WSRC-TR-2001-00006

Plutonium Immobilization Project

System Design Description
for
Can Loading System (U)

Revision E

December 15, 2000

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System Design Description for Can Loading System

Revision E

December 2000

Plutonium Immobilization Project
Westinghouse Savannah River Company
Aiken, South Carolina

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Summary of Changes

Revision No. and Date	*Verified/Checked by and Date*	*Pages Affected by the Change*	*Reason for Change*
Rev A, 2/7/00		All	Initial Draft
Rev. B, 3/24/00		All	Revised Draft
Rev. C, 7/10/00		1-4 (Summary)	Comments
Rev. D, 12/15/00		All	PIP 50 to 13 MT throughput

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
A/E	Architect / Engineer
ALARA	As Low As Reasonably Achievable
Am	Americium
ANS	American Nuclear Society
BMS	Balanced magnetic switches
cc	Cubic Centimeter
CCD	Charged Coupled Device
CCTV	Closed-circuit television
CFR	Code of Federal Regulations
CO2	Carbon Dioxide
Doc.	Document
DOCDR	Design-only conceptual design report
DOE	Department of Energy
DOF	Degree of Freedom
dpm	Disintegration Per Minute
D&T	Development & Testing
FDD	Facility Design Description
ft	Feet
He	Helium
HEPA	High Efficiency Particulate Air
hr	Hour
HVAC	Heating Ventilating and Air Conditioning
HYDOX	Hydride / Oxidation
I/O	Input / output
kg	Kilogram
LLNL	Lawrence Livermore National Laboratory
MAA	Material Access Area
min	Minute
MT	Metric Ton (1000 kg)
MTS	Material Transfer System
MC&A	Material Control and Accountability
mrem	Milliroentgen equivalent for man
NFPA	National Fire Protection Association
PDCF	Pit Disassembly and Conversion Facility
PIP	Plutonium Immobilization Plant
Pu	Plutonium
Pu-U	Plutonium-uranium
psig	Pounds per Square Inch, Gauge
rem	Roentgen equivalent for man
SDD	System Design Description
SNM	Special Nuclear Material

SRTC	Savannah River Technology Center
TBD	To Be Determined/Designed
TIG	Tungsten Inert Gas
TRU	Transuranic
U	Uranium
VAC	Volts Alternating Current
WEP	Water extended polyester
WSRC	Westinghouse Savannah River Company
yr	Year
ZPPR	Zero Power Physics Reactor

SUMMARY

The purpose of this System Design Description (SDD) is to specify the system and component functions and requirements for the Can Loading System and provide a complete description of the system (design features, boundaries, and interfaces), principles of operation (including upsets and recovery), and the system maintenance approach. The PIP will immobilize up to 13 metric tons (MT) of U.S. surplus weapons usable plutonium materials. The throughput requirements for the can loading system will be identified by the A/E during preliminary design as part of the overall facility computer simulation model analysis for the 1.3MT per year facility design capacity. This SDD includes some 13 MT changes to the DOCDR, Rev 3 dated November 2000. Some of the changes affected the equipment described in this SDD. This document does not contain changes from equipment operations described in the FDD (reference A.7.1)

The overall function of the Can Loading System is to automatically load ceramic pucks into sealed stainless steel cans. There is one Can Loading process line.

The Can Loading subsystems are:

- Puck Transfer Tray Transport Subsystem
- Can Loading Subsystem
- Bagless Transfer Subsystem
- Can InspectionSubsystem
- Can Handling Subsystem

The system receives trays of pucks from the material transport system and transports the trays into the can loading glovebox. The puck transfer tray transport cart moves a tray to a tray lift station and the tray lifter removes the tray from the cart. The Can Loading bridge robot uses a vacuum lifting tool to remove each puck from the tray, move it to a scale and dimensional measurement station, and then load the puck into one of two puck cans. The cart moves the empty tray from the tray lift station to the elevator.

The Can Loading robot places the helium hood over the can plug. The helium hood then grabs the can plug using a vacuum cup. The Can Loading robot places the helium hood over the full puck can and the helium hood seals to the can via an inflatable seal. The helium hood automatically removes the air from the can, fills the can with helium, and inserts the plug into the can. The corresponding bagless transfer system welds the plug to the can wall, and cuts the can and plug leaving the can stub in the sphincter seal.

The bagless transfer can holder lowers the can under the glovebox and swings the can to the glovebox center. The inspection robot uses an alpha probe to inspect the can exterior middle section. After the survey is complete, the can robot grabs the can middle section and removes the can from the bagless transfer can holder. The bagless transfer can holder swings out of the way and the can robot presents the puck can to the inspection robot. The inspection robot surveys the puck can top and bottom. If no external contamination is found, the can robot places the can in the helium bell jar leak detector to ensure the weld is leak tight. After the leak test is complete, the can robot places the can in a pallet on the puck can transport cart which leaves the bagless transfer enclosure.

Empty new cans, manually pre-loaded with plugs, are placed in a holder external to the bagless transfer enclosure. The puck can transport system brings the pallet of cans to the bagless transfer enclosure. The can robot removes the cans from the pallet and places them in storage areas. The can robot moves an empty new can from storage into the empty bagless transfer can holder and then the bagless transfer system raises the can. The previous can stub is pushed by the new can into the Can Loading glovebox and the Can Loading robot places the stub on a special waste tray. The waste tray and can stub leave the can loading glovebox on the puck transfer tray transport cart. The facility material transport system moves the waste tray to the waste handling glovebox. The Can Loading robot removes the plug from the new can and the loading process resumes. The Can Loading Robot will load the puck can in the first bagless transfer unit and while that can is being welded, cut, and inspected, the robot will load the puck can in the second bagless transfer unit.

The Can Loading System has the capability to process 8 puck cans per day (**HOLD**). The average daily throughput based on annual material balance and 200 days/year operation is 7 kg (**HOLD**) of plutonium.

The Can Loading system utilizes a mix of manual and automated operations.

The Can Loading process is housed in a glovebox and the can inspection processes are housed in a hood. The glovebox has an atmosphere of dry air The box will include shielding for gamma and neutron radiation **TBD**. HEPA-filtered ventilation will be required in the gloveboxes and the process room. The process area will be provided with alpha air monitoring, criticality monitoring, and a physical protection alarm system.

These operations are shown in Figure 1-1, Process Flow Diagram, as highlighted.

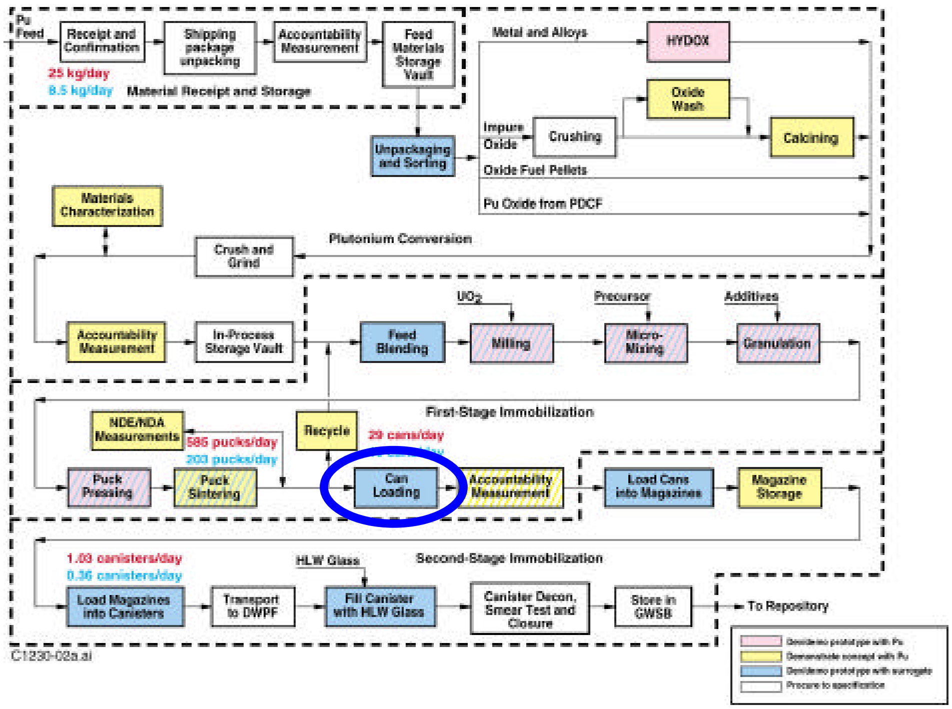

Figure 1-1. Process Flow Diagram

This SDD includes the following minor changes to the DOCDR. **TBD**

This SDD provides a complete description of the system (design features, boundaries, and interfaces), principles of operation including upsets and recovery, and the system maintenance approach and is organized as follows:

Section 1.0 specifies the system functions and requirements for which the system and components are to be designed. The section also includes the technical bases for these requirements.

Section 2.0 contains a description of the design and performance characteristics of the system and its major components. This description explains how the design satisfies the requirements specified in Section 1.0. The A/E will complete this section as part of preliminary design.

Section 3.0 describes the principles of system operation and provides outlines of critical system operating procedures. The A/E will complete this section as part of preliminary design.

Section 4.0 defines system operating set points, limits, and precautions. The A/E will complete this section as part of preliminary design.

Section 5.0 describes anticipated system upsets, and provides outlines of the corresponding recovery procedures. The A/E will complete this section as part of preliminary design.

Section 6.0 describes the overall maintenance approach and provides outlines of the procedures to be used for preventive and corrective maintenance, surveillance, and in-service inspection. The A/E will complete this section as part of preliminary design.

Section 7.0 contains the SDD Appendices, which include the references, system-to-system interface requirements, a requirements traceability matrix, and various tables of technical information applicable to the system.

Appendix F contains a list of major equipment.

Appendix G is provided to list equipment that will be provided with government assisted design information. However, all can loading equipment is thought to be designed and provided by the A/E.

TBDs (to be determined) or **HOLD**s are used in the SDD to identify information that is not provided or that has not been finalized. The "**TBD**" is used to identify places in the text where numeric values or descriptive information is not available at the time the SDD is being developed. A **HOLD** is used to identify information presented in the SDD that:

- is preliminary and unapproved;
- involves an uncertain design feature;
- has insufficient technical justification;
- needs verification; or
- creates a discrepancy or inconsistency.

TBDs and **HOLD**s will be tracked in a separate document.

1.0 SYSTEM FUNCTIONS AND REQUIREMENTS

This section contains the specific functions, performance requirements and design requirements that govern the design of the Can Loading System. These functions and requirements must be satisfied by the system to ensure the Can Loading System is able to fulfill its mission.

1.1 FUNCTIONS AND PERFORMANCE REQUIREMENTS

A function is a statement that describes the capability necessary for a facility, system, subsystem or component to fulfill its mission in support of the customer's needs. The top-level functions that must be performed by the facility are specified in the PIP FDD (Reference A.7.1). Also specified in the FDD are the major subfunctions that must be performed by the various systems that comprise the facility.

In this SDD section, the FDD subfunctions applicable to the Can Loading System are restated as system level functions. These system level functions are further broken down into more specific subfunctions applicable to subsystems and/or components of the system, and they are grouped according to functional classification.

The functional classifications have been assigned on a preliminary basis (Reference TBD) in accordance with FDD Sections 3.2 (Facility Classification) and 3.3 (Design Conditions and Constraints).

Related performance requirements are specified for each function. The performance requirements define how well a function needs to be performed in order to fulfill the function mission. Performance requirements provide specific parameters that are unique to the system and that must be met by the design.

The Can Loading System functions and subfunctions are summarized in Figure 1-2.

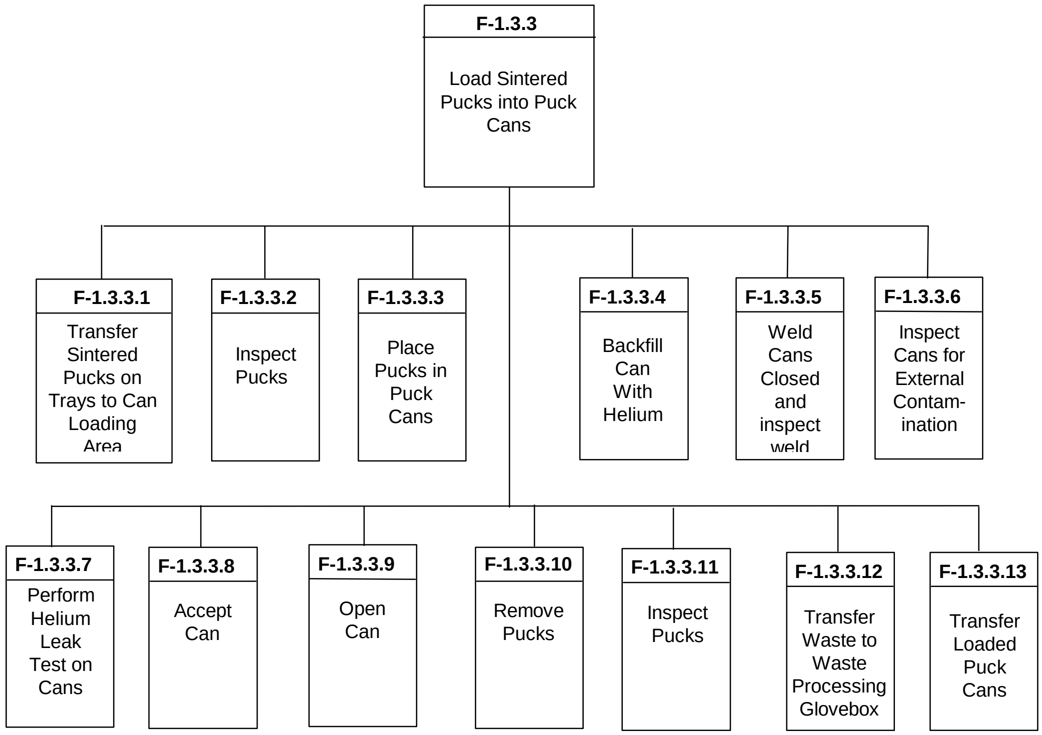

Figure 1-2. Can Loading System Functional Hierarchy

Functional Interrelationships

Appendix B contains the following figures and tables that show the interrelationship between the functions presented in this section, and the interrelationship between these functions and the components described in Section 2.0, Design Description:

- Figure B-1, Function Hierarchy Diagram that shows the top-level system functions broken down into subfunctions. The subfunctions are the actions or capabilities necessary to perform the system functions.
- Figure B-2, Functional Flow Diagram that shows the logical interrelationship of the subfunctions.
- Table B-1, Functions to Component Allocation Matrix that identifies the components that will perform the functions/subfunctions.

1.1.1 SAFETY CLASS (SC) FUNCTIONS

The Can Loading System performs no Safety Class functions.

1.1.2 SAFETY SIGNIFICANT (SS) FUNCTIONS

The Can Loading System performs no Safety Significant functions.

1.1.3 PRODUCTION SUPPORT (PS) FUNCTIONS

F-1.3.3 (PS) Load sintered pucks into puck cans

R-1.3.3A The system shall produce a minimum of 8 acceptable puck cans (HOLD) per 24 hours. Assume 1 puck can per week (HOLD) is unacceptable, see R-1.3.3.8B. System shall be capable of handling surge rates of up to 20% of stated rates. Surge capacity will be verified using computer modeling during initial design.

Basis: A derived requirement based on the facility producing 157pucks per day. Each puck can contains 20 pucks nominally (HOLD). Surges may occur following system outages.

R-1.3.3B Produce puck cans that are sealed with a leak rate less than TBD cc He/min and are free of external contamination.

Basis: To ensure that puck cans produced have the necessary characteristics to produce an Immobilized Pu Waste Form (IPWF) that meets preliminary geological repository qualification standards (Reference TBD).

F-1.3.3.1 (PS) Transfer Sintered Pucks on Trays to Can Loading Area

R-1.3.3.1A The system shall transfer 10 puck trays per day from the facility material transport system elevator into the can loading area.

Basis: A derived throughput requirement from facility throughput requirement of 157pucks (HOLD) per day and 16 pucks per tray.

F-1.3.3.2 (PS) Inspect Pucks

R-1.3.3.2A The system shall weigh and dimensionally measure each puck.

Basis: Process variations in puck manufacturing will require individual puck height measurements so that the height of pucks stacked in one can will be below a known limit. Total puck weight per can will also be recorded.

F-1.3.3.3 (PS) Place Pucks in Puck Cans

R-1.3.3.3A The system shall place 157 pucks into puck cans per day (HOLD).

Basis: Reference R-1.3.3A.

F-1.3.3.4 (PS) Backfill Can With Helium

R-1.3.3.4A The system shall fill 8 puck cans per day (HOLD) with helium.

Basis: Reference R-1.3.3A.

R-1.3.3.4B The system shall be capable of generating a vacuum of 20 inches of mercury (HOLD) or greater and then backfill shall be 3 psig or greater (HOLD) of helium.

Basis: Experience with FB-Line bagless transfer.

R-1.3.3.4C The can internal atmosphere shall be greater than 50% helium (HOLD) by volume after the welding process.

Basis: Experience with FB-Line bagless transfer helium leak check system.

F-1.3.3.5 (PS) Weld Cans Closed

R-1.3.3.5A The system shall weld 8 puck cans per day.

Basis: Reference R-1.3.3A. Weld Inspection based on experience with FB-Line bagless transfer weld system.

R-1.3.3.5B The system shall produce puck cans that leak less than TBD cc He per minute.

Basis: TBD

F-1.3.3.6 (PS) Inspect Cans for External Contamination

R-1.3.3.6A The system shall reject cans that generate more than 20 alpha dpm / 100 cm^2 (HOLD) on the can exterior.

Basis: SRS radiological work practice (Reference TBD).

R-1.3.3.6B The system shall accept puck cans that meet 10 CFR 835 Appendix D.

Basis: TBD.

R-1.3.3.6C The system shall be able to inspect 8 puck cans per day (HOLD) at the minimum.

Basis: Facility throughput requirement.

F-1.3.3.7 (PS) Perform Helium Leak Test on Cans

R-1.3.3.7A The system shall determine if the puck cans are leaking at a rate of less than TBD cc He/min.

Basis: TBD

R-1.3.3.7B The system shall be able to inspect 8 puck cans per day (HOLD) at the minimum.

Basis: Facility throughput requirement.

F-1.3.3.8 (PS) Accept Can

R-1.3.3.8A The system shall accept cans that have a leak rate less than TBD and a removable alpha contamination limits less than 20 alpha dpm / 100 cm^2 (HOLD).

Basis: TBD

F-1.3.3.9 (PS) Open Can

R-1.3.3.9A The system shall recycle pucks from failed cans.

Basis: TBD

R-1.3.3.9B The system shall be able to process 1 reject can per week (HOLD) at the minimum.

Basis: Estimated puck can failure rate.

F-1.3.3.10 (PS) Remove Pucks

R-1.3.3.10A The system shall be able to remove pucks from full puck cans that are not acceptable and are opened.

Basis: Recycle pucks from failed cans.

R-1.3.3.10B The system shall be able to process 1 reject can per week (HOLD) at the minimum.

Basis: Estimated puck can failure rate.

F-1.3.3.11 (PS) Inspect Pucks

R-1.3.3.11A The system shall be able to determine if pucks are not broken and TBD.

Basis: TBD

F-1.3.3.12 (PS) Transfer Waste to Waste Processing Glovebox

R-1.3.3.12A The system shall transfer 8 can stubs per day, 1 (HOLD) reject can per week to the Waste Processing Glovebox.

Basis: Reference R-1.3.3A.

F-1.3.3.13 (PS) Transfer Loaded Puck Cans

R-1.3.3.13A The system shall transfer 8 puck cans per day (HOLD) to the material transport system.

Basis: Reference R-1.3.3A

1.1.4 GENERAL SERVICES (GS) FUNCTIONS

The Can Loading System performs no General Service functions.

1.2 SYSTEM DESIGN REQUIREMENTS

This section contains the specific design criteria that impact the design of the Can Loading System. Design criteria include the requirements and constraints imposed on the system, subsystem and/or component design by authoritative sources such as national codes and standards; DOE Orders; federal, state and local regulations; and SRS engineering standards developed for unique design situations not adequately covered by other authorities. The technical bases for these requirements are provided in the basis statement below each requirement.

FDD/SDD Interrelationship

The FDD and SDDs identify the design criteria imposed on the design of the facility. The design criteria identified in the FDD are limited to the overall facility, to multiple systems, or to systems for which, there is no SDD. Those FDD requirements that are applicable to the Can Loading System are referenced in the appropriate subsections of this SDD. Unique Can Loading System requirements not included in the FDD are included in the subsections to follow.

1.2.1 STRUCTURAL

R-1.2.1A The Can Loading System performance classification shall be classified as Performance Category 3.

Basis: Classified in accordance with criteria in DOE-STD-1020-94 and DOE-STD-1021-93.

R-1.2.1B The Can Loading System Facility Hazard Use Category shall be Hazard Category TBD.

Basis: Per TBD document.

R-1.2.1C The Can Loading System shall meet the process material requirements in FDD (Reference TBD), Sections TBD.

Basis: Per FDD.

R-1.2.1D The Can Loading System shall meet the structural requirements in FDD (Reference TBD), Sections TBD.

Basis: Per FDD.

R-1.2.1E The Can Loading System shall meet the mechanical requirements in FDD (Reference TBD), Sections TBD.

Basis: Per FDD.

1.2.2 SYSTEM CONFIGURATION AND ESSENTIAL FEATURES

R-1.2.2A The Can Loading System shall consist of the following subsystems:

- Puck Transfer Tray Transport Subsystem
- Can Loading Subsystem
- Bagless Transfer Subsystem
- Can Inspection Subsystem
- Can Handling Subsystem

R-1.2.2.B The Bagless Transfer enclosure shall have a constant air monitor.

Basis: To detect and prevent the spread of contamination.

1.2.2.1 Puck Transfer Tray Transport Subsystem

R-1.2.2.1A The Puck Transfer Tray Transport Subsystem shall receive puck transfer trays from the facility material transport system elevator and move each tray through a door to the lift stations.

Basis: The pucks must enter the Can Loading glovebox and minimize contamination spread.

R-1.2.2.1B The subsystem shall use two lift stations to stage and hold puck transfer trays.

Basis: Derived from facility throughput requirement. The system can load pucks from one tray while it replaces the other tray.

1.2.2.2 Can Loading Subsystem

R-1.2.2.2A The Can Loading Subsystem shall use a can loading robot to move sintered pucks from the puck transfer trays to the puck cans.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.2B The Can Loading Subsystem shall measure and weigh each puck before it is placed in the puck can. The ceramic puck height is nominally 1.0 +/- 0.2 inches (HOLD), the diameter is 2.65 +/- 0.1 inches (HOLD), and the weight is 1.0 +/- 0.1 pounds (HOLD).

Basis: Reference R-1.3.3.2A.

R-1.2.2.2C The Can Loading Subsystem shall use a vision system to find pucks on the puck transfer tray.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.2D The Can Loading Subsystem shall use a puck lifting tool to grab sintered pucks.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.2E The Can Loading Subsystem shall use a helium hood to fill the puck cans with helium and insert the hollow plug.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.2F The Can Loading Subsystem shall use a can cutter to cut open reject puck cans.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

1.2.2.3 Bagless Transfer Subsystem

R-1.2.2.3A Two bagless transfer units shall be used in one can loading line.

Basis: Minimize the glovebox space and meet facility throughput requirements. Reference R-1.3.3A.

R-1.2.2.3B The bagless transfer system shall use a sphincter seal to the puck cans to the can loading glovebox.

Basis: FB-Line bagless transfer experience.

R-1.2.2.3C The bagless transfer system shall use a rotating pipe cutter to cut puck cans.

Basis: FB-Line bagless transfer experience.

R-1.2.2.3D The bagless transfer system shall use a TIG welder to weld the hollow plugs to the puck can walls.

Basis: FB-Line bagless transfer experience.

R-1.2.2.3E The bagless transfer system shall use a puck can holder to raise puck cans into the sphincter seal.

Basis: FB-Line bagless transfer experience.

1.2.2.4 Can Inspection Subsystem

R-1.2.2.4A The can inspection system shall use a small 6 axis (HOLD) jointed robot to survey the puck cans.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.4B The can inspection system shall use an alpha detector to determine if the puck can exterior is contaminated.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

1.2.2.5 Can Handling Subsystem

R-1.2.2.5A The Can Handling Subsystem shall use a 3 axis (HOLD) robot to move the puck cans from the bagless transfer puck can holder to the leak detection chamber and from the chamber to the puck can transport system.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.5B The can handling system shall use a leak detection chamber to determine if the puck cans are sealed properly.

Basis: PIP Can Loading D&T work determined this to be the best option for this task.

R-1.2.2.5C The can handling system shall be capable of processing a full puck can. Each full puck can will be 21 inches (HOLD) long, by 3 inches

(HOLD) in diameter, made from 304 stainless steel, and weigh 25 pounds (HOLD).

Basis: PIP Can Loading D&T work determined this to be the best option for this task (Reference A.2.1).

R-1.2.2.5D The can handling system shall be capable of processing an empty puck can. Each empty puck can will be 31 inches (HOLD) long, by 3 inches (HOLD) in diameter, made from 304 stainless steel, and weigh 5 pounds (HOLD).

Basis: PIP Can Loading D&T work determined this to be the best option for this task (Reference A.2.1).

R-1.2.2.5E Each puck can shall have a unique and permanent identification number on the can exterior.

Basis: The waste repository requires this documentation.

R-1.2.2.5F The Can Loading control system shall be able to read the identification number (or barcode) and report it to the PIP MC&A computer system.

Basis: The waste repository requires this documentation.

1.2.3 MAINTENANCE REQUIREMENTS

R-1.2.3A The following components shall be located outside the glovebox and accessible for routine maintenance:

- Tray transfer cart motor and actuator
- Tray lifter motors
- Vision system cameras

Basis: To permit routine component maintenance without opening glovebox and minimize radiation exposure.

R-1.2.3B The following components shall be removable without entering the Open-Glovebox Maintenance Mode:

TBD

Basis: To permit component replacement without opening glovebox.

R-1.2.3C The Can Loading System shall meet additional maintenance requirements in FDD (Reference TBD) Section TBD.

Basis: TBD

1.2.4 SURVEILLANCE AND IN-SERVICE INSPECTION REQUIREMENTS

R-1.2.4A TBD

Basis: TBD

1.2.5 POWER, INSTRUMENTATION AND CONTROL REQUIREMENTS

1.2.5.1 Electrical Power

R-1.2.5.1A The Can Loading System shall meet electrical power requirements in FDD (Reference TBD) Section TBD.

Basis: Per FDD.

1.2.5.2 Instrumentation

R-1.2.5.2A The Can Loading System shall meet instrumentation requirements in FDD (Reference TBD) Section TBD.

Basis: Per FDD.

1.2.5.3 Control

R-1.2.5.3A The Can Loading System shall meet control requirements in FDD (Reference TBD) Section TBD.

Basis: Per FDD.

R-1.2.5.3B All Subsystem Control Systems shall provide the ability to select either automatic, semi-automatic, or manual mode of operation.

Basis: TBD

R-1.2.5.3C All Subsystem Control Systems shall be able to communicate with the Supervisory Control System (TBD) for operation monitoring and data transmitting purposes.

Basis: TBD

R-1.2.5.3D All Subsystem shall have programmable safety interlocks to prevent accidental release of materials and collision.

Basis: TBD

1.2.6 INTERFACING SYSTEM REQUIREMENTS

The Can Loading System shall meet the interface requirements in Appendix C. These interface requirements include applicable functional, physical, and performance requirements and design constraints at a common boundary interface between the Can Loading System and other systems.

A description of the internal interfaces between the various Can Loading System subsystems is also provided.

1.2.7 QUALITY ASSURANCE REQUIREMENTS

The Can Loading System shall meet quality assurance requirements in FDD (Reference TBD) Section TBD.

1.2.8 APPLICABLE DOCUMENT REQUIREMENTS

Refer to Appendix A for a list of Can Loading System applicable documents.

1.2.9 RELIABILITY ASSURANCE REQUIREMENTS

R-1.2.9A The Can Loading System shall have a reliability of TBD.

Basis: TBD

R-1.2.9B All Subsystem reliability shall be TBD.

Basis: TBD

1.2.10 AVAILABILITY REQUIREMENTS

R-1.2.10A System and subsystem availability shall be TBD.

Basis: Reliability, Availability, Maintainability and Inspection Study (Reference TBD).

1.2.11 HUMAN FACTORS REQUIREMENTS

R-1.2.11A The Can Loading System shall meet human factors requirements in FDD (Reference TBD) Section TBD.

Basis: Per FDD.

1.2.12 FACILITY AND SYSTEM TRANSIENT REQUIREMENTS

TBD

1.2.13 EQUIPMENT QUALIFICATION REQUIREMENTS

TBD

1.2.14 RADIOLOGICAL REQUIREMENTS

R-1.2.14A The Can Loading System shall meet radiological requirements in FDD (Reference TBD) Section TBD.

Basis: Per FDD.

1.2.15 OTHERS

TBD

1.3 COMPONENT FUNCTIONS AND PERFORMANCE REQUIREMENTS

This section specifies the principal functions and performance requirements that must be performed by each of the major components of the Can Loading System. The functional classification for each function is also provided. The component functions are based on the Can Loading System Functions specified in Section 1.1.

1.3.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

F-1.3.1.1 Transport puck transfer trays from facility material transfer elevator to tray lifters.

R-1.3.1.1A The puck transfer tray transport shall move 30 pound payloads (HOLD).

Basis: The baseline puck transfer tray will have 16 one pound pucks and the tray will weigh five to ten pounds.

R-1.3.1.1B The system shall move 157 pucks per day (HOLD) at the minimum. If there are 16 pucks per tray, the system shall move 10 trays per day at the minimum.

Basis: Facility throughput.

F-1.3.1.2 Stage puck transfer trays.

R-1.3.1.2A The tray lifters will be able to lift 30 pounds (HOLD).

Basis: Reference R-1.3.1.1A.

R-1.3.1.2B Cycle time (lift up and down) shall not limit production rate.

Basis: Reference R-1.3.1.1A.

1.3.2 CAN LOADING SUBSYSTEM

F-1.3.2.1 Weigh pucks prior to canning.

R-1.3.2.1A The scale shall be capable of weighing pucks (nominal weight of 530 grams) with a precision of 0.1% and an accuracy of 0.1%.

Basis: Reference A.2.7.

F-1.3.2.2 Measure puck dimensions prior to canning.

R-1.3.2.2A Measure puck thickness with a precision of TBD and accuracy of TBD.

Basis: Puck thickness variations will result in the height of stacked pucks in a can possibly interfering with can lid insertion. This may result in some cans having 19 pucks instead of the nominal can fill of 20 pucks.

F-1.3.2.3 Move sintered pucks from the puck transfer tray to the puck inspection station and to the puck cans using the can loading robot.

R-1.3.2.3A The can loading robot shall be able to lift and move a 30 pound payload.

Basis: The robot may have to move a full puck can.

R-1.3.2.3B The can loading robot shall have each motion of axis (joint) repeatable to +/- 0.010 inches.

Basis: The robot needs this repeatability to complete the required tasks.

F-1.3.2.4 Place the helium hood on the puck can in the bagless transfer sphincter seal and remove it.

R-1.3.3.4A The can loading robot shall be able to lift and move a 30 pound payload (HOLD).

Basis: The robot may have to move a full puck can.

F-1.3.2.5 Move the cut puck can stubs from the sphincter seal to the puck transfer tray.

R-1.3.2.5A The can loading robot shall be able to lift and move the puck can stubs. Each stub will be 3 inches OD (HOLD) by 10 inches long (HOLD).

Basis: The robot must move these stubs to the waste tray on the puck transfer tray transport system.

F-1.3.2.6 Remove sintered pucks from reject puck cans.

R-1.3.2.6A The can loading robot shall be able to remove pucks from puck cans in the sphincter seal.

Basis: Reject puck cans must be remotely emptied.

F-1.3.2.7 Grab and move sintered pucks using a puck lifting tool.

R-1.3.2.7A The puck lifting tool shall be able to grab sintered pucks from the puck transfer tray and place the inside the puck cans. The smallest puck can ID is 2.88 inches (HOLD) and the sintered puck diameters will range from 2.5 inches (HOLD) to 2.75 inches (HOLD).

Basis: Facility baseline requirements.

F-1.3.2.8 Find puck centers when the pucks are on the puck transfer trays.

R-1.3.2.8A The vision system shall be able to determine the puck centers to +/- 0.125 inches (HOLD).

Basis: Prototype testing.

F-1.3.2.9 Determine the offset from a puck center and the puck lifting tool center.

R-1.3.2.9A The vision system shall be able to determine the offset to +/- 0.01 inches (HOLD).

Basis: Prototype testing.

F-1.3.2.10 Remove air from the puck can using a helium hood tool.

R-1.3.2.10A The helium hood shall be able to seal to the puck can and pull a vacuum on the puck can interior. The vacuum will be 20 inches of mercury (HOLD).

Basis: FB-Line experience.

F-1.3.2.11 Insert helium into the puck can.

R-1.3.2.11A The helium hood shall insert helium into the puck can at a pressure of 3 psig (HOLD).

Basis: FB-Line experience.

F-1.3.2.12 Insert the hollow plug into the puck can.

R-1.3.2.12A The helium hood shall be able to insert the hollow plug into the puck can.

Basis: TBD

F-1.3.2.13 Open cans that fail the acceptance tests in the can loading glovebox using the reject can cutter.

R-1.3.2.13A The reject can cutter in the can loading glovebox shall be able to cut a full puck can. The full puck can will be 3 inches (HOLD) in diameter and have a wall thickness of 0.060 inches (HOLD).

Basis: TBD

1.3.3 BAGLESS TRANSFER SUBSYSTEM

F-1.3.3.1 Seal the puck can to the can loading glovebox using a sphincter seal. The puck can open end will be inside the can loading glovebox.

R-1.3.3.1A The sphincter seal shall be able to accept and seal to the empty puck cans.

Basis: FB-Line bagless transfer experience.

R-1.3.3.1B The sphincter seal shall be able allow puck cans to be raised up through the seal while maintaining the seal.

Basis: FB-Line bagless transfer experience.

F-1.3.3.2 Weld the hollow plug to the can wall from outside the can using the puck can welder.

R-1.3.3.2A The puck can welder shall be able to weld the hollow plug to the can wall from the outside.

Basis: FB-Line bagless transfer experience.

F-1.3.3.3 Cut the puck in the weld area to separate the full puck can from the stub using the puck can cutter.

R-1.3.3.3A The puck can cutter shall be able to cut the puck can material and the weld fillet material without generating chips or significant rollover.

Basis: FB-Line bagless transfer experience.

F-1.3.3.4 Raise empty puck cans into the sphincter seal using the puck can holder

R-1.3.3.4A The puck can holder shall be able to lift 100 pounds (HOLD).

Basis: FB-Line bagless transfer experience.

1.3.4 CAN INSPECTION SUBSYSTEM

F-1.3.4.1 Survey the puck can exterior using a can inspection robot..

R-1.3.4.1A The can inspection robot shall be able to survey the middle section of the puck can exterior while it is in the puck can holder.

Basis: TBD

R-1.3.4.1B The can inspection robot shall be able to survey the bottom and top section of the puck can exterior while the puck can robot holds the can.

Basis: TBD

F-1.3.4.2 Survey the puck can exterior for alpha contamination levels using an alpha counter.

R-1.3.4.2A The alpha survey counter shall be able to count for contamination per SRS procedure (TBD).

Basis: TBD

F-1.3.4.3 Determine if full puck cans are leak tight using a leak detection chamber.

R-1.3.4.3A The leak detection chamber shall be able to determine if helium is leaking from the full puck cans.

Basis: TBD

1.3.5 CAN HANDLING SUBSYSTEM

F-1.3.5.1 Move the puck cans in the bagless transfer enclosure to the various components using the puck can robot.

R-1.3.5.1A The puck can robot shall be able to grab and move the full puck can. The can will weigh 25 pounds (HOLD), be 3 inches (HOLD) in diameter, and 21 inches (HOLD) long.

Basis: Reference A.2.1.

F-1.3.5.2 Move full puck cans from the bagless transfer enclosure to the material transport system using the puck can transporter.

R-1.3.5.2A The puck can transporter shall be able to move a full puck can. The can will weigh 25 pounds (HOLD), be 3 inches (HOLD) in diameter, and 21 inches (HOLD) long.

Basis: Reference A.2.1.

1.4 COMPONENT DESIGN REQUIREMENTS

This section specifies special design requirements that must be met by the component design. Special design requirements are those that specify unique features or extra capabilities that must be incorporated into the component design, in addition to the features/capabilities that would ordinarily be provided to meet the performance requirements.

1.4.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

R-1.4.1A The puck transfer tray transport shall use a magnetically coupled cart (HOLD). The actuator shall be outside the glovebox and the cart and rails shall be inside the glovebox.

Basis: To minimize equipment inside the glovebox, minimize maintenance inside the glovebox, and to reduce contaminated waste.

R-1.4.1B The puck transfer tray transport cart shall use 8 (HOLD) wheels.

Basis: To help the cart pass over gaps in the track.

R-1.4.1C The puck transfer tray lifters shall use magnetically coupled motors (HOLD). The motors shall be outside the glovebox and the actuators shall be inside the glovebox.

Basis: To minimize equipment inside the glovebox, minimize maintenance inside the glovebox, and to reduce contaminated waste.

1.4.2 CAN LOADING SUBSYSTEM

R-1.4.2A The puck inspection station shall measure individual puck weight using a load platform inside the glovebox that is within the working envelope of the Can Loading Robot. Weighing platform controller shall be located outside the glovebox.

Basis: To minimize equipment inside the glovebox, minimize maintenance inside the glovebox, and to reduce contaminated waste.

R-1.4.2B Puck weights shall be measured with a precision of 0.1% and an accuracy of 0.1%.

Basis: TBD

R-1.4.2C Puck height and diameter shall be measured using a laser based measurement instrument

Basis: Laser measurement of unsintered pucks is performed using this laser technique. An identical measurement system can be used here.

R-1.4.2C The can loading robot shall have 3 linear axes of motion, X, Y, Z. The robot X travel shall be 28 inches (HOLD), the Y travel shall be 60 inches (HOLD), and the Z travel shall be 36 inches (HOLD).

Basis: The can loading robot must be able to reach the pucks on ether puck transfer tray and place pucks in the 30 in long uncut puck can.

R-1.4.2D The can loading robot shall have each motion of axis (joint) repeatable to +/- 0.010 inches (HOLD).

Basis: The robot needs this repeatability to complete the required tasks.

R-1.4.2E The can loading robot shall have position feed back on each joint with an accuracy of +/- 0.001 inches (HOLD).

Basis: The robot needs this accuracy to complete the required tasks.

R-1.4.2F The can loading robot shall have payload of 30 pounds (HOLD).

Basis: The robot may lift a full puck can.

R-1.4.2G The puck lifting tool shall use a vacuum cup with a maintained vacuum to grab the sintered pucks from the top.

Basis: Prototype testing.

R-1.4.2H The puck lifting tool shall be 40 inches (HOLD) long.

Basis: Prototype testing.

R-1.4.2I The puck lifting tool shall be hollow to contain the vacuum cup air hoses.

Basis: Prototype testing.

R-1.4.2J The puck lifting tool shall be compatible with the can loading robot gripper. The vacuum cup air hose connection shall be made at the gripper and lifting tool interface.

Basis: Prototype testing.

R-1.4.2K The puck lifting tool vacuum cup shall have a smaller diameter than the sintered pucks. The sintered puck nominal diameter is 2.65 inches (HOLD).

Basis: Prototype testing.

R-1.4.2L The vision system shall use a standard CCD camera mounted above the tray lifters outside the glovebox.

Basis: Prototype testing showed this location worked to find the puck centers when the puck is on the puck transfer tray.

R-1.4.2M The vision system shall use a standard CCD camera mounted below and outside the can loading glovebox.

Basis: Prototype testing showed this location worked to find the puck centers when the puck is on the puck lifting tool.

R-1.4.2N The helium hood shall be designed so the can loading robot gripper can grab the helium hood.

Basis: Prototype can loading robot experience.

R-1.4.2O The reject can cutter in the can loading glovebox shall be a rotating pipe cutter.

Basis: TBD

1.4.3 BAGLESS TRANSFER SUBSYSTEM

R-1.4.3A The sphincter seal shall be made from TBD and shall use 6 (HOLD) seal layers. Each layer shall be 8 inches (HOLD) in diameter, have a 2.5 inch (HOLD) diameter hole in the center, and be 0.125 inches (HOLD) thick. Each layer shall be spaced 0.25 inches (HOLD) from the next layer.

Basis: FB-Line bagless transfer experience.

R-1.4.3B The puck can welder shall be a TIG welder.

Basis: FB-Line bagless transfer experience.

R-1.4.3C The puck can cutter shall be a Tri-Tool (HOLD) pipe cutter.

Basis: FB-Line bagless transfer experience.

R-1.4.3D The puck can holder shall be made from 304 stainless steel (HOLD).

Basis: FB-Line bagless transfer experience.

1.4.4 CAN INSPECTION SUBSYSTEM

R-1.4.4A The can inspection robot shall have 6 axes (HOLD) of motion and a minimum 2 pound (HOLD) payload capacity.

Basis: Conceptual design.

R-1.4.4B The can inspection robot shall have continuous path motion control to allow fully controllable motion. This is required for alpha surveys.

Basis: Alpha surveys are performed at a fixed rate while maintaining alpha probe a fixed distance above can surface.

R-1.4.44C The can inspection robot shall have redundant systems to stop motion if the robot enters a near miss zone with gloves, windows, or walls. This can be robot software, light curtains, or other sensors.

Basis: Conceptual design.

R-1.4.4D The leak detection chamber shall be made from 304 stainless steel.

Basis: Stainless steel is easier to decontaminate than other metals.

1.4.5 PUCK CAN TRANSPORT SUBSYSTEM

R-1.4.5A The puck can transport system shall be made from 304 stainless steel.

Basis: Stainless steel is easier to decontaminate than other metals.

R-1.4.5B The puck can robot shall be hold the puck can in the can inspection robot envelope so the can inspection robot can survey the top and bottom can sections.

Basis: Conceptual design.

2.0 DESIGN DESCRIPTION

The Can Loading System consists of a single process line with a Can Loading glovebox and a Bagless Transfer enclosure containing two identical bagless transfer systems. Puck transfer trays of sintered pucks enter the Can Loading glovebox and are presented to the Can Loading robot at two adjacent tray lift stations. The Can Loading robot removes the pucks from the puck transfer tray in either location. The Can Loading robot places twenty pucks in a puck can and places the helium hood over the puck can. The helium hood replaces the air in the can with helium and inserts the hollow plug. The bagless transfer system welds the plug to the puck can wall and cuts the can in the weld area. This cut separates the can from the stub. The can inspection robot surveys the can exterior and the puck can robot places the acceptable can in a leak detection chamber. Once the leak check is complete, the puck can robot places the acceptable can on the puck can transfer pallet carried by the puck can transport system. The puck can transport system moves the puck can to the facility material transport system.

WSRC and LLNL developed and tested a prototype can loading system under the PIP Development and Testing Plan. The design description in this document is based on the can loading D&T efforts.

2.1 DETAILED DESIGN DESCRIPTION

The Can Loading System consists of two identical process lines. Each line incorporates the following components:

- 1 Puck Transfer Tray Transport System
- 2 Tray Lifters
- 1 Puck Inspection Station
- 1 Can Loading Robot
- 1 Puck Lifting Tool
- 1 Vision System
- 1 Helium Hood
- 1 Reject Can Cutter

- 2 Sphincter Seals
- 2 Puck Can Welders
- 2 Puck Can Cutters
- 2 Puck Can Holders
- 1 Can Inspection Robot
- 1 Puck Can Robot
- 1 Leak Detection Chamber
- 1 Puck Can transport system

A puck transfer tray of pucks enters the Can Loading glovebox on the puck transfer tray transport system and a tray lift station lifts the tray from the transport system cart. The Can Loading robot uses a vision system to find the pucks and a puck lifting tool to remove the pucks from the tray. Pucks are then moved to the Puck Inspection Station where they are individually weighed on a scale and dimensionally measured using a laser based measurement system. The can loading robot loads the pucks into an available puck can. The puck transfer tray transport system moves the empty tray from the tray lift station to the elevator. The Can Loading robot can remove pucks from trays at two different lift stations. The cart can move one tray under a second tray at a lift station. This will allow the system to load pucks while the cart removes an empty tray and brings a new tray to the tray lift system.

The Can Loading robot places the helium hood over the can plug. The helium hood then grabs the can plug using a vacuum cup. The Can Loading robot places the helium hood over the full puck can in the sphincter seal, that was just filled with pucks, and the helium hood seals to the can via an inflatable seal. The helium hood removes the air from the can, fills the can with helium, and inserts the plug into the can. The bagless transfer system uses the puck can welder to weld the plug to the can wall, and the puck can cutter to cut the can and plug leaving the can stub in the sphincter seal.

The bagless transfer puck can holder lowers the can under the glovebox and the can inspection robot surveys the middle section of the can exterior. After the survey is complete, the puck can robot grabs the puck can in the middle section, removes the can from the bagless transfer puck can holder, and presents it to the puck can inspection robot. The can inspection robot surveys the top and bottom portions of the can exterior.

If the can exterior is free of contamination, the puck can robot places the can in the leak detection chamber to ensure the weld is leak tight. If the leak test is successful, the puck can robot places the acceptable can in a puck can transfer pallet on the puck can transport system and the can leaves the bagless transfer enclosure.

Empty new cans, manually pre-loaded with plugs, are placed in a holder external to the bagless transfer enclosure. The puck can transport system brings the pallet of cans to the bagless transfer enclosure. The puck can robot removes the cans from the puck can pallet and places them in storage areas. The puck can robot moves an empty new can from storage into the bagless transfer puck can holder and then the bagless transfer system raises the can. The previous can stub is pushed by the new can into the Can Loading glovebox and the Can Loading robot places the stub in a special waste tray. The waste tray with can stub leave the loading glovebox using the puck transfer tray transport system cart. The stub is taken to the elevator and then to the waste handling glovebox. The Can Loading robot removes the plug from the new can and the loading process resumes.

The following paragraphs describe the Can Loading error recovery processes, which should be infrequent. The control system use cameras and welder feedback to determine can weld failures during the bagless transfer process. The bagless transfer machine pushes cans that experience weld failures up into the sphincter seal exposing the top 3 inches of the can above the sphincter seal. The reject can cutter moves over the exposed can and the reject can cutter cuts the can open near the top. This cut is in the void space (approximately 0.5") above the pucks. The Can Loading robot removes the can top, the reject can cutter moves away, and the Can Loading Robot removes pucks from the damaged can. The bagless transfer puck can holder pushes the empty failed can up into the sphincter seal. The puck can robot places an empty can in the bagless transfer puck can holder and the puck can holder uses the empty can to push the failed can into the Can Loading glovebox. Cut can pieces or stubs are handled as waste using the special waste tray. The waste tray is sent to the waste handling glovebox. These items have sharp edges and require special handling procedures if they are manually processed. Operators manually perform any system maintenance including sphincter seal replacement.

The puck can robot places cans that fail the leak check in the bagless transfer puck can holder. The Can Loading robot processes these reject cans in a similar manner as the weld failure cans described above.

2.2 SYSTEM PERFORMANCE

The Can Loading System shall be able produce 8 puck cans per day (HOLD). The average daily throughput, based on the DOCDR annual material balance and 200 days/year operation, is 8 cans (HOLD) per day.

2.3 SYSTEM ARRANGEMENT

The current PIP Can Loading concept is one glovebox line consisting of a Can Loading glovebox and a Bagless Transfer enclosure. Figure 2.3-1 shows the Can Loading conceptual elevation, and Figure 2.3-2 shows the conceptual plan view. Figure 2.3-3 shows a 3-D view of the Can Loading concept.

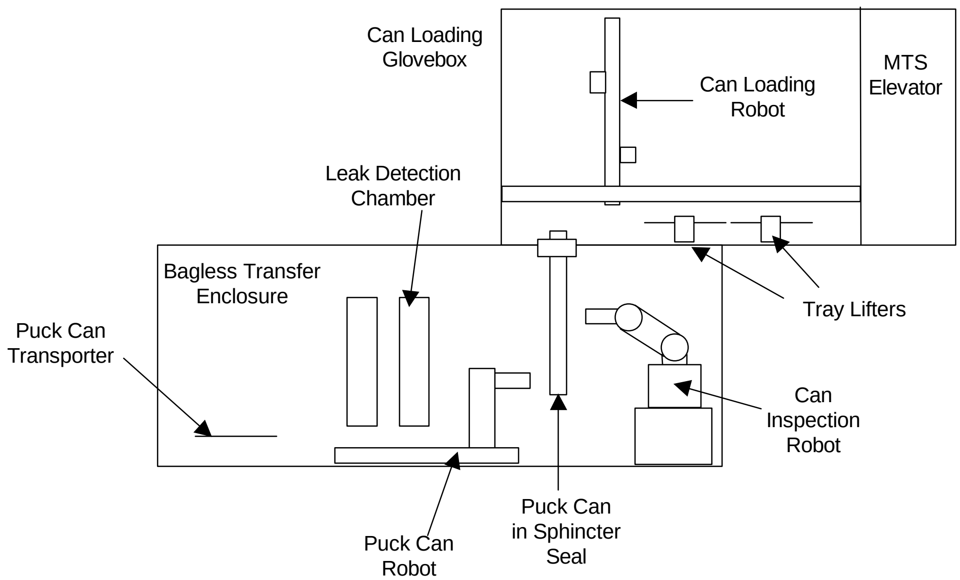

Figure 2.3-1. Conceptual Elevation View of Can Loading System

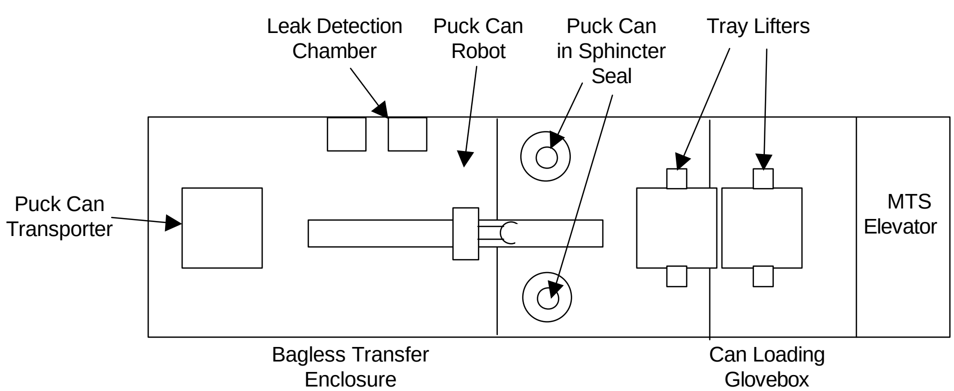

Figure 2.3-2. Conceptual Plan View of Can Loading System

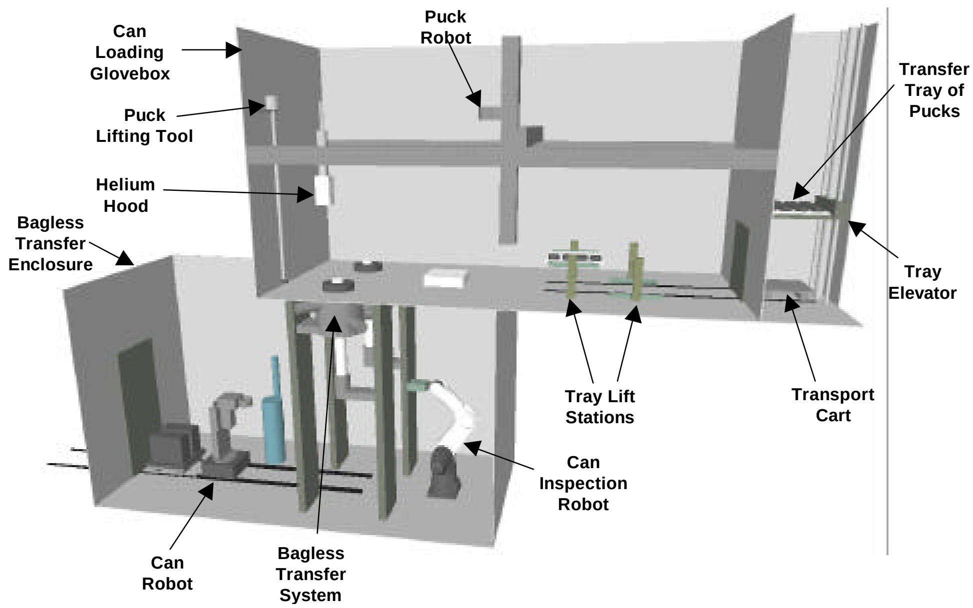

Figure 2.3-3. Conceptual 3-D View of Can Loading System

The Can Loading Glovebox contains the puck transfer tray transport system, tray lifters, Can Loading robot, helium hood, reject can cutter, puck inspection station, puck laser dimensional measurement station, and puck lifting tool. The Bagless Transfer Enclosure contains the sphincter seal, bagless transfer system, can inspection robot, puck can robot, leak detection chamber, and the puck can transfer pallet transport system.

2.4 SUBSYSTEM/COMPONENT DESIGN DESCRIPTION

2.4.1 TRAY TRANSFER SUBSYSTEM

The tray transfer subsystem includes the following components: the tray transporter and the tray lifters. The system shall perform the following tasks:

1) The tray transporter must receive a puck transfer tray loaded with pucks from the elevator and move the tray into the can loading glovebox. This includes passing through an automated seal door.

2) The tray lifters must raise the puck transfer tray off the transporter and hold the tray while the robot loads the pucks into the puck can.

3) The system must move empty puck transfer trays from the lift stations back to the elevator.

4) A special waste tray must also be handled identically to the puck transfer tray.

The baseline requirements for the puck transfer tray transport subsystem are to move 30 pound loads between the elevator and the tray lift stations, lift 30 pound loads, be simple to decontaminate, pass through airlock doors, provide ease of maintenance, and minimizing the equipment inside the glovebox.

The puck transfer tray transport cart design includes permanently mounted rails on the workcell floor, an eight-wheeled cart, rare earth magnets mounted to the cart bottom, and a drive system mounted below the workcell floor that moves rare earth magnets parallel to the cart rails. The magnets on the drive system (or linear synchronous motor) attract the magnets mounted under the cart and move the cart along the rails. This allows most of the moving and complex parts to be located outside the contaminated environment. Each lift station design includes two linear actuators mounted vertically, a face to face magnetically coupled shaft, and motors mounted below the workcell floor. The magnetically coupled shaft transfers shaft rotation from below the workcell floor into the workcell without a floor penetration or seals. Each tray lifter has a lifting fixture that will grab the puck transfer tray edges. The actuators move simultaneously so the tray is kept in the horizontal orientation during the entire move. The tray lifters raise the puck transfer tray high enough to allow a tray with pucks to pass under the tray.

The cart and lift control system includes a four axis commercial motion controller driving amplifiers coupled to stepping motors. The cart position resolution is 15,244 (HOLD) steps per inch and the tray lifter resolution is 125,000 (HOLD) steps per inch. Magnetic switches provide end of travel limits and a home sensor for the cart actuator. The lift actuators use absolute encoders for position sensors, so switches are not required. The cart and lift controls are in a single enclosure mounted with the Can Loading robot control enclosure. The interface between the cart and lift controller and the robot controller is described in the following section. The cart and lift control system is linked to the robot emergency stop circuit.

The puck transfer tray cart position repeatability is +/- 0.002 inches (HOLD) and the tray lifter repeatability is +/- 0.001 (HOLD). The maximum puck transfer tray cart acceleration is 28 inches/sec/sec (HOLD) and the maximum cart velocity is 45 inches/sec (HOLD). The magnetic coupling requires 40 pounds (HOLD) of force to decouple the cart.

2.4.2 CAN LOADING SUBSYSTEM

The Can Loading Subsystem includes the following components: the can loading robot, puck lifting tool, vision system helium hood, and reject can cutter. The system shall perform the following tasks:

1) The robot must move the helium hood over a new puck can so the hood can remove the hollow plug from the can.

2) The robot must remove the helium hood and place it in the hood holder.

3) The robot must pick up the puck lifting tool.

4) The robot must locate a puck center on the transfer tray using the overhead vision system.

5) The robot must retrieve the located puck with the lifting tool, then place the puck on a scale for weighing.

6) The robot must then move the puck to a dimensional measurement station so that puck thickness can be determined. This step may be eliminated if the thickness measurement is incorporated at the weigh point.

7) The robot must then pick up the puck and use the upward looking vision system to determine puck center-to-tool center offset.

8) Using this offset, the robot must accurately place the puck into the puck can.

9) The fourth through eight steps must be repeated until 20 pucks are loaded into the puck can.

10) The robot must place the helium hood on the puck can.

11) The robot must handle the can stubs when the bagless transfer system ejects them into the Can Loading glovebox.

12) The robot must handle any reject puck cans from the bagless transfer enclosure.

13) The robot must handle a fully loaded reject can in case of a can opening failure.

The baseline requirements for the Can Loading robot are to grab and lift 1 pound (HOLD) pucks, insert pucks into a puck can (puck OD 2.75 inch (HOLD) max, can ID 2.88 inch (HOLD) min), handle can stubs (3.00 inch (HOLD) OD, 10 inches (HOLD) long, approximately 2 lbs. (HOLD)), handle reject cans (3.00 inch (HOLD) OD, approximately 21 inches (HOLD) long, approximately 25 lbs. (HOLD)), and maneuver the Helium Hood (dimensions and weight TBD). A prototype Can Loading robot was purchased as part of the D&T module 6.6 development work and is shown in Figure TBD. The procurement specification and the vendor mechanical prints are in Reference A.2.6.

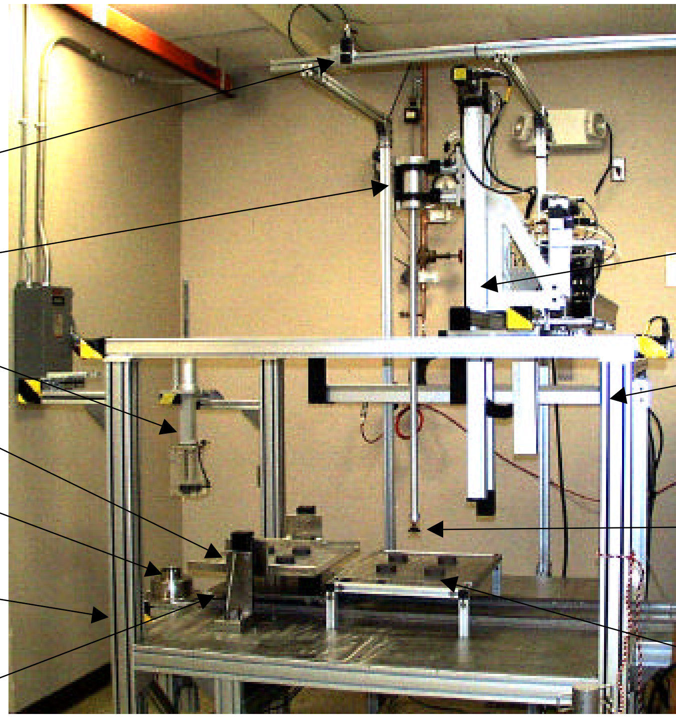

Figure 2.4.2-1. Can Loading Robot (D&T Module 6.6)

The robot design includes three linear axes of motion and a gripper. The first axis provides approximately 52 inches (HOLD) of motion in the X direction, the second axis provides approximately 40 inches (HOLD) of motion in the Y direction, and the third axis provides approximately 40 inches (HOLD) of motion in the Z or vertical direction. A brushless DC servomotor drives each axis and an encoder provides position feedback. An industrial computer running Windows NT®, Steeplechase®, and Citect® controls the system and provides an operator interface. The control computer also runs the pneumatic gripper and vacuum system. The gripper is designed to grab 3 inch (HOLD) OD objects. This allows the gripper to hold bagless transfer can stubs, reject puck cans, and various tools. Motionex provided a puck lifting tool that allows the robot to move pucks from the transfer trays into the puck can, see Attachment 2. The lifting tool is made from three parts, a suction cup, a 40 inch (HOLD) hollow pipe, and lifting fixture. The suction cup allows the tool to lift the pucks from the top surface and provides a little compliance due to the flexible cup material. This is an advantage since the total puck to can clearance is approximately 0.13 inches (HOLD). The vacuum line runs up the hollow pipe to a fitting on the lifting fixture. The mating fitting is on the gripper and the two are joined when the gripper closes on the tool lifting fixture. The lifting fixture is 3 inches (HOLD) in diameter where the gripper grabs the tool and it has a larger diameter flange above and below this area. The flanges prevent the tool from moving when the gripper is closed on the tool.

The Helium hood must perform the following tasks:

1) The hood will remove the plug from a new can.

2) The hood will grab the can plug with a vacuum cup.

3) The Can Loading robot will place the hood on the puck can.

4) The helium hood will seal to the puck can and pull a vacuum on the puck can.

5) The hood will insert helium into the can.

6) The hood will place the can plug into the can.

The baseline requirements for the Helium Hood are to remotely seal to the puck can, pull a vacuum to 20 inches (HOLD) of Mercury, fill the puck cans with 3 psig (HOLD) of Helium, and detect the plug vertical position in the puck can to +/- 0.05 inches (HOLD). The hood must be compatible with the Can Loading robot gripper to allow the robot to position it over the puck can.

The prototype Helium hood design includes an inflatable seal to make the seal to the puck can, a Plexiglas chamber for viewing demonstrations, and a taper below the inflatable seal to facilitate puck can alignment. Figure B shows the Helium hood test stand. The test stand actuators move the hood over the puck can and lower it onto the can. The inflatable seal is inflated and a vacuum is pulled to 20 inches of Mercury. Air is pumped in the chamber to 3 psi. since Helium is not available. The hollow rod actuator holds the plug in the chamber with a vacuum cup, inserts the plug in the can, and releases the plug.

The Can loading robot vision system must perform the following tasks:

1) Identify pucks on the puck transfer trays using the overhead camera.

2) Find each puck's center.

3) Convert puck centers into robot coordinates

4) Send the robot coordinates to the robot controller.

5) Find the puck center using the upward looking camera.

6) Calculate the offset between the puck center and the puck lifting tool center.

7) Convert the offset to robot coordinates.

8) Send the robot coordinates to the robot controller.

The baseline requirements for the vision system are to use standard commercial equipment, be accurate to +/- 0.2 inches with the overhead camera when finding puck centers, be accurate to +/- 0.05 inches when finding the puck center with the upward looking camera, place cameras outside the Can Loading glovebox, and communicate with the robot controller.

The vision system design includes two standard CCD cameras (640 x 480, RS-170 output), a Matrox Pulsar video frame grabber, a Dell 333 MHz computer, Windows 98 operating system, software written in Microsoft Visual C++, and a serial communications link with the robot controller. Once the communications between the robot and vision system are established, the robot asks for a puck location. The vision system grabs an image of the puck trays, finds all the pucks, determines the puck centers, converts the puck center data to robot coordinates using a nonlinear correlation, and sends the coordinates to the robot. The robot then grabs a puck and moves it to the upward looking camera. The vision system determines the offset between the puck center and the puck lifting tool center point. The system converts this offset to robot coordinates and sends the coordinates to the robot. The robot the places the puck into the puck can and asks the vision system if any more pucks are available.

2.4.3 BAGLESS TRANSFER SUBSYSTEM

The Bagless Transfer Subsystem includes four identical units and each contains the following components: a sphincter seal, puck can welder, the puck can cutter, and puck can holder. The system shall perform the following tasks, which are shown in Figure 2.4.3-1:

1) The bagless transfer puck can holder raises a new can into the bottom of the glovebox, (step 1). The new can displaces the remaining portion of the previous can stub from the sphincter seal.

2) The pucks to be transferred are placed inside the can, (step 2).

3) A hollow plug is inserted into the can, (step 3).

4) Helium replaces the air inside the puck can, not shown in figure.

5) The can is fused to the hollow plug via a TIG welding process through the puck can wall, (step 3).

6) Cameras monitor the welding process to visually inspect the entire weld.

7) The puck can is then cut (using a roller wheel equipped pipe cutter) in the middle of the welded area, separating the can from the glovebox while maintaining the integrity of both, (step 4). The cut exposes the clean interior portion of the plug.

8) After cutting, the can upper portion (stub) remains in the sphincter seal to maintain glovebox integrity, and the bottom portion forms a leak-tight, all-metal, welded puck can, (step 5).

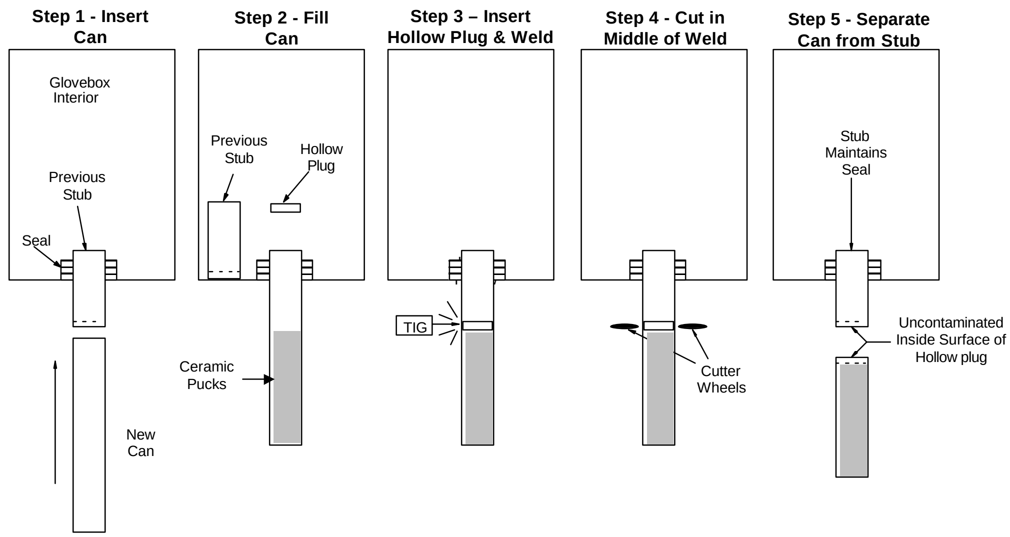

Figure 2.4.3-1. Bagless Transfer Process

2.4.4 CAN INSPECTION SUBSYSTEM

The Can Inspection Subsystem includes the following components: the can inspection robot and the alpha counter. The Can Inspection Subsystem shall perform the following tasks:

1) The can inspection robot will survey puck cans in the middle section while the puck can is in the puck can holder.

2) The can inspection robot will survey puck cans in the top and bottom section while the puck can robot hold the pucks can.

The can inspection robot maximum payload will be the 2 pound alpha detector. The can inspection robot requires a minimum of 6 degrees of freedom (DOF) (HOLD) and a gripper. The six DOFs allow the robot to maneuver the detector over the cylindrical can surface. The can inspection robot will need a minimum radial reach of 20 inches (HOLD). This will allow the robot to reach either puck can in the bagless transfer puck can holder. The can inspection robot requires repeatability of +/- 0.020 inches (HOLD) or less.

The gripper will hold the alpha detector. The can inspection robot and gripper parts will be fabricated from 304 stainless steel wherever possible and all moving parts will be covered where possible. If possible, the internal cavities will be slightly pressurized with nitrogen to help prevent contamination from entering the robot and gripper.

2.4.5 CAN HANDLING SUBSYSTEM

The Can Handling Subsystem includes the following components: puck can robot, leak detection chamber, and a puck can transporter. The Can Handling Subsystem shall perform the following tasks:

1) Load and unload puck cans in the bagless transfer can holder.

2) Present the puck cans to the can inspection robot so it is able to swipe the puck can top and bottom sections.

3) Load and unload cans in the leak detector.

4) Place puck cans on the puck can pallet on the puck can transport cart.

The puck can robot maximum payload will be the 25 pound (HOLD) fully loaded puck can. The puck can robot requires 4 degrees of freedom (DOF) (HOLD) and a gripper. The four DOFs allow the robot to load and unload puck cans at various stations. The robot must be able to reach all the can stations inside the bagless transfer enclosure. The puck can robot requires a repeatability of +/- 0.020 inches. A commercial robot of appropriate size is planned.

The gripper will hold 3 inch diameter puck cans. The puck can robot and gripper parts will be fabricated from 304 stainless steel wherever possible and all moving parts will be covered when possible. If possible, the internal cavities will be slightly pressurized to help prevent contamination from entering the robot and gripper.

2.4.6 INSTRUMENTATION AND CONTROL

2.4.6.1 Instrumentation and Control Architecture

The instrumentation and control system will be implemented with a supervisory system hierarchical architecture. The architecture will implement the following functions:

- A control room interactive console from which the operator can setup a batch run (that is, load 20 pucks into a puck can), initiate the run, monitor its progress and react to any abnormal conditions. The interactive console will provide the operator with a display of the current plant processing procedure, equipment status, alarm conditions, camera views, and trends of pertinent real-time or historical operating variables.
- Data handling including acquiring and archiving batch run information along with equipment parameters, vision system pictures, and process variables.
- Controlling the order and timing of the equipment tasks while imposing interlocks and granting permissives on mutually interdependent processes in the procedure.
- Automating the can loading process steps.
- Monitoring the process and generating alarms on abnormal conditions.
- Monitoring all MC&A data for cans, puck transfer trays, pucks, etc.

A Human Machine Interface (HMI) and Supervisory Control & Data Acquisition (SCADA) system will carry out the supervisory functions. The supervisory system software architecture depicted in Figure 2.5.1-1 shows how the HMI and SCADA capabilities are achieved via interconnects with a memory resident Real-time Database, the History and Event/alarm Log Files in a hard disk resident database management system, and the Supervisory Engine. The Supervisory Engine in turn accesses the key operating variable data registers in the process equipment front end processors via point-to-point and network software device servers to carry out the data acquisition, engineering unit scaling, event/alarm handling and historical trending.

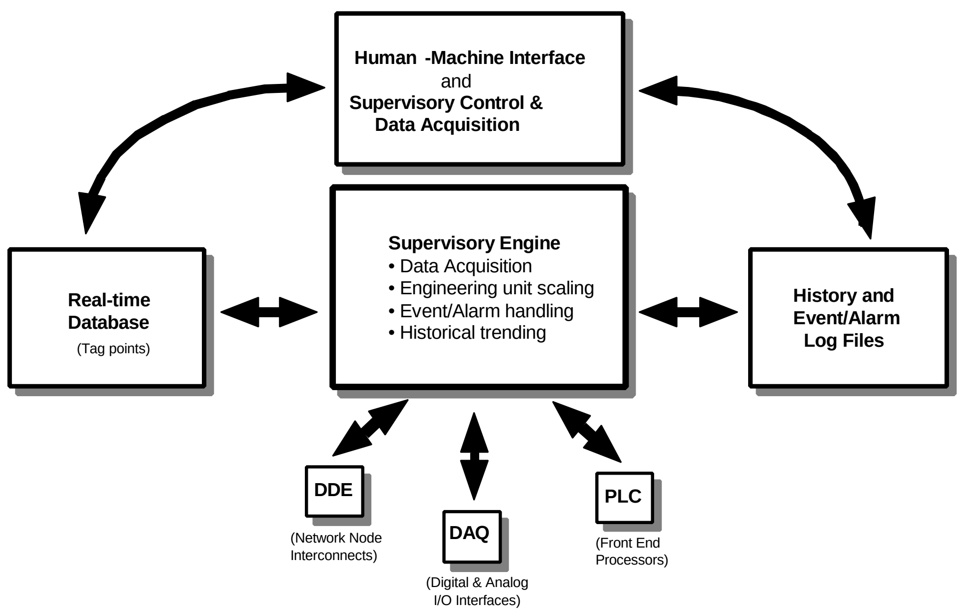

Figure 2.5.1-1. Can Loading Supervisory System Software Architecture

2.4.6.2 Can Loading Processing Sequence Control

The Supervisory Control System will direct the subsystem equipment in the Can Loading process batch run. The following is a sample of steps in this process:

1) Request puck transfer trays and record tray identification number.

2) Move puck transfer tray into can loading glovebox and record event.

3) Stop tray at one of two lift stations, raise tray, and record event.

4) Ask vision to find puck locations and record image.

5) Grab first puck , weigh, and measure thickness. Record these values.

6) Using the upward looking vision system, ask vision system to determine puck location, adjust robot position, recheck puck location, and record offsets and image.

7) Load puck into puck can and record event. During loading, ensure that total puck stack height is within maximum allowable limit.

A typical step is made up of a sequence of sub-steps; for example, the operation of moving a tray into the can loading glovebox involves the following sub-steps:

A) Verify the puck transfer tray transport cart is in the elevator position.

B) Lower the elevator and verify it is in the down position.

C) Open the first airlock door and verify it is open.

D) Move the tray transport cart into the air lock and verify it got there.

E) Close the airlock door and verify it is closed.

F) Open the second airlock door and verify it is open.

G) Move the transfer tray into the Can Loading glovebox and verify it got in.

H) Close the air lock door and verify it is closed.

2.4.6.3 Interlocks and Permissives

Equipment operation is usually dependent on the state of adjacent equipment in the processing line; for example, the can loading robot can not load pucks into the puck can until it receives a permissive indicating the tray lifter has a puck transfer tray in the up position, a puck is available, and there is space in the can for a puck.

During testing or maintenance activities where control has been transferred to the field remote control panel and adjacent equipment is off-line, there will be instances where it will be necessary to have interlock over-rides.

3.0 OPERATION

3.1 PRINCIPLES OF OPERATION

The Can Loading Subsystem will receive puck transfer trays containing 16 (HOLD) sintered pucks. The puck transfer trays are (TBD) inches by (TBD) inches. The pucks are in a (TBD) by (TBD) array. The pucks will vary in height from (TBD) inches to (TBD) inches and vary in diameter from 2.4 (HOLD) inches to 2.75 inches (HOLD). The pucks will not be in precise locations on the transport trays. The Can Loading Subsystem will remove each sintered puck from the transport tray, weigh and dimensionally measure each puck, assure that the puck will fit in a can and load the pucks into a puck can. The puck can will have an outside diameter of 3.00 inches, an internal diameter of 2.88 inches (HOLD) and be approximately 20 inches (HOLD) long. The system will stack pucks in the can until the can is filled to a height leaving room for less than one additional puck (nominally 20 pucks). The can will be evacuated and filled with 3 psig (HOLD) helium to ensure an atmosphere of 50% helium (HOLD) is in the puck can when it is seal welded. The can will be surveyed for contamination. If the can is contamination free, it will be leak tested for a gross leak and (TBD) atmospheric cc/sec of helium. The puck can will then be placed on the puck can transfer pallet transport system for transport to the facility material transport system. The Can Loading subsystem will produce 8 cans per day (HOLD) standard rate and (125% TBD) cans per day surge rate for 200 days per year. The cans will then be transported out of the Can Loading subsystem.

3.2 SYSTEM STARTUP, NORMAL OPERATIONS AND SHUTDOWN

The Can Loading System startup will include energizing all components, performing any required calibrations, and running all diagnostic tests. The system will be placed in a ready and waiting state once the startup procedure is complete. Normal operations will be ignited by events or commands from the PIP supervisor control system and executed automatically. An example event is a tray of pucks arrives at the Can Loading glovebox.

System shutdown will be initiated by the PIP supervisor control system or by a local operator. The Can Loading System control panel shall have a keyed Emergency Stop switch. This switch shall de-energize all Can Loading System items inside the glovebox including motors, drives, solenoids, and sensors. All items shall fail to a safe state when the Emergency Stop is activated or power is lost.

The Can Loading System control system shall interface closely with the PIP supervisory system for MC&A, material transport, and security. CCTVs will be used to monitor the material transfer operations remotely. Before the system is shutdown, it is required to return all actuators to a safe position using the routine commands of automatic mode.

3.2.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

During normal operations the Can Loading System supervisory control system shall send commands to the Puck Transfer Tray Transport Subsystem. The Puck Transfer Tray Transport Subsystem shall acknowledge these commands, execute the commands, and report status to the supervisory system upon completion. The Puck Transfer Tray Transport Subsystem shall also respond to supervisory status inquiries and halt commands at any time.

The Puck Transfer Tray Transport Subsystem shutdown process shall include stopping the current operations in a safe manner, operating the system to a safe condition, and de-energizing all motors, drives, and sensors. The Puck Transfer Tray Transport Subsystem control computer shall be left on in the shutdown mode. The Puck Transfer Tray Transport Subsystem control computer shall still respond to the supervisory computer system requests for status.

3.2.2 CAN LOADING SUBSYSTEM

During normal operations the Can Loading System supervisory control system shall send commands to the Can Loading Robot. The Can Loading Robot shall acknowledge these commands, execute the commands, and report status to the supervisory system upon completion. The Can Loading Robot shall also respond to supervisory status inquiries and halt commands at any time.

The Can Loading Robot shutdown process shall include stopping the current operations in a safe manner, operating the system to a safe condition (i.e. placing the current puck in the puck can and returning the puck lifting tool), and de-energizing all motors, drives, and sensors. The Can Loading Robot control computer shall be left on in the shutdown mode. The Can Loading Robot control computer shall still respond to the supervisory computer system requests for status.

3.2.3 BAGLESS TRANSFER SUBSYSTEM

The Bagless Transfer startup process shall include energizing motors, drives, and sensors. The control software shall activate any self test or diagnostic functions, determine current state of the cycle, and then enter a ready and waiting state.

During normal operations the Can Loading System supervisory control system shall send commands to the Bagless Transfer. The Bagless Transfer shall acknowledge these commands, execute the commands, and report status to the supervisory system upon completion. The Bagless Transfer shall also respond to supervisory status inquiries and halt commands at any time.

The Bagless Transfer shutdown process shall include stopping the current operations in a safe manner, operating the system to a safe condition, and de-energizing all motors, drives, and sensors. The Bagless Transfer control computer shall be left on in the shutdown mode. The Bagless Transfer control computer shall still respond to the supervisory computer system requests for status.

3.2.4 CAN INSPECTION SUBSYSTEM

During normal operations the Can Loading System supervisory control system shall send commands to the can inspection robot. The can inspection robot shall acknowledge these commands, execute the commands, and report status to the supervisory system upon completion. The can inspection robot shall also respond to supervisory status inquiries and halt commands at any time.

The Can Swiping shutdown process shall include stopping the current operations in a safe manner, operating the system to a safe condition, and de-energizing all motors, drives, and sensors. The Can Swiping control computer shall be left on in the shutdown mode. The Can Swiping control computer shall still respond to the supervisory computer system requests for status.

3.2.5 CAN HANDLING SUBSYSTEM

During normal operations the Can Loading System supervisory control system shall send commands to the puck can robot. The puck can robot shall acknowledge these commands, execute the commands, and report status to the supervisory system upon completion. The puck can robot shall also respond to supervisory status inquiries and halt commands at any time.

The Can Handling shutdown process shall include stopping the current operations in a safe manner, operating the system to a safe condition, and de-energizing all motors, drives, and sensors. The Can Handling control computer shall be left on in the shutdown mode. The Can Handling control computer shall still respond to the supervisory computer system requests for status.

4.0 SET-POINTS, SYSTEM LIMITATIONS, AND PRECAUTIONS

4.1 SYSTEM LIMITATIONS AND PRECAUTIONS

4.1.1 LIMITING CONDITIONS FOR OPERATIONS

The Can Loading System is operated with the Building TBD Concept of Operations, as described in the Facility Design Description (FDD), Section TBD (Reference TBD). The Can Loading System is operated and maintained in accordance with the Limiting Conditions for Operations (LCOs) and Administration Controls (AC) as defined in the FDD, Section TBD, Operating Conditions (Reference TBD). The Can Loading System is operated in accordance with the limitations and precautions specified below to ensure safe operation of the Can Loading System and interfacing systems.

4.1.1.1 Puck Transfer Tray Transport Subsystem

All actuators shall have limit switches and mechanical stops to prevent overruns and collisions. In addition, all motors shall have current limits to protect motors from over loading. Unless position set points or limit switches are satisfied, the control system will not proceed to the next step.

4.1.1.2 Can Loading Subsystem

All actuators shall have limit switches and mechanical stops to prevent overruns and collisions. In addition, all motors shall have current limits to protect motors from over loading. Valve actuators shall have limit switches to verify if valves are fully closed or opened before continuing to the next step. Unless position set points, limit switches, and can loading robot limitations are satisfied then the control system will not proceed to the next step. Puck weighing and dimensional measurements shall have an acceptability range depending upon sintered puck characteristics (**TBD**).

4.1.1.3 Bagless Transfer Subsystem

All actuators shall have limit switches and mechanical stops to prevent overruns and collisions. In addition, all motors shall have current limits to protect motors from over loading. Valve actuators shall have limit switches to verify if valves are fully closed or opened before continuing to the next step. Unless position set points, limit switches, puck can welder limitations, and puck can cutter are satisfied, the control system will not proceed to the next step.

4.1.1.4 Can Inspection Subsystem

All actuators shall have limit switches and mechanical stops to prevent overruns and collisions. In addition, all motors shall have current limits to protect motors from over loading. Unless position set points, limit switches, and puck can inspection robot limitations are satisfied, the control system will not proceed to the next step.

4.1.1.5 Can Handling Subsystem

All actuators shall have limit switches and mechanical stops to prevent overruns and collisions. In addition, all motors shall have current limits to protect motors from over loading. Unless position set points, limit switches, and puck can robot limitations are satisfied then the control system will not proceed to the next step.

4.2 SET-POINTS AND ALARMS

Instrument set points for alarms and interlocks are specified in the TBD Instrument Index/Set Point List (Reference TBD).

5.0 SYSTEM UPSETS AND RECOVERY PROCEDURES

It will be necessary to provide means for detecting abnormal equipment/operating conditions, and in certain situations, procedures for automatically overcoming these conditions.

Upset events are abnormal Can Loading System conditions which could affect the safe and functional operation of the system, or produce system degradation, and which will require corrective action to restore the system to a safe and orderly condition. Mitigation of these events is accomplished either by design features of the Can Loading System and/or by administrative controls to prevent or correct the event. In this section, the major anticipated Can Loading System upset events are described (Section 5.1), followed by a description of the design features intended to mitigate these events (Section 5.2), and then outlines of the recovery procedures to be followed by operations personnel (Section 5.3).

5.1 UPSET EVENTS

5.1.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

The Tray Transfer Subsystem upset events include a collision with other equipment and (TBD).

5.1.2 CAN LOADING SUBSYSTEM

The Can Loading Robot upset events include a dropped tool, dropped puck, helium hood leak, dropped hollow plug, a robot collision with other equipment, robot failure, and (TBD).

The Can Loading vision system shall reject abnormal sintered pucks and they will be sent back for recycling.

5.1.3 BAGLESS TRANSFER SUBSYSTEM

The Bagless Transfer upset events include a weld failure, cutting failure, sphincter seal leak, contaminated puck can, damaged puck can, and (TBD).

Failed cans are cut open with the reject can cutter, the can loading robot removes the pucks, and the can is sent to the waste handling glovebox.

5.1.4 CAN INSPECTION SUBSYSTEM

The Can Swiping upset events include a robot failure, robot collision with other equipment, and (TBD).

The puck can inspection subsystem shall reject puck cans that have external contamination and send them to the can loading glovebox. These cans are cut open with the reject can cutter, the can loading robot removes the pucks, and the can is sent to the waste handling glovebox.

The puck can leak detector shall reject puck cans that are not sealed properly. These cans are sent to the can loading glovebox. These cans are cut open with the reject can cutter, the can loading robot removes the pucks, and the can is sent to the waste handling glovebox.

5.1.5 CAN HANDLING SUBSYSTEM

The Can Handling upset events include a dropped puck can, a leaking puck can, a robot failure, robot collision with other equipment, and (TBD).

5.2 DESIGN FEATURES TO MITIGATE EFFECTS OF UPSET EVENTS

5.2.1 TRAY TRANSFER SUBSYSTEM

TBD

5.2.2 CAN LOADING SUBSYSTEM

TBD

5.2.3 BAGLESS TRANSFER SUBSYSTEM

TBD

5.2.4 CAN INSPECTION SUBSYSTEM

TBD

5.2.5 CAN HANDLING SUBSYSTEM

TBD

5.3 RECOVERY PROCEDURES

5.3.1 PUCK TRANSFER TRAY TRANSPORTSUBSYSTEM

When the Puck Transfer Tray Transport Subsystem experiences a system upset during the program mode, the Tray Transport system will stop in place, alert the operator, and wait on operator intervention.

5.3.2 CAN LOADING SUBSYSTEM

TBD

5.3.3 BAGLESS TRANSFER SUBSYSTEM

The following describes the Bagless Transfer weld failure error recovery processes, which should be infrequent. Operators will use cameras and welder feedback to determine can weld failures during the bagless transfer process. The bagless transfer machine will push cans that experience weld failures up into the sphincter seal exposing the top 3 inches of the can above the sphincter seal. The reject can cutter in the can loading glovebox will move over the exposed can and the can cutter will cut the can open near the top. This cut will be in the void space (approximately 0.5") above the pucks. The Can Loading robot will remove the can top (stub), the can cutter will move away, and the Can Loading Robot will remove pucks from the damaged can. The bagless transfer puck can holder will push the empty failed can up further into the sphincter seal. This allows the puck can robot room to place a new empty can in the bagless transfer puck can holder. The puck can robot will place an empty can in the bagless transfer puck can holder and the puck can holder will use the empty can to push the failed can into the Can Loading glovebox. The transfer carts will remove all pucks and support frames of cut can pieces from the Can Loading glovebox and all loaded cans from the bagless transfer enclosure. The cut can pieces and any can stubs will be sent to the waste handling glovebox. These items will have sharp edges and will require special handling procedures if they are manually processed. Operators will manually perform any system maintenance including sphincter seal replacement.

5.3.4 CAN INSPECTION SUBSYSTEM

The following describes the contaminated puck can error recovery. The can inspection subsystem will alert the control room when a can fails the survey. If the can fails the survey, the puck can robot will place it in the bagless transfer puck can holder. The bagless transfer puck can holder will push the failed can up into the sphincter seal and this will push the stub into the Can Loading glovebox. The Can Loading robot will place the stub in a support frame on an empty tray and the puck can robot will load a new can into the bagless transfer puck can holder. The bagless transfer puck can holder will continue to push the failed can further into the sphincter seal exposing the top 3 inches of the can above the sphincter seal. The Can Loading robot will process these reject cans in a similar manner as the weld failure cans described in section 5.3.3.

5.3.5 CAN HANDLING SUBSYSTEM

The following describes the Can Handling leaking puck can error recovery. The puck can robot will place cans that fail the leak check in the bagless transfer puck can holder. The bagless transfer puck can holder will push the failed can up into the sphincter seal and this will push a stub into the Can Loading glovebox. The Can Loading robot will place the stub on an empty tray and the puck can robot will load a new can into the bagless transfer puck can holder. The bagless transfer puck can holder will push the failed can into the sphincter seal exposing the top 3 inches of the can above the sphincter seal. The Can Loading robot will process these reject cans in a similar manner as the weld failure cans described in Section 5.3.3.

6.0 MAINTENANCE

This section defines the maintenance approach for the Can Loading System. This section provides maintenance procedure outlines for preventive and corrective maintenance, and identifies in-service inspections and surveillance only for those unique situations created by Can Loading System. The facility maintenance, in-service inspection and surveillance procedures will be modified to encompass the new SSCs which are not unique.

6.1 MAINTENANCE APPROACH

The SRS Plant maintenance philosophy is to construct gloveboxes so that there is an operation side and a maintenance side. Typically these sides would be separated into two (2) separate rooms by a floor-to-ceiling partition. Usually the operation side is more heavily shielded than the maintenance side, based on two points. The first point is more man-hours are spent on the operation side performing process checks and rounds than on the maintenance side. The second point is the radioactive material would be removed from the area before actual equipment maintenance is done. This permits reduced shielding on the maintenance side, which usually makes the equipment more accessible. Most of the equipment envisioned for the Can Loading System is compatible with this philosophy as discussed below.

Maintenance activities may be performed during the following three modes of operation provided the specified conditions are satisfied:

- Operation Mode
- Standby Mode (ready and waiting for inputs)
- Open-Glovebox Maintenance Mode

In addition, the proper balance of Preventive Maintenance (PM) and Corrective Maintenance (CM) activities provide a high degree of confidence that facility systems function as designed, personnel safety is enhanced, equipment degradation is identified and corrected, equipment life is optimized, and the Maintenance Program is cost effective.

The preventative maintenance shall include periodic glovebox cleaning. This will remove the small puck pieces that accumulate in the glovebox and thus reduce the radiation sources. The source reduction is consistent with SRS ALARA practices.

The following describes the specific maintenance approach for the Can Loading System. These items are in addition to the approach described in the FDD.

6.1.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

The Puck Transfer Tray Transport Subsystem shall be designed so that most components are outside the glovebox so they remain contamination free and maintenance will be “hands on”. The components inside the glovebox shall be maintained by personnel using gloveports. A modular design concept is required for easy assembly and maintenance of the system. The modules shall be joined using large fasteners and guide pins. For example, each lift station module includes a fixture to hold the tray, an actuator, and support stand. This lift station module shall be joined to the glovebox using guide pins and large fasteners, see reference A.7.4. This will allow the module to be replaced easily via the gloveports. All critical and sensitive hardware shall be placed outside the enclosure to eliminate complex maintenance operation in the glovebox. The best possible materials and commercial components shall be selected and used to reduce the maintenance frequency.

The positioning systems shall be designed so the position calibration can be verified from outside the glovebox. For example, the cart and rail are marked and these marks align when the cart is at position zero.

6.1.2 CAN LOADING SUBSYSTEM

The Can Loading Subsystem shall be designed so that most components are outside the glovebox so they remain contamination free and maintenance will be “hands on”. Personnel using gloveports shall maintain the components inside the glovebox. A modular design concept is required for easy assembly and maintenance of the system. The modules shall be joined using large fasteners and guide pins. Whenever possible, critical and sensitive hardware shall be placed outside the enclosure to eliminate complex maintenance operation in the glovebox. The best possible materials and commercial components shall be selected and used to reduce the maintenance frequency.

The positioning systems shall be designed so the position calibration can be verified from outside the glovebox. For example, each robot axis is marked and these marks align when the axis is at position zero.

6.1.3 BAGLESS TRANSFER SUBSYSTEM

The Bagless Transfer subsystem shall be designed so that most components are outside the bagless transfer enclosure so they remain contamination free and maintenance will be “hands on”. Personnel using access ports shall maintain the components inside the bagless transfer enclosure. A modular design concept is required for easy assembly and maintenance of the system. The modules shall be joined using large fasteners and guide pins. Whenever possible, critical and sensitive hardware shall be placed outside the enclosure. The best possible materials and commercial components shall be selected and used to reduce the maintenance frequency.

The positioning systems shall be designed so the position calibration can be verified from outside the glovebox.

6.1.4 CAN INSPECTION SUBSYSTEM

The Can Inspection Subsystem shall be designed so that most components are outside the bagless transfer enclosure so they remain contamination free and maintenance will be “hands on”. Personnel using access ports shall maintain the components inside the bagless transfer enclosure. A modular design concept is required for easy assembly and maintenance of the system. The modules shall be joined using large fasteners and guide pins. Whenever possible, critical and sensitive hardware shall be placed outside the enclosure. The best possible materials and commercial components shall be selected and used to reduce the maintenance frequency.

The positioning systems shall be designed so the position calibration can be verified from outside the glovebox. For example, each robot axis is marked and these marks align when the axis is at position zero.

6.1.5 CAN HANDLING SUBSYSTEM

The Can Handling subsystem shall be designed so that most components are outside the bagless transfer enclosure so they remain contamination free and maintenance will be “hands on”. Personnel using access ports shall maintain the components inside the bagless transfer enclosure. A modular design concept is required for easy assembly and maintenance of the system. The modules shall be joined using large fasteners and guide pins. Whenever possible, critical and sensitive hardware shall be placed outside the enclosure. The best possible materials and commercial components shall be selected and used to reduce the maintenance frequency.

The positioning systems shall be designed so the position calibration can be verified from outside the glovebox. For example, each robot axis is marked and these marks align when the axis is at position zero.

6.2 PROCEDURE OUTLINES

6.2.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

TBD

6.2.2 CAN LOADING SUBSYSTEM

TBD

6.2.3 BAGLESS TRANSFER SUBSYSTEM

TBD

6.2.4 CAN INSPECTION SUBSYSTEM

TBD

6.2.5 CAN HANDLING SUBSYSTEM

TBD

6.3 PREVENTIVE MAINTENANCE

6.3.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

The Puck Transfer Tray Transport Subsystem preventative maintenance shall include inspecting the cart wheels and rails for obstructions and maintaining a clean glovebox floor between the transport cart rails TBD.

6.3.2 CAN LOADING SUBSYSTEM

TBD

6.3.3 BAGLESS TRANSFER SUBSYSTEM

TBD

6.3.4 CAN INSPECTION SUBSYSTEM

TBD

6.3.5 CAN HANDLING SUBSYSTEM

TBD

6.4 IN-SERVICE INSPECTION

6.4.1 TRAY TRANSFER SUBSYSTEM

TBD

6.4.2 CAN LOADING SUBSYSTEM

TBD

6.4.3 BAGLESS TRANSFER SUBSYSTEM

TBD

6.4.4 CAN INSPECTION SUBSYSTEM

TBD

6.4.5 CAN HANDLING SUBSYSTEM

TBD

6.5 SURVEILLANCE

6.5.1 PUCK TRANSFER TRAY TRANSPORT SUBSYSTEM

TBD

6.5.2 CAN LOADING SUBSYSTEM

TBD

6.5.3 BAGLESS TRANSFER SUBSYSTEM

TBD

6.5.4 CAN INSPECTION SUBSYSTEM

TBD

6.5.5 CAN HANDLING SUBSYSTEM

TBD

7.0 APPENDICES

Appendix A	References
Appendix B	Functions Interrelationship
Appendix C	Interface Requirements
Appendix D	Traceability Matrix
Appendix E	Process Cycle Time
Appendix F	Equipment List
Appendix G	Government Assisted Design List

APPENDIX A References

A.1 Correspondence

A.1.1 TBD

A.2 Technical Reports

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A.2.2 *Plutonium Immobilization Can Loading Equipment Review (U)* USDOE Report WSRC-TR-98-00164, Savannah River Site, Aiken, SC 29808 (5/1/98)

A.2.3 *Plutonium Immobilization Preliminary Can Loading Concepts (U)* USDOE Report WSRC-TR-98-00165, Savannah River Site, Aiken, SC 29808 (5/29/98)

A.2.4 *Plutonium Immobilization Can Loading Conceptual Design (U)* USDOE Report WSRC -TR-98-00229, Savannah River Site, Aiken, SC 29808 (7/1/98)

A.2.5 *Plutonium Immobilization Can Loading Preliminary Specifications (U)* USDOE Report WSRC-TR-98-00291, Savannah River Site, Aiken, SC 29808 (9/1/98)

A.2.6 *Plutonium Immobilization Can Loading FY98 Year End Design Report (U)* USDOE Report WSRC-TR-98-00310, Savannah River Site, Aiken, SC 29808 (9/18/98)

A.2.7 *Plutonium* Immobilization Puck Handling Conceptual Design (U), Rev. 1, USDOE Report WSRC-TR-98-241, Savannah River Site, Aiken, SC 29808 (10/24/98)

A.2.8 *Plutonium Immobilization Can Loading FY99 Component Test Report (U)* USDOE Report WSRC-TR-99-00318, Savannah River Site, Aiken, SC 29808 (9/30/99)

A.2.9 *PIP Comparison of Bagless Transfer and Electrolytic Decontamination (U)* USDOE Report WSRC-TR-99-00480, Savannah River Site, Aiken, SC 29808 (12/99)

A.2.10 NQA-1-1997, "Quality Assurance Requirements for Nuclear Facility Applications"

A.2.11 DOE/RW-0333P Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance Requirements and Description

A.2.12 PIP 99-018, LLNL QA Program Description dated February 1999

A.3 Drawings and Specifications

A.3.1 TBD

A.4 Vendor Documents

A.4.1 TBD

A.5 Calculations

A.5.1 TBD

A.6 Codes, Orders, and Standards

A.6.1 Refer to FDD (Reference TBD), Section TBD, for Codes, Orders, and Standards

A.7 Other

A.7.1 PIP 00-67 Facility Design Description for the Plutonium Immobilization Plant, November 30,2000.

A.7.2 WSRC E7, Conduct of Engineering and Technical Support", Procedure 2.12, "Facility Design Descriptions and System Design Descriptions", Rev. 0, 09/30/93

A.7.3 WSRC-IM-93-18, Writer's Guide for the Preparation of Facility Design Descriptions and System Design Descriptions, Rev. 1, 09/30/96

A.7.4 American Nuclear Society Robotics and Remote Systems Division, "Design Guide for Radioactive Material Handling Facilities & Equipment," ANS order No. 690014, ISBN: 0-89448-554-7, Library of Congress No. 88-16610, 1988

A.7.5 WSRC-IM-95-58, Hood and Glovebox Guide, Rev 0,2/19/97

APPENDIX B Functions Interrelationship

Appendix B contains information, which shows the interrelationship between the applicable functions presented in SDD Section 1.1 and the interrelationship between these functions and the major system components described in SDD Section 2.0.

Figure B-1	Functional Hierarchy Diagrams, which show the top, level system functions broken down into sub-functions. These system functions are restated from the Function Hierarchy Diagram presented in Appendix G of the FDD. The sub-functions are the actions or capabilities necessary to perform the top-level functions.
Figure B-2	Functional Flow Diagram which shows the logical interrelationship of the functions/sub-functions.
Table B-1	Function to Component Allocation Matrix, which identifies the major system components that perform the sub-functions.

The function/sub-function numbers used in these diagrams and table are based on the top-level function numbers used in Appendix G of the FDD.

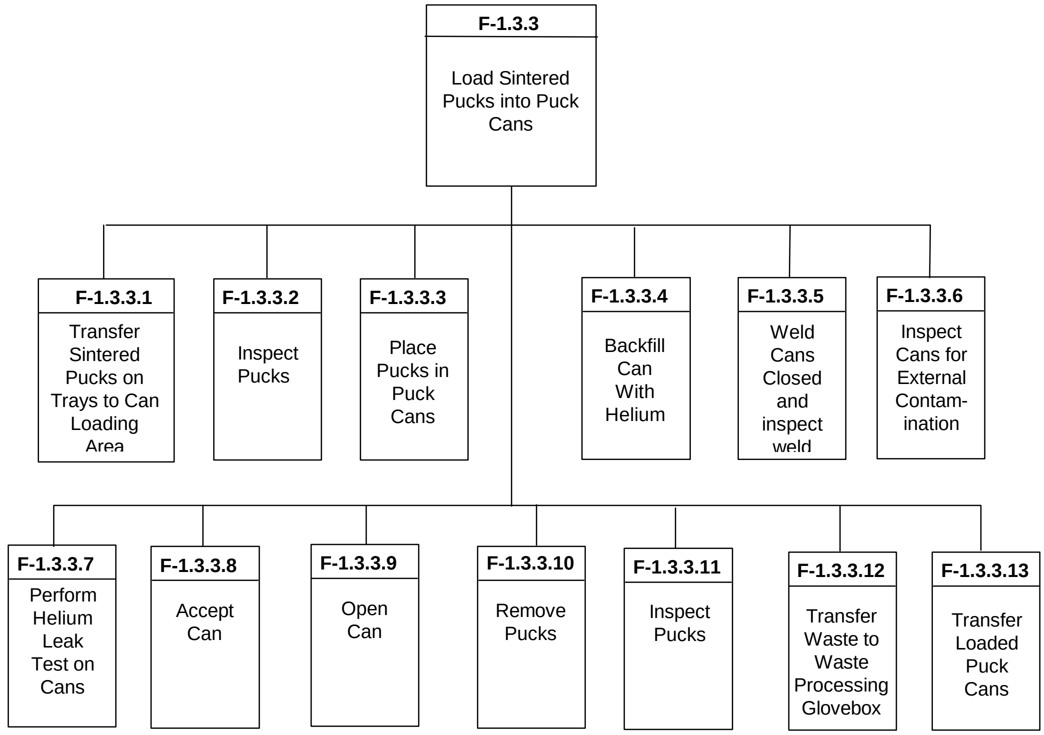


Figure B-1. Can Loading System Hierarchy Diagram

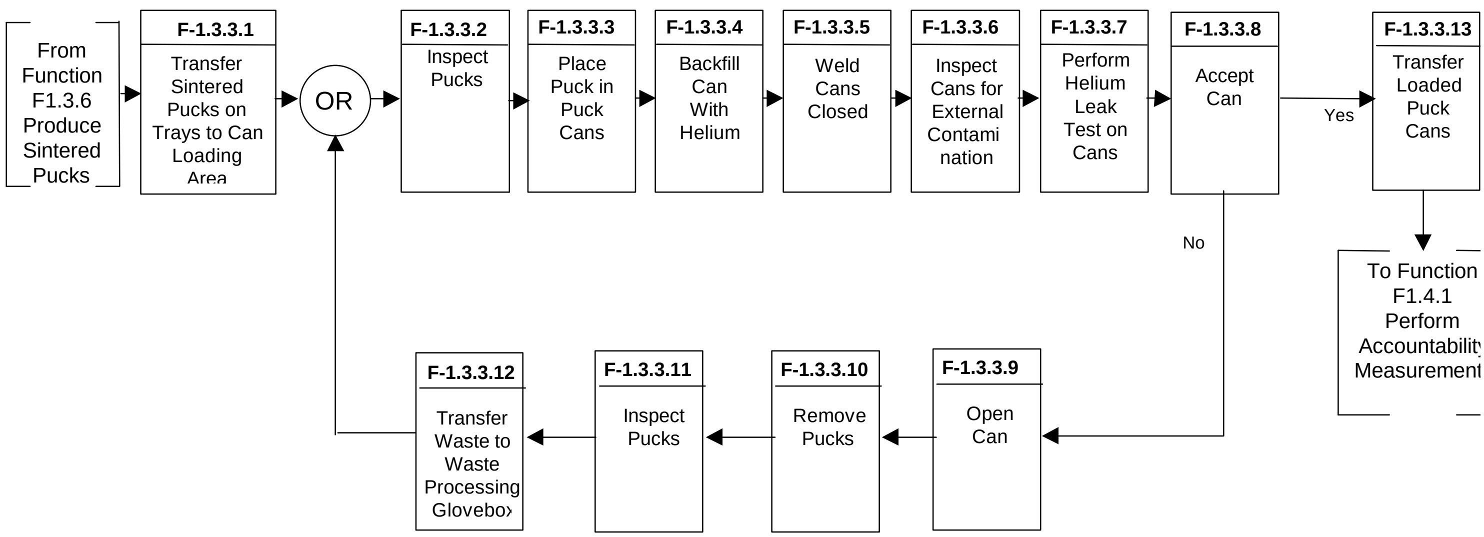


Figure B-2. Can Loading System Functional Flow Diagram

Table B-1
Can Loading System Functions to Component Allocation Matrix

Hierarchy Diagram Function No.	Function Description	Puck Transfer Tray Transporter and Lifter	Can Loading Robot	Bagless Transfer	Can Inspection Robot	Can Handling Robot	Puck Can Transferm Pallet Transporter	Control and Monitor Equipment
F-1.3.3	**Load Sinterd Pucks into Puck Can**							
F-1.3.3.1	Transfer Sintered Puck on Trays to Can Loading Are	X						X
F-1.3.3.2	Inspect Pucks	X	X					X
F-1.3.3.3	Place Puck in Puck Cans	X	X					X
F-1.3.3.4	Backfill Can With Helium		X	X				X
F-1.3.3.5	Weld Cans Closec			X				X
F-1.3.3.6	Inspect Cans foe External Contamination			X	X			X
F-1.3.3.7	Perform Helium Leak Test on Cans					X		X
F-1.3.3.8	Accept Car	X	X	X		X		X
F-1.3.3.9	Open Car		X	X				X
F-1.3.3.10	Remove Pucks	X	X					X
F-1.3.3.11	Inspect Pucks		X					X
F-1.3.3.12	Transfer Waste to Waste Processing Glovebo	X	X			X	X	X
F-1.3.3.13	Transfer Loaded Puck Cans						X	X

(1) Only components directly involved in the performance of system functions are included in this table.

(2) Primary confinement for the Can Loading System shall be provided by gloveboxes.

APPENDIX C Interface Requirements

This section presents the interface requirements between the Can Loading System and other systems. These systems may be internal or external.

The interfacing system is identified as either primary or secondary. These designations indicate the system imposing the requirement (primary system) or the system upon which the requirement is imposed (secondary system).

If the interface requirement is extensive (e.g., drawing, electrical load list, etc.) then the requirement consists of a qualitative statement and an Interface Control Document (ICD) is listed in the table which documents the interface details. This ICD documents and controls the interface. The system which agrees to accept responsibility for preparing, maintaining, and controlling the ICD are also identified. Both systems must agree to the interface requirements and any subsequent changes.

INTERFACING SYSTEMS		DESCRIPTION AND TOP LEVEL REQUIREMENTS OF INTERFACE	DOCUMENT CONTROLLING INTERFACE	SYSTEM RESPONSIBLE FOR CONTROLLING DOCUMENT
Primary	**Secondary**			
Material Transport System	Puck Transfer Tray Transporter	MTS shall provide trays of sintered pucks to the tray transporter.	TBD	TBD
Puck Transfer Tray Transporter	Tray Lifter	Tray transporter shall provide trays of sintered pucks.	TBD	TBD
Tray Lifter	Can Loading Robot	Tray lifter shall hold the trays of sintered pucks.	TBD	TBD
Can Loading Robot	Bagless Transfer	CL robot shall place sintered pucks into the puck can.	TBD	TBD
Bagless Transfer	Can Inspection Robot	BT shall present the sealed puck can to the puck robot.	TBD	TBD
Alpha Counter	Control System	Alpha counter shall provide count data to control system.	TBD	TBD
Bagless Transfer	Puck can robot	BT shall present the puck can to the puck can robot.	TBD	TBD

INTERFACING SYSTEMS		DESCRIPTION AND TOP LEVEL REQUIREMENTS OF INTERFACE	DOCUMENT CONTROLLING INTERFACE	SYSTEM RESPONSIBLE FOR CONTROLLING DOCUMENT
Primary	**Secondary**			
Puck can robot	Helium Leak System	Puck can robot shall place puck can into Helium Leak Chamber.	TBD	TBD
Helium Leak System	Puck can robot	Shall provide leak data to control system?	TBD	TBD
Puck can robot	Puck Can Transfer Pallet Transporter	Puck can robot shall place inspected puck can on puck can transfer pallet transporter.	TBD	TBD
Puck Can Transfer Pallet Transporter	Material Transport System	Shall deliver puck cans to the building material transport system.	TBD	TBD
Electrical Power	TBD	TBD	TBD	TBD
HVAC	TBD	TBD	TBD	TBD
Waste	TBD	TBD	TBD	TBD
Controls	TBD	TBD	TBD	TBD

Interfacing Subsystems

C-1 Can Loading System

The Can Loading System receives trays of sintered pucks from the facility material transport system and delivers sealed puck cans to the puck can MC&A module.

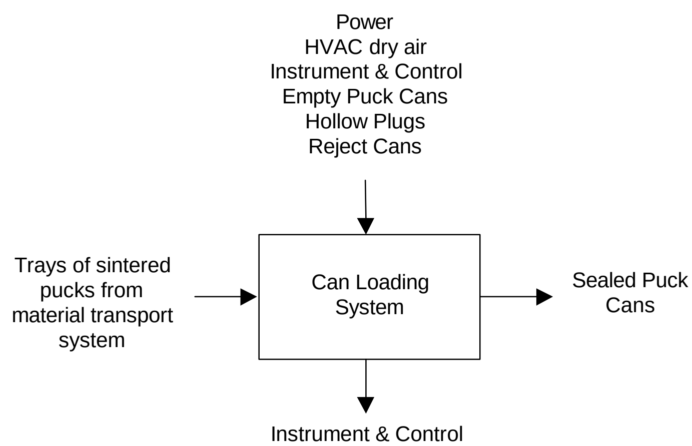
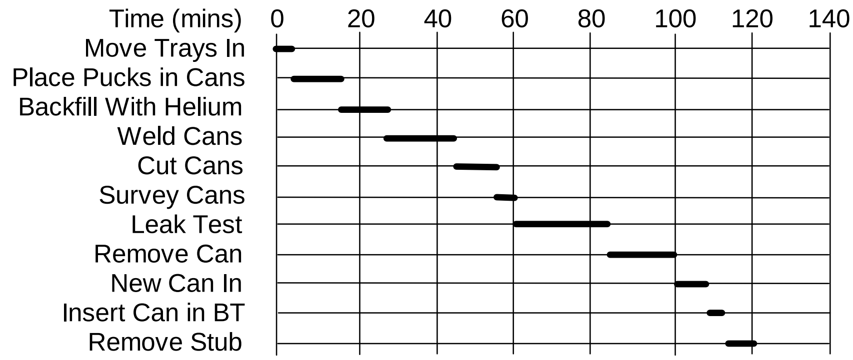


Figure C-1. Can Loading System Interfaces

APPENDIX D Traceability Matrix

TBD

APPENDIX E Process Cycle Time



Notes: All times are estimated.

Figure E-1. Can Loading Process Cycle Times

APPENDIX F Equipment List

Equipment Description	Quantity	Size	Comments
Tray Transfer Subsystem			
Cart	1	1' x 1' x 4"	inside glovebox
Cart Linear actuator	1	10' x 6" x 6"	outside - under glovebox
Rail system	1 set	10' x 1' x 2"	inside glovebox
Mechanical Tray Lifts	2 sets	6" x 6" x 1'	inside glovebox
Tray Lift Drives	2 sets	6" x 6" x 1'	outside - under glovebox
Can Loading Subsystem			
robot	1	3' x 10' x 5'	inside can loading glovebox
puck lifting tool	1	4" x 4" x 4'	inside can loading glovebox
helium hood tool	1	6" x 6" x 2.5'	inside can loading glovebox
puck weighing scale	1	1' x 1' x 0.5'	inside can loading glovebox
puck measurement system	1		inside can loading glovebox
vision system	1		outside can loading glovebox
reject can cutter	1	2' x 6" x 1'	inside can loading glovebox
barcode reader	1		inside can loading glovebox
Bagless Transfer Subsystem			
sphincter seal	2	9" dia x 4"	inside can loading glovebox
puck can welder	2	2' x 6" x 1'	bagless transfer enclosure
puck can cutter	2	2' x 6" x 1'	bagless transfer enclosure
puck can holder	2	2' x 6" x 1'	bagless transfer enclosure
Can Inspection Subsystem			
can inspection robot	1	4' x 4' x 4'	bagless transfer enclosure
alpha probe gripper	1		bagless transfer enclosure
alpha detector	1		bagless transfer enclosure
Can Handling Subsystem			
leak detector bell jar	1	6" dia x 2.5'	bagless transfer enclosure
puck can robot	1	8' x 3' x 3'	bagless transfer enclosure
puck can gripper	1		bagless transfer enclosure
barcode reader	1		bagless transfer enclosure
CCTV cameras	2		bagless transfer enclosure

APPENDIX G Government Assisted Design (GAD) List

I. System Requirements				
EQUIPMENT DESCRIPTION	Function: Basic functions of each structure, system and component	Performance requirements such as capacity, rating and system output for the system component	Codes and standards, regulatory requirements and commitments or responses to federal, state and local regulations which pertain to a given system component	Quality Assurance requirements, assurance that the materials, processes, parts and equipment are suitable for the application
Tray Transfer Subsystem				
Cart	DTO	A/E	A/E	A/E
Cart Linear Actuator	DTO	A/E	A/E	A/E
Rail System	DTO	A/E	A/E	A/E
Mechanical Tray Lifts	DTO	A/E	A/E	A/E
Tray Lift Drives	DTO	A/E	A/E	A/E
Can Loading Subsystem				
Robot	DTO	A/E	A/E	A/E
Puck Lifting Tool	DTO	A/E	A/E	A/E
Helium Hood Tool	DTO	A/E	A/E	A/E

Puck Weighing Scale	DTO	A/E	A/E	A/E

APPENDIX G Government Assisted Design (GAD) List

I. System Requirements (Continued)				
EQUIPMENT DESCRIPTION	Function: Basic functions of each structure, system and component	Performance requirements such as capacity, rating and system output for the system component	Codes and standards, regulatory requirements and commitments or responses to federal, state and local regulations which pertain to a given system component	Quality Assurance requirements, assurance that the materials, processes, parts and equipment are suitable for the application
Can Loading Subsystem (continued)				
Puck Measurement System	DTO	A/E	A/E	A/E
Vision System	DTO	A/E	A/E	A/E
Reject Can Cutter	DTO	A/E	A/E	A/E
Bagless Transfer Subsystem				
Sphincter Seal	DTO	A/E	A/E	A/E
Puck Can Welder	DTO	A/E	A/E	A/E
Puck Can Cutter	DTO	A/E	A/E	A/E
Puck Can Holder	DTO	A/E	A/E	A/E

APPENDIX G Government Assisted Design (GAD) List

I. System Requirements (Continued)				
EQUIPMENT DESCRIPTION	Function: Basic functions of each structure, system and component	Performance requirements such as capacity, rating and system output for the system component	Codes and standards, regulatory requirements and commitments or responses to federal, state and local regulations which pertain to a given system component	Quality Assurance requirements, assurance that the materials, processes, parts and equipment are suitable for the application
Can Inspection Subsystem				
Can Inspection Robot	DTO	A/E	A/E	A/E
Alpha Probe Gripper	DTO	A/E	A/E	A/E
Alpha Detector	DTO	A/E	A/E	A/E
Can Handling Subsystem				
Leak Detector	DTO	A/E	A/E	A/E
Puck Can Robot	DTO	A/E	A/E	A/E
Puck Can Gripper	DTO	A/E	A/E	A/E

APPENDIX G Government Assisted Design List (Continued)

II. System Description						
EQUIPMENT DESCRIPTION	Design conditions such as pressure, temperature, flow, fluid chemistry and voltage	Environmental Constraints: Loads such as seismic, wind, thermal and dynamic	Interface requirements including definition of the functional and physical interfaces involving structures, systems and components	Layout and arrangement requirements	Instrumentation and control requirements including indicating instruments, controls and alarms required for operation, testing and maintenance. Other requirements such as the type of instrument, installed spares, range of measurement, location of indication, calibration, measurement sensitivity and accuracy	Material requirements unique to the component
Tray Transfer Subsystem						
Cart	A/E	A/E	A/E	A/E	A/E	A/E
Cart Linear Actuator	A/E	A/E	A/E	A/E	A/E	A/E
Rail System	A/E	A/E	A/E	A/E	A/E	A/E
Mechanical Tray Lifts	A/E	A/E	A/E	A/E	A/E	A/E
Tray Lift Drives	A/E	A/E	A/E	A/E	A/E	A/E
Can Loading Subsystem						
Robot	A/E	A/E	A/E	A/E	A/E	A/E
Puck Lifting Tool	A/E	A/E	A/E	A/E	A/E	A/E
Helium Hood Tool	A/E	A/E	A/E	A/E	A/E	A/E
Puck Weighing Scale	A/E	A/E	A/E	A/E	A/E	A/E

APPENDIX G Government Assisted Design List (Continued)

II. System Description (continued)							
EQUIPMENT DESCRIPTION	Mechanical requirements	Structural requirements	Hydraulic requirements	Chemical Compatibility: Chemistry requirements (involves compatibility to chemical constituents in the system)	Electrical requirements	Handling, storage, cleaning and shipping requirements	Transportation requirements such as size and shipping weight, limitations and I.C.C. regulations
Can Loading Subsystem (continued)							
Puck Measurement System	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Vision System	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Reject Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E	A/E
	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Bagless Transfer Subsystem							
Sphincter Seal	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Welder	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Holder	A/E	A/E	A/E	A/E	A/E	A/E	A/E

APPENDIX G Government Assisted Design List (Continued)

II. System Description (continued)							
EQUIPMENT DESCRIPTION	Mechanical requirements	Structural requirements	Hydraulic requirements	Chemical Compatibility: Chemistry requirements (involves compatibility to chemical constituents in the system)	Electrical requirements	Handling, storage, cleaning and shipping requirements	Transportation requirements such as size and shipping weight, limitations and I.C.C. regulations
Can Inspection Subsystem							
Can Inspection Robot	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Probe Gripper	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Detector	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Can Handling Subsystem	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Leak Detector	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Robot	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Gripper	A/E	A/E	A/E	A/E	A/E	A/E	A/E

APPENDIX G Government Assisted Design List (Continued)

III. Operational Requirements						
EQUIPMENT DESCRIPTION	Operating Environment: Environmental conditions anticipated during storage, construction, operation and accident conditions (such as storage of feed materials prior to introduction to the process)	Operational requirements of the component under various operating and upset conditions	Testing Requirements: Test requirements including preoperational and subsequent periodic tests and the conditions under which they will be performed	Personnel requirements and limitations including the qualification and number of personnel available for operation, maintenance, testing and inspection	Automation And Remoting Requirements: Degree of hands on versus remote or automated operation required during normal operations and routine maintenance	Visibility Requirements: Personnel visibility requirements for normal operations and off-normal events
Tray Transfer Subsystem						
Cart	A/E	A/E	A/E	A/E	A/E	A/E
Cart Linear Actuator	A/E	A/E	A/E	A/E	A/E	A/E
Rail System	A/E	A/E	A/E	A/E	A/E	A/E
Mechanical Tray Lifts	A/E	A/E	A/E	A/E	A/E	A/E
Tray Lift Drives	A/E	A/E	A/E	A/E	A/E	A/E
Can Loading Subsystem						
Robot	A/E	A/E	A/E	A/E	A/E	A/E
Puck Lifting Tool	A/E	A/E	A/E	A/E	A/E	A/E
Helium Hood Tool	A/E	A/E	A/E	A/E	A/E	A/E
Puck Weighing Scale	A/E	A/E	A/E	A/E	A/E	A/E

APPENDIX G Government Assisted Design List (Continued)

III. Operational Requirements (Continued)						
EQUIPMENT DESCRIPTION	Operating Environment: Environmental conditions anticipated during storage, construction, operation and accident conditions (such as storage of feed materials prior to introduction to the process)	Operational requirements of the component under various operating and upset conditions	Testing Requirements: Test requirements including preoperational and subsequent periodic tests and the conditions under which they will be performed	Personnel requirements and limitations including the qualification and number of personnel available for operation, maintenance, testing and inspection	Automation And Remoting Requirements: Degree of hands on versus remote or automated operation required during normal operations and routine maintenance	Visibility Requirements: Personnel visibility requirements for normal operations and off-normal events
Can Loading Subsystem (continued)						
Puck Measurement System	A/E	A/E	A/E	A/E	A/E	A/E
Vision System	A/E	A/E	A/E	A/E	A/E	A/E
Reject Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E
Bagless Transfer Subsystem						
Sphincter Seal	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Welder	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Holder	A/E	A/E	A/E	A/E	A/E	A/E

Appendix G Government Assisted Design List (Continued)

III. Operational Requirements (Continued)						
EQUIPMENT DESCRIPTION	Operating Environment: Environmental conditions anticipated during storage, construction, operation and accident conditions (such as storage of feed materials prior to introduction to the process)	Operational requirements of the component under various operating and upset conditions	Testing Requirements: Test requirements including preoperational and subsequent periodic tests and the conditions under which they will be performed	Personnel requirements and limitations including the qualification and number of personnel available for operation, maintenance, testing and inspection	Automation And Remoting Requirements: Degree of hands on versus remote or automated operation required during normal operations and routine maintenance	Visibility Requirements: Personnel visibility requirements for normal operations and off-normal events
Can Inspection Subsystem						
Can Inspection Robot	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Probe Gripper	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Detector	A/E	A/E	A/E	A/E	A/E	A/E
						A/E
Can Handling Subsystem	A/E	A/E	A/E	A/E	A/E	A/E
Leak Detector	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Robot	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Gripper	A/E	A/E	A/E	A/E	A/E	

Appendix G Government Assisted Design List (Continued)

IV. Maintenance And Repair Requirements		
EQUIPMENT DESCRIPTION	Maintenance requirements: Accessibility, maintenance, repair and pre-service and in-service inspection requirements for the facility including the conditions under which they will be performed	Maintenance Access Path Requirements: Load path requirements for installation, removal and repair of equipment and replacement of major components
Tray Transfer Subsystem		
Cart	A/E	A/E
Cart Linear Actuator	A/E	A/E
Rail System	A/E	A/E
Mechanical Tray Lifts	A/E	A/E
Tray Lift Drives	A/E	A/E
	A/E	A/E
Can Loading Subsystem		
Robot	A/E	A/E
Puck Lifting Tool	A/E	A/E
Helium Hood Tool	A/E	A/E
Puck Weighing Scale	A/E	A/E

Appendix G Government Assisted Design List (Continued)

IV. Maintenance And Repair Requirements (Continued)		
EQUIPMENT DESCRIPTION	Maintenance requirements: Accessibility, maintenance, repair and pre-service and in-service inspection requirements for the facility including the conditions under which they will be performed	Maintenance Access Path Requirements: Load path requirements for installation, removal and repair of equipment and replacement of major components
Can Loading Subsystem (continued)		
Puck Measurement System	A/E	A/E
Vision System	A/E	A/E
Reject Can Cutter	A/E	A/E
	A/E	A/E
Bagless Transfer Subsystem	A/E	A/E
Sphincter Seal	A/E	A/E
Puck Can Welder	A/E	A/E
Puck Can Cutter	A/E	A/E
Puck Can Holder	A/E	A/E

Appendix G Government Assisted Design List (Continued)

IV. Maintenance And Repair Requirements (Continued)		
EQUIPMENT DESCRIPTION	Maintenance requirements: Accessibility, maintenance, repair and pre-service and in-service inspection requirements for the facility including the conditions under which they will be performed	Maintenance Access Path Requirements: Load path requirements for installation, removal and repair of equipment and replacement of major components
Can Inspection Subsystem	A/E	A/E
Can Inspection Robot	A/E	A/E
Alpha Probe Gripper	A/E	A/E
Alpha Detector	A/E	A/E
Can Handling Subsystem	A/E	A/E
Leak Detector	A/E	A/E
Puck Can Robot	A/E	A/E
Puck Can Gripper	A/E	A/E

Appendix G Government Assisted Design List (Continued)

V. Safety And Security Requirements								
EQUIPMENT DESCRIPTION	Security requirements to include access and administrative control requirements and system design requirements including redundancy, power supplies, support system requirements, emergency operational modes and personnel	Criticality Prevention: Requirements for criticality control and accountability of nuclear material	Personnel Safety: Safety requirements for preventing personnel injury	Fire protection or resistance requirements	Failure Mitigation: Failure effects requirements of structures, systems and components including a definition of those events and accidents which they must be designed to	Reliability: Reliability requirements of structures, systems and components including their interactions which may impair functions important to safety	Redundancy, diversity and separation requirements of structures, systems and components	Other requirements to prevent risk to the health and safety of the public
Tray Transfer Subsystem								
Cart	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Cart Linear Actuator	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Rail System	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Mechanical Tray Lifts	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Tray Lift Drives	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Can Loading Subsystem								
Robot	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Lifting Tool	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Helium Hood Tool	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Weighing Scale	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E

Appendix G Government Assisted Design List (Continued)

V. Safety And Security Requirements (Continued)								
EQUIPMENT DESCRIPTION	Security requirements to include access and administrative control requirements and system design requirements including redundancy, power supplies, support system requirements, emergency operational modes and personnel	Criticality Prevention: Requirements for criticality control and accountability of nuclear material	Personnel Safety: Safety requirements for preventing personnel injury	Fire protection or resistance requirements	Failure Mitigation: Failure effects requirements of structures, systems and components including a definition of those events and accidents which they must be designed to	Reliability: Reliability requirements of structures, systems and components including their interactions which may impair functions important to safety	Redundancy, diversity and separation requirements of structures, systems and components	Other requirements to prevent risk to the health and safety of the public
Can Loading Subsystem (continued)								
Puck Measurement System	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Vision System	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Reject Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Bagless Transfer Subsystem								
Sphincter Seal	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Welder	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Cutter	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Holder	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E

Appendix G Government Assisted Design List (Continued)

V. Safety And Security Requirements (Continued)								
EQUIPMENT DESCRIPTION	Security requirements to include access and administrative control requirements and system design requirements including redundancy, power supplies, support system requirements, emergency operational modes and personnel	Criticality Prevention: Requirements for criticality control and accountability of nuclear material	Personnel Safety: Safety requirements for preventing personnel injury	Fire protection or resistance requirements	Failure Mitigation: Failure effects requirements of structures, systems and components including a definition of those events and accidents which they must be designed to	Reliability: Reliability requirements of structures, systems and components including their interactions which may impair functions important to safety	Redundancy, diversity and separation requirements of structures, systems and components	Other requirements to prevent risk to the health and safety of the public
Can Inspection Subsystem								
Can Inspection Robot	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Probe Gripper	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Alpha Detector	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Can Handling Subsystem	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Leak Detector	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Robot	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E
Puck Can Gripper	A/E	A/E	A/E	A/E	A/E	A/E	A/E	A/E