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Conceptual Design Report for Immobilized High-Level Waste Interim Storage Facility (Phase 1)

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U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: The Hanford Site Canister Storage Building (CSB - Bldg. 212H) will be utilized to interim store Phase 1 HLW products. Project W-464, Immobilized High-Level Waste Interim Storage, will procure an onsite transportation system and retrofit the CSB to accomodate the Phase 1 HLW products. The Conceptual Design Report establishes the Project W-464 technical and cost basis.

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Conceptual Design Report

Immobilized High-Level Waste Interim Storage Facility (Phase 1)

Project W-464

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

W464CDR

CONCEPTUAL DESIGN REPORT

FOR

IMMOBILIZED LOW-ACTIVITY WASTE INTERIM STORAGE FACILITY PROJECT (PHASE I)

PROJECT W-464

Prepared by

Fluor Daniel Northwest, Inc.
Richland, Washington

Principal Lead Engineer
3/27/98
Date

Quality Engineering
3/27/98
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3/27/98
Date

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APPENDICES

ABBREVIATIONS AND ACRONYMS

ACD	advanced conceptual design
ALARA	as low as reasonably achievable
BNFL	British Nuclear Fuels Limited
CDR	conceptual design report
CFR	Code of Federal Regulation
CSB	Canister Storage Building
DBE	design basis earthquake
DOE	U.S. Department of Energy
DRD	design requirements document
DWPF	Defense Waste Processing Facility
Ecology	Washington State Department of Ecology
FEIS	Final Environmental Impact Statement
FFTF	Fast Flux Test Facility
FHA	fire hazards analysis
FSAR	final safety analysis report
HCA	hot conditioning annex
HCSA	hot conditioning system annex
HLW	high-level waste
HVAC	heating, ventilating, and air conditioning
HWVP	Hanford Waste Vitrification Project
IHLW	immobilized high-level waste
JSA	job safety analysis
LAW	low-activity waste
MCO	multi-canister overpack
MHM	multi-canister overpack handling machine
MPFL	maximum possible fire loss
NEPA	National Environment Policy Act
NFPA	National Fire Protection Association
NOI	notice of intent
NRC	Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PGA	peak ground acceleration
PHMC	Project Hanford Management Contractor
PSAR	preliminary safety analysis report
PSE	Preliminary Safety Evaluation
QA	Quality Assurance
QAPD	Quality Assurance Program Description
QAPP	Quality Assurance Project Plan
QARD	Quality Assurance Requirements and Description
RCRA	Resource Conservation and Recovery Act
RL	Richland Operations Office (DOE)
ROD	Record of Decision
SAR	Safety Analysis Report
SC	safety class

ABBREVIATIONS AND ACRONYMS (continued)

SCT	shielded canister transportation system
SNF	spent nuclear fuel
S/RID	standard/requirements identification document
SRS	Savannah River Site
SSI	soil structural interaction
TRIGA	Test Reactor and Isotope Production General Atomics
TWRS	tank waste remediation system
WAC	Washington Administrative Code
WBS	work breakdown structure
WDOH	Washington State Department of Health
WVDP	West Valley Demonstration Project

CONCEPTUAL DESIGN REPORT

IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY (PHASE 1)

PROJECT W-464

I. INTRODUCTION/BACKGROUND

As part of the Tank Waste Remediation System Program, managed by the Project Hanford Management Contractor (PHMC), the U.S. Department of Energy (DOE) has embarked on a course to acquire Hanford Site tank waste treatment and immobilization services using commercial facilities. These will be privately developed, financed, constructed, owned, operated, and deactivated (Reference 5). The successful bidders (i.e., vendor or team of vendors awarded a contract) are to be paid for the immobilized Hanford Site tank waste (product) that they have produced, thereby recouping their investment. This plan uses a two-phased approach. Phase 1 is proof-of-principle and commercial demonstration-scale effort and Phase 2 is a full-scale production effort. The referenced contract (Reference 28 and 29) describes the privatization process for both phases. Contracted work is only for the conceptual design of the Phase 1 facilities, termed Phase 1A. Follow-on contracts will be prepared for the definitive design, construction, and operations portion of Phase 1 work scope, Phase 1B. A separate contract will be prepared for Phase 2 work.

The primary purpose of Phase 1 is to demonstrate the technical and business viability of using privatized facilities to treat and immobilize Hanford Site low-activity waste (LAW) and high-level waste (HLW). This is to be accomplished using demonstration facilities (i.e., low-capacity immobilization plants) based on the successful bidder's design. PHMC planning assumes that two LAW demonstration vitrification plants and one HLW demonstration vitrification plant will be constructed during Phase 1. In addition, it is assumed that one LAW and one HLW production facility (i.e., high-capacity immobilization plants) will be designed, constructed, and operated during Phase 2. These production facilities are assumed to provide sufficient capacity to immobilize the remaining Hanford Site tank waste.

In accordance with the solicitation of Phase 1, services, transportation, interim storage, and disposal of various products from the demonstration plants are to be provided by the DOE. The Phase 1 products requiring interim storage in the Canister Storage Building (CSB) include immobilized high-level waste (IHLW) or vitrified HLW (glass), separated cesium from the LAW vitrification plant feed (dry free-flowing powder most likely cesium adsorbed onto an inorganic ion-exchange resin) hereafter referred to as Cesium Product, and non-routine HLW (i.e., failed melters and other equipment contacting the HLW products which cannot be practically decontaminated). The Phase 2 HLW products are canisters of IHLW from the balance of high-level tank waste. The Phase 2 IHLW will contain the contents of the cesium canisters generated in Phase 1. The tank waste remediation system (TWRS) program has established a construction project, project W-464, *Immobilized High-Level Waste Interim Storage Facility (Phase 1)*, to provide the capability to interim store the Phase 1 HLW products until they can be transferred to a federal geologic repository for disposal (IHLW and non-routine HLW) or processed further (cesium canisters incorporated into Phase 2 IHLW product).

The selected Phase 1 architecture entails outfitting the spent nuclear fuel (SNF) CSB, constructed under project W-379, to interim-store solidified HLW (References 3 and 30). The SNF Project and project W-464 established an MOA (Hansen) that assigned CSB Vaults 2 and 3 to the IHLW Interim Storage Project. Functions and requirements for the interim storage of Phase 1 HLW products in the CSB were established (Reference 31) and serve as the basis for the Phase 1 Project W-464 Design Requirements Document (DRD) (Reference 2). The DRD lists applicable constraint documents (i.e., *U.S. Code*, *Code of Federal Regulations*, *Washington Administrative Code* [WAC], DOE directives and standards, and other DOE requirements) and requirement documents (i.e., federal and state codes and standards and Hanford Site standards and miscellaneous documents) and provides system and performance requirements specific to Phase 1 HLW products and quality assurance (QA) provisions. These requirements and QA provisions are the basis for Phase 1 transportation system and CSB conceptual design. The DRD will require revision prior to initiation of the Phase 1 project W-464 definitive design phase to incorporate information developed by the Phase 1 privatization contractors during the Phase 1A contract period (conceptual design). Interface control documents have been established to outline interface activities between the IHLW Interim Storage Project and the private contractors. A detailed discussion of the project W-464 system engineering approach, project integration, interface control documents, and project mission and objectives is provided in the Project W-464 Project Plan (Reference 32).

The CDR was prepared in accordance with the ICF Kaiser Preparation Guides for Engineering Documents, (Reference 27). This document includes guidance for CDR preparation based on compliance with DOE Order 4700.1.

Existing Canister Storage Building (constructed under SNF Project, W-379)

The CSB is located in the 200-East Area of the Hanford Site, approximately 48 km (30 mi) northwest of Richland, Washington. It consists of 3 belowgrade, concrete vaults approximately 15.24 m (50 ft) wide by 41.15 m (135 ft) long by 12.50 m (41 ft) deep. SNF will be stored in the northernmost vault, Vault 1. The CSB structure includes a steel metal building 41 m (134 ft 6 in.) wide by 62 m (203 ft 6 in.) long by 17 m (55 ft 9 in.) tall. The metal building provides an operating area for SNF load-in/load-out. A metal building 15 m (49 ft 3 in.) wide by 37 m (121 ft 5 in.) long by 9 m (29 ft 6 in.) tall houses the mechanical, electrical, and support services. The SNF load-in/load-out area contains two service pits. One is designed specifically for transferring multi-canisters overpacks (MCOs) containing SNF from the onsite transport cask to the CSB shielded handling machine, referred to as the MCO handling machine (MHM). The second pit is much larger and is designed to accommodate service/transfer of larger SNF packages [i.e., Test Reactor and Isotope Production General Atomics (TRIGA) and Fast Flux Test Facility (FFTF) SNF.

The vaults are covered by a concrete deck and each vault has concrete air plenums on opposite sides. The below-deck concrete partition walls allow independent vault cooling. The northernmost vault, Vault 1, is equipped with carbon steel tubes installed vertically and an air intake and exhaust stack. Storage tubes and intake/exhaust stacks will not be installed in Vaults 2 and 3 as part of project W-379.

Each vault can provide for a storage tube matrix of 22 rows by 10 columns for a total of 220 storage tubes. Each vault can also accommodate six larger diameter tubes for canister overpack. Both the standard and overpack tubes can accommodate two 4.5 m (14-ft 10-in.)-tall by 0.61 m (2-ft)-diameter IHLW canisters and impact limiters at the bottom of the tube and between the canisters. A storage tube provides approximately 11.1 m (36 ft 6 in.) of vertical storage space with a 0.68 m (27-in.) internal diameter. The storage tubes are designed to be closed and sealed with a shielded plug installed at the deck level and a 1.27 cm (½-in.) plate seal-welded to the bottom of the tube. No shield plugs have been designed for or are provided for Vaults 2 and 3 as part of project W-379.

Each vault is designed to allow decay heat to be removed by natural convection. Cooling air is drawn through an inlet duct into a plenum that feeds each vault, flows across the outer surface of the storage tubes, and exits through an elevated exhaust stack that serves the vault. Buoyancy, caused by the different densities of hot air inside the vault and stack, draws cooling air through the vault.

An annex to the southernmost vault, Vault 3, is included as part of project W-379. The SNF annex is referred to as the hot conditioning annex (HCA) and provides the capability to sample gases generated during storage and seal weld the MCOs for long-term interim storage.

The HCA is a reinforced concrete structure that houses mounting plates for the process modules and seven process pits for HCA equipment. The HCA operating deck is 10.7 m (35 ft 3 in.) by 42.3 m (138 ft 11 in.) by 1.5 m (5 ft) thick; the reinforced concrete slab is supported at grade level.

The SNF CSB design does not include a wet-pipe sprinkler system because it has been determined that significant combustible loading does not exist, and the transient combustible loading is controlled, and a sprinkler system would be of minimal benefit. The CSB safety support functions are provided by backup electrical power and fire protection and monitoring systems.

CSB and Transportation System Features Required to Interim Store Phase 1 HLW Products

Use of the CSB for interim storage of Phase I HLW will require installation of equipment and subsystems that are not needed for storage of SNF. The existing CSB will also need to be modified. The transportation system, CSB modifications, and CSB equipment retrofit modifications and added equipment will be designed and constructed in accordance with the project W-464 design basis (References 2 and 26).

The following transportation system and CSB features will be required to support project W-464 objectives:

- A tractor/trailer/shielded-cask system must be procured and be capable of transporting the Phase 1 HLW products from the private contractors facilities to the CSB. The cask must meet all onsite transportation requirements and provide adequate cooling and shielding of the HLW products. The cask containing HLW product will be transported in a vertical orientation.

- A receipt/unloading area capable of housing the onsite transport system during cask unloading will be provided. This area will also include a transfer pit with ancillary equipment to remotely remove (or replace) the cask lid and store the cask lid during remote transfer of the HLW product from the cask to a CSB HLW canister handling system.

- Provide handling equipment necessary to support transfer operations.

- A shielded handling system and control equipment necessary to lift the HLW products from the onsite cask in the receipt/handling pit into the CSB handling system, transfer the HLW product to any storage tube location within the Vault 2 and 3 storage tube matrix and HLW overpack station (HCA Pit No.# 7), and emplace (or retrieve) the HLW product from the storage tube and overpack pit. This handling system must be capable of handling the 4.5 m long by 0.61 m dia. IHLW and non-routine HLW canisters produced by the HLW private contractors. In addition, the system must be capable of handling the 1.37 m long by 0.33 m dia. cesium canisters, generated by the ILAW private contractor(s) overpacked in a government supplied 4.5 m long canister with critical dimensions and handling features identical to the 4.5 m IHLW canisters. The private contractor will place the cesium canister in the overpack, close the overpack, and place the overpack in the project W-464 shielded onsite transport cask.

- Provide Vaults 2 and 3 (step tube design versus SNF straight tube design) storage tubes, tube shield plugs, tube impact absorbers (e.g., for potential or high-risk canister drop conditions); and cesium canister-handling assemblies.

- Provide CSB facility/structures and equipment to allow canister cooling in accordance with HLW product temperature requirements. This includes addition of inlet/exhaust stacks, temperature and flow monitoring equipment and any other equipment necessary to provide sufficient design margins to ensure canister temperatures are within threshold values.

- Provide CSB instrumentation and control systems; remote operating equipment, welding machines, shielding, and maintenance and other equipment needed to perform HLW product overpack operations in the event of an off-normal breach of the HLW product canister during onsite transportation or CSB handling operations.

- Provide utility services to allow performance of project W-464 construction and operations activities.

Conceptual Design - Constraints

To support the project W-464 objectives, a number of important design constraints were established and implemented by Fluor Daniel Northwest (FDNW), with PHMC concurrence in developing the project W-464 conceptual design. These design constraints were developed with the intent to more fully define the constraints associated with retrofit of the CSB, especially with the necessary integration with SNF operation. In addition, these design constraints were used to develop design solutions in accordance with the general design requirements identified in the project W-464 DRD. This more detailed subset of the design constraints will be included in future revisions of the DRD for definitive design, where necessary.

The subject design constraints used in the conceptual design effort are as follows:

- The project W-464 design will allow for SNF storage operations, safety, and security, according to current SNF schedules.

- No mixing of the different HLW products in an individual storage tube will be allowed (i.e., an individual tube can contain only either IHLW, cesium, or non-routine HLW canisters)

- Design, equipment, and construction practices will be according to industry standards for nonreactor nuclear facilities.

- To the extent practical, the most conservative design approach will be implemented where SNF and HLW design requirements are found to be conflicting.

- The SNF design strategies relative to radiological monitoring, fire hazards mitigation, temperature and air flow monitoring, and canister tracking system will be adopted by project W-464.

- The project W-464 transportation system and CSB design will be developed to provide HLW product centerline temperatures less than 400 °C. For the IHLW product, this requirement is required for disposal in the federal repository. This requirement will also be imposed on the non-routine HLW and cesium product.

- The IHLW 4.5-meter canister will include the same neck configuration as the West Valley Demonstration Project (WVDP) canister. The private contractors may propose one of three IHLW canister configurations using either a WVDP canister neck, a SRS canister neck, or another private contractor qualified neck design. The WVDP canister will be used as the basis for CSB HLW handling equipment design because the WVDP design is a qualified, proven design and allows greater glass capacity per canister.

- The canisters will not be designed to be stacked or to withstand a drop of one canister on top of another. The storage system will be designed to mitigate impacts of credible canister drop conditions.

- The existing CSB MHM crane will be parked at the north end of the CSB during the HLW shielded canister transporter (SCT) operation (no combined loading of the MHM crane and SCT will be on the operation deck at any time).

Programmatic Assumptions

A number of important programmatic assumptions were also generated for use in developing the conceptual design. These assumptions are as follows:

1. High temperature insulating concrete will be installed in Vaults 2 and 3 by project W-379. Installation of the subject concrete is included in project W-379 scope via baseline Change Request W379-025 W-379, *SNF Canister Storage Building*. The cost of adding insulating concrete is not provided in the cost estimate.

2. Project W-464 will not inherit any compliance or technical issues as a result of project W-379 design. The type and degree of issues cannot be assessed at this time. It is reasonable to assume that SNF project W-379 will comply with the respective project requirements.

3. Loading of HLW product canisters into the CSB will not commence until all project W-464 construction activities are completed. Preparation of the design/construction schedule is constrained by hot start-up.

4. HCA Pit No. 7 will be available for project W-464 overpack operations. Pit No. 7 is needed to accommodate the SCT.

5. The construction of the intake and exhaust structure for Vaults 2 and 3 will not be constrained by SNF operations and work can be performed on day shift.

6. SNF MCO sampling and welding operations will require movement of the SNF MHM over Vaults 2 and 3 during installation of project W-464 storage tubes. The subject SNF operations can be performed in two shifts and will allow a minimum of one shift per day to install project W-464 tube assemblies (storage tube, base plate, and bellows). If SNF sampling and welding operations require more than 2 shifts, the ability to install Vaults 2 and 3 tubes could be impacted.

7. The PHMC will amend the Authorization Basis to the CSB to satisfy project W-464 objectives.

8. Studies relative to early procurement of the project W-464 transportation system and long-lead items required for CSB retrofit and thermal and structural analysis will be performed in the advanced conceptual design (ACD) phase prior to initiation of definitive design activities. Project W-464 assumes information will be received from private contractors subsequent to completion of the CDR will be evaluated and impacts assessed in ACD. The DRD will be revised to reflect the design requirements used in preparing the CDR and private contractor information. Information required to revise the DRD is necessary prior to the start of definitive design.

9. No testing of the standard storage tube bellows will be required since project W-464 will use the same bellows used in Vault 1.

10. The characteristics of the 4.5 meter IHLW canister was provided as a supplement to the DRD used as the basis for project W-464 CD (Reference 26). The 4.5 meter canister information was developed based

on the latest (best available information) discussion between U.S. Department of Energy, Richland Operations Office (RL) staff and the federal geologic repository program. It is assumed that the Repository acceptance criteria will be revised to reflect this information.

11. Interior work on project W-464 abovegrade retrofits required before July 1, 2001, will be executed on an off-shift coincident with SNF operations to meet schedule for hot start-up.

12. Approval of the preliminary safety analysis (PSAR) (modified SNF final safety analysis report[FSAR]) prior to start of construction is required in accordance with DOE 6430.1A. The unresolved safety question (USQ) process will be used as applicable.

13. The allowable cesium product temperature has not been formally established at this time but is expected to be near 1000 °C based on adsorption of the cesium on commercially available inorganic ion exchange resins which are currently used (i.e., Zeolite IE-96) or being considered (crystalline silicotitanate or CST) for treatment of radioactive cesium.

14. Thermal evaluations relative to loaded cesium overpack were based on use of a single wall (single air gap) cesium canister design. The thermal evaluations were performed using a 1500 watt cesium canister heat load. This heat load cannot be obtained due to more restrictive dose rate contract requirements. If a double wall (two air gaps) cesium canister design is proposed by the private contractor, the heat load condition associated with the maximum 10^3 Sv gamma and 10^2 Sv neutron dose rate will need to be evaluated but is not expected to present an unacceptable heat load condition based on a higher acceptable centerline temperature.

15. A key permitting assumption identified in the Project W-464 Permitting Plan (Reference 17) is that a Resource Conservation and Recovery Act (RCRA) Part B (final) permit will not be required prior to hot operations. Interim status will be granted.

16. The HLW product characteristics relative to physical configuration and design of canisters and product information, specifically population heat load and source term, will be obtained from the private contractors (HLW and LAW) based on Phase 1 tank waste data/information and in support of definitive design activities. The project W-464 design requirements include very conservative design activities. The project W-464 design requirements include very conservative (worst case) design assumptions relative to HLW product source terms and heat loading. The DRD requirements used in the CDR significantly influence design of project W-464 equipment, primarily the CSB handling equipment.

II. SUMMARY

Project W-464 will procure two new integrated transport systems (includes tractor/trailer and shielded cask) to transport the Phase 1 HLW products from the private contractor facilities to the CSB. The system will consist of a low-boy trailer and transport cask to transport the HLW products vertically with appropriate cask/trailer constraints. The cask will be designed to maintain the HLW products below the maximum temperature requirements and provide shielding in accordance with Hanford Site transportation requirements.

In addition, project W-464 will modify the SNF CSB design to accommodate interim storage of Phase 1 HLW products in Vaults 2 and 3 of the CSB. The major modifications and additions to the CSB and associated equipment include the following:

HLW Load-in/Load-out Annex

A new HLW Load-in/Load-out Annex will be added to the southeast corner of the CSB to provide for receipt of the HLW transport system, unloading of the onsite transfer cask, remote handling of the HLW product during HLW product unloading from the cask, transfer of the HLW product from the cask to the CSB HLW handling system and maintenance of the CSB HLW handling system. The HLW Load-in/Load-out Annex will consist of a concrete slab abutting the CSB HCA operating deck, a 60-ton gantry crane for cask handling, steel superstructure and a transfer pit similar to the SNF MCO transfer pit. In addition the Load-in/Load-out Annex transfer pit will allow for maintenance of the CSB HLW handling system. The Annex will also include a new HVAC system which will include addition of two exhaust fans and filter housing assembly. Operation of cask transfer will require use of a 10-ton remote operated bridge crane located below the shield plug. The bridge crane will remove the cask lid and position it such that transfer activities can be performed. Construction of the new Annex will require rerouting of existing CSB conduit on the south wall of the CSB. The 60-ton receipt gantry crane will be designed and constructed to the same general requirements imposed on design of the SNF 60-ton receipt gantry crane. The Annex structural and building features will be designed and constructed to the same requirements imposed on the SNF receipt/transfer station. A new road supporting the new Load-in/Load-out Annex will also be added.

CSB HLW Handling System

A new handling system will be procured to handle HLW products in the CSB. The CSB HLW handling system will be similar to the handling system used to transfer HLW product canisters at The Savannah River Site (SRS) Defense Waste Processing Facility (DWPF). The DWPF system utilizes a SCT mounted on rubber tires with hydraulic systems for propulsion, raising and lowering the shielded cask, and steering and braking. The DWPF unit is powered by both diesel and electric motors. This system is designed to handle SRS 3.0-meter HLW canisters. The design will be modified to accommodate the longer Hanford 4.5-meter HLW canisters and HLW product canister configuration. The DWPF system is currently being used to transfer radioactive SRS HLW canisters and relative to this CDR is considered a proven, commercially available, system. This system concept will be used to emplace Hanford HLW canisters in Vaults 2 and 3 storage tubes and overpack station (HCA Pit No. 7) and will provide the flexibility to emplace HLW canisters in conjunction with SNF operations. Originally, the existing SNF MHM was evaluated to accommodate Phase 1 HLW product canisters. Though the MHM may be potentially viable from a technical standpoint, schedule constraints due to SNF operations precluded use of the MHM; therefore, the SCT was selected as the CSB HLW handling system.

Integrated Storage System

An integrated storage tube system will be added to the Vault 2 and 3 standard and overpack storage tube operating deck penetrations (440 standard tube locations and 3 overpack storage locations - see Summary discussion relative to outfitting of IHLW overpacks). The integrated storage system includes the storage tube assemblies (bellows and carbon steel storage tubes), tube shield plugs, tube impact absorbers and tube base assemblies. The storage tubes will be a step tube design to allow for impact absorbers between canisters. The bottom impact absorber will be designed to allow for a full canister drop condition (canister raised to maximum SCT internal height and drop to bottom of tube). The impact absorber between the canisters will rest on the seat of the storage tube step and will accommodate a canister drop to the respective elevation. Project W-464 will provide 10 impact absorbers, the remainder will be provided by Operations.

The bellows/tube assemblies will be brought into the CSB through the existing SNF HCA load-in bay doors and will require a portable crane to rotate the assembly into an upright position and to install the tube assemblies into the operating decks tube penetrations. No other significant construction equipment is required to install the tube assemblies. During conceptual design, the SNF straight tube design was evaluated for Vaults 2 and 3. The straight tube design resulted in the use of complex impact limiter designs to mitigate the drop of a canister on top of a canister located in the bottom tube position. The selected CDR concept adopts use of the step tube design which results in a simpler impact limiter design.

Natural Convection Cooling and Shielding System

The IHLW produced by the private contractor, responsible for vitrification of the Phase 1 HLW tank waste, must meet a Repository requirement that the canister centerline temperature not exceed 400 °C. Compliance with the Repository temperature requirement is also required for all project W-464 unit operations. Therefore, the project W-464 transportation system and CSB equipment and associated operations must also be designed such that the IHLW canisters do not exceed the subject repository requirement. The CSB HLW receipt/transfer pit, SCT system and storage vault design will provide adequate cooling of the IHLW canisters. The storage vault design is the primary control for HLW product cooling. Project W-464 will add the following vault equipment to provide adequate HLW product cooling. Appropriate sized inlet and exhaust stacks will be designed and constructed to allow cooling air to be drawn through each of the two vaults. Evaluation of the SNF Vault 1 natural convection system (inlet and exhaust stacks) was performed to determine if the SNF stacks provide adequate cooling of HLW products. This system is adequate and is the adopted basis for Vaults 2 and 3 inlet/exhaust stack design. In addition, air foils will be added on vault walls to direct air flow away from the vault walls to the vault storage tube matrix.

Louvers will be added to the exhaust section to reduce radiation sky shine to meet operating deck and environmental radiological requirements. Insulating concrete, added as part of project W-379, will provide protection of the structural concrete from Vaults 2 and 3 thermal conditions. The insulation concrete will also provide additional shielding protection for workers installing Vault 2 equipment (louvers, air foils, tube assemblies and tube base plates). Shielding evaluations have been performed that indicate that the shared structural wall between Vaults 1 and 2 provides shielding protection; the insulating concrete provides yet another level of shielding protection.

HLW Overpack Station

The SNF HCA Pit No. 7 design was evaluated for use as the HLW overpack station and was determined capable of performing the HLW overpack operation. Pit No. 6 will be covered to permit adequate clearance for the SCT. The following equipment will be added to provide the HLW overpack capability: remote pit shield gate, welding equipment and ancillary support equipment, and equipment necessary for smear testing of welded canister. The SNF MCO welding concept provides the basis for the CSB HLW overpack welding system.

Cesium Product Handling Assembly

Two cesium overpacks will be designed and fabricated as part of project W-464. The balance of cesium overpacks (151) will be provided as part of CSB HLW operations. The cesium overpacks will be designed to shield the cesium product to that of the IHLW canisters. The CSB HLW SCT will be designed to provide shielding for the maximum IHLW product source term. In addition, the cesium overpack will include overall dimensions and handling features identical to the IHLW 4.5 m canister produced by the private contractor. The CSB handling system design is based on use of the WVDP canister neck design.

4.5 Meter Canister Overpack

Two 4.5 meter canister overpacks will be provided by project W-464 in the event that a IHLW or non-routine HLW canister is breached during an off-normal event. The canisters will be designed to allow for the IHLW canister to fit into the overpack providing for IHLW canister and overpack canister design tolerances. The overpack canister will have essentially the same overall design, excluding overall canister diameter, as the 4.5 IHLW canister including a WVDP neck design identical to the IHLW canister (ES-W464-M09) (sketches are shown in Appendix L).

Three overpack tubes will be outfitted to provide for overpack of approximately 1% of total number of IHLW and non-routine HLW canisters produced during Phase 1. Storage tube shield plugs will be provided for the remaining nine overpack deck penetrations. Thermal evaluations of the vault cooling system included consideration of the IHLW overpack.

CDR Design Basis - Viability of Shielded Canister Transporter Concept

There is a high confidence that the SCT can be designed and operated in the CSB to safely perform the project W-464 handling function. The conclusion is based on the conservative structural evaluation performed as part of this CDR and the expected reduction of heat load and shielding requirements based on actual Phase 1 tank waste data.

- **Structural Evaluation**

  A conceptual design evaluation was performed to ascertain the viability of utilizing the SCT in conjunction with the existing CSB Vaults 2 and 3 design. The evaluation was performed considering the structural and seismic response associated with SCT operation. Thermal conditions used in the evaluation included SNF maximum vault heat loads (192 kW) in lieu of higher HLW product maximum vault heat loads (556 kW) specified in DRD supplements. The evaluation also included the weight of the SRS SCT with an additional 15% weight increase to account for modification of the SCT to accommodate the 4.5 m canister and included conservative structural design input information (see list of conservative inputs in Section IV.B, Concrete). The evaluation indicates that in some specific cases, the design margin is 1% to 2% too high. A detailed structural analysis including HLW heat loads needs to be performed in the ACD phase to confirm use of the SCT. More reasonable (less conservative) structural design constraints will also be used.

- **Heat Load and Shielding**

  The CDR SCT structural evaluation was based on design of an SCT capable of safely handling the Phase 1 HLW products based on product requirements provided in the DRD. The heat load associated with HLW products and required shielding of the products to allow safe operation in the CSB are major factors considered in the design of the SCT and in the evaluation of the deck to support SCT operation. Preliminary evaluations of the heat load and radionuclide inventories expected to be produced by the private contractor are well below the heat load and associated source terms provided in the DRD. The DRD requirements are based on heat load and shielding requirements included in the contract established between DOE and the private contractors. As an example, the cesium heat load design basis used in the CDR is 1500 watts; however, the contract dose rate requirement will limit the heat load to less than 900 watts, with a coincident reduction in radionuclide content. It is also important to note that shielding of the individual cesium canister can be provided by an overpack design specifically designed for storage in the CSB. In addition, the 4.5 m canister heat load design basis is 2450 watts. However, assessment of Phase 1 tank waste data results in a maximum heat load of 850 watts which also results in a much lower (approximately linear) radiation source term. Using the same conservative vault loading strategy used to develop the CDR maximum vault heat load case (556 kW), a vault heat load, calculated using actual tank waste data and containing both IHLW and cesium canisters, is projected to be 150 kW.

  Based on receipt of formal private contractor confirmation of the expected HLW product heat loads and source terms, it is assumed that the project W-464 DRD will be revised, with DOE approval, to include more accurate heat load and source term requirements specific to the interim storage function.

The new requirements would allow for design of a much lighter SCT (less shielding required and corresponding reduction in SCT support equipment size and weight) and will significantly increase the operating deck load capacity due to the reduction of thermally induced stresses.

Other General Summary Discussion

Constructibility assessments were performed relative to the identified CSB modifications and equipment retrofits; no significant construction or construction permitting issues were identified.

Procurement of the project W-464 onsite transportation system and identified CSB modifications and equipment retrofits can be accomplished in accordance with a June 2002 CSB radioactive start date.

The rationale relative to the RCRA permit is presented in the Project W-464 Permitting Plan.

Cost estimates and bases for project W-464 design, construction, facility startup, operations and facility closure are provided in this CDR. Project W-464 is a fiscal year 2000 Line Item. Total estimating engineering and construction costs of the project are $84,700.000 ; expense funded support costs are $19,400,000. The total project cost is $104,100,000.

III. JUSTIFICATION

The retrofit modifications and new installations provided by project W-464 for the SNF CSB supports the TWRS program, the DOE's privatization initiative and, in turn, supports the Tri-Party Agreement milestones for site clean-up, processing, and disposal of the Hanford tank wastes.

IV. DESCRIPTION OF PROJECT SCOPE

A. IMPROVEMENT TO LAND (460)

The existing two-lane service road with an HS-20 load capacity that is planned to service vehicle traffic to the CSB load-in/load-out area and loading/staging area will be extended south and east to the HLW Load-In/Load-Out Annex. A truck maneuvering area south of the main entrance to the Load-In/Load-Out Annex will also be provided. An existing fire hydrant south of the CSB will be removed and replaced as required by the roadway extension.

B. BUILDINGS (501)

1. Existing Canister Storage Building Modifications

Structural

Project W-464 will utilize Vaults 2 and 3 of the SNF CSB. The modifications required by the project to the structural systems of Vaults 2 and 3 include the addition of an air intake structure and air exhaust stack for each vault (ES-W464-M01). Concrete louvers will be added at each exhaust plenum for shielding, based on previous analysis performed for HWVP. The south wall of the operating area shelter structure will be modified to provide an opening, approximately 30 ft wide by 30 ft high, required for the travel of the SCT between the Load-In/Load-Out Annex and the operation deck area.

The existing hot conditioning system annex (HCSA) pits, 6 and 7 will be used to support project W-464 activities.

The existing CSB complex consists of the following buildings and structural systems:

- Vaults.
- Operating deck.
- Vault cooling intake structure (Vault 1).
- Vault cooling exhaust stack (Vault 1).
- Operating Area (including load-in/load-out and HCSA areas).
- Support Area.
- Storage tubes and plugs (Vault 1).

The operations area in the CSB is 41.86 m (137 ft. 4 in.) wide by 68.81 m (225 ft 9 in.) with a 12.50 m (41 ft) deep belowgrade reinforced concrete structure with a 1.73 m (5-ft 8-in.) thick basemat foundation and 1.52 m (5-ft) thick operating deck. Two 0.91 m (3-ft) thick common walls divide the structure into three vaults, each vault having a rectangular concrete intake plenum 3.25 m (10 ft 8 in.) by 4.88 m (16 ft) by 0.61 m (2 ft) thick and 16.92 m (55 ft 6 in.) high and a concrete exhaust plenum with concrete circular stack foundation having 6.25 m (20 ft 6 in.) O.D. by 3.51 m (11 ft 6 in.) I.D. by 3.66 m (12 ft) high. North of Vault 1 is the SNF load-in/load-out area and south of Vault 3 is the hot conditioning annex. Both these areas have concrete floors joined monolithically to the operating deck with the floors all at the same level. The operating deck, the SNF load-in/load-out area, and the hot conditioning annex floor form the operation deck area and are sheltered by a steel frame metal building (ES-W464-M01).

Each vault is designed to accommodate a storage tube matrix of 22 rows with 10 columns per row for a total of 220 carbon steel storage tubes and one row of 6 columns of overpack storage tubes located west of the canister storage tubes (ES-W464-M01). Existing embedments for the standard and overpack canister storage tube assemblies have been placed in the vault operating deck and in the basemat. The existing operating deck embedments are designed to receive the tube and the floor plug assemblies, the upper end of each tube will be welded to a stainless steel bellow that will be welded to the deck embeds. Tube base assemblies will be welded to the existing basemat embedments. The tube base assemblies are designed for the alignment and anchorage of the tubes (ES-464-M05).

The operation deck area includes crane rails 38.56 m (126 ft 6 in. apart) running east-west near column lines A.1 and E.9 for the MHM handling machine crane. Crane rails are also included in the load-in/load-out area 12.19 m (40 ft apart) running north-south at column lines 1 and 2 for the receiving 60-ton gantry crane (ES-W464-M01).

Vault 1 will be used by the project W-379 and is equipped with the storage tubes and shielded plugs. The intake and exhaust plenums of Vault 1 are equipped with the concrete and steel air intake structure and steel exhaust stack, respectively.

Concrete

Insulating concrete will be added to Vaults 2 and 3 by W-379 project prior to the start of project W-464 (Reference 4). The insulating concrete is required to protect the structural concrete from the higher heat loads produced by the IHLW (Reference 10 and 15).

Ten inches of insulating concrete will be added to the ceiling of the vaults (bottom of concrete operation deck) and the exhaust plenum area, and 0.15 m (6 in.) of insulating concrete will be added to the side walls of the vaults and the exhaust plenum area. The insulating concrete will be light-weight concrete of 960 kg/m^3 (60 lb/ft^3) density. The insulating concrete anchorage is similar to that designed for HWVP. The stack concrete foundation rings in the exhaust plenum area does not have insulating concrete.

Based on thermal analysis with all vaults loaded (References 10 and 15), the maximum structural concrete temperature at the ceiling is 57 °C (134 °F) (basemat temperature is anticipated to be lower). The maximum structural concrete temperature at the walls due to both convective and radiant heat transfer are as follows:

Long-term Exposure

	North Side	South Side	ΔT
Vaults 1 and 2 Wall	41 °C (105 °F)	51 °C (124 °F)	10 °C (19 °F)
Vaults 2 and 3 Wall	66 °C (150 °F)	64 °C (148 °F)	1.2 °C (2 °F)

Short-term Exposure, (6 hours duration)

Vaults 1 and 2	81 °C (178 °F)	91 °C (195 °F)	10 °C (17 °F)
Vaults 2 and 3	104 °C (220 °F)	104 °C (219 °F)	0 °C (1 °F)

A review/evaluation of existing design documents (References 20, 21, 22, 23, and 33) was performed to evaluate the impact of the higher temperature on the concrete (increase in temperature will result in an increase in the thermal stresses) and the wheel loads from the SCT.

For the CDR level of evaluation, it was concluded that the existing structural concrete can qualify for the proposed increase in temperature and the wheel loads from the SCT. Additional conservative features exist and have been identified as follows:

- The original design specified a 5,000 psi compressive stress limit for concrete. However, current design reduced this value by 1,000 psi to account for long-term thermal degradation (Reference 8).
- The design thermal conditions in the vaults are based on conservative assumptions such as,
    - The highest and lowest outside air temperatures are 46 °C (115 °F) and -32 °C (-27 °F), respectively, for a duration of 6 hours.
- The seismic analysis utilized a zero point acceleration input at a layer 2.4 m (8 ft) below the surface rather than at the surface (Reference 11).
- The shear modulus values used for the soil-structural interaction (SSI) analysis were varied by an uncertainty factor, C_v = 1.0, twice the allowed minimum value of C_v = 0.5, per ASCE 4-86 (Reference 11).

- The weight of the HLW canisters to be placed in the storage tubes is considerably less than the SNF canisters. The total maximum weight for two 4.5 m HLW canisters is 8400 kg (18,519 lb) and 17 240 kg (38,000 lb) for the SNF (Reference 26).

- Gravity and seismic loads from the exhaust stack can be reduced with the placing of concrete louvers in the exhaust plenum in lieu of the 12-in. of concrete shielding around the exhaust stack.

- In the evaluation of the demand capacity ratios (actual versus allowable stresses) for the concrete, the values can be reduced by taking into account the cracked section effective moment of inertia.

- Actual compressive strength of the existing concrete (test results) are higher than required design requirements.

- The SCT weight used for the evaluation of the deck is 1.245 MN (280,000 lb). This weight is based on a unit with two 175-hp diesel engines with two generators. The proposed SCT will be electrically driven with a 480 V external power source, therefore, it is expected that the actual weight be reduced.

To validate the above conclusion, a comprehensive evaluation/ analysis will be done during advanced conceptual design, taking into account the following:

- Probabilistic heat wave for the site.

- A three dimensional heat transfer model to simulate heat flow through the vaults with alternative storage tube loadings.

- Shielding analysis to validate and size the concrete louvers at the exhaust plenum.

- Wheel loads, from the shielded canister transporter on the operation deck.

- More detailed heat transfer, thermal gradients, and thermal load analyses.

- A comprehensive structural analysis.

Modifications

Project W-464 structural modifications to Vaults 2 and 3 include the addition of air intake structures and air exhaust stacks (ES-W464-M01). The air intake structures and the air exhaust stacks of Vaults 2 and 3 will be similar to those used by project W-379 in Vault 1. The air intake structures will be anchored to the concrete intake plenums, and the air exhaust stacks will be anchored to the existing concrete stack foundations.

Concrete louvers will be added at the pass-through into the exhaust plenums for shielding (see sketch ES-W464-MO1, sh 4).

Air foils will be installed along the walls of Vaults 2 and 3 similar to those for project W-379.

The existing structural design basis for the SNF CSB project includes the following:

- The design life of the SNF CSB is 40 years, except that the materials for the vault structure, the storage tubes, and other inaccessible structures have an expected life of 75 years.

- The general design criteria for the buildings and structures conform to DOE Order 6430.1A; UBC-1994; ASCE 7-88; HPS Architectural-Civil Design Criteria, HPS-SDC-4.1, Rev. 12; WHC-S-0425, Rev. 1; CSB performance specifications; ANSI/AISC N690-1984; ACI 349-90; and SNF CSB Design Basis Document (Reference 8).

- The CSB vaults belowgrade structures are designed and detailed as a Safety Class (SC) structure as follows:

    - Design basis earthquake (DBE) peak ground acceleration (PGA) of 0.350.

    - Self-straining thermal loads based on short duration concrete surface temperature as high as 57 °C (135 °F).

    - Live load of 100 psf plus MHM and receiving crane loads.

- The operation area structure is designed and detailed as a General Service structure, but is designed to sustain the following SC DBE, wind, tornado, and ashfall loading without collapse:

- Roof live load = 960 Pa (20 psf)
- Roof snow load = 960 Pa (20 psf)
- Design basis ground ash load = 1150 Pa (24 psf)
- Design basis wind load per ASCE 7-88 exposure "C" = 145 km/h (90 mph)
- DBE load is SC-1, peak ground acceleration = 0.359
- Design basis tornado wind = 320 km/h (200 mph)

The support facility is a General Services structure over safety significant items with the following loads:

- Roof live load = 960 Pa (20 psf)
- Roof snow load = 960 Pa (20 psf)
- Wind load per ASCE 7-88 exposure "C" = 113 km/h (70 mph)
- DBE load is SC 2, peak ground acceleration = 0.219
- Design basis tornado wind = 320 km/h (200 mph)

Foundations and belowgrade structures are designed for an allowable soil bearing pressure of 287,280 Pa (6,000 psf) with 33% increase allowed for wind or seismic loads. Active and passive earth pressures, including dynamic effects due to earthquake, soil thermal expansion, and surcharge loads due to the construction crane are also considered in the design.

Materials

Structural materials include the following:

- Reinforced concrete:
  compressive strength = 41 370 kPa (6,000 psi*) (CSB Vault above Elv. 215.6 m [704 ft])
  34 475 kPa (5,000 psi*) (CSB Vault below Elv. 215.6 m [704 ft])
  27 580 kPa (4,000 psi) (elsewhere)
  * Structural design is based on these values reduced by 6895 kPa (1,000 psi) to account for long-term thermal degradation (Reference 8).

- Reinforcing steel - ASTM A615 (Fy = 413 700 kPa [60,000 psi]).

- Structural steel and embeds - ASTM A36/A36M (Fy = 248.22 Mpa [36 ksi]).

- Air intake steel structure - ASTM-A588 GR A (Fy = 344.8 Mpa [50 ksi]).

- Exhaust stack - ASTM-A424 Type 1 or ASTM-A588 GR A (Fy = 344.8 Mpa [50 ksi]).

Canister Overpack Station

HCSA pit 7 will be used for overpacking damaged or defective canisters. The dimensions of an HCSA pit are adequate for overpacking the solidified HLW canisters. However, the recessed cavity at the top of the pit will be evaluated for methods to accommodate new welding equipment and a new process enclosure during project W-464 definitive design (ES-W464-MO7). A cover will be welded to the overpack and the process enclosure will provide confinement and shielding during the overpack welding. Project W-464 will provide the cover and welding equipment, (see Section D, Special Equipment and Process Systems). Centering guides and an overpack support pedestal or impact absorber will be installed in the pit (ES-W464-MO7). The centering guides will center the overpack in the pit and the support pedestal will locate the overpack to the proper level for welding.

Heating, Ventilating, and Air Conditioning

The heating, ventilating, and air conditioning (HVAC) and HEPA filtration systems designed for the SNF CSB provide heating, cooling, ventilation, and filtration for the operations area and for the support area. Due to the thermal insulation of Vaults 2 and 3, heat transfer from the vaults to the operating area is small. Based on review of the existing SNF design, capacity for air handlers and condensers is adequate. The existing HEPA filtration system meets the design requirements for project W-464. No modification to the existing systems will be required during construction.

The passive (natural convection) cooling system design for the SNF in Vault 1 will be duplicated for cooling of the HLW in Vaults 2 and 3, with the addition of shielding louvers. No HEPA filters are used on the exhaust as the vault storage tubes provide a containment function. Contamination of the vault airflow is not a credible scenario. The results of the thermal analysis (Reference 7 and 8) show that insulating concrete is required to protect the ceiling and walls in Vaults 2 and 3 (as proposed in earlier studies by Fluor Daniel, Inc.) This insulation is calculated to provide a temperature differential barrier of up to 13 °C (24 °F) at the vault ceiling. Other conclusions from the thermal analysis are:

- At the vault design heat load of 556 kW, (which includes HLW and cesium) the calculated airflow is approximately 53,000 cfm, at a mixed leaving air temperature of approximately 67 °C (152 °F). The peak (hot spot) air temperature in the vault will not exceed 69 °C (157 °F) (Reference 10).

- The maximum storage tube temperature will be approximately 132 °C (270 °F), and will occur at a tube with the maximum load of two HLW canisters at 2.54 kW each. The maximum structural concrete temperature in the vault ceiling is calculated to be 57 °C (134 °F). The maximum short-term temperature (6 hours) at the surface of the structural concrete walls is calculated to be 104 °C (220 °F) (Reference 15).

- The maximum HLW glass canister centerline temperature is calculated to be 283 °C (541 °F). This is well under the maximum allowable centerline temperature of 400 °C (752 °F). The maximum cesium container centerline temperature will be 407 °C (764 °F) which does not have a maximum allowable centerline temperature established at the time of this CDR preparation (see Uncertainties, Section VII).

An analysis of natural convective cooling of the SNF and IHLW has been performed by Fluor Daniel, Inc. The results of this analysis indicates that the convection method will provide adequate and continual cooling. Computer programs used were verified, and the entire analysis for SNF received a level of verification required for SC systems and the results were confirmed by British Nuclear Fuels Limited (BNFL). This analysis was performed for a single exhaust stack system. Project W-464 will have to perform testing to verify that a three stack design does not compromise the cooling capability because of flow interferences between the stacks.

The analytical methods of solution used for this study of IHLW in the CSB were identical to the methods (including computer programs) used by Fluor Daniel Inc., for their SNF and HLW thermal analyses. This natural convection methodology has been used worldwide.

Fire Protection

The abovegrade part of the CSB is Type II (000) noncombustible, nonfire-rated construction per NFPA 220. The belowgrade part of the building is reinforced concrete. The same construction is used for the floor of the building. The CSB is to be considered as a Special Purpose Industrial Occupancy facility per NFPA 101. The unload bay is to be treated as a "Special Purpose Industrial" occupancy. The storage of glass logs will be in a metal tube. Adequate emergency exits in accordance with NFPA 101 are provided.

DOE Orders 6430.1A and 5480.7A require that automatic sprinkler protection be provided in nonreactor nuclear facilities. However, automatic sprinkler protection systems will not be installed in the operations area of the CSB. This is consistent with the CSB fire hazards analysis (FHA) (Reference 12). An exemption to the sprinkler system requirement has been granted by RL (Reference 6). This exemption is based on a maximum possible fire loss (MPFL) being less than $1 million as defined in DOE Order 5480.7A. To continue this exemption, the materials, construction, operation, and other items can not increase the MPFL above the limit.

The CSB FHA lists the projected MPFL for the operations area to be $850,000. This would involve a truck fire with 100 gal. of fuel. If the fuel is limited to 40 gal. or less, the MPFL would be $280,000. The MPFL for the tube vent and purge cart is listed at $305,000. The MPFL for the SCT is expected to be less than that of a truck fire. The MPFL is expected to be less than $750,000. The MPFL is based on the use of the SCT in the CSB at the Savannah River Site, Aiken, South Carolina.

The shipping and handling of the glass log canisters in the CSB will not increase the combustibles in the operations area nor increase the MPFL as noted in the FHA.

During construction, close administrative control will be required to ensure that the bounding conditions (limit of combustibles) of the FHA are not exceeded. This will include limiting combustibles in the building, not allowing trucks into the building, and any other controls required when the CSB FHA is approved.

A pre-engineered CO_2 or inert gas fire extinguishing system may be required to protect enclosed electrical cabinets containing combustible cables. This requirement will minimize fire exposures when the MHM is in the unsprinklered CSB structure. This protection is consistent with recommendations in Factory Mutual Loss Prevention Data Sheet 1-62/17-16, *Cranes*. While this data sheet is listed for cranes, the operation of the SCT and a crane have similar fire potential conditions.

Adequate water supplies for fire protection purposes exist at the jobsite; water supplies were installed as part of the SNF project. The system includes a connection to the 200-Area water system and an onsite water supply (fire pumps taking suction from a tank). The fire pumps are expected to be placed into operation by the end of CSB construction. A 12-in. water loop with fire hydrants was installed to supply water for fire protection. Fire hydrants are located so that hose lays are no more than 300 ft from the hydrants to the exterior portions of a protected building. Fire hydrants are located more than 50 ft from the CSB. However, one hydrant will be relocated due to the new road for the HLW project.

Electrical

The existing CSB electrical system was evaluated and the system provides adequate services for project W-464. The existing interior/exterior lighting, convenience outlet, grounding and communication systems as installed will provide adequate coverage for IHLW interim storage with little or no changes.

Lightning protection will be installed on the new vault stacks consistent with the existing CSB installation.

Existing conduits and included cables, in the southeast corner installed along the south wall of the CSB, will have to be rerouted to allow for the installation of the HLW Load-in/Load-out Annex access opening.

Electrical power to the new overpack weld station will be provided from the existing CSB electrical system.

Instrumentation

Vault intake air temperature, intake air velocity, and exhaust air temperature will be measured to ensure that the natural air convection used to maintain the air temperature in the vault is achieved. The air measurement signals will be transmitted to a remote monitoring station (see Figure 1). There is a significant calculated margin below the maximum allowable centerline temperatures of the HLW canisters, therefore temperature measurement of individual storage tubes is not required. This strategy of measuring the air velocity and the outlet stack air temperature is also used by the SNF project in Vault 1.

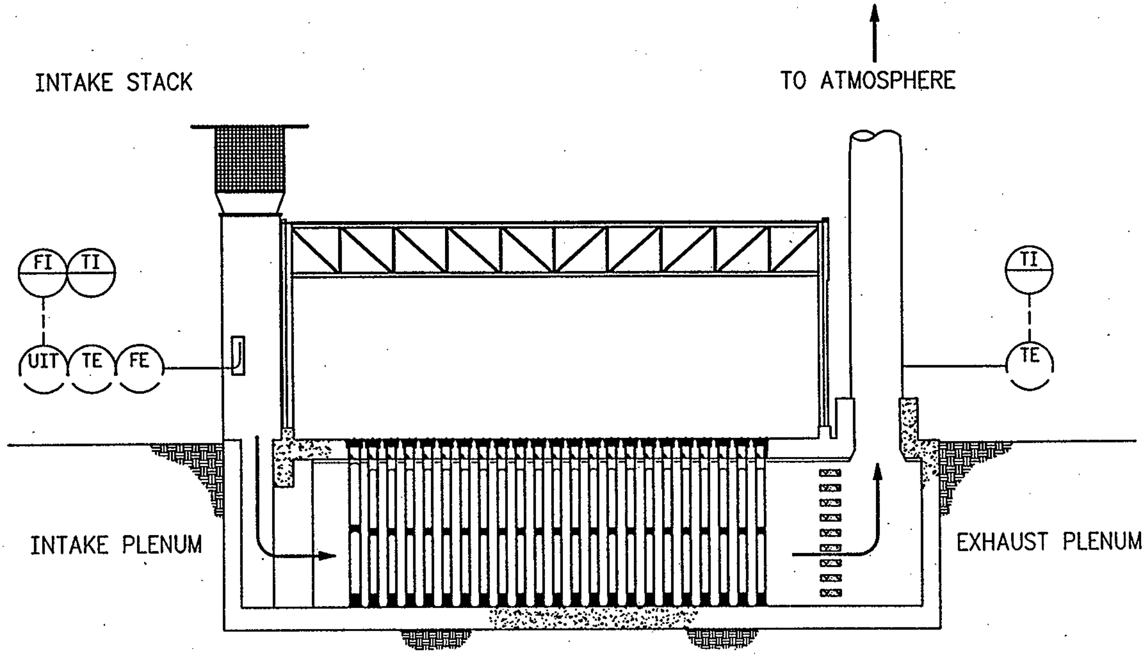

FIGURE 1. - CSB - TYPICAL FOR VAULTS 2 & 3

2. High-Level Waste Load-In/Load-Out Annex

Architectural

The HLW Load-in/Load-out Annex will be constructed as an addition to the existing CSB.

- The design life of this addition will be 40 years.
- The Occupancy Classification will be NFPA 101 Special Industrial Occupancy.
- Type Classification will be NFPA 220 Type II-000 non-rated construction and the area separation between occupancies will be per NFPA.
- Life Safety: Doors will be operable from the inside without excessive force and without keys or special knowledge. Exit ways will be clearly marked and illuminated with at least one footcandle upon path of travel at all times.
- Occupied spaces will be suitably lighted and ventilated for safe habitation at all times.
- Exterior roof drains will be used.
- The roof system will consist of welded metal decking covered with batt isolation having a minimum thermal resistance value of R-30. Standing seam metal roofing will match color, material, slope of the roofing system on the existing CSB.
- The exterior wall system will be insulated metal siding attached to a structural steel framing system. The minimum thermal resistance of

the siding system will be R-19. This system will match color, material, type of siding system on the existing CSB.

- Building envelope of the CSB plus the HLW Load-In/Load-Out Annex will seal sufficiently to allow maintaining an internal negative pressure.

The Annex will accommodate the following:

- The main level of the Annex will be approximately 3,000 ft^2 and will connect to the south wall of the Operations Area of the CSB maintaining the same floor elevation.
- The main level will provide a HLW cask receiving area and a HLW cask transfer pit.
- The south wall of the HLW cask receiving area will have double swinging exterior doors (20 ft wide by 24 ft high) providing access for entry of a transport trailer delivering a cask.
- The HLW cask transfer pit will be separated from the HLW cask receiving area by a vertical lift door. A full width opening to the CSB operations area is provided on the north side of the HLW cask transfer pit.
- Both the HLW cask transfer pit area and the HLW cask receiving area will be served by a 60-ton gantry crane on rails.
- A corridor on the west side of the Annex will provide an exterior exit, access to the CSB, access to the Annex, and a stairway to the lower level access tunnel.

- The access tunnel (13 ft - 0 in. below the Annex floor level with an 8 ft - 0 in. ceiling height) provides access to cask lid removal area.

- The cask lid removal area (10 ft by 16 ft) provides work and observation space. A cask lid bridge crane is provided.

- On the east side of the personnel access corridor will be an additional access tunnel with an exit ladder up on the east side of the Annex.

- There will be two exhaust fan and filter housing assemblies.

- A 12-in. diameter by 80 ft high stack will be located east of the Annex.

The design of the HLW Load-In/Load-Out Annex, including the building materials, method of construction, and architectural detailing will be coordinated with the existing CSB to provide a simple, unified, and harmonious building.

In some cases, code requirements conflict with necessary security and operational requirements that may be unique to nuclear facilities such as this. This design would comply with all applicable standards and regulations as listed.

Structural

The Load-in/Load-out Annex will be designed to receive HLW canisters by truck. A 60-ton gantry crane capable of handling the transport cask will be included. The transport cask will be picked up by the gantry crane and will be transferred into a below-grade transfer vault/pit. In the transfer vault/pit, a remotely operated bridge crane will remove the cask lid; the SCT will then remove the floor plug and pick up the HLW canister and transport it to the CSB operating area and place it in the storage tube.

The Load-in/Load-out Annex will be connected to the south wall of the operating area of the CSB. A seismic joint will be provided to isolate the two structures. The Annex area will consist of two sections: a HLW cask receiving area and a HLW cask transfer pit area. The cask receiving area will be isolated from the cask transfer pit are by a sealed door. The HLW cask transfer pit area will be open to the CSB operating area and will maintain the same atmospheric pressure.

The Load-in/Load-out Annex will consist of the following:

- HLW Cask Transfer Pit Area - this structure will be below grade consisting of 0.05 m (2-in.) thick reinforced concrete vault walls and floor approximately 4.88 m (16 ft) by 3.05 m (10 ft). Access to the vault is through a 1.52 m (5 ft) diameter floor plug and a personal labyrinth and door to the west. The floor of the vault includes a 1.52 m (5-ft) diameter by 5.79 m (19-ft) deep by 0.61 m (2-ft) thick reinforced concrete cask transfer pit. The vault will also include a 10-ton bridge crane for the removal and placement of the cask lid. This area also provides capability for access to the bottom of the SCT for maintenance.

- Operation Floor Area - this area consists of two sections: HLW cask receiving area and the HLW cask transfer pit area. The operation floor area will consist of a reinforced concrete floor 1.52 m to 0.61 m (5 ft to 2 ft) thick and will be sheltered by a steel framing structural system with metal roof and siding designed to the CSB design criteria.

The HLW cask receiving area will be isolated from the HLW cask transfer pit area by a vertical lift door. The main entrance to the HLW cask receiving area is through a double swinging exterior door (6.10 m [20 ft] wide by [20 ft] high) at the south wall. The double swinging door will be designed to resist tornado wind and missile loads. The north side of the Annex will be open to the CSB operation deck area.

- A 60-ton gantry crane and crane rails spanning north-south the full length of the floor area.
- A 300 mm (12-in.) diameter by 24.4 m (80-ft) high HVAC stack and stack foundation located east at the east at the north end of the Annex area.

Heating, Ventilating, and Air Conditioning

A new HEPA filter exhaust ventilation system of approximately 2000 cfm capacity will be provided for the new HLW Load-in/Load-out Annex (ES-W464-M01). The air flow will be adequate for personnel needs as well as means of cooling the new HLW cask transfer pit. Supply air will exfilterate from the operating area as was originally intended for the HCSA. The air will exhaust up a new stack and will be monitored for radiation. The use of HEPA filters is consistent with the design requirements for project W-464 and project W-379.

Fire Protection

The Annex is to be Type II (000) noncombustible, nonfire-rated construction in accordance with NFPA 220. The floor and belowgrade parts of the Annex will be reinforced concrete. The Annex is to be considered a Special Purpose Industrial Occupancy per NFPA 101 and will be used for the unloading and future loading of the HLW casks. The jeep (motor unit) will not be brought into the Annex for the unloading operation: It will be disconnected from the canister trailer and parked outside of the building. Adequate emergency exit will be provided in accordance with NFPA 101.

DOE Orders 6430.1A and 5480.7A require that automatic sprinkler protection be provided in nonreactor nuclear facilities. However, automatic sprinkler protection systems will not be installed in the Annex. This is consistent with the CSB FHA (Reference 12). An exemption to the sprinkler system requirement has been granted by RL (Reference 6). This exemption is based on a maximum possible fire loss (MPFL) being less than $1 million as defined in DOE Order 5480.7A. To continue this exemption, the bounding conditions must also be met.

These include the close administrative control will be required to ensure that the bounding conditions (limit of combustibles) of the FHA are not exceeded. This will include limiting combustibles in the building and on trucks and any other controls required when the CSB FHA is approved.

Electrical

Electrical power for the new HLW Load-In/Load-Out Annex will be supplied from the existing CSB 480 V ac power distribution system. A concrete encased duct bank and manhole system from the CSB electrical equipment room to the new Annex will be used to route electrical cables.

A new 480 V/277 V, 3-phase, 4 wire distribution panelboard will be installed in the new annex to provide 480 V power to HVAC equipment, miscellaneous power receptacles, SCT, bridge crane, electric operated doors, high bay light fixtures, and a 208/120 V, 3-phase, 4 wire panelboard.

The new gantry crane will have power provided from an existing CSB motor control center. The existing motor control center is capable of supplying normal power and in case of normal power system failure, diesel driven generated back-up power.

The 208/120 V panelboard will provide power for lighting (incandescent, fluorescent, outdoor, emergency, and exit), convenience outlets (indoor and outdoor), vehicle battery charger(s), air monitoring equipment, and control/monitoring systems.

Lightning protection will be installed on the new Annex and associated HVAC exhaust stack consistent with the existing CSB installation.

The existing CSB communication system will be extended into the new Annex.

Instrumentation

The new Annex exhaust stack will be provided with a continuous air monitoring system that will switch to the standby filter and exhaust fan in an upset condition.

The bridge crane will be provided with remote control capability. A closed circuit TV system will be installed to allow remote operation and monitoring of the transport cask lid removal/placement. The remote monitoring/control station will be located in the main floor of the Annex.

C. SPECIAL EQUIPMENT AND PROCESS SYSTEMS (700)

1. Shielded Canister Transporter

A new electrically powered SCT will be provided for handling and transporting HLW canisters between the HLW cask transfer pit and Vaults 2 and 3 (see Figure 2).

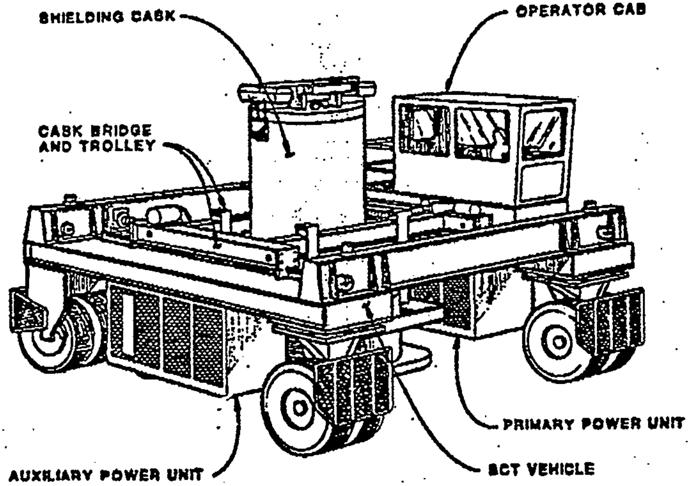

FIGURE 2

SHIELDED CANISTER TRANSPORTER

The SCT is comprised of a 100-ton capacity mobile straddle carrier for transporting a shielded cask and includes a bridge support structure and remote drive components. The shielded transfer cask includes a shielded valve, hoist, and grapple equipment. The control system includes CCTV monitors and controls, programmable controllers, interlock functions, and redundant back-up controls. The SCT will be electrically powered via a 480 V, 3-phase umbilical cord.

2. Transportation System

Two new onsite transportation casks and truck-based transporters will be provided by project W-464 (ES-W464-M01, sh 6). The transportation casks will be constructed of steel which will provide the proper shielding at a minimum thickness of 9 in. This will result in a cask with approximately a 43-in. outside diameter. The transportation cask will be built in only one size and will accommodate both the solidified IHLW canister and the overpack cesium canister. Project W-464 will provide two casks with trailers. Existing tractors will be used to transport the casks/trailers.

3. Storage Tubes

Standard storage tubes will store the IHLW canisters or the overpacked cesium canisters. There are 220 standard storage tubes in each vault. Two 4.5-m IHLW canisters or two overpack cesium canisters will fit in each standard storage tube. The standard storage tube consists of a standard floor embedment, standard tube/bellows assembly, standard tube base assembly, standard tube plug assembly, and a standard tube plug cover assembly (ES-W464-M05).

Overpack storage tubes will store the IHLW canister overpacks. There will be three overpack storage tubes in Vault 3. Two IHLW canister overpacks will fit in each overpack storage tube. The overpack storage tube consists of an overpack floor embedment, overpack tube/bellows assembly, overpack tube base assembly, overpack tube plug assembly, and an overpack tube plug cover assembly (ES-W464-M05).

The standard and overpack floor embeds are an existing part of the SNF CSB; the embeds have been extended by 10 in. to accommodate the insulating concrete. The standard and overpack tube base assemblies and tube plug cover assemblies will use the SNF designs, but fabrication and installation will be part of project W-464 scope (ES-W464-M05).

The design and fabrication of the standard and overpack tube assemblies will be similar to SNF CSB tube assemblies with two exceptions, a step is required to support the upper impact absorber (ES-W464-M05, sh 4) and the overpack tubes are larger in diameter.

The design and fabrication of the standard and overpack tube plug assemblies will be provided by project W-464 (ES-W464-M05). The design of the tube plug assemblies will be similar to the SNF design, and will be made up of 29.40 in. of concrete, and 8 in. of insulating concrete. (ES-W464-M05, sh 3).

The storage tube assemblies will be transported into Vaults 2 and 3 through the loading/tagging area of the main door at the southwest corner of the CSB and lowered through the operating deck embedment with a portable crane. Air balance will be maintained by construction of a temporary greenhouse. The top of the tube assembly (bellows) will be welded to the embedment in a similar way to the tubes for the SNF project in Vault 1.

4. Cesium Canister Overpacks

Cesium canisters, which are smaller than the IHLW canisters, will be placed in overpacks as shown in sketch ES-W464-M09. The privatization contractor will put the cesium canister into the overpack, and place the overpack into the transportation cask for shipment. The cesium overpack will have the same outside dimensions as the IHLW canisters which permits the use of the same sized transportation cask. The overpack will also provide additional shielding which will reduce the cesium dose rate at the surface of the overpack down to levels consistent with the IHLW canister dose rate. Project W-464 will provide two cesium overpacks.

5. Overpack Assemblies

Two overpack assemblies, built by project W-464, will be used for overpacking HLW canisters (ES-W464-M10, sh 1) that may become damaged during handling in the CSB. The damaged canister will be put into an overpack canister and the top cap will be welded on at the overpack weld station.

6. Impact Absorbers

Five upper and five lower impact absorbers will be provided by project W-464 for installation into standard (4 upper, 4 lower) and overpack (1 upper, 1 lower) storage tube assembly (ES-W464-MO6). The impact absorbers will be designed to limit the loading of a dropped waste canister to 35g or less, similar to the MCOs for SNF CSB.

7. Gantry Crane

A new 60-ton gantry crane will be provided in the HLW Load-In/Load-Out Annex for transferring the shielded cask from the transport trailer to the HLW cask transfer pit. A 10-ton hook will be provided for moving the cask transfer pit shield plug. Operation will be local.

8. Bridge Crane

A new 10-ton, remote operated, bridge crane will be provided in the HLW cask lid access area for removal of the shielded transport cask lid.

9. Overpack Weld Station

A new weld station will be provided for welding and weld inspections of the HLW overpack cap weld (ES-W464-M08, sh 3). The following remote equipment and systems will be required:

- Electrical power
- Bottled gas
- Mechanical lifting equipment
- Gas tungsten arc welding (GTAW) system
- Ultrasonic inspection equipment
- Weld repair equipment
- Gantry crane (approximately 7-½ ton capacity)
- Exhaust enclosure for confinement of the weld operation
- Local instrumentation and controls
- Overpack support pedestal
- Local shielding (portable).

E. DESIGN COMPLIANCE

The design and construction of project W-464 will comply with the codes, standards, regulations, and laws listed in the project DRD and applicable standard/requirements identification documents (S/RIDs) at the time of contract award for each phase.

V. METHODS OF PERFORMANCE

The methods of performance comply with the work breakdown structure (WBS) in Appendix A. The WBS indicates the major phases of work to be accomplished, i.e., engineering, construction, project management, and other project activities.

A. ARCHITECT-ENGINEER WORK (WBS 1.A AND WBS 1.C)

The contracted architect-engineer will provide definitive design, engineering during construction, construction management, and project management support throughout the life of the project.

Acceptance Inspection and National Electrical Code (NEC) compliance inspection will be acquired by the integrating contractor.

B. ONSITE PROJECT INTEGRATOR (WBS 1.D)

The project integrator will provide the following activities:

- Development of the definitive design DRD.
- Provide design input and reviews from cognizant facility and infrastructure (on-site utilities) personnel for definitive design and construction.
- Provide construction support, as needed.

C. PROCUREMENT (WBS 2.0)

The performance contractor is directly responsible to the PHMC for performing all activities associated with this project. The performance contractor will negotiate performance measures with the PHMC as well as manage and integrate scope, cost, and schedule through the life of the project.

The contracted architect/engineer, for the purpose of cost estimating, will provide project management and construction management resources to the performance contractor to support project execution from the conceptual phase through acceptance testing and project closeout.

The contracted architect/engineer, for the purpose of cost estimating, will procure and provide the following equipment as owner-furnished material for installation to the construction contractors:

- Standard/overpack tube assemblies
- Standard/overpack bellows assemblies
- Standard/overpack tube base assemblies
- Standard/overpack tube shield plug assemblies
- Tube plug cover assemblies
- Transfer pit shield plug assembly

- Motorized 60-ton cask handling gantry crane
- Overpack station enclosure and welding/inspection assembly
- Motorized 10-ton cask lid removal bridge crane.

The contracted architect/engineer will procure and provide the following equipment for use by the performance contractor:

- Two transport cask/trailers
- Ten Impact absorbers
- Two cesium canister overpack assembly
- Two canister overpacks
- One SCT.

The balance of equipment for project W-464 will be purchased and installed by the construction contractor (see outline specification in Appendix E).

D. CONSTRUCTION (WBS 3.0)

The construction contractor will be a CM-fixed price contractor who will provide the resources necessary to perform the construction work needed to implement project W-464. Two fixed-price contracts will be utilized to enhance the project schedule.

E. PROJECT INTEGRATION (WBS 4.0)

The project integrator will provide technical and construction coordination.

F. OTHER PROJECT COSTS (WBS 5.0)

The project integrator will coordinate project startup and verification.

VI. REQUIREMENTS AND ASSESSMENTS

A. SAFEGUARDS AND SECURITY

Project W-464 will take place within the 200-East Controlled Area and will require a Level 1 clearance and badging for access. Badge access is required for transport vehicles past the Wye Barricade and boundaries around this project. No new measures beyond the current site practices will be required as a result of this project.

Project W-464 will perform a vulnerability assessment analysis to determine the risks associated with SNF operations concurrently with project W-464 construction activities. A construction security plan will be prepared prior to the start of construction.

B. HEALTH AND SAFETY

Accommodations for the physically handicapped will not be provided for the CSB (see Appendix I).

Construction contractors will comply with State of Washington and Fluor Daniel Hanford, Inc., (FDH) standards during performance of the work, and will ensure that applicable Occupational Safety and Health Administration (OSHA) standards are enforced during the project. See Section 5.0 of the PSE for construction risk discussion. This will be documented and controlled by a job safety analysis (JSA) prepared and administered by each applicable contractor. These measures include providing continuous access to construction areas for emergency vehicles and personnel, and ensuring that emergency evacuation routes are unobstructed.

Based on the shielding analysis performed for the CSB, the dose rates in Vault 2, with Vault 1 loaded with SNF, will be less than 0.5 mrem/h and therefore will not require radiation protection measures (Reference 25).

Transporting, handling, and storage of IHLW and cesium canisters will involve management of the radiation. Preliminary shielding analysis results are as follows:

- The cesium canister overpack needs 2 in. of stainless steel to reduce it's dose rate to the bare IHLW canister equivalency.

- The cask needs 9 in. of steel to shield both gamma rays and neutrons to meet the NRC Code of Federal Regulations (CFR) 10 CFR 71.51 limitation for a transfer cask.

- Current tube plug assembly (16.515 in. of stainless steel, 29.40 in. of concrete, and 8 in. of insulation) is enough to reduce the dose rate at the top to 1.8 x 10^{-3} mrem/hr.

- The 18-in. cask transfer pit plug reduces the dose rate on the plug surface to 1.7 mrem/hr (99% from neutrons). Whether the transfer pit plug dose needs to meet the 0.25 mrem/hr facility operation limit depends on the operator occupancy of the location. A decision on ALARA (based on the time-motion analysis) or the administrative control to restrict the access to the area due to remote operation of MHM will be investigated during definitive design.

C. DECONTAMINATION AND DECOMMISSIONING

No decontamination is expected for the CSB. When in operation, all waste canisters will be sealed and contamination-free. Decommissioning of the facility at the end of its life cycle will be addressed by a future project.

D. PROVISIONS FOR FALLOUT SHELTERS

Provisions for fallout shelters are not required for this project.

E. MAINTENANCE AND OPERATION REQUIREMENTS

The project adds two new cask/transport vehicles, one new SCT, a new 60-ton gantry crane, a new 10-ton bridge crane, two new ventilation exhaust fan/filter assemblies, and an overpack welding station. Maintenance for this equipment will be provided locally or at an existing facility on the Hanford Site. The HLW cask transfer pit area provides maintenance access to the bottom of the SCT. Project W-464 does not provide for any new maintenance facilities or equipment.

An operations and maintenance concept will be established to provide a baseline for future reliability, availability, and maintainability (RAM) analysis for a basis for definitive design criteria.

Based on the operating sequence block diagram, (ES-W464-M02 Sheet 1), a throughput of two waste canisters per a 24-hour day can be achieved, which exceeds the DRD requirement for three waste canisters per week (Reference 2).

F. AUTOMATED DATA PROCESSING EQUIPMENT

The CSB automated data processing equipment will adequately support the IHLW packages. No new equipment will be provided by project W-464.

G. QUALITY ASSURANCE AND SAFETY CLASSIFICATION

Hanford project activities comply with the requirements of 10 CFR 830.120, *Quality Assurance Requirements*; and DOE Order 5700.6C, *Quality Assurance*, as set forth in the FDH *Quality Assurance Program Description* (QAPD), HNF-MP-599. A comparison of the FDH QAPD and any additional W-464 project-specific regulatory requirements will be performed to determine whether there are additional QA program requirements not covered by the FDH QAPD. The Office of Civilian Radioactive Waste Management's *Quality Assurance Requirements and Description (QARD)*, document RW-0333P, will apply to project W-464. A project-specific QAPD may be required to address any additional requirements.

The highest safety classification for project W-464 modification work is Safety Class. The safety classification of the major components for project W-464 are listed in Table 1 and are the result of the preliminary safety evaluation (PSE), see Appendix G. The classifications will be confirmed or modified as appropriate during

TABLE 1

Systems, Structures, and Components	Safety Classification	Safety Function
Impact Absorber	SS	Mitigate the consequences of a canister drop in the storage tube.
Storage Tube	SS SC (Seismic)	Containment of any release following a canister drop (SS). Prevent damage of storage canisters during a seismic event (SC). The safety class function is to hold the canisters within the tubes during a seismic event.
SCT, Grapple, & Lifting Devices ***	SS	Containment of any release following a canister drop (alternate safety SSCs).
Receiving Crane Grapple Lifting Devices (handling of transportation cask) ***	SS	Prevent the drop of the transportation cask into receiving pit.
Transportation Cask **	SS	Sustain the impact of a cask drop without breach.
Transporter Barriers	SC	Prevents transporter from impacting the MHM.
Shielding of SCT, receiving pit, storage tubes, plugs, louvers, concrete structures of the vaults	SS	Protect worker from unacceptable radiation doses (EDE Limit).
Cask Shielding	SS	Protect workers from unacceptable radiation doses (EDE Limit).
CSB Operating Deck	SC (Seismic)	Prevents failure of tube during a seismic event.
Vault Ventilation Inlet/Outlet Structures (plenums, louvers, stacks)	SC (Seismic)	Prevents damage to the operating deck and storage tubes that could result in a SC release during a seismic event.
CSB Structure	SC (Seismic)	Prevents collapse of building onto storage tubes.

* This preliminary safety equipment list provides suggested safety SSCs, and further design development may revise or add additional SSCs.

** Consequence results below, but near, guidelines. Should consider designation of cask as safety significant.

*** These are alternative safety SSCs to be considered in lieu of the chosen safety SSC for the prevention/mitigation of the respective accident.

design development and will be documented by revision to the existing CSB preliminary safety analysis report (PSAR) and final safety analysis report (FSAR). The work involved will include the cumulative engineering evaluation of CSB as-built drawings and specifications at completion of project W-464 construction work (Title III per DOE 4700.1). This work will include impact of project W-464 changes to the existing CSB calculations/analysis.

H. ENVIRONMENTAL COMPLIANCE

The RL is responsible for the transportation and interim storage of:

- IHLW produced primarily during Phase 1 vitrification plant operation (glass product):

- Radioactive cesium separated during Phase 1 low-activity waste (LAW) vitrification plant operation (separated cesium).

- Secondary high-level radioactive and high-level mixed waste produced during Phase 1 (HLW and LAW) vitrification plant operations (nonroutine HLW).

The permitting strategies for these products are as follows:

NEPA: The recommended strategy is to adhere to the Record of Decision (ROD) (62 FR 8693) for TWRS. The ROD was based on the Final Environmental Impact Statement (FEIS), *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE/EIS-0189F). This document was co-authored by DOE and Washington State Department of Ecology (Ecology).

SEPA: The recommended approach is to inform Ecology that the TWRS/FEIS (DOE/EIS-0189F) and issuance of permits necessary for construction of the CSB cover this action and request Ecology to adopt the existing NEPA documentation for SEPA. This will be included in the permitting notice of intent (NOI) to expand the capacity of the CSB.

RCRA: The recommended approach is to negotiate with Ecology to grant interim status so that hot operation of the CSB may begin without a final status permit. A de-listing effort needs to be conducted by the private vendor or by RL on a parallel path with this strategy for subsequent shipment of the products to a repository.

CLEAN AIR ACT: Confirmation from the Washington State Department of Health and from Ecology that the hermetically sealed canisters do not constitute a source of regulated emissions should be obtained in writing from each state agency.

TRANSPORTATION: The recommended strategy for the packaging and transporting of canisters of the various products is to conduct the design and safety evaluations within the onsite transportation safe program, taking full advantage of the flexibility and cost efficiency provided by this approach. The packaging design and safety evaluations should be conducted in parallel.

RADIATION PROTECTION STANDARDS/MONITORING: Use of existing data for the baseline limits project W-464 to ongoing monitoring. The ongoing monitoring can be accomplished by use of site programs and the specific monitoring established for storage by project W-379. It is not expected that storage of IHLW canisters will require monitoring beyond that done by routine site programs.

I. PERMITS

The required permits to construct/operate project W-464 are addressed in HNF-SD-ENV-EE-002, Rev. 0 (Reference 17).

VII. IDENTIFICATION AND ANALYSIS OF UNCERTAINTIES

A. STRUCTURAL

An evaluation of the operating deck was performed on the basis of the DWPF SCT weight plus 15% (280,000 lbs) and present SNF thermal loads. The preliminary structural analysis indicates that the operating deck is marginal in a few areas and in two cases slightly exceeds the demand capacity ratio. Because of the identified conservatisms (see Structural in Section IV), there is a high degree of confidence that a detailed analysis will show the structural integrity to be satisfactory. To mitigate this uncertainty, a detailed structural/thermal analysis will be required in the ACDR.

B. HEATING, VENTILATING, AND AIR CONDITIONING

The natural convection cooling design was based on a single exhaust stack and wind tunnel testing was performed for a single stack. Until testing can be completed for a three stack design, the possible flow interferences between stacks is an uncertainty.

C. HLW PRODUCTS HEAT LOAD, SHIELDING AND OTHER CHARACTERISTICS

Current Phase 1 HLW product heat load and source term requirements are based on contract maximums (worst case conditions) which are not practical relative to Phase 1 interim storage in the CSB. The IHLW heat load and source term requirements need to be assessed based on Phase 1 tank data and more accurate requirements established for Phase 1 interim storage in the CSB. In addition, the cesium canisters, design, source terms have not been finalized. Therefore, the shielding, cooling, handling, overpack, and transportation requirements relative to the cesium canisters must be confirmed.

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B. SKETCHES

ES-W464-C00, sh 1, Rev 0	Title Sheet
ES-W464-C00, sh 2, Rev 0	Title Sheet Site Plan and Drawing List
ES-W464-M01, sh 1, Rev 0	Mechanical Facility Layout Operations Floor Plan
ES-W464-M01, sh 2, Rev 0	Mechanical Facility Layout Vault Floor Plan
ES-W464-M01, sh 3, Rev 0	Mechanical Facility Layout Cross Section
ES-W464-M01, sh 4, Rev 0	Mechanical Facility Layout Longit Section
ES-W464-M01, sh 5, Rev 0	Mechanical Facility Load-in/Load-out Annex Sections
ES-W464-M01, sh 6, Rev 0	Mechanical Facility Layout Transport Trailer
ES-W464-M02, sh 1, Rev 0	Mechanical Operating Sequence CSB Block Diagram
ES-W464-M03, sh 1, Rev 0	Mechanical Misc. Details
ES-W464-M04, sh 1, Rev 0	Mechanical Temporary Covers
ES-W464-M05, sh 1, Rev 0	Mechanical Standard/Overpack Canister Storage Arrangement
ES-W464-M05, sh 2, Rev 0	Mechanical Tube Plug Cover Assemblies
ES-W464-M05, sh 3, Rev 0	Mechanical Standard/Overpack Tube Shield Plug Assemblies
ES-W464-M05, sh 4, Rev 0	Mechanical Standard/Overpack Tube Assemblies
ES-W464-M05, sh 5, Rev 0	Mechanical Standard/Overpack Bellows Assemblies
ES-W464-M05, sh 6, Rev 0	Mechanical Standard/Overpack Tube Base Assemblies
ES-W464-M06, sh 1, Rev 0	Mechanical Impact Absorbers & Overpack Station Canister Guides
ES-W464-M07, sh 1, Rev 0	Mechanical Overpack Station Plan & Section
ES-W464-M08, sh 1, Rev 0	Mechanical Overpack Weld Station Gantry Crane Section

ES-W464-M08, sh 2, Rev 0	Mechanical Overpack Weld Station Gantry Crane Installation
ES-W464-M08, sh 3, Rev 0	Mechanical Overpack Weld Station Cap Welder Assembly
ES-W464-M09, sh 1, Rev 0	Mechanical 4.5M Canister and 4.5M Overpack
ES-W464-M10, sh 1, Rev 0	Mechanical Cesium Canister Overpack Assembly

APPENDIX A

WORK BREAKDOWN STRUCTURE

WORK BREAKDOWN STRUCTURE

1.0 ENGINEERING
    1.A Definitive Design (Architect/Engineer)
    1.B Not Used
    1.C Engineering and Inspection (Architect/Engineer)
    1.D Project Support and Coordination (Integrating Contractor)

2.0 PROCUREMENT
    2.1 Early Procurement (Architect/Engineer)
    2.2 Late Procurement (Architect/Engineer)

3.0 CONSTRUCTION
    3.1 Not Used
    3.2 Fixed-Price Construction (Two Contracts)

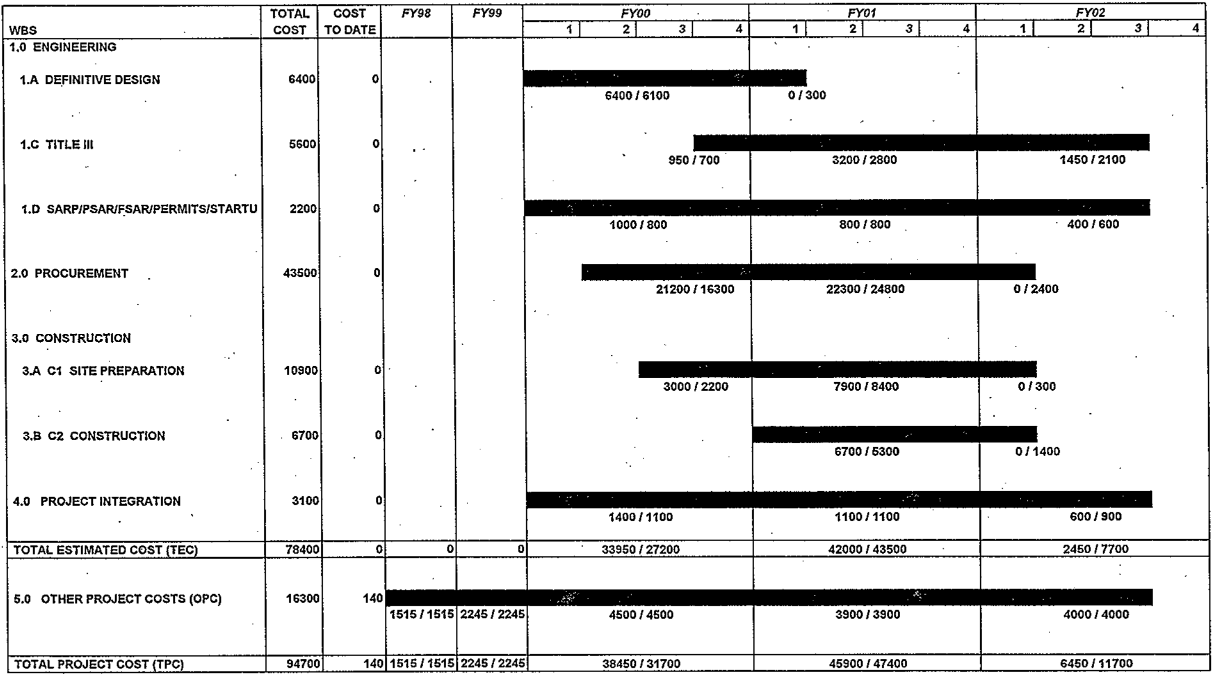
4.0 PROJECT INTEGRATION
    4.0 Project Coordination (Integrating Contractor)

5.0 OTHER PROJECT COSTS
    5.0 Other Project Costs (Integrating Contractor)

APPENDIX B

BUDGET AUTHORIZED/ BUDGET OUTLAY SCHEDULE

W-464 IMMOBILIZED HLW INTERIM STORAGE FACILITY PROJECT
TOTAL PROJECT COST (TPC)
BA/BO SCHEDULE
$(OOO)



WBS	TOTAL COST	COST TO DATE	*FY98*	*FY99*	*FY00*	*FY01*	*FY02*
1.0 ENGINEERING							
1.A DEFINITIVE DESIGN	6400	0			6400 / 6100	0 / 300	
1.C TITLE III	5600	0			950 / 700	3200 / 2800	1450 / 2100
1.D SARP/PSAR/FSAR/PERMITS/STARTU	2200	0			1000 / 800	800 / 800	400 / 600
2.0 PROCUREMENT	43500	0			21200 / 16300	22300 / 24800	0 / 2400
3.0 CONSTRUCTION							
3.A C1 SITE PREPARATION	10900	0			3000 / 2200	7900 / 8400	0 / 300
3.B C2 CONSTRUCTION	6700	0				6700 / 5300	0 / 1400
4.0 PROJECT INTEGRATION	3100	0			1400 / 1100	1100 / 1100	600 / 900
TOTAL ESTIMATED COST (TEC)	78400	0	0	0	33950 / 27200	42000 / 43500	2450 / 7700
5.0 OTHER PROJECT COSTS (OPC)	16300	140	1515 / 1515	2245 / 2245	4500 / 4500	3900 / 3900	4000 / 4000
TOTAL PROJECT COST (TPC)	94700	140	1515 / 1515	2245 / 2245	38450 / 31700	45900 / 47400	6450 / 11700

APPENDIX C

COST ESTIMATE SUMMARY

This appendix includes:

- Total Project Cost (TPC) Estimate
- Total Estimated Cost (TEC) Estimate
- Escalated Total Cost
- Contingency Estimate
- Decontamination and Decommissioning Estimate

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR01 - PROJECT COST SUMMARY

PAGE 1 OF 31
DATE 03/31/98 14:55:24
BY TLW/CDL/KLR/JJM

SORT	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
020	ENGINEERING - TITLE II	5,360,000	19	1,010,000	6,370,000
030	ENGINEERING - TITLE III	4,630,000	20	930,000	5,560,000
060	PROJECT MANAGEMENT	3,160,000	0	0	3,160,000
460	IMPROVEMENTS TO LAND	440,000	35	160,000	600,000
501	CONSTRUCTION - BUILDINGS	8,700,000	27	2,310,000	11,010,000
700	SPECIAL EQUIP/PROCESS SYSTEMS	41,470,000	19	8,040,000	49,510,000
	(ADJUSTED/ROUNDED)	40,000		(50,000)	(10,000)
TOTAL ESTIMATED CONSTRUCTION COST (TECC)		63,800,000	20	12,400,000	76,200,000
900	OTHER PROJECT COST	18,090,000	2	360,000	18,450,000
	(ADJUSTED/ROUNDED)	10,000		40,000	50,000
TOTAL OTHER PROJECT COST (OPC)		18,100,000	2	400,000	18,500,000
TOTAL PROJECT COST (TPC)		81,900,000	16	12,800,000	94,700,000

TYPE OF ESTIMATE	CONCEPTUAL REV. 1 MARCH 31, 1998	REMARKS: REV. 0 3/27/98
FDNW LEAD ESTIMATOR	ESTIMATING MANAGER H. Chadwick	
PROJECT MANAGER	J. Ruud	
CLIENT	K C Burgard	

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

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR02 - WORK BREAKDOWN STRUCTURE (WBS) SUMMARY

PAGE 2 OF 31
DATE 03/31/98 14:55:30
BY TLW/CDL/KLR/JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	SUB TOTAL	SITE ALLOCAT'N	TOTAL DOLLARS
1AA100	DRAWINGS	620888	5.63	34955	655843	20	131168	787012	242321	1029334
1AA200	SPECIFICATIONS	236215	5.63	13298	249513	25	62378	311892	96031	407924
1AA300	CHECKING & REVIEW	261196	5.63	14705	275901	20	55180	331081	101940	433021
1AA400	REPORTS & STUDIES	119250	5.63	6713	125963	20	25192	151156	46541	197697
1AA500	CALCS	510280	5.63	28728	539008	25	134752	673760	207451	881211
1AA600	SUPPORT	1557940	5.63	87712	1645652	15	246847	1892499	545576	2438076
1AA700	ESTIMATES	183554	5.63	10334	193888	20	38777	232665	71637	304303
1AA800	SUBMITTAL REVIEWS	234178	5.63	13184	247362	20	49472	296834	91395	388230
1AA900	QUALITY ASSURANCE	200780	5.63	11303	212083	15	31812	243896	45174	289070
SUBTOTAL 1A	DEFINITIVE DESIGN	3924281	5.63	220937	4145218	19	775582	4920800	1448069	6368870
1CC100	TITLE III - ENGINEERING	3252714	8.89	289166	3541880	20	708376	4250256	1308653	5558910
SUBTOTAL 1C	TITLE III - ENGINEERING	3252714	8.89	289166	3541880	20	708376	4250256	1308653	5558910
1D9EE3	MOBILIZE	168454	0.00	0	168454	20	33690	202144	0	202144
1D9EE4	DEFINITIVE DESIGN (TITLE I & II)	470960	0.00	0	470960	20	94192	565152	0	565152
1D9EE5	TITLE III	1181989	0.00	0	1181989	20	236397	1418386	0	1418386
SUBTOTAL 1D	PROJ SUPPORT (CAPITAL)	1821403	0.00	0	1821403	20	364280	2185683	0	2185683
SUBTOTAL 1	ENGINEERING	8998398	5.67	510103	9508501	19	1848239	11356740	2756723	14113464
210001	SHIELDED CANISTER TRANSPORTER (P1)	4860000	7.60	369360	5229360	15	784404	6013764	1323028	7336792
210005	STANDARD STORAGE TUBES (P3)	16054200	7.60	1220119	17274319	20	3454863	20729183	4560420	25289603
210007	CASK TRANSPORT SYSTEMS (P2)	4374000	7.60	332424	4706424	20	941284	5647708	1242495	6890204
SUBTOTAL 21	EARLY PROCUREMENT (PHMC)	25288200	7.60	1921903	27210103	19	5180552	32390655	7125944	39516600
220002	TRANSFER PIT CRANE (P4)	274320	8.11	22247	296567	15	44485	341052	75031	416083
220003	60 TON CRANE (P9)	1296000	8.11	105105	1401105	15	210165	1611271	354479	1965751
220004	PIT WELD STATION (P5)	686521	8.11	55676	742197	25	185549	927747	204104	1131851
220006	CANISTER OVERPACKS (P6)	232416	8.11	18848	251264	20	50252	301517	66333	367851
220010	CESIUM OVERPACKS (P7)	75384	8.11	6113	81497	20	16299	97797	21515	119312
SUBTOTAL 22	LATE PROCUREMENT (PHMC)	2564641	8.11	207992	2772633	18	506752	3279386	721464	4000851

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FLUOR DANIEL NORTHWEST, INC.                    ** IEST - INTERACTIVE ESTIMATING **                      PAGE  3  OF  31
NUMATEC HANFORD CORP.                        IMMOBILIZED HLW INTERIM STORAGE SYSTEM                     DATE  03/31/98 14:55:30
JOB NO. W464BAA1                                  VAULT 2 & 3   PHASE I  (REV 1)                        BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                        PHMCR02 - WORK BREAKDOWN STRUCTURE (WBS) SUMMARY

                                            ESTIMATE    ESCALATION        SUB     CONTINGENCY        SUB       SITE       TOTAL
 WBS   DESCRIPTION                          SUBTOTAL    %     TOTAL      TOTAL     %     TOTAL      TOTAL    ALLOCAT'N   DOLLARS
====== ================================    ========  ===== ========  =========  ===== ========  =========  =========  =========

  SUBTOTAL 2      PROCUREMENT (PHMC)        27852841   7.65  2129895   29982736    19   5687305   35670042    7847409   43517451

320101 VAULTS 2 & 3 INTAKE & EXHAUST         3766207   7.85   295647    4061854    20    812370    4874225     391139    5265365
320104 MODIFY ANNEX PIT (WELD STATION)         95026   7.85     7459     102485    25     25621     128107      31342     159449
320105 STORAGE TUBE & CANISTER OVERPACKS     2607688   7.85   204703    2812391    20    562478    3374870    1030685    4405555
320106 VAULT 2 & 3 AIR FOILS                  111189   7.85     8728     119917    30     35975     155892      26508     182401
320108 CONCRETE EXHAUST LOUVERS               560270   7.85    43981     604252    25    151063     755315     161839     917154

  SUBTOTAL 3201   F P CONSTRUCTION  - C1     7140381   7.85   560519    7700901    21   1587508    9288410    1641515   10929926

320209 10-TON GANTRY CRANE (ANNEX)             28852   8.89     2565      31417    35     10996      42413       9503      51917
320211 DEMOLITION (ANNEX)                     343482   8.89    30535     374017    35    130906     504923      24347     529271
320213 EQUIPMENT (ANNEX)                      658886   8.89    58575     717461    35    251111     968573      46705    1015279
320214 CONCRETE  (ANNEX)                      739151   8.89    65710     804861    35    281701    1086563      52395    1138958
320215 BUILDINGS (ANNEX)                     1112467   8.89    98898    1211366    35    423978    1635344      80378    1715722
320216 SITEWORK (ANNEX)                       263771   8.89    23449     287220    35    100527     387747      18697     406444
320217 HVAC  (ANNEX)                          557721   8.89    49581     607302    35    212555     819858      39534     859393
320218 ELECTRICAL (ANNEX)                     310938   8.89    27642     338581    35    118503     457084      82142     539226
320220 EQUIPMENT RENTAL (CRANES)              294975   8.89    26223     321198    20     64239     385437      18586     404024

  SUBTOTAL 3202   F P CONSTRUCTION  - C2     4310246   8.89   383180    4693427    34   1594519    6287946     372292    6660238

  SUBTOTAL 32     F P CONSTRUCTION          11450627   8.24   943700   12394328    26   3182028   15576357    2013807   17590165

  SUBTOTAL 3      CONSTRUCTION              11450627   8.24   943700   12394328    26   3182028   15576357    2013807   17590165

409HA1 PROJECT INTEGRATION                   3161944   0.00        0    3161944     0         0    3161944          0    3161944

  SUBTOTAL 40     PROJECT INTEGRATION        3161944   0.00        0    3161944     0         0    3161944          0    3161944

  SUBTOTAL 4      PROJECT INTEGRATION        3161944   0.00        0    3161944     0         0    3161944          0    3161944

502KA1 PROJECT MANAGEMENT/ADMIN              5860413   0.00        0    5860413     0         0    5860413          0    5860413
502KB1 DESIGN                                1969111   0.00        0    1969111     0         0    1969111          0    1969111
502KC1 PROCUREMENT                            391461   0.00        0     391461     0         0     391461          0     391461
502KD1 ENVIRONMENTAL                         1734994   0.00        0    1734994     0         0    1734994          0    1734994
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FLUOR DANIEL NORTHWEST, INC.                  ** IEST - INTERACTIVE ESTIMATING **                    PAGE  4  OF  31
NUMATEC HANFORD CORP.                       IMMOBILIZED HLW INTERIM STORAGE SYSTEM                   DATE  03/31/98 14:55:30
JOB NO. W464BAA1                               VAULT 2 & 3   PHASE I  (REV 1)                        BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                     PHMCR02 - WORK BREAKDOWN STRUCTURE (WBS) SUMMARY

                                         ESTIMATE    ESCALATION       SUB     CONTINGENCY        SUB       SITE      TOTAL
 WBS   DESCRIPTION                       SUBTOTAL    %    TOTAL      TOTAL    %     TOTAL       TOTAL    ALLOCAT'N  DOLLARS
====== ================================  ========  ===== ========  ========= =====  ========   =========  ========= =========

502KE1 SAFETY                             3227502   0.00        0    3227502    0         0    3227502          0   3227502
502KF1 QUALITY ASSURANCE                   126869   0.00        0     126869    0         0     126869          0    126869
502KG1 ORR & STARTUP                      2962819   0.00        0    2962819    0         0    2962819          0   2962819

  SUBTOTAL 50     OTHER PROJECT COST     16273169   0.00        0   16273169    0         0   16273169          0  16273169

  SUBTOTAL 5      OTHER PROJECT COST     16273169   0.00        0   16273169    0         0   16273169          0  16273169
                                        =================================================================================
PROJECT TOTAL                           67,736,979      3,583,699               15            82,038,253           94,656,193
                                                    5.29            71,320,679     10,717,573            12,617,940
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FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I
PHMCR03 - ESTIMATE BASIS SHEET

PAGE 5 OF 31
DATE 03/31/98
BY TLW/CDL

1. ESTIMATE PURPOSE

A. CONCEPTUAL COST ESTIMATE: THIS ESTIMATE WILL BE USED TO ESTABLISH THE PROJECT BUDGET(BASELINE).

2. ESTIMATE TECHNICAL BASIS

A. THIS ESTIMATE HAS BEEN PREPARED FOR THE IMMOBILIZED HLW INTERIM STORAGE SYSTEM VAULT 2 & 3 PHASE I PROJECT AS REQUESTED BY NUMATEC HANFORD CO.

B. A DESCRIPTION OF THE TECHNICAL SCOPE OF WORK MAY BE FOUND IN THE FOLLOWING REFERENCE DOCUMENTS:
1.) DRAFT CONCEPTUAL DESIGN REPORT FOR IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY (PHASE I).
DRAWINGS ES-W464-M01 (SHEETS 1 THROUGH 6), ES-W464-M02, ES-W464-M03, ES-W464-M04, ES-W464-M05,
(SHEETS 1 THROUGH 6) ES-W464-M06, ES-W464-M07, ES-W464-M08 (SHEETS 1 THROUGH 3), ES-W464-M09, ES-W464-M10
2.) REQUEST FOR ESTIMATE DATED 2/4/98.

C. THIS ESTIMATE UTILIZES AN ESTIMATE WORK BREAKDOWN STRUCTURE WHICH INTERFACES WITH THE PROJECT WORK BREAKDOWN STRUCTURE AS PROVIDED BY PROJECT MANAGEMENT/PROJECT CONTROLS.

3. ESTIMATE METHODOLOGY

A. DIRECT COSTS:
A BOTTOMS-UP TECHNIQUE HAS BEEN UTILIZED IN THE PREPARATION OF THIS ESTIMATE.
(1) CONSTRUCTION LABOR, MATERIAL AND EQUIPMENT UNITS HAVE BEEN ESTIMATED BASED UPON ONE OR MORE OF THE FOLLOWING STANDARD COMMERCIAL ESTIMATING RESOURCES, PUBLISHED ESTIMATING MANUALS/DATABASES: IN HOUSE DATABASES, CURRENT CONSTRUCTION ESTIMATES FOR LIKE ACTIVITIES, AND ACTUAL COSTS/LESSONS LEARNED FROM PREVIOUS CONSTRUCTION TASKS. THE UNIT RATES MAY HAVE BEEN FACTORED/ADJUSTED BY THE ESTIMATOR AS APPROPRIATE TO REFLECT INFLUENCES BY CONTRACT, WORK SITE, OR OTHER IDENTIFIED PROJECT OR SPECIAL CONDITIONS.
(2) FLUOR DANIEL HANFORD DIRECT COSTS HAVE BEEN PROVIDED BY FDNW PROJECT MANAGEMENT FOR INCLUSION INTO THIS ESTIMATE.
(3) PROJECT INTEGRATION AND OTHER PROJECT COSTS HAVE BEEN PROVIDED BY NHC PROJECT MANAGEMENT.

B. DIRECT COST FACTORS
(1) SALES TAX HAS BEEN APPLIED TO ALL MATERIALS AND EQUIPMENT PURCHASES AT 8%.
(2) CONTRACT ADMINISTRATION FACTOR OF 18.75% HAS BEEN APPLIED TO THE DIRECT CONTRACT VALUE WHICH INCLUDES COST FOR BID PACKAGE PREPARATION, CONTRACT MANAGEMENT & ADMINISTRATION AND PROJECT MANAGEMENT & PLANNING SUPPORT.

C. INDIRECT COSTS
FIXED PRICE CONTRACTOR OVERHEAD, PROFIT, BOND AND INSURANCE COSTS HAVE BEEN APPLIED ARE THE FOLLOWING PERCENTAGES: LABOR =30%, EQUIPMENT USE =10%, MATERIAL = 30% AND SUBCONTRACT = 15%, AND ARE REFLECTED IN THE "OH&P/B&I" COLUMN OF THE ESTIMATE DETAIL REPORT.

D. RATES
(1) FOR ESTIMATING PURPOSES, AVERAGE FDNW RATES BY OPERATIONS CODE HAVE BEEN DEVELOPED BASED UPON RECENT COST HISTORY AND ADJUSTED TO REFLECT INDUSTRY AVERAGE AE/CM RATES.
(2) FLUOR DANIEL NORTHWEST SERVICES (CONSTRUCTION CRAFT) LABOR RATES ARE THOSE LISTED IN APPENDIX A OF THE HANFORD SITE STABILIZATION AGREEMENT (HSSA). THE HSSA RATES INCLUDE BASE WAGE, FRINGE BENEFITS AND OTHER COMPENSATION AS NEGOTIATED BETWEEN FLUOR DANIEL HANFORD INC. AND THE NATIONAL BUILDING AND CONSTRUCTION TRADES DEPARTMENT, AFL-CIO. FLUOR DANIEL NORTHWEST INCORPORATES FACTORS TO COVER ADDITIONAL COSTS FOR WORKMANS COMPENSATION, FICA AND STATE AND FEDERAL UNEMPLOYMENT INSURANCE TO DEVELOPE A FULLY BURDENED RATE BY CRAFT.

(3) FDH & PHMC SUBCONTRACTOR STANDARD LABOR RATES ARE THOSE LISTED IN THE FINANCIAL DATA SYSTEM (FDS) FDST 321R REPORT ORGANIZATION RATES PLUS ADDERS.

E. SITE ALLOCATIONS FACTORS

SITE ALLOCATION FACTORS ARE DEVELOPED AND PROVIDED BY FLUOR DANIEL HANFORD (FDH) FOR ESTIMATING USE.

(1) GOVERNMENT FURNISHED SERVICES RATE IS APPLIED TO ALL COSTS TO LIQUIDATE GOVERNMENT FURNISHED SERVICES PROVIDED TO THE ENTERPRISE COMPANIES: 7% FOR FDNW AND FOR FDNWS (CONSTRUCTION).

(2) HANFORD SITE ESS AND G&A RATE OF 22% IS APPLIED TO ALL COSTS TO LIQUIDATE THE HANFORD GENERAL & ADMINISTRATIVE COSTS AND ESSENTIAL SITE SERVICES (I.E. FIRE, WATER, ELECTRICAL, ETC.).

FDNW APPLIES THE ABOVE FACTORS TO ESTIMATED COSTS AS FOLLOWS:

(1) FDH GFS/G&A/ESS CM FACTOR: A COMPOSITE FACTOR OF 30.54% HAS BEEN APPLIED TO TOTAL FDNW FIXED PRICE CONSTRUCTION MANAGEMENT WHICH INCLUDES GOVERNMENT FURNISHED SERVICES (GFS), SITE G&A, AND ESSENTIAL SITE SERVICES.

(2) FDH GFS/G&A/LABOR FACTOR: A COMPOSITE FACTOR HAS BEEN APPLIED TO TOTAL FDNW LABOR COSTS AS FOLLOWS:
AE/CM COSTS = 30.54%, FDNWS CONSTRUCTION LABOR = 30.54%, FDNWS CONSTRUCTION MANAGEMENT LABOR = 30.54%, FDNW CONTRACT MANAGEMENT AND ADMINISTRATION = 30.54%

(3) FDH MPR/G&A MATERIAL FACTOR: A COMPOSITE FACTOR OF 30.54% HAS BEEN APPLIED TO TOTAL FDNW MATERIAL COST .

4. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED FROM THE JANUARY 1997 UPDATE OF THE ECONOMIC ESCALATION PRICE CHANGE INDICES FOR DOE CONSTRUCTION PROJECTS AS PUBLISHED BY THE "OFFICE OF INFRASTRUCTURE ACQUISITION" FM-50. ESCALATION RATES FOR WBS 1D, 40, AND 50 WERE BASED ON THE PROJECT HANFORD MANAGEMENT CONTRACT FY 1998 COMPANY PLANNING RATES AS UTILIZED IN THE FY 1998 MULTI-YEAR WORK PLAN. THEY ARE: FY1999 1.027, FY 2000 1.055, FY 2001 1.083, FY 2002 1.112. THESE RATES ARE INCLUSIVE WITH THE COSTS PROVIDED BY OTHERS. FOR ESCALATION SHOWN IN THIS ESTIMATE SEE ESCALATION ANALYSIS SCHEDULE.

5. CONTINGENCY

A. DEFINITION OF CONTINGENCY AS PROVIDED BY DOE

"CONTINGENCY COVERS COSTS THAT MAY RESULT FROM INCOMPLETE DESIGN, UNFORESEEN AND UNPREDICTABLE CONDITIONS, OR UNCERTAINTIES WITHIN THE DEFINED PROJECT SCOPE. THE AMOUNT OF CONTINGENCY WILL DEPEND ON THE STATUS OF DESIGN, PROCUREMENT, AND CONSTRUCTION; AND THE COMPLEXITY AND UNCERTAINTIES OF THE COMPONENT PARTS OF THE PROJECT. CONTINGENCY IS NOT TO BE USED TO AVOID MAKING AN ACCURATE ASSESSMENT OF EXPECTED COST" (OFFICE OF WASTE MANAGEMENT (EM-30) COST AND SCHEDULE GUIDE.

B. CONTINGENCY ALLOWANCE GUIDELINES

THE DOE GUIDELINE CONTINGENCY ALLOWANCE FOR A...
CONCEPTUAL (BASED UPON DRD/CDR)
STANDARD 15-25%, EXPERIMENTAL/SPECIAL CONDITIONS UP TO 40%.

C. METHODOLOGY

CONTINGENCY IS EVALUATED AT THE LOWEST WORK BREAKDOWN STRUCTURE (WBS) LEVEL WITHIN THE COST ESTIMATE DETAILS. IT IS SUMMARIZED AT UPPER WBS LEVELS AND REPORTED ON THE SUMMARY REPORTS.

D. ANALYSIS

AN ASSESSMENT OF DESIGN MATURITY, WORK COMPLEXITY AND PROJECT UNCERTAINTIES HAS BEEN PERFORMED. AN EXPLANATION OF THIS ASSESSMENT AND CONTINGENCY RATES WHICH HAVE BEEN ADDED TO THE COST OF WORK ARE AS FOLLOWS:

ENGINEERING

WBS 1A AND 1C DEFINITIVE DESIGN/TITLE III

A CONTINGENCY OF 20% IS APPLIED DUE TO UNKNOWNS AND UNCERTAINTIES THAT ARE GENERALLY ENCOUNTERED WHEN DOING REMODEL AND RENOVATION WORK.

WBS 1D PROJECT SUPPORT (CAPITAL)

CONTINGENCY IS INCLUDED IN THE COSTS PROVIED TO ESTIMATING BY THE CLIENT.

AVERAGE ENGINEERING CONTINGENCY IS 20%

PROCUREMENT

WBS 21

AN AVERAGE CONTINGENCY OF 19% IS APPLIED FOR THE FOLLOWING REASONS: 1.) THE SHIELDED CANISTER TRANSPORTER IS BASED UPON A SIMILAR UNIT SUPPLIED TO THE SAVANNAH RIVER SITE. DISCUSSION WITH THE SUPPLIER INDICATES THE TRANSPORTER COULD BE BUILT FOR APPROXIMATELY THE SAME PRICE AND CONTINGENCY WOULD COVER POSSIBLE CHANGES TO SUPPORT A 4.5 METER CANISTER. 2.) THE STORAGE TUBES ARE BASED UPON PRELIMINARY QUOTES FOR FABRICATION TO THE INTENT OF ASME SECTION III AND IMPACTS WILL NOT BE KNOWN UNTIL THE SPECIFICATION IS FINALIZED. 3.) THE CASK VENDOR QUOTE IS BASED UPON PRELIMINARY DESIGN INFORMATION (SKETCHES) AND THICKNESS OF CASK WALLS HAS NOT BEEN DETERMINED AND COULD POTENTIALLY IMPACT COST.

WBS 22

AN AVERAGE CONTINGENCY OF 22% IS APPLIED FOR THE FOLLOWING REASONS: 1.) THE CRANE VENDOR PROVIDED PRELIMINARY QUOTES FROM VERBAL DESCRIPTIONS, WITHOUT SKETCHES, AND BECAUSE THE EXISTING CSB 60 TON CRANE COST IS INCREASING. 2.) THE WELD STATION PIT EQUIPMENT COSTS ARE BASED UPON A CSB STUDY ESTIMATE AND EXISTING PURCHASE REQUISITIONS. 3.) CANISTER OVERPACK QUOTES ARE BASED UPON PRELIMINARY VENDOR QUOTES FOR FABRICATION TO THE INTENT OF ASME SECTION III AND IMPACTS WILL NOT BE KNOWN UNTIL THE SPECIFICATION IS FINALIZED. 4.) THE CESIUM CANISTERS, DIMENSIONS, AND WASTE SOURCE TERMS HAVE NOT BEEN FINALIZED. THEREFORE THE SHIELDING, COOLING, HANDLING, OVERPACK, AND TRANSPORTATION REQUIREMENTS CAN NOT BE VALIDATED.

AVERAGE PROCUREMENT CONTINGENCY IS 19%

CONSTRUCTION

WBS 3201 C1 CONSTRUCTION

AN AVERAGE CONTINGENCY OF 21% IS APPLIED FOR THE FOLLOWING REASONS: 1.) INTAKE STACK STEEL AND EXHAUST STACK DETAILED DRAWINGS WERE NOT AVAILABLE AT THE TIME OF ESTIMATE PREPARATION. 2.) THE 60 TON CRANE INSTALLATION IS BASED UPON A LAST MINUTE SCOPE CHANGE. 3.) STORAGE TUBE AND CANISTER OVERPACKS EQUIPMENT IS

IS SIMILAR TO THE CSB PROJECT WHICH IS CURRENTLY ON HOLD UNTIL THEY FINISH A DROP TEST. 4.) THE OVERPACK PIT GUIDE INSTALLATION IS PERFORMED IN A CONFINED SPACE. 5.) THE NATURAL CONVECTION COOLING DESIGN IS BASED ON A SINGLE EXHAUST STACK AND WIND TUNNEL TESTING WAS PERFORMED FOR A SINGLE STACK. UNTIL TESTING CAN BE COMPLETED FOR A THREE STACK DESIGN, THE POSSIBLE FLOW INTERFERENCES BETWEEN STACKS IS AN UNCERTAINTY.

WBS 3202 C2 CONSTRUCTION
AN AVERAGE CONTINGENCY OF 34% IS APPLIED FOR THE FOLLOWING REASONS: 1.) THE TRANSFER PIT GUIDE INSTALLATION IS PERFORMED IN A CONFINED SPACE. 2.) THE ANNEX ADDITION TAKEOFF AND MATERIAL PRICING WAS PERFORMED IN A RESTRAINED TIME PERIOD. 3.) UTILITY RELOCATION INSIDE THE CSB, FOR THE ANNEX ADDITION, IS UNCLEAR AND IS NOT DEFINED ON DRAWINGS. 4.) THE TORNADO DOORS DEPICTED ON THE DRAWINGS DO NOT HAVE DEFINITIVE DETAILS OTHER THAN SIZE.

AVERAGE CONSTRUCTION CONTINGENCY IS 26%

WBS 50 PROJECT SUPPORT
CONTINGENCY IS INCLUDED IN THE COSTS PROVIED TO ESTIMATING BY THE CLIENT.

AVERAGE PROJECT CONTINGENCY IS 15%

6. ROUNDING

THE PROJECT COST SUMMARY REPORT IS SUMMARIZED AND ADJUSTED/ROUNDED AS FOLLOWS:
THE ESCALATED TOTAL COST COLUMN, CONTINGENCY TOTAL COLUMN AND TOTAL DOLLARS COLUMN SUB-TOTALS ARE SUMMARIZED BY FUNCTION. THE COLUMN SUBTOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST $10,000. THE PROJECT TOTAL SUMMARY LINE TOTALS ARE ADJUSTED/ROUNDED TO THE NEAREST $100,000.

7. REMARKS

MAJOR ASSUMPTIONS WHICH HAVE BEEN MADE IN THE PREPARATION OF THIS ESTIMATE ARE AS FOLLOWS:
ACRONYM: CANISTER STORAGE BUILDING (CSB).

A. ASSUME THAT THE WELDING STATION PIT WORK IS RADIOLOGICALLY CLEAN.
B. INSULATING CONCRETE WILL BE INSTALLED BY THE CSB PROJECT AND IS NOT IN THE SCOPE OF THIS COST ESTIMATE.
C. INSTALLATION OF TUBES IS BASED UPON NON RAD/CLEAN WORK AND WITHOUT DISRUPTION FROM PLANT OPERATIONS. ALLOWANCES FOR WORKER SECURITY CLEARANCES IS NOT INCLUDED.
D. COST ALLOWANCES FOR THE WELD STATION WERE EXTRACTED FROM THE CSB WELD STATION COST ESTIMATE, DATED 23 JAN, 1998. ALLOWANCES FOR AN ULTRA SONIC TESTER IS INCLUDED, BUT ALLOWANCES FOR SPECIAL DIE CHECK EQUIPMENT IS NOT.
E. CONSTRUCTION LABOR DOES NOT INCLUDE OVERTIME BUT DOES INCLUDE SHIFT DIFFERENTIAL FOR TUBE INSTALLATION DURING SWING SHIFT.
F. THIS COST ESTIMATE ASSUMES THAT FDNW WILL PROVIDE EQUIPMENT (IDENTIFIED IN PROCUREMENT WBS 2.0) TO THE FP CONTRACTOR.
G. THE FOLLOWING VENDORS PROVIDED "BUDGET" QUOTES:
   1. OREGON IRON WORKS - TUBE ASSEMBLIES
   2. TRANSNUCLEAR (WRITTEN) - CASKS AND TRAILERS
   3. FOSTER WHEELER (WRITTEN & VERBAL) - ABSORBERS
   4. EDERER - 60 TON CRANE
   5. DIMETRICS INC. (USED PAST PURCHASE REQ.) - WELDING EQUIPMENT
H. TEN ABSORBERS ARE INCLUDED IN THE COST ESTIMATE. THE BALANCE OF ABSORBERS ARE CONSIDERED AN OPERATIONAL EXPENSE.
I. CONTINGENCY FOR OPC'S IS INCLUDED IN THE COSTS PROVIDED TO ESTIMATING, EXCEPT FOR WBS 1D AS DIRECTED BY THE CLIENT.
J. ALLOWANCES FOR SECURITY GUARDS, DURING CONSTRUCTION, ARE NOT INCLUDED.
K. COSTS FOR TITLE III ARE ESTIMATED BASED UPON EXPERIENCE AND LESSONS LEARNED FROM THE CSB. A STAFFING ASSUMPTION HAS BEEN IDENTIFIED AND STAFFING HOURS ARE BASED UPON LEVEL LOADING TO THE SCHEDULE.

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FLUOR DANIEL NORTHWEST, INC.                ** IEST - INTERACTIVE ESTIMATING **           PAGE  9  OF  31
NUMATEC HANFORD CORP.                      IMMOBILIZED HLW INTERIM STORAGE SYSTEM         DATE  03/31/98 14:55:54
JOB NO. W464BAA1                             VAULT 2 & 3   PHASE I  (REV 1)               BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                             PHMCR04 - COMPANY/WBS SUMMARY

SORT                                        ESTIMATE   ESCALATION      SUB      CONTINGENCY       SUB       SITE      TOTAL
CODE/WBS            DESCRIPTION             SUBTOTAL   %     TOTAL     TOTAL    %      TOTAL      TOTAL    ALLOCAT'N  DOLLARS
=====================================       ========  ===== ========  ========= =====  ========  ========= ========= ========

FDNW     FLUOR DANIEL NORTHWEST

     1AA100 DRAWINGS                          620888  5.63    34955    655843   20    131168     787012    242321   1029334
     1AA200 SPECIFICATIONS                    236215  5.63    13298    249513   25     62378     311892     96031    407924
     1AA300 CHECKING & REVIEW                 261196  5.63    14705    275901   20     55180     331081    101940    433021
     1AA400 REPORTS & STUDIES                 119250  5.63     6713    125963   20     25192     151156     46541    197697
     1AA500 CALCS                             510280  5.63    28728    539008   25    134752     673760    207451    881211
     1AA600 SUPPORT                          1557940  5.63    87712   1645652   15    246847    1892499    545576   2438076
     1AA700 ESTIMATES                         183554  5.63    10334    193888   20     38777     232665     71637    304303
     1AA800 SUBMITTAL REVIEWS                 234178  5.63    13184    247362   20     49472     296834     91395    388230
     1AA900 QUALITY ASSURANCE                 200780  5.63    11303    212083   15     31812     243896     45174    289070

         SUBTOTAL 1A   DEFINITIVE DESIGN     3924281  5.63   220937   4145218   19    775582    4920800   1448069   6368870


     1CC100 TITLE III - ENGINEERING          3252714  8.89   289166   3541880   20    708376    4250256   1308653   5558910

         SUBTOTAL 1C   TITLE III - ENGINEERING 3252714 8.89  289166   3541880   20    708376    4250256   1308653   5558910


     1D9EE3 MOBILIZE                           97735  0.00        0     97735   20     19547     117282         0    117282
     1D9EE4 DEFINITIVE DESIGN (TITLE I & II)  470960  0.00        0    470960   20     94192     565152         0    565152
     1D9EE5 TITLE III                        1181989  0.00        0   1181989   20    236397    1418386         0   1418386

         SUBTOTAL 1D   PROJ SUPPORT (CAPITAL) 1750684 0.00        0   1750684   20    350136    2100820         0   2100820

         SUBTOTAL 1    ENGINEERING           8927679  5.71   510103   9437782   19   1834095   11271878   2756723  14028601


     320101 VAULTS 2 & 3 INTAKE & EXHAUST    3766207  7.85   295647   4061854   20    812370    4874225    391139   5265365
     320104 MODIFY ANNEX PIT (WELD STATION)    95026  7.85     7459    102485   25     25621     128107     31342    159449
     320105 STORAGE TUBE & CANISTER OVERPACK 2607688  7.85   204703   2812391   20    562478    3374870   1030685   4405555
     320106 VAULT 2 & 3 AIR FOILS             111189  7.85     8728    119917   30     35975     155892     26508    182401
     320108 CONCRETE EXHAUST LOUVERS          560270  7.85    43981    604252   25    151063     755315    161839    917154

         SUBTOTAL 3201 F P CONSTRUCTION  - C1 7140381 7.85   560519   7700901   21   1587508    9288410   1641515  10929926


     320209 10-TON GANTRY CRANE (ANNEX)        28852  8.89     2565     31417   35     10996      42413      9503     51917
     320211 DEMOLITION (ANNEX)                343482  8.89    30535    374017   35    130906     504923     24347    529271
     320213 EQUIPMENT (ANNEX)                 658886  8.89    58575    717461   35    251111     968573     46705   1015279
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FLUOR DANIEL NORTHWEST, INC.                 ** IEST - INTERACTIVE ESTIMATING **                 PAGE  10  OF  31
NUMATEC HANFORD CORP.                       IMMOBILIZED HLW INTERIM STORAGE SYSTEM               DATE  03/31/98 14:55:54
JOB NO. W464BAA1                              VAULT 2 & 3   PHASE I  (REV 1)                     BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                              PHMCR04 - COMPANY/WBS SUMMARY

SORT                                          ESTIMATE   ESCALATION        SUB      CONTINGENCY         SUB       SITE      TOTAL
CODE/WBS            DESCRIPTION               SUBTOTAL    %     TOTAL      TOTAL     %     TOTAL      TOTAL    ALLOCAT'N   DOLLARS
======================================        ========  ===== ========  =========  =====  ========  =========  =========  =========

    320214 CONCRETE  (ANNEX)                    739151  8.89    65710     804861    35    281701    1086563      52395    1138958
    320215 BUILDINGS (ANNEX)                   1112467  8.89    98898    1211366    35    423978    1635344      80378    1715722
    320216 SITEWORK (ANNEX)                     263771  8.89    23449     287220    35    100527     387747      18697     406444
    320217 HVAC  (ANNEX)                        557721  8.89    49581     607302    35    212555     819858      39534     859393
    320218 ELECTRICAL (ANNEX)                   310938  8.89    27642     338581    35    118503     457084      82142     539226
    320220 EQUIPMENT RENTAL (CRANES)            294975  8.89    26223     321198    20     64239     385437      18586     404024

       SUBTOTAL 3202 F P CONSTRUCTION  - C2    4310246  8.89   383180    4693427    34   1594519    6287946     372292    6660238

       SUBTOTAL 32   F P CONSTRUCTION         11450627  8.24   943700   12394328    26   3182028   15576357    2013807   17590165

       SUBTOTAL 3    CONSTRUCTION             11450627  8.24   943700   12394328    26   3182028   15576357    2013807   17590165


       TOTAL FDNW FLUOR DANIEL NORTHWEST      20378306  7.13  1453804   21832111    23   5016124   26848235    4770530   31618766


LMHC   LOCKHEED MARTIN HANFORD CORP.

    1D9EE3 MOBILIZE                              17871  0.00        0      17871    20      3574      21445          0      21445

       SUBTOTAL 1D   PROJ SUPPORT (CAPITAL)      17871  0.00        0      17871    20      3574      21445          0      21445

       SUBTOTAL 1    ENGINEERING                 17871  0.00        0      17871    20      3574      21445          0      21445


    210001 SHIELDED CANISTER TRANSPORTER (P1)  4860000  7.60   369360    5229360    15    784404    6013764    1323028    7336792
    210005 STANDARD STORAGE TUBES        (P3) 16054200  7.60  1220119   17274319    20   3454863   20729183    4560420   25289603
    210007 CASK TRANSPORT SYSTEMS        (P2)  4374000  7.60   332424    4706424    20    941284    5647708    1242495    6890204

       SUBTOTAL 21   EARLY PROCUREMENT (PHMC  25288200  7.60  1921903   27210103    19   5180552   32390655    7125944   39516600


    220002 TRANSFER PIT CRANE            (P4)   274320  8.11    22247     296567    15     44485     341052      75031     416083
    220003 60 TON CRANE                  (P9)  1296000  8.11   105105    1401105    15    210165    1611271     354479    1965751
    220004 PIT WELD STATION              (P5)   686521  8.11    55676     742197    25    185549     927747     204104    1131851
    220006 CANISTER OVERPACKS            (P6)   232416  8.11    18848     251264    20     50252     301517      66333     367851
    220010 CESIUM OVERPACKS              (P7)    75384  8.11     6113      81497    20     16299      97797      21515     119312

       SUBTOTAL 22   LATE PROCUREMENT (PHMC)   2564641  8.11   207992    2772633    18    506752    3279386     721464    4000851

       SUBTOTAL 2    PROCUREMENT (PHMC)       27852841  7.65  2129895   29982736    19   5687305   35670042    7847409   43517451
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FLUOR DANIEL NORTHWEST, INC.                  ** IEST - INTERACTIVE ESTIMATING **                PAGE  11  OF  31
NUMATEC HANFORD CORP.                       IMMOBILIZED HLW INTERIM STORAGE SYSTEM               DATE  03/31/98 14:55:55
JOB NO. W464BAA1                               VAULT 2 & 3   PHASE I  (REV 1)                    BY    TLW/CDL/KLR/JJH
FILE NO. W464BAA1                               PHMCR04 - COMPANY/WBS SUMMARY

SORT                                          ESTIMATE   ESCALATION        SUB      CONTINGENCY        SUB       SITE      TOTAL
CODE/WBS          DESCRIPTION                 SUBTOTAL    %    TOTAL      TOTAL      %     TOTAL      TOTAL    ALLOCAT'N  DOLLARS
====================================          ========  ===== ========  =========  =====  ========  =========  =========  ========


      TOTAL LMHC LOCKHEED MARTIN HANFORD COR  27870712   7.64  2129895   30000607     19   5690879   35691487    7847409  43538896


LMSI  LOCKHEED MARTIN SERVICES, INC.

    1D9EE3 MOBILIZE                              28288   0.00        0      28288     20      5657      33945          0     33945
      TOTAL LMSI LOCKHEED MARTIN SERVICES, I     28288   0.00        0      28288     20      5657      33945          0     33945


NHC   NUMATEC HANFORD CORPORATION

    1D9EE3 MOBILIZE                              24560   0.00        0      24560     20      4912      29472          0     29472

      SUBTOTAL 1D   PROJ SUPPORT (CAPITAL)       52848   0.00        0      52848     20     10569      63417          0     63417

      SUBTOTAL 1    ENGINEERING                  52848   0.00        0      52848     20     10569      63417          0     63417


    409HA1 PROJECT INTEGRATION                 3161944   0.00        0    3161944      0         0    3161944          0   3161944

      SUBTOTAL 40   PROJECT INTEGRATION        3161944   0.00        0    3161944      0         0    3161944          0   3161944

      SUBTOTAL 4    PROJECT INTEGRATION        3161944   0.00        0    3161944      0         0    3161944          0   3161944


    502KA1 PROJECT MANAGEMENT/ADMIN            5860413   0.00        0    5860413      0         0    5860413          0   5860413
    502KB1 DESIGN                              1969111   0.00        0    1969111      0         0    1969111          0   1969111
    502KC1 PROCUREMENT                          391461   0.00        0     391461      0         0     391461          0    391461
    502KD1 ENVIRONMENTAL                       1734994   0.00        0    1734994      0         0    1734994          0   1734994
    502KE1 SAFETY                              3227502   0.00        0    3227502      0         0    3227502          0   3227502
    502KF1 QUALITY ASSURANCE                    126869   0.00        0     126869      0         0     126869          0    126869
    502KG1 ORR & STARTUP                       2962819   0.00        0    2962819      0         0    2962819          0   2962819

      SUBTOTAL 50   OTHER PROJECT COST        16273169   0.00        0   16273169      0         0   16273169          0  16273169

      SUBTOTAL 5    OTHER PROJECT COST        16273169   0.00        0   16273169      0         0   16273169          0  16273169


      TOTAL NHC NUMATEC HANFORD CORPORATION   19459673   0.00        0   19459673      0      4912   19464585          0  19464585
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FLUOR DANIEL NORTHWEST, INC.                    ** IEST - INTERACTIVE ESTIMATING **                  PAGE  12  OF  31
NUMATEC HANFORD CORP.                          INMOBILIZED HLW INTERIM STORAGE SYSTEM                DATE  03/31/98 14:55:55
JOB NO. W464BAA1                                  VAULT 2 & 3   PHASE I  (REV 1)                     BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                                  PHMCR04 - COMPANY/WBS SUMMARY

SORT                                            ESTIMATE    ESCALATION      SUB      CONTINGENCY      SUB      SITE      TOTAL
CODE/WBS           DESCRIPTION                  SUBTOTAL    %    TOTAL     TOTAL     %     TOTAL     TOTAL   ALLOCAT'N  DOLLARS
========================================        ========  ===== ========  =========  ===== ========  ========= ========= =========
                                               ==================================================================================
PROJECT TOTAL                                 67,736,979       3,583,699             15          82,038,253           94,656,193
                                                          5.29           71,320,679       10,717,573           12,617,940
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FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR05 - CONSTRUCTION MANAGEMENT/OTHER COST SUMMARY

PAGE 13 OF 31
DATE 03/31/98 14:56:01
BY TLW/CDL/KLR/JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONSTRUCTION MANAGEMENT %	CONSTRUCTION MANAGEMENT TOTAL	OTHER COSTS	SUB TOTAL	TOTAL
1AA100	DRAWINGS	620888	0.00	0	0	0	620888
1AA200	SPECIFICATIONS	236215	0.00	0	0	0	236215
1AA300	CHECKING & REVIEW	261196	0.00	0	0	0	261196
1AA400	REPORTS & STUDIES	119250	0.00	0	0	0	119250
1AA500	CALCS	510280	0.00	0	0	0	510280
1AA600	SUPPORT	1557940	0.00	0	0	0	1557940
1AA700	ESTIMATES	183554	0.00	0	0	0	183554
1AA800	SUBMITTAL REVIEWS	234178	0.00	0	0	0	234178
1AA900	QUALITY ASSURANCE	200780	0.00	0	0	0	200780
SUBTOTAL 1A	DEFINITIVE DESIGN	3924281		0	0	0	3924281
1CC100	TITLE III - ENGINEERING	3252714	0.00	0	0	0	3252714
SUBTOTAL 1C	TITLE III - ENGINEERING	3252714		0	0	0	3252714
1D9EE3	MOBILIZE	168454	0.00	0	0	0	168454
1D9EE4	DEFINITIVE DESIGN (TITLE I & II)	470960	0.00	0	0	0	470960
1D9EE5	TITLE III	1181989	0.00	0	0	0	1181989
SUBTOTAL 1D	PROJ SUPPORT (CAPITAL)	1821403		0	0	0	1821403
SUBTOTAL 1	ENGINEERING	8998398		0	0	0	8998398
210001	SHIELDED CANISTER TRANSPORTER (P1)	4860000	0.00	0	0	0	4860000
210005	STANDARD STORAGE TUBES (P3)	16054200	0.00	0	0	0	16054200
210007	CASK TRANSPORT SYSTEMS (P2)	4374000	0.00	0	0	0	4374000
SUBTOTAL 21	EARLY PROCUREMENT (PHMC)	25288200		0	0	0	25288200
220002	TRANSFER PIT CRANE (P4)	274320	0.00	0	0	0	274320
220003	60 TON CRANE (P9)	1296000	0.00	0	0	0	1296000
220004	PIT WELD STATION (P5)	686521	0.00	0	0	0	686521
220006	CANISTER OVERPACKS (P6)	232416	0.00	0	0	0	232416
220010	CESIUM OVERPACKS (P7)	75384	0.00	0	0	0	75384
SUBTOTAL 22	LATE PROCUREMENT (PHMC)	2564641		0	0	0	2564641

FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW.INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR05 - CONSTRUCTION MANAGEMENT/OTHER COST SUMMARY

PAGE 14 OF 31
DATE 03/31/98 14:56:02
BY TLW/CDL/KLR/JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONSTRUCTION MANAGEMENT %	CONSTRUCTION MANAGEMENT TOTAL	OTHER COSTS	SUB TOTAL	TOTAL
SUBTOTAL 2	PROCUREMENT (PHMC)	27852841		0	0	0	27852841
320101	VAULTS 2 & 3 INTAKE & EXHAUST	3171543	18.75	594664	0	594664	3766207
320104	MODIFY ANNEX PIT (WELD STATION)	80022	18.75	15004	0	15004	95026
320105	STORAGE TUBE & CANISTER OVERPACKS	2195948	18.75	411740	0	411740	2607688
320106	VAULT 2 & 3 AIR FOILS	93633	18.75	17556	0	17556	111189
320108	CONCRETE EXHAUST LOUVERS	471807	18.75	88463	0	88463	560270
SUBTOTAL 3201	F P CONSTRUCTION - C1	6012953		1127428	0	1127428	7140381
320209	10-TON GANTRY CRANE (ANNEX)	24297	18.75	4555	0	4555	28852
320211	DEMOLITION (ANNEX)	289248	18.75	54234	0	54234	343482
320213	EQUIPMENT (ANNEX)	554852	18.75	104034	0	104034	658886
320214	CONCRETE (ANNEX)	622443	18.75	116708	0	116708	739151
320215	BUILDINGS (ANNEX)	936815	18.75	175652	0	175652	1112467
320216	SITEWORK (ANNEX)	222123	18.75	41648	0	41648	263771
320217	HVAC (ANNEX)	469660	18.75	88061	0	88061	557721
320218	ELECTRICAL (ANNEX)	261843	18.75	49095	0	49095	310938
320220	EQUIPMENT RENTAL (CRANES)	248400	18.75	46575	0	46575	294975
SUBTOTAL 3202	F P CONSTRUCTION - C2	3629681		680565	0	680565	4310246
SUBTOTAL 32	F P CONSTRUCTION	9642634		1807993	0	1807993	11450627
SUBTOTAL 3	CONSTRUCTION	9642634		1807993	0	1807993	11450627
409HA1	PROJECT INTEGRATION	3161944	0.00	0	0	0	3161944
SUBTOTAL 40	PROJECT INTEGRATION	3161944		0	0	0	3161944
SUBTOTAL 4	PROJECT INTEGRATION	3161944		0	0	0	3161944
502KA1	PROJECT MANAGEMENT/ADMIN	5860413	0.00	0	0	0	5860413
502KB1	DESIGN	1969111	0.00	0	0	0	1969111
502KC1	PROCUREMENT	391461	0.00	0	0	0	391461
502KD1	ENVIRONMENTAL	1734994	0.00	0	0	0	1734994

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FLUOR DANIEL NORTHWEST, INC.                  ** IEST - INTERACTIVE ESTIMATING **                  PAGE  15  OF  31
NUMATEC HANFORD CORP.                       IMMOBILIZED HLW INTERIM STORAGE SYSTEM                 DATE  03/31/98 14:56:02
JOB NO. W464BAA1                                VAULT 2 & 3   PHASE I  (REV 1)                     BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                         PHMCR05 - CONSTRUCTION MANAGEMENT/OTHER COST SUMMARY

                                                  ESTIMATE     CONSTRUCTION MANAGEMENT       OTHER          SUB
WBS    DESCRIPTION                                SUBTOTAL        %         TOTAL            COSTS         TOTAL          TOTAL
====== ====================================      ========      =====    =========        ========      =========      =========

502KE1 SAFETY                                      3227502      0.00            0               0              0        3227502
502KF1 QUALITY ASSURANCE                            126869      0.00            0               0              0         126869
502KG1 ORR & STARTUP                               2962819      0.00            0               0              0        2962819

 SUBTOTAL 50      OTHER PROJECT COST              16273169                      0               0              0       16273169

 SUBTOTAL 5       OTHER PROJECT COST              16273169                      0               0              0       16273169

                                           ==================================================================================
PROJECT TOTAL                                   65,928,986                                      0                    67,736,979
                                                                        1,807,993                      1,807,993
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FLUOR DANIEL NORTHWEST, INC.              ** IEST - INTERACTIVE ESTIMATING **               PAGE  16  OF  31
NUHATEC HANFORD CORP.                    IMMOBILIZED HLW INTERIM STORAGE SYSTEM             DATE  03/31/98 14:56:08
JOB NO. W464BAA1                           VAULT 2 & 3   PHASE I  (REV 1)                   BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                         PHMCR06 - SITE ALLOCATIONS BY WBS

                                                 ESTIMATE      DYN    FDH GFS/G&A   FDH MPR   FDH GFS/G&A FDH MPR/G&A  SITE ALLOC
WBS    DESCRIPTION                               SUBTOTAL   EQ.USAGE  CONST.MGMT  F.P./S.C.     LABOR      MATERIAL     SUBTOTAL
====== ====================================    =========  =========  =========  =========  =========  =========    =========

1AA100 DRAWINGS                                   620888       1552          0          0     189619          0       191171
1AA200 SPECIFICATIONS                             236215        590          0          0      72140          0        72730
1AA300 CHECKING & REVIEW                          261196        652          0          0      79769          0        80422
1AA400 REPORTS & STUDIES                          119250        298          0          0      36418          0        36717
1AA500 CALCS                                      510280       1275          0          0     155839          0       157115
1AA600 SUPPORT                                   1557940       3646          0          0     445482          0       449128
1AA700 ESTIMATES                                  183554        458          0          0      56057          0        56516
1AA800 SUBMITTAL REVIEWS                          234178        585          0          0      71517          0        72103
1AA900 QUALITY ASSURANCE                          200780        301          0          0      36886          0        37188

 SUBTOTAL 1A     DEFINITIVE DESIGN               3924281       9362          0          0    1143730          0      1153093

1CC100 TITLE III - ENGINEERING                   3252714       8131          0          0     993378          0      1001510

 SUBTOTAL 1C     TITLE III - ENGINEERING         3252714       8131          0          0     993378          0      1001510

1D9EE3 MOBILIZE                                   168454          0          0          0          0          0            0
109EE4 DEFINITIVE DESIGN (TITLE I & II)           470960          0          0          0          0          0            0
1D9EE5 TITLE III                                 1181989          0          0          0          0          0            0

 SUBTOTAL 1D     PROJ SUPPORT (CAPITAL)          1821403          0          0          0          0          0            0

 SUBTOTAL 1      ENGINEERING                     8998398      17494          0          0    2137109          0      2154603

210001 SHIELDED CANISTER TRANSPORTER  (P1)       4860000          0          0          0          0    1069200      1069200
210005 STANDARD STORAGE TUBES         (P3)      16054200          0          0          0          0    3531924      3531924
210007 CASK TRANSPORT SYSTEMS         (P2)       4374000          0          0          0          0     962280       962280

 SUBTOTAL 21     EARLY PROCUREMENT (PHMC)       25288200          0          0          0          0    5563404      5563404

220002 TRANSFER PIT CRANE             (P4)        274320          0          0          0          0      60350        60350
220003 60 TON CRANE                   (P9)       1296000          0          0          0          0     285120       285120
220004 PIT WELD STATION               (P5)        686521          0          0          0          0     151034       151034
220006 CANISTER OVERPACKS             (P6)        232416          0          0          0          0      51131        51131
220010 CESIUM OVERPACKS               (P7)         75384          0          0          0          0      16584        16584

 SUBTOTAL 22     LATE PROCUREMENT (PHMC)         2564641          0          0          0          0     564221       564221
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FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR06 - SITE ALLOCATIONS BY WBS

PAGE 17 OF 31
DATE 03/31/98 14:56:08
BY TLW/CDL/KLR/JJM

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	DYN EQ.USAGE	FDH GFS/G&A CONST.MGMT	FDH MPR F.P./S.C.	FDH GFS/G&A LABOR	FDH MPR/G&A MATERIAL	SITE ALLOC SUBTOTAL
SUBTOTAL 2	PROCUREMENT (PHMC)	27852841	0	0	0	0	6127625	6127625
320101	VAULTS 2 & 3 INTAKE & EXHAUST	3171543	0	181610	0	120614	0	302225
320104	MODIFY ANNEX PIT (WELD STATION)	80022	0	4582	0	18666	0	23249
320105	STORAGE TUBE & CANISTER OVERPACKS	2195948	0	125745	0	670642	0	796387
320106	VAULT 2 & 3 AIR FOILS	93633	0	5361	0	13545	0	18907
320108	CONCRETE EXHAUST LOUVERS	471807	0	27016	0	93030	0	120047
SUBTOTAL 3201	F P CONSTRUCTION - C1	6012953	0	344316	0	916500	0	1260816
320209	10-TON GANTRY CRANE (ANNEX)	24297	0	1391	0	5073	0	6465
320211	DEMOLITION (ANNEX)	289248	0	16563	0	0	0	16563
320213	EQUIPMENT (ANNEX)	554852	0	31772	0	0	0	31772
320214	CONCRETE (ANNEX)	622443	0	35642	0	0	0	35642
320215	BUILDINGS (ANNEX)	936815	0	53644	0	1034	0	54678
320216	SITEWORK (ANNEX)	222123	0	12719	0	0	0	12719
320217	HVAC (ANNEX)	469660	0	26893	0	0	0	26893
320218	ELECTRICAL (ANNEX)	261843	0	14993	0	40884	0	55878
320220	EQUIPMENT RENTAL (CRANES)	248400	0	14224	0	0	0	14224
SUBTOTAL 3202	F P CONSTRUCTION - C2	3629681	0	207844	0	46993	0	254837
SUBTOTAL 32	F P CONSTRUCTION	9642634	0	552161	0	963493	0	1515654
SUBTOTAL 3	CONSTRUCTION	9642634	0	552161	0	963493	0	1515654
409HA1	PROJECT INTEGRATION	3161944	0	0	0	0	0	0
SUBTOTAL 40	PROJECT INTEGRATION	3161944	0	0	0	0	0	0
SUBTOTAL 4	PROJECT INTEGRATION	3161944	0	0	0	0	0	0
502KA1	PROJECT MANAGEMENT/ADMIN	5860413	0	0	0	0	0	0
502KB1	DESIGN	1969111	0	0	0	0	0	0
502KC1	PROCUREMENT	391461	0	0	0	0	0	0
502KD1	ENVIRONMENTAL	1734994	0	0	0	0	0	0

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FLUOR DANIEL NORTHWEST, INC.           ** IEST - INTERACTIVE ESTIMATING **              PAGE  18  OF  31
NUMATEC HANFORD CORP.                IMMOBILIZED HLW INTERIM STORAGE SYSTEM             DATE  03/31/98 14:56:08
JOB NO. W464BAA1                        VAULT 2 & 3   PHASE I  (REV 1)                  BY    TLW/CDL/KLR/JJH
FILE NO. W464BAA1                      PHMCR06 - SITE ALLOCATIONS BY WBS

                                                ESTIMATE      DYN    FDH GFS/G&A   FDH MPR   FDH GFS/G&A FDH MPR/G&A  SITE ALLOC
WBS    DESCRIPTION                              SUBTOTAL   EQ.USAGE  CONST.MGMT  F.P./S.C.     LABOR      MATERIAL    SUBTOTAL
====== =====================================  ========== ========== ========== ========== ========== ========== ==========

502KE1 SAFETY                                    3227502          0          0          0          0          0          0
502KF1 QUALITY ASSURANCE                          126869          0          0          0          0          0          0
502KG1 ORR & STARTUP                             2962819          0          0          0          0          0          0

 SUBTOTAL 50      OTHER PROJECT COST            16273169          0          0          0          0          0          0

 SUBTOTAL 5       OTHER PROJECT COST            16273169          0          0          0          0          0          0

                                              ==========================================================================
PROJECT TOTAL                                 65,928,986              552,161               3,100,602             9,797,883
                                                             17,494                 0                 6,127,625
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FLUOR DANIEL NORTHWEST, INC.
NUMATEC HANFORD CORP.
JOB NO. W464BAA1
FILE NO. W464BAA1

** IEST - INTERACTIVE ESTIMATING **
IMMOBILIZED HLW INTERIM STORAGE SYSTEM
VAULT 2 & 3 PHASE I (REV 1)
PHMCR07 - SITE ALLOCATION ESCALATION/CONTINGENCY REPORT

PAGE 19 OF 31
DATE 03/31/98 14:56:20
BY TLW/CDL/KLR/JJM

WBS	DESCRIPTION	SITE ALLOC SUBTOTAL	ESCALATION %	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY %	CONTINGENCY TOTAL	TOTAL DOLLARS
1AA100	DRAWINGS	191171	5.63	10762	201934	20	40386	242321
1AA200	SPECIFICATIONS	72730	5.63	4094	76825	25	19206	96031
1AA300	CHECKING & REVIEW	80422	5.63	4527	84950	20	16990	101940
1AA400	REPORTS & STUDIES	36717	5.63	2067	38784	20	7756	46541
1AA500	CALCS	157115	5.63	8845	165960	25	41490	207451
1AA600	SUPPORT	449128	5.63	25285	474414	15	71162	545576
1AA700	ESTIMATES	56516	5.63	3181	59698	20	11939	71637
1AA800	SUBMITTAL REVIEWS	72103	5.63	4059	76162	20	15232	91395
1AA900	QUALITY ASSURANCE	37188	5.63	2093	39281	15	5892	45174
SUBTOTAL 1A	DEFINITIVE DESIGN	1153093	5.63	64919	1218012	19	230056	1448069
1CC100	TITLE III - ENGINEERING	1001510	8.89	89034	1090544	20	218108	1308653
SUBTOTAL 1C	TITLE III - ENGINEERING	1001510	8.89	89034	1090544	20	218108	1308653
1D9EE3	MOBILIZE	0	0.00	0	0	0	0	0
1D9EE4	DEFINITIVE DESIGN (TITLE I & II)	0	0.00	0	0	0	0	0
1D9EE5	TITLE III	0	0.00	0	0	0	0	0
SUBTOTAL 1D	PROJ SUPPORT (CAPITAL)	0	0.00	0	0	0	0	0
SUBTOTAL 1	ENGINEERING	2154603	7.15	153953	2308557	19	448165	2756723
210001	SHIELDED CANISTER TRANSPORTER (P1)	1069200	7.60	81259	1150459	15	172568	1323028
210005	STANDARD STORAGE TUBES (P3)	3531924	7.60	268426	3800350	20	760070	4560420
210007	CASK TRANSPORT SYSTEMS (P2)	962280	7.60	73133	1035413	20	207082	1242495
SUBTOTAL 21	EARLY PROCUREMENT (PHMC)	5563404	7.60	422818	5986222	19	1139721	7125944
220002	TRANSFER PIT CRANE (P4)	60350	8.11	4894	65244	15	9786	75031
220003	60 TON CRANE (P9)	285120	8.11	23123	308243	15	46236	354479
220004	PIT WELD STATION (P5)	151034	8.11	12248	163283	25	40820	204104
220006	CANISTER OVERPACKS (P6)	51131	8.11	4146	55278	20	11055	66333
220010	CESIUM OVERPACKS (P7)	16584	8.11	1345	17929	20	3585	21515
SUBTOTAL 22	LATE PROCUREMENT (PHMC)	564221	8.11	45758	609979	18	111485	721464

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FLUOR DANIEL NORTHWEST, INC.              ** IEST - INTERACTIVE ESTIMATING **                    PAGE  20  OF  31
NUMATEC HANFORD CORP.                   IMMOBILIZED HLW INTERIM STORAGE SYSTEM                   DATE  03/31/98 14:56:20
JOB NO. W464BAA1                           VAULT 2 & 3   PHASE I  (REV 1)                        BY    TLW/CDL/KLR/JJH
FILE NO. W464BAA1                 PHMCR07 - SITE ALLOCATION ESCALATION/CONTINGENCY REPORT

                                            SITE ALLOC        ESCALATION          SUB         CONTINGENCY          TOTAL
 WBS   DESCRIPTION                           SUBTOTAL        %     TOTAL         TOTAL        %      TOTAL        DOLLARS
====== ================================     =========     ===== ========     =========    =====  ========      =========

  SUBTOTAL 2     PROCUREMENT (PHMC)           6127625      7.65   468577      6596202       19   1251207        7847409


320101 VAULTS 2 & 3 INTAKE & EXHAUST           302225      7.85    23724       325949       20     65189         391139
320104 MODIFY ANNEX PIT (WELD STATION)          23249      7.85     1825        25074       25      6268          31342
320105 STORAGE TUBE & CANISTER OVERPACKS       796387      7.85    62516       858904       20    171780        1030685
320106 VAULT 2 & 3 AIR FOILS                    18907      7.85     1484        20391       30      6117          26508
320108 CONCRETE EXHAUST LOUVERS                120047      7.85     9423       129471       25     32367         161839

  SUBTOTAL 3201  F P CONSTRUCTION  - C1       1260816      7.85    98974      1359791       21    281724        1641515


320209 10-TON GANTRY CRANE (ANNEX)               6465      8.89      574         7039       35      2464           9503
320211 DEMOLITION (ANNEX)                       16563      8.89     1472        18035       35      6312          24347
320213 EQUIPMENT (ANNEX)                        31772      8.89     2824        34596       35     12108          46705
320214 CONCRETE  (ANNEX)                        35642      8.89     3168        38811       35     13583          52395
320215 BUILDINGS (ANNEX)                        54678      8.89     4860        59539       35     20838          80378
320216 SITEWORK (ANNEX)                         12719      8.89     1130        13850       35      4847          18697
320217 HVAC  (ANNEX)                            26893      8.89     2390        29284       35     10249          39534
320218 ELECTRICAL (ANNEX)                       55878      8.89     4967        60846       35     21296          82142
320220 EQUIPMENT RENTAL (CRANES)                14224      8.89     1264        15488       20      3097          18586

  SUBTOTAL 3202  F P CONSTRUCTION  - C2        254837      8.89    22655       277492       34     94799         372292

  SUBTOTAL 32    F P CONSTRUCTION             1515654      8.02   121629      1637283       23    376523        2013807

  SUBTOTAL 3     CONSTRUCTION                 1515654      8.02   121629      1637283       23    376523        2013807


409HA1 PROJECT INTEGRATION                          0      0.00        0            0        0         0              0

  SUBTOTAL 40    PROJECT INTEGRATION                0      0.00        0            0        0         0              0

  SUBTOTAL 4     PROJECT INTEGRATION                0      0.00        0            0        0         0              0


502KA1 PROJECT MANAGEMENT/ADMIN                     0      0.00        0            0        0         0              0
502KB1 DESIGN                                       0      0.00        0            0        0         0              0
502KC1 PROCUREMENT                                  0      0.00        0            0        0         0              0
502KD1 ENVIRONMENTAL                                0      0.00        0            0        0         0              0
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FLUOR DANIEL NORTHWEST, INC.                 ** IEST - INTERACTIVE ESTIMATING **                     PAGE  21  OF  31
NUMATEC HANFORD CORP.                        IMMOBILIZED HLW INTERIM STORAGE SYSTEM                  DATE  03/31/98 14:56:20
JOB NO. W464BAA1                               VAULT 2 & 3   PHASE I  (REV 1)                        BY    TLW/CDL/KLR/JJM
FILE NO. W464BAA1                    PHMCR07 - SITE ALLOCATION ESCALATION/CONTINGENCY REPORT

                                             SITE ALLOC      ESCALATION         SUB       CONTINGENCY          TOTAL
 WBS   DESCRIPTION                           SUBTOTAL      %      TOTAL        TOTAL      %       TOTAL       DOLLARS
====== ==============================      =========   ===== ========    =========   =====  ========     =========

502KE1 SAFETY                                        0   0.00         0            0       0         0             0
502KF1 QUALITY ASSURANCE                             0   0.00         0            0       0         0             0
502KG1 ORR & STARTUP                                 0   0.00         0            0       0         0             0

  SUBTOTAL 50     OTHER PROJECT COST                 0   0.00         0            0       0         0             0

  SUBTOTAL 5      OTHER PROJECT COST                 0   0.00         0            0       0         0             0
                                            ===========================================================================
PROJECT TOTAL                                9,797,883          744,159                   20              12,617,940
                                                         7.60              10,542,043           2,075,896
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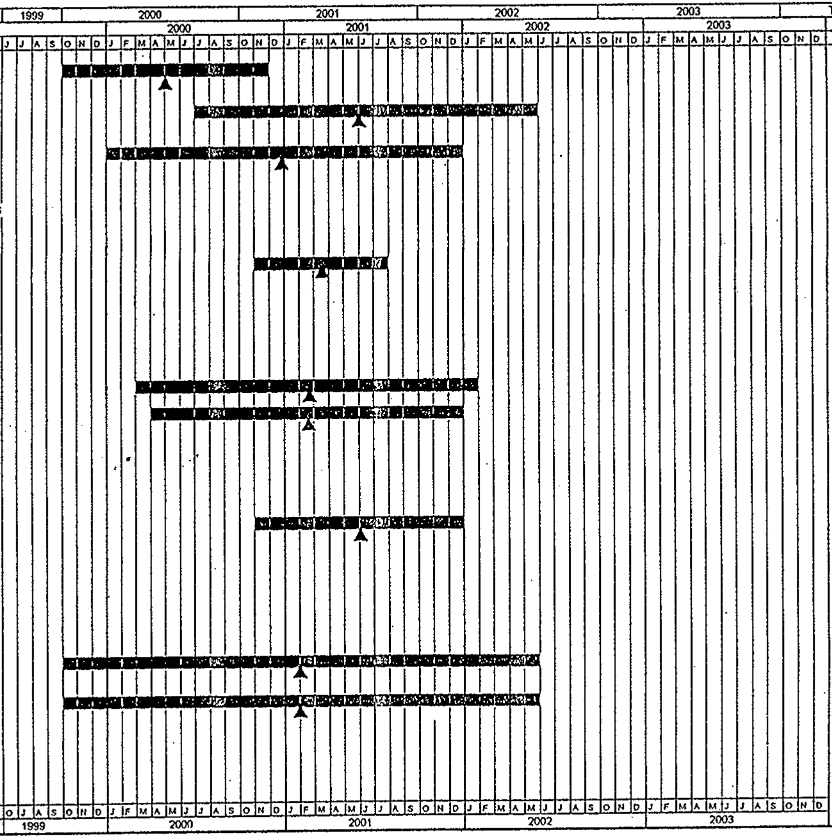
FLUOR DANIEL NORTHWEST

ESCALATION ANALYSIS SCHEDULE

Project No/Work Order No. W464
Title: IMMOBILIZED HLW INTERIM STORAGE SYSTEM
Date: 3/20/98
Requested By:
Prepared by: TLW/ SMF

TABLE MONTH / YR: MAR. /98



WBS		MID PONT YEAR	MID PONT MONTH	ESCALATION RATE
1A.	DEFINITIVE DESIGN	2000	MAY	5.63
1C.	ENG SUPT / INSPECTION	2001	JUN	8.89
2.	PROCUREMENT (EARLY)	2001	JAN	7.6
210001	SHIELDED CANISTER TR. P1			
210005	ST. TUBE P3			
210007	CASK XPORT SYS. P2			
10100	PROCUREMENT MANHOURS			
	LATE PROCUREMENT			
220002	TRANSFER PIT CRANE P4	2001	MAR	8.11
220003	60 TON CRANE P9			
220004	ANNEX PIT (WELD ST.) P5			
220006	CANISTER OVERPKS P6			
220010	Cs OVERPACKS			
32.	CM CONSTRUCTION			
321000	CONSTRUCTION MANAGEM.	2001	FEB	7.85
	C1 CONSTRUCTION	2001	FEB	7.85
320101	VAULTS 2 & 3 INTAKE & EXH			
320104	MODIFY ANNEX PIT (W. ST.)			
320105	VAULT 2 & 3 AIR FOILS			
320108	CONCRETE EXHAUST LOUV.			
320120	EQUIP. RENTAL (CRANES)			
	C2 CONSTRUCTION	2001	JUNE	8.89
320211	DEMOLITION (ANNEX)			
20213	EQUIPMENT (ANNEX)			
0214	CONCRETE (ANNEX)			
20215	BUILDINGS (ANNEX)			
320216	SITEWORK (ANNEX)			
320217	HVAC (ANNEX)			
320218	ELECTRICAL (ANNEX)			
400000	PROJECT INTEGRATION	2001	FEB	6.65
502	PROJECT SUPPORT	2001	FEB	6.65
502KB1	DESIGN			
502KC1	PROCUREMENT			
502KD1	ENVIRONMENTAL			
502KE1	SAFETY			
502KF1	QUALITY ASSURANCE			
502KG	ORR & STARTUP			

W464ESC1.XLS

Revision 1 (04-28-93)

STATEMENT OF WORK
Project W-464
Architect/Engineer

IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY PROJECT W-464 - DEFINITIVE DESIGN/ENGINEERING INSPECTION

CLIENT: NHC
COMPANY W.O. NO.: N-01
PREPARED BY: FDNW
DATE: March 1998

PROJECT SCOPE

This statement of work describes the work scope to be performed by Fluor Daniel Northwest, Inc., as primary contractor (hereafter referred to as the architect-engineer [A/E]) under the direction of Lockheed Martin Hanford Company, hereafter referred to as the buyer. Specifically, the A/E shall prepare definitive design (DD) documents for the Immobilized High-Level Waste (IHLW) Interim Storage Facility.

The DD work scope covers the design phase of the IHLW Interim Storage Facility (Project W-464), hereafter referred to as the project. This design phase entails services for producing construction drawings, and construction and procurement specifications for the project. A large fraction of the DD effort will encompass retrofit modifications to the existing Canister Storage Building (CSB) and Vaults 2 and 3 and the addition of a HLW Load-In/Load-Out Annex.

The engineering inspection (EI) work scope covers the construction phase of the project. The construction phase entails engineering services in support of construction with resolution of field problems, review, and disposition of construction submittals, preparing, and issuing engineering change notices (ECNs), resolution, and disposition of nonconformance reports (NCRs), construction management, records management, and the as-builting of project drawings.

The overall function of the project is to transport high-level waste (HLW) canisters loaded with vitrified waste (provided by the immobilization vendors) from the HLW Immobilization Facility, provide interim storage for the waste canisters, and if necessary, overpack, and store any damaged canisters.

The project will provide transport casks, equipment, and facilities for accomplishing the transport ILHW function and the interim storage IHLW function. The scope of the project includes the design and construction to provide for IHLW storage space, design and procurement of transport vehicle(s) and shielded casks, and canister handling for placement of IHLW within the CSB storage area.

Project Engineering/Design Administration (201)

The project engineering/design administration will provide overall design coordination between the various design disciplines and the buyer. Project engineering will coordinate/interface with the inspection group(s) and participate in final acceptance activities associated with official acceptance of construction (OAC).

Project Engineering Support (205)

The project engineering support will include:

- Engineering, construction, and submittal document control functions
- Specifications (Procurement and Construction)

Survey (210)

Provide any field conditions required during the design effort.

Architecture (220)

The Architectural group will provide:

- Code Search and Report
- Research and Coordination - existing CSB, Construction and Building Materials, As-Built Drawings, CSB PSAR, DBD
- Assist with HLW Load-In/Load-Out Annex PSAR, DBD
- Human Factor Program Plan Input
- Value Engineering Study Input
- Construction Specification Input
- Systems Engineering Management Plan Compliance Input
- Architectural Drawings (14)
- Critical Design Review
- Early Procurement Submittal Review
- Early Procurement Specification Input
- Management Self Assessments (Incorporate Comments)

Civil/Structural (215)

The civil/structural group will provide:

- Civil Drawings (7)
- Structural Drawings (31)
- Calculations (41)
- Construction Specification Input (C1 & C2)
- Independent Seismic Review
- Transportation Plan Input
- Systems Engineering Management Plan Compliance Input

- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Early Procurement Submittal Review
- Early Procurement Specification Input
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Environmental (230)

The environmental group will provide:

- Project documentation reviews as applicable.

Heating, Ventilating, and Air Conditioning (235)

The HVAC group will provide:

- Drawings (6)
- Construction Specification Input
- Calculations (8)
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Early Procurement Submittal Reviews
- Early Procurement Specification Input
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Fire Protection and Safety Review (245)

The fire protection group will provide:

- Fire Hazards Analysis, Update CSB FHA
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Mechanical (255)

The mechanical systems groups will provide:

- Early Procurement Specification Input (3)
- Procurement Specifications (6)
- Early Procurement Submittal Reviews
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Drawings to be Included in the Procurement Specification (69)
- Construction Drawings (9)
- Drawings (Operations Flow Diagrams) (3)
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Electrical (265)

The electrical group will provide:

- ECN Existing CSB Drawings
- Drawings (23)
- Calculations (3)
- Construction Specification Input
- Input to Three Procurement Specifications
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Early Procurement Submittal Review
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Instrumentation and Control (I&C) (270)

The I&C group will provide:

- Drawings (4)
- Construction Specification Input
- Procurement Specification Input (3)
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input

- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Early Procurement Submittal Review
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Nuclear Engineering/Shielding (290)

The nuclear engineering/shielding group will provide:

- Calculations (9)
- ALARA Report (1)
- Systems Engineering Management Plan Compliance Input
- Human Factors Program Plan Input
- Maintainability Analysis Input
- Alignment and Value Engineering Session
- As-build Review of Existing CSB Drawings
- Critical Design Review
- Early Procurement Submittal Review
- PSAR Support
- Management Self Assessments (Incorporate Comments).

Project Control (300)

The project control engineer will develop and maintain the project schedule and cost baseline, and will provide monthly cost, progress, and schedule reports.

Estimating (310)

The estimating scope includes production of the 30% and final definitive design estimate, plus other estimates as required.

Subcontract/Procurement (430)

The subcontract/procurement specialist will manage the development and placement of early procurement packages, and will provide support during the bid/award cycles for both procurement and fixed-price construction.

Construction Management (501)

Construction management includes both construction forces (CF) and construction management (CM) administration. This support includes performance of the constructibility review, plus input to the construction and procurement specifications, as well as input to the final design estimate and construction schedule.

Construction Engineering (505)

The construction engineering function provides support to the constructibility review and the final design estimate.

ENGINEERING/INSPECTION (EI)

Work provided by the A/E firm on project W-464 during construction will consist of the following discipline efforts.

Civil/Structural (215)

A full-time, civil/structural engineer will be assigned to support the construction efforts during the early civil/structural stage of construction. This support function will include: 1) review and disposition of fixed-price contractor submittals; 2) prepare and issue ECNs; 3) disposition NCRs; 4) attend construction meetings; 5) be available to assist construction personnel in resolving technical issues; and 6) final as-documenting of drawings and specifications.

HVAC Engineering (235)

A full-time HVAC engineer will be assigned to support construction for installation of the HVAC equipment associated with the HLW Load-In/Load-Out Annex. This support function will include: 1) review and disposition of building contractor submittals; 2) prepare and issue ECNs; 3) disposition NCRs; 4) attend construction meetings; and 5) final as-documenting of drawings and specifications.

Safety/Fire Protection Engineering (245)

The safety and fire protection engineer will perform overview safety review and approval of project ECNs and NCRs.

Mechanical Engineering (255)

A full-time, mechanical engineer will be assigned to support the construction effort during the installation phase of mechanical equipment on the project. This support function will include: 1) review and disposition of fixed-price contractor submittals; 2) prepare and issue ECNs, 3) disposition NCRs; 4) attend construction meetings; 5) be available to assist construction personnel in resolving technical issues; 6) provide acceptance test plan (ATP) input, and 7) final as-documenting of drawings and specifications.

Instrumentation Engineering (270)

A full-time, instrumentation engineer will be assigned to support the construction effort during the latter phases of construction while instrumentation installation and check-out activities are in progress. This support function will include: 1) review and disposition of fixed-price contractor submittals; 2) prepare and issue ECNs, 3) disposition NCRs; 4) attend construction meetings; 5) be available to assist construction personnel in resolving technical issues; 6) provide ATP input, and 7) final as-documenting of drawings and specifications.

Electrical Engineering (265)

A full-time electrical engineer will be assigned to support construction during installation and testing of the electrical system. This support function will include: 1) review and disposition of building contractor submittals; 2) prepare and issue ECNs; 3) disposition NCRs; 4) attend construction meetings; and 5) final as-documenting of drawings and specifications.

Project Engineer/Design Administration (201)

Coordinate interdiscipline activities and provide performance/progress information to support schedule and cost statusing.

Project Management (101)

Provide overall coordination of all EI activities. Responsible for cost and schedule performance and reporting.

Quality Engineering (41)

Provide review of ECNs and NCRs for compliance with appropriate criteria and procedures. Provide auditing services to verify that project work is performed in accordance with appropriate procedures.

Project Controls (300)

Set up and maintain costs and schedule baselines. Provide schedule analysis and cost trending.

Estimating (310)

Provide estimating support during construction as required to support disposition of contractor change requests.

Construction Submittals (206)

Provide contractor submittal control and distribution system to ensure timely disposition of submittals.

Construction Forces Administration (505)

Responsible for managing and coordinating CF activities.

Construction Management (501)

The fixed-price contractor will be managed by FDNW CM.

Records Management and Turnover (205)

Maintain project engineering/management files. Transmit project documents internally and externally. Responsible for project records turnover at project completion.

BASIS FOR ESTIMATE

The basis used to prepare this estimate include:

1. The electrical design is General Services.
2. Existing ventilation systems do not require modification.
3. Procurement and submittal reviews are performed during definitive design for the SCT, transportation system, and storage tubes.
4. Privatization vendors will use the same waste canister design.
5. Welding and inspection of the overpack cap installation will permit some hands-on functions.
6. Seals, venting, or inerting will not be required for HLW canister transporting, handling, and storing.
7. There will be no radioactive contamination affecting this project.
8. The existing designs for the intake and exhaust structures and storage tube assemblies can be used for HLW.
9. The overpack weld station can use SNFs gantry crane, hoists, and ventilation system.
10. Combustible loading and associated fire loss potentials will be less than the DOE limits and a fire suppression system will not need to be installed in the operations area of the CSB.
11. Original CSB definitive design documents shall be used as a reference source for matching methods and materials of construction and reusing similar details and specifications for the HLW load-in/load-out definitive design effort.
12. The 3D thermal analysis for HLW in Vaults 2 and 3 and the confirmatory structural anlaysis based on the results of the thermal analysis and the SCT loads will be completed as part of the ACDR effort.

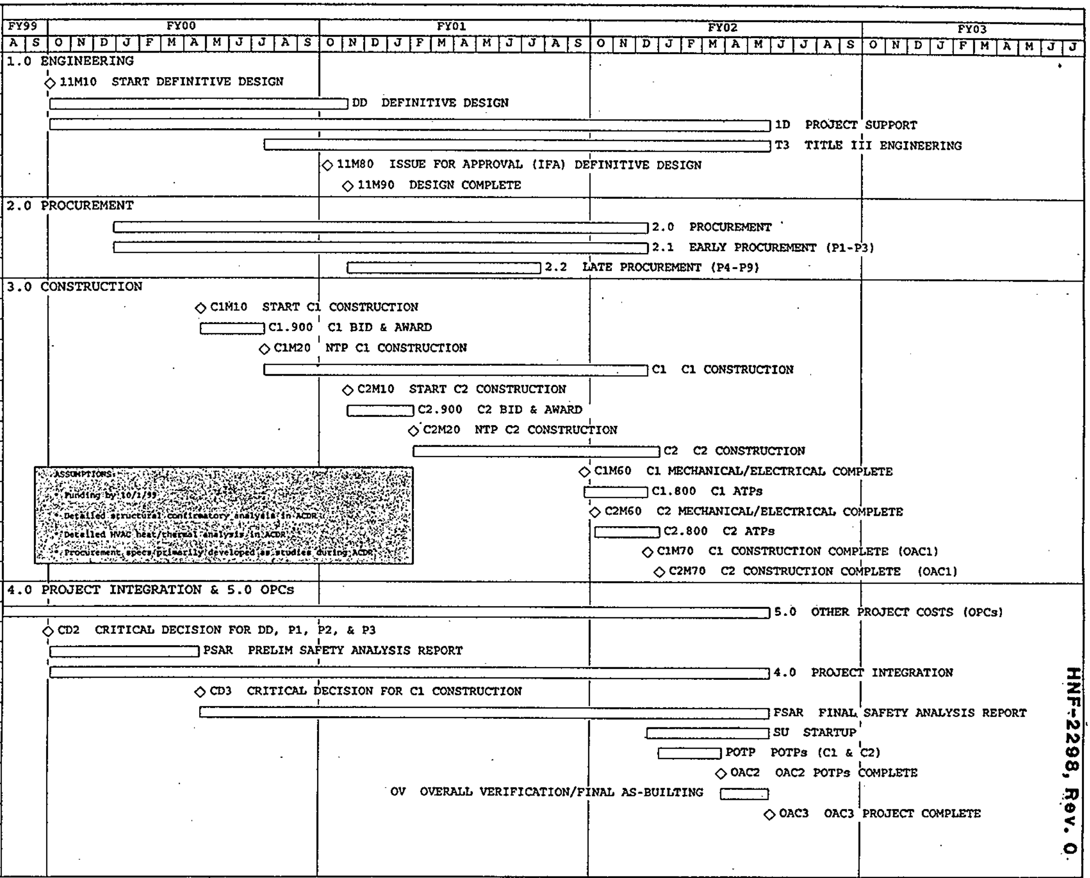
APPENDIX D

CONCEPTUAL PROJECT SCHEDULE

This appendix includes the overall project schedule including:

- Schedule for start and completion of definitive design.
- Schedule for start and completion of various project procurements, early procurement, construction, and various closeout activities.

The basis of the DRD was that the SNF CSB operations were complete prior to initiation of project W-464 construction activities. Since the issuance of the DRD, the SNF schedule has slipped by at least 18 months. Therefore, the CDR schedule was prepared to ensure project W-464 integration with the current SNF schedule.



EARLY START	EARLY FINISH	
		1.0 ENGINEERING
4OCT99	1OCT99	◇ 11M10 START DEFINITIVE DESIGN
4OCT99	8NOV00	DD DEFINITIVE DESIGN
4OCT99	31MAY02	1D PROJECT SUPPORT
19JUL00	31MAY02	T3 TITLE III ENGINEERING
12OCT00	11OCT00	◇ 11M80 ISSUE FOR APPROVAL (IFA) DEFINITIVE DESIGN
9NOV00	8NOV00	◇ 11M90 DESIGN COMPLETE
		2.0 PROCUREMENT
29DEC99	17DEC01	2.0 PROCUREMENT
29DEC99	17DEC01	2.1 EARLY PROCUREMENT (P1-P3)
9NOV00	26JUL01	2.2 LATE PROCUREMENT (P4-P9)
		3.0 CONSTRUCTION
24APR00	21APR00	◇ C1M10 START C1 CONSTRUCTION
24APR00	18JUL00	C1.900 C1 BID & AWARD
19JUL00	18JUL00	◇ C1M20 NTP C1 CONSTRUCTION
19JUL00	17DEC01	C1 C1 CONSTRUCTION
9NOV00	8NOV00	◇ C2M10 START C2 CONSTRUCTION
9NOV00	5FEB01	C2.900 C2 BID & AWARD
6FEB01	5FEB01	◇ C2M20 NTP C2 CONSTRUCTION
6FEB01	2JAN02	C2 C2 CONSTRUCTION
24SEP01	21SEP01	◇ C1M60 C1 MECHANICAL/ELECTRICAL COMPLETE
24SEP01	17DEC01	C1.800 C1 ATPs
8OCT01	5OCT01	◇ C2M60 C2 MECHANICAL/ELECTRICAL COMPLETE
8OCT01	2JAN02	C2.800 C2 ATPs
18DEC01	17DEC01	◇ C1M70 C1 CONSTRUCTION COMPLETE (OAC1)
3JAN02	2JAN02	◇ C2M70 C2 CONSTRUCTION COMPLETE (OAC1)
		4.0 PROJECT INTEGRATION & 5.0 OPCs
1OCT98	31MAY02	5.0 OTHER PROJECT COSTS (OPCs)
1OCT99	30SEP99	◇ CD2 CRITICAL DECISION FOR DD, P1, P2, & P3
4OCT99	21APR00	PSAR PRELIM SAFETY ANALYSIS REPORT
4OCT99	31MAY02	4.0 PROJECT INTEGRATION
24APR00	21APR00	◇ CD3 CRITICAL DECISION FOR C1 CONSTRUCTION
24APR00	31MAY02	FSAR FINAL SAFETY ANALYSIS REPORT
18DEC01	31MAY02	SU STARTUP
3JAN02	28MAR02	POTP POTPs (C1 & C2)
29MAR02	28MAR02	◇ OAC2 OAC2 POTPs COMPLETE
29MAR02	31MAY02	OV OVERALL VERIFICATION/FINAL AS-BUILTING
3JUN02	31MAY02	◇ OAC3 OAC3 PROJECT COMPLETE

ASSUMPTIONS:
- Funding by 10/1/99
- Detailed structural confirmatory analysis in ACDR
- Detailed HVAC heat/thermal analysis in ACDR
- Procurement specs primarily developed as studies during ACDR

Plot Date	26MAR98
Data Date	2MAR98
Project Start	1JAN97
Project Finish	31MAY02

▭	Activity Bar/Early Dates
▭	Critical Activity
▭	Progress Bar
◇ /▸	Milestone/Flag Activity

464F

FLUOR DANIEL NORTHWEST, INC.
W-464 HLW CDR
CONCEPTUAL SCHEDULE (SUMMARY)

Sheet 1 of 1

BC-03 TASK ORDER N-01

Date	Revision	Checked	Approved
3/26/98			

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FLUOR DANIEL NORTHWEST, INC.                 PRIMAVERA PROJECT PLANNER                        W-464 HLW CDR

REPORT DATE 18MAR98  RUN NO. 1380                                                             START DATE  1JAN97  FIN DATE 31MAY
          9:47
SR-02 MILESTONE DESCRIPTIONS                                                                  DATA DATE   2MAR98  PAGE NO.   1

----- -----  ---- ---- - --- ---------- ---------------------------------------------- -------- -------- -------- -------- ----
  ACTIVITY                                       ACTIVITY DESCRIPTION                       SCHEDULED
     ID                                                                                   START   FINISH
----- -----  ---- ---- - --- ---------- ---------------------------------------------- -------- -------- -------- -------- ----
1.0 ENGINEERING
  11M10                                 START DEFINITIVE DESIGN                         4OCT99   1OCT99*

                                        INITIATE DEFINITIVE DESIGN ACTIVITIES

  11M30                                 ISSUE FOR APPROVAL (IFA) DEFINITIVE DESIGN     12OCT00  11OCT00

                                        PROVIDE C2 DESIGN TO OPERATING CONTRACTOR FOR
                                        APPROVAL AND RELEASE FOR CONSTRUCTION

  11M90                                 DESIGN COMPLETE                                 9NOV00   8NOV00

                                        ALL DESIGN ACTIVITIES ARE COMPLETED.
                                        DESIGN DELIVERABLES ARE APPROVED BY OPERATING
                                          CONTRACTOR AND RELEASED FOR CONSTRUCTION.

3.0 CONSTRUCTION
  C1M10                                 START C1 CONSTRUCTION                          24APR00  21APR00

                                        INITIATE BID & AWARD FOR C1 FIXED PRICE
                                        CONSTRUCTION, AND INITIATE CM SUPPORT
                                        ACTIVITIES.  C1 ACTIVITIES INCLUDE:
                                          -  STORAGE TUBE INSTALLATION
                                          -  FAB & INSTALL INTAKE & EXHAUST STACKS
                                          -  LOUVERS
                                          -  AIRFOILS

  C1M20                                 NTP C1 CONSTRUCTION                            19JUL00  18JUL00

                                        NOTICE TO PROCEED (NTP) C1 FIELD ACTIVITIES.

  C2M10                                 START C2 CONSTRUCTION                           9NOV00   8NOV00

                                        INITIATE BID & AWARD FOR C1 FIXED PRICE
                                        CONSTRUCTION, AND INITIATE CM SUPPORT
                                        ACTIVITIES.  C2 ACTIVITIES INCLUDE:
                                          -  CONSTRUCTION OF LOAD-IN/LOAD-OUT ANNEX
                                          -  INSTALLATION OF CRANES (P4 & P9)
                                          -  CONSTRUCTION OF OVERPACK/WELD STATION

  C2M20                                 NTP C2 CONSTRUCTION                             6FEB01   5FEB01

                                        NOTICE TO PROCEED (NTP) C2 FIELD ACTIVITIES

  C1M60                                 C1 MECHANICAL/ELECTRICAL COMPLETE              24SEP01  21SEP01

                                        C1 CONSTRUCTION ACTIVITIES ARE COMPLETE EXCEPT
                                        FOR ACCEPTANCE TEST PROCEDURES (ATPs)

  C2M60                                 C2 MECHANICAL/ELECTRICAL COMPLETE               8OCT01   5OCT01

                                        C2 CONSTRUCTION ACTIVITIES ARE COMPLETE EXCEPT
                                        FOR ACCEPTANCE TEST PROCEDURES (ATPs)

  C1M70                                 C1 CONSTRUCTION COMPLETE (OAC1)                18DEC01  17DEC01

                                        C1 FIELD CONSTRUCTION AND ATPs COMPLETE FOR USE

  C2M70                                 C2 CONSTRUCTION COMPLETE  (OAC1)                3JAN02   2JAN02

                                        C2 FIELD CONSTRUCTION AND ATPs COMPLETE FOR USE

4.0 PROJECT INTEGRATION
  CD2                                   CRITICAL DECISION FOR DD, P1, P2, & P3          1OCT99  30SEP99

                                        APPROVAL TO INITIATE DEFINITIVE DESIGN
                                        AND EARLY PROCUREMENT (P1, P2, & P3)
                                          -  P1 SHIELDING CANISTER TRANSPORTER
                                          -  P2 TRANSPORT CASKS
                                          -  P3 STORAGE TUBES

  CD3                                   CRITICAL DECISION FOR C1 CONSTRUCTION          24APR00  21APR00

                                        APPROVAL TO INITIATE C1 FIXED PRICE CONSTRUCTION

  OAC2                                  OAC2 POTPs COMPLETE                            29MAR02  28MAR02

                                        PRE-OPERATIONAL TEST PROCEDURES (POTPs) COMPLETE
                                        OFFICIAL ACCEPTANCE OF CONSTRUCTION PART II
                                        SIGNED OFF.

  OAC3                                  OAC3 PROJECT COMPLETE                           3JUN02  31MAY02

                                        ALL DESIGN AND CONSTRUCTION ACTIVITIES COMPLETE.
                                        OFFICIAL ACCEPTANCE OF CONSTRUCTION PART III
                                        IS APPROVED.
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APPENDIX E

OUTLINE SPECIFICATION

This appendix provides an outline of expected specification elements for design, procurement, construction, and estimating purposes.

OUTLINE SPECIFICATIONS

DIVISION 2 - SITEWORK

Section 02000 Clearing and Grubbing

1. Clear and grub areas affected by excavation or embankment.

Section 02200 Earthwork

1. Excavation and Embankment (fill):
    a. Structural fill: 75 mm (3 in.) maximum aggregate size, compacted Method B, meeting WSDOT M 41-10, Section 2-03.
    b. Common fill: 300 mm (12 in.) maximum loose lifts, 150 mm (6 in.) maximum aggregate size, optimum moisture, compact uniformly over full width by one pass of vibratory equipment.
2. Stabilization: Base course, WSDOT M 41-10.
3. Soil Compaction Testing (Structural fill only).

Section 02235 Road Subgrade and Granular Base

1. Base Course: WSDOT M 41-10.
2. Leveling Course: WSDOT M 41-10.
3. Material and Compaction Testing.

Section 02512 Hot-Laid Asphaltic Concrete Pavement

1. Asphalt Concrete Pavement: WSDOT M 41-10.
    a. Asphalt: AR-4000-W
    b. Aggregate: Class B
2. Material and Density Testing.

Section 02831 Security Chain Link Fences and Gates

1. Fence fabric: FS RR-F-191/1, Type I, 2 inch mesh, 11 gage, 84 inch height, top and bottom selvages twisted and barbed.

2. Posts, top rails and braces: FS RR-F-191/3, Class 1, Grade A or B.

3. End members of gate frames: FS RR-F-191/4, extending 12 inches above tope of fabric for attachment of barbed wire, fitted with ball top or similar fitting to shed water.

4. Hinges, latches, stops, and keepers: FS RR-F-191/2, zinc-coated steel.

DIVISION 3 - CONCRETE

Section 03300 Reinforced Concrete

1. Compressive Strength (f'_c) = 6,000 psi - CSB Vault above Elev 704' - 0"
   5,000 psi - CSB Vault below Elev 704' - 0"
   4,000 psi - elsewhere

2. Reinforcing Steel: ASTM A 615 (fy = 60,000 psi)

3. Welded Wire Fabric: ASTM A 185

DIVISION 5 - METALS

Section 05120 Structural Steel

1. Stack: ASTM A 242 TYP1 or ASTM A 588 Grade A (Fy = 50 ksi)

2. Structural Steel: ASTM A 36/A 36M (Fy = 36 ksi)

3. Structural Tubing: ASTM A 500 Grade B (Fy - 46 ksi)

4. Steel Pipe: ASTM A 53 Type E or S Grade B (Fy - 35 ksi)

5. Welding Material: AWS D1.1, E70XX Electrode

6. Crane Rails: ASTM A 759, S3 & S5

7. Stainless Steel:

   a. Plate: ASTM A 240 Type 304L

   b. Bars and Shapes: ASTM A276 Type 304L (Fy = 25 ksi)

   c. Pipe: ASTM A 312/A 312M Grade TP304L

   d. Welding Material: E/ER 308L Electrode for Stainless to Stainless Steel
   E/ER 309L Electrode for Stainless to Carbon Steel

8. Bolts, Nuts, and Washers:

   a. Common Bolts: ASTM A 36 or A 307

   b. High Strength Bolts: ASTM A 325

   c. Nuts: ASTM A 563

   d. Hardened Washers: ASTM F 436

   e. Rail Anchor Bolts: ASTM A 449

   f. Rail Sole Plate: ASTM A 36

   g. Rail Clips (clamps): ASTM A 572 Grade 50

Section 05515 Ladders and Rungs

1. Structural Tubing: ASTM A 500, Grade B (Fy-36ksi)

2. Welding Material: ASTM A 759

Section 05532 Gratings and Trench Covers

Section 05720 Railings and Handrails

1. Structural Tubing: Fabricate using steel pipe.

2. Welding Fittings: Preformed turns and fittings, using complete penetration welds at connections. Grind smooth.

3. Paint: Prime ferrous metal in accordance with Section 09900.

Section 05800 Expansion Control

Expansion Anchor Installation

DIVISION 7 - THERMAL AND MOISTURE PROTECTION

Section 07100 Dampproofing and Waterproofing

1. Asphalt: ASTM D 449, Type II. Apply to belowgrade exterior surfaces of concrete walls which enclose usable space.

Section 07200 Thermal Protection

1. Conforming to ASTM C 665, Type II, Class C. Installed in Metal Siding and Roof System sandwich panels.
2. Wall Insulation: Minimum thermal resistance of R-19.
3. Roof Insulation: Minimum thermal resistance of R-30.

Section 07410 Standing Seam Roof System

1. Standing Seam Roof System shall match the roof system used on the Canister Storage Building.
2. Resist wind loading defined in ASCE 7-93.
3. Attachment of metal roofing system to the structural decking designed to resist earthquake forces calculated in accordance with UBC Chapter 16.
4. Guarantee:
   2-year guarantee warranting the weather tightness of the building.
   10-year manufacturer's warranty for finished surfaces.

Section 07465 Metal Wall System

1. Metal Siding Panels to match existing Canister Storage Building metal siding panels. Prefinished steel sandwich construction.
2. System designed to resist wind loading defined in ASCE 7-93.
3. System designed to resist earthquake forces calculated in accordance with UBC Chapter 23.
4. Metal Trim: Metal closure strips, top, base, head, sill, and jamb or corner trims shall be same material, thickness, and finish as siding

Section 07620 Sheet Metal Flashing and Trim

1. Sheet Metal Flashings and Trim to match existing Canister Storage Building.
2. Downspouts and Gutters: Fabricate from same material as siding. Match Canister Storage Building downspouts.

Section 07900 Joint Sealers

DIVISION 8 - DOORS AND WINDOWS

Section 08100 Metal Doors and Frames

1. Doors and Welded Steel Frames shall be constructed and hung according to SDI 100.

Section 08310 Access Doors and Panels

1. Factory fabricated access doors for installation in walls or ceiling shall be of the same level of quality as those manufactured by Milcor.

Section 08342 Industrial Doors

1. Design Wind Load 23 psf.
2. Tornado Wind Impact Load approximately 92 psf.
3. Seismic Load in accordance with UBC Section 1630 for Seismic Zone 2B.

Section 08710 Hardware

DIVISION 9 - FINISHES

Section 09965 Industrial Resinous Coating

1. Materials and system of application shall be in accordance with ANSI N512.

Section 09910 Paints

1. Coating materials shall be applied in accordance with SSPC Paint-1 (Steel Structures Painting Council).

DIVISION 10 - SPECIALTIES

Section 10440 Interior Signage

Section 10520 Fire Protection Specialties

DIVISION 13 - SPECIAL CONSTRUCTION

Section 13440 Instrumentation

1. Intake stack air temperature and velocity measuring system

   The mass flow indicating transmitter shall be capable of receiving flow signals (total and static pressures) from probes equipped with temperature sensing means, and of amplifying, correcting, extracting the square root (linearizing), and scaling to produce a 4–20 mA DC output signal linear and scaled to standard air volume. The mass flow indication transmitter shall contain an integral digital process display capable of continuous indication of standard air volume in SCFM, and selectable displays of air temperature in ^{0}F and air pressure in inches water.

2. Stack probe

   a. Volumetric flow transverse probe

   b. Material: stainless steel

   c. Mounting 6" 150 lb flange with 8 3/4" bolt pattern

   d. Probe: flow measuring manifolds with total pressure, static pressure, and thermocouple probes.

3. Mass flow indicating transmitter

   a. Adjustable flow span: 0 to 400 fpm

   b. Accuracy: ± 0.5% of span

   c. Thermocouple ranges -100 °F to 1600 °F

   d. Indication: digital, 4-digit, 0.5 inch high, LED process displays, continuous in standard air volume (SCFM). Selectable indication of air velocity (SFPM) and air temperature (°F) and air pressure (inches of Hg).

   e. Output: 4–20 mA DC

   f. Power: standard 4-wire 120 V AC

4. Exhaust stack temperature probe

   a. Thermocouple ranges: -100°F to 1600 °F

5. Continuous Air Monitor

   a. Eberline, Beta/Gamma, AMS' - 4

6. Closed Circuit TV

   a. Remote controlled camera(s)

   b. Monitor/control station

DIVISION 15 - MECHANICAL

Section 15500 HVAC

HEPA Filter Housing

Requirements:

HEPA filter housing assemblies shall be of stainless steel and shall meet the following:

- Capacity: 2000 CFM
- Housing Design Pressure: 10 inches of water gauge
- Medium efficiency filter: 2 inches thick with prefilter single
- HEPA filter: Single stage
- Gas temperature: 10 °C (50 °F) min, 93 °C (200 °F) max

Functional Design Requirements:

The HEPA filter housing shall be a single filter design meeting the requirements of ASME N509 with the following clarifications/exceptions:

- Safety classification is non-ESF
- Paragraphs related to carbon absorber, fan, drive, heating coil, dampers, and duct to not apply
- Lighting is not required
- Vendor standard mechanical design of the housing is acceptable provided they meet the performance requirements of ASME N509
- The filter housing shall be located outdoors
- Injection and sampling manifold for DOP testing are required. The location of injection and sampling ports shall be determined by the vendor for DOP testing in accordance with ASME N510

Maximum airstream relative humidity (RH): 100% RH

Housing ambient conditions: -26 °C (50 °F) to 54 °C (130 °F), 20 to 100% RH

Centrifugal Fan

Equipment Description

- Fans covered by this section are of carbon steel construction, direct or belt driven, for installation in air filtration units.
- Fan performance shall be as follows:
  - Capacity: 2000 scfm
  - Static Pressure 7 inches of water gauge

- Performance Ratings: The fan shall be tested and certified in accordance with ASHRAE 51-85 and AMCA 210-85 Test Code and shall bear an AMCA Seal.

- Sound Ratings: The fan shall have sound rating per AMCA 301, tested to AMCA 300, and bear the AMCA Certified Sound Rating Seal.

- Ratings are based on AMCA 99 standard for air. Specified equipment ratings for air handling units are minimum requirements. Specified rating for filtration unit exhaust fans are maximum rating (filter train fully loaded). These fan motors will be provided with variable speed drive (VSD) by other.

- The fans shall be selected below the first critical speed and in the stable region of the corresponding performance curves such that even at a lower speed, if applicable, it remains instable operating region. In addition, fans shall be selected for maximum efficiency in the operating range.

Ducting and Accessories

Ducting:

- 12 inches round, 16 ga stainless steel, all weld
- 12 inches diameter isolation dampers no.: 4

Exhaust Stack:

- 12 inches diameter carbon steel, 80 feet tall, 1/4 inches wall

DIVISION 16 - ELECTRICAL

Section 16400 Service and Distribution

1. Lightning protection equipment/materials adhering to NFPA 780, Lightning Protection Code

2. Panelboards, 480Y/277 V or 208/120 V, 3 phase, 4 wire, 60 Hz UL 67, NEMA PB 1

3. Transformer, dry-type, 480-208/120 V, 3 phase, 4 wire, 60 Hz UL1561, NEMA ST 20

4. Lighting Fixtures

    a. High bay industrial 400 W, metal halide with quartz standby, pendant mount, high efficiency ballast

    b. Fluorescent industrial, T-8 lamps, electronic high efficiency ballast

c. Incandescent, industrial, vapor tight

d. Low pressure sodium, outdoor, 35 W with photo cell control

e. Emergency, self contained maintenance free battery, UL 924

f. Roadway, low pressure sodium, pole mounted

APPENDIX F

ENERGY CONSERVATION REPORT AND ANALYSIS

Energy consumption of the high-level waste systems will not be noticeably different from the spent nuclear fuel (SNF) systems. The size of the new Annex is less than the minimum size requirement for an energy conservation report. Therefore, the existing energy conservation features (and report) for the SNF project are appropriate for project W-464.

The heating, ventilating, and air conditioning (HVAC) systems for the SNF project were designed to meet the energy conservation requirements of ASHRAE Standard 90A and DOE Order 6430.1A, Section 0110-12.

APPENDIX G

PRELIMINARY SAFETY EVALUATION

This section will include the preliminary safety evaluation including hazards analysis, hazards classification, preliminary safety classifications, and nuclear/non-nuclear designations when the approved document is provided by Numatec.

PRELIMINARY SAFETY EVALUATION FOR PROJECT W-464, IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE

April 1998

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FOREWORD

As part of the Tank Waste Remediation Systems (TWRS) Project W-464, this Preliminary Safety Evaluation (PSE) identifies and evaluates hazards associated with the construction and operation of the immobilized high level waste interim storage facility (IHLW-ISF). This PSE was developed concurrently with the conceptual design for the IHLW-ISF as part of the Project W-464 design activities. Concurrent preparation of the PSE ensures incorporation of safety considerations into the design and permits the PSE to be issued as part of the Conceptual Design Report (CDR).

The PSE utilizes a Preliminary Hazards Analysis (PHA) for the identification of hazards associated with the operation of the proposed activity. At the time the PHA was developed, the conceptual design for Project W-464 utilized a receiving pit in the Canister Storage Building (CSB) receiving area and the multicanister overpack (MCO) handling machine (MHM) for unloading the cask and transport of the IHLW and Cesium (Cs) canisters. The receiving area, receiving crane and MHM are being designed and constructed by Spent Nuclear Fuel (SNF) Project W-379 for receipt and handling of the spent nuclear fuel within the CSB. Subsequent to the development of the PHA and preparation of the PSE, the design approach was revised to design and construct a separate receiving area, the High Level Waste Load-in/Load-out Annex, for receipt of the casks containing the IHLW and Cs canisters. A new gantry crane and cask transfer pit will be provided for receipt of the casks and a new handling machine, the Shielded Canister Transporter (SCT), will be provided for transfer of the canisters from the casks to the storage tubes. These systems and components are described in Section IV of the CDR.

The operations associated with the receipt and unloading of the casks and transport of the canisters with the SCT will be similar to those described in the PSE. The hazards and potential accident scenarios identified in the PSE are expected to be typical of those for the revised design approach. In addition, the safety functions required to prevent or mitigate the potential consequences of the accidents developed in the PSE will need to be considered in the design development for the revised approach. These functions include those for prevention or mitigation of the consequences of a cask drop, drop of a canister, and shear of a canister.

The revised design may present additional hazards which will need to be addressed during further design development. The design and operational sequence has not progressed to the point where it would be effective to revise the PHA. However, a revision of the PHA and analysis of new hazards will be done prior to development of the PSAR. Hazards to be considered are the interactions of the new systems for receipt and handling of the IHLW and Cs canisters with other systems in the CSB, and design features which may increase the severity of the potential accidents or introduce new accident scenarios.

As noted above, the PSE does identify safety functions which will need to be considered during the design development. The continued interaction between the safety analysis and the design activities will identify any new hazards and required safety features associated with the design.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS

ALARA	as low as reasonably achievable
ARF	airborne release fraction
BR	breathing rate
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
CSB	Canister Storage Building
DBA	design basis accident
DBE	design basis earthquake
DCF	dose conversion factor
DOE	Department of Energy
DRD	Design Requirements Document
EDE	effective dose equivalent
EPA	Environmental Protection Agency
FSAR	Final Safety Analysis Report
HLW	high level waste
HVAC	heating, ventilating, and air conditioning
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IHLW	immobilized high level waste
IHLW-ISF	immobilized high level waste interim storage facility
LPF	leak path factor
MAR	material at risk
MCO	multicanister overpack
MDF	mass dose factor
MHM	multicanister overpack handling machine
PHA	preliminary hazards analysis
PNNL	Pacific Northwest National Laboratory
PSAR	Preliminary Safety Analysis Report
PSE	preliminary safety evaluation
RF	respirable fraction
SARP	Safety Analysis Report for Packaging
SC	Safety Class
SCT	Shielded Canister Transporter
SNF	Spent Nuclear Fuel
SS	Safety Significant
SSCs	structures, systems, and components
ST	source term
TSR	Technical Safety Requirement
TWRS	Tank Waste Remediation System
USQ	Unreviewed Safety Question
WRAP	Waste Receiving and Processing
WHC	Westinghouse Hanford Company

PRELIMINARY SAFETY EVALUATION FOR PROJECT W-464, IMMOBILIZED HIGH LEVEL WASTE INTERIM STORAGE FACILITY

1.0 INTRODUCTION AND SUMMARY

1.1 INTRODUCTION

This PSE evaluates the hazards associated with the IHLW-ISF in the available vaults of the CSB, and ensures that major safety considerations are identified during the conceptual design phase of the project. This PSE for Project W-464 fulfills the safety documentation guidance of HNF-PRO-703, *Safety Analysis Process - New Project.* The format and content of this PSE follows the guidance provided in HNF-PRO-703, Attachment A, *"PSE Format and Content."*

The Design Requirements Document (DRD, WHC 1996a) identifies the functions, performance requirements, and constraints necessary to define the IHLW-ISF. Based on the preliminary design information available in the DRD (WHC 1996a) and the CDR, this PSE addresses the following specific topics:

- Evaluation of the existing CSB structures, systems, and components (SSCs) that interface with the storage of the IHLW canisters
- Facility radioactive and hazardous material inventories
- Facility hazard categorization
- Preliminary assessment of the design's ability to adequately contain the radioactive and hazardous material inventories
- Evaluation of the design with respect to safety requirements and safety related design criteria
- Identification of SSCs that can prevent and/or mitigate postulated accidents
- Risks to the CSB and surrounding facilities arising from construction activities
- Future safety documentation requirements to support the start of construction and operations
- Interfaces with related projects, facilities, and activities
- Safety related issues that must be resolved prior to the start of operations

Project W-464 will provide interim storage for canisters containing high level waste described in Section 1.0 of the CDR. These canisters contain vitrified high level waste (HLW) which is in the form of glass poured into the canister, canisters of Cs loaded ion exchange resin (free flowing powder), and "nonroutine" canisters containing failed melter material and other equipment contacting the HLW. The canisters of vitrified waste and the "nonroutine" canisters will be collectively referred to as IHLW canisters.

Project W-464 will complete Vaults 2 and 3 of the existing CSB. Project W-464 will require modifications to the existing facility, such as the addition of the storage tubes, MHM/crane modifications, and replacement of the 5-ton cask lid crane with a 10-ton crane. The following items and services, required to complete the IHLW storage system, are not in the Project W-464 scope (i.e., they are existing or planned CSB features):

- CSB above ground structure
- Below grade, shielded storage vaults with storage tube access from the grade level operating area above
- Embedded sleeves through the 5 foot thick reinforced concrete operating deck
- Service building, adjacent to the operating structure, that houses the equipment necessary for compressed air, electrical power, HVAC, security, and fire protection
- The inert gas system that consists of a bottle rack located outside of the building with the gas hard piped into the operating area
- The receiving crane that unloads the transportation cask from the transport vehicle into the receiving area (northwest corner of the operating area)
- The MHM that transports the canister within the CSB. The MHM is a large and complex machine consisting of a cask mounted on a gantry crane which can deposit or retrieve canisters at any of the locations intended for storage
- Monitoring and control systems associated with the equipment which moves, places, stores, and retrieves the canisters
- Remote loading and unloading equipment for moving canisters into and out of the transportation casks
- Addition of insulating concrete in Vaults 2 and 3

Project W-464 will perform the following activities:

- Design, fabricate, construct, test, and qualify Vaults 2 and 3 ventilation inlet and outlet structures, storage tubes, tube plugs, impact absorbers, transportation cask, and truck based transport vehicle
- Replace the existing 5-ton cask lid crane with a 10-ton crane
- Modify the MHM to provide additional shielding, a longer turret body casting, improved controls, increased load capacity, and a new grapple
- Procurement of two cask transport vehicles for cask transportation from the private contractor facility to the CSB

CSB Operations will be responsible for:

- Acceptance and handling of IHLW or Cs canisters
- Storing of the IHLW or Cs canisters on an interim basis
- Retrieving the IHLW or Cs canisters from interim storage

The concept for the IHLW-ISF is to receive IHLW and Cs canisters at the CSB inside of a shielded transportation cask. The transportation cask is lowered into the service pit where additional shielding is put in place and the cask lid is removed. The IHLW or Cs canister is lifted from the transportation cask and into the MHM. The MHM transports the canister to the storage tube located in the floor of the CSB. The MHM inserts the canister into the storage tube and places the storage tube plug. Eventually the canister will be retrieved from storage and prepared for final offsite disposal.

The CSB is located on the western side of the 200 East Area of the Hanford Site, and consists of two major buildings, the operating structure and the service building. The operating structure houses the handling equipment, embedded storage tubes, and three storage vaults. Vault 1 will hold MCOs containing spent nuclear fuel. Vaults 2 and 3 will be completed and then used for the interim storage of the IHLW or Cs canisters. Each vault consists of 22 rows of 10 storage tubes each and 6 additional storage tubes dedicated for possible overpacked canisters for a total of 226 tubes. The vaults are air cooled by natural convection.

The preliminary Fire Hazards Analysis, as required by DOE Order 5480.7A, *Fire Protection*, DOE Order 6430.1A, *General Design Criteria*, HNF-PRO-340, *Fire Protection Program Overview*, and HNF-PRO-703, will be a revision to HNF-SD-SNF-FHA-002, Rev 2, *Phase 2 Fire Hazard Analysis for the Canister Storage Building*, (HNF 1997b) and will be scheduled and completed during preparation of future Project W-464 safety documentation. The PHA (Attachment

A) identifies several process related fire hazard scenarios but does not encompass the construction and industrial fire hazards (e.g., electric cables and equipment, paints, etc.) Therefore, the development of a comprehensive list of hazards is deferred until a more detailed design is available.

1.2 SUMMARY

The results of this PSE are summarized as follows:

- The IHLW-ISF represents a hazard category 2 nuclear facility. This is based upon a preliminary hazard categorization considering total inventory, regardless of form or dispersibility, per DOE-STD-1027-92. The addition of the W-464 inventory does not change the existing CSB hazard category as discussed in Section 3.4.
- The IHLW and Cs canisters serve to provide the first barrier to mitigate a potential release of radioactive waste to the environment. However, the qualification of the canisters to resist impacts such as drops during handling operations was unknown at the time this PSE was developed.
- The analysis of the postulated accidents indicates that some potential dose consequences (without mitigation) exceed the Safety Significant (SS) or Safety Class (SC) thresholds. Therefore Safety Significant and Safety Class SSCs might be required to prevent or mitigate the potential consequences.
- Section 4.1.2.4 lists PHA findings for safety improvements to be considered for enhancing the safety of the facility operation.

2.0 DESIGN CRITERIA

2.1 DESIGN CRITERIA IDENTIFICATION

The DRD Section 3.3.6, "Safety and Regulatory Compliance," specifically identified the following safety design criteria:

- Design Basis Accidents. The project shall be designed to withstand the effects of design basis accidents (DBAs), as delineated in DOE Order 6430.1A, *General Design Requirements*, DOE Order 5480.23, *Nuclear Safety Analysis Reports*, and DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Non-Reactor Nuclear Facilities Safety Analysis Report* with confinement of radioactive and toxic materials to maintain potential releases within allowable limits. The performance category PC3 requirements from DOE Order 5480.28, *Natural Phenomena Hazard Mitigation*, shall be applied for the Design Basis Earthquake.

- Abnormal Operation. The design shall include provisions to monitor, and alarm on detection, abnormal conditions such as radioactive particulate release, liquid intrusion, gaseous release, abnormal radiation levels, fires, and overheating or pressurization.

- Personnel Radiation Exposure. Personnel radiation exposure shall be in accordance with as low as reasonably achievable (ALARA) principles, and 10 CFR Part 835, *Occupational Radiation Protection*.

In addition, the design shall comply with DOE Order 5480.24, *Nuclear Criticality Safety* (DOE 1992c) as stated in Section 3.3.8 of the DRD.

2.2 COMPLIANCE WITH SAFETY DESIGN CRITERIA

The W-464 Project has addressed the design criteria as found in DOE Order 6430.1A, *General Design Requirements*; DOE Order 5820.2A, *Radioactive Waste Management*; DOE Order 5480.4, *Environmental Protection, Safety, and Health Protection Standards;* DOE Order 5400.5, *Radiation Protection of the Public and Environment*; DOE Order 5480.28, *Natural Phenomena Hazards*; and DOE Order 5480.7A, *Fire Protection*. There are no planned deviations from the above criteria with the exception of DOE Order 5480.7A. This exception is due to the absence of automatic fire suppression system (sprinklers) over the operating deck as discussed in Section IV of the CDR.

Appendix E of the CDR provides the summary level specifications for the design and construction of the W-464 Project based on the design criteria in the DRD.

2.3 SAFETY STRUCTURES, SYSTEMS, AND COMPONENTS

This section identifies the Safety Significant and Safety Class SSCs per criteria in HNF-PRO-704 and DOE-STD-3009-94, Chapter 4. Suggested Safety Significant and Safety Class SSCs for the safe operation of the IHLW-ISF are shown in Table 2-1. The Safety Class SSCs for the IHLW-ISF are designed to the existing CSB seismic requirements and are qualified to withstand an earthquake with a peak horizontal ground acceleration of 0.35 g. The following existing structures are seismically qualified for an earthquake with a peak horizontal ground acceleration of 0.35 g (HNF 1997c).

- Building structure, including load-in/load-out and Hot Conditioning Annex areas
- Operating deck
- Operating deck penetrations
- Below grade vaults

Table 2-1. Preliminary Safety Equipment List.*

SSC	Accident Analysis Section	Safety Classification	Safety Function
Impact Absorber	4.2.7.1, 4.2.7.2, & 4.2.7.3	SS	Mitigate the consequences of a canister drop in the storage tube.
Storage Tube	4.2.7.1 4.2.7.2 4.2.7.3 & 4.2.7.8	SC	Containment of any release following a canister drop (SS). Hold storage canisters within the tube during a seismic event to prevent possible damage (SC).
MHM-Tube Seal	4.2.7.1, 4.2.7.2,& 4.2.7.3	SS	Containment of any release following a canister drop.
MHM Grapple and Lifting Device ***	4.2.7.1, 4.2.7.2,& 4.2.7.3	SS	Prevent the drop of the canister.
Receiving Crane, Grapple, Lifting Devices (handling of transportation cask) ***	4.2.7.4	SS	Prevent the drop of the transportation cask into the receiving pit.
Transportation Cask **	4.2.7.4	SS	Sustain the impact of a cask drop without breach.
MHM Brake and Lateral Restraint	4.2.7.5, 4.2.7.6, & 4.2.7.7	SC	Maintain the position of the MHM during a seismic event.
Truck Barriers	4.2.7.7	SC	Prevent truck from impacting the MHM.
Shielding of MHM, receiving pit, storage tube plugs, louvers, vault structure, and operating deck	4.1.2.3	SS	Protect workers from unacceptable radiation doses during normal operations.
Cask Shielding	4.1.2.3	SS	Protect workers from unacceptable radiation doses during normal operations.
CSB Operating Deck	4.2.7.8	SC	Prevent failure of tube during a seismic event.
Vault Ventilation Inlet/Outlet Structures (plenums, louvers, stacks)	4.2.7.8	SC	Prevent damage to the operating deck and storage tubes that could result in a release during a seismic event.
CSB Roof	4.2.7.8	SC	Prevent collapse of building onto storage tubes.

* This preliminary safety equipment list identifies safety SSCs; further design development may revise the list.

** The unmitigated onsite consequence is below, but near, the guideline. Designation of the cask as Safety Significant should be considered.

*** These are alternative safety SSCs to be considered for the prevention/mitigation of the respective accident.

2.4 ASSUMPTIONS

Significant assumptions used in this PSE are listed below.

- The building structure, vault, and operating deck are designed to sustain a Safety Class design basis earthquake, wind, tornado, and ashfall (HNF 1997c).
- The waste packaging process will ensure that no water is present inside the IHLW or Cs canisters when received at the CSB.
- Design provisions at the CSB are adequate to preclude the entrance of water into the storage tubes.
- The facility will be capable of receiving the transportation casks, placing the canisters in their designated interim storage locations, and retrieving the canisters from storage (WHC 1996a).
- The normal operations at the CSB will safely monitor and control the equipment for the canister movement, placement in tubes, and retrieval.
- The CSB handling equipment as modified for the IHLW-ISF will provide the necessary shielding to limit exposure to facility workers (WHC 1996a).
- The canister maintains sufficient integrity following a canister drop to limit the release of radioactive material. The analysis uses a leak path factor (LPF) of 0.1 to account for the limited release.
- The glass fines generated during fragmentation of the glass from the canister drop events are the only significant source of material for release. Any pre-existing glass fines (such as those created by glass fracture from thermal stresses) would not be a significant contributor to the release.
- For a multiple glass canister drop accident, two worst case inventory canisters are involved in the accident (see Section 4.2.6.2).
- Engineered safety features or administrative controls are adequate to prevent the canister from being raised more than 1.5 m above the CSB operating deck.

The above assumptions must be maintained through any design evolution process in order to preserve the conclusions of this PSE. Technical Safety Requirements (TSRs) and safety SSCs may be required to maintain some of these assumptions. Some of the assumptions are also the subject of items requiring further resolution and are addressed in Section 8.0.

3.0 HAZARDOUS MATERIAL INVENTORIES

This section describes the radiological and nonradiological hazardous material inventories to be handled at the facility for use in quantifying accident consequences. Domentation requirements for the canister inventory will be identified in the Interface Control Documents. Future safety analysis will address the hazard associated with exceeding inventory limits and will establish the appropriate control requirements.

3.1 RADIOLOGICAL INVENTORY

The HLW glass canisters are stainless steel, 4.5 m long x 0.61 m in diameter, meeting the leak rate criteria specified in the DRD (WHC 1996a). The maximum capacity is 3,060 kg of glass; the nominal capacity is 2,735 kg of glass. The density of the glass is 2,640 kg/m^3. The glass will have a maximum concentration of radionuclides as shown in Table 3-1 (data from WHC 1996a, Table 3-4). The nominal average inventories per container in curies, are also listed in Table 3-1. These inventories were calculated by taking the product of the concentration limits (Ci/kg) and the nominal canister glass mass of 2,735 kg. The inventory in the "nonroutine" canisters is assumed to be bounded by the inventory in the HLW glass canisters.

The overall size of the Cs canisters is the same as for the IHLW canisters. Each stainless steel Cs canister can have up to 3.2 x 10^5 Ci of ^{137}Cs/^{137m}Ba and 2.1 Ci ^{135}Cs in each container. However, the aggregate inventory per storage tube will not exceed 3.2 x 10^5 Ci of ^{137}Cs/^{137m}Ba and 2.1 Ci ^{135}Cs regardless of the number of containers per storage tube (WHC 1996b). The limit on Cs per tube can all be in one canister with no others present, or in multiple canisters with the sum of the multiple canister curie contents not to exceed 3.2 x 10^5 Ci of ^{137}Cs/^{137m}Ba and 2.1 Ci ^{135}Cs. The shipper will determine and certify the Cs content of the canisters and it is the responsibility of the IHLW-ISF operator to allocate placement in the tubes.

Table 3-1. Container Radiological Inventory.

Isotope	Glass Radionuclide Concentration (Ci/kg)	Nominal Canister Inventory (Ci/Canister)(1)	Isotope	Glass Radionuclide Concentration (Ci/kg)	Nominal Canister Inventory (Ci/Canister)(1)
^{55}Fe	1.6 E-02	4.4 E+01	^{135}Cs	4.8 E-04	1.3 E+00
^{59}Ni	2.3 E-04	6.3 E-01	^{137}Cs	4.8 E+01	1.3 E+05
^{60}Co	4.8 E-02	1.3 E+02	^{134m}Ba	4.8 E+01	1.3 E+05
^{63}Ni	2.6 E-02	7.1 E+01	^{144}Ce	1.6 E-03	4.4 E+00
^{79}Se	6.8 E-06	1.9 E-02	^{144}Pr	1.6 E-03	4.4 E+00
^{90}Sr	5.0 E+01	1.4 E+05	^{144m}Pr	1.6 E-06	4.4 E-03
^{90}Y	5.0 E+01	1.4 E+05	^{147}Pm	2.6 E+00	7.1 E+03
^{93m}Nb	1.4 E-03	3.8 E+00	^{151}Sm	1.5 E+00	4.1 E+03
^{93}Zr	2.3 E-03	6.3 E+00	^{152}Eu	2.4 E-03	6.6 E+00
^{99}Tc	7.3 E-02	2.0 E+02	^{154}Eu	2.6 E-01	7.1 E+02
^{106}Ru	3.2 E-03	8.8 E+00	^{155}Eu	1.5 E-01	4.1 E+02
^{106}Rh	3.2 E-03	8.8 E+00	^{234}U	1.2 E-05	3.3 E-02
^{107}Pd	6.5 E-05	1.8 E-01	^{235}U	5.2 E-07	1.4 E-03
^{110m}Ag	1.6 E-07	4.4 E-04	^{236}U	1.3 E-06	3.6 E-03
^{113m}Cd	1.8 E-02	4.9 E+01	^{238}U	9.4 E-06	2.6 E-02
^{113m}In	3.0 E-05	8.2 E-02	^{237}Np	3.7 E-04	1.0 E+00
^{113}Sn	3.0 E-05	8.2 E-02	^{238}Pu	1.8 E-03	4.9 E+00
^{115m}Cd	1.1 E-08	3.0 E-05	^{239}Pu	1.5 E-02	4.1 E+01
^{119m}Sn	1.6 E-07	4.4 E-04	^{240}Pu	4.2 E-03	1.1 E+01
^{121m}Sn	1.5 E-04	4.1 E-01	^{241}Pu	1.1 E-01	3.0 E+02
^{126}Sn	7.7 E-04	2.1 E+00	^{242}Pu	1.1 E-06	3.0 E-03
^{124}Sb	4.2 E-08	1.5 E-04	^{241}Am	6.9 E-01	1.9 E+03
^{126}Sb	7.8 E-05	2.1 E-01	^{242}Am	5.0 E-04	1.4 E+00
^{126m}Sb	5.5 E-04	1.5 E+00	^{242m}Am	5.2 E-04	1.4 E+00
^{125}Sb	1.6 E-01	4.4 E+02	^{243}Am	8.1 E-05	2.2 E-01
^{125m}Te	4.8 E-02	1.3 E+02	^{242}Cm	6.0 E-04	1.6 E+00
^{129}I	1.5 E-06	4.1 E-03	^{244}Cm	1.5 E-02	4.1 E+01
^{134}Cs	1.1 E-01	3.0 E+02			

(1) Inventory per canister obtained by multiplying the concentration limit by the nominal glass mass per canister of 2,735 kg.

3.2 TOXICOLOGICAL INVENTORY (HAZARDOUS CHEMICALS)

There are no process chemicals or waste chemicals present in the IHLW interim storage facility. There are no processing activities or generation of waste streams in this facility.

Ordinary industrial chemicals may be allowed at the facility in the form of solvents and cleaners, paints, printer toner, etc. Specific chemicals have not been identified, but unacceptable hazards are not expected with these chemicals. Unless these chemicals are brought into the facility in inordinate quantities, they represent hazards which are accepted on a daily basis by the general public and are therefore outside the scope of this PSE. If large quantities of these ordinary chemicals or an unusual chemical are brought into the facility or placed in such a location so as to pose a reactivity hazard, then this assumption must be re-evaluated.

3.3 BOUNDING INVENTORY

The CSB design includes three below grade vaults, two of which will be used to store the IHLW or Cs canisters. As discussed earlier, each vault consists of a matrix of 22 rows by 10 columns for a total of 220 steel storage tubes. Six oversized storage tubes are also provided in each vault to accommodate overpacked canisters. With the capacity for two 4.5 m long canisters in each tube, the total per vault loading is potentially 452 canisters. The maximum loading per vault of Cs containers could range from 226 (1 Cs canister per storage tube) to 452. However the aggregate inventory per storage tube will not exceed 3.2 x 10^5 Ci of ^{137}Cs/^{137m}Ba and 2.1 Ci ^{135}Cs regardless of the number of containers per storage tube (see Section 3.1).

3.4 HAZARD CATEGORIZATION

For the SNF storage mission, the CSB has been designated as a Hazard Category 2 facility (HNF 1997c) before consideration of the IHLW inventory. The IHLW inventory will be an addition to the inventory of the CSB.

DOE Order 5480.23 defines a facility's hazard category based on the consequences of unmitigated releases determined by a hazard analysis of the facility's nuclear activities. These are then classified as Category 1, 2, or 3 based on the following definitions.

Category 1. The hazard analysis shows the potential for significant offsite consequences.

Category 2. The hazard analysis shows the potential for significant onsite consequences.

Category 3. The hazard analysis shows the potential for significant, but localized consequences.

DOE-STD-1027-92 provides guidance on determination of hazard categories based on comparison of individual radionuclides to the threshold quantities for Hazard Category 2 and 3. The ratios between the facility inventory at risk and the category threshold quantity for each radionuclide are summed if all the individual quantities are less than the threshold quantities. If a facility falls below the Category 3 threshold, it is exempt from the requirements of DOE Order 5480.23.

The Category 2 threshold quantities are used to determine the facility hazard categorization if the Category 3 facility threshold quantities are exceeded. The facility is Hazard Category 3 if the Category 2 threshold quantities are not exceeded. The facility is Hazard Category 2 if it contains more than the Category 2 threshold quantities of radioactive material and it is not a Category A reactor or designated as Hazard Category 1 by the Program Secretarial Officer.

Table 3-2 provides curie contents of isotopes for a single IHLW canister with the nominal inventory, the Category 2 and 3 threshold values for the isotopes, and the ratio of the isotope inventory to the Category 2 threshold quantity. Many isotope inventories exceed Category 3 thresholds, therefore, the comparison is performed to the Category 2 thresholds. The result is that some of the radionuclides exceed the Category 2 thresholds. Because the ratio of the canister inventory to the Category 2 thresholds exceeds 1.0 for some isotopes, such as ^{90}Sr, ^{137}Cs, and ^{241}Am, the sum of the ratios will also exceed 1.0. Therefore, the IHLW-ISF will be classified preliminarily as a Hazard Category 2 facility on the basis of only one canister.

The CSB was previously described as a Hazard Category 2 facility (HNF 1997c) without consideration of the inventory described above. The IHLW inventory will be an addition to the spent nuclear fuel inventory of the CSB. The designation for the CSB facility will remain as Hazard Category 2.

Table 3-2. Hazard Categorization.

Isotope	Nominal Canister Inventory from Table 3-1 (Ci/Canister)	Category 3 Threshold Values (Ci)	Category 2 Threshold Values (Ci)	Ratio Inventory/ Category 2
^{55}Fe	4.4 E+01	5.4 E+03	1.1 E+07	4.0 E-06
^{59}Ni	6.3 E-01	--	4.3 E+05	1.5 E-06
^{60}Co	1.3 E+02	2.8 E+02	1.9 E+05	6.8 E-04
^{63}Ni	7.1 E+01	5.4 E+03	4.5 E+06	1.6 E-05
^{79}Se	1.9 E-02	--	4.3 E+05	4.4 E-08
^{90}Sr	1.4 E+05	1.6 E+01	2.2 E+04	6.4 E+00
^{90}Y	1.4 E+05	--	--	--
^{93m}Nb	3.8 E+00	--	4.3 E+05	8.8 E-06
^{93}Zr	6.3 E+00	6.2 E+01	8.9 E+04	7.1 E-05
^{99}Tc	2.0 E+02	1.7 E+03	3.8 E+06	5.3 E-05
^{106}Ru	8.8 E+00	1.0 E+02	6.5 E+03	1.4 E-03
^{106}Rh	8.8 E+00	--	4.3 E+05	2.0 E-05
^{107}Pd	1.8 E-01	--	4.3 E+05	4.2 E-07
^{110m}Ag	4.4 E-04	2.6 E+02	5.3 E+05	8.3 E-10
^{113m}Cd	4.9 E+01	1.1 E+01	1.8 E+04	2.7 E-03
^{113m}In	8.2 E-02	--	4.3 E+05	1.9 E-07
^{113}Sn	8.2 E-02	1.3 E+03	3.2 E+06	2.6 E-08
^{115m}Cd	3.0 E-05	--	4.3 E+05	7.0 E-11
^{119m}Sn	4.4 E-04	--	4.3 E+05	1.0 E-09
^{121m}Sn	4.1 E-01	--	4.3 E+05	9.5 E-07
^{126}Sn	2.1 E+00	1.7 E+02	3.3 E+05	6.4 E-06
^{124}Sb	1.2 E-04	3.6 E+02	1.3 E+06	9.2 E-10
^{126}Sb	2.1 E-01	2.8 E+02	2.5 E+06	8.4 E-08
^{126m}Sb	1.5 E+00	--	4.3 E+05	3.5 E-06
^{125}Sb	4.4 E+02	--	4.3 E+05	1.0 E-03
^{125m}Te	1.3 E+02	--	4.3 E+05	3.0 E-04
^{129}I	4.1 E-03	9.2 E-01	1.8 E+03	2.3 E-06
^{134}Cs	3.0 E+02	4.2 E+01	6.0 E+04	5.0 E-03
^{135}Cs	1.3 E+00	--	4.3 E+05	3.0 E-06
^{137}Cs	1.3 E+05	6.0 E+01	8.9 E+04	1.5 E+00
^{137m}Ba	1.3 E+05	--	4.3 E+05	3.0 E-01
^{144}Ce	4.4 E+00	1.0 E+02	8.2 E+04	5.4 E-05
^{144}Pr	4.4 E+00	--	4.3 E+05	1.0 E-05
^{144m}Pr	4.4 E-03	--	4.3 E+05	1.0 E-08

Table 3-2. Hazard Categorization.

Isotope	Nominal Canister Inventory from Table 3-1 (Ci/Canister)	Category 3 Threshold Values (Ci)	Category 2 Threshold Values (Ci)	Ratio Inventory/ Category 2
^{147}Pm	7.1 E+03	1.0 E+03	8.4 E+05	8.5 E-03
^{151}Sm	4.1 E+03	1.0 E+03	9.9 E+05	4.1 E-03
^{152}Eu	6.6 E+00	2.0 E+02	1.3 E+05	5.1 E-05
^{154}Eu	7.1 E+02	2.0 E+02	1.1 E+05	6.5 E-03
^{155}Eu	4.1 E+02	9.4 E+02	7.3 E+05	5.6 E-04
^{234}U	3.3 E-02	4.2 E+00	2.2 E+02	1.5 E-04
^{235}U	1.4 E-02	4.2 E+00	2.4 E+02	5.8 E-06
^{236}U	3.6 E-03	--	5.5 E+01	6.5 E-05
^{238}U	2.6 E-02	4.2 E+00	2.4 E+02	1.1 E-04
^{237}Np	1.0 E+00	4.2 E-01	5.8 E+01	1.7 E-02
^{238}Pu	4.9 E+00	6.2 E-01	6.2 E+01	7.9 E-02
^{239}Pu	4.1 E+01	5.2 E-01	5.6 E+01	7.3 E-01
^{240}Pu	1.2 E+01	--	5.5 E+01	2.0 E-01
^{241}Pu	3.0 E+02	3.2 E+01	2.9 E+03	1.0 E-01
^{242}Pu	3.0 E-03	--	5.5 E+01	5.5 E-05
^{241}Am	1.9 E+03	5.2 E-01	5.5 E+01	3.5 E+01
^{242}Am	1.4 E+00	--	5.5 E+01	2.5 E-02
^{242m}Am	1.4 E+00	5.2 E-01	5.6 E+01	2.5 E-02
^{243}Am	2.2 E-01	5.2 E-01	5.5 E+01	4.0 E-03
^{242}Cm	1.6 E+00	3.2 E+01	1.7 E+03	9.4 E-04
^{244}Cm	4.1 E+01	--	5.5 E+01	7.5 E-01

-- No threshold value for the isotope in this category.

4.0 ACCIDENT EVALUATION

The purpose of this accident evaluation is to identify facility hazards, facility specific safety features and functions, and assess the adequacy of the facility's design to withstand the postulated accidents. Since this project modifies Vaults 2 and 3 of the CSB for the storage of IHLW and Cs canisters, this analysis will not only evaluate the new design, but also the existing CSB SSCs that will be used to prevent/mitigate accidents involving the IHLW or Cs canisters.

4.1 PRELIMINARY HAZARDS ANALYSIS

The PHA is a form driven exploratory procedure for identifying hazards and candidates for controls. The PHA results are used for binning and screening of hazards and the development of accident scenarios.

4.1.1 Methodology

This section presents the methodology used to identify and characterize hazards associated with the handling and storage of the IHLW and Cs canisters in the CSB. The form used for the PHA is shown in Attachment A.

4.1.1.1 Hazard Identification. Hazards identification is the process of identifying material, system, process, and facility characteristics with the potential to initiate accidents having undesirable consequences. The primary method of Hazard Identification/Hazard Evaluation used for Project W-464 was a PHA. A PHA is a systematic approach in which the basic elements of the system and the hazards of interest at the conceptual design stage are identified, potential causes and effects are qualitatively evaluated, and possible corrective and/or preventive measures are proposed. The PHA was performed by personnel with experience in safety analysis methodology and personnel with knowledge of the IHLW-ISF design. The completed Project W-464 PHA table is contained in Attachment A.

4.1.1.2 Recording of Identified Hazards. The PHA table consists of 11 columns as shown in Attachment A. The first column, designated "ID", is a an alphanumeric identifier for the line of information in the table. The ID identifier permits cross referencing the information contained in the PHA with assumptions found in the accident scenarios. Block numbers are also shown in this column and originate from a block diagram of the operating sequence that was used for identifying hazards. The task is divided into three phases for the purpose of designating the ID identifier. The phase for receipt of the cask at the CSB is designated with a "D". The phase for handling the canister and placing it in the storage tube with the MHM is designated with an "M". The phase associated with the removal of the cask from the CSB is designated with an "R". The ID identifiers are maintained throughout this document to permit identification of the source of the accident information.

The second column, designated "Operating Sequence Mode/Block", is used to describe the task step being reviewed.

The third column, "Hazard, Energy Source, Material", identifies the specific hazard that is being evaluated.

The fourth column, "Hazardous Condition", identifies the upset state that results from the hazard, energy source, or material identified in the third column.

The fifth column, "Cause", contains a description of the operation and/or conditions necessary for the hazard to become an accident.

The sixth column, "Potential Accident", contains a description of the accidents, that could release hazardous materials and cause consequences to the facility worker, onsite collocated worker, or the offsite receptor.

The seventh column, "Consequence", lists the consequences of the potential accident without mitigation or preventative measures.

The eighth column, "Safety Features", is further divided into "Engineered Features" used to list the physical design features that may be used to mitigate or prevent the event being considered and "Administrative Features" listing the potential administrative controls such as procedures, training, practices, etc., that could mitigate or prevent the event.

The ninth column, "Cons Cat" (for consequence category), contains a qualitative estimate of the result of the event, assuming that no engineered or administrative controls are present. However, naturally occurring phenomena (i.e., physical laws) that limit the consequence of an event are taken into account. The consequence ranking column is a "first cut", qualitative, consensus estimate of the safety severity of the consequences. An alphanumeric system was used to designate the severity, with the following "S" rankings characterizing consequences:

S0	No effect outside the facility confinement systems and no safety concerns for the environment, the facility worker, the onsite worker, or members of the general public.
S1	Potential industrial injury, radiological dose consequences or chemical exposure to the facility worker; limited environmental discharge of hazardous material outside the facility.
S1*	Potential life threatening injury or death for a facility worker, including significant internal or acute external exposures leading to medical treatment or care.
S2	Potential significant radiological dose consequences or chemical exposure to the onsite worker outside of the facility;

environmental discharge of hazardous material within the Hanford site boundary.

S3 Potential significant radiological dose consequences or chemical exposure to the offsite population; environmental discharges of hazardous material outside the Hanford site boundary or to the groundwater.

The tenth column, "Freq Cat" (for frequency category), contains a "first cut", qualitative, consensus estimate of the frequency for the consequences assuming that no engineered or administrative safety features are present. An alphanumeric system was used to designate the frequency, with the following "F" rankings characterizing frequency ranges:

F0 Events not expected to occur and categorized as beyond extremely unlikely. The frequency is < 1 E-06 yr^{-1}.

F1 Events not expected to occur within the lifetime of a typical facility and categorized as extremely unlikely. The frequency is between 1 E-06 yr^{-1} and 1 E-04 yr^{-1}.

F2 Events which could occur during the lifetime of the facility and categorized as unlikely. The frequency is between 1 E-04 yr^{-1} and 1 E-02 yr^{-1}.

F3 Events which are expected to occur one or more times during the lifetime of the facility and categorized as anticipated. The frequency is greater than 1 E-02 yr^{-1}.

The "Remarks" column contains information that the team judged to require documentation. The information presented here includes, but is not limited to, assumptions and/or concerns about the specific step in the task identified in the PHA meeting.

4.1.1.3 PHA Performance Methodology. This section describes the process used in the PHA. The PHA table (Attachment A) is organized in sections to provide a structure that ensures a comprehensive look has been taken at all aspects of the operation associated with canister storage. Each section is oriented either to a Delivery, an MHM operation, or a Return phase. The PHA sections are:

D-01 through D-25	These are the activities involved in delivery of the transport cask and transfer of the cask to the unloading pit.
M-01 through M-38	These are the activities involved in the transfer of the canister from the cask (residing in the pit) into the MHM and transport of the canister to a position over a storage tube where it is lowered to its storage position.

R-01 These are the activities involved in removal of the cask from the pit.

Operational activities were evaluated by the team applying questions addressing: (1) the activity or function intended or expected to be seen at specific time intervals, (2) the definition of equipment malfunction and task failure, (3) the characteristics or modes associated with the failure. (4) the hazardous material affected with such a malfunction or failure, and (5) the estimated consequence and frequency.

The qualitative consequence and frequency estimates for accidents potentially resulting from the identified events were generated by the PHA team using a Delphi approach based on the team members' experience and judgment. A Delphi approach can be quite extensive. An example of the Delphi approach is presented in IEEE Standard 500-1984, *IEEE Guide to the Collection and Presentation of Electrical, Electronic, Sensing Component, and Mechanical Equipment Reliability Data for Nuclear Power Generating Stations*. The criteria for the consequence and frequency categories are listed in Section 4.1.1.2.

4.1.1.4 Hazard Evaluation/Accident Selection Methodology. The selection of accidents for further quantitative analysis was then performed with a binning process as recommended by DOE-STD-3009-94 and HNF-PRO-704.

All accidents were binned according to the potential accidents identified in column 6 in the PHA table (Attachment A). The binning was based on grouping similar accidents that challenged similar barriers. The potential accidents were grouped into eight bins: (1) Cask/Lid Drop accidents, (2) Fire/Explosion accidents, (3) Canister Drop Accidents, (4) Canister Pinch/Shear Accidents, (5) High Temperature in Canisters, (6) Loss of Confinement Accidents, (7) Natural Phenomena accidents, and (8) Worker Safety. Affixing the characteristics for the specific hazards to these respective bins is done through the use of the same ID identifier as in the PHA Table (Attachment A). This process is referred to as binning and is presented in Table 4-1.

After binning, the accidents are screened considering the magnitude of their consequences. The accident screening criteria used is based entirely on qualitative consequence rankings from the PHA table. All accidents postulated in the S2 and S3 consequence categories (except those determined as "Beyond Extremely Unlikely") are candidates for later quantitative analysis. This results in a broader spectrum of candidate accidents being considered for quantitative analysis than is recommended by DOE-STD-3009-94, which allows the accident frequency to be considered in determining accidents which do not require further analyses.

The hazards were labeled as accidents which would not have effects of concern outside the facility boundary of the CSB (S0, S1 and S1* category consequences), accidents which could potentially have effects of concern to the onsite individual (S2 category consequences), and accidents identified as having potential effects to the offsite receptors (S3 category consequences).

The results of the binning and screening process are provided in Table 4-1. The table covers each hazard presented in the PHA. Table 4-1 also includes the selection of the representative accident for each bin. The representative accident and the basis for its selection is given in the last column.

Further discussion of the basis for selection is given in the following section.

Table 4-1. Binning, Screening, and Representative Accident Selection.

Bin No.	Title		Consequence Category	Representative Accident Basis
1.	Cask/Lid Drop			D-14 chosen to be representative accident because its 7 m drop distance into the pit is greater than 1 to 2 m drop for lids. Release fraction for glass is dependent on drop distance.
	D-14	Cask Drops into Pit (Section 4.2.7.4)	S2	
	D-17	Cask Lid Drop	S2	
	D-22	Cask Lid Drop	S2	
	M-03	Cask Lid Drop (Shield Hatch Assembly)	S2	
	Accidents W/S1 or S0 Consequences			Accidents of S1 and S0 consequence do not require further analysis.
	D-7/D-15	Yoke Drops on Cask	S0	
	D-9/D-12	Cask Falls to Floor	S0	
	D-10	Crane Falls on Cask	S0	
	M-18/M-19	Tube Plug Drop	S0	
	M-35	Tube Plug Drop (Seismic)	S0	
2.	Fire/Explosion			Aircraft accident has a frequency of occurrence determined to be Beyond Extremely Unlikely [HNF 1997d]) so no further analysis is required. Accidents of S1 and S0 consequences do not require further analysis.
	D-05	Aircraft Strikes Building	S3	
	D-20	Ignition at Cask Opening	S1	
	D-04	Truck Fire During Delivery	S0	
3.	Canister Drop			Three representative accidents were chosen to be analyzed, since there are several different combinations of radiological sources that could be dropped.
	M-07	MHM Canister Drop	S3	
	M-08/M-29	Canister Drop (Seismic)	S3	
	M-21	Canister Drop W/no Impact Limiter (Section 4.2.7.1)	S3	M-21 is representative of a single glass canister drop.
	M-23	Canister Drop onto Second Canister (Section 4.2.7.2)	S3	M-23 is representative of a multiple glass canister drop.
	M-24	Canister Drop in Cs Tube (Section 4.2.7.3)	S3	M-24 is representative of a multiple Cs canister drop.
	Accidents W/S0 & S1 Consequences			Accidents of S1 and S0 consequences do not require further analysis.
	M-20	Canister in Wrong Tube	S0	
	M-22	Overload Tube	S0	
	M-26	Canister Binds in Tube	S0	
4.	Canister Pinch/Shear			D-03 and M-09/M-30 were both chosen to be representative accidents.
	D-03	Truck Induced Impact (Section 4.2.7.7)	S3	
	M-09/M-30	Seismic Canister Shear (Glass & Cs) (Sections 4.2.7.5, 4.2.7.6)	S3	
	M-10	MHM Canister Pinch	S3	
	M-25	MHM Canister Pinch	S3	

Table 4-1. Binning, Screening, and Representative Accident Selection.

Bin No.	Title	Consequence Category	Representative Accident Basis
5.	High Temperature in Canister		Accidents of S1 and S0 consequence do not require further analysis.
	D-21/D-25 High Canister Temp in Pit	S1	
	M-31 High Canister Temp (Seismic)	S1	
	M-06/M-16/M-37 High Canister Temp in MHM	S0	
	M-32 High Canister Temp in MHM	S0	
6.	Loss of Confinement		Accidents of S1 and S0 consequence do not require further analysis.
	D-18/D-23 Release from Cask	S1	
	M-04 Cask Lid Removed	S1	
	M-14 Cask Lid Removed	S1	
	M-33 Canister Corrosion	S0	
7.	Natural Phenomena		
	M-27 Loss of Vault Cooling due to Natural Event (Section 4.2.7.9)	S0	Loss of cooling not expected to result in failure of canisters. Thermal analysis based on loss of total ventilation is in progress.
	D-06 High Wind, Ash and Snow Loading	S3	
	M-28 Earthquake Fails Tubes (Section 4.2.7.8)	S3	M-28 chosen to be representative accident because damage sustained would include any damage from M-29. Consequences from M-28 would bound any from M-29.
	M-29 Earthquake Fails Structure (Includes Ventilation Inlet/Outlet Structures)	S3	
8.	Worker Safety		Worker safety issues discussed in Section 4.1.2.3.
	D-19/D-24/M-05 High Radiation Exposure	S1*	Accidents designated S1* have consequences that involve worker fatality or serious injury to workers. S1* accidents will require Safety Significant SSCs or administrative controls for prevention or mitigation.
	M-11/M-13/M-36 High Radiation at MHM	S1*	
	M-34 Criticality	S1*	
	Accidents W/S0 & S1 Consequences		Accidents with S0 or S1 consequences do not require further analysis.
	D-01 Transporter Accident	S1	
	D-02 Transporter Accident (Heart attack)	S1	
	D-08/D-16 Yoke Drops on Worker	S1	
	D-11 Crane Falls on Worker	S1	
	D-20 Ignition at Cask Opening	S1	
	M-01/M-02 MHM Strikes Crane	S0	
	M-12/M-15 Worker Falls into Pit	S1	
	M-17/M-38 MHM Impact	S1	
	R-01/D-13 Cask Drop on Worker	S1	

4.1.2 Hazard Analysis Results

This section presents the results of the hazards analysis process and lists the accident scenarios to be further analyzed.

4.1.2.1 Hazard Identification Results. Because the PHA consequence ranking is based on the worst case potential consequence, it is important to recognize that accidents with potential consequences of concern affecting the offsite individual would generally also have potential consequences of concern affecting both the onsite individual and the facility worker. Furthermore, even though various accidents would have virtually the same consequences, they could be initiated by a number of events.

The hazards identified during the PHA (Attachment A) are documented as hazards with potential effects to the facility worker, hazards with potential effects to the onsite worker, and hazards with potential effects to the offsite public.

4.1.2.2 Selected Accidents. Accident analysis criteria require that a set of accidents be quantitatively analyzed. The accident selection methodology is described below and the results of the accident selection activity are shown.

For each selected hazard type with an S2 or S3 consequence in Table 4-1, a representative (bounding) accident was chosen for further analysis. A representative accident bounds the consequences of similar accidents or accident types. Similar accidents challenge analogous barriers. Analogous barriers reflect the same design philosophy for prevention and mitigation of the same accident type, even though they may be in different locations.

The accidents determined to be representative and to bound consequences from the bins of accidents are listed below along with the sections where they are evaluated.

1. Glass Canister Drop Accident
   (From Bin 3, ID M-21, Section 4.2.7.1)

2. Multiple Glass Canister Drop Accident
   (From Bin 3, ID M-23, Section 4.2.7.2)

3. Cs Canister Drop Accident
   (From Bin 3, ID M-24, Section 4.2.7.3)

4. Transport Cask with Canister Drop Accident
   (From Bin 1, ID D-14, Section 4.2.7.4)

5. Seismic Induced Glass Canister Shear Accident
   (From Bin 4, ID M-09/M-30, Section 4.2.7.5)

6. Seismic Induced Cs Canister Shear Accident
   (From Bin 4, ID M-09/M-30, Section 4.2.7.6)

7. Truck Impact with MHM Causing Canister Shear
(From Bin 4, ID D-03, Section 4.2.7.7)

8. Seismic Accident Causing Tube Failure
(From Bin 7, ID M-28, Section 4.2.7.8)

9. Loss of Cooling Accident
(From Bin 7, ID M-27, Section 4.2.7.9)

4.1.2.3 **Worker Safety.** Worker safety for Project W-464 is assured by a combination of confinement and shielding features and institutional practices defined in the SNF and TWRS Health and Safety Plans. These features and practices are integral to the facility design and operation. Accidents identified as worker safety concerns are shown in Table 4.1, Bin 8.

The industrial safety requirements for DOE sites are governed by 29 CFR 1910, which addresses such topics as working surfaces, machinery and machine guarding, compressed gas and compressed air equipment, and electrical requirements. Protection of the facility worker from standard industrial hazards (S1 consequences) is achieved through adherence to the requirements of 29 CFR 1910 and does not require specific Safety Significant SSCs or administrative features. The major features of worker protection from S1* consequence accidents are associated with radiation protection and criticality issues. The facility shielding design is designated as Safety Significant for worker protection. This applies to the transportation cask, the MHM, the receiving pit, operating deck, storage tube plugs, and the vault ventilation louvers. The shielding design and the radiological control program are established to meet ALARA goals for radiological exposure. Controls on the glass canisters will be established to address criticality concerns (see Section 4.2.8). A criticality safety evaluation will be performed during definitive design to assess the adequacy of the criticality controls.

4.1.2.4 **Design and Operational Safety Improvements Under Consideration.** In the process of performing the PHA, the team identified a number of potential opportunities to enhance the safety of the facility operations:

- The cask should be designed for transportation accidents, for the design basis earthquake (DBE) and for other possible hazards while in the CSB.
- The MHM should not be used during trailer movement.
- There should be a fuel limit for the truck.
- The truck should be removed before the outer door is closed and the cask is moved to the receiving pit.
- The cask should be hooked to the crane before the tiedowns are removed.

- A maximum lift height for the cask should be established and/or limited by design.

- The cask lid and cask should be engineered to prevent damage to contents from a drop of the lid.

- Canisters should be designed for impact resistance.

- The cask atmosphere should be checked before opening.

- The process sequence should be evaluated to assure adequate shielding is provided at all times.

- Requirements for cleanliness and dryness of the cask interior should be established.

- The design should ensure that cooling is sufficient to protect the integrity of the IHLW glass, the Cs ion exchange resin, and the canister.

- Limits on cask residence time in the pit should be established if required to maintain temperatures within limits.

- Recovery actions for equipment failures should be developed to prevent overheating.

- Interlocks should be provided to prevent movement of the MHM when the receiving crane is in the area.

- Procedures governing crane and MHM movement should be developed.

- At the MHM/pit interface, an O-ring sealed nose piece should be used to provide confinement.

- A guard should be provided to prevent personnel from closely approaching the MHM when a canister is present.

- The grapple should be designed with sensors that verify the MHM grapple has engaged the canister.

- Requirements should be developed to control the number of canisters in process at a given time.

- The MHM should have a touch bar to stop its motion when an object is contacted.

- An alarm and/or light should be activated when the MHM is in motion.

- Access ports should be provided to allow access to the plug hoist and grapple.
- Accountability Controls should be established to prevent intermingling waste types and to control the Cs radionuclide inventory in the storage tubes.
- Procedures for placement of canisters should be developed.
- Procedures for impact limiter installation should be developed.
- An interlock should be provided to prevent the grapple from opening before the canister reaches the intended position.
- The canister grapple should be designed so that it can not open under load.
- Controls on the quantity and use of water or solvents in the CSB should be established.

4.2 ACCIDENT ANALYSIS

This chapter presents the accident analyses performed for selected accident scenarios. The selected accident scenarios are described, including the key assumptions, and analyzed to determine the unmitigated consequences to onsite and offsite receptors. The consequences are compared to equipment design guidelines for determination of potential safety SSCs.

4.2.1 Consequence Analysis Methodology

Radiological doses to receptors are determined for the accident analysis with the following equation:

$$\text{Dose} = (\text{ST})(\Sigma\text{MDF or DCF})(\chi/Q')(\text{BR})$$

where:

Dose = inhalation effective dose equivalent (EDE) (rem)
ST = source term - respirable airborne release (kg or Ci)
ΣMDF = sum of isotope-specific mass dose factors for IHLW glass (rem/kg glass inhaled)
DCF = inhalation dose conversion factor (rem/Ci)
χ/Q' = atmospheric dispersion coefficient (s/m^3)
BR = breathing rate (m^3/s)

4.2.2 Source Term

A specific source term represents the product of the material at risk (MAR), the airborne release fraction (ARF), respirable fraction (RF), and the leak path factor (LPF). The general equation for the determination of a source term is:

Source term (ST) = (MAR)(ARF)(RF)(LPF)

4.2.2.1 MAR. For the purpose of these analyses, the MAR is assumed to be the postulated maximum inventory, which will be the mass of IHLW glass or Cs involved in each accident.

4.2.2.2. ARF and RF. The bases for the postulated releases and their associated ARFs and RFs are taken from DOE-HDBK-3010-94, *Airborne Release Fractions/Rates, and Respirable Fractions for Nonreactor Nuclear Facilities.* This reference provides factors for estimating the radiological releases in deterministic analyses of accident scenarios postulated for nonreactor nuclear facilities. The factors in DOE-HDBK-3010-94 are based on experimental data.

Glass Considerations. Mechanical impact releases from vitrified waste are found in DOE-HDBK-3010-94 in Section 4.3.3, which addresses impaction stress for nonmetallic or composite solids. In this section, it is noted that brittle materials such as glass can be fragmented when impacted or crushed. Data is presented from experiments to measure the fraction and size distribution generated by the impact of falling objects on various brittle materials resting on an unyielding surface. The degree of fragmentation and the size distribution were found to be a function of the material, strength and age of the material, and the energy input per volume. The fraction in the size range 10μm aerodynamic equivalent diameter and less for glass was empirically correlated with the energy input. The correlation was presented as:

ARF x RF (respirable release fraction) = (A)(P)(g)(h)

where:
ARF = airborne release fraction
RF = respirable fraction
A = empirical constant (2.0×10^{-11} cm-s^2/g)
P = specimen density g/cm^3
g = acceleration of gravity (980 cm/s^2)
h = height of drop (cm).

The glass samples used in the experiments were uniformly free of cracks and flaws. Vitrified waste, depending on its cool down rate, has been found to develop cracks and generation of glass fines within the cracks. These cracks were evenly distributed throughout the volume of the poured glass cylinders. Impact damage and fragmentation, as covered by the above correlation, is localized near the point of impact so contributions from existing fines would not be significant.

Cs Considerations. The ion exchange media holding Cs as received from the vendor has a particle size of 20 to 50 mesh (397 to 208 μm) as specified in WHC 1996a. Because no information is provided on the percentage of fines in the resin, it is estimated from PNNL 1981, that 0.1% of the resin will have been reduced to particles with a diameter of < 10 μm (i.e., the RF).

4.2.2.3 LPF. Using the guidelines of DOE-STD-3009-94, analysis of unmitigated scenarios may take credit for reduction of releases by passive design features (e.g., buildings) that may be assumed to remain in place during and after the accident. The reduction factor assumed for the passive design features is the LPF. In the accident scenarios presented in Section 4.2.7, credit is taken only for the existence of the canister. No credit is taken for the CSB structure or for the ventilation system. Transport of releases by the ventilation system would not affect the amount of material assumed to be released in the accident scenarios since the analyses take no credit for holdup of the releases in the building.

A source term is considered to be the amount of respirable material that has escaped containment and is available for transport to a receptor location. To determine the amount of material that could exit a canister during a mechanical release as the result of a container rupture, crush, or fall, an LPF as described in DOE-HDBK-3010-94 is used. The LPF is the fraction of airborne radioactive material that escapes from containment (e.g., the canister); therefore, the LPF accounts for the fractional release of contents from the damaged but still present container.

Information on damage to, or openings in, the canister as a result of drops or other accidents is not available. In the absence of direct data for the canisters, an LPF is conservatively based on information existing for storage drums. In HNF-SD-W026-SAR-002, *Final Safety Analysis Report (FSAR) For Waste Receiving and Processing (WRAP) Facility*, (HNF 1997a) an LPF of 0.1 was derived for the release of respirable material escaping from DOT 7A waste drums damaged due to falls or vehicle impacts. This value was based on the estimated area of the opening created by the accident as a percentage of the total surface area of the container. The validity of this LPF for use with the canister damage will be further verified when more information is available.

The LPF multiplied by the respirable release fraction (ARF x RF) yields the total respirable release fraction.

4.2.3 Mass Dose Factor

The consequences used for comparison to the equipment design guidelines are EDEs. The EDE is the sum of the products of the dose equivalent in a tissue or organ and the weighting factor for that tissue or organ. Since there are a significant number of isotopes in the MAR, each with a unique EDE inhalation DCF, the DCF for each isotope is multiplied by the respective activity per kilogram in Table 4-2 to yield an isotope-specific MDF. The isotope-specific MDFs are summed to determine a total MDF (ΣMDF) for glass containing all of the isotopes.

The EDE inhalation DCFs (in Sv/Bq) were obtained from *Limiting Values of Radionuclide Intake and Air Concentration and Waste Package Dose Factors for Inhalation, Submersion, and Ingestion* (EPA 1988). These values are converted to rem/Ci by multiplying by 3.7×10^{12} rem-Bq/Sv-Ci. For example, the inhalation DCF for insoluble ^{239}Pu (lung clearance class W) is 1.16×10^{-4} Sv/Bq or 4.29×10^{8} rem/Ci.

Table 4-2. Derivation of ΣMDF for IHLW Glass.

Isotope	Inventory from Table 3-1 (Ci/kg)	Inhalation dose conversion factor (Sv/Bq)	Inhalation dose conversion factor (rem/Ci)	Mass Dose Factor (rem/kg glass inhaled)
^{55}Fe	1.6E-02	7.26E-10	2.69E+03	4.30E+01
^{59}Ni	2.3E-04	3.58E-10	1.32E+03	3.04E-01
^{60}Co	4.8E-02	5.91E-08	2.19E+05	1.05E+04
^{63}Ni	2.6E-02	8.39E-10	3.10E+03	8.06E+01
^{79}Se	6.8E-06	2.66 E-09	9.84 E+03	6.69 E-02
^{90}Sr	5.0E+01	6.47 E-08	2.39 E+05	1.20E+07
^{90}Y	5.0E+01	2.28 E-09	8.44 E+03	4.22E+05
^{93m}Nb	1.4E-03	7.90E-09	2.92E+04	4.09E+01
^{93}Zr	2.3E-03	8.67E-08	3.21E+05	7.38E+02
^{99}Tc	7.3E-02	2.25 E-09	8.33 E+03	6.08 E+02
^{106}Ru	3.2E-03	1.29 E-07	4.71 E+05	1.53E+03
^{106}Rh	3.2E-03	5.77 E-11	2.13 E+02	6.82E-01
^{107}Pd	6.5E-05	3.45 E-09	1.27 E+04	8.26E-01
^{110m}Ag	1.6E-07	2.17 E-08	8.03 E+04	1.28E-02
^{113m}Cd	1.8E-02	4.13 E-07	1.53 E+06	2.75E+04
^{113m}In	3.0E-05	1.11 E-11	4.11 E+01	1.23E-03
^{113}Sn	3.0E-05	2.88 E-09	1.07 E+04	3.21E-01
^{115m}Cd	1.1E-08	1.95 E-08	7.22 E+04	7.94E-04
^{119m}Sn	1.6E-07	1.69 E-09	6.25 E+03	1.00E-03
^{121m}Sn	1.5E-04	3.11 E-09	1.15 E+04	1.73E+00
^{126}Sn	7.7E-04	2.69 E-08	9.95 E+04	7.66E+01
^{124}Sb	4.2E-08	6.80 E-09	2.52 E+04	1.06E-03
^{126}Sb	7.8E-05	3.17 E-09	1.17 E+04	9.13E-01
^{126m}Sb	5.5E-04	9.17 E-12	3.39 E+01	1.86E-02
^{125}Sb	1.6E-01	3.30 E-09	1.22 E+04	1.95E+03
^{125m}Te	4.8E-02	1.97 E-09	7.29 E+03	3.50E+02
^{129}I	1.5E-06	4.69 E-08	1.74 E+05	2.61 E-01
^{134}Cs	1.1E-01	1.25 E-08	4.63 E+04	5.09E+03
^{135}Cs	4.8E-04	1.23 E-09	4.55 E+03	2.18E+00
^{137}Cs	4.8E+01	8.63 E-09[1]	3.19 E+04[1]	1.53E+06
^{137m}Ba	4.8E+01	--	--	--
^{144}Ce	1.6E-03	1.01 E-07	3.74 E+05	5.98 E+02
^{144}Pr	1.6E-03	1.17 E-11	4.33 E+01	6.93 E-02
^{144m}Pr	1.6E-06	--[2]	--	--

Table 4-2. Derivation of ΣMDF for IHLW Glass.

Isotope	Inventory from Table 3-1 (Ci/kg)	Inhalation dose conversion factor (Sv/Bq)	Inhalation dose conversion factor (rem/Ci)	Mass Dose Factor (rem/kg glass inhaled)
^{147}Pm	2.6E+00	1.06 E-08	3.92 E+04	1.02 E+05
^{151}Sm	1.5E+00	8.10 E-09	3.00 E+04	4.50 E+04
^{152}Eu	2.4E-03	5.97 E-08	2.21 E+05	5.30 E+02
^{154}Eu	2.6E-01	7.73 E-08	2.86 E+05	7.44 E+04
^{155}Eu	1.5E-01	1.12 E-08	4.14 E+04	6.21 E+03
^{234}U	1.2E-05	3.58 E-05	1.32 E+08	1.58 E+03
^{235}U	5.2E-07	3.32 E-05	1.23 E+08	6.40 E+01
^{236}U	1.3E-06	3.39 E-05	1.25 E+08	1.63 E+02
^{238}U	9.4E-06	3.20 E-05	1.18 E+08	1.11 E+03
^{237}Np	3.7E-04	1.46 E-04	5.40 E-08	2.00 E+05
^{238}Pu	1.8E-03	1.06 E-04	3.92 E+08	7.06 E+05
^{239}Pu	1.5E-02	1.16 E-04	4.29 E+08	6.44 E+06
^{240}Pu	4.2E-03	1.16 E-04	4.29 E+08	1.80 E+06
^{241}Pu	1.1E-01	2.23 E-06	8.25 E+06	9.08 E+05
^{242}Pu	1.1E-06	1.11 E-04	4.10 E+08	4.51 E+02
^{241}Am	6.9E-01	1.20 E-04	4.44 E+08	3.06 E+08
^{242}Am	5.0E-04	1.58 E-08	5.84 E+04	2.92 E+01
^{242m}Am	5.2E-04	1.15 E-04	4.26 E+08	2.22 E+05
^{243}Am	8.1E-05	1.19 E-04	4.40 E+08	3.56 E+04
^{242}Cm	6.0E-04	4.67 E-06	1.73 E+07	1.04 E+04
^{244}Cm	1.5E-02	6.70 E-05	2.47 E+08	3.71 E+06
Total(ΣMDF)				3.34 E+08

1 Includes daughter product ^{137m}Ba.
2 No value given for ^{144m}Pr in EPA 1988.

The Cs canisters will contain free flowing ion exchange resin. The maximum inventory in each storage tube is 3.2 x 10^5 Ci of ^{137}Cs/^{137m}Ba and 2.1 Ci ^{135}Cs (see Section 3.1). Given that all of this inventory could be present in one Cs canister (in which case only one canister would be allowed in the storage tube), the maximum inventory in a Cs canister is the same as the maximum inventory in the storage tube.

4.2.4 Atmospheric Dispersion

The degree of atmospheric dispersion between the source term release point and a receptor location can be characterized with an atmospheric dispersion coefficient, or χ/Q' (where χ = airborne concentration at a given receptor, in Ci/m^3 or mg/m^3; and Q' = release rate, in Ci/s or mg/s).

The onsite, near river bank, and offsite receptor χ/Q's are shown in Table 4-3. Calculations for these χ/Q's are documented in HNF-SD-SNF-RPT-004 (HNF 1997c). Note in Table 4-3 that these χ/Q's are for a ground level release. The use of a ground level release in all of the calculations is conservative. Releases which could occur if material is released into the vault cooling air flow and carried out the elevated stack would have lower consequences than those calculated for a ground level release.

Table 4-3. Dispersion Factors for Receptors Associated with the Canister Storage Building.

Worst Case Receptor Locations			χ/Q' for Ground Level Release (s/m^3)[1]
Description	Distance	Direction	
Onsite	100 m	E	3.41 E-02
Near River	15.0 km	E	1.96 E-05
Offsite	18.3 km	E	1.32 E-05

[1] Assuming point source release without building wake

4.2.5 Breathing Rate

For calculation of inhalation doses, a breathing rate is required. The breathing rate used is the acute, light activity rate given in *Reference Man: Anatomical, Physiological, and Metabolic Characteristics* (ICRP 1975). Its value is 3.3×10^{-4} m^3/s.

4.2.6 Equipment Design Guidelines

Acceptability of accidents from a risk perspective is not evaluated in this analysis since the design has not progressed far enough to estimate accident frequencies accurately. However, for design purposes, unmitigated accident consequences are compared to the Safety Class and Safety Significant thresholds used in HNF-SD-SNF-RPT-004 (HNF 1997c) with consideration only for whether the accident is credible. The Safety Class threshold is 0.5 rem (5 mSv) for the offsite receptor, and the Safety Significant threshold is 5 rem (50 mSv) for the onsite receptor. These thresholds are consistent with those in HNF-PRO-704. Future safety analysis will address the risk associated with the potential accidents.

4.2.7 Analysis of Radiological Accident Scenarios

In the following sections, various accident scenarios associated with ILHW-ISF are evaluated:

- o Four canister drop scenarios (a glass canister drop in Section 4.2.7.1, a multiple glass canister drop in Section 4.2.7.2, a Cs canister drop in Section 4.2.7.3, and a transport cask/canister drop in Section 4.2.7.4)
- o Two seismically induced canister shear scenarios (involving a glass canister in Section 4.2.7.5 and a Cs canister in Section 4.2.7.6)
- o A vehicle-induced glass canister shear scenario in Section 4.2.7.7
- o A seismically induced tube failure in Section 4.2.7.8
- o A loss of cooling accident in Section 4.2.7.9

4.2.7.1 Glass Canister Drop Accident. Dropping a glass canister from the MHM into an empty tube is an operational accident that could be caused by human error or equipment failure.

Scenario and key assumptions. A release is postulated to occur as the result of dropping a glass canister during a transfer from the MHM to a storage tube. An MHM failure or human error during raising or lowering operations could result in dropping a glass canister into an empty tube. The storage tube is not actively ventilated, although it will be vented via a cartridge filter to the operation area. Cooling is provided by natural convection that occurs through the vault. This natural convection flow is around the exterior of the tube, and is then exhausted through the CSB stack. The MHM will be in place over the tube when the drop occurs.

Facility personnel in the vicinity of the accident would be aware immediately of the event upon occurrence and could initiate emergency response actions. However, for this scenario, it is assumed that no response or recovery action occurs.

Source Term Analysis. Information and assumptions used to determine the amount of material released are as follows.

- It is assumed that the impact absorbers are not in place and no other canisters are present. The dropped canister is assumed to rupture when it impacts at the bottom of the tube, releasing airborne particulate from the shattered glass within.

- For the drop of a canister into an empty tube, the height of the drop would be the depth of the tube (12.8 m) plus the distance from the top of the tube to the bottom of the canister when raised inside the MHM (1.5 m) for a total of 14.3 m.

- The release from the canister is assumed to enter the vault area or the CSB area due to a breach of the tube or the MHM-tube seal.

From Section 4.2.2, the respirable release fraction is determined by:

$$ARF \times RF = (A)(P)(g)(h)$$

The drop height is 14.3 m. The density of the vitrified waste is 2.64 g/cm^3. The respirable release fraction is therefore:

$$ARF \times RF = (2.0 \text{ X } 10^{-11} \text{ cm-s}^2/\text{g})(2.64 \text{ g/cm}^3)(980 \text{ cm/s}^2)(14.3 \times 10^2 \text{ cm})$$

$$= 7.4 \times 10^{-5}$$

With consideration of the LPF of 0.1 from Section 4.2.2, the total respirable release fraction is:

$$(ARF \times RF)(LPF) = (7.4 \text{ X } 10^{-5})(0.1)$$

$$= 7.4 \times 10^{-6}$$

Since a canister can contain up to 3,060 kg of glass (the MAR), the total respirable release (source term) is:

$$ST = (MAR)(ARF \times RF \times LPF)$$

$$= (3.060 \times 10^3 \text{ kg})\ (7.4 \times 10^{-6})$$

$$= 2.3 \times 10^{-2} \text{ kg}$$

Unmitigated dose consequences.

From Section 4.2.1, the dose is determined by:

$$Dose = (ST)(\Sigma MDF)(\chi/Q')(BR)$$

The onsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (2.3 \times 10^{-2} \text{ kg})\left(3.34 \times 10^8 \frac{\text{rem}}{\text{kg}}\right)$$
$$\left(3.41 \times 10^{-2} \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4} \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 8.6 \times 10^1 \text{ rem EDE onsite}$$

The near river radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (2.3 \times 10^{-2}\ \text{kg}) \left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right) \left(1.96 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right) \left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 5.0 \times 10^{-2}\ \text{rem EDE near river}$$

The offsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (2.3 \times 10^{-2}\ \text{kg}) \left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right) \left(1.32 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right) \left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 3.3 \times 10^{-2}\ \text{rem EDE offsite}$$

Comparison with equipment design guidelines. As shown in Table 4-4, the unmitigated onsite dose consequence resulting from a dropped glass canister exceeds the guideline.

Table 4-4. Dropped Glass Canister Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	8.6 E+01	5.0 E+00
Near river	5.0 E-02	5.0 E-01
Offsite	3.3 E-02	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. If this accident is not mitigated or prevented by designed safety features, the onsite radiological dose consequence exceeds the Safety Significant guideline from Section 4.2.6. If this scenario remains credible in subsequent analyses, Safety Significant SSCs might be required for prevention or mitigation of the accident consequences. For accidents involving a drop of a canister, the preventive or mitigative equipment would be the impact absorber which would cushion the fall and prevent damage to the canister and possible breach of the storage tube. Alternate options for consideration as preventive or mitigative equipment would include the MHM-tube seal, the MHM grapple, and any lifting devices. See Table 4-7 (Section 4.2.7.3) for a summary of the potential safety SSCs for prevention and mitigation of the canister drop accidents.

4.2.7.2 Multiple Glass Canister Drop Accident. Dropping a glass canister from the MHM into a tube that already contains one or more glass canisters is an operational accident that could be caused by human error or equipment failure.

Scenario and key assumptions. The scenario and key assumptions are the same as those in Section 4.2.7.1 except that a glass canister is assumed to be in the tube when a second canister is dropped.

Source Term Analysis. Information and assumptions used to determine the amount of material released are as follows.

- Since a tube can hold two large canisters, it is assumed that one canister is already in the tube.
- Each canister contains the maximum quantity of glass, 3,060 kg.
- The canister is designed to maintain its containment if impact absorbers are in place at the bottom of the tube and above the existing canister in the tube. For this scenario, it is assumed that the impact absorbers are not in place, so the dropped canister is assumed to rupture along with the one already in the tube, releasing airborne particulate from the shattered glass within.
- The release from the canisters is assumed to enter the vault area or the CSB area due to a breach of the tube or the MHM-tube seal.

From Section 4.2.2, the respirable release fraction is determined by:

$$ARF \times RF = (A)(P)(g)(h)$$

Each canister is 4.5 m in height and with one already in tube, the height of the drop is approximately 14.3 m - 4.5 m = 9.8 m. The density of the vitrified waste is 2.64 g/cm^3. The respirable release fraction is therefore:

$$ARF \text{ X } RF = (2.0 \text{ X } 10^{-11}\ \text{cm-s}^2/\text{g})(2.64\ \text{g/cm}^3)(980\ \text{cm/s}^2)(9.8 \times 10^2\ \text{cm})$$

$$= 5.1 \times 10^{-5}$$

With consideration of the LPF Of 0.1 from Section 4.2.2, the total respirable release fraction is:

$$ARF \times RF \times LPF = (5.1 \text{ X } 10^{-5})(0.1)$$

$$= 5.1 \times 10^{-6}$$

Since a canister can contain up to 3,060 kg of glass (the MAR), and two canisters are involved, the respirable release (source term) is:

$$ST = (MAR)(ARF \times RF \times LPF)$$

$$= 2(3{,}060\ \text{kg})\ (5.1 \times 10^{-6})$$

$$= 3.1 \times 10^{-2}\ \text{kg}$$

Unmitigated dose consequences.

From Section 4.2.1, the dose is determined by:

$$\text{Dose} = (ST)(\Sigma MDF)(\chi/Q')(BR)$$

The onsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.1 \times 10^{-2}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)$$
$$\left(3.41 \times 10^{-2}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 1.2 \times 10^{2}\ \text{rem EDE onsite}$$

The near river radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.1 \times 10^{-2}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)$$
$$\left(1.96 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 6.7 \times 10^{-2}\ \text{rem EDE near river}$$

The offsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.1 \times 10^{-2}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)$$
$$\left(1.32 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 4.5 \times 10^{-2}\ \text{rem EDE offsite}$$

Comparison with equipment design guidelines. As shown in Table 4-5, the unmitigated onsite dose consequence resulting from a multiple glass canister drop accident exceeds the guideline.

Table 4-5. Multiple Glass Canister Drop Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	1.2 E+02	5.0 E+00
Near river	6.7 E-02	5.0 E-01
Offsite	4.5 E-02	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. The same design and control considerations presented in Section 4.2.7.1 apply to this scenario. For this scenario, a second impact absorber is needed between the first and second canisters. See Table 4-7 (Section 4.2.7.3) for a summary of the potential safety SSCs for prevention and mitigation of the canister drop accidents.

4.2.7.3 Cs Canister Drop Accident. Dropping a Cs canister during unloading or during placement into a storage tube is an operational accident that could be caused by human error or equipment failure.

Scenario and Key Assumptions. The scenario and key assumptions presented in Section 4.2.7.1 for the glass canister drop are applicable to this scenario except the canister contains Cs instead of glass.

Source Term Analysis. Information and assumptions used to determine the amount of material released are as follows.

- The inventory at risk is the maximum radionuclide inventory in a Cs container, 3.2 x 10^5 Ci of ^{137}Cs and 2.5 Ci of ^{135}Cs (see Section 3.1). For accidents involving Cs canisters, the dose contribution from the allowable quantity of Cs-135 is insignificant in relation to the allowable quantity of Cs-137 because (a) the quantity of Cs-137 allowed (3.2E+5 Ci) is 5 orders of magnitude larger than the quantity of Cs-135 allowed (2.1 Ci), and (b) the inhalation dose conversion factor for Cs-137 (3.19E+4 rem/Ci inhaled) is nearly an order of magnitude larger than that for Cs-135 (4.55E+3 rem/Ci inhaled). Since the Cs-135 contribution to the accident dose consequences is insignificant, it is not addressed in the consequence calculation.

- This scenario envelopes all scenarios involving Cs containers in a single storage tube because the inventory of Cs postulated for this accident is the maximum allowable for a single storage tube.

- It is assumed that 0.1% of the resin is in respirable particles and that all of the respirable material is made airborne (see Section 4.2.2).
- The LPF from Section 4.2.2 is 0.1.
- For this scenario, it is assumed that the impact absorber is not in place, so the dropped canister is assumed to rupture, releasing airborne particulate from the Cs resin.
- The release from the canister is assumed to enter the vault area or the CSB area due to a breach of the tube or the MHM-tube seal.

Assuming that 0.1% of the resin is in respirable particles and that all of the respirable material is made airborne, the respirable release fraction (ARF x RF) is 1.0×10^{-3}.

With consideration of the LPF of 0.1 from Section 4.2.2 the total respirable release fraction is:

$$(ARF \times RF)(LPF) = (1.0 \text{ X } 10^{-3})(0.1)$$
$$= 1.0 \times 10^{-4}$$

Since the amount of Cs in a tube is limited to 3.2×10^{5} Ci, the respirable release (source term) is:

$$ST = (MAR)(ARF \times RF \times LPF)$$
$$= (3.2 \times 10^{5} \text{ Ci } ^{137}Cs)\ (1.0 \times 10^{-4})$$
$$\doteq 3.2 \times 10^{1} \text{ Ci } ^{137}Cs$$

Unmitigated dose consequences.

From Section 4.2.1, the dose is determined by:

$$\text{Dose} = (ST)(\text{Inhalation DCF for } ^{137}Cs)(\chi/Q')(BR)$$

The onsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.2 \times 10^{1} \text{ Ci})\left(3.19 \times 10^{4}\ \frac{\text{rem}}{\text{Ci}}\right)$$
$$\left(3.41 \times 10^{-2}\ \frac{s}{m^{3}}\right)\left(3.3 \times 10^{-4}\ \frac{m^{3}}{s}\right)$$

$$\text{Dose (rem)} = 1.2 \times 10^{1} \text{ rem EDE onsite}$$

The near river radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.2 \times 10^{1}\ \text{Ci})\left(3.19 \times 10^{4}\ \frac{\text{rem}}{\text{Ci}}\right)\left(1.96 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 6.6 \times 10^{-3}\ \text{rem EDE near river}$$

The offsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (3.2 \times 10^{1}\ \text{Ci})\left(3.19 \times 10^{4}\ \frac{\text{rem}}{\text{Ci}}\right)\left(1.32 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 4.5 \times 10^{-3}\ \text{rem EDE offsite}$$

Comparison with equipment design guidelines. As shown in Table 4-6, the unmitigated onsite dose consequence resulting from a Cs canister drop accident exceeds the guideline.

Table 4-6. Cs Canister Drop Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	1.2 E+01	5.0 E+00
Near river	6.6 E-03	5.0 E-01
Offsite	4.5 E-03	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. The same design and control considerations presented in Section 4.2.7.1 apply to this scenario. In this scenario, a second impact absorber is needed if canister inventories are such that two canisters are to be stored in one tube. See Table 4-7 for a summary of the potential safety SSCs for prevention and mitigation of the canister drop accidents.

Table 4-7. Potential Safety SSCs for Canister Drop Accidents (Bin 3 in Table 4-1).

ID	Title	Safety Functions	Potential Safety SSCs for Prevention or Mitigation of Accident Consequences	Safety Classification
M-21	Single Glass Canister Drop	1) Mitigation of Drop 2) Prevention of Drop 3) Containment of Release	1) Impact absorber 2) Grapple and lifting device that prevents a canister drop * 3) MHM-tube seal, storage tube *	Safety Significant (SS)
M-23	Multiple Canister Drop	Same as M-21	Same as M-21	SS
M-24	Cs Canister Drop	Same as M-21	Same as M-21	SS
M-07	MHM Canister Drop	Same as M-21	Same as M-21	SS
M-08/29	Canister Drop (Seismic)	Same as M-21	Same as M-21	SS

* Alternate options for consideration as preventive or mitigative equipment

4.2.7.4 Transport Cask with Canister Drop Accident. The glass and Cs canisters will be transported to the CSB in an onsite transportation cask via a diesel truck. The truck vestibule is an extension of the CSB that provides a transition area for the receiving crane to unload the cask from the trailer, transport it through the airlock and lower it into the receiving pit. Dropping a cask with a canister from the crane into an empty pit is an operational accident that could be caused by human error or equipment failure.

Scenario and key assumptions. A release is postulated to occur as the result of dropping a cask containing a canister during a transfer to the receiving pit. A crane failure or human error during raising or lowering operations could result in dropping the cask.

Facility personnel in the vicinity of the accident would be aware immediately of the event upon occurrence and could initiate emergency response actions; however, for this scenario, it is assumed that no response or recovery action occurs.

For the postulated drop heights, the consequences of a dropped glass canister (Table 4-4) are higher than the consequences of a dropped Cs canister (Table 4-6). Therefore, the consequences of dropping a transport cask are evaluated assuming the canister in the transport cask is a glass canister, which bounds the scenario where a Cs canister might be involved.

Source Term Analysis. Information and assumptions used to determine the amount of material released are as follows:

- For this scenario, the dropped cask and canister are assumed to rupture or open when the cask impacts the bottom of the pit, releasing airborne particulate from the shattered glass within.
- For the drop of a cask with a canister into the pit, the height of the drop is the depth of the pit (5.0 m), plus the trailer height above the floor (1.0 m), plus the assumed lift height above the trailer before it is lowered (1.0 m), for a total of 7.0 m.
- It is assumed that the cask containment is breached such that the release from the canister enters the CSB area.

From Section 4.2.2, the respirable release fraction is determined by:

$$ARF \times RF = (A)(P)(g)(h)$$

The height of the drop is 7.0 m. The density of the vitrified waste is 2.64 g/cm^3. The respirable release fraction is therefore:

$$ARF \times RF = (2.0 \text{ X } 10^{-11} \text{ cm-s}^2/\text{g})(2.64 \text{ g/cm}^3)(980 \text{ cm/s}^2)(7.0 \times 10^2 \text{ cm})$$

$$= 3.6 \times 10^{-5}$$

Since shipping casks are qualified to withstand transportation accidents, it is expected that (a) catastrophic failure of the cask would not occur, and (b) very little damage would occur to a dropped cask. As such, application of an LPF of 0.1 for the cask, in addition to an LPF of 0.1 for the canister as discussed in Section 4.2.2, appears to be appropriate. With consideration of these leak path factors, the total respirable release fraction is:

$$(ARF \times RF)(LPF) = (3.6 \text{ X } 10^{-5})(0.1)(0.1)$$

$$= 3.6 \times 10^{-7}$$

Since a canister can contain up to 3,060 kg of glass (the MAR), the total respirable release (source term) is:

$$ST = (MAR)(ARF \times RF \times LPF)$$

$$= (3.060 \times 10^3 \text{ kg})\ (3.6 \times 10^{-7})$$

$$= 1.10 \times 10^{-3} \text{ kg}$$

Unmitigated dose consequences.

From Section 4.2.1, the dose is determined by:

$$\text{Dose} = (\text{ST})(\Sigma\text{MDF})(\chi/\text{Q}')(\text{BR})$$

The onsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (1.10 \times 10^{-3}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)\left(3.41 \times 10^{-2}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 4.1 \times 10^{0}\ \text{rem EDE onsite}$$

The near river radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (1.10 \times 10^{-3}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)\left(1.96 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 2.4 \times 10^{-3}\ \text{rem EDE near river}$$

The offsite radiological dose consequence is determined as follows:

$$\text{Dose (rem)} = (1.10 \times 10^{-3}\ \text{kg})\left(3.34 \times 10^{8}\ \frac{\text{rem}}{\text{kg}}\right)\left(1.32 \times 10^{-5}\ \frac{\text{s}}{\text{m}^3}\right)\left(3.3 \times 10^{-4}\ \frac{\text{m}^3}{\text{s}}\right)$$

$$\text{Dose (rem)} = 1.6 \times 10^{-3}\ \text{rem EDE offsite}$$

Comparison with equipment design guidelines. As shown in Table 4-8, the unmitigated dose consequences resulting from a drop of a transport cask with a canister do not exceed the guidelines.

Table 4-8. Transport Cask with Canister Drop Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	4.1 E+00	5.0 E+00
Near river	2.4 E-03	5.0 E-01
Offsite	1.6 E-03	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. The results of the unprevented and unmitigated accident analysis show that the consequences of a cask drop are within the guidelines from Section 4.2.6. However the onsite consequence is sufficiently close to its guideline that preventive or mitigative Safety Significant SSCs should be considered. The cask will be required to withstand transportation accidents and as such may meet the Safety Significant requirements to withstand a drop into the receiving pit. The cask design will be assessed in the Safety Analysis Report for Packaging (SARP) and will be considered for mitigation of the drop accident in future safety analysis. Alternate options for consideration would be to designate the cask handling equipment as Safety Significant.

4.2.7.5 Seismic Induced Glass Canister Shear Accident. It is postulated that an MHM could be moved laterally while lowering or raising a glass canister into or out of a storage tube.

Scenario and key assumptions. A release is postulated to occur as the result of an earthquake moving the MHM such that it shears a canister during a transfer from the MHM to a storage tube. Lateral movement of the MHM during raising or lowering operations could result in shearing a glass canister with the damaged canister falling into a tube.

Analysis of this accident is identical to the analysis of glass canister drop in Section 4.2.7.1 with the exception that no LPF would be applied. The reason for this is that if the canister were sheared in two, the damage to the canister shell would be much greater than for the canister drop and would provide a more open path for release from the damaged glass, possibly with large surfaces of glass exposed.

Source term analysis. In Section 4.2.7.1, the total respirable release fraction of 6.6 x 10^{-6} was based on an LPF of 0.1. Since the LPF is not applicable in this case, the total respirable release fraction would be 6.6 x 10^{-5}, and the dose consequences obtained in Section 4.2.7.1 would be increased by a factor of 10.

Unmitigated dose consequences. Dose consequences resulting from a glass canister shear accident resulting from a seismic event are shown in Table 4-9.

Comparison with equipment design guidelines. As shown in Table 4-9, the unmitigated onsite dose consequence resulting from a seismic induced canister shear accident exceeds its guideline, the dose at the near river bank consequence is at its guideline, and the offsite dose consequence is very close to its guideline.

Table 4-9. Seismic Induced Glass Canister Shear Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	8.6 E+02	5.0 E+00
Near river	5.0 E-01	5.0 E-01
Offsite	3.3 E-01	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. If this accident is not mitigated or prevented by designed safety features, the radiological dose consequences exceed the Safety Significant guideline and are at or very close to the Safety Class guideline. (The guidelines are addressed in Section 4.2.6.) If this scenario remains credible in subsequent analyses, SSCs relevant to this scenario might have to be designated as Safety Class.

For accidents involving shearing a container, the preventive equipment could be MHM brakes and a lateral restraint. See Table 4-12 (Section 4.2.7.7) for a summary of potential safety SSCs associated with canister shear events.

4.2.7.6 Seismic Induced Cs Canister Shear Accident. It is postulated that an MHM could be moved laterally while lowering or raising a Cs canister into or out of a storage tube.

Scenario and key assumptions. A release is postulated to occur as the result of an earthquake moving the MHM such that it shears a Cs canister during a transfer from the MHM to a storage tube. Lateral movement of the MHM during raising or lowering operations could result in the shearing of a Cs canister with the damaged canister falling into a tube.

Analysis of this accident is identical to the analysis of a Cs canister drop in Section 4.2.7.3 with the exception that no LPF would be applied. The reason for this is that if the canister were sheared in two, the damage to the canister shell would be much greater than for the canister drop. In the drop event, the canister would remain mostly intact with a rupture opening along either the top or bottom welded seams. This rupture would be the leak path for material to exit from the canister. In the shear event, the canister could possibly end up in two separate parts allowing all of the Cs to be released.

Source term analysis. In Section 4.2.7.3, the total respirable release fraction of 1.0 x 10^{-4} was based on an LPF of 0.1. Since the LPF is not applicable in this case, the total respirable release fraction would be 1.0 x 10^{-3}, and the dose consequences obtained in Section 4.2.7.3 would be increased by a factor of 10.

Unmitigated dose consequences. Dose consequences resulting from a Cs canister shear accident resulting from a seismic event are shown in Table 4-10.

Comparison with equipment design guidelines. As shown in Table 4-10, the unmitigated onsite dose consequence resulting from a seismic induced Cs canister shear accident exceeds the onsite guideline.

Table 4-10. Seismic Induced Cs Canister Shear Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment Design guideline (EDE, rem)
Onsite	1.2 E+02	5.0 E+00
Near river	6.6 E-02	5.0 E-01
Offsite	4.5 E-02	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. If this accident is not mitigated or prevented by designed safety features, the onsite radiological dose consequence exceeds the Safety Significant guideline from Section 4.2.6. If this scenario remains credible in subsequent analyses, SSCs might require designation as Safety Significant because of the onsite consequence.

For accidents involving shearing a Cs canister, the preventive equipment could be MHM brakes and a lateral restraint. See Table 4-12 (Section 4.2.7.7) for a summary of potential safety SSCs associated with canister shear events.

4.2.7.7 Truck Impact with MHM Causing Canister Shear. It is postulated that an MHM could be moved laterally while lowering or raising a canister into or out of a cask.

Scenario and key assumptions. A release is postulated to occur as the result of the shear of a container during a transfer from the cask in the pit to the MHM, initiated by a truck backing into the MHM. Lateral movement of the MHM during raising or lowering operations could result in the shearing of a canister with the damaged canister falling into a tube.

Source term analysis. Analysis of this accident is similar to the analyses of the seismically induced glass and Cs canister shear events in Sections 4.2.7.5 and 4.2.7.6. For this accident, the initiating event is a truck backing into the MHM while at the receiving pit. As such, the preventative or mitigative SSCs will be different than those identified in Sections 4.2.7.5 and 4.2.7.6. The source term is assumed to be the same as for the seismically induced canister sheer.

Unmitigated dose consequences. The consequences of a seismically induced glass canister shear (Table 4-9) are higher than the consequences of a seismically induced Cs canister shear (Table 4-10). Therefore, the consequences of a shear event caused by a truck impact to the MHM are evaluated assuming the involved canister is a glass canister, which bounds the scenarios in which a Cs canister might be involved. Dose consequences resulting from a glass canister shear accident resulting from a truck impact are shown in Table 4-11.

Comparison with equipment design guidelines. As shown in Table 4-11, the unmitigated onsite dose consequence resulting from a truck impact induced canister shear accident exceeds its guidelines, the near river bank consequence is at its guideline, and the offsite consequence comes close to its guideline.

Table 4-11. Truck Impact Induced Canister Shear Accident.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	8.6 E+02	5.0 E+00
Near river	5.0 E-01	5.0 E-01
Offsite	3.3 E-01	5.0 E-01

EDE = effective dose equivalent.

Summary of Potential equipement design requirements. If this accident is not mitigated or prevented by designed safety features, the radiological dose consequences exceed the Safety Significant guideline and are at or very close to the Safety Class guideline. (The guidelines are addressed in Section 4.2.6.) If this scenario remains credible in subsequent analyses, SSCs relevant to this scenario might require designation as Safety Class.

For accidents involving shearing a container that results from a truck impact, the preventive equipment could be a barrier to prevent the truck from backing into the MHM. See Table 4-12 for a summary of the potential safety SSCs associated with canister shear/pinch accidents.

Table 4-12. Potential Safety SSCs Associated with Canister Shear/Pinch Accidents (Hazard Bin 4 in Table 4-1).

ID	Title	Safety Functions	Potential Safety SSCs for Prevention or Mitigation of Accident	Safety Classification
M-09/30	Seismic Canister Shear (Glass)	Prevention of shear/pinch	MHM brake/restraint	Safety Class (SC)
M-09/30	Seismic Canister Shear (Cs)	Same as M-09/30	Same as M-09/30	SC
D-03	Truck Induced Impact with MHM	Prevention of shear/pinch	Truck barriers	SC
M-10	MHM Canister Pinch	Same as M-09/30	Same as M-09/30	SC
M-25	MHM Canister Pinch	Same as M-09/30	Same as M-09/30	SC

4.2.7.8 Seismic Event Causing Tube Failure. It is postulated that an earthquake could dislodge storage tubes from their fixtures to the vault ceiling, causing them to fall and damage the canisters inside of them.

Scenario and key assumptions. A release is postulated to occur as the result of damage to canisters in storage tubes which fall as the result of an earthquake. Dislodged tubes could result in impact damage to the glass canisters (two per tube) in the tubes.

Source term analysis. Analysis of this accident will utilize the analysis of the multiple glass canister drop in Section 4.2.7.2, because that accident involved the maximum number of canisters in each tube and bounds the same scenario involving Cs canisters.

Unmitigated dose consequences. The dose consequences of the multiple glass canister drop accident are given in Table 4-5. Multiplying these consequences by the total number of tubes in Vaults 2 and 3 (452 tubes from Section 3.3) gives the consequences resulting from a seismic accident involving failure of all 452 tubes in the vaults (see Table 4-13).

Comparison with equipment design guidelines. As shown in Table 4-13, the unmitigated onsite and offsite dose consequences resulting from an earthquake exceed the guidelines.

Table 4-13. Seismic Event Causing Tube Failure.

Receptor location	Dose consequence (EDE, rem)	Equipment design guideline (EDE, rem)
Onsite	5.4 E+04	5.0 E+00
Near river	3.0 E+01	5.0 E-01
Offsite	2.0 E+01	5.0 E-01

EDE = effective dose equivalent.

Summary of potential equipment design requirements. If this accident is not mitigated or prevented by designed safety features, the radiological dose consequences exceed the Safety Significant and Safety Class guidelines from Section 4.2.6. If this scenario remains credible in subsequent analyses, SSCs relevant to this scenario might require designation as Safety Class because of the offsite consequence.

For accidents involving an earthquake, the preventive equipment could be seismically qualified tubes and operating deck. SSCs whose failure could result in damage to the operating deck and storage tubes must also be designed for natural phenomena events (e.g., vault ventilation inlet/outlet structures, and the CSB roof).

Table 4-14 summarizes the potential safety SSCs associated with this seismic event and other natural phenomena events.

Table 4-14. Potential Safety SSCs Associated with Natural Phenomena (Hazard Bin 7 in Table 4-1).

ID	Title	Safety Functions	Potential SSCs for Prevention or Mitigation of Accident	Safety Classification
M-28	Earthquake Fails Tubes	Prevention of structural failure	Storage tubes	Safety Class (SC)
M-29	Earthquake Fails Structure	Same as M-28	Operating deck Cooling inlets and outlets	SC SC
D-06	High Wind, Ash, & Snow Loading	Same as M-28	Roof	SC

4.2.7.9 Loss of Cooling Accident. Decay heat from the glass and Cs canisters will normally be removed by natural convection. Cooling air is drawn through an inlet duct into a plenum that distributes it into the vault, flows across the tubes, and exits through an exhaust stack. The motive force for drawing cooling air through the vault is natural convection caused by a density difference between hot air inside the vault and stack, relative to cool intake air (WHC 1996a).

Scenario and key assumptions. Debris from high winds, snow, frost, or ashfall accumulations could plug the inlet or outlet to the vault cooling plenums. An external fire could impact natural circulation cooling. The canisters would begin to heat up and may reach temperatures at which the contents degenerate.

Source term analysis. No source term analysis was performed because the CDR does not contain the detail needed to do so for a loss of cooling event. This accident is identified as an item requiring further resolution in Section 8.0.

Unmitigated dose consequences. No accident consequences were developed because the CDR does not contain the detail needed to do so for a loss of cooling event. A separate analysis for a loss of cooling event is being performed and will be available for inclusion in the more detailed safety analyses to follow this PSE.

Summary of potential equipment design requirements. The cooling inlets and outlets might become Safety Class SSCs based on Table 4-14 to protect against a catastrophic failure (e.g., a seismic event that might cause structural failure of the inlets or outlets such that other facility damage could occur). The cooling inlets and outlets might also require designation as Safety Class or Safety Significant to maintain vault cooling in the event of an accident or natural phenomena.

4.2.8 Nuclear Criticality

The IHLW-ISF can contain more than 3% of a minimum critical mass. HNF-PRO-334 is applicable and a criticality safety evaluation will be performed. It will be specified in the contract with the glass vendor that the canisters to be received at the CSB shall be capable of being (a) handled inside casks, (b) handled with the MHM, and (c) stored in the tubes without any additional controls for criticality.

5.0 CONSTRUCTION RISKS

This section addresses the potential risks arising from construction activities associated with Project W-464. These risks include those associated with construction activity hazards, the radiation from the SNF stored canisters during construction, and the fire risk from the storage of construction combustibles on the operating deck area and near the CSB.

The nearest adjacent facility is an underground crib, approximately 150 m northeast of the CSB, that is no longer in use. Another adjacent facility is B Plant whose closest part is located approximately 455 m directly east of the CSB. The 2704HV Building is located approximately 200 m north. These neighboring facilities are far enough away that construction activities should not have any interaction with them.

Any excavation work will be controlled by existing programs and will be unlikely to affect adjacent facilities by interruptions of utilities. The details involved with the handling of storage tubes outside of the building are not available but will probably involve the use of large cranes. The storage tubes will enter the building at the south end of the CSB (opposite end from the stored SNF). The tubes will be moved to their permanent position by a transport vehicle, up-ended, and lowered into the vault. Work in the vault will be limited to aligning the tubes and welding them to the tube base assembly (embedded in the vault floor). Since there will be no lifting or transporting of equipment or materials over Vault 1, the risk to the stored SNF is minimal.

During construction, provisions will be made to protect the workers from the existing stored radioactive SNF canisters in the CSB in compliance with ALARA principles. Adequate shielding in the walls is present to protect the workers by limiting the radiation dose in Vaults 2 and 3 to 0.5 mrem/hr. A security fence (probably chain link) is planned to be installed across the operating deck separating Vault 1 from the construction activities. Storage of construction materials on the operating deck area and near the CSB facility will be limited by reduction of combustibles. The fire hazards related to the storage of construction combustibles will be addressed during definitive design.

Other construction risks to be considered during the definitive design are as follows:

- Welding operations
- Crane operations
- Vehicle operations
- Toxic materials
- Building structure interfaces
- Tripping hazards
- Temporary power distribution
- Ladders and scaffolding use

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6.0 SAFETY DOCUMENTATION

As discussed throughout this PSE and its associated CDR, Project W-464 provides for the IHLW and Cs canisters produced in privately owned facilities to be built and operated on the Hanford Site. Project W-464 is part of the TWRS Project and is being carried out by the Project Hanford Management Contract subcontractor for the TWRS Project. Therefore, the TWRS Project has responsibility for ensuring that safety is properly addressed in the design and planned operations of the IHLW interim storage facility. The TWRS Project also has the responsibility to develop and obtain DOE approval for the nuclear safety Authorization Basis to operate this facility. The PSE is the first formal step in the process to fulfill these two responsibilities.

The CSB, which will be modified by TWRS Project W-464, is a new facility built by the SNF Project. Ultimately, a portion of the facility (Vault 1) will contain nuclear materials which are part of the SNF Project while another portion of the facility (Vaults 2 and 3) will contain the IHLW from the TWRS Project. Because the building is new and does not yet contain any nuclear materials, the SNF Project is on its own path to seek and obtain a nuclear safety Authorization Basis for the full building, and for Vault 1 operations in particular. The SNF Project is not seeking DOE approval for any activities associated with the interim storage of TWRS IHLW in the CSB. This is solely the responsibility of the TWRS Project; although, the sub-contractors for each project and the integrating contractor for the Hanford Project are coordinating both project efforts. The performance of a formal review of this PSE by SNF Project personnel is an important example of the inter-project coordination.

The TWRS Project is following the standard process for new nuclear facilities to establish the safety documentation for the W-464 Project. As a nuclear facility proceeds through the design stages and into operation, DOE requirements stipulate the need for safety documentation addressing the adequacy of the design and operations. The application of these requirements to Project W-464 is as follows:

(1) The PSE is the first safety document in the project life cycle. For Project W-464, the PSE is an appendix to the project CDR and is the first formal safety analysis input to project design. The PSE serves primarily to establish a preliminary Hazard Categorization, provide a preliminary identification of Safety Class and Safety Significant SSCs, and to identify major safety concerns and issues. This PSE establishes the TWRS Project portion of the CSB to be a Hazard Category 2 facility. The CSB was previously determined to be a Hazard Category 2 facility for the storage of spent nuclear fuel. For a Hazard Category 2 facility, the applicable nuclear safety Authorization Basis documentation requirements are those found in DOE Orders 5480.21, 5480.22 and 5480.23. The PSE is not a nuclear safety Authorization Basis document.

(2) The PSE will be followed by a Preliminary Safety Analysis Report (PSAR). The PSAR serves as input to project definitive design and must be

approved by DOE prior to the start of construction. The PSAR documents the detailed analysis of the project definitive design, identifies the safety classification of SSCs, evaluates adequacy of the design for safety considerations, and identifies technical issues requiring further analysis and resolution in a Final Safety Analysis Report (FSAR). No operations or activities involving nuclear materials are authorized by the PSAR. The PSAR is not a nuclear safety Authorization Basis document.

(3) An FSAR is a nuclear safety Authorization Basis document. Consistent with the definitions in DOE Order 5480.23, approval of an FSAR provides authorization to conduct operations in a nuclear facility. A special consideration for Project W-464 is the dual mission of the CSB to serve both the SNF and TWRS Projects. This consideration has been factored into the overall regulatory strategy for Project W-464 by the plan to amend the CSB FSAR developed for the spent nuclear fuel storage mission as opposed to providing a stand-alone CSB FSAR for TWRS-related operations. This decision has been made in anticipation of having a single operations organization for all activities in the CSB. Having a single nuclear safety Authorization Basis document for the CSB is considered to be beneficial from the standpoints of Conduct of Operations and successfully achieving regulatory approval.

The approved CSB FSAR for spent nuclear fuel storage will allow the SNF Project to use Vault 1. All Project W-464 construction activities in the CSB will have to be screened against the approved CSB FSAR as part of the Unreviewed Safety Question (USQ) process. Subsequent approval of the TWRS amendment to the CSB FSAR will allow concurrent operation of the CSB in support of the SNF and TWRS missions. Once the CSB FSAR, amended to address both the SNF and TWRS missions, has been approved by DOE, all physical and operational changes involving any part of the CSB, must be evaluated in accordance with the USQ process requirements of DOE Order 5480.21.

In addition to the operations to take place within the CSB, the TWRS Project must account for the transport of the IHLW and Cs canisters from the private vitrification facilities to the CSB. Safety considerations for the transport of the IHLW and Cs canisters will be addressed in one or more SARPs. The TWRS Project subcontractor will establish the interface with the Project Hanford Management Contract subcontractor responsible for Hanford Site transportation and packaging, for the preparation of the SARP.

7.0 PROJECT INTERFACES

The IHLW-ISF will provide the capability to: (1) receive IHLW and Cs canisters in transportation containers at the CSB, (2) load and unload a waste canister from its transportation cask, (3) handle IHLW and Cs canisters for placement and retrieval within the CSB storage area, (4) provide space suitable for storing the IHLW canisters safely, (5) survey the integrity of the IHLW and Cs canisters in storage, and (6) retrieve and place IHLW and Cs canisters into transportation containers for transport from the CSB.

The primary interfaces associated with the intended function of the IHLW storage system are components and operations associated with the existing CSB. The existing CSB components include the above ground building structure, the service building, the receiving crane, the receiving pit, the operating deck and the MHM. Interfaces between the IHLW storage facility and the private contractor facilities that prepare the IHLW for storage are beyond the scope of this PSE, and will be managed through Interface Control Documents.

Potential hazards to the safe operation of the CSB from adjacent facilities or activities in nearby facilities are covered in the CSB SAR (HNF 1997c). Risks associated with adjacent facilities during the construction phase of Project W-464 are addressed in Chapter 5.

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8.0 ITEMS REQUIRING FURTHER RESOLUTION

As discussed in the Foreword to this PSE, a design change occurred close to the completion of the CDR. This change introduced the use of an SCT in place of the MHM for the handling of the IHLW and Cs canisters in Vault 2 and 3. Section 8.1 documents the items requiring, further resolution for the IHLW-ISF design assuming use of the MHM. Section 8.2 documents the additional items requiring further resolution assuming the use of an SCT.

8.1 PROJECT DESIGN ASSUMING MHM

Details of the storage system design and process will be required to strengthen the conclusion of this PSE. However, conservative assumptions were used to the extent possible to assure a bounding analysis. Preventive and mitigative features (Safety Class and Safety Significant) are deemed necessary. However, as the design becomes more firmly established, some conservatisms may be removed. Design and operational considerations which must be further addressed include:

Design Considerations

- The waste packaging process must ensure that no water is present inside the IHLW or Cs canisters when received at the CSB.
- Design provisions for the CSB must be adequate to preclude the entrance of water into the storage tubes.
- The design must provide adequate shielding for worker safety as discussed in Section 4.1.2.3.
- The update of the Fire Hazards Analysis may result in additional fire protection requirements.
- The consequences of a loss of cooling accident need to be determined to show that the maximum temperatures reached in the tubes will not result in unsafe conditions.
- The seismic design of the MHM brake/restraint must be qualified for the new MHM loadings.
- The LPFs for the canister and for the cask after the drop accidents need to be validated.
- Criticality must be addressed in a criticality analysis to establish any associated design and storage requirements.
- The radiological inventory of non-routine canisters must be verified to be bounded by the inventory established for the canisters containing the glass.

- The ARF and RF for the Cs product must be verified to be within the assumptions in the accident analyses.

Operational Considerations

- The facility operations must provide for the receipt of the transportation casks. The placement of the canisters in their designated interim storage locations, and retrieval of the canisters from storage (HNF 1997c).
- The normal operations at the CSB must include safely monitoring and controlling the equipment for the IHLW movement, placement in tubes, control of storage environment, and canister retrieval.
- Controls must be established to maintain the maximum canister radiological inventory within the limits established in Section 3.1.

The path forward for these considerations is to continue the design process as scheduled. The ongoing safety documentation process will incorporate information as it becomes available during detailed design. Based on the results of this PSE, it is judged that Safety Class and Safety Significant SSCs and TSRs can be developed to ensure that the IHLW and Cs canisters can be safely stored within the CSB vaults.

8.2 PROJECT DESIGN ASSUMING SCT

For the design assuming use of the SCT, the operations associated with the receipt and unloading of the cask and the transport of the canisters will be similar to those identified in the current PHA. The operating sequence block diagram will be updated to identify operational steps associated with the design changes. The block diagram and design information for the receiving pit, receiving crane and SCT will provide the basis for revising the PHA. The PHA will provide a systematic evaluation of any new hazards or hazards where consequences may be different than previously considered. The hazards and accident scenarios identified in Section 4.0 are expected to be typical for the revised operating sequence. As such, the safety functions required for the prevention and mitigation of potential accident consequences in Section 4.0 will need to be considered during the design development. Safety considerations which will need to be addressed include:

- The Fire Hazards Analysis may result in additional fire protection requirements to accommodate SCT operations. The combustible loading needs to be minimized to preclude the need for automatic fire suppression in the CSB. Use of water for fire protection in the CSB could result in additional hazards not currently addressed in the CSB SAR (HNF 1997c) or in this PSE.

- The design needs to provide features to prevent the shear of an IHLW or Cs canister during transfer by the SCT as a result of natural phenomena or due to impacts by the cask transporter truck or the MHM.

- The design needs to provide features to prevent the shear of the MCO containing spent nuclear fuel due to impact of the SCT on the MHM.

- Design analysis is needed to ensure that the safety functions of SSCs qualified for the natural phenomena (i.e., seismic loads) are not compromised by loads imposed by the SCT.

- The design needs to address the potential for a spill of fuel or hydraulic fluid from the SCT and the potential for hydrogen generation if the fluid gets into the storage tubes.

- The design requirements for the cask or the canister may need to be revised to account for changes in the potential drop height while being handled in the CSB.

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9.0 REFERENCES

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ATTACHMENT A

PRELIMINARY HAZARDS ANALYSIS TABLE

The PHA was performed by personnel with experience in safety analysis methodology and personnel with knowledge of the IHLW-ISF design. The following personnel were involved:

Donald R. Porten	Safety Analysis and Risk Assessment, Fluor Daniel Northwest, Inc.
Milton V. Shultz	Safety Analysis and Risk Assessment, Fluor Daniel Northwest, Inc.
Kenneth C. Burgard	Project W-464 Manager, Lockheed Martin Hanford Corporation
Ronald B. Calmus	CSB Engineering, SGN Eurisys Services Corporation
Pascal J. Mouette	Licensing Engineer, Numatec Hanford Corporation
Chris A. Petersen	Design Authority, Numatec Hanford Corporation
Dean A. Smith	Safety Analysis Support, Fluor Daniel Northwest, Inc.

Immobilized High-Level Waste Interim Storage Hazard Analysis

Date 8/28/97
Participants: Milt Shultz, Don Porten, Ken Burgard, Pascal Mouette, Ron Calmus, Dean Smith, Chris Petersen

ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
(Block 1) D-01	Back Cask Transporter into Facility and Remove Tractor	Kinetic Linear Energy	Impact on Door/Bldg.	Human Error	Damage Transporter or Damage Inner or Outer Door Possible injury to worker	Process upset	None	None	S1	F3	Possible Industrial Accident S1 based on possible injury to worker S0 for process upset
D-02				Human Failure (Heart Attack or Seizure)	Sudden uncontrolled acceleration of truck	Loss of controlled barrier (The Building) Possible injury to worker	Cask design for transport over normal highways and associated accidents	None	S1	F3	S1 based on possible injury to worker S0 for loss of control barrier
D-03				Human Failure	Trailer backs into MHM	Damage to the MHM and Possible damage to canister being handled by MHM (shear of canister)	None	MHM not in use during trailer movement	S3	F3	Cs Canister may have higher consequence than Glass canister Cs Will be nonexplosive, nonpyrophoric, nonreactive with canister interior
D-04		Flammable Liquids Fuel	Fire	Human error or random event	Truck fuel fire while in entry area	No cask damage Degraded product for future disposal (degradation addressed in cask design)	Cask design (Cask is qualified by SARP to withstand fire)	40 gal. Fuel Limit Remove tractor before outer door closed and cask moved to receiving pit	S0	F3	Existing FHA for CSB says no structural damage from 100 gal. fire S0 is related to cask design (taking credits for existing passive barrier) Cask is qualified for fire hazards.

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							Engineered Features	Administrative Features			
D-05		External Events Vehicles in motion	Airplane/ Helicopter Event	Human error or equipment failure	Aircraft strikes building	Building damage possible fire	N/A	N/A	S3	F0	Analysis indicates that this event is Beyond Extremely Unlikely (Referenced in Spent Fuel SAR) S3 Engineering estimates of Hazards Team
(Block 1 continued) D-06		Natural Phenomena	Everything but seismic				Facility qualified for "Design Basis" natural phenomena events	N/A	S2	F2	Everything but earthquake covered in CSB SAR Earthquake addressed in CSB SAR. Building structure and components designed for DBE
(Block 2) D-07	Retrieve Yoke from rack or floor and connect to cask	Mass Gravity Height	Drop Yoke on cask	Human error or equipment failure	Cask damage Damage to Yoke	Process delay	Cask design (see remarks) and crane design	Operating process training	S0	F3	Based on cask design for impact resistance. (Need to verify this to be true)
D-08		Mass, Gravity, Height, and Kinetic Linear			Drop Yoke on person Horizontal or vertical	Facility worker injury	None	Personnel training and operating procedures	S1*	F3	Industrial safety
(Block 3) D-09	Remove Tiedowns and Platforms from Transport Cask	Natural Phenomena	Cask Movement	Seismic	Cask falls	Damage to cask	Cask design	Cask is hooked to crane before the tie downs removed	S0	F2	Need to determine G loading at which cask comes off trailer Design requirement Cask/Trailer attachment, adequately designed

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							Engineered Features	Administrative Features			
D-10					Crane falls on cask	Damage to cask	Crane designed to withstand DBE.	None	S0	F2	Assumes the crane will withstand seismic and not fall on cask or cask can withstand crane fall
D-11					Crane falls on worker	Facility worker injury	Crane design	None	S1*	F2	Assumes the crane will withstand seismic
(Block 4) D-12	Lift and move cask	Natural Phenomena Kinetic Linear Mass, Gravity, Height	Cask drop	Seismic Human error or equipment failure Operating control system failure	Cask falls onto floor	Damage to cask Damage to floor	Cask designed to withstand impact Crane designed to not fall during seismic event Floor design Lift height limited	Procedures specify maximum lift height	S0 S0 S0	F2 F3 F3	Assumes the floor withstands cask drop
D-13						Facility worker injury	Lift height limited	Training and Procedures	S1*	F3 Human event F2 Seismic	
D-14	Lower cask	Mass, Gravity, Height Natural Phenomena	Cask drop	Human error Equipment failure Operating/control system failure Seismic	Cask falls in pit	Damage to cask Damage to pit	Lift height limited		S2	F3 Human event F2 Seismic	
(Block 5) D-15	Remove Yoke from cask or place on floor	Mass, Gravity, Height	Drop Yoke on cask	Human error or equipment failure	Cask damage Damage to Yoke	Process delay	Cask design (see remarks) and crane design	Operating process training	S0	F3	Based on cask design for impact resistance. (Need to verify this to be true)

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							Engineered Features	Administrative Features			
D-16					Drop Yoke on facility worker Horizontal or vertical	Facility worker injury	None	Personnel training and operating procedures	S1*	F3	Industrial safety

ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
(Block 6) D-17	Remove Cask Lid and Store in Designated Area	Kinetic Linear Mass, Gravity, Height	Cask lid drop	Equipment failure or Human error	Lid drop can damage top of cask contents and could breach container	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	Cask Lid and Cask will be engineered to prevent damage to contents by a drop of the lid	Operating procedures and training	S2	F3	Note: Current block diagram doesn't specify how shielding is provided after removal of cask lid. Canister is designed to withstand a certain level of impact (currently unknown) Consequence assigned for screening purposes Consequence need to be evaluated for more detail With this concept, the canister shell (the bottle) is the only confinement

Immobilized High-Level Waste Interim Storage Hazard Analysis

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
D-18		Radioactive material	Release of contamination	Contamination release inside cask during loading or shipping	Cask lid removed and contamination released	Contamination release in building	Canister sealing process performed at the vendor	Check of cask atmosphere before removing cask lid By contact, vendor cleaning and cleanliness requirements	S1	F3	Open item in ICO's 13, 14, & 17 (Study team recommends system for secondary confinement)
D-19		Radioactive material	Exposure to direct radiation	Removal sequence for cask shield lid	Worker exposure due to open cask from direct and shine	Large worker exposure	--	Process sequence needs to be evaluated to provide shielding of all times	S1 *	F3	Shine is significant Project must evaluate this problem and provide the appropriate solution

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
(Block 6 continued) D-20		Explosives/Pyrophorics	Presence of hydrogen	Radiolytic decomposition of canister cleaning solution	Ignition of flammable gas upon cask lid removal	Facility worker injury Possible canister damage Possible equipment damage		Vendor requirements for cleanliness and dryness of cask interior Vendor demonstrates that any H_2O remaining in cask cannot generate significant quantities of hydrogen Vendor will not use cleaning solution that represent significant H_2 sources due to radiolytic decomposition (organics)	S1	F2	Team expects that canister will not be damaged This hazard does not address Cs canister flammability issues. It is assumed that the canister will not contain flammable gas.
D-21		Thermal	High temperature in canister	Long stay or duration in receiving pit	Possible breaching of canister due to high temperature	Radioactive material release	Design will ensure that cooling is sufficient to protect glass/canister integrity	Time limits established for Cask residence time in receiving pit. Recovery actions for equipment failures to prevent overheating	S1	F2	Main concern is Cs canister Glass is highly, stable Seismic event applies as an initiator

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
(Block 7) D-22	Retrieve and Install Shield Hatch Assembly Over Pit	Kinetic-Linear Mass, Gravity, Height	Shield hatch drop	Equipment failure or Human error	Lid drop can damage top of cask contents and breach container	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	Cask Lid and Cask will be engineered to prevent damage to contents by a drop of the lid	Operating procedures and training	S2	F3	Unclear at this time how the process sequence will appropriately protect workers from unshielded radiation exposure. Project will need to address this. Note: Current block diagram doesn't specify how shielding is provided after removal of cask lid. Canister is designed to withstand a certain level of impact (currently unknown) Consequence assigned for screening purposes Consequence need to be evaluated for more detail With this concept, the canister shell (the bottle) is the only confinement

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
D-23		Ionizing radiation sources	Release of contamination	Contamination release inside cask during loading or shipping	Cask lid removed and contamination released	Contamination release in building	Canister sealing process performed at the vendor	Check of cask atmosphere before removing cask lid By contact, vendor cleaning and cleanliness requirements	S1	F3	Open item in ICO's 13, 14, & 17 (Study team recommends system for secondary confinement)
(Block 7 continued) D-24		Ionizing radiation sources	Exposure to direct radiation	Removal sequence for cask shield lid	Worker exposure due to open cask from direct and shine	Large worker exposure	--	Process sequence needs to be evaluated to provide shielding of all times	S1*	F3	Shine is significant Project must evaluate this problem and provide the appropriate solution
D-25		Thermal	High temperature in canister	Long stay or duration in receiving pit	Possible breaching of canister due to high temperature	Radioactive material release	Design will ensure that cooling is sufficient to protect glass/canister integrity	Time limits established for Cask residence time in receiving pit. Recovery actions for equipment failures to prevent overheating	S1	F2	Main concern is Cs canister Glass is highly, stable Seismic event applies as an initiator
(Block 8) M-01	Place MHM over pit	Kinetic-Linear	MHM strikes receiving crane	Human error	MHM strikes receiving crane	Process upset	Interlocks to prevent movement when receiving crane in area	Procedures governing crane and MHM movement	S0	F3	Consequences same as Block 4

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
M-02		Kinetic-Linear	MHM strikes 10 ton crane	Human error	MHM strikes 10 ton crane	Process upset		Procedures governing crane and MHM movement	S0		Consequences same as Block 6
(Block 9) M-03	Retrieve and Install Shield Hatch Assembly Over Pit	Kinetic-Linear	Cask lid drop	Equipment failure or Human error	Lid drop can damage top of cask contents and breach container	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	Cask Lid and Cask will be engineered to prevent damage to contents by a drop of the lid	Operating procedures and training	S2	F3	Unclear at this time how the process sequence will appropriately protect workers from unshielded radiation exposure. Project will need to address this. Note: Current block diagram doesn't specify how shielding is provided after removal of cask lid. Canister is designed to withstand a certain level of impact (currently unknown) Consequence assigned for screening purposes Consequence need to be evaluated for more detail With this concept, the canister shell (the bottle) is the only confinement

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
M-04		Ionizing radiation sources	Release of contamination	Contamination release inside cask during loading or shipping	Cask lid removed and contamination released	Contamination release in building	Canister sealing process performed at the vendor	Check of cask atmosphere before removing cask lid By contact, vendor cleaning and cleanliness requirements	S1	F3	Open item in ICO's 13, 14, & 17 (Study team recommends system for secondary confinement)
(Block 9 continued) M-05		Ionizing radiation sources	Exposure to direct radiation	Removal sequence for cask shield lid	Worker exposure due to open cask from direct and shine	Large worker exposure	--	Process sequence needs to be evaluated to provide shielding of all times	S1*	F3	Shine is significant Project must evaluate this problem and provide the appropriate solution
M-06		Thermal	High temperature in canister	Long stay or duration in receiving pit	Possible breaching of canister due to high temperature	Radioactive material release	Design will ensure that cooling is sufficient to protect glass/canister integrity	Time limits established for Cask residence time in receiving pit. Recovery actions for equipment failures to prevent overheating	S0	F2	Main concern is Cs canister Glass is highly, stable Seismic event applies to all blocks as an initiator

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
(Block 10) M-07	Place IHLW canister into MHM cask	Mass, Gravity, Height	Canister drop	Human error or Equipment failure	Canister drop results in canister damage or breach	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	O ring sealed Nose piece. (MHM interface to pit provides confinement) Active ventilation system in MHM Glass canister qualified for 7 meter drop Cs canister may have impact limiters in bottom of cask Design is considering containing Cs canister in modified glass canister	Operating procedures	S3	F3	Glass canisters are less prone to significant release as compared to Cs canisters S3 based on Cs canister breach, Cs canister is assumed to not have flammable gas, based on vendor contract. Assumed that possible glass canister drop does not exceed 7 meters maximum Design requirements needs to address catch points for Cs or glass canister drop

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
M-08		Natural Phenomena; Mass, Gravity, Height	Canister drop	Seismic event	Canister drop results in canister damage or breach	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	For Shear, there is a seismic qualification of .35 g for MHM nose piece to not shear canister	Design is considering containing Cs canister in modified glass canister	S3	F2	Design requirements needs to address catch points for Cs or glass canister drop The MHM confinement system may not be qualified for seismic event.
(Block 10 continued) M-09		Natural Phenomena; Kinetic, Linear	Canister Shear	Seismic event	Canister drop results in canister damage or breach	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	For Shear, there is a seismic qualification of .35 g for MHM	Design is considering containing Cs canister in modified glass canister	S3	F2	This hazard does not address Cs canister flammability issues. It is assumed that the canister will not contain flammable gas. Building is more seismically qualified than the MHM.

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							Engineered Features	Administrative Features			
M-10		Kinetic, Linear	Canister pinch	Human error or equipment failure	Canister shearer from drive activation (shear implies dent or breach)	Release of material from glass log (distribution of particles tends to large particles) Release of Cs Ion Exchange Mat'l (distribution of particles tends to much smaller particles)	Movement interlock	Procedures and training	S3	F3	S3 based on Cs canister shear Not known whether machine can shear glass or Cs canisters MHM has large mass so large momentum Movement negates confinement
(Block 10 continued) M-11		Ionizing radiation sources	Direct exposure	Equipment design flaw Events that cause MHM movement away from receiving pit Personnel remaining in near contact with MHM while canister present	High radiation from MCO	Facility worker exposure	Shielding design Guard that prevents personnel from hugging MHM when canister present!		S1*	F3	MHM design for shielding keeps exposure within requirements Glass and Cs canisters have higher rad levels as compared to spent fuel There needs to be a FMEA to identify failures High level waste, waste package dose factor exceeds MCO (which is the design criteria for MHM)

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							Engineered Features	Administrative Features			
(Block 11) M-12	Replace Shield Hatch Plate Over Pit	None	Facility worker hazards only		No accidents identified						Nothing in the pit.
(Block 12-19) R-01	Remove empty cask and return it to the vendor	Various	Facility worker hazards only						S1*	F3	12-19 deal with an empty cask. Only industrial hazards are significant
(Block 12, 13) M-13	Decon and Survey of Cask in Receiving Pit	Ionizing radiation sources	Radioactive material	Canister inadvertently left in cask	Facility worker exposed Unshielded radiation source	Facility worker exposure	MHM load sensors Grapple design with sensors verifies that grapple has engaged canister	Procedures for monitoring the transfer cask	S1*	F2	May need other positive methods to verify that MHM picked up canister Need to check what features are in current designs
(Block 12, 13 continued) M-14		Ionizing radiation sources	Radioactive material	Leak in Cs canister	Facility worker is contaminated with radioactive material	Facility worker exposure	Canister design prevents leaks	Procedures for monitoring	S1	F2	Expectation is that the cask is "sniffable" before cask cover is removed
(Block 20) M-15	Remove storage tube cover plate	Various	Industrial hazards only								

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							Engineered Features	Administrative Features			
(Block 21) M-16	Move MHM Over Storage Tube	Thermal	Canister overheat	Canister remains in MHM for excessive time	Canister overheats with possible breach	Release of Cs inside MHM	Cooling systems if found to be needed. MHM provides secondary confinement	Time limits on canister residence time in MHM Possible ability to return canister to receiving pit Requirements controlling how many canisters in process at a given time	S0	F3	Glass overheating only affects glass quality. If occurs, then can't take to permanent storage. Thermal loading and overheating needs to be evaluated. No ability to detect breached container in MHM.
M-17		Kinetic-Linear	MHM strikes objects	Objects involved with Spent Fuel Storage is in the way of this MHM travel.	MHM runs into object or personnel associated with Spent Fuel Storage	Facility worker injury Damaged equipment Introduction of air into Spent Fuel Storage Tube	MHM touch bar for stopping when object contracted. Alarm, Buzzer, or light when MHM moving	Lock out of MHM while spent fuel activities in progress	S1* S0	F3 F3	MHM moves very slowly
(Block 22) M-18	Remove Storage Tube Plug Assembly	Mass, Gravity, Height	Drop Plug	Human error or equipment failure	Drop plug and damage sealing surface or jam plug	Upset operations	Plug is tapered Deck and plug capable of withstanding some level of drop Limited lift height		S0	F3	Operational upset only

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							Engineered Features	Administrative Features			
M-19			Jam Plug in MHM	Human error or equipment failure	Drop plug and damage sealing surface or jam plug	Upset operations	Access ports to plug hoist and grapple Lift load limiter		S0	F3	Operational upset only
(Block 23) M-20	Transfer Canister to Storage Tube	Mass, Gravity, Height	Wrong storage tube chosen	Human error	Place glass canister onto Cs canister	Unexpected process upset with possible need to unload tube		Use designated vault for only one type of canister	S0	F3	Loading sequence not currently specified Not intended to mix canister types in storage tubes
M-21		Mass, Gravity, Height		Human error	Put an additional canister in the tube with drop		Impact limiter Ventilation system or MHM		S3	F3	Impact limiter may not be in place since it is a load into a wrong tube.
M-22		Mass, Gravity, Height		Human error	Attempt to put an additional canister in the tube without drop	Process upset	Grapple height interlock	Procedures for placement of canisters	S0	F3	
(Block 23 continued) M-23		Mass, Gravity, Height	Drop with wrong storage tube chosen	Human error	Drop of glass canister on to Cs canister	Possible breach of Cs canister	Impact limiter Canisters qualified for 7 meter drop Grapple designed to not open under load. Canister must stop before grapple can be opened	Requirements and procedures for impact limiter installation	S3	F3	If Cs canister overpacked with glass canister the drop problem goes away. 7 meter drop qualification is only for the Bottom of the canister

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ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
M-24		Mass, Gravity, Height	Drop with correct tube chosen	Human error or mechanical failure	Drop of glass canister on to Cs canister	Possible breach of Cs canister	Grapple designed to not open under load Canisters qualified for 7 meter drop Impact limiter	Requirements and procedures for impact limiter installation	S3	F3	Glass on glass or glass on Cs are bad Any drop without impact limiters is bad 7 meter drop qualification is only for the <u>Bottom</u> of the canister
M-25		Kinetic-Linear	Pinch canister with MHM	Human error or mechanical failure	Put 3rd canister tube - No drop. Attempt to index MHM	Possible breach of Cs canister	Grapple height interlock	Procedures for canister placement	S3	F3	Study in progress to determine if indexing with canister not fully down will cause shear. (Affects Block 10) (Shear due to indexing)
M-26	Transfer Canister to Storage Tube	Mass, Gravity, Height	Impact Limiter Misplacement	Canister cocks in storage tube	Inability to continue storage in this tube	Process upset	Grapple movement indication		S0	F3	

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							Engineered Features	Administrative Features			
(Block 23 continued) M-27		Thermal	Overheat in storage tube	Design less than adequate Natural phenomena - High wind with tumble weeds plugging ventilation - Tornado damage to exhaust stack	Vent system plugging Exhaust stack collapse	Canister overheat (exceed product spec) Canister overheat	Exhaust stack designed to withstand tornado	Procedures to keep vault inlet/outlet clean.	S0	F3	1. Heat transfer model will be developed and validated by spent fuel program 2. Heat transfer model will be run to verify storage tube loading configuration do not result in waste temperature in excess of specs. before tube, loaded.
M-28		Natural Phenomena; Kinetic-Linear	Storage tube failure	Seismic event	Seismic event fails storage tubes	Possible canister rupture	Facility designed for DBE		S3	F2	Seismic damage to other parts of the CSB such as the roof or floor will not result in material release as long as the tubes are intact.
M-29			CSB structural failure	Seismic event	Seismic event causes CSB structural failure	Radioactive material release	Facility designed for DBE		S3	F2	
M-30		Natural Phenomena; Kinetic-Linear	Canister shear	Seismic event	Seismic causes canister shear (see prior node Block 10)	Radioactive material release	Cask lid and cask will be engineered to prevent damage to contents by accidents	Operating procedures and training	S3	F2	

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							Engineered Features	Administrative Features			
M-31		Natural Phenomena; Kinetic-Linear		Seismic event	Loss of ventilation	Storage tubes overheat possible release	Stack qualified to .35 gs		S1	F2	
M-32		Thermal	High temperature	Long dwell time in MHM	Over heat canister	See other nodes on MHM long hold time			S0	F3	
(Block 23 - continued) M-33		Corrosives	Canister breach during storage	Corrosion over long period due to canister/waste interactions	Canister breach due to corrosion failure	Release of rad material into storage tube	Storage tube forms confinement barrier Building has cathodic protection?	No water or solvents allowed in building or tubes	S0	F2	Study needed to verify problem has been addressed. S0 as long as tube performs confinement function (otherwise F2 or F3)
M-34		Ionizing radiation sources	Concentrated fissile material	Human error or uncontrolled storage of concentration fissile material Mechanism present to concentrate fissile material	Criticality	Significant facility worker exposure		Criticality prevention program	S1*	F1	Fissile material is not highly concentration in waste. Study may be needed. HWVP addressed this.
(Block 24) M-35	Replace storage tube plug assembly	Mass, Gravity, Height	Drop plug	Human error or equipment Seismic	Plug fragments and falls into tube	Inability to retrieve stored waste	Short drop distance due to MHM design Design of grapple prevents inadvertent unlatch under load		S0	F3	Need procedures and equipment to recover from this event.

Immobilized High-Level Waste Interim Storage Hazard Analysis

Date 8/28/97
Participants: Milt Shultz, Don Porten, Ken Burgard, Pascal Mouette, Ron Calmus, Dean Smith, Chris Petersen

ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
M-36		Ionizing radiation sources	Unshielded radioactive material	Human error	Forgot to replace plug before moving the MHM	Facility worker exposure from SHINE	Interlock prevents MHM movement while weight still on plug grapple	Operating procedures	S1*	F3	
(Block 25) M-37	Move MHM Over Storage Tube	Thermal	Canister overheat	Canister remains in MHM for excessive time	Canister overheats with possible breach	Release of Cs inside MHM	Cooling systems if found to be needed. MHM provides secondary confinement	Time limits on canister residence time in MHM Possible ability to return canister to receiving pit Requirements controlling how many canisters in process at a given time	S0	F3	Glass overheating only affects glass quality. If occurs, then can't take to permanent storage. Thermal loading and overheating needs to be evaluated. No ability to detect breached container in MHM.
M-38		Kinetics	Strike objects	Objects involved with Spent Fuel Storage is in the way of this MHM travel.	MHM runs into object or personnel associated with Spent Fuel Storage	Personnel Injury or damaged equipment or introduction of air into Spent Fuel Storage Tube	MHM touch bar for stopping when object contracted. Alarm, Buzzer, or light when MHM moving	Lock out of MHM while spent fuel activities in progress	S1* S0 S0	F3 F3 F3	MHM moves very slowly
Failed Canister Mitigation	MHM Retrieval	No difference from current hazard **(except for confinement)						Hazards addressed in Block 21 and 22			**Confinement concerns are present in regard to the level of protection required for specific condition of failed canister recovery.

Immobilized High-Level Waste Interim Storage Hazard Analysis

Date 8/28/97
Participants: Milt Shultz, Don Porten, Ken Burgard, Pascal Mouette, Ron Calmus, Dean Smith, Chris Petersen

ID (Block #)	Operating Sequence Mode/ Block	Hazard, Energy Source, Material	Hazardous Condition	Cause	Potential Accident	Consequence	Safety Features		Cons Cat	Freq Cat	Remarks
							Engineered Features	Administrative Features			
	MHM Transport	No difference (except confinement)						Hazards addressed in Block 23			We need to have good evaluation on frequency of canister failure
Failed Canister Mitigation (continued)	MHM Transfer to Overpack Facility	No difference (except confinement)						Hazards addressed in Block 23			Putting in impact absorbers in the overpack tubes should have no significant differences from standard impact absorbers
	Decontamination of various equipment • MHM • Plugs • Covers • Perform Overpacks - Put canister in overpack - Seal overpack - Decon overpack • Pickup overpack • Transport overpack • Put overpack into storage	Outside anything currently evaluated (to be evaluated at time when process is more defined) Similar to existing PHA									Putting impact absorbers is similar to putting in shield plugs - hazards similar, weight less, *Study for Decon Process needed *Need thermal analysis for overpack in detail design *Need study of overpack interaction with existing equipment (identify interfaces)

APPENDIX H

ECONOMIC ANALYSIS AND LIFE CYCLE COST ANALYSIS

(Provided by Numatec)

(Provided by the Performance Contractor under a separate cover)

This appendix will include significant decisions involving rationale for choosing the Canister Storage Building based upon earlier studies. The remainder of lesser choices was primarily dictated by technical or environmental conditions.

APPENDIX I

PHYSICALLY HANDICAPPED ASSESSMENT

(Provided by Numatec)

ACCOMMODATIONS OF PHYSICALLY HANDICAPPED

PROJECT NO. W-464

PROJECT TITLE Immobilized High Level Waste Interim Storage facility

LOCATION 200 East (area) BUILDING Canister Storage Building

Prepared By Ken Burgard Title Project Manager

Date 02/26/98

Type of Project:

- ☒ New Building (or Building Addition)
- ☐ Building Alteration
- ☐ Site Development (Grading, Walks, Parking Lots)
- ☐ Other

Application of Regulations:

DOE Order 6430.1A, "General Design Criteria," General Requirements 0101-4, "Handicapped Provisions."

41 CFR, Public Contracts and Property Management, Subtitle C, 101-19.6, "Accommodations for the Physically Handicapped."

- ☐ All Regulations
- ☐ Limited Application (indicate in comments section)

Exceptions:

DOE Order 6430.1A, "General Design Criteria," General Requirements 0101-4, "Handicapped Provisions."

- ☒ a. Not intended for occupancy or use by the handicapped
- ☐ b. Alteration not involving existing stairs, doors, elevators, toilets, etc.
- ☐ c. Not structurally possible

General Comments:

K.C. Burgard
Signature Ken Burgard

02/26/98
Date

A-6000-806 (09/92)

APPENDIX J

PLANT FORCES WORK REVIEW

(Provided by Numatec)

F D H	Fluor Daniel Hanford, Inc. P.O. Box 1000, Richland, WA 99352-1000 **PLANT FORCES WORK REVIEW**	Plant Forces Work Review No. FDH-	Date	Page 1 of 3

Title PROJECT W-464 - IMMOBILIZED HIGH LEVEL WASTE INTERIM STORAGE FACILITY (PHASE 1)	JCS Work Pkg or Project No. W-464	Area 200E	Bldg. No. 212-H

REQUESTER

Estimated Cost of Work:

*1.	Procured Material/Equipment	$ 39.2M
*2.	Materials/Equipment Purchased for Shop Fabrication	$ 0
*3.	Job-Site Material	$ 4.0M
4.	Shop Labor	$ 0
5.	Job-Site Labor	$ 4.4M
6.	Other Costs (design, field inspection, and contingency allowance)	$ 28.6M
7.	General Overhead (Labor Only)	$ 1.1M
	*Include estimated fair value of material or equipment acquired on site — Total Job	$ 77.3M

Requester's Name and Phone No. John B. Payne, 372-1386 Date 3/23/98

FDH

Reviewed By:

Area Work Review Agent John E. Allison Date

Company Work Review Agent *Gary Maxwell* Date

DOE

The following determination has been made regarding applicability of the Davis-Bacon Act, as amended, to the work described above:

Applicable [ ] Construction

Not Applicable [ ] Plant Forces

Chairman RL-Labor Standards Board Date

"Description of Work"

Briefly state the reason for this work activity:

This project will provide the transportation and facility infrastructure for the interim storage of Solidified High Level Waste produced by DOE's private vendor. Storage will occure at the current site of the Spent Fuel Canister Storage Facility (See PFWR 263-97).

Job summary:

Project W-464 will require the procurement/fabrication/certification of a transporter, the addition of an ANNEX to the Spent Fuel Canister Storage Building (CSB), and modification to Vaults #2 and #3 of the CSB.

Discuss all programmatic or physically associated work planned, underway, or recently completed in the work area:

No programmatic or physically associated work is planned, underway, or recently completed in the work area.

Describe entire work scope. Fully describe complete job scope using a stepped work flow format. Describe and estimate the cost of labor and material on foundations, structures, utility systems, or other construction type activity. Provide sketches or measurements for all work:

See sketches in Attachment A.

Capital Procurements:

- Shielded canister transporter.
- 10 ton bridge crane - remote.
- 60 ton gantry crane.

- Welding station.
- 440 Standard Tube Assemblies.
- 2 canister overpacks.
- 2 new cask transport systems.

Work Scope:

1. Excavate approximately 10,670 cubic yard for annex building and pit.
2. Construct 600 linear feet of new asphalt roadway.
3. Place stabilization gravel on approximately 10,000 square feet.
4. Remove 1,600 square feet of metal siding and girts.
5. Place 883 cubic yards of concrete for annex building slabs, pitwalls, and curbing.
6. Erect 14,000 square feet of ceiling and wall metal liner and install 14,000 square feet of insulation.
7. Install 5 - 3'x7' doors and 1- 20'x24' swing door.
8. Install 72 linear feet of handrail.
9. Erect 1-24"x100' high exhaust stack with stack monitor.
10. Excavate 500 linear feet of trenching, install 1" sch 40 PVC and backfill.
11. Install 3 - 135 watt LPS lights with arm and 30' steel pole.
12. Install 1000 feet of 3/4" conduit with fittings and supports.
13. Install 4 - 35 watt LPS wallmount fixtures and lamps.
14. Install 6 400 watt metal halide fixture with lamp and wire guard.
15. Install 11 emergency battery units.
16. Install bridge, crane power and controls including 2 cctv units.
17. Install 13,750 feet of #10/#12 THHN, #12 XHHW, #4 XHHW, and #2 XHHW wire.
18. Install 1 - 3 phase, 240V, 225A panel board.
19. Install 1 - 3 phase, 600V, 400A, distribution panel board.
20. Install 6 - 5/8" x 10' ground rods with lightning air terminals and down leads.
21. Install 1 welding station with cooling system and helium and argon systems.

F D H	Fluor Daniel Hanford, Inc. P.O. Box 1000, Richland, WA 99352-1000 PLANT FORCES WORK REVIEW Continued	Plant Forces Work Review No. FDH-	Page 3 of 3

22. Form 13,640 square feet of walls for new air inlet structures and place 992 feet of key joints, 280,000 pounds of 538lb rebar, and 124 anchor bolts.

23. Place 426 cubic yards of concrete.

Work Scope (continued):

24. Install 94 Tons of steel.

25. Install 200 feet if lightning protection copper cable and 2 new carbon steel exhaust stacks.

26. Install 440 - 40' x 28" carbon steel standard tube assemblies and base assemblies.

27. Install 12 - 40' x 30" carbon steel overpack tube assemblies and base assemblies.

28. Install 60 - 10'8" long 10 gauge carbon steel airfoils.

29. Install 4,900 square feet of forms and place 94,000 pounds of 600lb rebar for placement of 200 cu yds of concrete for exhaust louvers.

APPENDIX K

COMPLIANCE MATRIX

The purpose of the attached matrix is to provide the basis for developing the requirements for the design and construction phases of the project.

The matrix includes the listing of identified requirements at the time that this CDR was developed. The columns marked "Yes" indicate that the requirement is applicable. "NA" indicated that the requirement is not applicable for that column or in its entirety.

Legend:

C = Constructor/Procurer
DRD = Design Requirement Document
EC = Engineer/Contractor
FDH-CON = Fluor Daniel Contract
OC = Operating Contractor or Performance Contractor
SAR = Safety Analysis Report (includes PSAR = Preliminary Safety Analysis Report and FSAR = Final Safety Analysis Report)
SRIDs = Standards/Requirements Inventory Document
WASRD = Waste Acceptance System Requirements Document

Note: The WASRD document is only written for 3-meter canisters.

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
10 CFR 1021 (1994)	National Environmental Policy Act Implementation Procedures	Yes		Yes	Yes		OC		Not within project scope
10 CFR 1021, 321	Environmental Assessments			Yes			NA		
10 CFR 1021, Part 200	NEPA			Yes			NA		
10 CFR 1021, part 211	Limitations on the NEPA Process			Yes			NA		
10 CFR 1021, Part 300	EIS, EA Process			Yes			NA		
10 CFR 1021, part 322				Yes			NA		
10 CFR 1021, Part 400	NEPA Review Process			Yes			NA		
10 CFR 1021, Part 410	Categorical Exclusions			Yes			NA		
10 CFR 1926	Safety and Health Regulations for Construction			Yes	Yes		OC/E/C		
10 CFR 20 (1994)	Standards for Protection Against Radiation	Yes			*		OC/E/C		NRC equivalency and Performance Spec
10 CFR 40.13 (c)(6)						Yes	OC		
10 CFR 435 (1994)	Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Building	Yes			Yes		NA		The degree of applicability
10 CFR 436	Federal Energy Management and Planning Programs - Subpart A, Methodology and Procedures for Life Cycle Cost Analysis				Yes		OC/E		Mandated by 10 CFR 435
10 CFR 50 (1994)	Domestic Licensing of Production and Utilization Facilities	*Yes			Yes	*	NA		*WASRD states that this is not required to CRWMS
10 CFR 71				Yes		Yes	OC		
10 CFR 72 (1994)	Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste	Yes		Yes	Yes	Yes	OC		
10 CFR 75.1 21,.113,.131,.135						Yes	OC		
10 CFR 830 (1994)	Nuclear Safety Management - Subpart A, General Provisions, Section 830.120, Quality Assurance Requirement	Yes		Yes	Yes		Part 120 only OC/E/C		
10 CFR 835 (1993)	Occupational Radiation Protection	Yes		Yes	Yes		OC/E/C		
10 CFR 961						Yes	OC/E		
29 CFR 1904				Yes			OC/EC		
29 CFR 1910 (1994)	Occupational Safety and Health Standards	Yes		Yes	Yes		OC/EC		
29 CFR 1910.119	Process Safety Management of Highly Hazardous Chemicals			Yes	Yes		OC/E		
29 CFR 1915	Safety and Health				Yes		OC/E/C		Via DOE direction cc:Mail RL#97-011 dated 1/17/97 applicable by law

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
29 CFR 1918	Safety and Health				Yes		OC/E/C		Via DOE direction cc:Mail RL#97-011 dated 1/17/97 applicable by law
29 CFR 1926				Yes			OC/EC		
29 CFR 1928	Safety and Health				Yes		OC/E/C		Via DOE direction cc:Mail RL#97-011 dated 1/17/97 applicable by law
29 USC 651 et. Seq. (654(a) - (b))						Yes	OC		
29 USC 655, et. seq.	Occupational Safety and Health Act of 1970	Yes			Yes		OC/E/C		
36 CFR 1220				Yes			OC		
36 CFR 1228				Yes			OC		
36 CFR 1234				Yes			OC		
40 CFR 1500-1508 (1986)	Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act	Yes			Yes		OC		
40 CFR 1501, Part 2	Application NEPA	Yes					NA		
40 CFR 1506, Part ½	Actions During NEPA Process	Yes					NA		
40 CFR 1508, Part 25	NEPA Actions	Yes					NA		
40 CFR 1508, Part 4	Categorical Exclusions	Yes					NA		
40 CFR 1508, Part 9	Environmental Assessment	Yes					NA		
40 CFR 191	Radiation Dose Regulations			Yes			OC/E		
40 CFR 261						Yes	OC		
40 CFR 262				Yes		Yes	OC		
40 CFR 262, Part 32	Marking			Yes			OC		
40 CFR 264 (1986)	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Yes					NA		
40 CFR 268, Part 40 (a)(b)(c)	Waste (Restricted)			Yes			OC		
40 CFR 279, Part 10(b)	Used Oil			Yes			NA		
40 CFR 279, Part 21	Hazardous Waste Mixing			Yes			NA		
40 CFR 279, Part 22	Used Oil Storage			Yes			NA		
40 CFR 279, Part 81	Disposal			Yes			NA		
40 CFR 355 Part 40				Yes			OC		
40 CFR 61 (1994)	National Emissions Standards for Hazardous Air Pollution"	Yes		Yes	Yes	OC	NA		More restrictive than WAC-26-247 (Dose Driver)
40 CFR 61, Part 14(f)	Records Management (Owner)			Yes			NA		
40 CFR 61, Part 9	Construction Startup			Yes			OC		
40 CFR 61, Part 92				Yes			OC		
40 CFR 61, Part 93				Yes			OC		
40 CFR 61, Part 94	Compliance Reporting			Yes			OC		
40 CFR 61, Part 95	Recordkeeping Requirements			Yes			OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
40 CFR 61, Part 96	Construction/Modification Applications			Yes			OC		
40 CFR 761, Part 40(a)(b)(e)(h)	Waste Labeling			Yes			OC		
42 USC 13106				Yes			OC		
42 USC 4321, et. seq.	National Environmental Policy Act (NEPA) of 1969	Yes					OC		Not within E/C scope - in TPA
42 USC 6901, et. seq.	Resource Conservation and Recovery Act (RCRA) of 1976	Yes					OC/E		Included in TPA
42 USC 2210	Price-Anderson Amendments Act of 1988				Yes		OC/E/C		
49 CFR 171, Part 3	Miscellaneous Transportation Requirements			Yes			OC		
49 CFR 172						Yes	OC		
49 CFR 172, Part 101(c)(8)(9)(10(12)	Hazardous Substances Packaging			Yes			OC		
49 CFR 172, Part 203(c)(8)(9)(10(12)	Radioactive Packaging			Yes			OC		
49 CFR 172, Part 200	Applicability			Yes			OC		
49 CFR 172, Part 201	General Entries (Packaging)			Yes			OC		
49 CFR 172, Part 202	Description of Hazardous Materials on Shipping Papers			Yes			OC		
49 CFR 172, Part 203(f)	Transportation by Air			Yes			OC		
49 CFR 172, Part 203(j)	Dangerous When Wet Material Transportation			Yes			OC		
49 CFR 172, Part 203(m)93)	Poisonous by Inhalation Transportation			Yes			OC		
49 CFR 172, Part 204				Yes			OC		
49 CFR 172, Part 205				Yes			OC		
49 CFR 172, Part 301	Marking Non-Bulk Packaging			Yes			OC		
49 CFR 172, Part 302	Marking Bulk Packaging			Yes			OC		
49 CFR 172, Part 303				Yes			OC		
49 CFR 172, Part 304	Marking Requirements			Yes			OC		
49 CFR 172, Part 310	Radioactive Material Marking			Yes			OC		
49 CFR 172, Part 312	Liquid Hazardous Materials Marking, etc.			Yes			OC		
49 CFR 172, Part 313(a)	Poisonous Hazardous Material Marking			Yes			OC		
49 CFR 172, Part 313(b)	Non-Bulk Plastic Outer Packaging Marking			Yes			OC		
49 CFR 172, Part 324	Portable Tanks (Marking)			Yes			OC		
49 CFR 172, Part 328	Cargo Tanks (Marking)			Yes			OC		
49 CFR 172, Part 332				Yes			OC		
49 CFR 172, Part 334				Yes			OC		
49 CFR 172, Part 336				Yes			OC		
49 CFR 172, Part 400	General Labeling Requirements			Yes			OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
49 CFR 172, Part 401				Yes			OC		
49 CFR 172, Part 402	Additional Labeling Requirements			Yes			OC		
49 CFR 172, Part 403	Radioactive Material Markings			Yes			OC		
49 CFR 172, Part 404	Labels for Mixed and Consolidated Packaging			Yes			OC		
49 CFR 172, Part 405				Yes			OC		
49 CFR 172, Part 406	Placement of Labels			Yes			OC		
49 CFR 172, Part 500				Yes			OC		
49 CFR 172, Part 502				Yes			OC		
49 CFR 172, Part 504	General Placarding Requirements			Yes			OC		
49 CFR 172, Part 505	Placarding for Subsidiary Material			Yes			OC		
49 CFR 172, Part 506	Highway Placarding			Yes			OC		
49 CFR 172, Part 507				Yes			OC		
49 CFR 172, Part 516				Yes			OC		
49 CFR 172, Part 600				Yes			OC		
49 CFR 172, Part 602	Emergency Response			Yes			OC		
49 CFR 172, Part 604	Emergency Response Telephone Number			Yes			OC		
49 CFR 173, Part 12	Exceptions for Shipments of Waste Materials			Yes			OC		
49 CFR 173, Part 121(a)	Class 3 Material Packaging			Yes			OC		
49 CFR 173, Part 125 (a) (b) (c) (d)	Class 4 Material Packaging			Yes			OC		
49 CFR 173, Part 127(b)	Assignment of Packing Groups			Yes			OC		
49 CFR 173, Part 133	Packaging Hazard Zones Division 6.1 Materials			Yes			OC		
49 CFR 173, Part 137	Assignment of Packing Group			Yes			OC		
49 CFR 173, Part 164 (c)	Mercury Transportation			Yes			OC		
49 CFR 173, Part 173 (a) (b)	Packaging Paint, Adhesives & Ink			Yes			OC		
49 CFR 173, Part 173.2a	Classification of Materials Having More Than One Hazard			Yes			OC		
49 CFR 173, Part 20(a)	Non-Bulk Packaging Liquid Hazardous Materials			Yes			OC		
49 CFR 173, Part 201				Yes			OC		
49 CFR 173, Part 202(a)	Non-Bulk Packaging Liquid Hazardous Materials			Yes			OC		
49 CFR 173, Part 203(a)	Non-Bulk Packaging of Class III Liquids			Yes			OC		
49 CFR 173, Part 211(a)	Non-Bulk Packaging of Solid Hazardous Materials (Packing Group I)			Yes			OC		
49 CFR 173, Part 212(a)	Non-Bulk Packaging of Solid Hazardous Material (Packing Group II)			Yes			OC		
49 CFR 173, Part 213(a)	Non-Bulk Packaging of Solid Hazardous Material (Packing Group III)			Yes			OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
49 CFR 173, Part 216	Packaging Asbestos						OC		
49 CFR 173, Part 22 (a)	Exemption Packaging			Yes			OC		
49 CFR 173, Part 226	Packaging Materials Poisonous by Inhalation (Hazard Zone A)			Yes			OC		
49 CFR 173, Part 227	Packaging Materials Poisonous by Inhalation (Hazard Zone B)			Yes			OC		
49 CFR 173, Part 24 A/B	Bulk Packaging			Yes			OC		
49 CFR 173, Part 29	Empty Packagings			Yes			OC		
49 CFR 173, Part 3	Packaging			Yes			OC		
49 CFR 173, Part 300				Yes			OC		
49 CFR 173, Part 413	Waste Packaging			Yes			OC		
49 CFR 173, Part 415	Authorized Type A Packages			Yes			OC		
49 CFR 173, Part 417	Packaging Fissile Materials			Yes			OC		
49 CFR 173, Part 419	Packaging Oxidizing Radioactive Materials			Yes			OC		
49 CFR 173, Part 421	Limited Quantity Packaging			Yes			OC		
49 CFR 173, Part 422	Additional Requirements for Excepted Packages Containing Class 7 Materials			Yes			OC		
49 CFR 173, Part 423	Requirements for Multiple Hazard Limited Quantity Class 7 Materials			Yes			OC		
49 CFR 173, Part 424	Excepted Packages for Instruments and Articles			Yes			OC		
49 CFR 173, Part 425	Low Specific Activity Packaging			Yes			OC		
49 CFR 173, Part 427	Transport Requirements for LSA Class 7 Materials and SCO			Yes			OC		
49 CFR 173, Part 428	Empty Class 7 Material Packaging			Yes			OC		
49 CFR 173, part 431	Activity Limits for Type A & B			Yes			OC		
49 CFR 173, Part 433	Requirements for Determining A1 and A2 Values			Yes			OC		
49 CFR 173, Part 435							OC		
49 CFR 173, part 441	Radiation Level Limitations			Yes			OC		
49 CFR 173, Part 442	Thermal Limitations for Packaging			Yes			OC		
49 CFR 173, Part 443	Contamination Control			Yes			OC		
49 CFR 173, Part 448				Yes			OC		
49 CFR 173, Part 455	Classification of Fissile Material Packages			Yes			OC		
49 CFR 173, Part 457	Transporting of Fissile Class III			Yes			OC		
49 CFR 173, Part 459				Yes			OC		
49 CFR 173, Part 471	Waste Packaging			Yes			OC		
49 CFR 173, Part 475				Yes			OC		
49 CFR 177, Part 848				Yes			OC		
49 CFR 262, Part 31	Labeling			Yes			OC		
54-FR-3904				Yes			OC/EC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
A/E Standard, GC-LOAD-01, (Kaiser 1996a)	Standard Architectural-Civil Design Criteria, Design Loads for Facilities	Yes*					NA		*Negated by DOE 5480.28
A/E Standard, GH-CLIM-01 (Kaiser 1996b)	Design Climate for Hanford Site	Yes			Yes		OC/E/C		
All NEPA Codes and Standards		Yes		Yes*			OC		*Only when more restrictive than DOE 5480.7A
ANSI N300-1975 (ANSI 1975)	Design Criteria for Decommission of Nuclear Fuel Reprocessing Plants	Yes					NA		
ANSI/ACI, 1985 ANSI/ACI 349-85	Code Requirements for Nuclear Safety Related Concrete Structures				Yes		OC/E/C		
ANSI/AISC, 1994 ANSI/AISC N690-94	Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities				Yes		OC/E/C		
ANSI/ANS, 1992 ANSI/ANS-57.9 - 1992	Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)				Yes		OC/E/C		
ANSI/ANS-3.2-88 (ANSI/ANS 1988)	Administrative Controls and Quality Assurance for the Operational Phase of Nuclear Power Plants	Yes					NA		
ANSI/ANS-57.1 - 1992	Design Requirements for Light Water Reactor Fuel Handling Machine				Yes		OC/E		
ANSI/ASHRAE/IES 90A-1980 (ANSI/ASHRAE/IES 1980)	Energy Conservation in New Building Design	Yes					NA		
API Standard 650 (API 1993)	Welded Steel Tanks for Oil Storage	Yes			Yes		OC		Emergency generator - SC-2
ASCE 1986 ASCE-4-86	Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standard for Seismic Analysis of Safety-Related Nuclear Structures				Yes		OC/E		
ASCE 1995 ASCE-7-95	Minimum Design Loads for Building and Other Structures				Yes		OC/E		
ASHRAE 52.1-1992 (ASHRAE 1992)	Gravimetric and Dust-Spot Procedures for T Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter	Yes			*		NA		* By reference to Calcs and DRD
ASHRAE Handbook (API 1993)	ASHRAE Handbook - Fundamentals	Yes			*		NA		*By reference to Calcs and DRD
ASME 1993 ASME B30.20 - 1993	Below-the- Hook Lifting Devices				Yes		OC/E		
ASME B30 Series (ASME 1944a)	Miscellaneous Specifications for Cranes, Hoists, and Hooks	Yes			Yes		NA		
ASME B31.1-1992 (ASME 1992)	Power Piping	Yes			Yes		OC/E		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
ASME B31.3-1990 (ASME 1990)	Chemical Plant and Petroleum Refinery Piping	Yes			Yes		OC/E		
ASME N509-1989 (ASME 1989a)	Nuclear Power Plant Air-Cleaning Units and Components	Yes			Yes		OC/E		
ASME N510-1989 (ASME 1989b)	Testing of Nuclear Air Treatment Systems	Yes			Yes		OC/E		
ASME NOG-1 - 1989 (ASME 1989c)	Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)	Yes			Yes		OC/E		
ASME NQA-1 - 1989	QA Program Requirements for Nuclear Facilities				Yes		NA*		*Will use the 1994 version
ASME NQA-1 -1994-IA (ASME 1989c)	Quality Assurance Program Requirements for Nuclear Facility Applications	Yes			Yes		OC/E/C		
ASME Section III (ASME 1995a)	Boiler and Pressure Vessel Codes, Section VIII, Rules for Construction of Nuclear Power Plant Components	Yes			Yes		OC		Will need to make decision on applicability
ASME, Section VIII Division 1 (1955a)	Boiler and Pressure Vessel Code	Yes			Yes		OC/E/C		
ASME-NOG-1 - 1995	Rules for Construction of Overhead and Gantry Cranes				Yes		OC/E		
ASME/ANSI B31-9-1988 (ASME/ANSI 1988)	Building Services Piping Code	Yes			Yes		OC		
AWWA	American Water Works Association	Yes			Yes		OC/E/C		
CGA P-1-1991 (CGA 1991)	Safe Handling of Compressed Gas in Containers	Yes			Yes		OC/E/C		
CMAA Specification #70 (CMMA 1994)	Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes	Yes			Yes		NA		
DE-RP06-96RL13308	TWRS Privatization Request for Proposals	Yes					OC		
DOE 1220.1A	Congressional & Intergovernmental Affairs		Yes				NA		
DOE 1230.2	American Indian Tribal Government Policy		Yes				OC		
DOE 1240.2B	Unclassified Visits & Assignments by Foreign Nationals		Yes				OC		
DOE 1270.2B	Safeguards Agreement with the International Atomic Energy Agency		Yes				OC		
DOE 1300.2A	Department of Energy Technical Standards Program		Yes				NA		
DOE 1300.3	Policy on the Protection of Human Subjects		Yes				OC		
DOE 1324.2A	Records Disposition			Yes		Yes	OC		*Canceled by DOE 1324.5B
DOE 1324.2A	Records Disposition					Yes	OC		Canceled by DOE 1324.2A
DOE 1324.3	Files Management			*Yes			OC		Canceled ordered see
DOE 1324.5.A	Records Management			*Yes			OC		*Canceled by DOE 1324.5B

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE 1324.5B	Records Management Program		Yes	Yes		Yes*	NA		Canceled 1324.2a and 1324.2
DOE 1324.6	Automated Electronic Recordkeeping			Yes			OC		Canceled by DOE 1324.5B
DOE 1330.1D	Computer Software Management		Yes	Yes			OC/E	Potential	
DOE 1340.1B	Management of Public Communications Publications & Scientific, Technical, and Engineering Publications		Yes				OC		
DOE 1350.1	Audiovisual and Exhibits Management		Yes				OC/E/C		Applied to any contractors doing work for DOE
DOE 1360.2B	Unclassified Computer Security Program		Yes				OC		
DOE 1410.2	Mail Management		Yes				NA		Not within scope
DOE 1430.1D	Scientific & Technical Information Management		Yes				NA		Not within scope
DOE 1450.3A	Call Control/Verification Programs & Authorized Use of Government Telephone System		Yes				OC/E/C		
DOE 1450.4	Consensual Listening-In To or Recording Telephone/Radio Conversations		Yes				OC/E/C		
DOE 1500.3	Foreign Travel Authorizations		Yes				OC		Not part of project scope
DOE 1540.2	Hazardous Material Packaging for Transport - Administrative Procedures		Yes				OC		
DOE 1700.1	Freedom of Information Program		Yes				OC/E/C		
DOE 1800.1A	Privacy Act		Yes				OC/E/C		
DOE 2030.4B	Reporting Fraud, Waste, and Abuse to the Office of Inspector General		Yes				OC/E/C		
DOE 210.1 - 1995	Performance Indicators and Analysis of Operations Information				Yes		OC		
DOE 2100.8A	Cost Accounting, Cost Recovery, & Interagency Sharing of Information Technology Facilities		Yes				OC		For major computer network servers
DOE 2110.1A	Pricing of Departmental Materials & Services		Yes				OC/C		
DOE 2300.1B	Audit Resolution & Follow-up		Yes				NA		Should apply to DOE only
DOE 2320.1C	Cooperation with the Office of the Inspector General		Yes				OC/E/C		
DOE 2320.2B	Establishment of Departmental Position on Inspector General Reports		Yes				NA		Should be DOE only
DOE 3220.1A	Management of Contractor Personnel Policies and Programs		Yes				NA		Not part of project scope
DOE 3220.4A	Contractor Personnel and Industrial Relations Reports		Yes				OC		
Doe 3220.6A	Federal Labor Standards		Yes				OC/E/C		
DOE 3309.1A	Reductions in Contractor Employment		Yes				OC/E/C		
DOE 3790.1A	Federal Employee OSH Program					*Yes	OC		*Canceled by DOE 3790.1B
DOE 3790.1B	Federal Employee OSH Program					Yes	OC		Superseded DOE 3790.1B

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE 3830.1	Policies & Procedures for Pension Programs Under Operating and Onsite Service Contracts		Yes				OC		
DOE 3890.1A	Contractor Insurance and Other Health Benefit Programs		Yes				OC/E/C		
DOE 3900.1B	Parking		Yes				OC		Specific parking requirements should be sent to subs
DOE 4210.9A	Unsolicited Proposals		Yes						
DOE 4300.2C	Non-DOE Funded Work (Work-For-Others)		Yes				OC/E/C		
DOE 4330.2D	In-House Energy Management		Yes				OC		
DOE 4330.4B	Management Mgt. Program			Yes			OC		
DOE 4700.1 - 1987	Project Management System			Yes	Yes	Yes	NA		Canceled order
DOE 4700.5				Yes			OC		
DOE 5000.3B -1993	Occurrence Reporting and Processing				Yes		NA		*DOE 232.1 supersedes this order
DOE 5300.1C	Telecommunications	Yes	Yes				OC/E/C		
DOE 5300.2D	Telecommunications: Emission		Yes				OC/E/C		
DOE 5300.3D	Telecommunications: Communications		Yes				OC/E/C		
DOE 5300.4D	Telecommunications: Protected		Yes				OC/E/C		
DOE 5400.1	General Environmental Protection Program		Yes				OC/E/C		
DOE 5400.2A	Environmental Compliance Issue Coordination		Yes		Yes		OC		
DOE 5400.5	Radiation Protection of the Public and the Environment	Yes	Yes	Yes	Yes		OC/E/C		
DOE 5440.1E	National Environmental Policy Act Compliance Program		Yes				OC/E/C		
DOE 5480.10	Contractor Industrial Hygiene Program	Yes	Yes	Yes	Yes		OC/E/C		
DOE 5480.11	Radiation Protection for Occupational Workers		Yes				OC/E/C		
DOE 5480.13A	Aviation Safety		Yes				OC		Not a subcontractor responsibility
DOE 5480.16A	Firearms Safety		Yes				OC		
DOE 5480.17	Site Safety Representatives		Yes				OC		
DOE 5480.18B	Nuclear Facility Training Accreditation Program		Yes				OC		
DOE 5480.19	Conduct of Operations Requirements for DOE Facilities		Yes	Yes	Yes		OC		
DOE 5480.20A	Personnel Selection, Qualifications, and Training Requirements for DOE Nuclear Facilities		Yes	Yes	Yes		OC*		*Only Attachment 1 applies directly to subcontractors
DOE 5480.21	Unreviewed Safety Questions		Yes	Yes	Yes		OC*		*E/C involvement needs to be based on OC procedure
DOE 5480.22	Technical Safety Requirements		Yes	Yes	Yes		OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE 5480.23	Nuclear Safety Analysis Reports	Yes	Yes	Yes	Yes		OC		
DOE 5480.24	Nuclear Criticality Safety	Yes	Yes	Yes			OC		Design requirements need to be sent to E/C
DOE 5480.26	Trending and Analysis of Operations Information Using Performance Indicators		Yes	Yes			OC		Reportable Performance Indicator
DOE 5480.28	Natural Phenomena Hazards Mitigation	Yes	Yes		Yes		OC/E*		*E needs performance categories and equipment list
DOE 5480.29	Employee Concerns Management System		Yes	Yes			OC/E/C		
DOE 5480.3	Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes		Yes	Yes	Yes*		OC/E/C		*Interface item-receipt acceptance requirement
DOE 5480.30	Nuclear Reactor Safety Design Criteria		Yes				NA		
DOE 5480.31	Startup and Restart of Nuclear Facilities	Yes	Yes	Yes	Yes		OC		
DOE 5480.4	Environmental Protection, Safety, and Health Protecting Standards	Yes	Yes	Yes			OC/E/C		
DOE 5480.6	Safety of DOE-Owned Nuclear Reactors		Yes				NA		
DOE 5480.7	Fire Protection			Yes*			OC		*Canceled by DOE 5480.7A
DOE 5480.7A	Fire Protection	Yes	Yes	Yes			OC/E/C	Required for DBE water supplies/ sprinklers	
DOE 5480.8A	Contractor Occupation Medical Program		Yes	Yes			OC/E/C		
DOE 5480.9A	Construction Project Safety and Health Management		Yes	Yes	Partial		OC/E/C		Related to tube covers and temporary walls
DOE 5481.1B	Safety Analysis and Review System		Yes		Yes		OC		
DOE 5482.1B	Environment, Safety, Health, and Quality Assurance Appraisal and Surveillance Program		Yes	Yes			OC/E/C		
DOE 5483.1A	Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated (GOCO) Facilities	Yes	Yes	Yes	Yes		NA		
DOE 5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements	Yes	Yes	Yes			OC/E/C		
DOE 5500.10	Emergency Readiness Program		Yes		Yes		OC*		E/C's role should be passed down via OC procedures(s)
DOE 5500.1B	Emergency Management System		Yes	Yes			O*		E/C's role should be passed down via OC procedures(s)
DOE 5500.2B	Emergency Categories, Classes, and Notification and Reporting Requirements		Yes				OC*		E/C's role should be passed down via OC procedures(s)
DOE 5500.3A	Planning and Preparedness for Operational Emergencies		Yes	Yes			OC*		E/C's role should be passed down via OC procedures(s)

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE 5500.4A	Public Affairs Policy and Planning Requirements for Emergencies		Yes				OC/E/C		
DOE 5500.7B	Emergency Operating Records Protection Program	Yes	Yes				OC*		E/C roll should be passed down via OC procedures
DOE 5530.1A	Accident Response Group		Yes				OC		
DOE 5530.2	Nuclear Emergency Search Team		Yes				OC		
DOE 5530.3	Radiological Assistance Program		Yes				OC/E/C*		*As needed basis
DOE 5530.4	Aerial Measuring System		Yes		Partial		OC		Monitoring of air & site by others
DOE 5530.5	Federal Radiological Monitoring and Assessment Center		Yes				NA		Staffing the FRMAC team is DOE's responsibility
DOE 5560.1A	Priorities and Allocations Program		Yes				OC/E/C		
DOE 5610.13	Joint Department of Energy/Department of Defense Nuclear Weapon Safety, Security, and Control		Yes				NA*		This is a facility operator's responsibility to control nuclear weapons
DOE 5610.14	Transportation Safeguards System Program Operations		Yes				NA*		Applies to the Albuquerque office only
DOE 5610.2	Control of Weapon Data		yes				NA*		Not related to this project
DOE 5630.11	Safeguard and Security Inspection and Assessment Program			Yes*			OC		*Canceled by DOE 5630.12
DOE 5630.12A	Safeguards and Security Inspection and Assessment Program		Yes				NA*		Not related to this project
DOE 5631.2C	Personnel Security Program (Chapters I-IX only)		Yes	Yes			OC/E/C*		*E/C to the degree directed from OC
DOE 5631.4A	Control of Classified Visits			Yes*			OC		*Canceled order
DOE 5632.1B	Safeguards and Security			Yes*			OC		*Canceled by DOE 5632.1C
DOE 5632.1C	Protection and Control of Safeguards and Security Interests	Yes	Yes	Yes			OC/E/C		
DOE 5632.7A	Protection Force Program		Yes				OC		
DOE 5633.3B	Control and Accountability of Nuclear Materials		Yes	Yes			OC*		Applies to the operator of the facility
DOE 5639.5	Reporting (Safeguards/Security) Violations			Yes*			OC		*Canceled order
DOE 5650.2B	Identification of Classified Information		Yes				OC*		*The OC needs to classify documents
DOE 5660.1B	Management of Nuclear Materials		Yes				OC*		*An operations functions
DOE 5670.1A	Management and Control of Foreign Intelligence		Yes				OC/E/C		
DOE 5670.3	Counterintelligence Program		Yes				NA		Not applicable to this project
DOE 5700.6C	Quality Assurance		Yes				OC/E/C		
DOE 5700.7C	Work Authorization System		Yes				NA		Applies to M+O contractors only
DOE 5800.1A	Research and Development Laboratory Technology Transfer Program		Yes				NA		Not on this project
DOE 5820.2A	Radioactive Waste Management	Yes	Yes	Yes			OC/E/C		ID's waste, quantity interface requirements

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Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE 6430.1A	General Design Criteria	Yes	Yes	Yes	Yes		OC/E/C		SAR exemption for Fire Protection/Sprinklers
DOE C 425.1				Yes			OC		
DOE C 471.2				Yes			OC/EC		
DOE M 471.2-1	Manual for Classified Matter Protection & Control		Yes				OC		
DOE M 5632.1C-1	Manual for Protection and Control of Safeguards and Security Interests	Yes	Yes	Yes			OC/E/C*		*E/C's role should be passed down via OC procedures - In CSB Performance Spec.
DOE M 5632.7-1	Firearms Qualifications Courses Manual		Yes				NA		Applies to security contractor like Protec
DOE M 5639.6A-1	Manual of Security Requirements for the Classified Automated Information System Security Program		Yes				NA*		*Canceled order
DOE N 5400.0	Sealed Radioactive Source		Yes				OC*		*E/C involvement should be further defined
DOE N 5480.11	Extension of Radiological Control Manual, Rev. 1		Yes				OC/E/C		
DOE O 130.1	Budget Formulation Process		Yes		Yes		OC/E/C		
DOE O 232.1	Occurrence Reporting & Processing of Operations Information		Yes	Yes			OC		
DOE O 430.1	Life-Cycle Asset Management		Yes				NA		Not used on CSB (W-464)
DOE O 440.1	Occupational Safety and Health				Yes		OC/E/C		Via DOE direction cc:Mail RL#97-011 dated 1/17/97 applicable by law
DOE O 460.1 (1955a)	Packaging and Transportation Safety	Yes			Yes		OC		Receiving and shipping to check compliance
DOE O 470.1	Safeguards and Security Program		Yes	Yes			OC/E/C		
DOE O 471.1	Identification & Protection of Unclassified Controlled Nuclear Information		Yes				OC/E/C		
DOE O 471.2	Information Security Program		Yes				OC/E/C		
DOE O 472.1	Personnel Security Activities		Yes				OC		
DOE O 534.1	Accounting		Yes				OC/E/C		
DOE-0223	RL Emergency Implementing Procedures		Yes				OC		To the degree applicable to this job
DOE-0225	Hanford Emergency Assessment Resource Manual (HEARM)		Yes				NA		No within project scope
DOE-95-SWT-186 (1995c)	Hazardous Material Packaging and Shipping	Yes			Yes		OC/E		Receiving and Shipping Requirements
DOE-M-5632.1C	Safeguards and Security			Yes			OC		
DOE-RL-HPS-SD-4.1 1993	A/E Civil Design Criteria, Design Loads for Facilities				Yes		NA*		*Canceled by GC-LOAD and DOE 5480.28
DOE-RWO328P							OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE-STD-1020-94 (1994d)	Natural Phenomena Hazard Design and Evaluation Criteria for Department of Energy Facilities	Yes			Yes		OC		Enveloped by NRC Equivalency
DOE-STD-1021-93 (1993d)	Performance Categorization Criteria for Structures, Systems, and Components at DOE Facilities Subject to Natural Phenomena Hazards	Yes			Yes		OC		Enveloped by NRC Equivalency
DOE-STD-1022-94 (1994e)	Natural Phenomena Hazards Site Characterization Criteria	Yes			Yes		OC		Enveloped by NRC Equivalency
DOE-STD-1023-95 (1995b)	Natural Phenomena Hazards Assessment Criteria	Yes			Yes		OC		Enveloped by NRC Equivalency
DOE-STD-1073-93	Configuration Management			Yes	Yes		OC		
DOE-STD-3009-94	Preparation Guide for Non-Reactor Nuclear Facility Safety Analysis Report	Yes			Yes		OC		
DOE-STD-3009-95 (1994f)	Preparation Guide for U.S. Department of Energy Non-Reactor Nuclear Facilities Safety Analysis Report	Yes			Yes		OC		Enveloped by NRC Equivalency
DOE/EH 0135	Training Standards			Yes			OC		
DOE/EH 0135 TS.2.12				Yes			OC		
DOE/EH 0135.0A.6				Yes			OC		
DOE/EH 256T Article 616.3/4				Yes			OC		
DOE/EH-0173T				Yes			OC		
DOE/EIS-0189	Final Environmental Impact Statement for Tank Waste Remediation System	Yes					OC		
DOE/EM-0093 (DOE/EM 1995)	Waste Acceptance Produce Specifications for Vitrified High-level Waste Forms (WAPS)	Yes			*		OC		*HLW Study
DOE/EP-0180	Standard for Fire Protection of AEC Electric Computer			Yes			OC*		*But are for computer facilities and should be NA
DOE/EV-0043, 8-79	Standards on Fire Protection for Portable Structures						OC		
DOE/EV-016194	DOE Explosives Safety Manual			Yes			OC		
DOE/RL 94-02 Rev. 0	Emergency Program Management			Yes			OC		
DOE/RL 94-125	Federal Building Self Protection Plan		Yes				NA		Not within project scope
DOE/RL-92-36 (RL 1993a)	Hanford Site Hoisting and Rigging Manual	Yes	Yes	Yes	Yes		OC/E/C		Enveloped by NOG-1
DOE/RL-92-49	Radiological Assistance Program Plan - Region 8		Yes				OC		
DOE/RL-93-75	Hanford Facility Contingency Plan		Yes				Major Contractor		
DOE/RL-94-02	Hanford Emergency Response Plan		Yes	Yes	Yes		OC		
DOE/RL-94-55	Hanford Analytical Services QA Plan		Yes				NA		Not within project scope
DOE/RL-94-97	Selection of Analytical Methods for Mixed Waste Analysis at Hanford		Yes						

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Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
DOE/RW-033P (DOE/RW 1995)	Quality Assurance Requirements and Description for Civilian Radioactive Waste Management (QARD)	Yes		Yes	Yes		OC/E/C		
DOE/RW-0351P (DOE/RW 1996)	Waste Acceptance System Requirements Documents (WASRD)	Yes					NA		
FF-01	Radionuclide Emissions			Yes			OC/E		
Generic Letter 88-14	Instrument Air Supply/Safety Related Equipment				Yes		OC/E		
HNF-MP-599 Rev.1	FDH Quality Assurance Program Description	Yes					OC/E/C		
HSL&T-1	Hanford Site Lock and Tag Standard		Yes				OC/E/C		
HSRCM-1 (RL 1993b)	Hanford Site Radiological Control Manual	Yes			Yes		OC/E/C		
ICBO (ICBO 1991)	Uniform Plumbing Code	Yes			Yes		OC/E/C		
ICBO (ICBO 1994)	Uniform Building Code	Yes			Yes		OC	Required	Difference between UBC and NFPA
IEE C2-1993 (IEEE 1993)	National Electrical Safety Code	Yes					OC/E/C		
IES Standards (IES 1993)	Illumination Engineering Society of America	Yes					OC/E/C		
ISO 9000 Series (ISO 1994)	Quality Management and Quality Assurance Standards	Yes					NA*		*Not is CSB SAR
MIL-STD-1472D (DOD 1993)	Human Engineering Design Criteria for Military System Equipment and Facilities	Yes			*		OC/E		By reference to CSB Human Factors and Control Room Analysis
NEMA	National Electrical Manufacturers Association	Yes			Yes		OC/E/C		
NFPA 101 (NFPA 1994b)	Life Safety Code	Yes					OC/E/C	Required*	*Need decision on UBC or NFPA
NFPA 13 (NFPA 1994a)	Installation of Sprinkler Systems	Yes			Yes		OC/E/C	Required	Need decision between UBC/NFPA)
NFPA 70 (NFPA 1993a)	National Electrical Code	Yes			Yes		OC/E/C	Required*	*Need decision on UBC or NFPA
NFPA 72 (NFPA 1993b)	National Fire Alarm Code	Yes			Yes		OC/E/C	Required*	*Need decision on UBC or NFPA
NRC Reg. Guide 1.26	Quality Group Classification & Standards				Yes		OC		
NRC Reg. Guide 1.3	Loss of Coolant Accident				Yes		NA		Not within project scope
NRC Reg. Guide 1.78 (1974a)	Habitability of Nuclear Power Plan Control Rooms During Postulated Hazardous Chemical Release				Yes		NA		Not within project scope
NRC Reg. Guide 3.48	Format for the Safety Analysis Report				Yes		OC		
NRC Reg. Guide 3.60	Design of an Independent Spent Fuel Storage Installation				Yes		OC/E		
NUREG-0554 (NRC 1979)	Single Failure-Proof Cranes for Nuclear Power Plants	Yes			Yes		NA		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
NUREG-0700 (NRC 1981)	Guidelines for Control Room Design Reviews	Yes			*				*Via the CSB Performance Spec.
NUREG-0800	Standard Review Plan	*					OC		*Performance Spec
NUREG/CR-0098 (1978)	Development Criteria for Seismic Review of Selected Nuclear Power Plants				Yes		NA		Not within project scope - already established by CSB
OSHA-IS-1-12-14 (1978)	Guards for Rotating Equipment				Yes		OC/E/C		
PNL-6577 (PNL 1988)	Health Physics Manual for Good Practice for Reducing Exposure to Levels that are ALARA	Yes					NA		
Public Law 91-596				Yes			OC/EC		
RCRA-B (DW) 940829	Dangerous Waste Regulations	Yes		Yes			OC		
RLID 1300.1C	Richland Operations Office Facility Representative Program		Yes				NA*		*Not applicable to this project
RLID 1360.2B	Unclassified Computer Security Program		Yes				OC/E/C		If deemed applicable to this project
RLID 232.1	occurrence Reporting and Processing of Operations Information		Yes				OC/E/C		
RLID 425.1				Yes			OC		
RLID 430.1	Systems Engineering Criteria Document and Implementing Directive		Yes				OC*		*E/C's role must be addressed per project/job - see CSB Performance Spec. and System Engineering Functional Requirements Document
RLID 471.2	Informational Security Program		Yes				OC/E/C		
RLID 473.1	Protection of Safeguards and Security Interests		Yes	Yes			OC/E/C		
RLID 5000.1	Baseline Execution and Management Process		Yes				OC		
RLID 5000.2	Long Range Planning Process		Yes				OC*		Not applicable to this project
RLID 5480.7	Fire Protection		Yes	Yes			OC	Required	Canceled by DOE 5480.7A
RLID 5480.13A	Aviation Safety		Yes				NA		Not applicable this job scope
RLID 5480.19	Conduct of Operations Requirements for RL		Yes				OC		
RLID 5480.29	RL Employee Concerns Program		Yes				OC/E/C*		* Only on RL request basis
RLID 5480.31	Startup and Restart of Nuclear Facilities		Yes				NA		Not within the scope of project
RLID 5633.3	Control and Accountability of Nuclear Materials at RL		Yes				NA		Not within the scope of project
RLID 5635.1	Special Access and Top Secret Access Authorization		Yes				NA		Not within the scope of project
RLID 5670.3	Counterintelligence Program		Yes				NA		Not within the scope of project
RLIP 1322.1B	RL Forms Management		Yes				NA		Not within the scope of project

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Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
RLIP 5484.1A	Environmental Protection, Safety, and Health Protection Information Reporting Requirements		Yes				OC/E/C		
RLPD 430.1	Hanford Site Systems Engineering Policy		Yes				OC*		*E/C's role must be identified by OC
RLPD 5000.1	Site Management System		Yes				OC		
SCS-W-96-576	Drop Analysis of Multi-Canister Overpack in CSB				Yes		OC/E		
SEN-15-90	National Environmental Policy Act		Yes				OC		
SEN-22-90	DOE Policy on Signatures of RCRA Permit Applications		Yes				OC		
SEN-30A-92	Staying the Course for Technology Transfer at the Department of Energy		Yes				NA*		*Not applicable to this project
SEN-35-91	Nuclear Safety Policy		Yes	Yes			NA*		*Facility operator - this job would be governed by lower tier DOE Orders
SEN-39-92	Department of Energy Occupational Safety and health (OSH) Incentives Programs		Yes				OC/E/C		VPP, etc. programs
UBC	Uniform Building Code	Yes					OC/EC		
UPC	Uniform Plumbing Code	Yes					OC/EC		
WA 7890008967-DW Part III.2B.h	Containers Utilized for Off-Site Shipment			Yes			OC		
WAC 170-12 Section 050 (3)	Marking (Tank Vehicles)			Yes			OC		
WAC 173-216, Section 110	Entrance by State	*		Yes			OC		*Via Performance Spec
WAC 173-218	Underground Injection Control			Yes			NA		
WAC 173-303	Dangerous Waste Regulations	Yes		Yes	*		OC/E/C		See NOC
WAC 173-400	General Air Regulations"	Yes		Yes	*		OC/E/C		See NOC
WAC 173-401	Duty to Apply			Yes			OC		
WAC 173-460	Toxic Air Pollutants"	Yes		Yes	*		OC/E		See NOC
WAC 173-480	Ambient Air Quality Standards and Emission Limits for Radionuclides"	Yes			*		OC/E		See NOC
WAC 197-11, Section 305	Categorical Exemptions			Yes			NA		
WAC 212-80				Yes			OC/EC		
WAC 246-247	Radiation Protection - Air Emissions"	Yes		Yes	*		OC/E		Less restrictive than 40 CFR 60 (Concentration driven) see NOC
WAC 246-272	On Site Sewage System"	Yes			*		OC		See NOC
WAC 246-290	Public Water Supplies	Yes			*		OC		See NOC
WAC 246-292				Yes			OC		
WAC 296-62, Sec. 3140				Yes			OC		
WAC-173-303 Section 190 (3)	Marking			Yes			OC		

Project W-464 Engineer/Constructor Requirements Matrix

Requirement & Regulation	Title	DRD	FDH CON	SNF SRIDS	CSB SAR	WASRD	Responsible	Waiver Required	Comment
WAC-173-400	Construction Application			Yes			OC/C		
WHC-CM-1-5, Section 7.3	Identifying and Resolving Unreviewed Safety Questions				Yes		OC/E		
WHC-CM-2-14	Hazardous Materials Packaging and Shipping	Yes			*		NA		*Shipping and Receiving requirements
WHC-CM-4-29	Nuclear Criticality Safety Manual	Yes			Yes		OC		
WHC- CM-4-3	Industrial Safety Manual	Yes			Yes		OC		
WHC-CM-4-40	Industrial Hygiene Manual				Yes		NA		
WHC-CM-4-46	Safety Analysis Manual	Yes			*		OC/E		*Reference: Sellers 1996
WHC-CM-6-12	Project Department Procedures				Yes		OC/E/C		
WHC-CM-7-5	Environmental Compliance	Yes			Yes		OC/E/C		
WHC-EP-0063-04 (Willis 1993)	Hanford Site Solid Waste Acceptance Criteria	Yes			*		NA		*By reference in Waste Treatment Interface Document
WHC-IP-1043 (WHC-995b)	WHC Occupational ALARA Program	Yes			*		OC/E/C		*Equivalency Analysis
WHC-S-0425	Performance Specification for the SNF-CSB	*			Yes		OC/E/C		*Can't interface with mission
WHC-S-0468	Specification for Multi-Canister Overpack Handling Machine	*			Yes		OC/E/C		*Can't interface with mission
WHC-SD-DGS-30011 (WHC 1994)	Radiological Design Guide	Yes			*		OC/E/C		*Equivalency Analysis
WHC-SD-SNF-DB-003	NRC Equivalency			Yes			OC/E		
WHC-SD-SNF-DB-004	SNF Seismic DC, NRC Equivalency Report				Yes		OC/E		
WHC-SD-SNF-DB-009	CSB Natural Phenomena/Hazards				Yes		OC/E		
WHC-SD-SNF-FHA-002 (1996)	Fire Hazard Analysis for the CSB Vaults				Yes		OC/E		
WHC-SD-SNF-HC-007	Hazard Category Analysis for the Canister Storage Building				Yes		OC/E		
WHC-SD-SNF-MP-001 (1995b)	SNF - Project Document Management Plan				Yes		OC/E/C		
WHC-SD-SNF-PLN-012	SNF - Project Integrated Safety Management Plan				Yes		OC/E/C		
WHC-SD-SNF-QAPP-004 (1996)	SNF Quality Assurance Plan				Yes		NA		QC will provide project QAPP
WHC-SD-SNF-TI-029	Multi-Canister Overpack				Yes		OC/E		
WHC-SD-W236-TI-002	Probabilistic Seismic Hazard Analysis, DOE Hanford Site				Yes		OC/E		
WHC-SP-113 (1995c)	Site Implementation Plan				Yes		OC		
WHC-SP-1131 Rev. 0	WHC QA Program Plan			Yes			OC		

APPENDIX L

SKETCHES

PROJECT TITLE:

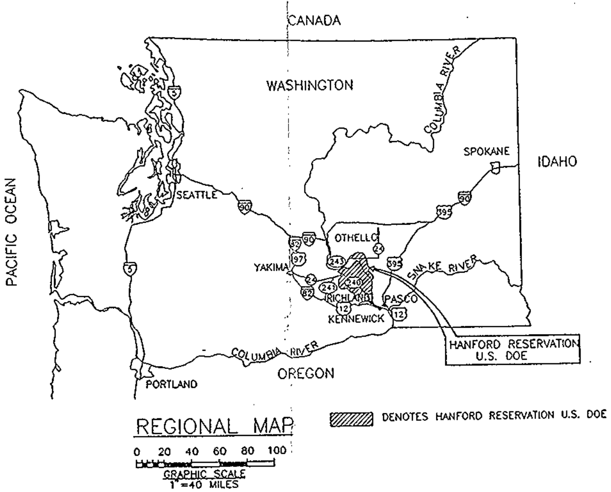
W - 464
IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

FOR:

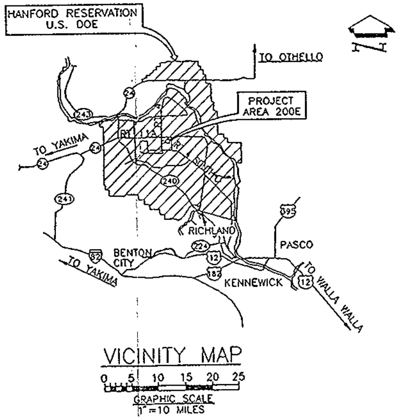
U S DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

BY:

FLUOR DANIEL NORTHWEST



REGIONAL MAP



VICINITY MAP

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

Prepared by: P LAING

Checked: JRE

Title: TITLE SHEET

Sketch no. ES-W464-C00

Sh 1 of

Cadfile I464C00A

Rev 0

PROJECT TITLE:

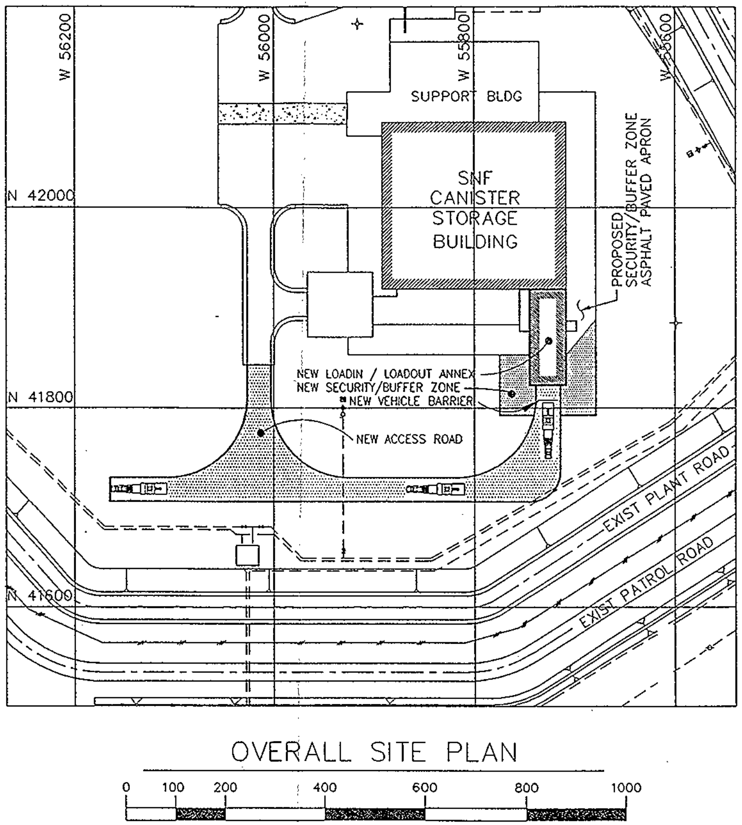
W - 464
IMMOBLIZIED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

FOR:

U S DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE

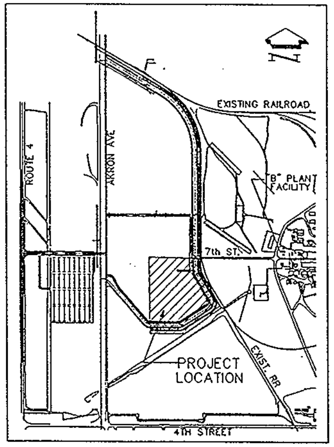
BY:

FLUOR DANIEL NORTHWEST



OVERALL SITE PLAN

DRAWING	SHEET	TITLE
CIVIL		
ES-W464-C00	SH 1	TITLE SHEET
ES-W464-C00	SH 2	SITE PLAN & DRAWING LIST
MECHANICAL		
ES-W464-M01	SH 1	FACILITY LAYOUT OPERATIONS FLOOR PLAN
ES-W464-M01	SH 2	FACILITY LAYOUT VAULT FLOOR PLAN
ES-W464-M01	SH 3	FACILITY LAYOUT CROSS SECTION
ES-W464-M01	SH 4	FACILITY LAYOUT LONGIT SECTION
ES-W464-M01	SH 5	FACILITY LOAD-IN/LOAD-OUT ANNEX SECTIONS
ES-W464-M01	SH 6	FACILITY LAYOUT TRANSPORT TRAILER
ES-W464-M02	SH 1	OPERATION SEQUENCE CSB BLOCK DIAGRAM
ES-W464-M03	SH 1	MISC DETAILS
ES-W464-M04	SH 1	TEMPORARY COVERS
ES-W464-M05	SH 1	STANDARD/OVERPACK CANISTER STORAGE ARRANGEMENT
ES-W464-M05	SH 2	TUBE PLUG COVER ASSEMBLIES
ES-W464-M05	SH 3	STANDARD/OVERPACK TUBE SHIELD PLUG ASSEMBLIES
ES-W464-M05	SH 4	STANDARD/OVERPACK TUBE ASSEMBLIES
ES-W464-M05	SH 5	STANDARD/OVERPACK BELLOWS ASSEMBLIES
ES-W464-M05	SH 6	STANDARD/OVERPACK TUBE BASE ASSEMBLIES
ES-W464-M06	SH 1	IMPACT ABSORBER & OVERPACK STATION CANISTER GUIDES
ES-W464-M07	SH 1	OVERPACK STATION PLAN & SECTION
ES-W464-M08	SH 1	OVERPACK WELD STATION GANTRY CRANE SECTION
ES-W464-M08	SH 2	OVERPACK WELD STATION GANTRY CRANE SECTIONS
ES-W464-M08	SH 3	OVERPACK WELD STATION CAP WELDER ASSEMBLY
ES-W464-M09	SH 1	4.5 M CANISTER & 4.5 M OVERPACK
ES-W464-M10	SH 1	CESIUM CANISTER OVERPACK ASSEMBLY



PROJECT AREA MAP

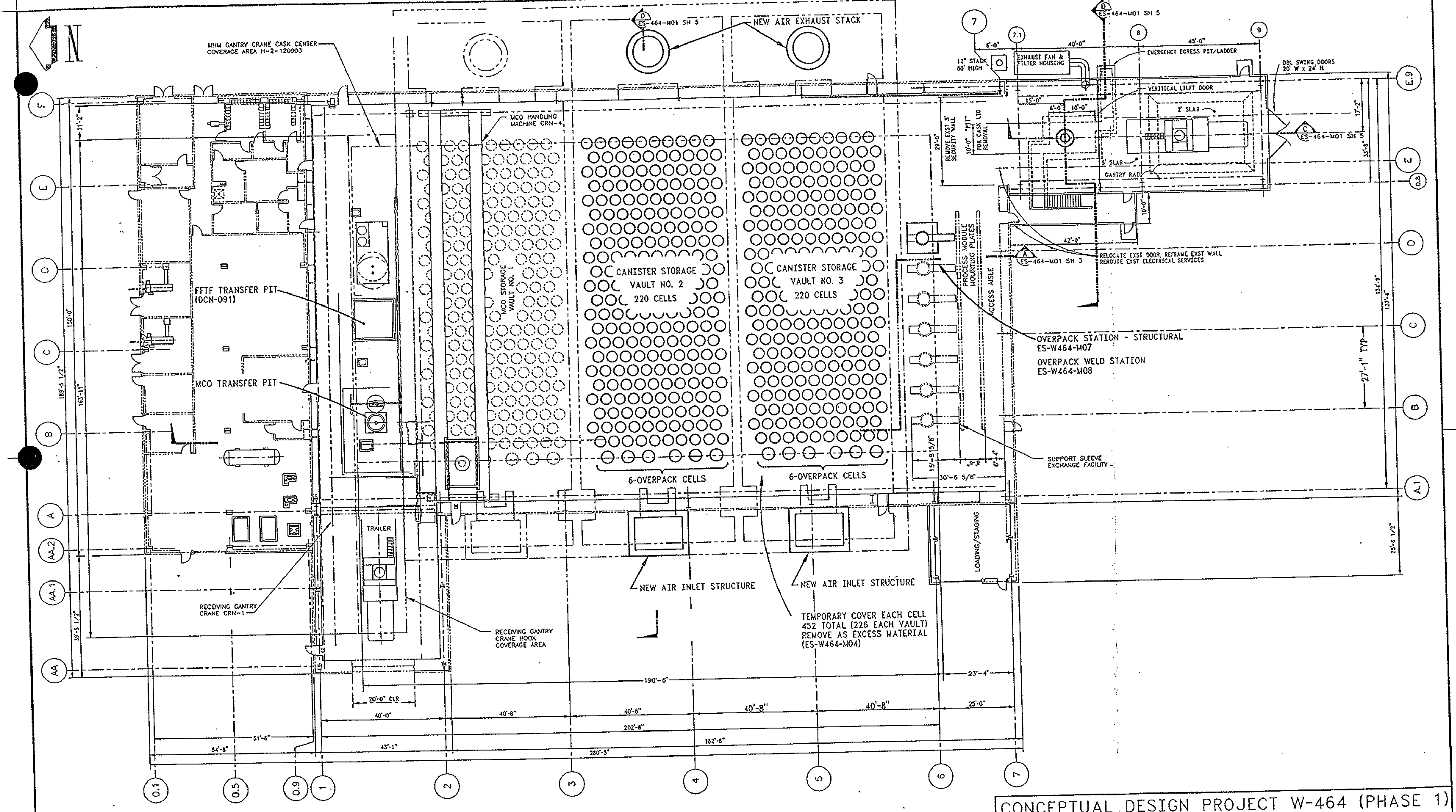
H-2-116003	TITLE SHEET
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

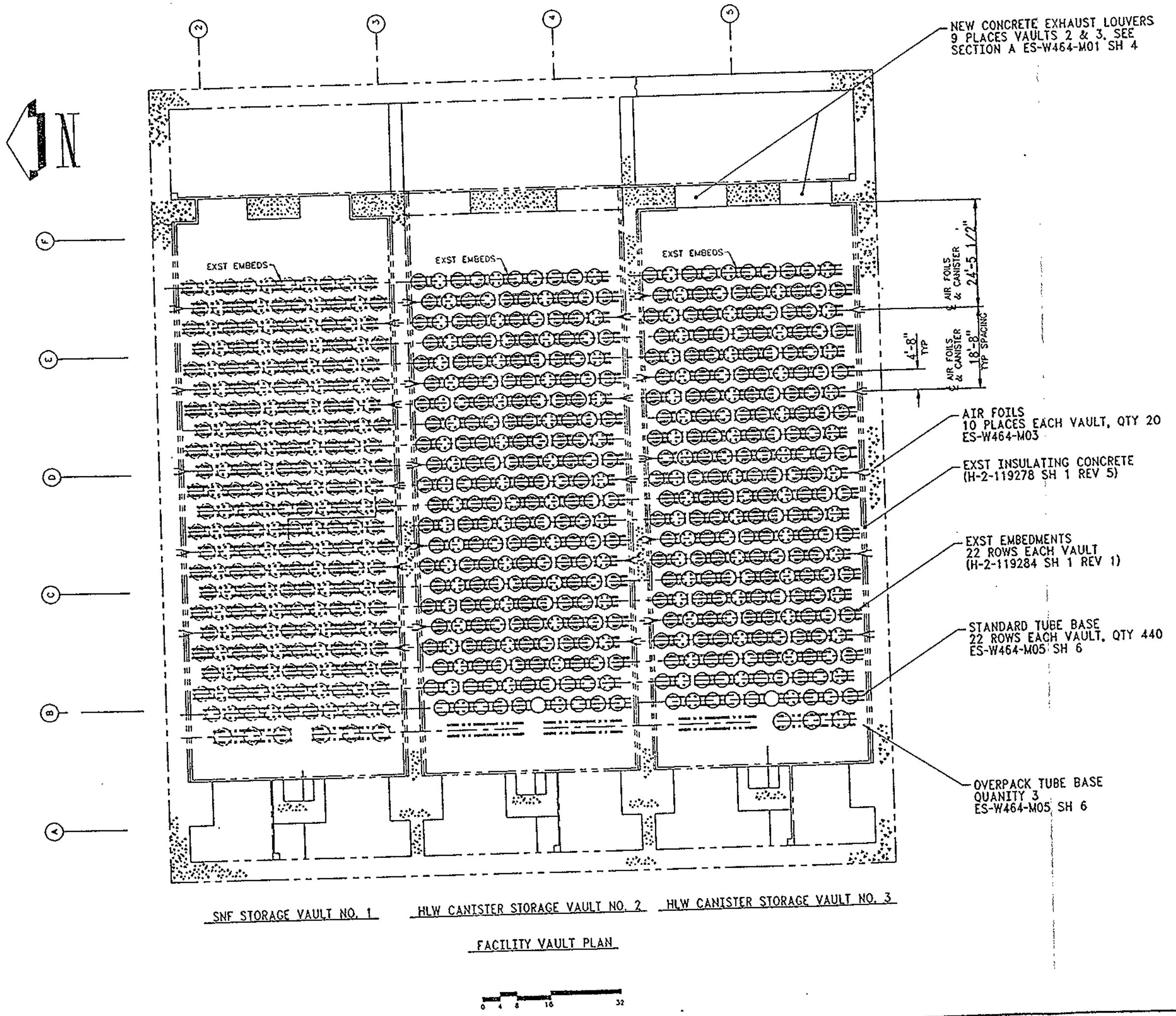
Prepared by: P LAING
Checked by:
Title: TITLE SHEET SITE PLAN & DRAWING LIST
Sketch no. ES-W464-C00
Sh 2 of
Cadfile I464C008
Rev 0



FACILITY FLOOR PLAN

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST	PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY			
Prepared by: P LAING Checked:	Title: MECHANICAL FACILITY LAYOUT OPERATIONS FLOOR PLAN	Sketch no. ES-W464-M01	Sh 1 of Cadfile I464M01A	Rev 0



FACILITY VAULT PLAN

SK-120900	SCB SPACE ALLOCATION
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

Prepared by: P LAING

Checked by:

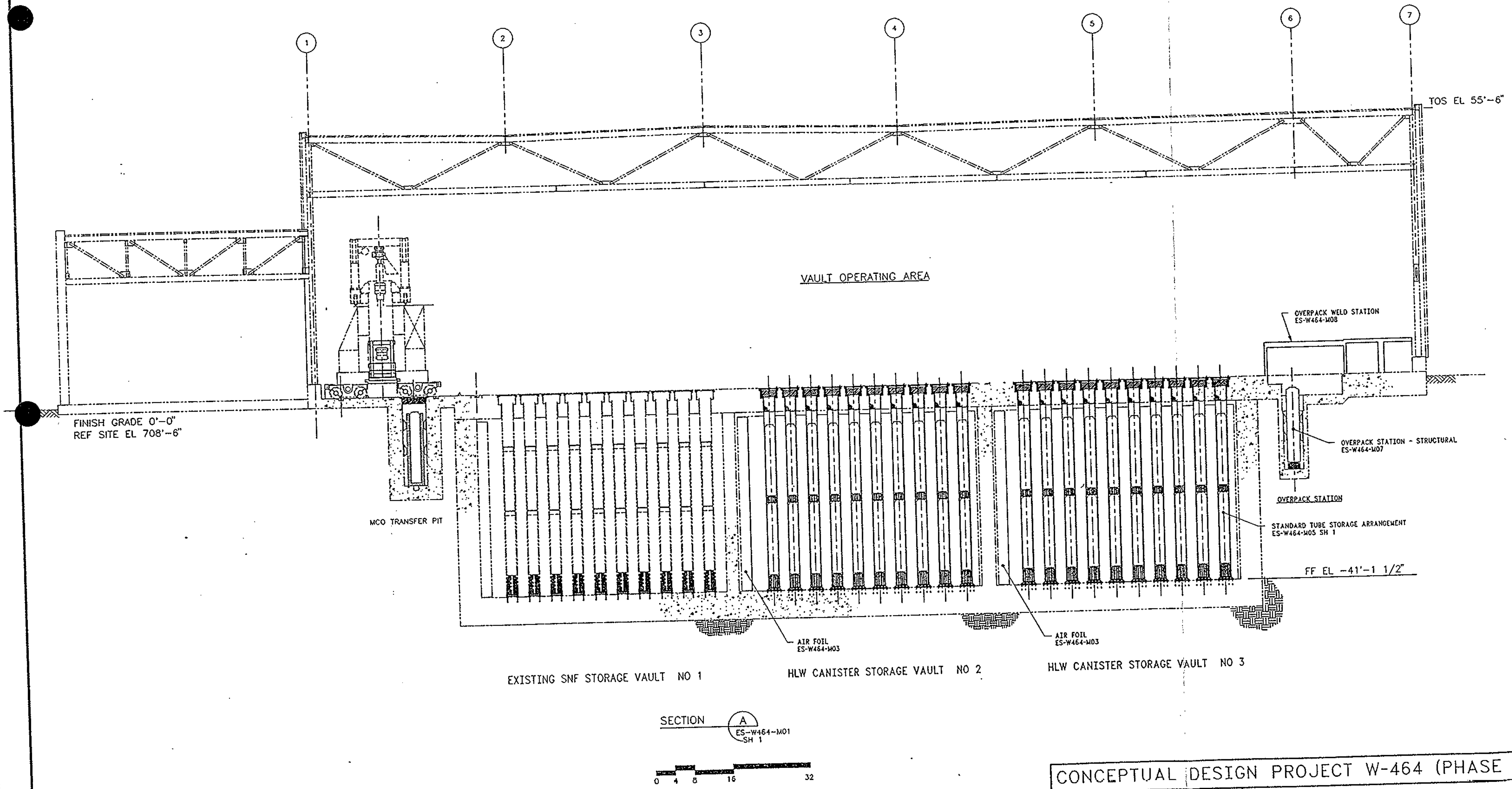
Title: MECHANICAL FACILITY LAYOUT VAULT FLOOR PLAN

Sketch no. ES-W464-M01

Sh 2 of

Cache I464M01B

Rev 0



CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P LAING
Checked: Jkl

Title:
MECHANICAL
FACILITY LAYOUT
CROSS SECTION

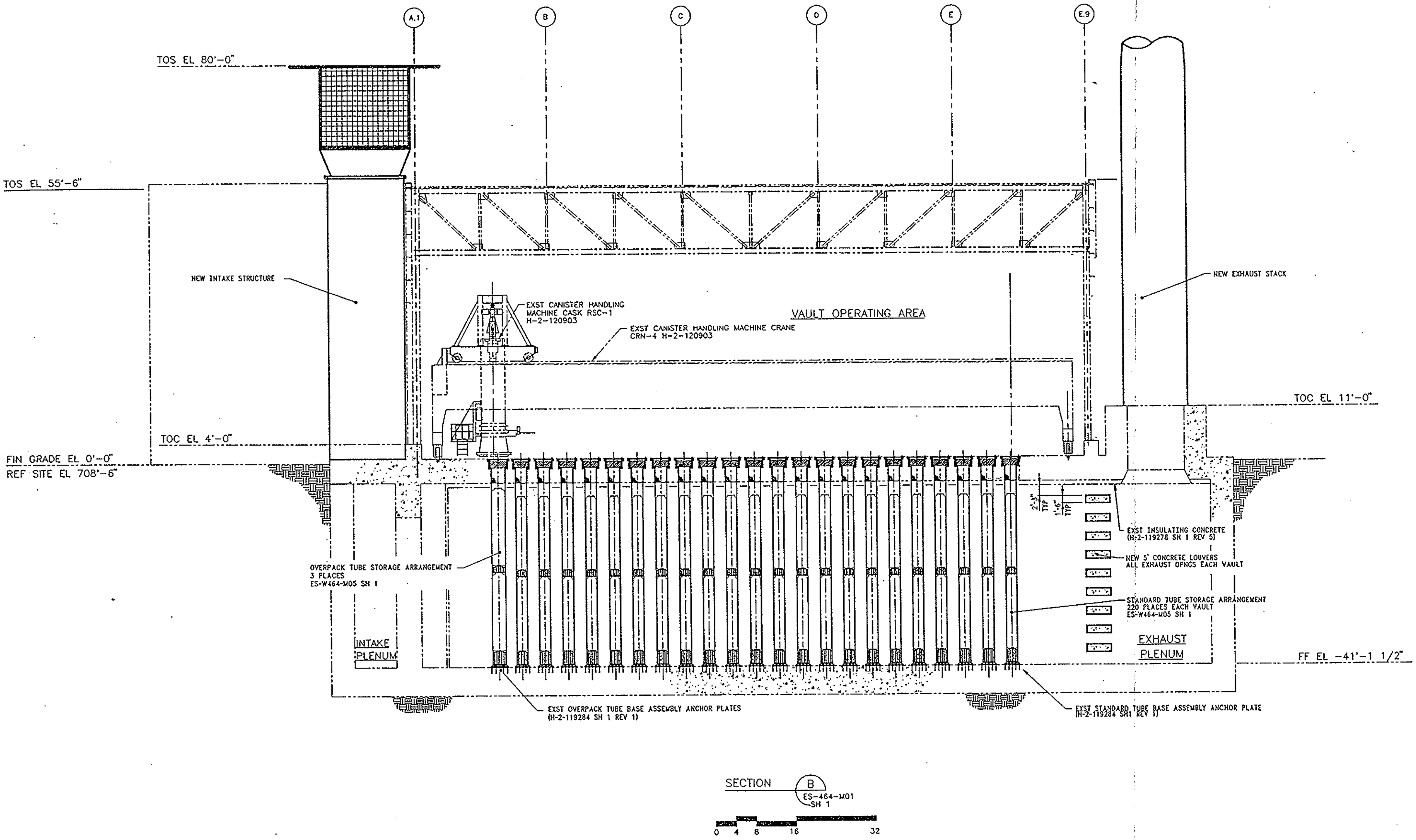
Sketch no.
ES-W464-M01

Sh 3 of

Cadfile I464M01C

Rev 0

H-2-120900	CSB SPAVE ALLOCATION
DWG NO	TITLE
DRAWING TRACEABILITY LIST	



H-2-120900	CSB SPACE ALLOCATION
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

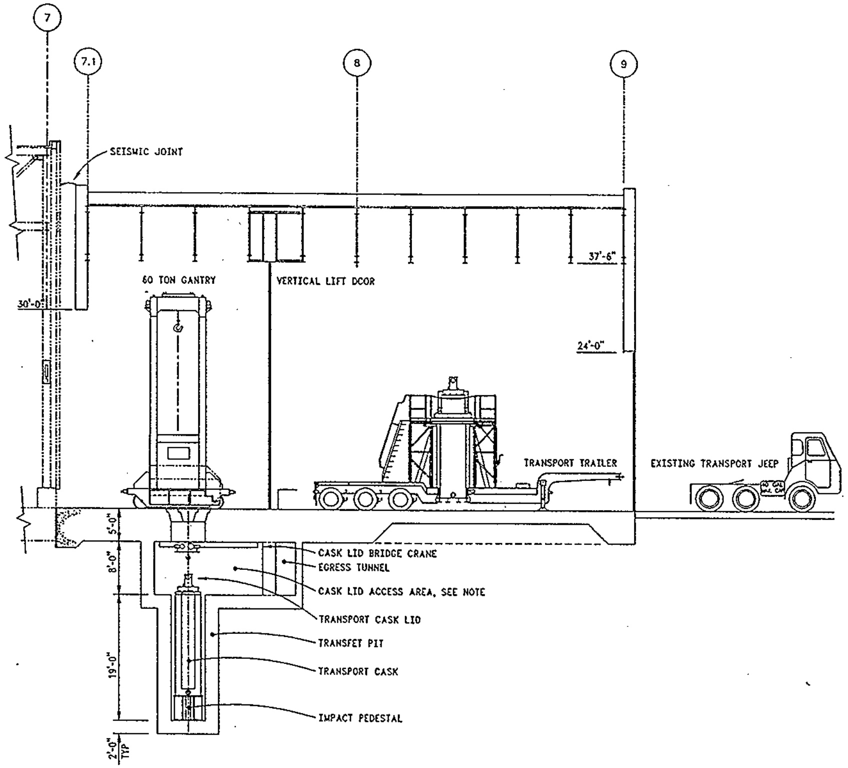
PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P LAING
Checked by:

Title:
MECHANICAL
FACILITY LAYOUT
LONGIT SECTION

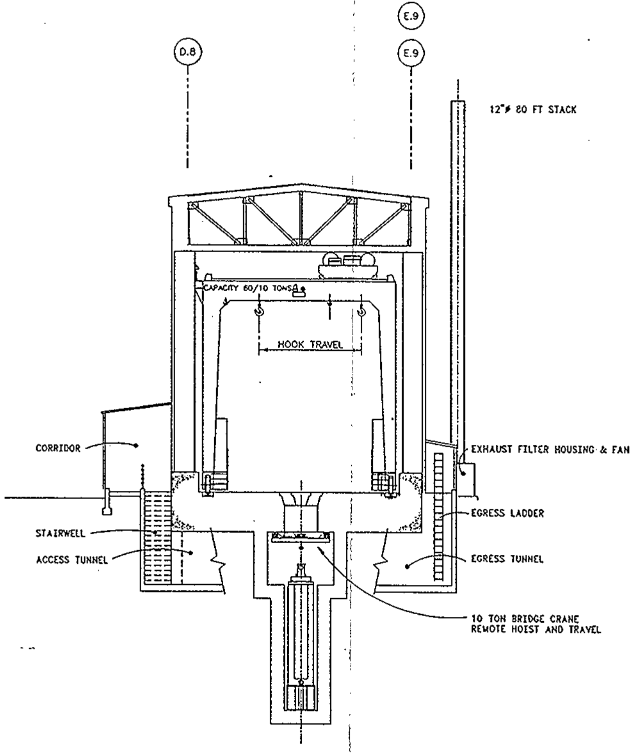
Sketch no.
ES-W464-M01

Sh 4 of
Cadfile I464M01D
Rev 0



SECTION C ES-W464-M01 SH 1

NOTE:
CASK LID REMOVAL AREA WILL ALSO SERVE AS SCT UNDERCARRIGE MAINTENANCE AREA BY PLACING GRATING OVER PIT OPENING AND USING A HOIST MECHANISM TO REMOVE SCT COMPONENTS AS NECESSARY



SECTION D ES-464-M01 SH 1

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

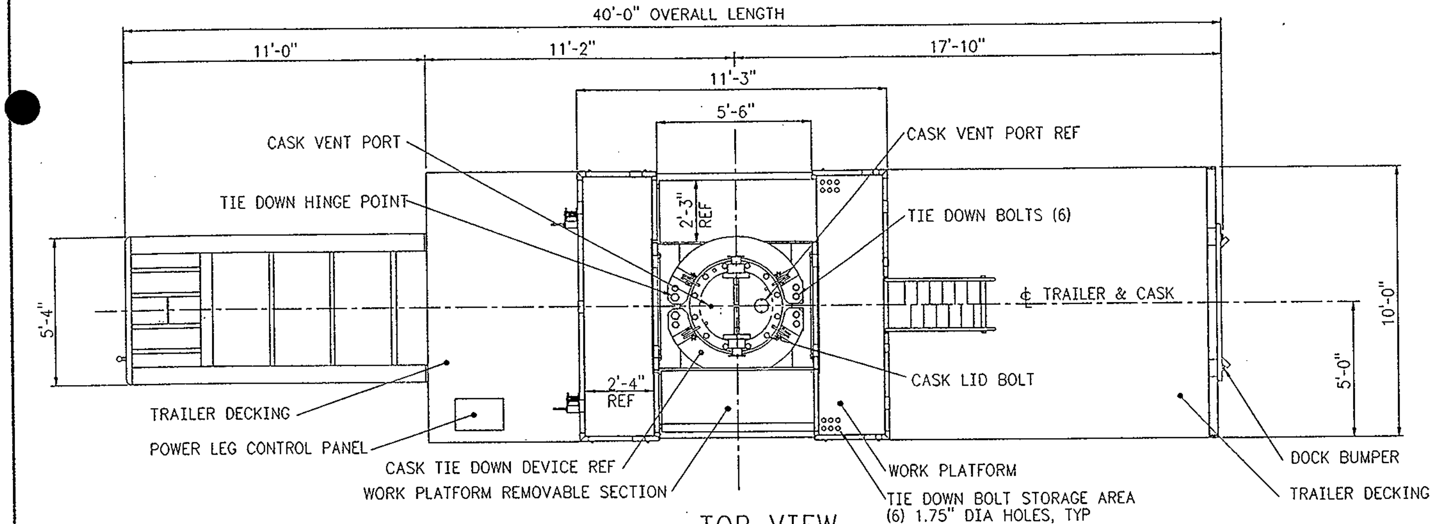
FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

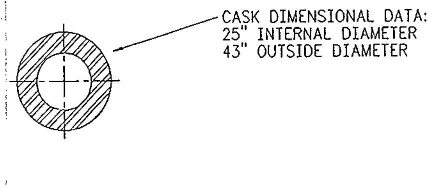
Prepared by: P LAING
Checked by:
Title:
MECHANICAL
FACILITY LOADIN/LOADOUT
ANNEX SECTIONS
Sketch no. ES-W464-M01
Sh 5 of
Cadfile I464M01E
Rev 0

NOTES:

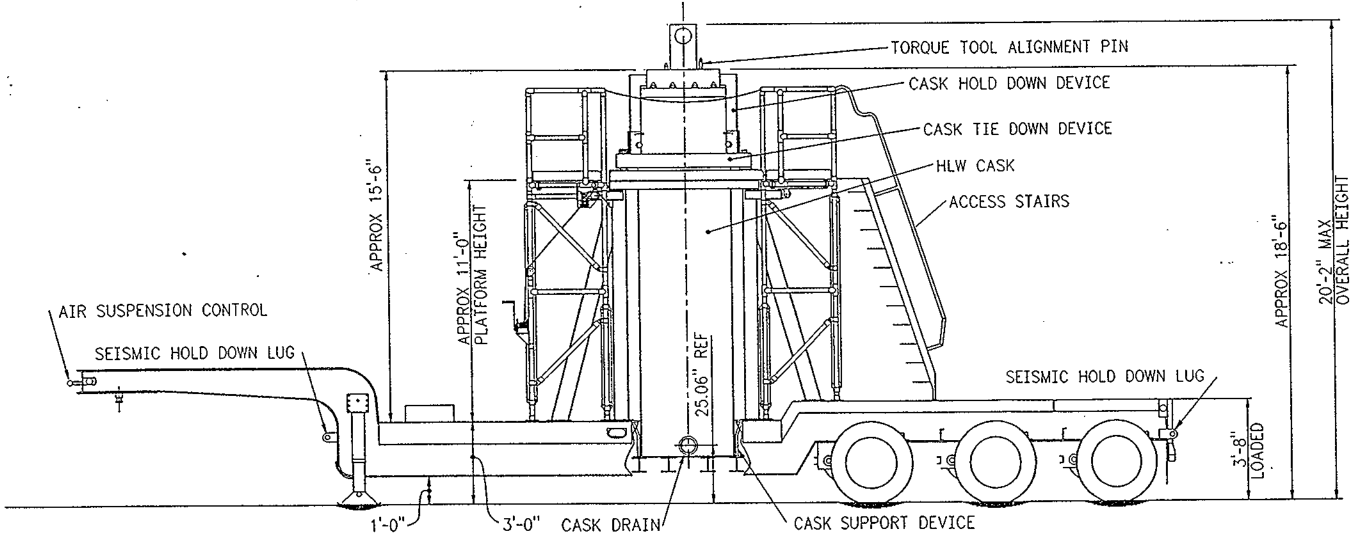
1. ESTIMATED CASK PLUS HLW CANISTER: 33 TON.
2. MAXIMUM PAYLOAD AS SHOWN AT 32,000 LBS PER 4 WHEEL AXLE, TOTAL CURB WEIGHT WITH 3 AXLES IS: 48 TON.
3. DIMENSIONS SHOWN ARE PRELIMINARY AND APPROXIMATE



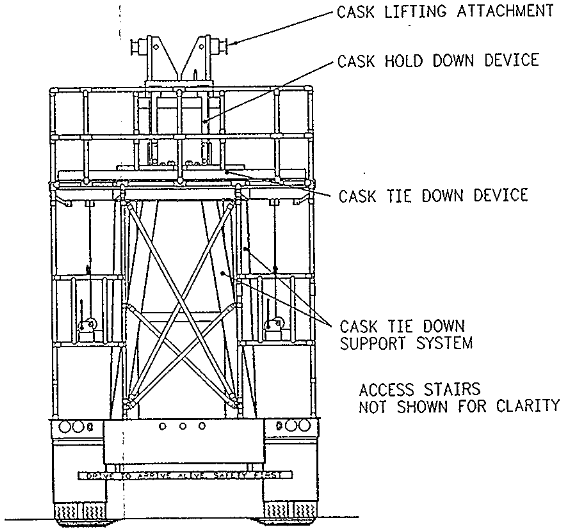
TOP VIEW



CASK SECTION



SIDE VIEW



END VIEW

DWG NO	TITLE
30353	TRANSNUCLEAR INC

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked: Jel

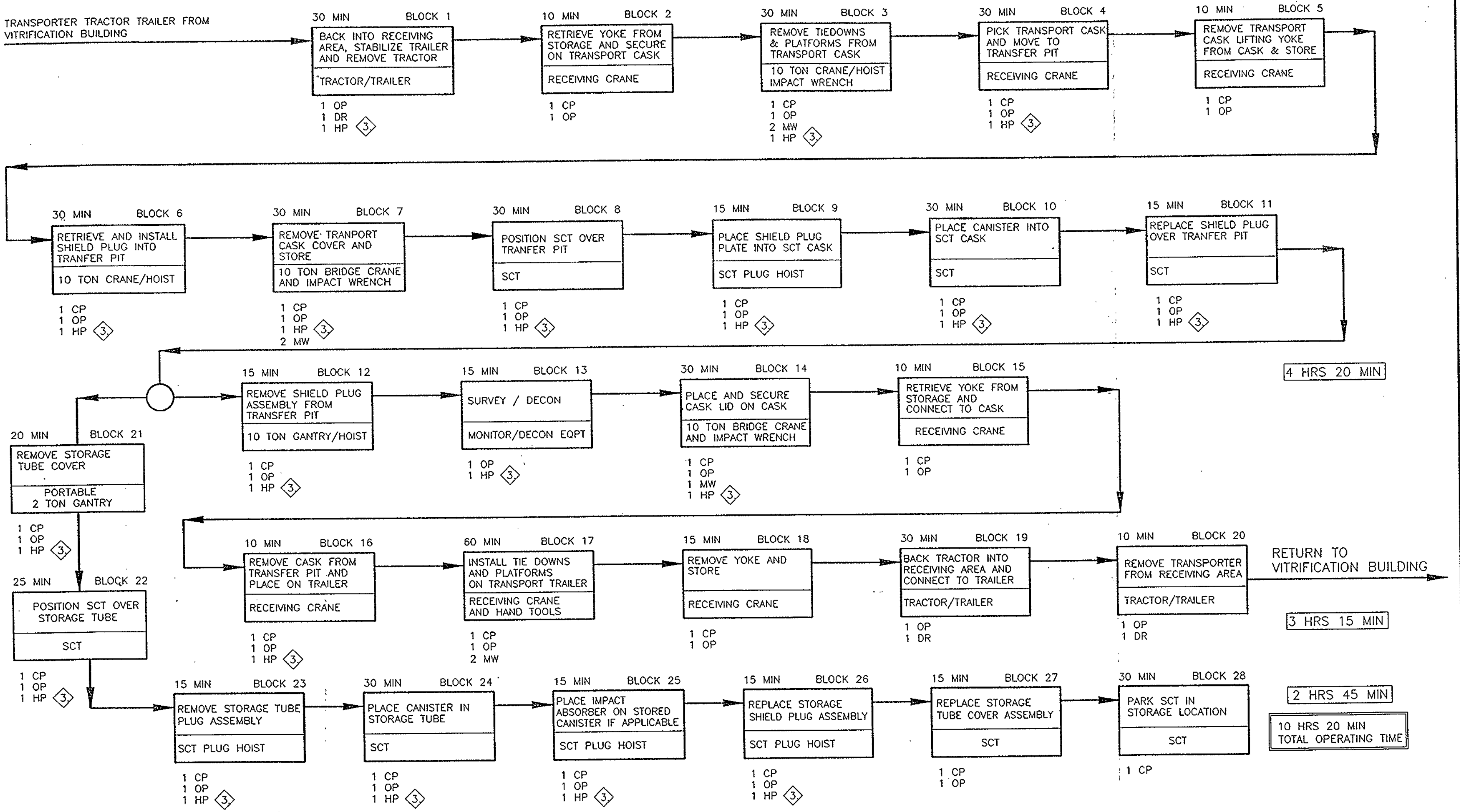
Title:
MECHANCIAL
FACILITY LAYOUT
TRANSPORT TRAILER

Sketch no. ES-W464-M01

Sh 6 of

Cadfile I464M01F

Rev 0



NOTES:

1. SUPERVISOR WILL SPEND 1 TO 2 HOURS PER SHIFT ON OPERATING DECK DURING TRANSFER PROCESS.
2. MAJOR EQUIPMENT ITEMS ARE THE TRANSPORTER, RECIEVING CRANE, IMPACT WRENCH, LIFTING YOKE, TRANPORT CASK, SHIELD HATCH. THERE IS ONE OF EACH ITEM AND EACH ITEM IS DEDICATED FOR USE AS NEEDED. ALL ITEMS LISTED ARE DESIGNED AND FABRICATED.

③ HP WILL BE IN AREA AND WILL PROVIDE COVERAGE ON AN AS NEEDED BASIS.

(CONT)

4. NO ALLOWANCE GIVEN FOR HP UNAVILABILITY
5. IT HAS BEEN ASSUMED THAT THE BOTTOM IMPACT ABSORBER HAS BEEN PREVIOUSLY INSTALLED.

LEGEND

DR = DRIVER · · · · · · · · · · 1
MW = MILL WRIGHT · · · · · · · · 2
CP = CRANE OPERATOR · · · · · 1
OP = OPERATOR · · · · · · · · · 1
HP = HEALTH PHYSICIST · · · · 1
SUPERVISOR · · · · · · · · · · 1
TOTAL MANPOWER REQUIRED · · 7

TIME ACTIVITY #
DESCRIPTION OF TASK
EQUIPMENT USED
PERSONNEL REQUIRED
1 OP
1 HP ③ SEE NOTE NO.
FLOW

CHART 6	BLOCK DIAG. HLW CANISTER	
DWG NO	TITLE	
DRAWING TRACEABILITY LIST		

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

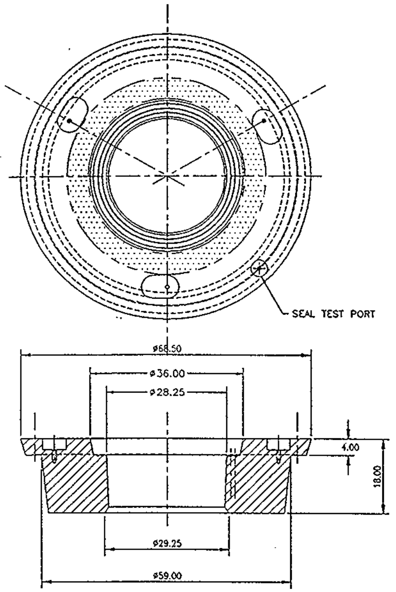
FLUOR DANIEL NORTHWEST

Project Title: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

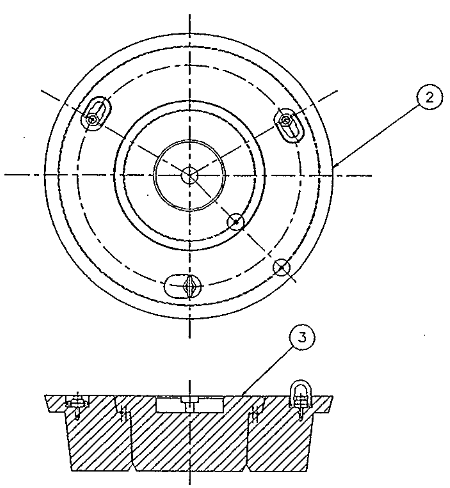
Prepared by: P LAING
Checked:

Title: MECHANICAL OPERATING SEQUENCE CSB BLOCK DIAGRAM

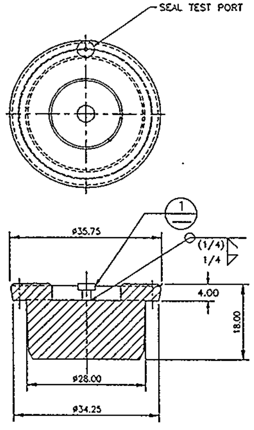
Sketch no. ES-W464-M02
Sh 1 of
Cadfile I464M02
Rev 0



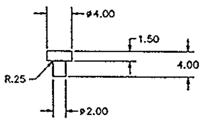
② PRIMARY SHIELD PLUG



SHIELD PLUG ASSEMBLY



③ CENTER SHIELD PLUG

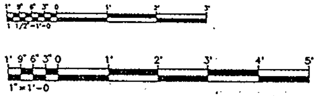


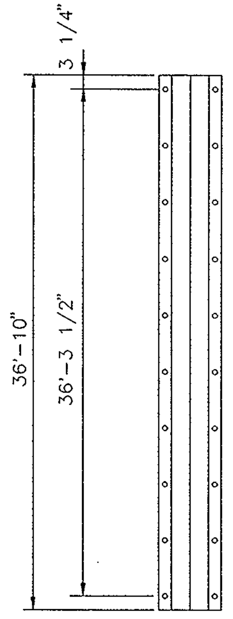
DETAIL ①
1 1/2"=1'-0"

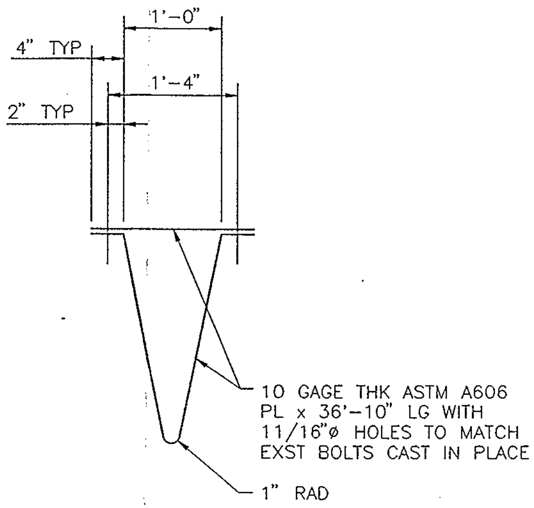
UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAXIMUM
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX.

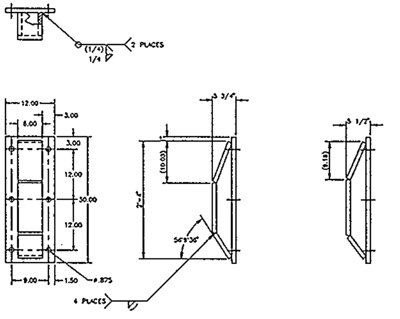
TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16"
ANGULAR: ± 1°







AIR FOIL DETAIL



LOWER CASK GUIDE
1" PLATE TYPICAL

UPPER CASK GUIDE
SAME AS ITEM 3
EXCEPT AS SHOWN

TRANSFER PIT GUIDES

H-2-120908	SERVICE STA SHEILD MATCH
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

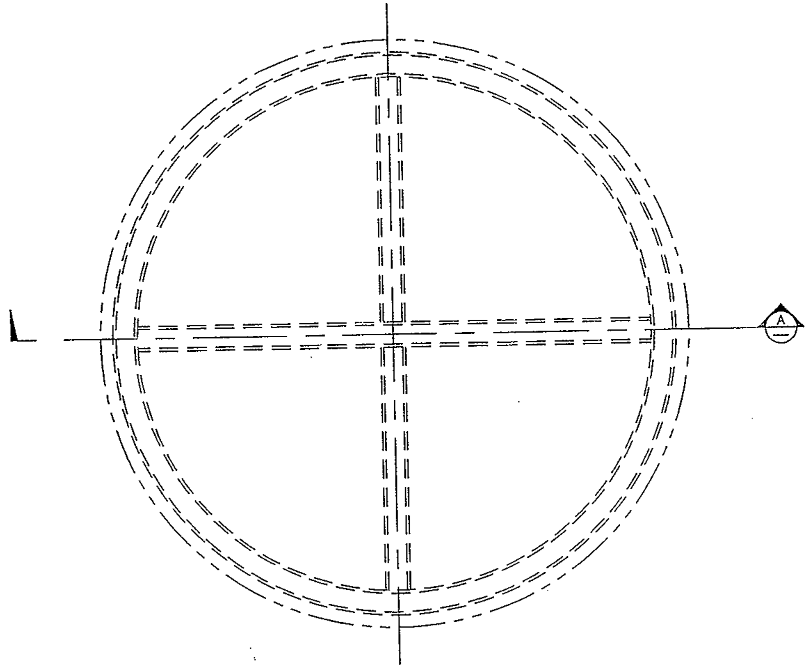
Prepared by:
P LAING
Checked by:

Title:
MECHANICAL
MISC DETAILS

Sketch no.
ES-W464-M03

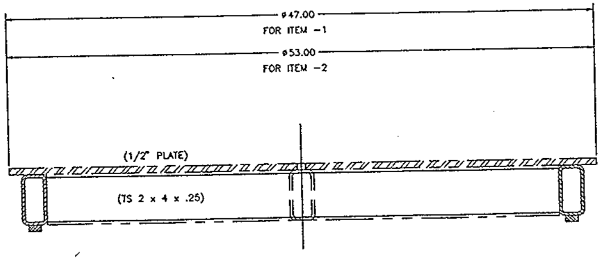
Sh 1 of
Cadfile I464M03

Rev
0



① STANDARD TEMPORARY COVER ASSEMBLY
EXCESS 440

② OVERPACK TEMPORARY COVER ASSEMBLY
EXCESS 9



SECTION Ⓐ

NOTES:

1. THIS DRAWING PROVIDED FOR DEMOLITION/EXCESS ESTIMATING ONLY

H-2-120914	CSB CELL COVERS
DWG NO	TITLE

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBLIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P LAING
Checked by:

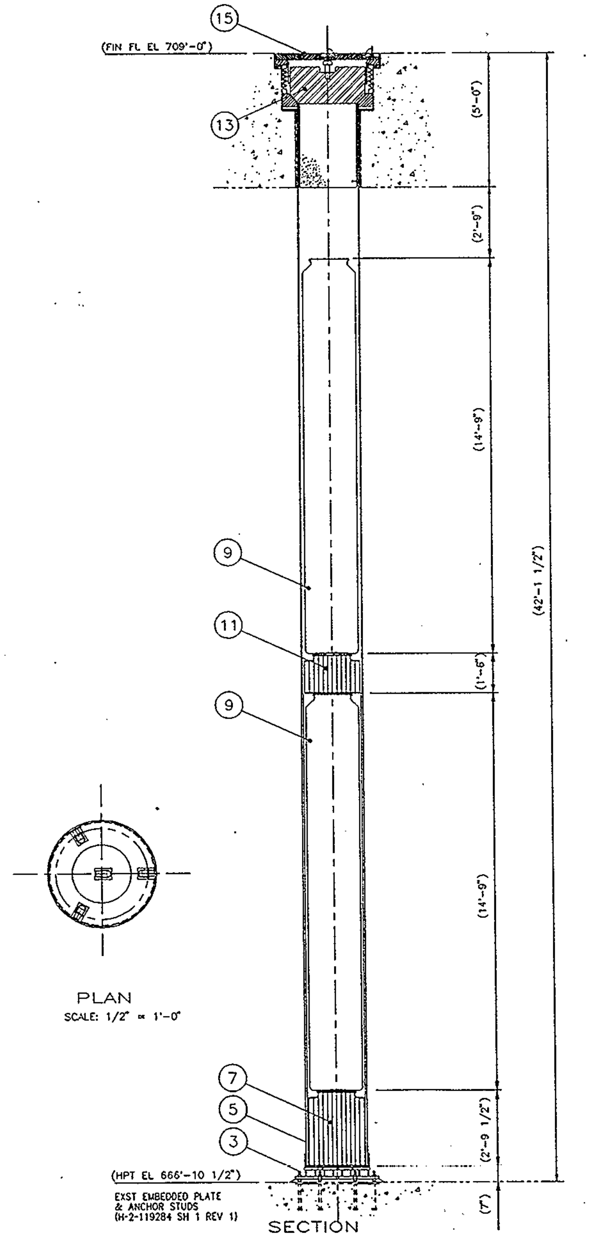
Title:
MECHANICAL
TEMPORARY COVERS

Sketch no.
ES-W464-M04

Sh 1 of

Cadfile
I464M04

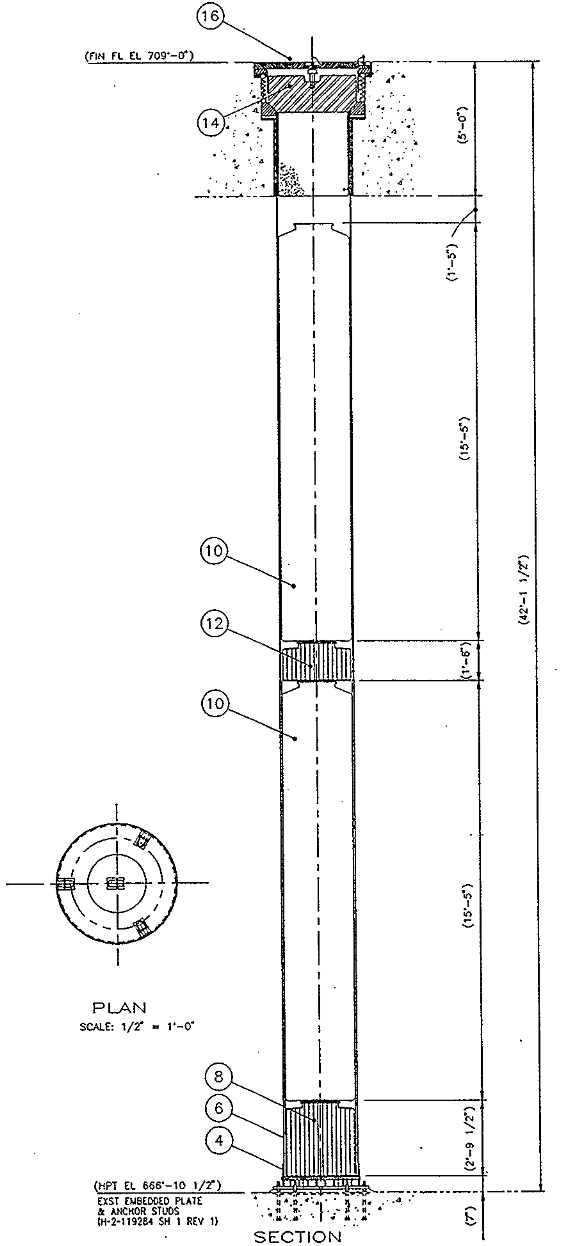
Rev
0



SECTION

① STANDARD CANISTER STORAGE ARRANGEMENT

SCALE: 1/2" = 1'-0"



SECTION

② OVERPACK CANISTER STORAGE ARRANGEMENT

SCALE: 1/2" = 1'-0"

PARTS/MATERIAL LIST

QTY REQ'D -020	QTY REQ'D -010	NOMENCLATURE/DESCRIPTION	REFERENCE DRAWING	ITEM NO.
☒		STANDARD CANISTER STORAGE ARRANGEMENT -010		1
☒		OVERPACK CANISTER STORAGE ARRANGEMENT -020		2
	1	STANDARD TUBE BASE ASSEMBLY	ES-W464-M05 SH 6	3
1		OVERPACK TUBE BASE ASSEMBLY	ES-W464-M05 SH 6	4
	1	STANDARD TUBE ASSEMBLY	ES-W464-M05 SH 4	5
1		OVERPACK TUBE ASSEMBLY	ES-W464-M05 SH 4	6
	1	STANDARD LOWER IMPACT ABSORBER	ES-W464-M06	7
1		OVERPACK LOWER IMPACT ABSORBER	ES-W464-M06	8
	1	STANDARD CANISTER	ES-W464-M09	9
1		OVERPACK CANISTER	ES-W464-M09	10
	1	STANDARD UPPER IMPACT ABSORBER	ES-W464-M06	11
1		OVERPACK UPPER IMPACT ABSORBER	ES-W464-M06	12
	1	STANDARD TUBE SHIELD PLUG ASSY	ES-W464-M05 SH 3	13
1		OVERPACK TUBE SHIELD PLUG ASSY	ES-W464-M05 SH 3	14
	1	STANDARD PLUG COVER ASSEMBLY	ES-W464-M05 SH 2	15
1		OVERPACK PLUG COVER ASSEMBLY	ES-W464-M05 SH 2	16
				17
				18
				19
				20

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

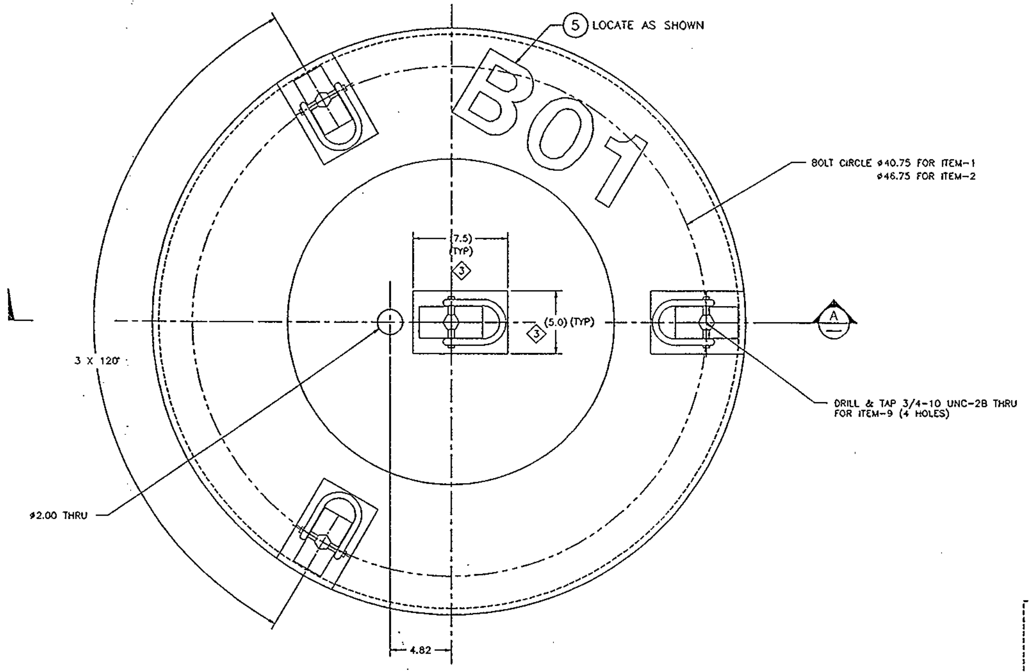
FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by: P. LAING
Checked:

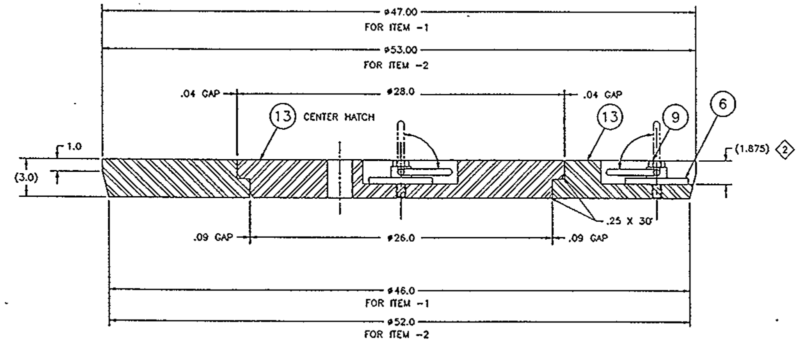
Title:
MECHANICAL
STANDARD/OVERPACK
CANISTER STG ARRANGEMENT

Sketch no. ES-W464-M05
Sh 1 of
Cadfile E464M05A
Rev 0



① STANDARD TUBE PLUG COVER ASSEMBLY
QUANTITY 440

② OVERPACK TUBE PLUG COVER ASSEMBLY
QUANTITY 3



SECTION Ⓐ

	QTY REQ'D -020	QTY REQ'D -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
		X	-010	STANDARD TUBE PLUG COVER ASSEMBLY		1	01
	X		-020	OVERPACK TUBE PLUG COVER ASSEMBLY		1	02
							03
							04
◇5	3	3		LETTERS, 6 HIGH x 1" STROKE	PAINTED BLACK ON WHITE		05
	4	4		SWIVEL LIFTING PLATE	MC MASTER-CARR CAT NO. 3070T21		06
							07
◇4		1		CHAIN SLING-3 LEG X 4' LG.	MC MASTER-CARR CAT NO. 3408T56		08
	4	4		HEX BOLT 3/4-10 UNC-2A X 2 1/2" LG.	ASTM A-193 CLASS 2 GRADE 88		09
							10
							11
							12
	AR	AR		PLATE 3" THK	ASTM A-36		13

PARTS/MATERIAL LIST

NOTES: UNLESS OTHERWISE SPECIFIED

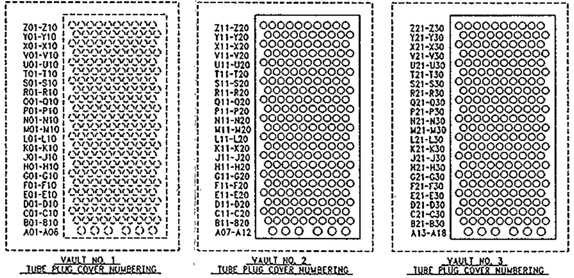
1. FABRICATION AND ASSEMBLY OF THIS EQUIPMENT SHALL BE IN ACCORDANCE WITH SPECIFICATION W-379-C-CSB SECTION 13088.

◇2 THIS DIMENSION TO BE VERIFIED BY CONTRACTOR WITH THE LIFTING BAIL IN THE FOLDED DOWN POSITION TOP OF BOLT TO BE COPLANER WITH TOP SURFACE OF ITEM 6.

◇3 THESE DIMENSIONS TO BE VERIFIED BY CONTRACTOR. DIMENSIONS SHALL ALLOW 1/4" MIN TO 1/2" MAX WORKING CLEARANCE AROUND ITEM-6 (TYP 4 PLACES).

◇4 THREE CHAIN SLINGS ARE REQUIRED FOR THE ENTIRE QUANITY OF TUBE PLUG COVERS.

◇5 THE LETTERS REQUIRED ON THE TUBE PLUB COVERS SHALL BE AS SHOWN BELOW, USING ALL LETTERS OF THE ALPHABET EXCEPT I, O AND W.



VAULT NO. 1
TUBE PLUG COVER NUMBERING

VAULT NO. 2
TUBE PLUG COVER NUMBERING

VAULT NO. 3
TUBE PLUG COVER NUMBERING

Ⓑ TUBE PLUG COVER NUMBERING

UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAXIMUM
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX.

TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16"
ANGULAR: ± 1°

1/4 SCALE

DWG NO	TITLE
H-2-120912	CSB TUBE PLUG COVER

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked by: [illegible]

Title:
MECHANICAL
TUBE PLUG COVER
ASSEMBLIES

Sketch no. ES-W464-M05

Sh 2 of

Cadfile I464M05B

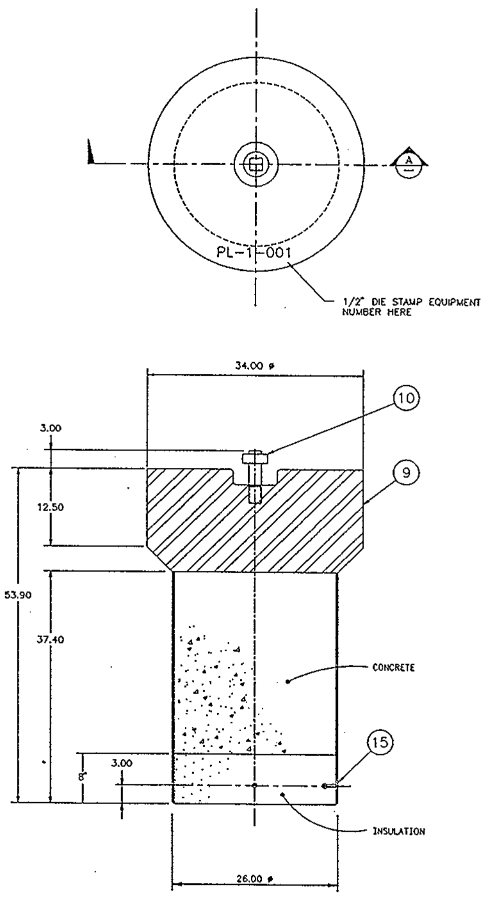
Rev 0

PARTS/MATERIAL LIST

QTY REQD -020	QTY REQD -010	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO.
	☒	-010	STANDARD TUBE SHIELD PLUG ASSEMBLY PL-1-001		1	1
☒		-020	OVERPACK TUBE SHIELD PLUG ASSEMBLY PL-2-001		1	2
						3
						4
						5
						6
						7
						8
	1	-001	STEEL CASTING	ASTM-A 27/A27M GRADE N-2 CLASS 1		9
1	1	-02X	SHORT LIFTING LUG	ASTM-A108 ANSI 1040		10
						11
1		-004	STEEL CASTING	ASTM-A 27/A27M GRADE N-2 CLASS 1		12
						13
						14
6	6		NELSON HEADED WELD STUD, ø1/2 X 2 1/8 L	ASTM-A108 GR-C-1010/C-1020		15

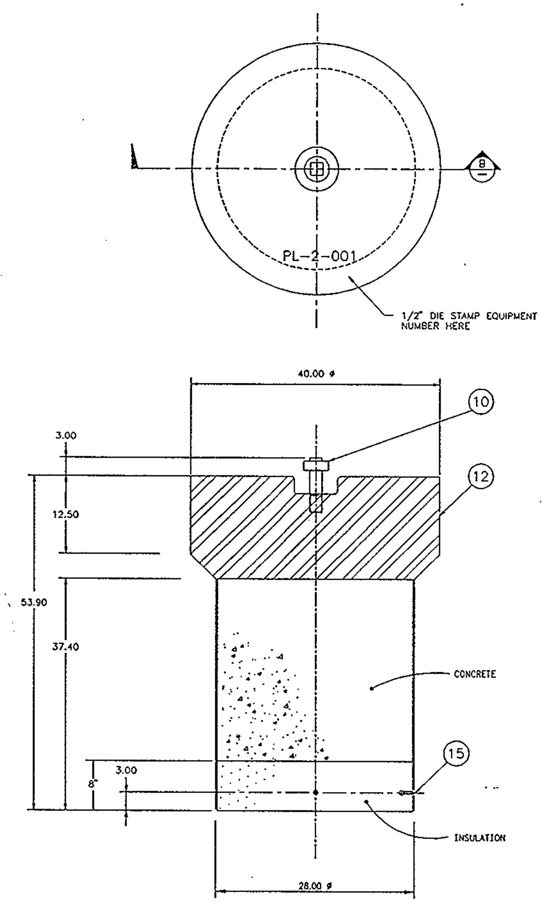
NOTES: UNLESS OTHERWISE SPECIFIED

1. FILL BOTTOM OF PLUG CAVITY WITH LIGHT WEIGHT INSULATING CONCRETE



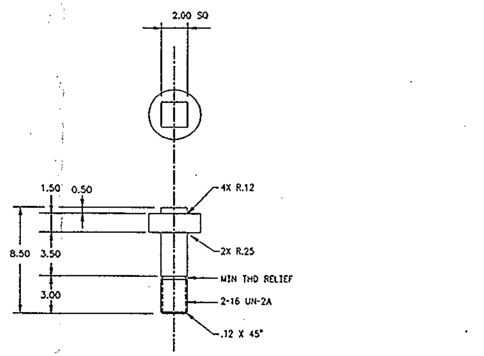
A SECTION
SCALE: 1/8

① STANDARD TUBE
SHIELD PLUG ASSEMBLY
QUANTIY 440



B SECTION
SCALE: 1/8

② OVERPACK TUBE
SHIELD PLUG ASSEMBLY
QUANITY 3



⑩ SHORT LIFTING LUG
PL-02X

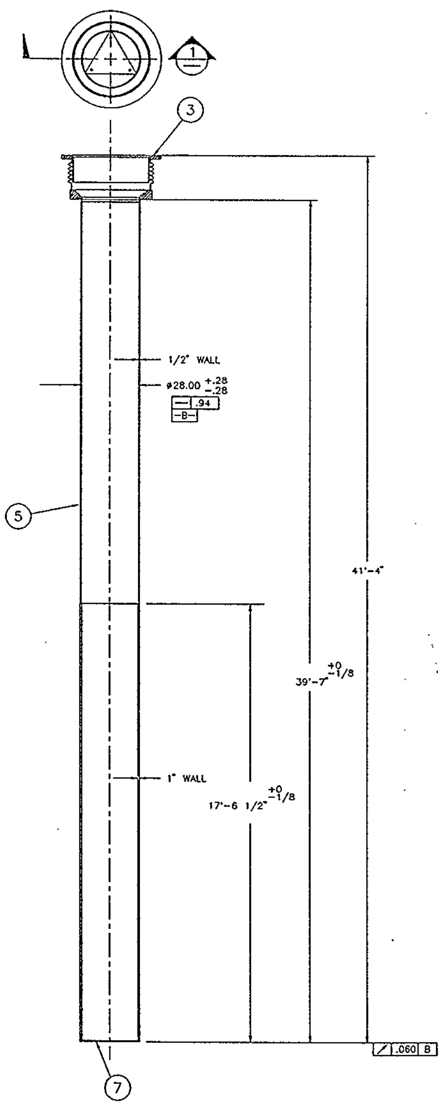
UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125√ MAX
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX

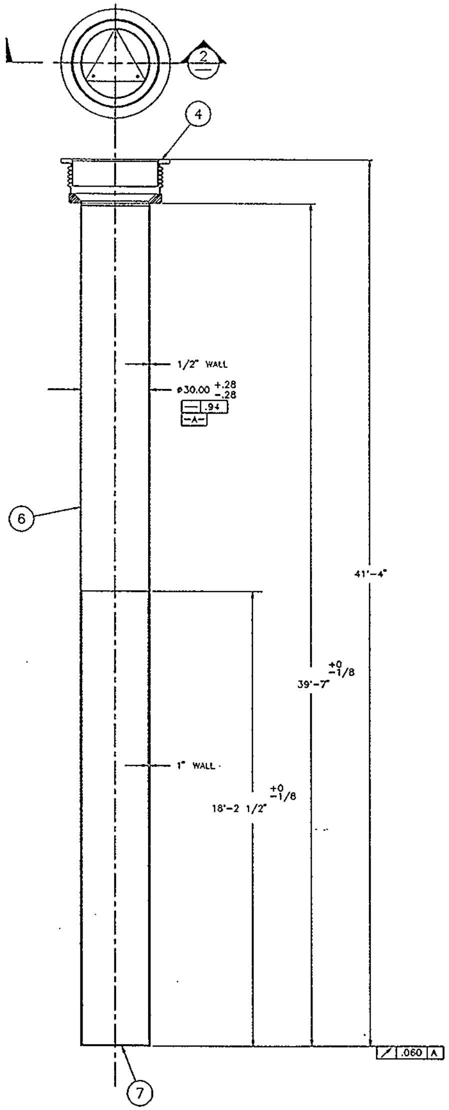
TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16
ANGULAR: ± 1/2°

10" 5" 0 10" 20"
1/8 SCALE

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)
FLUOR DANIEL NORTHWEST
PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY
Prepared by: P. LAING
Checked by:
Title: MECHANICAL STANDARD/OVERPACK TUBE SHIELD PLUG ASSEMBLIES
Sketch no. ES-W464-M05
Sh 3 of
Cadfile I464M05C
Rev 0



① STANDARD TUBE ASSEMBLY
QUANITY 440



② OVERPACK TUBE ASSEMBLY
QUANITY 3

PARTS/MATERIAL LIST

QTY REQD -020	QTY REQD -010	PART/DASH NO.	NOMENCLATURE/DESCRIPTION	MAT'L/REF	SHEET	ITEM NO.
	☒	-010	STANDARD TUBE ASSEMBLY			1
☒		-020	OVERPACK TUBE ASSEMBLY			2
	1	-030	STANDARD BELLOWS ASSEMBLY	ES-W464-M05	5	3
1		-040	OVERPACK BELLOWS ASSEMBLY	ES-W464-M05	5	4
	AR		PIPE 28"	CARBON STEEL PIPE		5
AR			PIPE 30"	CARBON STEEL PIPE		6
AR	AR		PLATE, 1/2" THK	ASME-SA36		7

UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAX
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX

TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/8
ANGULAR: ± 1/2°

0 1 2 3 4 5 6 7 8 9 10
GRAPHIC SCALE
1/2" = 1'-0"

DWG NO	TITLE
H-2-120395	STD/OPACK TUBE ASSEMBLIES

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

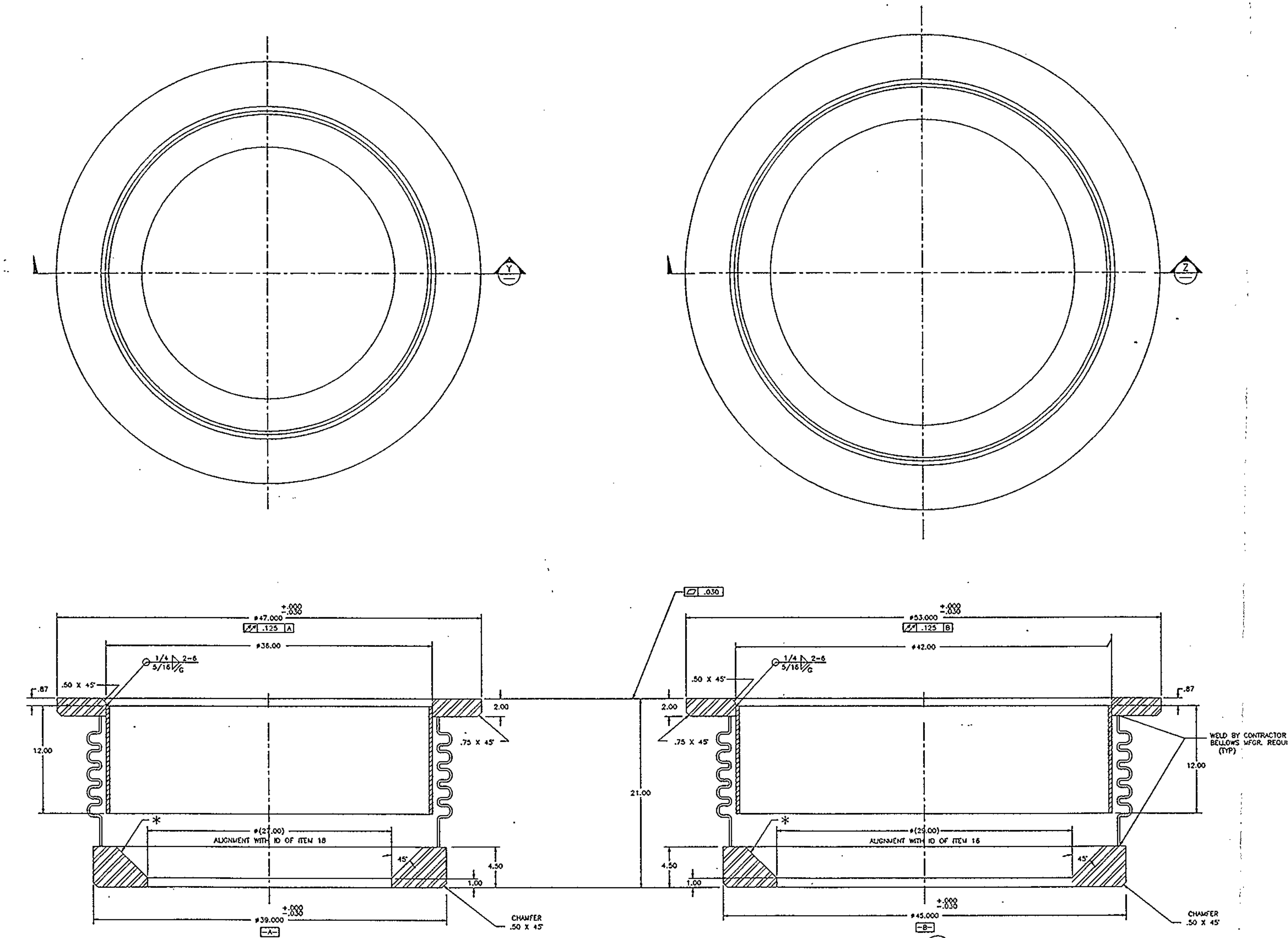
PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P LAING
Checked by:

Title:
MECHANICAL
STANDARD/OVERPACK
TUBE ASSEMBLIES

Sketch no.
ES-W464-M05

Sh 4 of
Cadfile I464M05D
Rev 0



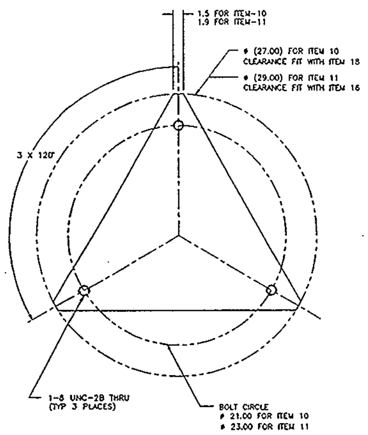
SECTION Y
SCALE: 1/4

STANDARD BELLOWS ASSEMBLY
QUANTITY 440

* THIS SURFACE MUST BE PROTECTED DURING ALL MANUFACTURING PROCESSES

SECTION Z
SCALE: 1/4

OVERPACK BELLOWS ASSEMBLY
QUANTITY 3



STANDARD LIFTING PLATE
SCALE : 1/4

OVERPACK LIFTING PLATE
SCALE : 1/4

ITEM A: THREE REQUIRED FOR ENTIRE PROJECT
ITEM B: ONE REQUIRED FOR ENTIRE PROJECT

UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAX
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX

TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16
ANGULAR: ± 1/2°

5' 4' 3' 2' 1' 0 5' 15'
1/4 SCALE

H-2-120395	STD/OPACK BELLOWS ASSY
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P. LAING
Checked by:

Title:
MECHANICAL
STANDARD/OVERPACK
BELLOWS ASSEMBLIES

Sketch no.
ES-W464-M05

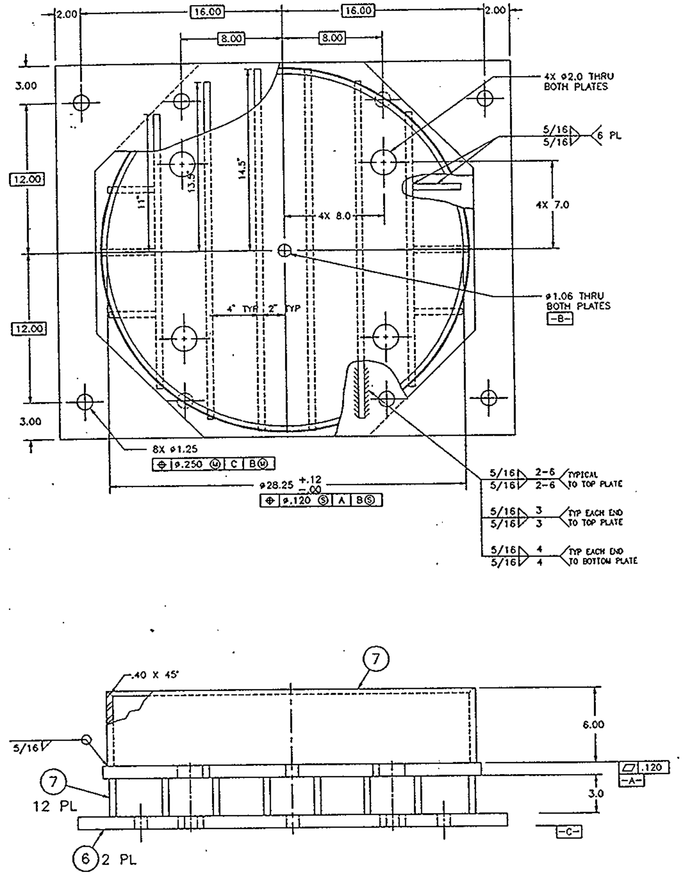
Sh 5 of
Cadfile I464M05E
Rev 0

PARTS/MATERIAL LIST

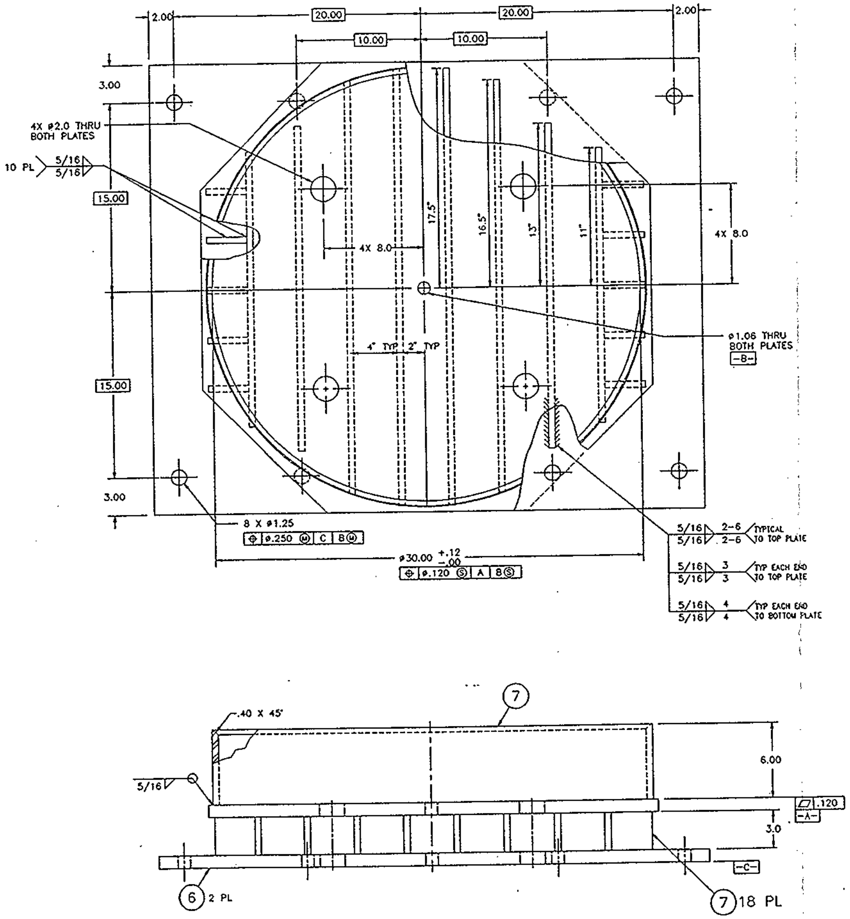
QTY REQD -020	QTY REQD -010	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO.
	☒	STANDARD TUBE BASE ASSEMBLY			1
☒		OVERPACK TUBE BASE ASSEMBLY			2
					3
					4
					5
	AR	PLATE, 1 THK	ASME-SA36		6
	AR	PLATE, 1/2 THK	ASME-SA36		7

NOTES: UNLESS OTHERWISE SPECIFIED

1. INSTALLATION POSITIONS SHALL ALIGN VERTICALLY WITH FLOOR EMBEDMENTS IN THE OPERATING LEVEL CONCRETE SLAB ABOVE THE VAULTS.



① STANDARD TUBE BASE ASSEMBLY
SCALE: 1/4 QUANITY 440



② OVERPACK TUBE BASE ASSEMBLY
SCALE: 1/4 QUANITY 3

UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAX
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX

TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16
ANGULAR: ± 1°

5" 4" 3" 2" 1" 0 5" 15"
1/4 SCALE

H-2-120396	STD/OPACK TUBE BASE ASSY
DWG NO	TITLE

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by:
P LAING
Checked by:

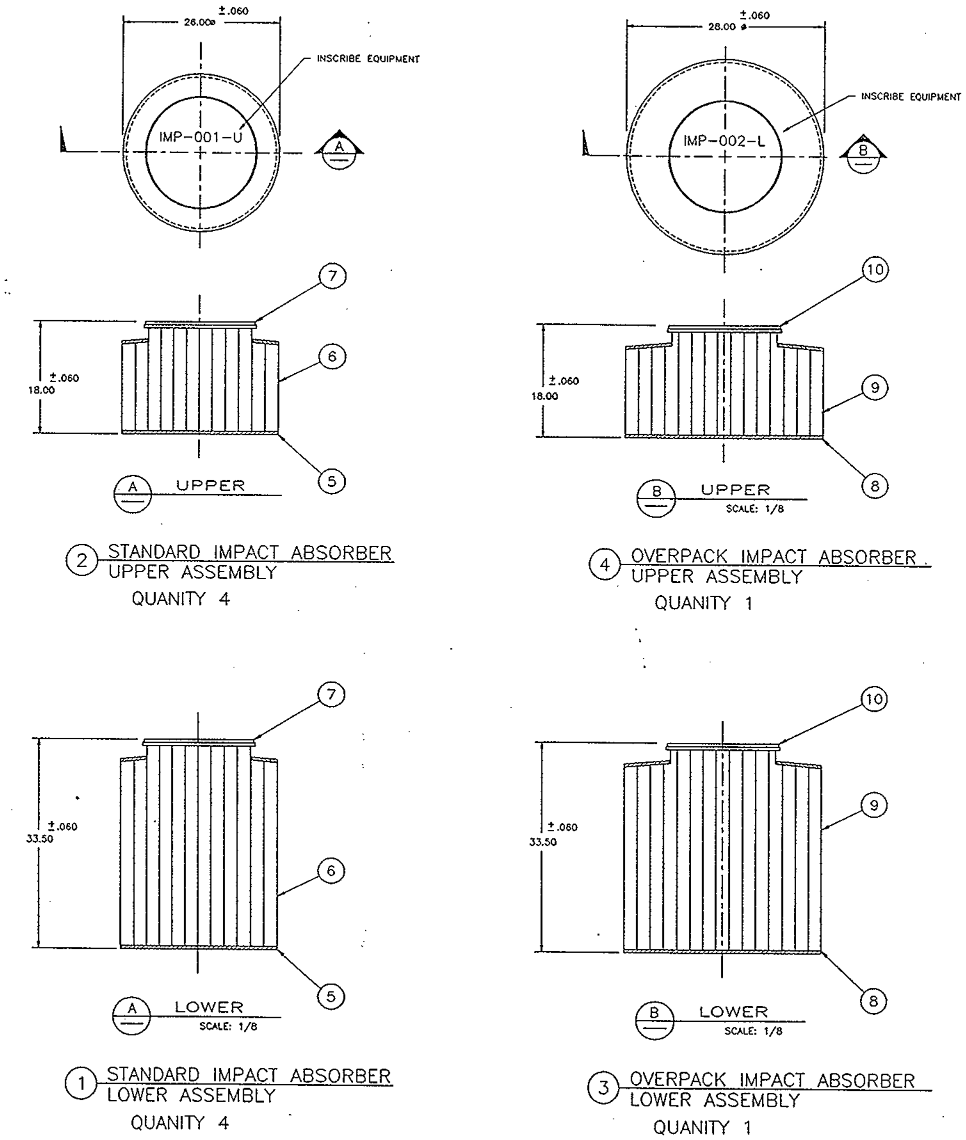
Title:
MECHANICAL
STANDARD/OVERPACK
TUBE BASE ASSEMBLIES

Sketch no.
ES-W464-M05

Sh. 6 of
Cadfile I464M05F
Rev 0

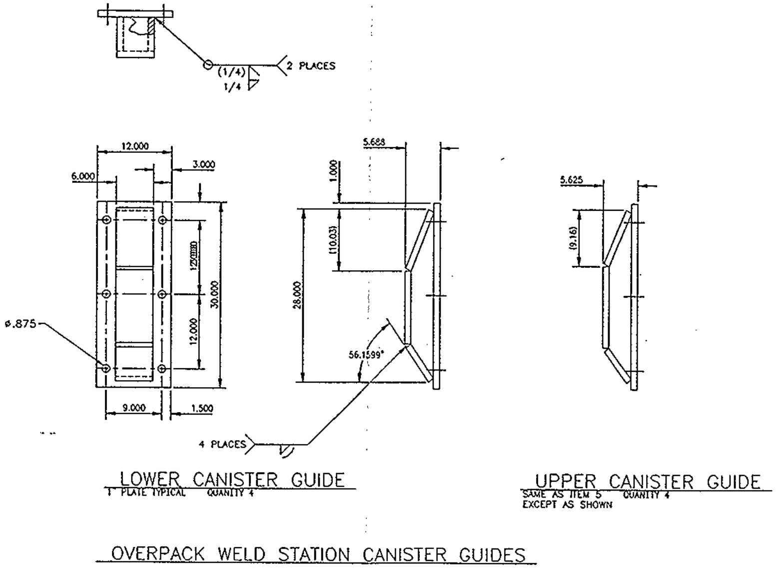
PARTS/MATERIAL LIST

QTY REQD				PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	ITEM NO.
			☒	-L	STANDARD IMPACT ABSORBER ASSEMBLY IMP-001		1
		☒		-U	STANDARD IMPACT ABSORBER ASSEMBLY IMP-001		2
	☒			-L	OVERPACK IMPACT ABSORBER ASSEMBLY IMP-002		3
☒				-U	OVERPACK IMPACT ABSORBER ASSEMBLY IMP-002		4
		1	1		STANDARD IMPACT LOWER PLATE, .50 THK		5
		AR	AR		STANDARD IMPACT ABSORBER MATERIAL		6
		1	1		STANDARD IMPACT UPPER PLATE ASSEMBLY, .50 THK		7
1	1				OVERPACK IMPACT LOWER PLATE, .50 THK		8
AR	AR				OVERPACK IMPACT ABSORBER		9
1	1				OVERPACK IMPACT UPPER PLATE ASSEMBLY, .50 THK		10



NOTES: UNLESS OTHERWISE SPECIFIED

1. IMPACT ABSORBER UPPER PLATE SHALL BE IDENTICAL TO CANISTER CONFIGURATION.



UNLESS OTHERWISE SPECIFIED

1. DIMENSIONS AND TOLERANCES ARE IN INCHES
2. ALL MACHINED SURFACES SHALL BE 125/ MAX
3. REMOVE BURRS AND BREAK ALL SHARP EDGES .03 MAX

TOLERANCES:
DECIMALS: .X = ± .1
.XX = ± .03
.XXX = ± .010
FRACTIONS: ± 1/16
ANGULAR: ± 1°

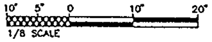


FIG 1 PG 10	E CANIS
DWG NO	TITLE

DRAWING TRACEABILITY LIST

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE:
IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked by:

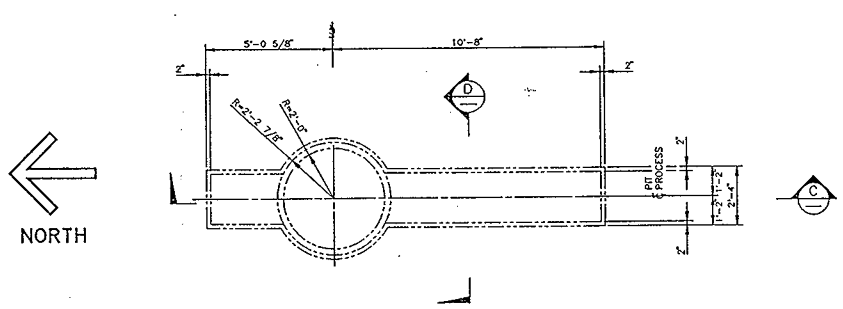
Title: MECHANICAL
IMPACT ABSORBERS &
OVERPACK STA CANISTER GUIDES

Sketch no. ES-W464-M06

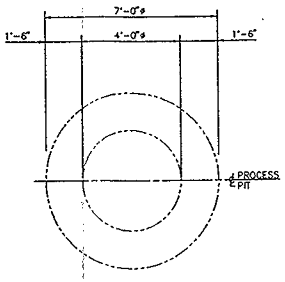
Sh 1 of

Cadfile I464M06

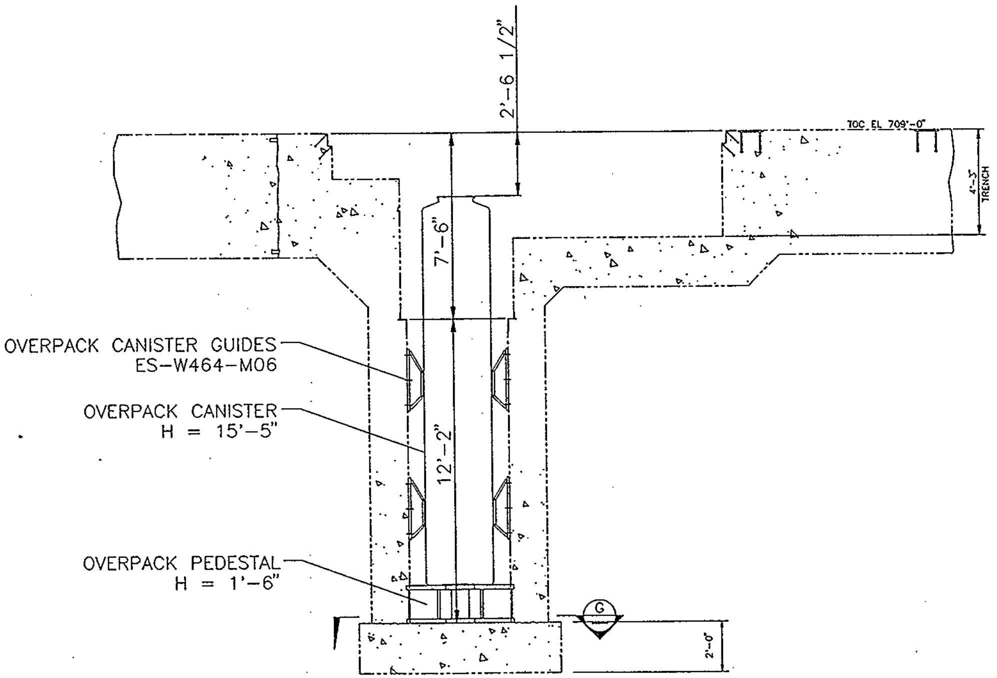
Rev 0



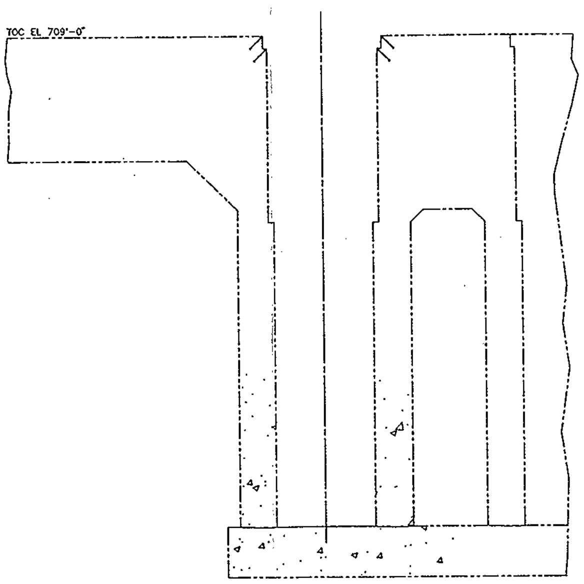
PLAN



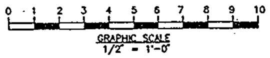
SECTION G



SECTION C



SECTION D



H-2-119337	HOT CONDITIONING ANNEX
DWG NO	TITLE
DRAWING TRACEABILITY LIST	

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

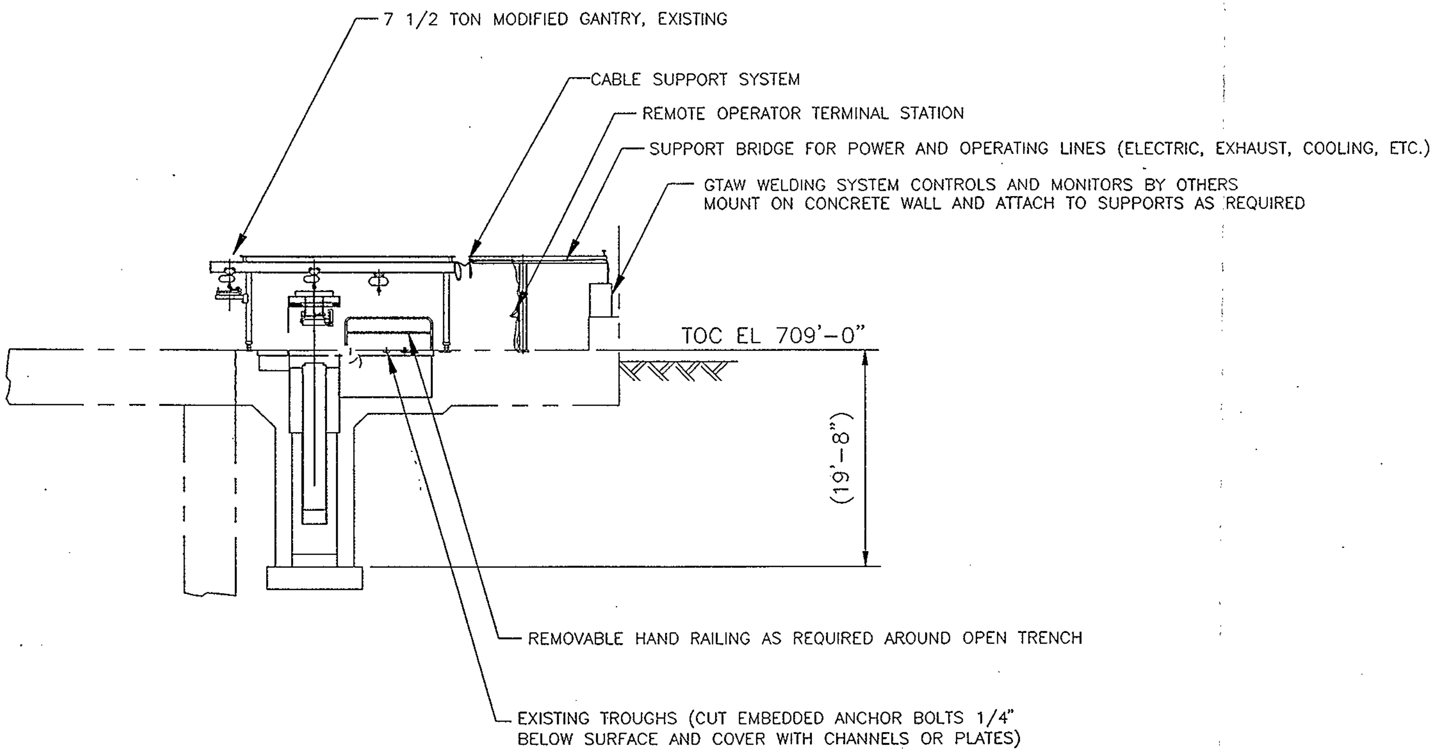
PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE
INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked by:

Title: MECHANICAL
OVERPACK STATION
PLAN & SECTION

Sketch no. ES-W464-M07

Sh 1 of
Cadfile I464M07
Rev 0



OVERPACK WELD STATION
GANTRY CRANE SECTION

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked by: JPL

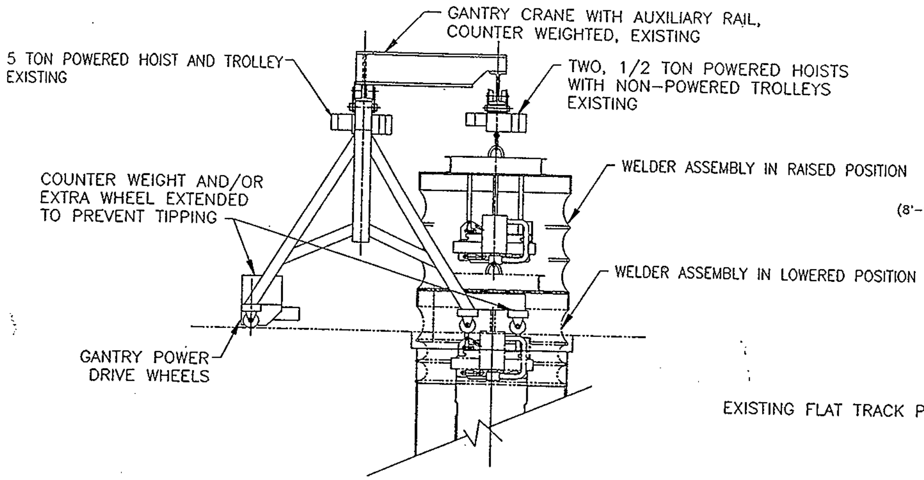
Title: MECHANICAL OVERPACK WELD STATION GANTRY CRANE SECTION

Sketch no. ES-W464-M08

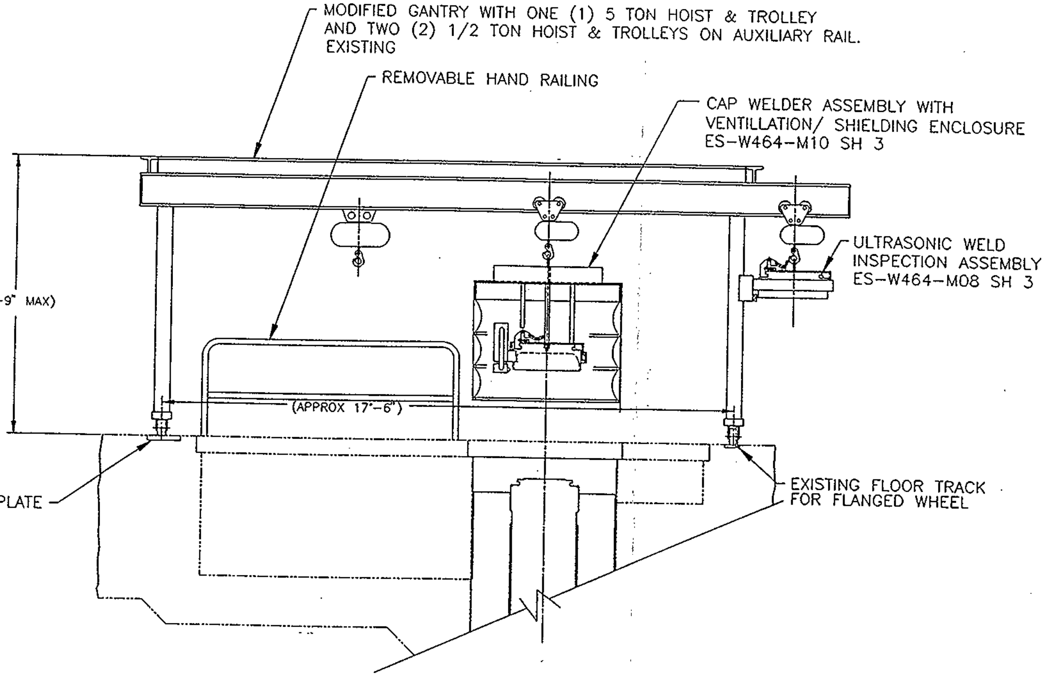
Sh 1 of 3

Cadfile 1464M08

Rev 0



ELEVATION
LOOKING NORTH



① INSTALLATION
LOOKING WEST
ELECTRICAL AND UTILITY
LINES ARE NOT SHOWN

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

FLUOR DANIEL NORTHWEST

Project title: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY

Prepared by: P LAING
Checked by:

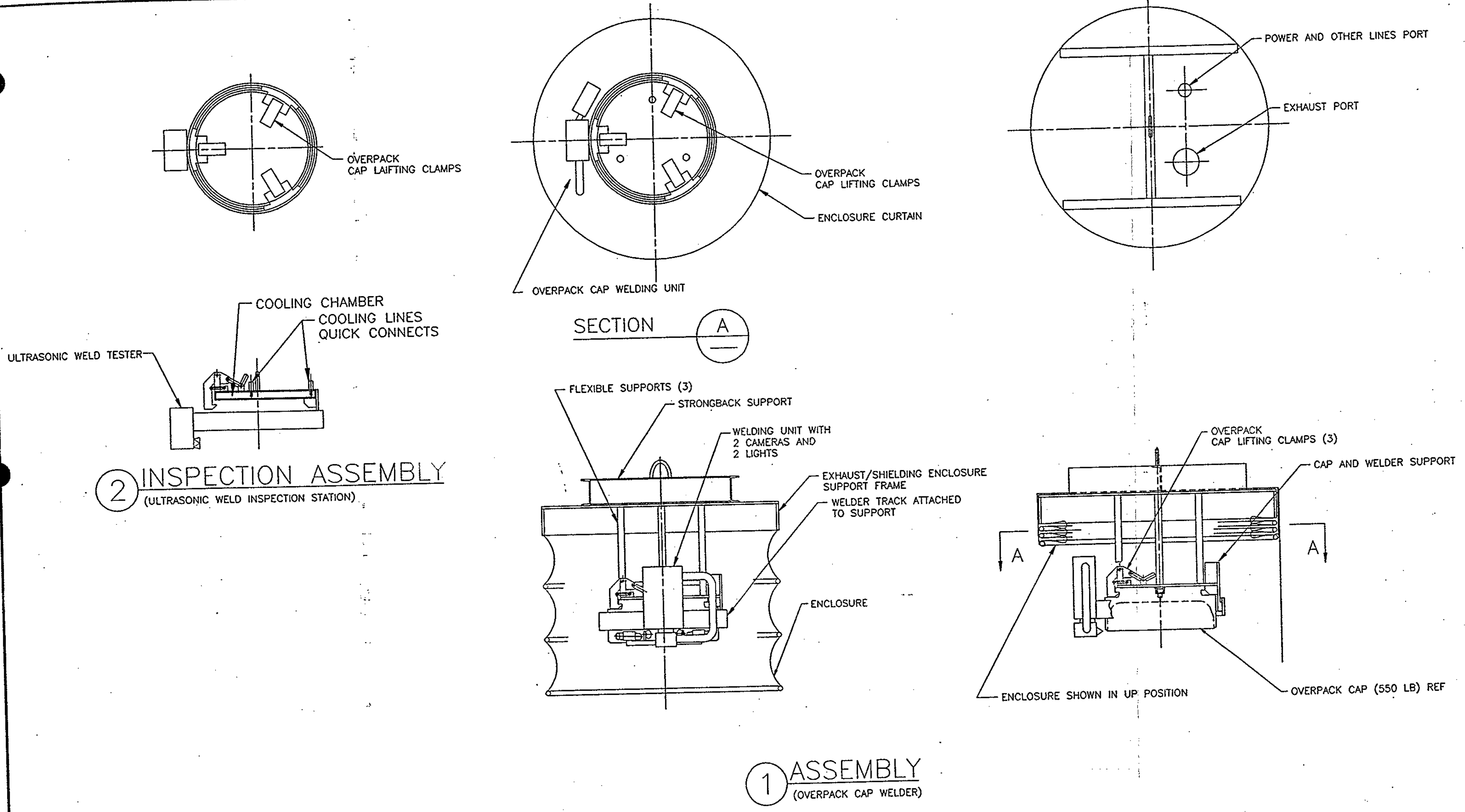
Title: MECHANICAL
OVERPACK WELD STATION
GANTRY CRANE INSTALLATION

Sketch no. ES-W464-M08

Sh 2 of 3

Cadfile I464M08B

Rev 0



SECTION A

2 INSPECTION ASSEMBLY
(ULTRASONIC WELD INSPECTION STATION)

1 ASSEMBLY
(OVERPACK CAP WELDER)

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)

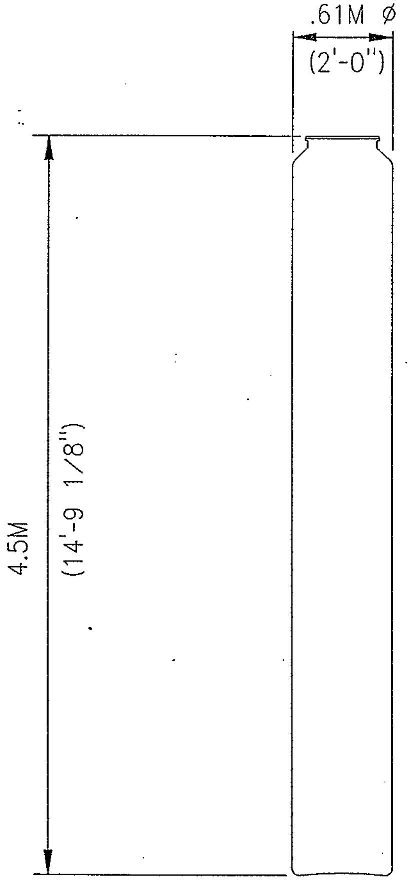
FLUOR DANIEL NORTHWEST	PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY		
Prepared by: P LAING Checked by:	Title: MECHANICAL OVERPACK WELD STATION CAP WELDER ASSEMBLY	Sketch no. ES-W464-M08	Sh 3 of 3 Cadfile I464M08C Rev 0

CANISTER ASSEMBLY NOTES:

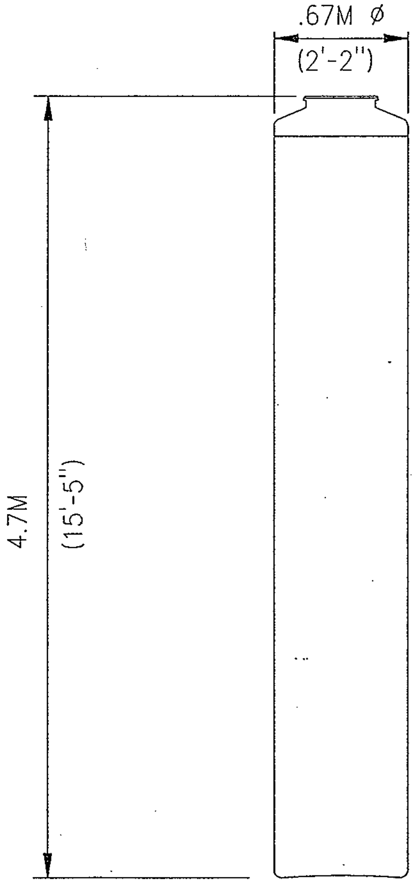
TOTAL NOMINAL WEIGHT AS SHOWN = 3751 kg (8,290 lbs)
TOTAL MAXIMUM WEIGHT = 4200 kg (9,282 lbs)

CANISTER OVERPACK NOTES:

ALL WELDED CONSTRUCTION
NEW COVER DESIGN
MATERIAL THICKNESS .95 CM (ASTM A240 304L)



CANISTER
SEE NOTE 1.



CANISTER OVERPACK
SEE NOTE 2:

NOTES:

1. CANISTER PROVIDED BY OTHERS.
2. PROJECT W-464 TO PROVIDE 2 CANISTER OVERPACKS

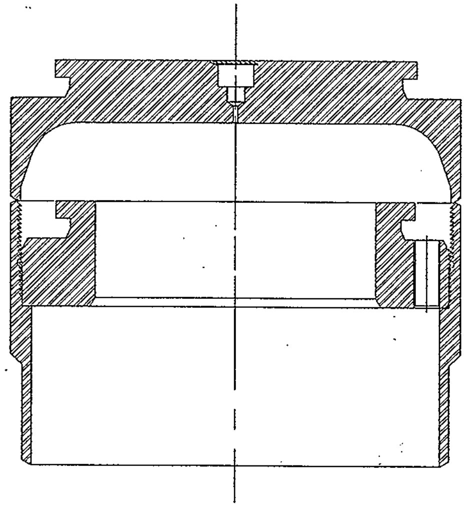
CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)
FLUOR DANIEL NORTHWEST
PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY
Prepared by: P LAING
Checked by:
Title: MECHANICAL 4.5 M CANISTER & 4.5M OVERPACK
Sketch no. ES-W464-M09
Sh 1 of
Cadfile I464M09
Rev 0

NOTES:

1. QUANITY = 2 PROVIDED BY PROJECT W-464
2. Cs WASTE CANISTER BY OTHERS.

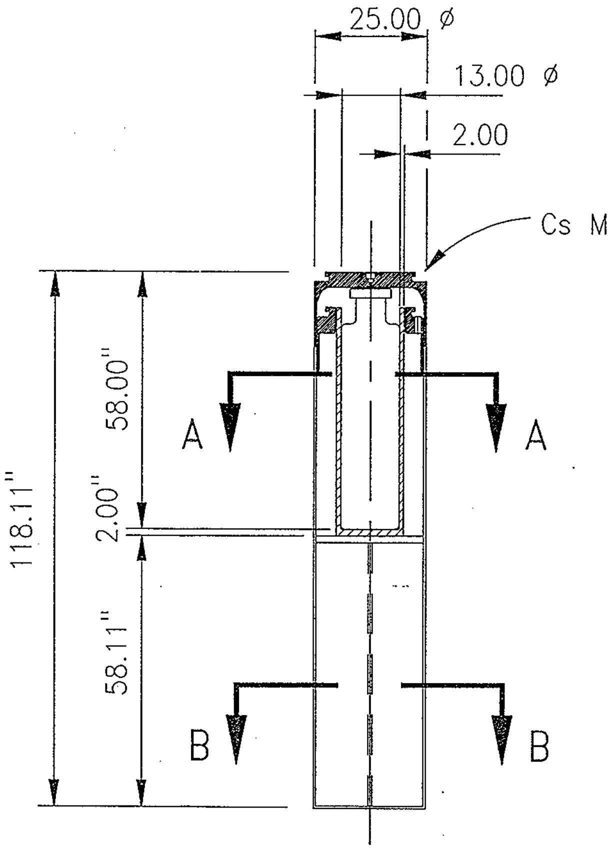
CARRIAGE ASSEMBLY NOTES

ALL WELDED CONSTRUCTION
NEW COVER DESIGN, MATERIAL ASTM A240 304L
MATERIAL THICKNESS 1/2" UNO

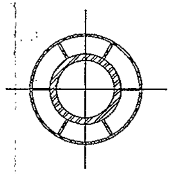


THIS DEVICE IS A COMBINATION OF THE FOLLOWING:
CANISTER COVER ASSEMBLY
LOCKING & LIFTING RING
CANISTER COLLAR

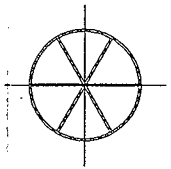
Cs MODIFIED COVER/LIFT RING



ELEVATION



SECTION A-A



SECTION B-B

CONCEPTUAL DESIGN PROJECT W-464 (PHASE 1)
FLUOR DANIEL NORTHWEST
PROJECT TITLE: IMMOBILIZED HIGH-LEVEL WASTE INTERIM STORAGE FACILITY
Prepared by: P LAING
Checked by:
Title: MECHANICAL CESIUM CANISTER OVERPACK ASSEMBLY
Sketch no. ES-W464-M10
Sh 1 of
Cadfile I464M10
Rev 0

DISTRIBUTION SHEET

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		Date 04-09-98
Project Title/Work Order W-464 HLW		EDT No. 624079
		ECN No.

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CA PETERSEN	H6-37	X			
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