria and reduces the effect of evaluator bias on the analysis. The performance of each alternative is evaluated with respect to each criterion in Section A7.4 through A7.11. The performance level is judged as 'poor' to 'good' with a corresponding score of 1 through 5, respectively, when compared to each other. That is, for a specific category at least one alternative must receive a score of 5 and a different alternative must receive a score of 1, otherwise that category is deemed 'not applicable' for purposes of evaluating differences between the alternatives.

Once an alternative receives a performance ranking score of 5 and another receives a score of 1, the remaining alternatives receive a score based how they compare with those two alternatives. No two alternatives are to receive the same performance ranking score unless they are identical in how they meet the evaluation criterion. The weighted score is the product of the performance ranking score (1 to 5) and the applicable weighting factor. Table A.2 shows the weighting factors of the evaluation criteria. The score total for each alternative is the sum of the weighted scores.

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Table A.1. Evaluation Criteria Descriptions

Criterion	Description
Operability	Interfaces with site utilities: • Electrical power providing 250 kW @ 480 VAC • Water providing two sources with a capacity of at least [redacted] • Sewer capacity for a staff of 25 to 30 (~600 gal/day) Transport interfaces: • Easy rail and road access to support delivery • Rail marshalling yard for [redacted] • Adequate truck and rail unloading support Support facilities for staff of 25 to 30 *Security interfaces*
Expandability	Space to hold 4,000 canisters
Environmental	Minimize destruction of mature sage-steppe habitat Minimize emissions (vehicle and facility)
Stakeholder values	Operational efficiency Safety Habitat conservation Land use Sharing of functions Nuclear facility sprawl prevention Cost
Safety	Control facility worker radiation exposure to ALARA levels *Minimize radioactive, toxic, industrial, and environmental* hazards and emissions during construction, maintenance, and operations
Capital costs	Design Procurement Construction Testing
Operating costs	Facility operations
Security	Interfaces with site utilities, such as the Hanford Site fiber *optic and telephone backbones* Sharing of functions Protective force support at the facility and during transportation Design

ALARA = as low as reasonably achievable.

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Table A.2. Evaluation Criteria Weighting Factors

Criterion	Weighting Factor
Operability	10
Environmental	10
Stakeholder values	15
Safety	15
Capital cost	20
Operating cost	15
[redacted]	[redacted]
Total	100

A7.4 OPERABILITY

This section qualitatively evaluates the operability performance of the alternatives against interfaces associated with other facilities, utilities, transportation, and security.

Some of the evaluation factor considerations are different for the HSF without storage and the HSF with storage; therefore, they are evaluated separately in the following sections. The results of the two evaluations are summarized in Table A.3.

A7.4.1 Operability: Building Interfaces

Building interface scores are intended to incorporate both positive and negative impacts of interfaces with the adjacent and nearby building. Alternatives 3 and 5A have direct connections to the adjacent CSB and HLW vitrification buildings that will significantly reduce operations associated with loading and unloading onsite transportation casks and will allow sharing of facilities and operations personnel. Alternatives 1 and 5B have interfaces with adjacent facilities (Alternative 1: 2704-HV and CSB, Alternative 3: 2704-HV and CSB, Alternative 5A: WTP facilities, Alternative 5B: WTP facilities) allowing sharing of personnel and facility resources. Alternatives 2 and 4 have less convenient interfaces with adjacent facilities (Alternative 2: ETF and Alternative 4: WTP facilities). There is a potential for congestion and other operational interface problem associated with Alternatives 5A and 5B because of WTP operations that has not been quantified. Based on these interfaces the alternatives were assigned the ratings shown in Table A.3.

Table A.3. Hanford Shipping Facility Operability Evaluation Results

Evaluation Criterion	Alt. 1 Score	Alt. 2 Score	Alt. 3 Score	Alt. 4 Score	Alt. 5A Score	Alt. 5B Score
Building Interfaces	4	1	5	2	3	3
Road Interface Including Ease of Canister Transport	1	2	3	4	5	5
Railroad and Marshalling Yard Interface	5	3	4	2	1	1
Sewer Interface	3	3	3	1	5	5
Potable Water Interface Including 2 Sources	3	3	3	4	5	5
Raw Water Interface	5	1	5	1	3	3
Electrical Interface	3	3	5	1	4	4
Communications Interface	2	1	5	1	5	5
Facilities for a Staff of 25 to 30	4	3	5	4	5	5
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	34	21	43	22	39	39
HSF without storage Total Score	3	1	5	1	4	N/A
HSF with storage Total Score	3	1	5	1	N/A	4

HSF = Hanford Shipping Facility.
NA = not applicable.

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A7.4.2 Operability: Road Interface

Two factors contribute to the road interface score: (1) road travel distance for the transport of both the IHLW canisters to the HSF and the transport of SNF from CSB to the HSF and (2) any facility features or constraints which ease or make more difficult the transfer of canisters into the HSF. The road travel distances for each of the facilities are shown in Table A.4. These mileages are based on a total of 9,400 IHLW canisters with 880 stored in the CSB. Alternative 5A will receive all IHLW canisters through a transfer tunnel, avoiding operations associated with loading and unloading onsite transportation casks. Similarly, Alternative 3 will receive the canisters stored in the CSB via a transfer tunnel. All the other alternatives will receive all canisters via onsite transportation cask. All canister shipments to Alternative 2 are via inter-area shipments, whereas shipments will be intrafacility for Alternatives 1, 4, and 5B. Table A.4 shows the road interface ranking development for the alternatives.

Table A.4. Road Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
IHLW Transport Distance (miles)	4.9	2.4	4.8	0.5	0	0.2
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transport Distance	42,433	24,692	40,896	10,284	6,571	8,138
Transport Score	1	3	2	4	5	5
Canister Delivery Ratings	2	1	4	3	5	3
Total Score	3	4	6	7	10	8
Ranking Score	1	2	3	4	5	5

IHLW = immobilized high-level waste.
SNF = spent nuclear fuel.

A7.4.3 Operability: Rail Interface

The railroad and marshalling yard interface ranking is intended to identify any advantages or disadvantages associated with either the interface with the railroad system and installation of the marshalling yard for each of the alternatives. Table A.5 shows the railroad interface ranking development for the alternatives.

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Table A.5. Railroad Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Railroad Tie-in [a]	(1,450 ft) 5	(2,750 ft) 3	(2,000 ft) 4	(5,550 ft) 1	(5,400 ft) 1	(4,550 ft) 2
Marshalling Yard [b]	5	4	5	3	1	1
Total of sub-criteria scores	10	7	9	4	2	3
Score	5	3	4	2	1	1

[a] The railroad tie-in easy/difficulty ranking is based on the length of the tie-in line. Topography for the new rail and marshalling yard is similar at all sites.

[b] The marshalling yard rankings were used to identify any advantages or disadvantages associated with installation of the marshalling yards. Alternatives 5A and 5B involved installing the marshalling yard at a modest distance from the Hanford Shipping Facility due to physical site constraints. The marshalling yard for these two alternatives is installed on an area that has been reclaimed from a contaminated effluent trench. The marshalling yards for Alternatives 2 and 4 are installed in natural habitat areas with Alternative 4 ranked slightly lower than the marshalling yard area for Alternative 2.

A7.4.4 Operability: Sewer Interface

The sewer interface rankings are intended to identify any advantages or disadvantages associated with providing sewer services to the alternative sites. Table A.6 shows the sewer interface ranking development for the alternatives.

Table A.6. Sewer Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Sewer Line Length	(1,250 ft) 1	(300 ft) 5	(1,280 ft) 1	(475 ft) 4	(500 ft) 4	(500 ft) 4
New Sewer Tile Field Required?	No 5	Yes 1	No 5	Yes 1	No 5	No 5
Total of sub-criteria scores	6	6	6	5	9	9
Score	3	3	3	1	5	5

A7.4.5 Operability: Potable Water Interface

The potable water interface rankings are intended to identify any relative advantages or disadvantages with providing raw water service to the alternative sites. Table A.7 shows the potable water interface ranking development for the alternatives.

Table A.7. Potable Water Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Potable Water Tie-in Length	(1,180 ft) 3	(1,000 ft) 4	(1,280 ft) 3	(1,000 ft) 4	(500 ft) 5	(500 ft) 5
Water Tie Interface Problems	No potable water line tie-in problems were identified.					
Total of sub-criteria scores	3	4	3	4	5	5
Score	3	3	3	4	5	5

A7.4.6 Operability: Raw Water Interface

The raw water interface rankings are intended to identify any relative advantages or disadvantages with providing raw water service to the alternative sites. The raw water system must also be able to provide two independent sources of water to the facility for firefighting. Table A.8 shows the raw water interface ranking development for the alternatives.

Table A.8. Raw Water Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Raw Water Tie-in Length	(160 ft) 5	(3,700 ft) 1	(160 ft) 5	(3,700 ft) 1	(500 ft) 3	(500 ft) 3
Water Tie Interface Problems	No raw water line tie-in problems were identified and there are two independent sources of water for all the alternative sites.					
Total of sub-criteria scores	5	1	5	1	3	3
Score	5	1	5	1	3	3

A7.4.7 Operability: Electrical Interface

The electrical power interface rankings are intended to identify any relative advantages or disadvantages with providing electrical power to the alternative sites. Table A.9 shows the electrical interface ranking development for the alternatives.

Table A.9. Electrical Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Electrical Tie-in Length	(1,000 ft) 3	(1,000 ft) 3	(300 ft) 5	(7,000 ft) 1	(500 ft) 4	(500 ft) 4
Electrical Power System Advantages/ Disadvantages [a]	0	0	+2	-1	0	0
Total of sub-criteria scores	3	3	7	0	4	4
Score	3	3	5	1	4	4

[a] Alternative 3 received a +2 score because it will only have to install a short line from an existing CSB 480 VAC transformer. Alternative 4 received a – 1 score because it will have to install both a 13.8 KVA line and a 480 VAC transformer to supply power to the HSF.

CSB = Canister Storage Building.
HSF = Hanford Shipping Facility.

A7.4.8 Operability: Communications Interface

The communication system interface rankings are intended to identify any relative advantages or disadvantages with connecting the alternative sites to the 200 Area communications system. Table A.10 shows the communication interface ranking development for the alternatives.

Table A.10. Communications Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Communications Tie-in Length	(1,000 ft) 2	(1,200 ft) 1	(500 ft) 5	(1,200 ft) 1	(500 ft) 5	(500 ft) 5
Communications System Advantages/ Disadvantages	No other advantages or disadvantages were identified for the communications tie-ins.					
Total of sub-criteria scores	2	1	5	1	5	5
Score	2	1	5	1	5	5

A7.4.9 Operability: Staff Support Interface

The facilities for a staff of 25 to 30 interface rankings are intended to identify any relative advantages or disadvantages of the alternative facility sites for providing the facilities and services to support the staff needed to man the HSF. Table A.11 shows the staff support interface ranking development for the alternatives.

Table A.11. Staff Support Interface Ranking Evaluation

Criteria	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Meets Staff Support Requirements	Yes 0	Yes 0	Yes 0	Yes 0	Yes 0	Yes 0
Can Take Advantage of Nearby Facilities	4	3	5	4	5	5
Total of sub-criteria scores	4	3	5	4	5	5
Score	4	3	5	4	5	5

A7.4.10 Operability: Security Interface

[redacted]

A7.5 EXPANDABILITY

Evaluation of the expandability criterion to rank the alternatives based on site abilities to support potential expansion of the HSF to hold 4,000 canisters was dropped from the decision criterion because expansion is not applicable to the HSF without storage decision and all of the HSF with storage alternatives could accommodate expansion to hold 4,000 canisters.

A7.6 ENVIRONMENTAL

This section evaluates the alternatives based on potential impacts to the ecosystem, which include the following

- Destruction of mature sage-steppe habitat
- Emissions (transport vehicle and facility)
- Pollution prevention (including recycling).

It is assumed that each alternative will be constructed and managed in compliance with environmental regulations. Table A.12 shows the summary of the environmental evaluation results.

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Table A.12. Summary of Environmental Evaluation Results

Facility	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
HSF without storage	4	2	4	1	5	NA
HSF with storage	4	2	4	1	NA	5

HSF = Hanford Shipping Facility.
NA = not applicable.

Alternatives 1, 3, 5A, and 5B would not disturb the existing habitat because construction activities would be in areas previously cleared by other projects. Alternatives 2 and 4 would disturb 17 and 21 acres, respectively. The habitat disturbed by Alternative 2 would be moderate to low-grade sage-steppe and dry-land grass habitat. The habitat disturbed by Alternative 4 is dense, mature sage-steppe habitat and would have the greatest negative impact to the ecosystem in that regard.

Facility emissions are expected to be the same for all alternatives; however, transport vehicle emissions vary greatly. The distance each cask transporter must travel varies from 0 mile for Alternative 5A, to 4.9 miles for Alternative 1. Rail travel on the Hanford Site also varies from 21.5 miles for Alternative 2 to 32.1 miles for Alternative 5B. Table A.13 compares travel distances for each alternative.

Table A.13. Road and Rail Travel Distance Comparisons

Alternative	Distance from WTP by road[a] (miles) (IHLW/SNF/Total)	Distance from Richland by rail (miles)
1	4.9/0.5/4.3	28.1
2	2.4/3.1/2.5	21.5
3	4.8/0/4.1	28.5
4	0.5/4.4/1.0	31.8
5A	0[b]/4.8/0.7	32.0
5B	0.5/4.7/0.8	32.1

[a] Because in addition to IHLW canisters being transported to HSF, SNF canisters will also be transported from the CSB to HSF; both sets of mileage have to be accounted for to normalize the CSB to HSF mileage. The canister transport mileage is normalized assuming 1,369 canisters in CSB (418 MCOs + 71 DOE + 880 IHLW) and total of 9,400 IHLW canisters. Mileage is normalized as follows: (# CSB canisters * SNF miles + # IHLW canisters * IHLW miles) / (total # canisters)

[b] Road miles are not applicable to this alternative because the IHLW canisters would be transported to the HSF via an underground tunnel.

CSB = Canister Storage Building.
DOE = U.S. Department of Energy.
HSF = Hanford Shipping Facility.
IHLW = immobilized high-level waste.
MCO = multi-canister overpack.
SNF = spent nuclear fuel.
WTP = Waste Treatment Plant.

Of the four alternatives that would avoid destruction of habitat (Alternatives 1, 3, 5A, and 5B), Alternative 5A has the lowest transporter emissions because the vast majority of the canisters shipped to the HSF would go through an underground tunnel. Only the canisters transferred from the CSB would require truck transport. Similarly, Alternative 5B does not disturb habitat and has a short transport distance. The marginally longer train travel to this site is not significant. For these reasons, Alternatives 5A and 5B received the highest ranking for the environmental criterion and are given a score of 5.

The two alternatives that would disturb between 17 and 22 acres of habitat are Alternatives 2 and 4. Because of the difference in quality of the habitat at these two sites, Alternative 4 received the lowest environmental ranking, a score of 1, and Alternative 2 received the second lowest ranking, a score of 2.

Alternatives 1 and 3 are in the middle range of the environmental ranking; neither of them involves any habitat damage but they do have higher vehicle emissions than Alternatives 5A and 5B. They each received a score of 4.

Should HSF with storage expansion be required, Alternatives 1 and 3 appear to be equivalent with regard to habitat impact. These alternatives are also basically equivalent with regard to vehicle emissions; therefore, Alternatives 1 and 3 were given the same score of 4.

A7.7 STAKEHOLDER VALUES

Each alternative was evaluated on the ability to meet the expectations of the various stakeholders. A stakeholder is an individual, agency, or group that has an active interest in one or several of the aspects to be considered in the site selection process. Individually or combined elements of interest to a typical stakeholder may include the following:

- Operational efficiency and safety
- Habitat conservation
- Land use
- Sharing of functions with adjoining facilities
- Prevention of nuclear waste facility sprawl
- Cost.

The uncertainty of the number of canisters that will eventually need to be stored, most stakeholders would expect the facility to be expandable in such a manner that storage and handling capacity would not be over-built. Stakeholder interests were applied subjectively to evaluate each alternative. Table A.14 shows the summary of the stakeholder evaluation results.

Table A.14. Summary of Stakeholder Evaluation Results

Facility	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
HSF without storage	3	2	4	1	5	NA
HSF with storage	3	1	5	2	NA	4

HSF = Hanford Shipping Facility.
NA = not applicable.

Results of the evaluation of the alternatives against anticipated stakeholders areas of interest are shown in Tables A.15 and A.16 for the HSF without storage and HSF with storage, respectively.

A7.8 SAFETY

The safety evaluation criteria encompass radiological, toxicological, industrial, and environmental hazards associated with worksite activities during construction, maintenance, and operation of the HSF. Controlling radiation exposure to employees at as low as reasonably achievable levels is a primary goal. The safety evaluation was performed by ranking the alternatives by their relative ability to meet the safety criteria. Table A.17 shows the summary of the safety evaluation results. Table A.18 shows the evaluation of the transportation safety against its sub-criteria.

Operating Safety – The operating safety evaluation is based on the number of operations that must be performed at the alternative site. Alternative 5A received a score of 5 because it receives IHLW canisters via a transfer tunnel such that cask loading and unloading operations are only required for the canisters from the CSB. Similarly, Alternative 3 received a score of 4 because it receives the canisters from the CSB via a transfer tunnel. Alternatives 1, 2, 4, and 5B receive all canisters via onsite transportation cask. Transportation of the IHLW canisters to Alternatives 4 and 5B received a score of 3 because transportation of the IHLW canisters will be within the WTP facility site, thereby limiting the need for transportation escorts. Alternative 1 received a score of 2 because transportation of canisters from CSB to Alternative 1 will be within the HWVP facility site. Alternative 2 received the lowest score because all canisters must be transported between facility sites.

Transportation Safety – The alternatives are score according to the number of transport miles because the number of miles traveled is a prominent factor in the probability of having an accident. Alternative 5A has the lowest transport miles as shown in Table A.13 and received the highest score. Similarly, the other alternatives are scored according to the number of miles for canister transport with Alternative 1 receiving the lowest score.

Table A.15. Hanford Shipping Facility Without Storage Stakeholder Areas of Interest Evaluation

Stakeholder Areas of Interest	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A
	Score	Score	Score	Score	Score
Operational efficiency[a]	3	1	5	1	4
Safety[b]	1	3	3	5	4
Habitat conservation[c]	5	2	5	1	5
Land use[d]	5	2	5	1	5
Sharing of functions[e]	3	1	5	2	4
Nuclear waste facility sprawl prevention[f]	4	1	5	1	4
Cost[g]	4	2	5	1	4
Score total	**25**	**12**	**33**	**12**	**30**
Ranking score	**3**	**1**	**5**	**1**	**4**

[a] The operational efficiency rankings are a repeat of the operability rankings determined in Section A7.4.

[b] The safety rankings are a repeat of the safety rankings determined in Section A7.8.

[c] The habitat conservation rankings were based on whether the alternatives impacted habitat and if they did the amount and quality of that habitat.

[d] The land use rankings were determined based on whether the alternative site was within an existing facility area (those that did, Alternatives 1, 3, and 5, were given a score of 5) or whether it involved the use of new previously undisturbed land. Alternative 4 received a score of 1 because of the amount and quality of habitat impacts. Alternative 2 received a score of 2 because of the quality of habitat it impacts is less than that impacted by Alternative 4.

[e] The sharing of functions rankings were determined based on the extent to which the alternatives could take benefit from facilities and services located close to them. Alternatives 3 and 5A received the highest ranking because they are close-coupled to a facility that performs similar functions. Alternative 3 scores the highest because the CSB and HSF share security functions. Alternative 1 ranked third because it is located close to the 2704-HV Building with which it can share some facilities. Alternative 4 ranked fourth because of the distances to most of the WTP facilities. This longer distance reduces the value of sharing functions and services with these facilities. Alternative 2 ranked last due to its distance from the ETF and the relatively small size of that facility.

[f] The nuclear waste facility sprawl rankings were determined based on whether the alternatives used new land or existing facility grounds and on the relative compactness of the facility layouts. Alternative 3 received the highest ranking because of its compactness (it is close-coupled to the existing CSB) and the fact that it uses no new land; Alternatives 5A and 1 received the next highest ranking. Alternative 5A was rated lower than Alternative 3 due to the potential for problems in the tight confines of the WTP and Grout Facility sites into which the alternative was squeezed. Alternative 1 falls completely within the old HWVP site, but does use up an area of that site that has not previously been used for anything but a laydown area. Alternatives 2 and 4 were both ranked lowest because they are both built on areas outside existing facility fence lines and impact habitat.

[g] The cost rankings were determined by summing the capital and operating cost rankings determined in Sections A7.9 and A7.10. The rankings were then assigned based the highest total receiving the highest score and continuing on down to the lowest value receiving the lowest score.

CSB = Canister Storage Building.
ETF = Effluent Treatment Facility.
HSF = Hanford Shipping Facility.
HWVP = Hanford Waste Vitrification Plant.
WTP = Waste Treatment Plant.

Table A.16. Hanford Shipping Facility With Storage Stakeholder Areas of Interests Evaluation

Share Holder Areas of Interest	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5B
	Score	Score	Score	Score	Score
Operational efficiency[a]	3	1	5	1	4
Safety[b]	1	3	3	5	4
Habitat conservation[c]	5	2	5	1	5
Land use[d]	5	2	5	1	5
Sharing of functions[e]	3	1	5	2	4
Nuclear waste facility sprawl prevention[f]	3	1	5	1	4
Cost[g]	4	2	5	1	3
Score total	24	12	33	12	29
Ranking score	3	1	5	1	4

[a] The operational efficiency rankings are a repeat of the operability rankings determined in Section A7.4.

[b] The safety rankings are a repeat of the safety rankings determined in Section A7.8.

[c] The habitat conservation rankings were based on whether the alternatives impacted habitat and if they did the amount and quality of that habitat.

[d] The land use rankings were determined based on whether the alternative site was within an existing facility area (those that did were given a score of 5) or whether it involved the use of new previously undisturbed land (those that did were given a score of 1).

[e] The sharing of functions rankings was determined based on the extent to which the alternatives could take benefit from facilities and services located close to them. Alternative 3 received the highest ranking because it is close-coupled to a facility that performs similar functions, including security. Alternative 5B ranked second because it is within the WTP site. Alternative 1 ranked third because it is located vary close to the 2704-HV office facility with which it can share some facilities. Alternative 4 ranked fourth because of the distances to most of the WTP site facilities, which reduces the value of sharing functions and services with these facilities. Alternative 2 ranked last because of its distance from the ETF and the relatively small size of that facility.

[f] The nuclear waste facility sprawl rankings were determined based on whether the alternatives used new land or existing facility grounds and on the relative compactness of the facility layouts. Alternative 3 received the highest ranking because of its compactness (it is close-coupled to the existing CSB) and the fact that it uses no new land; Alternatives 5B and 1 received the next highest ranking. Alternative 5B was good site as it is within the WTP site. Alternative 1 falls completely within the old HWVP site, but does use up an area of that site that has not previously been used for anything but a laydown area. Alternatives 2 and 4 were both ranked lowest because they are built on areas outside existing facility fence lines and impact habitat.

[g] The cost rankings were determined by summing the capital and operating cost rankings determined in Sections A7.9 and A7.10. The rankings were then assigned based the highest total receiving the highest score and continuing on down to the lowest value receiving the lowest score.

CSB = Canister Storage Building.
ETF = Effluent Treatment Facility.
HWVP = Hanford Waste Vitrification Plant.
WTP = Waste Treatment Plant.

Table A.17. Summary of Safety Evaluation Results

Safety Criterion	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Operating safety	2	1	4	3	5	3
Construction safety	5	5	2	5	1	3
Transportation safety	1	3	3	4	5	4
Total score	8	9	9	12	11	10
HSF without storage Rank	1	3	3	5	4	NA
HSF with storage Rank	1	3	3	5	NA	4

HSF = Hanford Shipping Facility.
NA = not applicable.

Table A.18. Hanford Shipping Facility With and Without Storage Transportation Safety Evaluation

Safety Criterion	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
Travel distance	1	3	2	4	5	5
Other traffic	2	1	3	4	5	4
Train crossing	4	5	4	2	1	1
Total score	7	9	9	10	11	10
Ranking score	1	3	3	4	5	4

Because of mingling with other Hanford Site traffic, the alternatives that require a longer cask transporter haul distance have the potential for an increased number of safety incidents. The alternatives that require the cask transporter to merge onto main inter-area roads create a higher potential for a safety incident than those alternatives where the transporter stays on lower-speed, lighter-traveled, intra-area roads. Alternative 5A received the highest score because only the canisters from the CSB are in road transport. All canisters are road transported to Alternatives 4 and 5B, but transport of the IHLW canisters is within the WTP site, and thus these alternatives receive a score of 4. Alternative 3 received a score of 3 because only the IHLW canisters would be transported via road. All canisters will be road transported to Alternatives 1 and 2, but the canisters from the CSB will be transported within the facility site. Alternatives 1 and 2 received scores of 2 and 1, respectively.

The number and type of railroad crossings that the repository cask railcars must navigate to move between the alternative site and the point of where the rail system enters the 200 Areas Plateau is used to approximate the potential for a safety incident. None of the railroad crossings in the 200 Area have crossing controls. Alternative 2 connects to the railroad just as it crests the hill and would be routed to the HSF with only one road crossing. It is therefore given a score of 5. Alternatives 1 and 3 connect to the railroad line shortly after it enters the 200 East Area fence and involve only the four crossings outside the 200 East Area after the railroad tracks cross the 200 Areas Plateau. They both receive a score of 4. Alternatives 4 and 5 have a number of crossings within the 200 East Area. However, Alternative 5 has more road crossings because of the complex routing required to get the tracks to the Alternatives 5A and 5B sites. Therefore, Alternative 4 is given a score of 2 while Alternatives 5A and 5B are given a score of 1.

**Construction Safety** – Alternatives 1, 2, and 4 would construct new facilities on clean sites and receive the highest score. Alternatives 3 and 5A are close-coupled to existing facilities imposing a potential for contamination, radiation exposure problems, and other construction interferences resulting in a higher level of risk. Also, Alternative 5A is adjacent to several operating process facilities that present additional concern for incidents. Thus Alternatives 3 and 5A are given scores of 2 and 1, respectively.

A7.9 CAPITAL COST

The capital cost comparison assumes that the basic HSF costs will be approximately equal for the sites under consideration. The ranking of the alternative sites was, therefore, done based on the supporting infrastructure cost estimates for these sites. Table A.19 shows the details of the capital cost ranking process.

A7.10 OPERATING COST

The cost of transportation to and from each alternative site, as well as any additional container handling or energy use that would be caused by the construction of one site verses the others and the potential for cost savings due to sharing of personnel and/or support systems is compared. The results of this comparison are shown in Table A.20.

Table A.19. Capital Cost Evaluation (Based on Relative Scoping Cost Estimates)

Alternatives	1		2		3		4		5A		5 B	
Sub-Criterion	Criterion Item Length/Value	Installation Cost ($K)	Criterion Item Length/Value	Installation Cost ($K)	Criterion Item Length/Value	Installation Cost ($K)	Criterion Item Length/Value	Installation Cost ($K)	Criterion Item Length/Value	Installation Cost ($K)	Criterion Item Length/Value	Installation Cost ($K)
Railway track length and cost @ $178/ft	5,050	898.9	6,350	1,130.3	5,600	996.8	9,150	1,628.7	9,000	1,602.0	8,150	1,450.7
Sewer length and cost @ $45/ft	1,250	56.3	300	13.5	1,280	57.6	475	21.4	500	22.5	500	22.5
Potable water line length and cost @ $45/ft	1,180	53.1	1,000	45.0	1,280	57.6	1,000	45.0	500	22.5	560	25.2
Raw water /fire line length and cost @ $50/ft	160	8.0	3,700	185.0	160	8.0	3,700	185.0	500	25.0	560	28.0
Electrical line length and cost @ $132/ft	1,000	132.0	1,000	132.0	300	39.6	7,000	325.5[a] 1,302.0[a]	500	66.0	500	66.0
Comm. line length and cost @ $132/ft	1,000	132.0	1,200	158.4	500	66.0	1,200	158.4	500	66.0	500	66.0
Total cost	–	**1,280.3**	–	**1,664.2**	–	**1,225.6**	–	**2,962.5**	–	**1,804.0**	–	**1,652.7**
Ranking score	5		3		5		1		3		3	

[a] In Alternative 4, both a 13.8 KVA line extension ($1,302K) and a 480 KVA line from the transformer into the facility ($325K) are required to supply power to the facility.

Table A.20. Operating Cost Evaluation

Facility	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
HSF without storage	2	1	4	3	5	NA
HSF with storage	2	1	4	3	NA	5

HSF = Hanford Shipping Facility.
NA = not applicable.

For the HSF without storage, the low operating cost alternative is Alternative 5A. This is the result of the combination of the close coupling of the HLW vitrification building and the HSF that provides the capability to transfer IHLW canisters to HSF instead of transporting them via cask. Also, Alternative 5A has the ability to share staff and resources with other WTP complex facilities. Alternative 5A received a score of 5. Alternative 3 placed second because it will also achieve operational cost savings by sharing staff and support resources with the CSB facility, and because of the reduced number of cask shipments. It has, therefore, received a score of 4. Alternative 1 is ranked next because shipping of SNF canisters will be simpler and shorter and [redacted] It, therefore, received a score of 3. Alternative 4 is ranked fourth over Alternative 2, because it provides better resource sharing possibilities. They received scores of 2 and 1, respectively.

For the HSF with storage facility alternatives, the low operating cost alternative is Alternative 3. Again, this is the result of the combination of the close-coupling with the CSB and the ability to share staff and resources with the CSB. Alternative 3 will also require [redacted] and received a score of 5. Alternative 1 placed second because it will also achieve operational cost savings by sharing operating and security staff and some support resources with the CSB facility. It has, therefore, received a score of 4. The remaining three alternatives are scored in order of their relative abilities to be supported and share resources with adjacent facilities. Alternatives 2, 4, and 5B received scores of 1, 2, and 3, respectively.

A7.11 SECURITY

[redacted]

Table A.21. Security Evaluation

Safety Criterion	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5A	Alt. 5B
[redacted]						
Total score	[redacted]					
HSF without storage Rank	[redacted]					
HSF with storage Rank						

HSF = Hanford Shipping Facility.
NA = not applicable.

[redacted]

[redacted]

[redacted]

[redacted]

A7.12 EVALUATION RANKING RESULTS

To determine the evaluation ranking results, the ranking scores from each of the evaluation criterion are multiplied by the appropriate weighting factor and the resulting weighted scores are summed for each alternative. Tables A.22 and A.23 show the siting evaluation results for the HSF without storage and the HSF with storage, respectively.

Table A.22. Hanford Shipping Facility Without Storage Site Evaluation Criteria Matrix

Evaluation Criteria	Criteria Weight	Alt. 1		Alt. 2		Alt. 3 PREFERRED		Alt. 4		Alt. 5A	
		Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score
Operability	10	3	30	1	10	5	50	1	10	4	40
Environmental	10	4	40	2	20	4	40	1	10	5	50
Stakeholder	15	4	60	2	30	5	75	2	30	5	75
Safety	15	1	15	3	45	3	45	5	75	4	60
Capital cost	20	5	100	3	60	5	100	1	20	3	60
Operating cost	15	3	45	1	15	4	60	2	30	5	75
[redacted]											
Total weighted score	**100**	**24**	**350**	**13**	**195**	**31**	**445**	**14**	**205**	**27**	**375**
Raw ranking		**3rd**		**5th**		**1st**		**4th**		**2nd**	
Weighted ranking			**3rd**		**5th**		**1st**		**4th**		**2nd**

Table A.23. Hanford Shipping Facility With Storage Site Evaluation Criteria Matrix

Evaluation Criteria	Criteria Weight	Alt. 1		Alt. 2		Alt. 3 PREFERRED		Alt. 4		Alt. 5B PREFERRED	
		Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score	Raw Score	Weight Score
Operability	10	3	30	1	10	5	50	1	10	4	40
Environmental	10	4	40	2	20	4	40	1	10	5	50
Stakeholder	15	4	60	2	30	5	75	2	30	5	75
Safety	15	1	15	3	45	3	45	5	75	4	60
Capital cost	20	5	100	3	60	5	100	1	20	3	60
Operating cost	15	4	60	1	15	5	75	2	30	3	45
[redacted]											
Total weighted score	**100**	**25**	**365**	**13**	**195**	**32**	**460**	**14**	**205**	**27**	**375**
Raw ranking		**3rd**		**5th**		**1st**		**4th**		**2nd**	
Weighted ranking			**3rd**		**5th**		**1st**		**4th**		**2nd**

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A8.0 RISK EVALUATION

A8.1 PROJECT AVAILABILITY TIMELINE VS. CANISTER PRODUCTION RATES AND MONITORED GEOLOGIC REPOSITORY START DATE

There is a risk that the HSF will not be operational before the production of IHLW canisters exceeds the available storage capacity at Hanford. It will take approximately five to seven years using an appropriately prioritized DOE project funding approach to initial HSF operations. Though there is adequate time available to initiate the required project and design and build the required facilities to meet the currently envisioned need date, adequate scheduling and funding prioritization attention is required to ensure that the required studies, criteria development, and planning occur to support the required project.

There is a risk that Project W-464, which is to remodel the CSB to provide storage capacity for 880 IHLW canisters, will not be completed in time to support receipt of IHLW canisters until HSF is ready to begin operations. The project was validated and is currently scheduled to complete construction by August 2010. The current WTP schedule indicates the production of IHLW canisters will start in 2010 with an initial annual production rate of 120 canisters a year. At this nominal rate, the CSB will be full by mid 2014. However, the initial annual rate is planned to increase to 240 per year by 2011. Depending on the rate at which the increase to 240 is implemented, the CSB could be full as early as mid 2013.

The time for operations of the MGR could impact both the need date and capacity of the HSF. The current Yucca Mountain repository timeline indicates that the earliest the facility will begin to accept nuclear waste is in 2013. However, the recommendation to the U.S. Congress for going ahead with the Yucca Mountain site was actually made in early 2002, 1 year later than the planned date. The Yucca Mountain project currently appears to be almost a year behind schedule; so, based on the original facility schedule, the operational date could easily slip to 2014.

Further delay of the MGR poses a risk to the Hanford Site in that there may not be enough storage capacity available for the IHLW that will be produced, especially if the production rate is increased to meet current *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) milestones. The *Hanford Federal Facility Agreement and Consent Order* sets 2028 as the year by which the mixed waste storage tanks at Hanford are to be closed ("DOE Hedges on 2028 Deadline" [Stang 2002]). The "CASE 5" (DOE 2003) schedule developed to support the 2028 tank closure date has a maximum IHLW canister production rate of 480 canister per year beginning in 2013.

With the current IHLW canister production rate projections (see Table A.24), the CSB will be filled in mid 2013. At a production rate of 480 IHLW canisters a year, the initial HSF 2,000 IHLW canister storage capacity would be full in early 2017. Should the Yucca Mountain repository project be continually delayed, additional HSF 2,000-canister expansions would need to be initiated about every 3½ years to support interim storage.

Table A.24. Project Immobilized High-Level Waste Canister Production Rates

Number of Canisters	Schedule Period
56	May 2010 to January 2011
240	February 2011 to January 2012
360	January 2012 to January 2013
480 per year	January 2013 to end of mission

A8.2 WASTE TREATMENT PLANT CONSTRUCTION AND OPERATIONS INTERFERENCE POTENTIAL

The second area of risk for the HSF project is the potential for interferences between HSF construction and WTP construction and/or operational activities. Examples of the types of interferences include:

- Activities that require movement of material or personnel through areas required for HSF construction that would inhibit or prevent the HSF construction activity
- WTP construction activities that disrupt HSF construction support such as interruption of electrical power, interruption of raw or sanitary water services
- WTP construction or operational activities that temporarily block access to the HSF construction site.

This risk could not be quantified at this time because of lack of input from the WTP project, but could have significant schedule and/or cost impacts on the HSF construction. Because the potential WTP interferences is considered to be at least moderate, it is recommended that a second or backup alternative be considered for both the HSF with and without storage if Alternatives 5A and/or 5B are pursued.

A9.0 RECOMMENDATIONS

A9.1 HANFORD SHIPPING FACILITY WITHOUT STORAGE SITE RECOMMENDATION

The preferred site for the HSF without storage was determined to be the Alternative 3 site. Of the five candidate sites investigated, the Alternatives 3 and 5A sub-site scored the highest, 445 and 375 respectively. See the Attachment, Drawing CEES-04-044-C-004, sheet 2, for details of the Alternative 3 configuration and site.

A9.2 HANFORD SHIPPING FACILITY WITH STORAGE SITE RECOMMENDATION

The preferred site for the HSF with storage is Alternative 3. Of the five candidate sites investigated, Alternatives 3 and 5B scored the highest with 460 and 375, respectively. See the Attachment, Drawing CEES-04-044-C-004, sheet 1, for details of the Alternative 3 configuration and site.

A10.0 REFERENCES

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ATTACHMENT
HANFORD SHIPPING FACILITY SITE EVALUATION STUDY DRAWINGS

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