TFR-152
Revision 2
October 11, 2002

System Design Criteria for the OU 7-10 Glovebox Excavator Method Project

Packaging Design Criteria

October 2002

Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

TFR-152
Revision 2
October 11, 2002

System Design Criteria for the OU 7-10 Glovebox Excavator Method Project

Packaging Design Criteria

October 2002

Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

System Design Criteria
for the OU 7-10 Glovebox Excavator Method Project

Packaging Design Criteria

TFR-152
Revision 2

October 2002

Approved by

Robert J. Carpenedo, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Packaging System Design Lead

10/2/02
Date

Brent R. Helm, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Design Lead

10/3/02
Date

Steven A. Davies, Bechtel BWXT Idaho, LLC
OU 7-10 Glovebox Excavator Method Project
Project Engineer

10/07/02
Date

CONTENTS

ACRONYMS v

1. INTRODUCTION 1

1.1 Facility Description 1

1.2 Limitations of the System Design Criteria 2

1.3 Ownership of the System Design Criteria 2

2. OVERVIEW 3

2.1 Facility Structure, System, Component Functions 3

2.2 Facility Structure, System, and Component Classification 3

2.3 Operational Overview 3

2.3.1 Waste Transfer Equipment Operation 4
2.3.2 Packaging Glovebox System 4

3. DESIGN CRITERIA AND BASES 6

3.1 General Packaging System 6

3.1.1 Operational Design Criteria 6
3.1.2 Accident Design Criteria 11
3.1.3 Safety-Significant Items 12
3.1.4 Applicable Regulatory and Contractual Requirements 12
3.1.5 Applicable Industry Codes and Standards 13

3.2 Waste Transfer Subsystem 13

3.2.1 Operational Design Criteria 14
3.2.2 Accident Design Criteria 15
3.2.3 Safety-Significant Items 15
3.2.4 Applicable Regulatory and Contractual Requirements 16
3.2.5 Applicable Industry Codes and Standards 16

4. REFERENCES 17

Appendix A—Packaging Glovebox System Critical Attributes List A-1

ACRONYMS

AGS	American Glovebox Society
ANSI	American National Standards Institute
D&D&D	deactivation, decontamination, and decommissioning
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
FFA/CO	Federal Facility Agreement and Consent Order
HEPA	high efficiency particulate air
I&C	instrumentation and control
INEEL	Idaho National Engineering and Environmental Laboratory
NFPA	National Fire Protection Association
OU	operable unit
PC	performance category
PGS	Packaging Glovebox System
RCS	Retrieval Confinement Structure
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SDC	system design criteria
SSC	system, structure, or component
TFR	technical and functional requirement
TRU	transuranic
WAG	Waste Area Group
WES	Weather Enclosure Structure

System Design Criteria for the OU 7-10 Glovebox Excavator Method Project

Packaging Design Criteria

1. INTRODUCTION

This Operable Unit (OU) 7-10 system design criteria (SDC) document establishes the packaging system design criteria for the OU 7-10 Glovebox Excavator Method Project. It is intended to augment the parent document (*OU 7-10 Glovebox Excavator Method Project Technical and Functional Requirements* [INEEL 2002a]) to enable performance of the project detailed design, engineering, and evaluation activities.

The *Record of Decision: Declaration of Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory, Idaho Falls, Idaho* (DOE-ID 1993) specifies the environmental remediation of transuranic (TRU) waste from OU 7-10 (which comprises Pit 9) of Waste Area Group (WAG) 7. On October 1, 2001, the Idaho National Engineering and Environmental Laboratory (INEEL) published the *WAG 7 Analysis of OU 7-10 Stage II Modifications Report* (INEEL 2001), which identified a feasible approach for retrieving waste from OU 7-10. The OU 7-10 Glovebox Excavator Method Project was established to accomplish the objectives presented in that report. The overall objectives for the project are as follows:

- Demonstrate waste zone material retrieval
- Provide information on any contaminants of concern present in the underburden
- Characterize waste zone material for safe and compliant storage
- Package and store waste onsite, pending decision on final disposition.

This project was requested by the U.S. Department of Energy Idaho Operations Office (DOE-ID) in support of the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (FFA/CO) (DOE-ID 1991), OU 7-10 Record of Decision (DOE-ID 1993), *Explanation of Significant Differences for the Pit 9 Interim Action Record of Decision at the Radioactive Waste Management Complex at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1998), and Appendix A of the *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit OU 7-10 (Pit 9 Project Interim Action)* (LMITCO 1997).

1.1 Facility Description

The INEEL is a U.S. Department of Energy Facility (DOE) facility, located 52 km (32 mi) west of Idaho Falls, Idaho, and occupies 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Idaho Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEEL. The Subsurface Disposal Area (SDA) is a 39-ha (97-acre) area located in the RWMC. Waste Area Group 7 is the designation recognized by Comprehensive Environmental Response, Compensation and Liability Act (42 USC § 9601 et seq.) and in the FFA/CO

for the RWMC, which comprises the SDA buried waste site. Waste Area Group 7 has been divided into 13 OUs[a]. Operable Unit 7-10 is located in the northeast corner of the SDA. The OU 7-10 site is an area into which chemicals, radioactive materials, and sludge from DOE weapons plants and other government programs were disposed. While such disposal at the RWMC began in 1952, OU 7-10 was used and filled in the late 1960s. The pit contains characteristic hazardous, listed hazardous, low-level radioactive, and TRU waste.

The OU 7-10 Glovebox Excavator Method Project facilities and processes are being designed to safely conduct a waste zone material retrieval demonstration in a selected area of OU 7-10. The project processes consist of excavation and retrieval; sampling, packaging, and interim storage; shutdown; deactivation, decontamination, and decommissioning (D&D&D); and environmental monitoring. Project facilities include a Weather Enclosure Structure (WES), Retrieval Confinement Structure (RCS), excavator, ventilation system, and other supporting equipment. The packaged material will be stored onsite, pending decision on final disposition.

1.2 Limitations of the System Design Criteria

This SDC document defines the criteria for the packaging design aspects of the project. The SDC flow directly from the OU 7-10 Technical and Functional Requirements (TFRs) document (INEEL 2002a), and are intended to include detail not provided in the TFRs, client requirements, and those codes, standards, and regulations that will be used as a basis for the design of the packaging system. Design criteria will be revised, as needed, as the project proceeds.

This SDC document focuses only on the packaging system design criteria. System design criteria for general structures and site, process, excavation, fire protection, facility and infrastructure, and instrumentation and control are addressed in separate documents.

1.3 Ownership of the System Design Criteria

This SDC document is the product of the combined activities of the project team. The project engineer has the ultimate responsibility for the content and approval of this document.

---

a. Operable Units 13 and 14 were combined in the 1995 comprehensive remedial investigation and feasibility (Huntley and Burns 1995).

2. OVERVIEW

2.1 Facility Structure, System, Component Functions

The Packaging Glovebox System (PGS) consists of three identical gloveboxes that interface with and extend through the RCS. The lead end of each glovebox consists of structural members that support a powered transfer cart. This cart receives waste and interstitial soil from the excavator and transports it into the glovebox. Inside the glovebox, the waste and soil materials are sorted and loaded into one of three drums: two 55-gal drums and one 85-gal drum. The incoming waste is sampled and sized as necessary for placement in the drums. The samples are removed from the glovebox and sent to a laboratory for analysis. The waste is removed from the glovebox via 55- and 85-gal drums through a drum loadout enclosure tent system, located below the glovebox. In addition, a fissile monitoring station is located inside the glovebox where some forms of waste are monitored for fissile content.

2.2 Facility Structure, System, and Component Classification

No safety-class structures, systems, or components (SSCs) are associated with this project.

The *Preliminary Documented Safety Analysis for the Operable Unit 7-10 Glovebox Excavator Method* (INEEL 2002b) describes the facility safety basis and identifies its safety- significant design features. It prescribes minimum design criteria and functional requirements for the project to follow. In accordance with the Preliminary Documented Safety Analysis (PDSA) (INEEL 2002b), the PGS structure is safety significant. The critical attributes list included in Appendix A identifies what attributes or characteristics of the PGS are essential to perform its safety-significant function.

2.3 Operational Overview

The project includes systems to support retrieval and packaging of waste zone material. The site where the facilities will be located has 6-in. diameter probes that were installed to refusal during Stage I of the OU 7-10 Staged Interim Action Project. These probes may be moved during waste zone material retrieval as necessary to facilitate retrieval and underburden sampling operations. Overburden will be excavated and packaged before disturbing waste zone material.

A manned excavator will retrieve the waste zone material. The operator will be located in the WES outside the RCS. The excavator arm, contained within the RCS, will excavate an angular swath. The retrieved material in the excavator bucket will then be placed into a transfer cart. One transfer cart is located at the entrance of each of the three material packaging gloveboxes. The carts transport waste zone material into the gloveboxes where it will be inspected, sampled, and packaged. Packaged waste will then be assayed to determine total fissile mass. The waste will then be stored onsite, pending decision on final disposition.

After waste zone material excavation is complete and samples of the underburden are taken, the pit will be backfilled to cover the waste for closure before the D&D&D phase.

Waste is moved into the PGS by the waste transfer equipment, which consists of the waste transfer cart, cart rails, rail structural supports, and cart drive system. The cart has an electric drive for smooth and reliable starts, stops, and controlled speed. The waste transfer cart is a 31 × 41-in. stainless steel weldment that is approximately 6-in. deep. It has a bed that accepts and supports a 55-gal drum or holds approximately 3 ft^3 of waste material.

The cart rides on linear ball bushings and is driven by an epoxy composite nut high lead screw that spans the length of the glovebox. The linear ball bushings are supported by a steel structure.

2.3.1 Waste Transfer Equipment Operation

The transfer cart is lined with a disposable liner to receive the waste and is positioned at the end of the rails inside the RCS. After the excavator places the waste load on the waste liner, the cart drive system is energized and the cart is transported into the glovebox. After the cart is emptied in the PGS and fitted with a new liner, it is returned into the RCS by driving the screw in the opposite direction.

2.3.2 Packaging Glovebox System

Waste zone material is brought into the glovebox and opened, inspected, sampled, sized, monitored, packaged, and bagged out in the packaging gloveboxes.

2.3.2.1 Waste Receipt. Waste zone material is transferred from the RCS area into the glovebox by the waste transfer cart. The cart is fitted with a cart liner with nylon loops incorporated for lifting. The cart, loaded with material in the liner, is driven into the glovebox.

2.3.2.2 Waste Removal from Drums. Waste in intact or partially deteriorated drums must be removed from the drum for inspection and sorting. The drum lid is removed at the second glovebox station, either by removing the nut on the locking hoop or cutting the hoop with the Sawsall or other hand-operated equipment. A second glovebox cart is moved next to the drum at the sorting station and the drum contents are pulled out and placed on the second cart. If the second cart is full before the drum is empty, the drum is driven back into the RCS to wait. The waste on the cart in the glovebox is then segregated and sampled as described below. Finally, the waste is lifted in the cart liner by a 1-ton hoist in the PGS using the nylon loops on the cart liner, and placed into one of the two 55-gal drums at the bag-out stations. When the intact drum is empty, it is placed in the 85-gal drum at the bag-out station or cut up with the Sawzall and placed in a 55- or 85-gal drum.

2.3.2.3 Waste Inspection

The waste is inspected to locate outliers and prohibited items. This material will be handled as described in *System Design Criteria for the OU 7-10 Glovebox Excavator Method Process Design Criteria* (Borland 2002). Waste removed from drums is inspected on the cart at the sorting station. Bags of waste are opened and their contents inspected.

2.3.2.4 Waste Sampling. Subsamples are collected from each cart-full of waste for composing samples. The number and type of samples taken from each cart are identified in the Field Sampling Plan for the Operable Unit 7-10 Glovebox Excavator Method Project (Draft)"(Salomon et al. 2002).

2.3.2.5 Waste Size Reduction. Drum remnants that cannot be placed in an 85-gal drum will be sized and placed in 85- or 55-gal drums. Intact and partially deteriorated undeformed empty 55-gal waste drums can be placed in an 85-gal drum with no size reduction. Size reduction is done using a Sawzall, shears, or nibblers at the inspection station. In general, steel sheets up to 1/8-in thick can be cut with the shears or nibblers; plate or bolts up to 1/2-in. thick can be cut with the Sawzall. Waste drums that weigh in excess of 350 lb will be sized in the pit and the remnants placed in the cart for processing in the glovebox.

2.3.2.6 Waste Fissile Monitoring. Waste that is unidentified combustible material is monitored for fissile content. The waste is moved to the outermost gloveport station where it is placed in a shielded enclosure. A fissile monitor located outside the glovebox detects fissile activity from waste inside the enclosure. This waste is dispositioned according to the results of the fissile monitoring. In this manner, the amount of fissile material can be kept below the limit of 200 g per drum.

2.3.2.7 Waste Packaging. Unidentified combustible material must be segregated and fissile monitored. Nitrate waste may be segregated from organic waste if possible. Waste is packaged in the two 55-gal bag-out drum stations at either side of the sorting station. Normally, one of the drums is in the process of being bagged out while the other drum is being loaded with waste. Material suspected to be filter media with high fissile content is monitored as discussed in Section 2.3.2.6 and packaged on a case-by-case basis to ensure that the fissile gram limit of a 55-gal drum is not exceeded.

Most waste is packaged in 55-gal drums. The 85-gal bag-out drum is only used to package intact drums or parts of drums that do not fit in a 55-gal drum. If an empty intact drum is placed in an 85-gal drum, additional metal debris may be added to increase the packaging efficiency.

2.3.2.8 Waste Bag-out. A drum bag-out method is used to seal the drums and maintain confinement and externally clean, bagged-out drums. A clamped bag-out stub is attached to the bottom of the bag-out port when a new empty drum arrives at the station. The bag-out stub forms the confinement under the bag-out port.

A new drum is then positioned under the bag-out stub. The new drum has a clean drum transfer bag when it arrives. A scissors lift positions the drum at the proper height so that the new bag can be sealed to the port above the old bag-out stub. When the seal is made, the bag-out stub is pulled into the drum and the new bag now forms the confinement. After the drum is filled, the bag is clamped and cut above the drum to form a new stub. The bottom half of the stub is pushed into the drum, the drum lid is attached, and the drum is removed from the loading station. This completes a bag-out cycle.

3. DESIGN CRITERIA AND BASES

3.1 General Packaging System

The PGS handles and packages waste zone soil and material. Three identical gloveboxes and related equipment comprise the packaging glovebox system. The gloveboxes will interface with the Facility Floor Structure, the RCS, the ventilation system, the instrumentation and control (I&C) system, the excavation system, and the waste transfer subsystem.

3.1.1 Operational Design Criteria

This section contains the operational design criteria for the general packaging system:

1. The PGS components shall be designed for contact handling of waste.

   Basis: Idaho National Engineering Laboratory, *Comparison of the Pit 9 Project Inventory of Contaminants Against the Corresponding Portion of the Historical Data Task Inventory and Recommended Revised Quantities* (LMITCO 1996), establishes that the target Rocky Flats waste was all contact-handled. Contact-handled TRU waste, by definition, is less than 200 mR/hour. In accordance with TFR Section 3.2.1-1, the project must be capable of handling waste that measures up to 200 mR/hour on contact with the outer container.

2. The packaging gloveboxes shall provide the capability to package material in 55- and 85-gal standard waste drums.

   Basis: Standard waste containers include 55- and 85-gal drums. Safe and effective storage and transportation of hazardous materials requires packaging in standard waste containers. TFR Sections 3.1.2.4-1 and 3.1.2.4-3.

3. The packaging gloveboxes and equipment associated with the gloveboxes shall be maintainable for nominal preventative maintenance through gloveports and view ports.

   Basis: Manned entry into the gloveboxes is not possible. TFR Section 3.4.4-1.

4. The packaging gloveboxes shall be capable of removing waste zone materials from deteriorated waste containers that contain TRU, low-level, mixed, and hazardous waste zone materials.

   Basis: Waste from the OU 7-10 Glovebox Excavator Method excavation zone must be retrieved. Some drums containing the waste may be deteriorated and therefore, it will be necessary to retrieve the waste that was from those drums. TFR Section 3.1.1.2-1 and 3.1.2.1-4.

5. The packaging gloveboxes shall package waste samples in 250-mL containers for subsequent analysis.

   Basis: As defined in the "Field Sampling Plan for the Operable Unit 7-10 Glovebox Excavator Method Project (Draft)." Sampling is necessary to support safe interim storage. TFR Section 3.1.2.3-1.

6. The packaging gloveboxes shall provide a bag-out port(s) for materials and equipment to aid in preventing releases of radioactive and hazardous contaminants to the WES and to the environment during bag-in/bag-out operations.

Basis: WAG 7 Analysis of OU 7-10 Stage II Modifications, Section 4.3.1, Retrieval System. TFR Sections 3.1.1.1-2, 3.2.2-3, 3.2.7-1, 3.2.7-2, 3.2.7-3, and 3.3.1-1.

7. The packaging glovebox shall be capable of overpacking 55-gal drum remnants in 85-gal drums.

Basis: WAG 7 Analysis of OU 7-10 Stage II Modifications, October 1, 2001. The material packaging system described on 4-22 includes a box for packaging items too large to fit into a 55-gal drum. Also discussed on 4-5 under "Drum or Box" Packaging, waste that cannot be reduced in size will be left in place. The current design uses an 85-gal drum for oversized drum remnants instead of a box. TFR Section 3.1.2.4-2.

8. The packaging gloveboxes shall form a part of the confinement and be operable at an internal pressure down to -1.0 iwg.

Basis: This is the minimum pressure that a glovebox can operate and still have gloves operable. TFR Sections 3.2.7-1, 3.2.7-2, and 3.2.7-3.

9. The gloveboxes shall be equipped with external differential pressure gages.

Basis: The operators must know that there is sufficient negative pressure in the glovebox to safely operate them. TFR Sections 3.2.7-1, 3.2.7-2, and 3.2.7-3.

10. The packaging gloveboxes shall accommodate a fissile material monitor enclosure. The fissile material monitor detector shall be outside the glovebox.

Basis: The fissile material monitors are necessary to ensure that the drum meets the interim storage criteria. In addition, ensures drums do not exceed the administrative limit of 200-g fissile material content limit. Specific requirements pertaining to the Fissile Material Monitor are addressed in TFR-155, *System Design Criteria for the OU 7-10 Glovebox Excavator Method Project Instrumentation and Control Design Criteria*. TFR Sections 3.2.3-1 and 3.2.3-2.

11. The fissile monitor enclosure located at the end of the glovebox, shall be capable of weighing its contents up to 50 lb.

Basis: The overloaded fissile material limit is 380 g per drum, while the operational limit is set at 200 g. Some waste streams will be identified through process knowledge and should not produce overloaded drums. Other waste streams need to be monitored as drums are loaded to ensure compliance with fissile loading limits. Certain waste streams, if overloaded, lead to difficult operational recovery process to be repackaged. The weight is needed to calculate the fissile content of the material in the enclosure. Specific requirements pertaining to the Fissile Material Monitor are addressed in TFR-155, *System Design Criteria for the OU 7-10 Glovebox Excavator Method Project Instrumentation and Control Design Criteria*. TFR Sections 3.2.3-1 and 3.2.3-2.

12. The fissile monitor enclosure shall have the ability to be decontaminated so that background contamination will not bias the fissile monitor count.

Basis: In order to ensure that bag-out drums have an accurate estimate of the fissile content. Specific requirements pertaining to the Fissile Material Monitor are addressed in

TFR-155, *System Design Criteria for the OU 7-10 Glovebox Excavator Method Project Instrumentation and Control Design Criteria*. TFR Sections 3.2.3-1 and 3.2.3-2.

13. The packaging gloveboxes shall provide for handling and opening of intact drums.

    Basis: Intact waste drums below 350 lb shall be retrieved intact and be opened, handled, and repackaged in the PGS. TFR Sections 3.1.2.4-2 and 3.3.1-3.

14. The packaging gloveboxes shall be designed to use an approximately 3 × 4-ft cart liner for hoisting soil and sludge into drums.

    Basis: To aid in ease of packaging. To minimize cross contamination. To aid in D&D&D. TFR Section 3.1.2.2-2.

15. The packaging gloveboxes shall contain a remote control 1-ton hoist, with a working envelope that covers the length of the glovebox, for transferring filled cart liners and intact drums into the bag-out drums.

    Basis: To aid in ease of packaging. This includes intact waste containers that are empty or contain TRU, low-level, mixed, and hazardous waste material. The maximum weight drum that will be brought into the glovebox is 350 lb. TFR Section 3.1.2.2-2.

16. The packaging gloveboxes shall be designed to upend an empty 55-gal drum to its vertical position for placement into an 85-gal bag-out overpack drum.

    Basis: Drums entering the PGS will enter the PGS in the horizontal position and must be placed in the vertical position for placement in an 85-gal bag-out drum. TFR Section 3.1.2.4-2.

17. The packaging gloveboxes shall store portable tools and equipment used for waste sizing, sorting, and sampling.

    Basis: In accordance with the WAG 7 Analysis of OU 7-10 Stage II Modifications, "The material packaging system described in 4-22 includes a box for packaging items too large to fit into a 55-gal drum. Also discussed in 4-5 under "Drum or Box," packaging waste that cannot be reduced in size will be left in place." TFR Sections 3.1.2.2-3 and 3.1.2.3-1.

18. The packaging gloveboxes shall contain high-efficiency particulate air (HEPA) filtered air inlet penetrations for ventilation of the glovebox from the WES and into the RCS. The HEPA filter housing shall be DOP testable per American National Standards Institute (ANSI) N-510 or have automatic shut-off dampers in case of flow reversal.

    Basis: DOE-HDBK-1132-99, "DOE Handbook Design Considerations" (associated with DOE Order 420.1, "Facility Safety") recommends HEPA filters at the inlet of gloveboxes in case of flow reversals. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.1.1.2-3, 3.2.2-3, 3.2.7-1, and 3.2.7-2.

19. The packaging gloveboxes shall be designed to facilitate visual examination of waste zone material.

    Basis: To facilitate safe and efficient packaging. TFR Sections 3.1.1.2-1 and 3.2.6-1.

20. The packaging gloveboxes shall be capable of handling up to 350 lb of waste zone material per batch.

    Basis: While the excavator is capable of handling larger loads, the glovebox requires a lower weight limit for safety and hazard considerations. For safety reasons, handling 1,000-lb drums in the gloveboxes presents unacceptable risks to the workers (finger, hand, wrist, and arm injuries). For hazard considerations, handling 1,000-lb drums in the gloveboxes poses a higher risk of load slippage and breach of the windows. TFR Section 3.3.1-5.

21. The packaging gloveboxes shall be capable of handling deformed 55-gal drums.

    Basis: Some drums may be deteriorated, while others may be substantially intact in various forms of deformation. TFR Section 3.1.2.1-4.

22. The packaging gloveboxes shall provide operators with adequate flexibility to perform tasks such as collecting samples, engaging locks and latches, sifting through waste debris for handling, waste sizing, rigging vertical lifts, opening poly bags, and opening containers.

    Basis: The glovebox gloves must have sufficient flexibility to support operations while resisting deterioration of the glove material. TFR Sections 3.1.2.2-2, 3.1.2.2-3, 3.1.2.3-1, 3.1.2.4-1, and 3.2.6-1.

23. Material handling equipment within the packaging gloveboxes shall be locally controlled from an operator platform on one side of the glovebox.

    Basis: To minimize the possibility of inadvertent equipment motion within the glovebox, controls shall be located on one side only. Inadvertent movement could be a safety hazard. TFR Sections 3.1.2.2-3, 3.1.2.3-1, and 3.2.6-1.

24. The packaging gloveboxes shall confine alpha emitting radionuclides consistent with radiological release and radiation control standards.

    Basis: WAG 7 Analysis of OU 7-10 Stage II Modifications, Section 4.3.1, Retrieval System. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.1.1.2-3, 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.7-2.

25. The packaging gloveboxes shall be designed to prevent back flow of contamination from the confinement through utility and instrumentation type penetrations.

    Basis: To support as low as reasonably achievable goals. The primary goal of the OU 7-10 Glovebox Excavator Method is to protect the public, workers, and the environment. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.1.1.2-3, 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.7-2.

26. The packaging gloveboxes shall provide operators with an optimum working height of 48 in. for normal glovebox operations.

    Basis: As directed by the American Glovebox Society (AGS) Standard AGS-G001-1998, Section 5.10.1.2. The optimum work height should accommodate a 95th-percentile male operator. TFR Sections 3.2.4-1 and 3.2.6-1

27. The packaging gloveboxes work platforms shall be guarded by standard railing and toeboards.

Basis: Fall protection (standard railing and toeboards) are required by the Occupational Safety and Health Administration, in accordance with 29 CFR 1926, Subpart M, "Fall Protection," for elevated working surfaces over 4 ft high. TFR Section 3.2.4-1.

28. The packaging gloveboxes shall have ventilation inlet HEPA filters that are replaceable without breaching confinement.

    Basis: To ensure continuous confinement of hazardous and radioactive constituents during routine maintenance. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.1.1.2-3, 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.7-2.

29. The packaging gloveboxes shall provide access for forklift or pallet jack transport of loaded and unloaded containers to and from each drum bag-out station.

    Basis: To facilitate safe and efficient transportation of empty and loaded drums. TFR Section 3.1.2.2-2.

30. The packaging gloveboxes shall ensure the exterior surfaces of new 55- and 85-gal waste drums are maintained in an uncontaminated state.

    Basis: To ensure confinement of hazardous and radioactive constituents. TFR Sections 3.1.1.1-2, 3.1.1.2-3, 3.2.2-1, 3.2.2-2, and 3.2.2-3.

31. The packaging glovebox drum loadout stations shall be designed to handle a new, fully loaded 55- or 85-gal bag-out drum, not to exceed 750 lb.

    Basis: Standard waste containers include 55- and 85-gal drums. Safe and cost-effective storage and transport of hazardous materials requires packaging in standard waste containers. TFR Section 3.1.2.4-1.

32. The packaging gloveboxes shall use storage containers made from or lined with materials that will not react with the waste zone material being packaged.

    Basis: To ensure safety during packaging and storage. To ensure the integrity of the drums. TFR Section 3.1.1.3-2.

33. The packaging gloveboxes shall maintain confinement of materials throughout the packaging process.

    Basis: WAG 7 Analysis of the OU 7-10 Stage II Modifications, Section 4.3.1, "Retrieval System." TFR Sections 3.1.1.1-2 and 3.1.1.2-3.

34. The packaging gloveboxes shall provide mounting, electrical power, and I&C penetrations as required for each glovebox.

    Basis: Mounting, electrical power distribution and I&C penetrations must be integral to the packaging glovebox system to ensure confinement of radiological and hazardous materials. Various electric tools used for material sizing will be used in the PGS. Internal power must be provided to eliminate the need for bulkhead connections for tools, equipment, and instrumentation power. TFR Section 3.1.1.1-2.

35. The packaging gloveboxes shall provide approximately 5 kVA of electrical power for internal equipment, tooling, and instrumentation to each glovebox.

Basis: Various electric tools used for material sizing will be used in the PGS. Internal power must be provided to eliminate the need for bulkhead connections for tool, equipment, and instrumentation power. The electric hoist must also be provided with power. TFR Sections 3.1.1.1-2 and 3.1.2.2-3.

36. The packaging gloveboxes shall provide internal power cabling (using bulkhead fittings) that is replaceable without breaching confinement.

Basis: To ensure confinement. Various electric tools used for material sizing will be used in the PGS. Internal power must be provided to eliminate the need for bulkhead connections for tools, equipment, and instrumentation power. TFR Sections 3.1.1.1-2 and 3.1.2.2-3.

37. The packaging gloveboxes shall provide lighting that is mounted outside of the confinement.

Basis: To facilitate ease of maintenance without requiring manned entry into the PGS. TFR Sections 3.2.6-3 and 3.4.4-1.

38. The design concentrated load shall be a 350-lb drum hanging from the hoist or any place in the glovebox while on a glovebox cart.

Basis: This is the maximum load that can be brought into the glovebox for which the glovebox has been analyzed. TFR Sections 3.3.1-4 and 3.3.1-5.

39. The packaging gloveboxes shall incorporate a lip around drum loadout ports to prevent water from collecting in the drums.

Basis: PDSA 2.7.6.2. Prevent water from fire water system from collecting in drums. TFR Section 3.1.2.2-4.

40. The packaging glovebox materials shall be compatible with the radioactive and hazardous waste expected to be encountered in the excavation.

Basis: To ensure reliability of the gloveboxes. Reactions with hazardous or radioactive waste material may cause corrosion and general deterioration. Information regarding compatibility with the radioactive and hazardous waste can be located in EDF-2041 and EDF-ER-211.

3.1.2 Accident Design Criteria

The following accident design criteria are specific to the packaging gloveboxes and associated equipment:

1. The packaging glovebox system shall be provided with local dry fire-retardant material suitable for extinguishing pyrophoric metal fires.

Basis: In accordance with Section 5.3 of the *Preliminary Fire Hazards Analysis for the OU 7-10 Glovebox Excavator Method* (Gosswiller, 2001), ". . .it is not anticipated that pyrophoric materials in quantities capable of producing significant exposure to the glovebox walls will be encountered. Such an ignition could, however, challenge the integrity of the

combustible windows, seals, and glove materials if adjacent combustible waste materials become involved." As such, means to extinguish pyrophoric metal fires must be provided. TFR Section 3.3.7-2, 3.3.7-3, and 3.3.7-4.

2. The packaging glovebox system shall be provided with a confinement around the drum loadout ports.

   Basis: To limit the spread of contamination in case the bag-out operation breaches the glovebox confinement. TFR Sections 3.1.1.1-2, 3.1.1.1-5, 3.1.1.2-3, 3.2.2-1, 3.2.2-2, 3.2.2-3, and 3.2.7-2.

3. The packaging glovebox system shall be able to withstand the drop of a 350-lb load from a height of 6-in. without breaching the glovebox confinement.

   Basis: To ensure confinement in the event of an accidental drop of a loaded drum. TFR Section 3.3.1-5.

4. The packaging glovebox system shall be able to withstand the forces exerted by a 350-lb intact drum impacting the glovebox by tipping without breaching the glovebox confinement.

   Basis: To ensure confinement in the event of an intact drum tipping and impacting the glovebox. TFR Section 3.3.1-5.

5. The accident design differential pressure load within the confinement area shall be -4.0 iwg.

   Basis: This is the minimum pressure at which the glovebox will be tested for leakage. TFR Section 3.2.7-1, 3.2.7-2, and 3.2.7-3.

6. The packaging gloveboxes shall be designed to withstand the seismic effects of a design basis earthquake. Refer to earthquake criteria in the "General Structures and Site Design Criteria" SDC (INEEL 2002c).

   Basis: In accordance with DOE O 420.1, Facility Safety, systems, structures, and components must be designed, constructed, and operated to withstand the effects of natural phenomena to ensure the confinement of hazardous material. TFR Section 3.2.5-1.

7. The packaging gloveboxes shall allow for reattachment of drums to the bag-out ports for repackaging of drums suspected of being overloaded.

   Basis: In the event drums are determined to be overloaded, the packaging gloveboxes must provide a means for repackaging overloaded drums. Overloaded drums must weigh less than 350 lb to be allowed back in the PGS. TFR Section 3.2.3-2.

3.1.3 Safety-Significant Items

The portions of the packaging gloveboxes and associated equipment that forms a part of the confinement boundary, including related structural support systems, are safety-significant items.

3.1.4 Applicable Regulatory and Contractual Requirements

The following are specific regulatory and contractual requirements specific to the packaging gloveboxes and associated equipment:

- DOE O 420.1, "Facility Safety" (November 2000)
- DOE-HDBK-1132-99, "DOE Handbook Design Considerations" (April 1999)
- DOE-STD-1090-2001, "DOE Standard Hoisting and Rigging" (April 2001)
- DOE 5400.5, "Radiation Protection of Public and the Environment" (January 1993)
- DOE O 435.1, "Radioactive Waste Management" (August 2001)
- DOE-ID "Architectural Engineering Standards" (2001)
- DOE-STD-1020-94, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities" (1996)
- 10 CFR 835, "Occupational Radiation Protection" (2000)
- 29 CFR 1910, "Worker Safety" (2000)
- 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants" (2002).

3.1.5 Applicable Industry Codes and Standards

The following industry codes and standards are specific to the packaging gloveboxes and associated equipment:

- American Conference of Governmental Industrial Hygienists, Publication 2092, *Industrial Ventilation: A Manual of Recommended Practice* (2001)
- AGS-G001-1998, *Guideline for Gloveboxes*, 2nd ed. (1998)
- AGS-G002-1998, *Standard Practice for Design and Fabrication of Glovebags* (1998)
- ANSI B30.16, *Overhead Hoists* (2001)
- ANSI/ASME HST-1M, "Performance Standards for Electric Chain Hoists" (1999)
- National Fire Protection Association (NFPA) 801, "Fire Protection for Facilities Handling Radioactive Materials" (1998).

3.2 Waste Transfer Subsystem

The waste transfer subsystem shall consist of the waste cart, a rail and rail support system, and a cart transport mechanism. The cart shall receive OU 7-10 waste zone material from the excavator inside the RCS. The cart, supported by rails and structural support beams, shall be moved inside the packaging glovebox. A cart transport system will move the cart between the inside of the RCS and the glovebox sorting station.

3.2.1 Operational Design Criteria

In addition to the operational design criteria identified for the general excavation system, the following operational design criteria are specific to the waste transfer subsystem:

1. The driven cart system shall be designed to transport loads up to 350 lb. The undriven cart shall be designed for loads up to 200 lb.

   Basis: While the excavator is capable of handling larger loads, the glovebox requires a lower weight limit for safety and hazard considerations. For safety reasons, handling 1,000-lb drums in the gloveboxes presents unacceptable risks to the workers (finger, hand, wrist, and arm injuries). For hazard considerations, handling 1,000-lb drums in the gloveboxes poses a higher risk of load slippage and breach of the windows. TFR Sections 3.1.2.1-3, 3.1.2.2-2, and 3.3.1-4.

2. The cart and cart support frame shall protrude into the RCS far enough for the excavator to load waste zone material and drums into it without significant overspillage.

   Basis: To prevent the spread of contamination. TFR Sections 3.1.2.2-2 and 3.5.5-3.

3. The cart shall be able to transport at least 3 ft^3 of loose waste zone material.

   Basis: The maximum amount given the width of the glovebox and the distance between bag-out stations. TFR Section 3.1.2.2-2.

4. The cart shall be able to deliver an intact drum with its major axis oriented along the length of the glovebox.

   Basis: The glovebox can only accommodate an intact drum in this orientation.

5. The packaging gloveboxes cart shall be designed to manage 5 gal of uncontained liquid waste.

   Basis: A manageable liquid volume for the 31 × 41 × 7-in. deep glovebox cart. TFR Sections 3.1.2.2-2 and 3.1.2.2-4.

6. The cart rails shall be protected from waste zone material and interstitial soil that may overspill the cart.

   Basis: To ensure operability and reliability of the transfer cart. To facilitate ease of D&D&D. TFR Sections 3.5.5-3 and 3.5.6-5.

7. The cart shall be motor driven and the drive mechanism shall be protected from waste zone material and interstitial soil that may overspill the cart.

   Basis: To ensure operability and reliability of the transfer cart. To facilitate ease of D&D&D. TFR Sections 3.5.5-3 and 3.5.6-5.

8. The cart and rail system materials shall be compatible with the radioactive and hazardous waste expected to be encountered in the excavation.

   Basis: To ensure the reliability of the cart and rail system. Reactions with hazardous and radioactive waste may cause deterioration of the cart and rail system. Information

regarding compatibility with the radioactive and hazardous waste can be located in EDF-2041 and EDF-ER-211.

9. The cart and rail system shall be protected from inadvertent impacts from the excavation system.

   Basis: Impact of the excavator to the cart and rail system may render the cart and rail system unusable; therefore, protection of the system is required.

3.2.2 Accident Design Criteria

The following accident design criteria are specific to the waste transfer subsystem:

1. The cart rail support system shall withstand a design basis earthquake with a nominal operating load of 350 lb.

   Basis: In accordance with DOE O 420.1, "Facility Safety," systems, structures, and components shall be designed, constructed, and operated to withstand the effects of natural phenomena as necessary to ensure the confinement of hazardous material, the operation of essential facilities, the protection of government property, and the protection of life safety systems. TFR Section 3.2.5-1.

2. The cart, with a nominal load of 350 lb, shall remain on the rails during a design basis earthquake and the rails shall remain intact.

   Basis: In accordance with DOE O 420.1, "Facility Safety," systems, structures, and components shall be designed, constructed, and operated to withstand the effects of natural phenomena as necessary to ensure the confinement of hazardous material, the operation of essential facilities, the protection of government property, and the protection of life safety systems. TFR Section 3.2.5-1.

3. The cart, rails, rail support, and drive mechanism shall be constructed of noncombustible materials.

   Basis: In accordance with DOE O 420.1, "Facility Safety," noncombustible or fire resistive construction should be used where appropriate. TFR Section 3.3.7-1.

4. The cart system shall be able to withstand, and remain functional after, the impact of a 350-lb drum dropped from 1 ft and without causing a breach of confinement.

   Basis: Engineering judgement based upon Temporary Facility designation, probability of encountering an intact drum, and short duration of operations. TFR Section 3.3.1-4.

5. The cart bed shall be constructed of stainless steel for ease of decontamination.

   Basis: To support D&D&D. TFR Section 3.5.6-5.

3.2.3 Safety-Significant Items

The material transfer cart is considered safety significant. Refer to Appendix A for the critical attributes of the material transfer cart.

3.2.4 Applicable Regulatory and Contractual Requirements

In addition to the applicable regulatory and contractual requirements listed for the general excavation and packaging system, the following is specific to the waste transfer subsystem:

DOE-ID "Architectural Engineering Standards."

3.2.5 Applicable Industry Codes and Standards

The following industry codes and standards are specific to the waste transfer subsystem:

American Institute of Steel Construction *Manual of Steel Construction.*

4. REFERENCES

10 CFR 835, 2002, Title 10, "Energy," Part 835, "Occupational Radiation Protection," *Code of Federal Regulations*, Office of the Federal Register.

29 CFR 1910, 2002, Title 29, "Labor," Part 1910, "Occupational Safety and Health Administration," *Code of Federal Regulations*, Office of the Federal Register.

29 CFR 1926, 2002, Title 29, "Labor," Part 1926, "Safety and Health Regulations for Construction," Subpart M, "Fall Protection," *Code of Federal Regulations,* Office of the Federal Register.

40 CFR 61, 2002, Title 40, "Protection of Environment," Part 61, "National Emission Standards for Hazardous Pollutants," *Code of Federal Regulations*, Office of the Federal Register.

42 USC § 9601 et seq., 1980, "Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA/Superfund)," *United States Code.*

ACGIH, 2001, *Industrial Ventilation: A Manual of Recommended Practice*, Publication 2092, 24th ed., American Conference of Governmental Industrial Hygienists.

AGS-G001-1998, 1998, *Guidelines for Gloveboxes*, 2nd ed., American Glovebox Society Standards Committee.

AGS-G002-1998, *Standard Practice for Design and Fabrication of Glovebags,* American Glovebox Society Standards Committee.

AISC, 1989, *Manual of Steel Construction—Allowable Stress Design,* 9th ed., ISBN 1564240002, American Institute of Steel Construction, Chicago.

ASME, 1999, *Performance Standards for Electric Chain Hoists*, ASME-HST-1M, American Society of Mechanical Engineers.

ASME, 2001, *Overhead Hoists (Underhung)*, superceding ANSI B30.16, American Society of Mechanical Engineers.

Beitel, G. A., 2002, *OU 7-10 Chemical Compatibility of Glovebox Excavator Method Project Materials*, Engineering Design File EDF-2041, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Borland, Mark W., *System Design Criteria for the OU 7-10 Glovebox Excavator Method Process Design Criteria,* Technical and Functional Requirement TFR-158, Rev. 1, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

DOE O 420.1, 2000, "Facility Safety," Change 3, U.S. Department of Energy, November 22, 2000.

DOE O 435.1, 2001, "Radioactive Waste Management," U.S. Department of Energy, August 28, 2001.

DOE O 5400.5, 1993, "Radiation Protection of the Public and the Environment," February 8, 1990, Change 2, U.S. Department of Energy, January 7, 1993.

DOE-HDBK-1132-99, 1999, "DOE Handbook Design Considerations," U.S. Department of Energy, April 1999.

DOE-ID O 420.D, 2000, "Requirements and Guidance for Safety Analysis," U.S. Department of Energy Idaho Operations Office, Idaho Falls, Idaho, July 2000.

DOE-ID, 1998, *Explanation of Significant Differences for the Pit 9 Record of Decision at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory*, Administrative Record No. 10537, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; and Idaho Department of Health and Welfare.

DOE-ID, 1993, *Record of Decision: Declaration of Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory*, Administrative Record No. 5569, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; and Idaho Department of Health and Welfare.

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory,* Administrative Record No. 1088-06-29-120, U.S. Department of Energy Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare

DOE-ID, 2001, "Architectural Engineering Standards," Rev. 28, U.S. Department of Energy Idaho Operations Office, URL: http://www.inel.gov/publicdocuments/doe/archeng-standards/default.shtml.

DOE-STD-1020-94, 1996, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," Change 1, U.S. Department of Energy, January 1996.

DOE-STD-1027-92, 1997, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports," Change Notice No. 1, U.S. Department of Energy, September 1997.

DOE-STD-1090-2001, 2001, "Hoisting and Rigging," U.S. Department of Energy, April 2001.

Gosswiller, Eric B., 2001, *Preliminary Fire Hazards Analysis for the OU 7-10 Glovebox Excavator Method*, INEEL/EXT-01-01680, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Hipp, Thomas M., 2002, *System Design Criteria for the OU 7-10 Glovebox Excavator Method Project Instrumentation and Control Design Criteria,* TFR-155, Rev. 1, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Huntley, R. M., and D. E. Burns, 1995, *Scope of Work for Operable Unit 7-13/14 Waste Area Group 7 Comprehensive Remedial Investigation/Feasibility Study*, INEL-95/0253, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

INEEL, 2002a, *OU 7-10 Glovebox Excavator Method Technical and Functional Requirements*, INEEL/EXT-1998-00444, TFR-2527, Rev. 3, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

INEEL, 2002b, *Preliminary Documented Safety Analysis for the OU 7-10 Glovebox Excavator Method Project*, INEEL/EXT-01-01474, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

INEEL, 2002c, *System Design Criteria for the Operable Unit 7-10 Glovebox Excavator Method Project – General Structures and Site Design Criteria*, TFR-154, Rev. 0, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho, March 2002.

INEEL, 2001, *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications*, INEEL/EXT-01-01105, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

LMITCO, 1997, *Remedial Design/Remedial Action Scope of Work and Remedial Design Work Plan: Operable Unit 7-10 (Pit 9 Project Interim Action)*, INEL-94/0110 (formerly EGG-ER-11055), Rev. 2, Idaho National Engineering and Environmental Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

LMITCO, 1996, *Comparison of the Pit 9 Project Inventory of Contaminants Against the Corresponding Portion of the Historical Data Task Inventory and Recommended Revised Quantities*, INEL-96-0055, Rev. 0, Idaho National Engineering Laboratory, Lockheed Martin Idaho Technologies Company, Idaho Falls, Idaho.

NFPA, 1998, "Fire Protection for Facilities Handling Radioactive Materials," NFPA 801, National Fire Protection Association.

O'Holleran, Thomas P., Argonne National Laboratory – West, 2000, *OU 7-10 Materials Compatibility Study for Stage I and Stage II Enclosures*, INEEL/EXT-2000-00926, Engineering Design File EDF-ER-211, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Salomon, Hopi, Daryl Haefner, Beth McIlwain, Jila Banaee, Jeff Einerson, and Anna Podgorney, 2002, "Field Sampling Plan for the Operable Unit 7-10 Glovebox Excavator Method Project (Draft)," INEEL/EXT-02-00542, Rev. B, Idaho National Engineering and Environmental Laboratory, Bechtel BWXT Idaho, LLC, Idaho Falls, Idaho.

Appendix A

Packaging Glovebox System Critical Attributes List

Appendix A

Packaging Glovebox System Critical Attributes List

Table A-1. Development of quality assurance requirements for the Packaging Glovebox System.

System, Structure, or Component	Safety Function	Technical and Functional Requirement	Critical Characteristic	Supporting Technical and Functional Requirement	Specification	Method of Verification
PGS	Confinement of radioactive contamination and hazardous materials	3.1.1.2-3. The project shall provide ventilation as defense-in-depth to confine airborne radiological and hazardous materials during waste zone material characterization and packaging.	Required flow on glove loss	Same as general requirement	Minimum of 125 ft/minute through glove port	Calculation
			Maintain vacuum in glovebox	Same as general requirement	Able to maintain -0.5 to -0.7 iwg for normal operation	Demonstration and test
			Ability to survive and remain functional after DBE	3.2.5-1 Resist natural phenomena	IBC earthquake criteria with I = 1.5, DOE PC-2	Analysis and design verification (MCP-9217[a])
PGS	Confinement of radioactive contamination and hazardous materials	3.1.1.2-3. The project shall provide ventilation to confine airborne radiological and hazardous materials during waste zone material characterization and packaging.	Leak rate	Same as general requirement	No leaks per leak test criteria	Leak test
			Ability to resist design-basis accidents	3.3.7 Fire protection	Meet fire hazard analysis requirements	Analysis, design verification, and inspection of the fire protection system
			Ability to survive and remain functional after DBE	3.2.5-1 Resist natural phenomena	IBC earthquake criteria with I = 1.5, DOE PC-2	Analysis and design verification (MCP-9217[a])

DBE = design-basis earthquake DOE = U.S. Department of Energy IBC = Institutional Biosafety Committee MCP = management control procedure
PC = performance category PGS = Packaging Glovebox System
a. MCP-9217, 2002, "Design Verification," Rev. 1, November 1, 2001.

Table A-2. Attributes or characteristics of the Packaging Glovebox System that are essential to perform its safety-significant function.

Packaging Glovebox System Component	Safety Function	Applicable Performance Category-2 Criteria	Critical Characteristics	Supporting Documents	Method of Verification
PGS structural framing including structural connections	Resist design loads including DBE and remain functional	PC-2 earthquake loading	Material strength	Vendor data	Certificate of conformance to ASTM requirements or CMTRs
			IBC earthquake criteria with I = 1.5, DOE PC-2	Design and analysis report or EDF	Independent peer review
PGS skin, access panel(s) and windows	Confine materials	Okay for deflections from PC-2 earthquake loading	No holes		Leak test
	Resist design pressures		Material strength	Design and analysis report or EDF	Same as for structural framing
PGS gloveports	Confine materials	Not applicable	No holes, sealing of joints	Test report	Leak test
PGS ventilation system	Confine materials	PC-2 for those item that are directly attached to the PGS	No holes or leaks in ductwork or filter housings	Test report	Leak test
			Filter integrity	Test report	Filter acceptance test
			Support resistance earthquake load	Design and analysis EDF	Analysis and design verification
PGS/RCS interface seal	Confine materials	Okay for deflections from PC-2 earthquake loading	No holes	Test report	Leak test
	Resist design pressures			Design and analysis EDF	Analysis and design verification
PGS window joints	Confine materials	Okay for deflections from PC-2 earthquake loading	Sealing of joints	Test report	Leak test

Table A2. (continued).

Packaging Glovebox System Component	Safety Function	Applicable Performance Category-2 Criteria	Critical Characteristics	Supporting Documents	Method of Verification
PGS penetrations	Confine materials	Okay for deflections from PC-2 earthquake loading	Sealing of penetration	Test report	Leak test
PGS fire protection system	Mitigate design basis fire	PC-2 earthquake loading	Flow rate	Test report	Flow test of system up through glovebox connection (NFPA-ABC)
			Coverage	Test report	Design verification
					Quality supplier of nozzles
					Verify model # upon receipt inspection
					Verify placement during glovebox fabrication
			Survive DBE	Design and analysis EDF	Analysis and design verification (MCP-9217)
PGS painting	None	None applicable	NA	NA	NA
RCS lighting	None	Mounting to resist PC-2 earthquake loading	NA	NA	NA
PGS material transfer cart	Limit volume of free liquid in material transfer cart	Not applicable	Limit volume of free liquid in material transfer cart	Design and Criticality Safety Evaluation	Analysis of postulated criticality accident

ABC = atomic, biological, chemical ASTM = American Society for Testing and Materials CMTR = Certified Material Test Report DBE = design-basis earthquake
DOE = U.S. Department of Energy EDF = engineering design file IBC = Institutional Biosafety Committee NA = not applicable
NFPA = National Fire Protection Association PC = performance category PGS = Packaging Glovebox System RCS = Retrieval Confinement Structure