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Engineering Report (Conceptual Design) PFP Solution Stabilization

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Abstract This Engineering Report (Conceptual Design) addresses remediation of the plutonium-bearing solutions currently in inventory at the Plutonium Finishing Plant (PFP)

The recommendation from the Environmental Impact Statement (EIS) is that the solutions be treated thermally and stabilized as a solid for long term storage

For solutions which are not discardable the baseline plan is to utilize a densitration process to stabilize the solutions prior to packaging for storage

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ENGINEERING REPORT (CONCEPTUAL DESIGN)

PPF SOLUTION STABILIZATION

PROJECT C-226

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for the
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**PFP SOLUTION STABILIZATION
ENGINEERING REPORT (CONCEPTUAL DESIGN)**

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LIST OF ACRONYMS, ABBREVIATIONS AND DEFINITIONS

acfm	actual cubic feet per minute (Actual Flow Rate)
ALARA	As Low As Reasonably Achievable
BMS	Balanced Magnetic Switch
C	Celsius
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DNFSB	Defense Nuclear Facilities Safety Board
DOE	United States Department of Energy
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
F	Fahrenheit
FDC	Functional Design Criteria
FMEF	Fuels and Materials Facility
FPT	Feed Pump Tank
FRT	Feed Receipt Tank
FST	Filtrate Storage Tank
FT	Flush Tank
gal	gallon
HAZOPS	Hazardous Operations
HEPA	High Efficiency Particulate Air
kg	kilogram
kW	kilowatt
l	liter
lb	pound
LOI	Loss on Ignition
NaOH	Sodium Hydroxide
NEPA	National Environmental Policy Act
NOC	Notice of Construction
NOx	Nitric Oxide
PBS	Plutonium-bearing solutions
PFP	Plutonium Finishing Plant
PR	Product Receiver
PRF	Plutonium Reclamation Facility
PSAR	Preliminary Safety Analysis Report
PST	Phase Separator Tank
Pu	Plutonium
PuO	Plutonium Oxide
PUMP	Plutonium Vulnerability Management Plan
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RLID	Richland Operations Implementing Directive
RLIP	Richland Operations Implementing Procedure
ROD	Record of Decision
SAR	Safety Analysis Report
scfm	standard cubic feet per minute (Standard Flow Rate)
SISMP	Site Integrated Stabilization Management Plan

SNM	Special Nuclear Material
SSSRT	Spent Scrubber Solution Receiver Tank
TBX	Terminal Distribution Box
VDC	Vertical Denitration Calciner
VCT	Vent Catch Tank
VT	Vacuum Tank
WAC	Washington Administrative Code
WDOH	Washington State Department of Health
WHC	Westinghouse Hanford Company

Loss on Ignition - Percentage of mass loss measured when a representative sample of processed (e.g., thermally stabilized) plutonium-bearing oxide is heated at a specified temperature for the time period required (as demonstrated by certification procedures) to remove residual moisture and other volatile species from the sample. LOI test can be accomplished by heating the sample in an oxidizing atmosphere to a temperature of 1,000°C (1,832°F) for at least 1 hour.

resin - An ion-exchange medium; organic polymer used for the preferential removal of certain ions from a solution.

thermally stabilize - A process that exposes a plutonium-bearing material to a high temperature or air, or other oxidizing atmosphere for the period of time required to convert reactive constituents to oxide while reducing the amount of adsorbed water and other chemical species to a level compliant with the LOI specification for storage. Thermal stabilization can be accomplished by heating to a recommended temperature of 950°C (1,742°F) for at least one hour.

PFP SOLUTION STABILIZATION

1.0 INTRODUCTION

1.1 Background

The Hanford Site has completed its production mission and is now in its new mission of environmental restoration. Part of the new mission is to stabilize and suitably store or dispose of all plutonium-bearing material.

In response to this mission, the Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-1, dated May 26, 1994, made recommendations that resulted in the generation of the Hanford Site Integrated Stabilization Management Plan (SISMP). This SISMP covers the stabilization and storage or disposal of plutonium-bearing material in inventory at facilities at the Hanford site and those materials (non-waste) arising from terminal cleanup of Hanford Site facilities.

For stabilization considerations, all plutonium-bearing materials at the Hanford Site have been grouped into three categories: solutions, residues and oxides with <50 weight percent [wt%] Pu, and metals and oxides with >50 wt% Pu. This project addresses the stabilization of approximately 4,800 liters (1,268 gallons) of solutions.

For solutions which are not discardable, the baseline plan is to utilize a denitration process to stabilize the solutions prior to packaging for storage, in accordance with the Record Of Decision (ROD), signed July 1996, for the *Plutonium Finishing Plant Stabilization Environmental Impact Statement* DOE/EIS-0244-F.

The Environmental Impact Statement (EIS) recommended ion exchange, vertical calcination, and thermal stabilization as the preferred alternative for stabilization of the plutonium-bearing solutions. Hanford will utilize the suggested processes to process the plutonium-bearing solutions as stated in the attached (Appendix 8.6) WNC letter 9651687 (Vogt 1996) to the Department of Energy.

1.2 Scope

This document addresses remediation of the approximate 333 kg (734 lb) of plutonium contained in approximately 4,804 liters (1,268 gal) of solutions currently in inventory (approximately 2 kg (4 lb) have been stabilized during the prototype testing phase) at the Plutonium Finishing Plant (PFP). This inventory includes:

- * Product Plutonium nitrate: Approximately 1,224 liters (323 gal) with approximately 209 kg total Pu are from the PRF and PUREX

processes. This solution is contained in Product Receiver (PR) cans and needs no pretreatment.

- * Concentrated filtrate solution: Approximately 1,190 liters (314 gal) with approximately 37 kg total Pu are contained in PR cans. Some lab testing has indicated that these solutions may need pretreatment using ion exchange or some other pretreatment process to remove extraneous substances prior to processing.
- * Flush solutions: Approximately 2,390 liters (631 gal) with approximately 87 kg total Pu may need pretreatment due to uncertain composition. Lab testing has shown that these solutions may have elevated levels of sodium, iron, nickel, or chromium which may be removed using ion exchange prior to processing.

The product form for the stabilized solutions will be plutonium oxide fired to meet the minimum temperature (950°C for at least one hour) necessary to meet the definition of thermal stabilization as specified in the DOE standard, DOE-STD-3013-94, for 60-year storage.

2.0 SUMMARY

Project C-226 will construct a Solution Stabilization system that consists of two main components, a Vertical Denitration Calciner (VDC) system and a Pretreatment system. The VDC system takes liquid plutonium nitrate solutions, removes the liquids, destroys the nitrates, and oxidizes the solid residues at 1000°C to render a stable plutonium oxide powder suitable for packaging and storage. The pretreatment system processes solutions normally unsuitable for use as calciner feed to render them compatible. Both the calciner and the pretreatment system will connect to existing plant services and use some of the existing gloveboxes. The process flow and glovebox arrangements in 234-52 are shown in figures 1 and 2 respectively.

The VDC system includes feed and flush solution storage, off-gas treatment, product and waste receivers, and the calciner itself, along with associated high-temperature furnaces, power supplies, instrumentation and controls.

The VDC system will be installed in a modified glovebox obtained from the Fuels and Materials facility (FMEF). This glovebox (230-C-2) will be located in room 230C of the 234-52 Building.

The pretreatment system will use existing gloveboxes HC-7C, HC-9B, and HA-46 including the mini canyon. These gloveboxes are located in rooms 228A and 232 respectively. HC-7C will need some plumbing to be rerouted and a new resin column to be installed. The rest of the gloveboxes will also need existing plumbing to be modified or rerouted to allow transfer of liquids for the process and waste streams. The plumbing in the HA-46 mini canyon will need to be connected to the existing plant drain system that goes to the OS tank.

Supporting these two systems will be gloveboxes HC-227-T and HC-227-S. These are existing gloveboxes designed to retrieve plutonium bearing solutions from their storage containers. HC-227-T has existing liquid transfer lines connecting it to HC-7C. A new transfer line will need to be installed to connect to the 230-C-2 glovebox. This new line will allow the transfer of solutions to the calciner.

Plant services required for the solution stabilization system include electrical power, instrument air, process vacuum, E-4 ventilation, caustic and acid lines.

Definitive design for this project will be performed by PFP Engineering and the on site engineer/constructor contractor. Specific design and construction tasks are identified in Section 5.0 Method of Performance.

The total estimated cost for this project is \$6,600,000.

Figure 1

Process Flow for Vertical Calciner

3.0 JUSTIFICATION

The intent of this project is to provide compliance with the Defense Nuclear Facilities Safety Board Recommendation 94-1, dated May 26, 1994 and the Plutonium Vulnerability Management Plan (PVMP) released by the Department Of Energy in March 1995. In response to the DNFSB and PVMP, Hanford established the SISMP for stabilization and safe storage of plutonium-bearing material and initiated development of a prototype calciner to stabilize the plutonium nitrate held at PFP. This prototype development documented in the *Technical Assessment of the PFP Vertical Denitration Calciner* HMF-SQ-CP-TA-009, established the production vertical calciner as the preferred alternative for stabilization of plutonium-bearing solutions. Completion of construction and startup activities to support PFP milestones is shown in Appendix 8.2. Stabilization of the solutions is projected to be completed in January 1999. The SISMP preliminary schedules show completion of stabilization processing, repackaging, and storage of all materials in the year 2002.

4.0 DESCRIPTION OF PROJECT SCOPE

4.1 Buildings

The process equipment and its supporting utilities will be installed within the existing 234-SZ Building in 200 West area of the Hanford site. This project will not significantly modify the 234-SZ building structure.

Major process components (gloveboxes) will be used in the following rooms of the 234-SZ building:

Room 227: Re-use existing HC-227-T & HC-227-S for plutonium bearing solution (PBS) load-in, blending and sampling, and, if necessary, load-out;

Room 230C: Install an uncontaminated glovebox (230-C-2) to contain the vertical denitration calciner (VDC) process and connect this glovebox to existing conveyor HC-3;

Room 228A: Refurbish/renovate existing glovebox HC-7C to contain a solution pre-treatment process which removes metallic impurities that would preclude adequate operation of the VDC system;

Rooms 228A, 232 & 232A: Refurbish/renovate existing glovebox HC-9B piping, HA-46, and the mini-canyon to collect pre-treatment system raffinate until it has been determined that the raffinate is acceptable for discharge to tank D8 in the 241-2 facility;

Rooms 227, 263, (or 228A, 228B, 228C, 230A & 230B) & 230C: Install encased transfer lines to transfer feed PBS from HC-227-S to 230-C-2, and VDC processing residue liquid from 230-C-2 to HC-227-S. 230-C-2 must be connected to the D8 drain system to gravity drain spent scrubber solution from SSRT-1/2.

4.2 Utilities

4.2.1 Electrical

The VDC system requires approximately 250 Amps at 480 Volts. The bulk of the power is needed to operate the two high temperature furnaces. Other loads include the agitator drive motor, feed pumps, and various instruments and controls.

The power for the vertical denitration calciner glovebox will be provided from an existing 480 volt panelboard in room 235B. The wiring will be routed through a new relay cabinet in room 235B to room 230C where the process glovebox and furnace power supply will be located. Glovebox lighting will be required for the new installation in room 230C.

4.2.2 Instrument Air

A source of compressed air operating at least 60 psi, and up to 10 scfm will be required to supply the calciner feed injector and the off gas filter blow-back mechanism. The injector air is used to provide insulation between the feed injector tube and the hot calciner baseplate and prevent the feed from boiling within the tube. The injector air also atomizes and disperses the feed solution up into the hot calciner material bed. The filter blow-back system back flushes the off-gas filters to prevent load up of the filters.

The air for the vertical denitration calciner glovebox will be connected to existing services in the plant. New lines will be routed from the glovebox to existing lines in the duct level in room 263.

4.2.3 Process Ventilation

Process ventilation is used to maintain negative pressure within the gloveboxes as a radiological confinement barrier. Ventilation flow of at least 100 acfm is required in the calciner glove box to remove excess heat and prevent excessive internal temperatures.

Ventilation ducts will be routed from the new glovebox to existing E4 glovebox exhaust system ventilation duct flanges located within the room. This will be a hot tap requiring the use of glovebags and scaffolding to connect to the E4 exhaust system.

4.2.4 Process Vacuum

Twenty-six inches (Hg) of vacuum at 5 scfm is required for calciner off-gas removal and treatment.

The process vacuum for the vertical denitration calciner glovebox will be connected to existing services in the plant. New lines will be routed from the glovebox to existing lines in the duct level in room 263. This will be a hot tap requiring the use of glovebags to connect to the process vacuum system.

4.3 Special Equipment/Process Systems

4.3.1 Process Equipment

The vertical denitration calciner was developed from a prototype as documented in the *Technical Assessment of the PFP Vertical Denitration Calciner* WMC-SD-CP-TA-009. Operability enhancements were identified with each test run and incorporated into the production calciner resulting in an improved design from the development unit.

The process equipment for operating the vertical denitration calciner process is summarized below (See Appendix B.4 for applicable Vertical Calciner Drawings, pages B.4.2 thru B.4.44).

As the feed material to the process consists of a plutonium nitrate solution containing up to 8 molar nitric acid, with small amounts of hydrochloric and possibly hydrofluoric acid, all tanks are glass with stainless steel end flanges, unless specified otherwise. All components within process gloveboxes, transfer lines, items comprising part of the containment structure or potentially exposed to corrosive material will be fabricated from stainless steel or other suitable nonreactive material. The operational life of the system is less than 2 years. The process shall be designed to minimize solid and liquid waste generation.

As these processes utilize large quantities of plutonium all design shall conform to the requirements of the Nuclear Criticality Safety Manual NMC-CN-4-29.

TANK (Acronym)	Length of Pipe (")	Services In	Level Instrumentation	Design Existing /New
FRT	24"	Feed, Vent, cold chem.	1 Warrick	New
FPT	24"	Feed, Vent, cold chem.	Weight Factor	New
FT	12"	Vent, cold chem.	None	MC-7C OR AS VCT
PST	24"	Regulated Vacuum, Vent	2 Warrick's	New
VT	18"	Vacuum, Vent	2 Independent Warrick's	H-2-26108*
VCT	12"	Vacuum, Vent, Vent header	None	H-2-26107*
SSSRT-1/2	48" x 2 cylinders each tank	Vent, Vacuum, PST Recirculation	Weight Factor	New

* Existing item from PFP spares. Usable with minor design work and modifications.

NOTE: Feed Receipt Tank (FRT), Feed Pump Tank (FPT), Flush Tank (FT), Phase Separator Tank (PST), Vacuum Tank (VT), Vent Catch Tank (VCT) and Spent Scrubber Solution Receiver Tank (SSSRT).

CALCINER: The vertical denitration calciner operates by injecting a 600 gm/l Pu liquid feed solution at a maximum feed rate of 4 l/hr upward through the base into a bed of hot (3000°C) oxide powder. The oxide powder is kept in motion through the action of an agitator driven from above. As the feed solution contacts the hot oxide, it flashes off the liquid steam. The solid residue left behind quickly oxidizes as it works its way upward through the material bed. When the level builds up above a set amount, the top surface overflows into the collection vessel located below the calciner. The vapors and decomposition gases pass upward through a set of three one micron ceramic off-gas particle filters within the calciner vessel prior to treatment in the off-gas scrubber.

One of the principal benefits of the vertical calciner design is the location of bearings and seals outside of the harsh abrasive, corrosive, and heated region of the assembly. This facilitates operation and maintenance, and greatly enhances system reliability and will provide the ability to operate continuously.

The VDC will be a stainless steel (Type 310S) assembly roughly 6 inches in diameter by 3 feet tall. Reference drawing SK-2-300303 for details (Appendix 8.4). Modular construction is required to enhance maintainability.

SCRUBBER: The off-gas scrubber processes the calciner off-gases by bubbling the heated gases through a chilled caustic solution. It cools then condenses out excess water vapor, while at the same time removes MOX and corrosives from the off-gases.

The scrubber will be made of 6 inch tempered glass pipe with stainless steel end caps. It stands about four feet tall. The gases pass downward under vacuum through a stainless steel inlet tube and dispersing filter. Small bubbles provide pumping action to circulate the scrub solution around the cooling coils and suspends precipitated solids. Condensable calciner off-gases, caustic make-up solution and suspended solids overflow through an internal stand pipe and are transported under vacuum to the PST. Solution is pumped from the PST back to the scrubber or to SSSRT-1/2.

FURNACES: The calciner will be heated through a dual furnace system. A small 1100 Watt cartridge heater operating at about 1400°C heats the surface of the overflow dome to 3000°C. A high power vertical tube furnace surrounds the lower section of the calciner. This "jacket heater" will operate at up to 1650°C, providing 15kW of radiant heat to the calciner vessel adjacent to the bed of oxide material. The design life of the heaters shall be in excess of 6 months.

CHILLER: The chiller pumps solution through the scrubber cooling coils, providing cooling to maintain the scrub liquid at about 10°C. The chiller operates from a 480 Volt, 15 kilowatt power supply to provide 10,650 Watts of cooling capacity.

PUMPS: Two identical metering pumps will be provided, one for the feed solution, and one for the scrubber caustic makeup. The pumps must be capable of accurately metering solutions from zero to at least four, but no more than ten liters per hour. They must be compatible with corrosive and caustic solutions. They must also be capable of limiting output pressure to 50 psi or less (see Table below).

Feed to Calciner	Metering - on/off
NaOH to scrubber	Metering - on/off
PST Circulation	Magnum 600* or Wilden on/off
SSSRT circulation:	Magnum 600* on/off
GE 230-C-2 liquid spills to MC-227-S	Magnum 600* on/off

* Compressed air operated Magnum 600 pumps drawn from existing FFP spares, Spare part # 6111-8060-5652.

4.3.2 Instrumentation

The vertical denitration calciner will be automatically controlled from the existing sludge furnace program logic controller located in room 230A. A local control panel will be located in room 230C which will house the furnace power supply and an emergency shutdown feature. This panel will also be used as a termination cabinet for control and power wiring between the program logic controller and the relay cabinet located in room 235B. The relay cabinet located in room 235B will house the bulk of the control components used to operate the calciner glovebox. Similar to the furnace power supply cabinet the relay cabinet will house the termination wiring for the signal and power required in rooms 230A and 230C.

4.3.3 Pretreatment System

The pretreatment system processes solutions normally unsuitable for use as calciner feed to render them compatible. Solutions

containing significant quantities of chlorides, fluorides organics, calcium, sodium or potassium would likely require treatment prior to injection into the calciner.

The pretreatment system will use existing gloveboxes HC-7C, HC-9B, and HA-46, including the mini-canyon (see Appendix B.4 for applicable Pretreatment Drawings, pages B.4.45 thru B.4.62). These gloveboxes are located in rooms 228A and 232 respectively. HC-7C will need some plumbing to be rerouted and a new resin column to be installed. An existing resin column at the HC-7C Filtrate Storage Tank (FST) will be replaced. The HA-46 vacuum pump (P-HF-6) needs to be replaced with a centrifugal pump. The rest of the gloveboxes will also need existing plumbing to be modified or rerouted to allow transfer of liquids for the process and waste streams. The plumbing in the HA-46 mini canyon will need to be connected to the existing plant drain system to the D8 tank.

Supporting these two systems will be gloveboxes HC-227-T and HC-227-S. These are existing gloveboxes designed to retrieve plutonium bearing solutions from their storage containers. Glovebox HC-227-S has existing liquid transfer lines connecting it to HC-7C. A new transfer line will need to be installed to connect to the 230-C-2 glovebox. This new line will allow the transfer of solutions to the calciner.

4.3.4 Transfer Line

Solution transfer lines will be provided between gloveboxes to transport process chemicals. The transfer lines will consist of three 1/2 inch stainless steel tubes in a 2 inch stainless steel encasement in accordance with DOE and industry standards for conveying nuclear wastes. Leak location/detection system similar to the Permalert PAL-AI will be installed to provide continuous monitoring of a sensor string for leaks. The sensor string will be resistant to acids, bases and solvents (eg., nitric acid). The unit must have a sensing range of at least 500 feet and should have the capability of monitoring the pipe for additional leaks after acknowledgement of a current leak.

4.3.5 Fire Protection

The calciner glovebox (230-C-2) will have an engineered fire detection and dry chemical suppression system.

4.4 Standard Equipment

GB'S: The vertical denitration calciner process will be installed inside an un-contaminated glovebox (230-C-2) to be located inside Room 230C. The VDC process glovebox will be connected to existing (contaminated) conveyor HC-3 via a transition piece assembly.

HVAC: The exhaust from the VDC process glovebox (230-C-2) will be connected to the existing PFP E-4 glovebox ventilation system in

Room 230C. Supply air into 230-C-2 will come from a combination of air flow from the MC-3 conveyor into 230-C-2 and air drawn directly into GB 230-C-2 from Room 230C via an inlet HEPA filter. Based on the prototype system operation in the Process Plutonium Support Labs, the high calcination temperatures (950-1000° C) forms PuO₂ powder with a high density and low specific surface area. The experience with product PuO₂ powder from the prototype unit indicates that it not nearly as hygroscopic as PuO₂ produced by the Hanford normal oxalate precipitation process. This non-hygroscopic powder means that the air supply to GB 230-C-2 does not have to be dry air. The produced product must meet the Loss on Ignition and residence time at 1000°C requirements of the DOE-STD-3013-94 standard.

4.5 Demolition

The demolition involved in installing the project equipment will be minor.

It is expected that the demolition will be limited to removing about 100' feet of tubing inside glovebox MC-7C, removing the MC-7C Filtrate Storage Tank (FST), removing about 40' of pipe and minor equipment in the HA-46F mini-canyon and HA-46F glovebox.

4.6 Design Compliance

The design and construction of this project will comply with the codes and regulations listed in Section 7.

5.0 METHODS OF PERFORMANCE

5.1 Onsite Architect-Engineer Work

Definitive design drawings will be performed by the onsite engineer/constructor contractor. The existing calciner design was developed from a prototype. Operability enhancements were identified with each test run and incorporated into the production calciner design. This will include all design drawings for the vertical calciner, pretreatment gloveboxes and facility services.

5.2 Procurement Strategy

The onsite engineer/constructor will procure all equipment and material for the vertical calciner and the pretreatment system.

5.3 Construction Work By Onsite Construction Contractor

The onsite construction contractor will fabricate/assemble and install the vertical calciner and the pretreatment system in PFP.

5.4 Work Planned For The Operating Contractor

The PFP operations contractor will perform the definitive design engineering. PFP planning will perform planning for work within PFP. PFP Operations will perform vent and balancing and will provide Radiological Control Technicians and Radiological Waste Disposal. The operating contractor will also provide project management during design, procurement and construction on this project and will provide software development services for this project. Operational testing will be provided by PFP operations.

6.0 REQUIREMENTS AND ASSESSMENTS

6.1 Safeguards and Security

The processing of Special Nuclear Material requires physical protection as outlined in the Department of Energy orders, DOE 5632.1C "Protection and Control Of Safeguards and Security Interests" and DOE 5633.3B "Control and Accountability of Nuclear Materials".

The most cost effective alternative that allows for compliance with DOE orders is to upgrade the existing security sensor system. The existing sensors were abandon in-place when prior processing activities were terminated. The existing sensors are now obsolete and no longer manufactured. The security sensor upgrade design requires new sensor locations to provide coverage of the work area gloveboxes. Wherever possible existing noncontaminated conduits will be used. Existing conduit with internal contamination is not cost effective to use and will be replaced.

The *94-1 Stabilization Project Vulnerability Risk Analysis*, HMC-96-00015, was performed using the DOE approved theft and sabotage scenarios. The Risk Analysis determined that the physical protection of room 230C is acceptable for the stabilization process.

Another Vulnerability Risk Analysis using the DOE approved theft and sabotage scenarios will be required for room 228A.

Process Pretreatment will be performed in the HC-7C hood in Room 228A. The category of material in this room will require the following security upgrades. NOTE: All equipment for these upgrades will be new unless otherwise noted.

The interior of the room will be monitored by 6 intrusion sensors providing target coverage of the operating gloveboxes. These sensors will detect any unauthorized access to the target materials within the gloveboxes.

Doors 607 and 612 will be monitored by Balanced Magnetic Switch (BMS) sensors to detect unauthorized use of these doors.

A Closed Circuit Television (CCTV) camera will be used for surveillance of target areas. A Security Police Officer will be dispatched to assess sensor alarms.

The existing terminal distribution box (TBX) will be replaced to accommodate new security sensors.

About 85 foot of new conduit will be required in room 228A. About 115 foot of new conduit will be required in the duct level. Both of these areas are radiological controlled. Scaffolding will be

required for some of the room 228A work and most of the duct level work.

The material category processed or stored in room 232, as defined in DOE 5633.3B (see appendix 8.8), is expected to be category 3 or 4. Based on the planned material category level, room 232 would not require security upgrades.

6.2 Health and Safety

6.2.1 Industrial Safety

Hazards involved in this project will be eliminated or reduced through implementation of the WHC Safety and Health Standards, procedures and policies, WHC-CN-1-10 *Safety Manual*. In addition to common construction hazards, work involving electrical circuits will be in accordance with section 15, "Electrical Work Safety", and section 16, "Electrical Installation Safety", of the Safety Manual. As part of the PFP readiness assessment, a job hazard walkdown shall be performed by PFP Industrial Safety Engineers.

6.2.2 Industrial Hygiene

The design and construction shall assure compliance with applicable industrial health and safety standards (29 CFR's 1910 and 1926), WHC-CN-4-40 and WHC-CN-1-11, and the most recent consensus standards applicable to occupational safety and health (e.g. ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices).

6.2.3 Fire Protection

Glovebox fire protection systems shall be designed in accordance with DOE/RLID 5480.7A, "Fire Protection"; Glovebox Fire Protection Criteria as adopted by the U.S. Department of Energy, Richland Office and implemented through the RLID 5480.7A; WHC-SO-CP-FHA-004 *Fire Hazards Analysis for Plutonium Finishing Plant Complex*; and applicable NFPA standards.

6.3 Decontamination and Decommissioning

The scope of decontamination and decommissioning (D&D) involved in installing the project equipment will be minor. The solid, plutonium contaminated waste from all changes necessary to install the project equipment should fit into one standard size (ca 4' x 4' x 8') burial box.

The project installs a new glovebox (23D-C-2) which increases the amount of material to be dispositioned during PFP D&D. This increase amounts to 1% to 5% of the PFP's present inventory, based on area of

contaminated glovebox-type enclosure. New equipment to be installed will be similar to existing PFP equipment for D&O.

6.4 Provisions for Fallout Shelters

There are no requirements to design, fabricate or install Fall Out Shelters as part of this ER. This construction activity modifies an existing area within an existing facility creating no new floor space or personal comfort features.

6.5 Quality Assurance and Safety Classification

6.5.1 Quality Assurance Activities

Project activities for all contractors involved in design, procurement, construction, and acceptance will be governed, as applicable, by the requirements of the Code of Federal Regulations (CFR) 10 CFR 830.120 "Quality Assurance". Minimum project quality requirements are included in the project-specific quality assurance program plan (QAPP). The QAPP specifies the quality assurance (QA) requirements corresponding to the applicable safety classification assignments, and programmatic criteria, which are applicable to this project. Additional requirements may be added by appropriate controlling documents during Title II design. The specific technical and quality programmatic requirements, material certifications, qualification/certification of personnel, inspections, examinations/testing, and applicable QA records will be established during Title II design and included in design documents.

6.5.2 Safety Classification

Safety classifications of systems, components, and structures are established in accordance with WMF-CM-4-46, *Safety Analysis Manual*.

Safety classifications are determined through analyses of consequences of system or component failures as indicated in the preliminary safety evaluation section 6.8. Safety Significant is the highest level applied to any system, component, and/or structure of the project.

6.6 Environmental Compliance

The Washington State Department of Ecology regulates dangerous waste under Washington Administrative Code (WAC) 173-303. All waste generated must be managed and disposed of according to WAC 173-303. The spent scrub receiver tanks and drain piping associated with the vertical calciner must be managed as dangerous waste accumulation tanks. Likewise, the ion exchange raffinate tanks and waste piping will require the same controls. The tanks will require design and operation in accordance with the dangerous waste tank regulation in WAC 173-303-640.

The National Environmental Policy Act (NEPA) is mandated for actions pursued by Federal Agencies or on activities taking place on federal lands. Requirements for NEPA can be found in 10 CFR 1021. The Plutonium Finishing Plant prepared the Plutonium Finishing Plant Stabilization Final Environmental Impact Statement (EIS) in May 1995. The EIS satisfies the requirement for a NEPA review. The Record of Decision was signed July 1996, and work may commence.

6.7 Permits

The Washington State Department of Health (WDOH) implements MAC 173-400 to regulate radioactive air emissions. A Notice of Construction (NOC) must be submitted to the WDOH and the U.S. Environmental Protection Agency (EPA) for approval, which covers both installation and operation, 90 days prior to installation of the vertical calciner.

The Washington State Department of Ecology (Ecology) implements MAC 173-460 for non-radioactive air emissions. Since no non-radioactive emissions will be generated, approval from Ecology will not be required.

Material that will be processed in the vertical calciner is special nuclear material (SNM). SNM is not waste and therefore no RCRA treatment permit is needed. No RCRA permit is required to accumulate the spent scrubber solution as long as the waste is not stored for greater than 90 days.

6.8 Preliminary Safety Evaluation

The installation and operation of the calciner system described in this engineering report adds no unusual hazards to the PFP operations based upon a review of the PFP Final Safety Analysis Report WMC-SD-CP-SAR-021, the detailed HAZOP analysis WMC-SD-CP-PHA-004, the PFP Fire Hazards Evaluation WMC-SD-CP-PHA-004 and the USQ evaluation PFP-96-14 (Appendix 8.7.1). The USQ evaluation found the planned operations to be bounded by the existing safety documentation; however it requires an upgrade to the PFP SAR to incorporate ion exchange descriptive information and accident analysis.

While there were no accidents that involved on and off site personnel, several areas of concern were identified that require mitigation through the design documentation. The Fire Hazards Analysis identified the need to provide in-glovebox fire detection and protection for the new glovebox as part of the design basis. A Preliminary Safety Analysis Report (PSAR) will be required as part of the design activity.

6.9 Risk Identification

The installation of the pretreatment and calcination capabilities in rooms 228A, 232, and 230C does not affect the analyzed on and off site doses of the PFP SAR WMC-SD-CP-SAR-021. The installation is within the

walls enclosing the Remote Mechanical A and C lines. The SAR analysis indicates that releases in this area are retained and are not part of the overall plant accident releases. The HAZOPS provides an early analysis of the hazards expected from the operation of the process equipment. Identified accidents are reviewed and mitigating features are incorporated into the equipment design.

7.0 CODES, STANDARDS, AND REFERENCES

7.1 CODES AND STANDARDS

In general, applicable Occupational Safety and Health Administration standards, and the "national consensus" codes and standards as developed by such organizations as the American Society of Mechanical Engineers, and the American National Standards Institute shall be used.

The design and construction of the stabilization system shall comply with the current versions of the following codes and standards:

- * American Conference of Government Industrial Hygienists (ACGIH)
- * American Society of Mechanical Engineers (ASME)
- * Environmental Protection Agency (EPA)
- * Institute of Electrical and Electronics Engineers (IEEE)
- * Instrument Society of America (ISA)
- * National Fire Protection Association (NFPA)
- * National Electrical Code (NEPA 70)
- * National Environmental Policy Act (NEPA)
- * National Emissions Standards and Hazardous Air Pollutants (NESHAP)
- * Resource Conservation and Recovery Act (RCRA)
- * Uniform Building Code (UBC)

All applicable DOE orders and standards in effect at the start of the design and all Federal, State, and local laws and regulations shall apply to the extent specified in S/RID (HNF-SO-MP-SRID-003).

7.2 U.S. CODE OF FEDERAL REGULATIONS AND STATE LAWS

- * 10 CFR 830.120, "Nuclear Safety Management Quality Assurance".
- * 10 CFR 835, "Occupational Radiation Protection".
- * 29 CFR 1910, "Occupational Safety and Health Standards".
- * 29 CFR 1926, "Safety and Health Regulations for Construction".

- * 40 CFR 262, "Standards Applicable to Generators of Hazardous Waste".
- * Washington Administrative Code (WAC) 173-303-170, "Dangerous Waste Regulations".

7.3 U.S. DEPARTMENT OF ENERGY - HEADQUARTERS

- * Department of Energy DOE-STD-3012-94, "Criteria for Safe Storage of Plutonium Metals and Oxides".
- * Department of Energy DOE/EIS/0244-F, "Plutonium Finishing Plant Stabilization Final Environmental Impact Statement".
- * Department of Energy DOE/EV/1830.T5, "A Guide to Reducing Radiation Exposure to As Low As Reasonable Achievable (ALARA)".
- * Department of Energy DOE/EM/0199, "Plutonium Vulnerability Management Plan".
- * Department of Energy Order 5632.1C, "Protection and Control Of Safeguards and Security Interests".
- * Department of Energy Order 5633.3B, "Control and Accountability of Nuclear Materials".

7.4 U.S. DEPARTMENT OF ENERGY FIELD OFFICE, RICHLAND

- * Department of Energy-Richland Operations Order RL HSREM-1, "Hanford Site Radiological Control Manual".
- * Department of Energy-Richland Operations Implementing Directive (RLID) 5480.7, "Fire Protection".
- * Department of Energy-Richland Operations Implementing Procedure (RLIP) 4700.1A, Attachment V-1, "Functional Design Criteria".

7.5 REFERENCES

Vogt, E.C., 1996, *Completion of the Solution Stabilization Development Program, Milestone TRP-96-410*, (external letter 9651687 to J.E. Mecca, U.S. Department Of Energy, Richland Operations Office, April 12, 1996), Westinghouse Hanford Company, Richland, Washington.

WHC-CN-4-29, *Nuclear Criticality Safety Manual*.

WHC-SD-CP-FDC-003, *Functional Design Criteria PFP Solution Stabilization*.

HNF-SD-CP-ER-043, Rev. 0

WHC-SD-CP-FHA-004, *Fire Hazards Analysis for Plutonium Finishing Plant Complex.*

WHC-SD-CP-PHA-004, *Preliminary Hazards Analysis for Vertical Denitration Calciner (VDC).*

WHC-SD-CP-SAR-021, *Plutonium Finishing Plant Safety Analysis Report.*

8.0 APPENDIXES

- 8.1 Cost Estimate Summary**
- 8.2 Schedule**
- 8.3 Outline Specifications**
- 8.4 Drawings**
- 8.5 Statement of Work**
- 8.6 Milestone TRP-95-410 Completion Letter**
w/ Attachments: Evaluation of Vertical Calciner
Precipitation of Pu from Acidic Solutions
Results of Testing Eichrom Resins for Pretreatment
Evaluation of Rellix HPQ Anion Exchange Resin
- 8.7 USQ Evaluation PFP-95-14**
- 8.8 DOE-5833.3W Control and Accountability of Nuclear Materials**

8.1 COST ESTIMATE SUMMARY

8.1.1

KAISER ENGINEERS HAWFORD
HASTINGHOUSE HAWFORD COMPANY
JOB NO. H52272/C226NAME
FILE NO. C226BAP2

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HNF-SD-CP-ER-043, Rev. 0
(Rev 2-2-83)

** TEST - INTERACTIVE ESTIMATING **
PFP SOLUTION STABILIZATION
C - 2 2 6 CONCEPTUAL
DOE_R01 - PROJECT COST SUMMARY

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BY TLM JPM DEK RDP

COST CODE	DESCRIPTION	ESCALATED TOTAL COST	CONTINGENCY %	TOTAL	TOTAL DOLLARS
010	ENGINEERING - TITLE I & II	510.000	24	110.400	640.000
030	ENGINEERING - TITLE III	170.000	24	60.000	700.000
060	PROJECT MANAGEMENT	150.000	24	36.000	100.000
TOTAL DESIGN AND MANAGEMENT		1.000.000	24	206.400	1.200.000
700	SPECIAL EQUIP/PROCESS SYSTEMS	4.400.000	22	594.000	7.220.000
		10.000		20.000	70.000
TOTAL CONSTRUCTION		1.450.000	22	604.000	3.250.000
TOTAL ESTIMATED CONSTRUCTION COST (TECC)		1,450,000	22	800,000	4,450,000
900	OTHER PROJECT COSTS	2,110.000	4	*	2,110.000
	ADJUSTED TO MEET DOE \$100.0)	(120.000)			(20.000)
		2,150.000			2,150.000
PROJECT TOTAL (TEC)		5,420.000	13	800.000	6,600.000

TYPE OF
ESTIMATE CONCEPTUAL SEPTEMBER 1, 1996

ARCHITECT
ENGINEER

OPERATING
CONTRACTOR

James L. With 9-3-96
Dennis J. Kovis 9-3-96

REMARKS.

REV. 2 - INCORPORATES REVIEW COMMENTS.
SEE REMARKS A. AND CC..

(ROUNDED/ADJUSTED TO THE NEAREST * 10.000 / 100.000 * - PERCENTAGES NOT RECALCULATED TO REFLECT ROUNDING)

8.1.2

ELITE ENGINEERS HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 057077/0126882
FILE NO. 0126882

WBS	DESCRIPTION	SUBTOTAL	UNITS	SUB	RECALCULATION	SUB	CONTINGENCY	TOTAL		
			INDIRECTS	TOTAL	% TOTAL	TOTAL	% TOTAL	DOLLARS		
311001	TITLE 1 & 2 INHC	135449	0	135449	1.57	2130	317019	20	37864	155293
311002	TITLE 3 & 4 INHC YDC	333956	0	333956	0.50	3044	336940	20	67393	404356
311003	TITLE 5 & 6 INHC PRETREATMENT	52309	0	52309	0.90	471	52780	20	10584	63393
SUBTOTAL 11	DEFINITIVE DESIGN	521956	0	521956	1.07	5407	527363	20	105513	633076
121000	ENGINEERING/INSPECTION - (ICP EM)	216177	0	216177	2.36	7442	323439	20	64728	388207
SUBTOTAL 12	ENGINEERING/INSPECTION	216177	0	316377	2.36	7442	323439	20	64728	388207
SUBTOTAL 3	ENGINEERING	130123	0	938177	1.56	13449	851202	20	170243	1021442
224000	PROCUREMENT-O/C	106930	0	106930	1.11	2476	119906	25	47981	236256
226000	PROCUREMENT-O/C	88400	0	88400	1.13	981	19181	25	22348	111727
SUBTOTAL 2	PROCUREMENT	295330	0	295330	1.11	3456	210206	25	65536	397987
319001	MODIFY GLOVEBOX INHC-ZETAC	54166	0	54166	2.15	1885	55931	20	11066	66396
319002	MODIFY GLOVEBOX INHC-7C	208450	0	208450	2.15	4355	208960	30	82850	291810
319003	MODIFY GLOVEBOX INHC-7B	20251	0	20251	2.15	807	20858	30	8450	29151
319004	MODIFY GLOVEBOX INHC-66F	135714	0	135714	1.94	2420	140542	18	24871	165314
319005	NEW YDC GLOVEBOX	537739	0	537739	2.15	15511	549300	13	85024	610388
319006	STEP OFF PAD SUPPORT & TRAINING	90409	0	90409	2.15	1713	92114	15	13842	106276
319007	PRETREATMENT DORMOUT	224423	0	224423	2.15	4625	219548	25	57314	286863
SUBTOTAL 3101	GLOVEBOX MODS-INSTALLATIONS	1296337	0	1296337	2.13	27130	1362487	19	247587	1550058
319001	TRANSFER PIPE (2 ACTIVE / 1 SPARE)	89811	0	89811	2.15	1930	91741	25	22926	114677
319002	NAOH PIPING	870	0	870	2.10	17	927	25	297	1074
319004	INSTRUMENT AIR PIPING	11497	0	11497	2.15	247	11740	25	2916	14611
319005	CHILLED WATER PIPING	17163	0	17163	2.15	369	17562	25	4348	21910
319006	DRAINS AND SAMPLE CONNECTIONS	113295	0	113295	2.15	2436	115731	30	34719	150450
319007	VACUUM SYSTEM	21498	0	21498	2.15	462	21960	25	5451	27450
319008	E-8 VENTILATION & EXHAUST SYSTEM	102224	0	102224	2.15	2201	104527	25	24111	126638
319009	CHEMICAL FIRE PROTECTION	27802	0	27802	2.15	598	28399	25	7140	35498
319011	STEP OFF PAD SUPPORT & TRAINING	90409	0	90409	2.15	1914	92314	15	13842	106276
SUBTOTAL 3102	PROCESS PIPING	474630	0	474630	2.15	10205	484835	29	117770	602604

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 7-17-91

ENTER ENGINEERS HANFORD
 WESTINGHOUSE HANFORD COMPANY
 JOB NO. W52272/C226282
 FILE NO. C226282

** TEST - INTERACTIVE ESTIMATING **
 PPP SOLUTION STABILISATION
 C - 2 3 6 CONCEPTUAL
 DOE-202 - WORK BREAKDOWN STRUCTURE SUMMARY

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 BY TLM JPM DDM RDP

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	ONSET INDEFINITE	SUB TOTAL	RECALCULATION % TOTAL	WBS TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS		
110001	POWER WERING	140310	0	140310	2.16	4070	153040	25	88541	241735
110002	INSTRUMENTATION	140750	0	140750	2.25	3036	113784	25	15946	170734
110003	SECURITY ESCORTS	136244	0	136244	2.25	6334	201174	25	54294	251468
SUBTOTAL 310	GLOVESBOOKS & PROCESS EQUIP.	2277042	0	2277042	2.24	46665	1325708	21	42394	2423455
SUBTOTAL 31	PA CONST-ONLINE E/C	2277042	0	2277042	2.24	46665	1325708	21	42394	2423455
120000	CONSTRUCTION-O/C	23050	0	23050	1.27	613	39573	25	7918	43589
SUBTOTAL 32	CONSTRUCTION-O/C	23050	0	23050	1.27	613	39573	25	7918	43589
SUBTOTAL 3	CONSTRUCTION	2316142	0	2316142	2.13	45278	1365272	22	504462	2475244
410000	PROJECT MANAGEMENT	150000	0	150000	1.57	2255	180355	20	36471	182426
SUBTOTAL 4	PROJECT INTEGRATION	150000	0	150000	1.57	2255	180355	20	36471	182426
500000	CONCEPTUAL DESIGN PHASE	347623	0	347623	1.53	4831	215622	0	0	342753
510000	DEFINITIVE DESIGN - OPC'S	72140	0	72140	1.53	1242	50423	0	0	69898
520000	PROCUREMENT - OPC'S	45045	0	45045	1.53	707	45712	0	0	45712
530000	CONSTRUCTION - OPC'S	800149	0	800149	1.53	12563	213710	0	0	432739
540000	SYSTEM TESTING - OPC'S	404317	0	404317	1.53	6240	410665	0	0	434445
550000	PLANNING - OPC'S	312263	0	312263	1.53	3430	222497	0	0	222497
560000	SYSTEMS TESTING OPC BURNOUT	46157	0	46157	1.53	1353	47514	0	0	47514
570000	ADVANCED CONCEPTUAL DESIGN	176623	0	176623	1.53	4	175087	0	0	175087
SUBTOTAL 5	OTHER PROJECT COST	2134373	0	2134373	1.43	30485	2167452	0	0	2167462
PROJECT TOTAL		5,716,537	0	5,716,517	1.72	91,347	5,414,784	13	780,170	6,194,957

ICF KAISER HANFORD
WESTINGHOUSE HANFORD COMPANY
JOB NO. 852212
FILE NO. C226HAB2

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** TEST - INTERACTIVE ESTIMATING **
PPF SOLUTION STABILIZATION - REV.2
CONCEPTUAL
DOF_R47 - ESTIMATE BASIS SHEET

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BY TLM JFM DKK RDP

1. DOCUMENTS AND DRAWINGS

DOCUMENTS:

DRAFT WITHOUT SIGNATURES "CONCEPTUAL DESIGN REPORT" PPF SOLUTION STABILIZATION, PROJECT C-226, DATED MAY 12, 1996. DOE LETTER 16-TPO-112 (REVIEW OF C-226 CONCEPTUAL COST ESTIMATE INDEPENDENT REVIEW) ICF-KAISER HANFORD COST ESTIMATE C226HAB2 & C226HAB1 (REV.1). DSI DATED 8/30/94.

DRAWINGS:

ASB LINES EXISTING SHOP & PLANT DRAWINGS.

2. MATERIAL PRICES

UNIT COSTS REPRESENT CURRENT PRICES FOR SPECIFIED MATERIAL. VENDOR INFORMATION WAS OBTAINED FOR THE FOLLOWING ITEMS.
STEEL-FIB, ARLINGTON, VA. 1 BACK GLOVE BOX TRANSITION PIECE \$150.000.
GENERAL FIRE SYSTEMS. EPOXANE, MA. 3 EACH ANSUL 2101-30 DRY CHEMICAL FIRE PROTECTION SYSTEMS.
GLOVE BOX TANKAGE. CALCINE AND SCROGGER EQUIPMENT. MATERIALS AND DIMENSIONS WERE SELECTED FROM BILL OF MATERIAL LISTE ON PROVIDED M-2 SHOP DRAWINGS.

3. LABOR RATES

- A.) ICF-KH HOURLY RATES ARE BASED ON THE 1996 FISCAL YEAR BUDGET LIQUIDATION RATES AS ISSUED BY KEM FINANCE (EFFECTIVE 3-09-96). SEE ALSO THE FY 1996 PLANNING RATES - (REPORT BGH870121).
B.) HMC HOURLY RATES ARE BASED UPON THE FY 1996 PLANNING RATES - (REPORT BGH82001).
C.) BASE CRAFT RATES ARE AS ISSUED BY KEM FINANCE (EFFECTIVE 10-01-95). RATES INCLUDE PRINCE BENEFITS, LABOR INSURANCE, TAXES, TRAVEL, DEPARTMENTAL OVERHEADS AND GSA/EMS.
" SEE HANFORD SOFT REPORTING, PDS BUDGET GUIDELINE HANDBOOK, SECTION 2 - COMPANY INFORMATION, FY 1996 PLANNING RATES.

4. GENERAL REQUIREMENTS/TECHNICAL SERVICES/OVERHEADS

- A.) ON SITE CONSTRUCTION FORCES GENERAL REQUIREMENTS AND TECHNICAL SERVICES COSTS ARE INCLUDED AS A COMPOSITE PERCENTAGE BASED ON THE ICF-KH ESTIMATING FACTORS FOUND IN SECTION 2 OF THE BUDGET GUIDELINE HANDBOOK (BGH8) LOCATED ON HANFORD SOFT REPORTING, PDS BUDGET GUIDELINE HANDBOOK. THE PERCENTAGE APPLIED TO ON SITE CONSTRUCTION FORCES LABOR. FOR THIS PROJECT, IS 75% FOR SHOP WORK AND 52% FIELD WORK, WHICH IS REFLECTED IN THE "OM&P/347" COLUMN OF THE ESTIMATE DETAIL.

5. ESCALATION

ESCALATION PERCENTAGES WERE CALCULATED FROM THE JANUARY 1996 UPDATE OF THE ECONOMIC ESCALATION PRICE CHANGE INDICES FOR DOE CONSTRUCTION PROJECTS AS FORWARDED BY THE "OFFICE OF INFRASTRUCTURE ACQUISITION" FM-56.

6. ROUNDING

U.S. DEPARTMENT OF ENERGY - DOE ORDER 5100.4 PAGE 1-32 SUBPARAGRAPH (M), REQUIRES ROUNDING OF ALL GENERAL PLANT PROJECTS (OP&P) AND LINE ITEM (LI) COST ESTIMATES. REFERENCE: DOE 5100.4, FIGURE 1-11. DATED 10-21-94.

7. REMARKS

- A.) DEMOLITION MATERIALS IN GLOVE BOX FOR PWS. MC-227 TAS, MC-9B, MC-7 AND RA-46P WILL NOT REMAIN IN GLOVE BOX. ESTIMATE INCLUDES FUNDING FOR REMOVAL AND DISPOSAL OF ABANDONED MATERIALS.

- D.) AVERAGE GLOVE BOX DOSE RATES (DEMA) IS THE BASIS FOR BURNOUT CALCULATIONS.
- C.) ICKN SHOPS PROVIDED LABOR & MATERIAL QUOTES FOR GLOVE BOX VACUUM TRAP, FEED AND FLUSH TANKS, SCRUBBER, PHASE SEPARATOR TANK, WASTE AND VENT TANKS FROM PREVIOUSLY CONSTRUCTED SIMILAR GLOVE BOXES.
- D.) ESTIMATE HAS ALLOWED PLACEMENT OF CHILDER TO BE WITHIN TWENTY LINEAL FEET OF 210-C2 GLOVE BOX
- E.) PRODUCTIVITY FACTORS WERE USED TO ACCOUNT FOR INEFFICIENCIES DURING CONSTRUCTION. THESE ARE REFLECTED AS 10% FOR SHP AND 10% DOUBLE SECURITY (BOTH ARE APPLIED TO LABOR).
- F.) ALLOWANCES HAVE BEEN INCORPORATED INTO ESTIMATE FOR CHEMICAL FIRE PROTECTION SYSTEMS AT MC-1 GLOVE BOX AND 210-C2 GLOVE BOX. COSTS ARE A RESULT OF PREVIOUSLY QUOTED SIMILAR SYSTEMS.
- G.) ALL OF GLOVE BOX WHA-14 MODIFICATIONS WAS ESTIMATED AS MAKE WORK.
- H.) IS COLUMN REBAR REPLACEMENT COSTS ARE NOT PART OF THIS PROJECT.
- I.) ALL WORK WAS ASSUMED TO BE PERFORMED DURING REGULAR WORKING HOURS. COST FOR OVER TIME AND SHIFT DIFFERENCES IS NOT INCLUDED.
- J.) ASSUME GLOVE BOX WINDOWS FOR BOX 210-C HAVE BEEN PREVIOUSLY PURCHASED AND COSTS WILL NOT BE IN THIS PROJECT.
- K.) ESTIMATE INCLUDES AN ALLOWANCE OF 2.2 HOURS FOR 3 MONTHS. AN ALLOWANCE FOR BADDS CLEARANCES IS NOT INCLUDED.
- L.) PIPING LENGTH, SIZES AND METALLIC MAKE-UP PROVIDED BY ENGINEERING.
- M.) CONTROLS (HARDWARE/SOFTWARE) PROVIDED BY WMC AND IS NOT IN ESTIMATE COST. INSTALLATION OF HW/SW IS INCLUDED IN ESTIMATE.
- N.) CONNECTIONS IF GLOVE BOX IS CIRCUMFERENTIAL (COS) THRU GLOVE BOX.
- O.) TESTING AND RETROFIT OF EXISTING GLOVE BOX INTERIOR PIPING AND TRANSPORT PIPING WILL BE ACCOMPLISHED BY DC/CONTRACTOR.
- P.) CLEANING AND TESTING OF EXISTING GLOVE BOXES WILL BE BY OPERATING CONTRACTOR.
- Q.) ASSUME DUCT LEVEL BELOW 8' ELEVATION IS NOT CONTAMINATED AND SHP WORK RULES WILL NOT APPLY BELOW THIS LEVEL.
- R.) AS DIRECTED BY PROJECT MANAGEMENT DUCT LEVEL PIPE TIE-INS WILL BE COMPLETED USING GLOVE BAGS.
- S.) OPERATING CONTRACTOR HAS REQUESTED THAT ESTIMATE INCLUDE 4.5% OF DIRECT CONSTRUCTION COSTS FOR FUNDING DC/PROJECT MANAGEMENT.
- T.) GLOVE BOX SUPPORTS FOR MC-1 AND MC-22788T ARE INCLUDED.
- U.) OFC COSTS HAVE BEEN PROVIDED BY THE OPERATING CONTRACTOR (WMC) AND ARE INCLUSIVE OF CONTINGENCY.
- V.) ASSUME NO BURNOUT WILL BE REQUIRED AT DEAIN 118 INH. DOSE RATES FOR TIE INS HAVE NOT BEEN PROVIDED.
- W.) ASSUME ALL WORK IN DUCT LEVEL WILL BE BELOW 8' LEVEL.
- X.) WBS \$10000 SYSTEM TESTING IS EXPENSE FUNDING WORK PERFORMED BY THE ON SITE E/C.
- Y.) GLOVE BOX TANKAGE, CALCIMER AND SCRUBBER EQUIPMENT, MATERIALS AND DIMENSIONS WERE SELECTED FROM BILL OF MATERIAL LISTS ON PROVIDED H-2 SHOP DRAWINGS.

ICF KAISER HANFORD
ENGINEERING HANFORD COMPANY
JOB NO. 131272
FILE NO. C2243A3

== TEST - INTERACTIVE ESTIMATING ==
PPP SOLUTION STABILIZATION
CONCEPTUAL
DOB_R0 - ESTIMATE BASIS SHEET

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DATE 09/03/98 13:34:58
BY TLM JPK DEW RDP

- AA.) ALL ENGINEERING SUPPORT (PROJECT CONTROLS, ESTIMATING, CONSTRUCTIBILITY, ETC.) PROVIDED BY HMC.
- BB.) ALLOWANCES FOR FAIR COST ESTIMATES ON PROCUREMENT ARE NOT INCLUDED.
- CC.) LABOR RATE FOR ICF KAISER ENGINEERING IS COMPOSITE RATE OF 10% ENGINEER AND 90% DESIGNER.

ICF KAISER HANFORD
 WESTINGHOUSE HANFORD COMPANY
 JOB NO. B52372
 FILE NO. C2245A23

** LIST INTERACTIVE ESTIMATING **
 PPS SOLUTION STABILIZATION
 CONCEPTUAL
 DOE-203 - ESTIMATE BASES SHEET

PAGE 7 OF 21
 DATE 09/03/80 13:54:59
 BY TLM JPM DKE RDP

KAISER ENGINEERS HANFORD COST ESTIMATING GUIDELINES FOR FY 1996 PROVIDES COST ESTIMATING BENCHMARK PERCENTAGES
 A COMPARISON TO THESE PERCENTAGES ARE AS FOLLOWS

NOTE ALL COST SHOWN ARE ESCALATED DOLLARS

TOTAL DEFINITIVE DESIGN COST AS A PERCENTAGE OF TOTAL CONSTRUCTION COST	21.9%
WBS 11 IS \$33,073 / WBS 3 IS \$2,447,070 (CONSTR LESS S/OUT COSTS)	
TOTAL ENGINEERING SUPPORT & INSPECTION AS PERCENTAGE OF TOTAL CONSTRUCTION COST	13.4%
WBS 12 IS \$18,387 / WBS 3 IS \$2,447,070 (CONSTR LESS S/OUT COSTS)	
TOTAL SD & I RE PERCENTAGE OF TOTAL CONSTRUCTION COST	33.3%
WBS 1 IS \$1,011,442 / WBS 3 IS \$2,447,070 (CONSTR LESS S/OUT COSTS)	
TOTAL PROJECT MANAGEMENT A PERCENTAGE OF TOTAL CONSTRUCTION COST	4.3%
WBS 6 IS \$12,828 / WBS 3 IS \$2,447,070 (CONSTR LESS S/OUT COSTS)	
TOTAL OTHER PROJECT COST AS PERCENTAGE OF TOTAL CONSTRUCTION COST	75.0%
WBS 5 IS \$12,167,442 / WBS 3 IS \$2,447,070 (CONSTR LESS S/OUT COSTS)	
TOTAL CONSTRUCTION FORCE CONSTRUCTION MANAGEMENT AS A PERCENTAGE OF TOTAL CF CONSTR LABOR COST	33.5%
EST DETAIL REPORTER BE ONWP COLUMN \$22,517 LESS ONWP BE DPC WORK (WBS 5) \$119,427 =	
\$555,248 ONWP OF CF WORK / TOTAL CF LABOR \$1,241,623 LESS BUREAU \$224,422 = \$1,017,199	

KALISER ENGINEERING HANFORD
 WASHINGTON HANFORD COMPANY
 JOB NO. 25227/C2268A02
 FILE NO. C2268A02

HNF
 HNC-SD-CP-ER-043, Rev. 0
 TEST - INTERACTIVE ESTIMATING **
 PFP SOLUTION STABILIZATION
 C - 2 2 4 CONCEPTUAL
 DOB_R04 - COST CODE ACCOUNT SUMMARY

PAGE 8 OF 31
 DATE 07/27/96 07:44:25
 BY TLM JFM UGR RDP

COST CODE/NA	DESCRIPTION	ESTIMATE SUBTOTAL	OFFSITE INDIRECTS	SWR TOTAL	ESCALATION % TOTAL	SWR TOTAL	CONTINGENCY % TOTAL	TOTAL DOLLARS

010	ENGINEERING - TITLE I & II							
111001	TITLE I & II (HNC)	135600	0	135600	1.87	2170	20	165181
111002	TITLE I & II (HNC) VOC	233300	0	233300	0.90	1000	20	401393
111003	TITLE I & II (HNC) PRETREATMENT	62240	0	62240	0.90	471	20	83336
	TOTAL 010 ENGINEERING - TITLE I & II	621956	0	621956	1.07	5607	20	833075
020	ENGINEERING - TITLE III							
111000	ENGINEERING/INSPECTION - (ICP HNC)	316177	0	316177	2.36	7462	20	388367
	TOTAL 020 ENGINEERING - TITLE III	316177	0	316177	2.36	7462	20	388367
060	PROJECT MANAGEMENT							
110000	PROJECT MANAGEMENT	150000	0	150000	1.57	2355	20	182026
	TOTAL 060 PROJECT MANAGEMENT	150000	0	150000	1.57	2355	20	182026
700	SPECIAL EQUIP/PROCESS SYSTEMS							
220000	PROCUREMENT-Q/C	105930	0	105930	1.11	2076	25	127426
220100	PROCUREMENT-Q/C	80400	0	80400	1.11	911	25	111727
310101	MODIFY GLOVESBOX HNC-227T&S	54146	0	54146	2.15	1816	20	66390
310102	MODIFY GLOVESBOX HNC-1C	204500	0	204500	2.15	4190	20	271650
310103	MODIFY GLOVESBOX HNC-08	28250	0	28250	2.15	607	20	37516
310104	MODIFY GLOVESBOX HNC-16P	126714	0	126714	1.94	2620	10	162316
310105	NEW VOC GLOVESBOX	537735	0	537735	2.15	11561	13	640320
310106	STOP OFF PAD SUPPORT & TRAINING	90400	0	90400	2.15	1945	14	108276
310107	PRETREATMENT BURNOUT	220420	0	220420	2.15	4816	25	296500
310201	TRANSFER PIPE (2 ACTIVE / 1 SPARE)	89011	0	89011	2.15	1910	25	116677
310202	WAKO PIPING	830	0	830	2.10	17	25	1036
310204	EXHAUSTION AIR PIPING	11437	0	11437	2.15	247	25	14661
310206	CHILLED WATER PIPING	17182	0	17182	2.15	349	25	21900
310208	DRAINS AND SAMPLE CONNECTIONS	113220	0	113220	2.15	2414	20	150450
310207	VACUUM SYSTEM	21620	0	21620	2.15	462	25	27450

KAISER ENGINEERS HANFORD
ESTIMATING HANFORD COMPANY
JOB NO. E12171/C126BAMZ
FILE NO. C226BAMZ

WMC-SD-CP-ER-043, Rev. 0
TEST - INTERACTIVE ESTIMATING -
FEED SOLUTION STABILIZATION
C - 2 1 1 - CONCEPTUAL
DDR_004 - COST CODE ACCOUNT SUMMARY

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DATE 07/03/76 09:44:36
BY TLM RPH DCM EDT

COST CODE/YES	DESCRIPTION	ESTIMATE SUBTOTAL	ON SITE INDIRECTS	SUB TOTAL	ESCALATION TOTAL	SUB TOTAL	CONTINGENCY TOTAL	TOTAL DOLLARS		
310201	E-4 VENTILATION & EXHAUST SYSTEM	102326	0	102326	2.15	2201	101527	25	26131	130650
310203	CHEMICAL FIRE PROTECTION	27001	0	27001	2.15	590	20399	25	7100	35490
310211	STEP OFF PAD SUPPORT & TRAINING	30000	0	30000	2.15	1905	32014	15	23662	306274
310301	POWER WIRING	307310	0	307310	2.15	4070	193300	25	40347	341735
310302	INSTRUMENTATION	140750	0	140750	2.15	3026	143780	25	35900	170730
310400	SECURITY ESCORTS	170700	0	170700	2.15	4230	201170	25	50030	251000
330000	CONSTRUCTION-G/C	330000	0	330000	2.57	813	330713	25	7710	475007
TOTAL 304	SPECIAL EQUIP/PROCESS SYSTEM	2981431	0	2981431	2.07	62330	2643705	21	579400	3223227
300 OTHER PROJECT COSTS										
300000	CONCEPTUAL DESIGN PHASE	307001	0	307001	1.57	4831	312022	0	0	312622
310000	DEFINITIVE DESIGN - OPC'S	79100	0	79100	1.57	1241	80421	0	0	80423
320000	PROCESSEMENT - OPC'S	40000	0	40000	1.57	707	40732	0	0	40712
330000	CONSTRUCTION - OPC'S	800000	0	800000	1.57	12007	812000	0	0	812000
340000	SYSTEM TESTING - OPC'S	400127	0	400127	1.57	6300	406665	0	0	410000
350000	PLANNING - OPC'S	210000	0	210000	1.57	3000	213000	0	0	213000
360000	SYSTEMS TESTING OPC SHUTDOWN	100000	0	100000	1.57	1500	101500	0	0	101500
370000	ADVANCED CONCEPTUAL DESIGN	150000	0	150000	0.00	0	150000	0	0	150000
TOTAL 300	OTHER PROJECT COSTS	2136973	0	2136973	1.41	30000	2167000	0	0	2167000

PROJECT TOTAL		5,118,404	0	5,118,404	1.72	92330	5,016,700	21	740,000	6,594,957

LAISSE ENGINEERS WAMPORD
 WASHINGTON WAMPORD COMPANY
 JOB NO. 852277/C226A22
 FILE NO. C226A22

Heif
 WHE-SD-CP-ER-043, Rev. 0
 (Sustained)
 ** TEST - INTERACTIVE ESTIMATING **
 PPP SOLUTION STABILIZATION
 C - 2 2 5 CONCEPTUAL
 DOR-R05 - ESTIMATE SUMMARY BY CSI DIVISION

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 DATE 09/03/94 09:40:43
 BY TLW JPH BRH RDP

CSI	DESCRIPTION	ESTIMATE SUBTOTAL	ON-SITE INDIRECTS	SUB TOTAL	ESCALATION 1 TOTAL	SUB TOTAL	CONTINGENCY 1 TOTAL	TOTAL DOLLARS
00	TECHNICAL SERVICES	2693452	0	2693452	1.57	42199	2735641	8 178281
01	GENERAL REQUIREMENTS	177878	0	177878	2.15	8324	384002	38 78018
05	METALS	21137	0	21137	2.15	455	21592	22 4701
13	MECHANICAL	1621674	0	1621674	1.94	31485	1653159	21 350984
14	ELECTRICAL	346313	0	346313	2.15	7445	353758	25 88439
18	PROJECT MANAGEMENT	250000	0	250000	1.57	2255	252255	20 20671
20	SUBTOTAL	586873	0	586873	1.12	6384	593257	13 57314
TOTAL CONSTRUCTION		5,716,537	0	5,716,537	1.72	58,247	5,814,784	11 780,170
PROJECT TOTAL		5,716,537	0	5,716,537	1.72	58,247	5,814,784	11 780,170

REFERENCE: ESTIMATE BASIS SHEET
COST CODE ACCOUNT SUMMARY

PAGE 4 & 5 OF 21
PAGE 7 & 8 OF 21

THE U.S. DEPARTMENT OF ENERGY - RICKLAND ORDER 5740.3 "COST ESTIMATING, ANALYSIS AND STANDARDIZATION" DATED 3-27-89, PROVIDES GUIDELINES FOR ESTIMATE CONTINGENCIES. THE GUIDELINE FOR A CONCEPTUAL ESTIMATE SHOULD HAVE AN OVERALL RANGE OF 15 TO 25%.

CONTINGENCY IS EVALUATED AT THE THIRD COST CODE LEVEL AND SUMMARIZED AT THE PRIMARY AND SECONDARY COST CODE LEVEL OF THE DETAILED COST ESTIMATE.

ENGINEERING
COST CODE 020

[TITLE I & II DESIGN]

A 20% CONTINGENCY WAS APPLIED DUE TO UNCERTAINTIES OF RECONFIGURING CLEAN GLOVE BOX EQUIPMENT INITIALLY INTENDED FOR USE IN PPF. MODIFICATIONS OF EXISTING PIPING AND EQUIPMENT INSIDE SEVERAL EXISTING PPF GLOVE BOXES AND BRACK ROUTING OF TRANSFER PIPING IN THE PPF DUST LEVEL.

COST CODE 028

[TITLE III ENGINEERING AND INSPECTION]

A 20% CONTINGENCY WAS APPLIED DUE TO UNCERTAINTIES IN TITLE II DESIGN (ABOVE), COMPLETENESS AND TIMELINESS OF RECEIPT OF VENDOR SUBMITTALS, NEED FOR REVISED CONSTRUCTION METHODS TO MINIMIZE DOSS AND UNKNOWN AVAILABILITY OF THE AFFECTED WORK AREA DURING INSPECTION.

COST CODE 049

[PROJECT MANAGEMENT]

A 20% CONTINGENCY WAS APPLIED DUE TO UNCERTAINTIES IN PERMITTING ACTIVITIES AND SAFETY ANALYSIS, MULTIPLE TIER REVIEWS OF PERMITTING AND SAFETY DOCUMENTS, DOCUMENTS, DEVELOPMENT OF DOCUMENTATION TO SUPPORT KEY DECISIONS AND POTENTIAL DELAYS IN RECEIPT OF KEY DECISIONS.

AVERAGE ENGINEERING CONTINGENCY 20%

CONSTRUCTION

700 SPECIAL EQUIP/PROCESS SYSTEMS

310106
310213

A 10% CONTINGENCY ALLOWANCE WAS FIRST APPLIED TO STEP OFF PAD FOR ADDITIONAL SUPPORT PERSONNEL AVAILABILITY AS A RESULT OF OVERTOOL.

310103
310104

A 20% CONTINGENCY WAS USED DUE TO UNCERTAINTIES ARISING FROM APPLYING AN AVERAGE DOSS RATE PROVIDED BY THE OPERATING CONTRACTOR.

310105

A 21% CONTINGENCY WAS BEEN APPLIED TO THE NEW VDC GLOVE BOX TO ALLOW FOR DIFFICULTIES THAT WILL BE ENCOUNTERED DURING INSTALLATION OF THE TWO EXISTING SECTIONS AND FABRICATION OF THE TRANSITION PIECE. THE CONTINGENCY FURTHER ALLOWS FOR DIFFICULTIES DURING INSTALLATION OF THESE THREE PIECES TO THE EXISTING GLOVE BOX LINE.

ICP KAISER MANFORD
 WESTINGHOUSE MANFORD COMPANY
 JOB NO. K52277
 FILE NO. Q226AA1

** IBET - INTERACTIVE ESTIMATING **
 PPP SOLUTION STABILIZATION
 CONCEPTUAL
 DOE_R04 - CONTINGENCY ANALYSIS BASIS SHEET

PAGE 13 OF 21
 DATE 05/01/96
 BY TLM JPM DKH RDP

220900 A 25% CONTINGENCY HAS BEEN APPLIED TO PROCUREMENT DUE TO PRESENT CONCEPTUAL LEVEL
 220100 DETAILS FOR GLOVE BOX TRANSITION PIECE.

210107 A 25% CONTINGENCY WAS APPLIED TO BURNOUT AS AN AVERAGE RATE OF 25MR WAS APPLIED.
 THIS ALLOWANCE IS FOR MODEST INCREASES ONLY.

110201
 110202
 110104 AN AVERAGE CONTINGENCY OF 25% HAS BEEN APPLIED TO THESE CONSTRUCTION ACTIVITIES DUE TO THE
 110105 CONCERNS OF ENCOUNTERING UNKNOWN CONTAMINATED MATERIALS, WORKING IN PROCESS FACILITIES
 110207 AND POSSIBLE OTHER CONSTRUCTION PROJECTS RUNNING CONCURRENTLY MAY CAUSE THIS PROJECT TO GO
 110208 ON S&P AND FULL SCALE.
 110209
 110301
 110302
 110400

110402 A 30% CONTINGENCY IS APPLIED TO HC-2C AND HC-2B GLOVE BOX MODIFICATIONS AND DRAIN TIE INS
 110403 DUE TO HIGH DOSE RATES, ALSO LIMITED INFORMATION REGARDING TIE IN REQUIREMENTS AND
 110406 MATERIALS AND LABOR NEEDED TO ACCOMPLISH DRAIN CONNECTIONS.

AVERAGE CONSTRUCTION CONTINGENCY 221
 AVERAGE PROJECT CONTINGENCY 131

KRISTE ENGINEERS HANFORD
 HESTINGHOUSE HANFORD COMPANY
 JOB NO. H52277/C236BAND
 FILE NO. C236BAND

HNF
 HNC-SD-CP-ER-043, Rev. 0
 1987 - INTERACTIVE ESTIMATING **
 PFP SOLUTION STABILIZATION
 C - 2 2 4 CONCEPTUAL
 DDH_007 - DSHITE INDIRECT COSTS BY WBS

PAGE 13 OF 11
 DATE 08/03/96 09:44:50
 BY TGM JFM GKM BDF

WBS	DESCRIPTION	ESTIMATE SUBTOTAL	CONTRACT TOTAL	ADMINISTRATION TOTAL	WID PACK PREP.	DYSEN INDIRECTS	TOTAL INDIRECTS
-----	-----	-----	-----	-----	-----	-----	-----
111001	TITLE & I I [HNC]	135499	0.00	0	0	0	0
111002	TITLE & I I [HNC] YOC	322988	0.00	0	0	0	0
111003	TITLE & I I [HNC] PRETREATMENT	82209	0.00	0	0	0	0
121000	ENGINEERING/INSPECTION - (ICF IN)	216177	0.00	0	0	0	0
220000	PROCUREMENT-O/C	191920	0.00	0	0	0	0
220100	PROCUREMENT-O/C	39400	0.00	0	0	0	0
220101	MODIFY GLOVESOX	54166	0.00	0	0	0	0
220102	MODIFY GLOVESOX	264519	0.00	0	0	0	0
220103	MODIFY GLOVESOX	26251	0.00	0	0	0	0
220104	MODIFY GLOVESOX	133714	0.00	0	0	0	0
220105	NEW YOC GLOVESOX	517739	0.00	0	0	0	0
220106	STEP OFF PAD SUPPORT & TRAINING	90443	0.00	0	0	0	0
220107	PRETREATMENT BURNOUT	221423	0.00	0	0	0	0
220201	TRANSFER PIP (2 ACTIVE / 1 SPARE)	69012	0.00	0	0	0	0
220202	WAGE PIPING	310	0.00	0	0	0	0
220203	INSTRUMENT AIR PIPING	11497	0.00	0	0	0	0
220204	CHILLED WATER PIPING	17183	0.00	0	0	0	0
220205	DRILLS AND SAMPLE CONNECTIONS	112295	0.00	0	0	0	0
220207	VACUUM SYSTEM	21498	0.00	0	0	0	0
220208	3-4 VENTILATION & EXHAUST SYSTEM	142226	0.00	0	0	0	0
220209	CHEMICAL FIRE PROTECTION	27901	0.00	0	0	0	0
220301	STEP OFF PAD SUPPORT & TRAINING	90443	0.00	0	0	0	0
220301	POWER PIPING	169218	0.00	0	0	0	0
220302	INSTRUMENTATION	140718	0.00	0	0	0	0
220400	SECURITY ESCORTS	196940	0.00	0	0	0	0
330000	CONSTRUCTION-O/C	39089	0.00	0	0	0	0
410000	PROJECT MANAGEMENT	150890	0.00	0	0	0	0
500000	CONCEPTUAL DESIGN PHASE	107431	0.00	0	0	0	0
520000	DEFINITIVE DESIGN - OPC'S	79180	0.00	0	0	0	0
530000	PROCUREMENT - OPC'S	45005	0.00	0	0	0	0
540000	CONSTRUCTION - OPC'S	360167	0.00	0	0	0	0
550000	SYSTEM TESTING - OPC'S	144317	0.00	0	0	0	0
560000	PLANNERS - OPC'S	218363	0.00	0	0	0	0
570000	SYSTEMS TESTING OPC BURNOUT	64547	0.00	0	0	0	0
570000	ADVANCED CONCEPTUAL DESIGN	196087	0.00	0	0	0	0
PROJECT TOTAL		5,714,537	0	0	0	0	0

8.2 SCHEDULE

8.2.1

1996

1997

1998

JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

ELS ROD COMPLETE

START ADVANCED CONCEPTUAL DESIGN

START PROCUREMENT

START DEFINITIVE DESIGN

START CONSTRUCTION

AIR PERMITTING-NOC

COMPLETE DEFINITIVE DESIGN

COMPLETE PROCUREMENT

DOING START UP VERTICAL CALCINER

COMPLETE CONSTRUCTION CALCINER

COMPLETE CONSTRUCTION

START UP CALCINER

START UP PRE TREATMENT

PROJECT COMPLETE

1.1 DEFINITIVE DESIGN

1.2 ENGINEERING INSPECTION/ DURING CONSTRUCTION

2.2 PROCUREMENT

3.1 CP CONSTRUCTION

3.1.1 PROJECT CLOSEOUT

4.1 PROJECT MANAGEMENT

5.0 OPCS

Plot Date 10/24/96
Data Date 10/24/96
Project Start 10/24/96
Project Finish 12/24/96

Activity: Activity Group
Control Activity
Resource for
Responsible Activity

1026

Rev. 1 of 1

PFP SOLUTION STABILIZATION
NESTINGHOUSE HANFORD COMPANY
C-226 CONCEPTUAL PROJECT SCHEDULE

C-226 CONCEPTUAL PROJECT SCHEDULE

Date	Revision	Checked	Approved
10/24/96	1.0		

(c) Primavera Systems, Inc.

Jerry Hunt

MMF-SD-CP-ER-043, Rev. 0

8.3 OUTLINE SPECIFICATIONS

8.3.1

HNF-SO-CP-ER-043, Rev. D

VERTICAL CALCINER OUTLINE SPECIFICATION

System Description

Process Feed Line:

Internal To Glove Box:

- 6ft of $\frac{1}{2}$ inch 3000# 304SS tubing.
 - 2-Male Connectors, Swagelok SS-B10-1-B.
 - 3-90° tube bends.
 - 4-tubing joints to be made up.
- } Process Feed Line between encasement glove box penetrator and Feed Receipt Tank

External To Glove Box:

- 252 ft of $\frac{1}{2}$ inch 3000# 304SS tubing.
 - 8-Unions, Swagelok SS-B10-6.
 - 6-90° tube bends.
 - 18-tubing joints to be made up.
- } See Attached Drawings H-2-B02A9. Shts 2 & 3

Encasement:

- 252 ft of 2 inch Sch 40 304L SS piping.
- 6-90° ELLS, Std. Wt. 304L SS
- 14-2 inch full penetration butt welds
- 1-Electric Resistance Leak Detection System

Scaffolding:

50 linear feet of 5ft high scaffolding will be required for Encasement/Process feed line installation

Pipe Hangers - 25 (see attached sketch Den-2)

Tube Supports - 40 (see attached sketch Den-3)

Client WHC WO/Job No. F&W301
Subject EUCASEMENT Hanger Date 5/16/96 By Don MacLean
DETAILS Checked By
Location 234-52, 200 West Area Revised By

ITEM No*	Description
①	Standard U-bolt for 2" sch 40 pipe, Grinnel Fig 137
②	L 4"x4"x 1/4" ASTM A36
③	Base plate 8"x8"x 5/8", ASTM A36
④	HILTI Kwik Bolt II, 1/2" dia w/ 3/4" embed

Note: 25 (total) Hangers are required.

Client VHC WO/Job No EDW3DL
Subject Tube Supports (with glove- Date 5/17/96 By Don Mac Isaac
box) Checked _____
Location 234-SZ, 200 West Area Revised _____ By _____

Item #1: Unistrut One Hole Clamp for OD Tubing in the following quantities:

P2008 (1/4") - 10

P2012 (1/2") - 30

System Description:

Process Line Between Feed Receipt Tank and Feed Pump Tank:

- 3ft of $\frac{1}{2}$ inch 3000# 304 SST tubing.
- 6 Male Connectors, Swagelok SS-810-1-8.
- 3-90° tube bends.
- 6-tubing joints to be made up.

Process Feed Line Between Feed Pump Tank and Feed Pump:

- 3ft of $\frac{1}{2}$ inch 3000# 304 SST tubing.
- 4 Male Connectors, Swagelok SS-810-1-8.
- 3-90° tube bends.
- 6-tubing joints to be made up.

Process Feed Line Between Feed Pump and Calciner Feed Nozzle:

- 5ft of $\frac{1}{4}$ inch 3000# 304 SST tubing.
- 5 Male Connectors, Swagelok SS-810-1-8.
- 2-90° tube bends.
- 6-tubing joints to be made up.

Flush Line Between Flush Tank and Feed Pump Suction Line:

- 6ft of $\frac{1}{2}$ inch 3000# 304 SST tubing.
- 3 Male Connectors, Swagelok SS-810-1-8.
- 2-90° tube bends.
- 4-tubing joints to be made up.

System Description

Vent Line Connecting Feed Receipt, Feed Pump and Flush Tank:

- 8ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
- 3- Male Connectors, Swagelok SS-810-1-3.
- 1- Union Tee, Swagelok SS-810-3.
- 4- 90° tube bends.
- 5- tubing joints to be made up.

Vent Line Connecting Flush Tank to Vent Catch Tank:

- 10ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
- 4- Male Connectors, Swagelok SS-810-1-8.
- 4- 90° tube bends.
- 4- tubing joints to be made up.

Scrubber Solution Recirc Line, Downstream of Recirc Pump:

- 8 ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
- 1- Union Tee, Swagelok SS-810-3
- 1- Male Connector, Swagelok SS-810-1-8.
- 4- 90° tube bends.
- 4- tubing joints to be made up.

Scrubber Solution Recirc Line Between Scrubber and Phase Separator

- 5ft of $\frac{3}{4}$ inch 3000* 304sst tubing.
- 2ft of $\frac{1}{2}$ inch 3000* 304sst tubing (Draw Line Connector).
- 4- Male Connector, Swagelok SS-810-1-8.
- 2- Male Connector, Swagelok SS-1210-1-12.
- 1- Reducer, Swagelok SS-810-R-12.
- 2- tubing bends / 8- tubing joints to be made up.

System Description

Scrubber Solution Recirc Pump Suction Line:

- 2 ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
- 2-Male Connectors, Swagelok SS-810-1-B.
- 1-90° tube bend.
- 2-tubing joints to be made up.

Spent Scrub Solution Line to Spent Scrub Receiver Tanks:

- 12 ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
- 4-Union Elbow, Swagelok SS-810-9.
- 1-90° tube bend
- 14-tubing joints to be made up.
- 2-Male Connectors, Swagelok SS-810-1-B.

Spent Scrub Receiver Tanks Drain Line:

- 8 ft of $\frac{1}{2}$ inch 3000* 304sst tubing.
 - 3-Union Elbow, Swagelok SS-810-9.
 - 1-Union Tee, Swagelok SS-810-3.
 - 2-Male Connectors, Swagelok SS-810-1-B.
 - 13-tubing joints to be made up.
- } from Spent Scrub Receiver Tanks to glovebox penetration

- 15 ft of 1 inch Schedule 40 304L sst pipe
 - 4-90° ELLs, Socket Weld, 3000#, 304L sst.
 - 9-socket weld joints to be made.
- } from glovebox penetration to existing drainage Room (D3/D4)

System Descriptions

Denitrator Off Gas System:

6ft of $\frac{3}{4}$ inch 3000* tubing.

1-Union Tee, Swagelok SS-1210-3.

1-Reducing Union, Swagelok SS-1210-6-4.

1-45° tube bend/2-90° tube bends to be made.

1-Male Connector, Swagelok SS-1210-1-12.

6 tubing joints to be made up.

Blowback Air from Accumulator Tank:

18ft of $\frac{1}{4}$ inch 3000* tubing.

3-Male Connectors, Swagelok SS-400-1-4.

2-Male Elbows, Swagelok SS-400-2-4.

2-Male Branch Tees, Swagelok SS-400-3-4TTM.

1-Male Connector, Swagelok SS-400-1-8.

1-ft of $\frac{1}{2}$ inch Sch 40 304 ss pipe.

1-90° EL Std. WT.

11 tubing joints/5 Threaded Piping joints to be made up.

Process Air to Accumulator Tank:

3ft $\frac{1}{2}$ inch 3000* tubing.

3-Male Connectors, Swagelok SS-810-1-8.

2-Male Elbows, Swagelok SS-810-2-8.

2-90° tube bends.

6 tubing joints to be made up.

System Description

Process Air to Feed Nozzle:

Internal To GloveBOX:

- 10ft of $\frac{1}{2}$ " 3000 # 304 SS tubing.
 - 2- Check Valves, Swagelok SS-8C-1.
 - 8- Male Connectors, Swagelok SS-8D-1-8.
 - 4- 90° tube bends
 - 12- tubing joints to be made up.
- } Process Air from Glovebox penetration to Calender feed Nozzle Connection.

External To GloveBOX:

- 55ft of 1" Sch 40 Carbon Steel pipe
- 4- 90° ELBs, SW / 1 Tee, SW / 1 Reducing Bushing.
- 12- Sbl joints to be made up.

Air Filter Regulator:

Type: Adjustable

Manufacturer: Hargrett, Model No* R22-405-RNMA.

End Connections: $\frac{1}{2}$ " NPT

Scaffolding: 15 lineal ft of 10ft high scaffolding will be required in Room 230C. 30 ft of 15 high Scaffolding will be required in duct level.

Note: See Attached marked up drawings (designated Don - 7).

Pipe Hangers: See Attached Sketch Don - 5. 7 hangers required

Client WHCWO/Job No. F0W3DLSubject Process Air/Vac. HangerDate 5/17/96By Don MacIsaac

Configuration

Checked

By

Location 23d-S. 7, 200 West Area

Revised

By

ITEM No ^o	
- (1)	Standard U-Bolt for 1" sch 40 pipe, Grinnell Fig # 137
(2)	L 3x3x3/8 x 12" L9, ASTM A36
- (3)	L 4x4x1/4 x 4" L4 ASTM A36
- - (4) - -	Base Plate, 8x8x3/4", ASTM A36
(5)	HILTI KWIK BOLTE, 5/8" dia w/4 1/2" embed

System Description

Instrument Air:

External to Glove Box:

- 18ft of 1 inch Sch 40 Carbon Steel piping.
- 4- 90° Ells, Std. Wt., Carbon Steel.
- 6- 1" Weld joints.

Internal to Glove Box:

- 10ft of 3/4 inch 3000* 304SS tubing
- 6- Male Connectors, Swagelok SS-400-1-4.
- 2- Union Tees, Swagelok SS-400-
- 4- 90° tube bends
- 14- tubing joints to be made up.

Scaffolding: 5 Linear ft. of 10ft high scaffolding will be required for Instrument Air Line installation.

Note: See Attached marked up drawings (designated Don-7).

Pipe Hangers: See Attached Sketch Don-5. 1 hanger required

System Description

Sodium Hydroxide:

Internal To GloveBox:

- 4 ft of $\frac{1}{2}$ inch 300S* 304set tubing.
- 2-Male Connectors, Swagelok SS-810-1-B.
- 2-90° tube bends.
- 2-tubing joints to be made up.

External To GloveBox:

- 180 ft of $\frac{1}{2}$ inch Sch 40 304L set pipe
- 5-90° Elbows, Socket weld, 300S*, 304C S&T.
- 13- Socket weld joints to be made.

Scaffolding: 15 linear feet of 6ft high scaffolding will be required for glovebox service connections and NaOH Line in Room 230C. 60 ft of 15 high scaffolding in duct level.

Valves:

- 2- $\frac{1}{2}$ inch Socket weld, CLASS 150, Gate Valve, SST, Certe Fig 114.
- 1- $\frac{1}{2}$ inch Socket weld, CLASS 150, Check Valve, SST, Certe Fig. 374.

Note: See Attached MARKED up drawings (designated Don - 6) AND drawing H-2-BSE49 sht 9.

Pipe Hangers: See Attached sketch Don-2..20 hangers required.

System Description

Miscellaneous Draws and Sample Connections:

- 3ft of $\frac{1}{2}$ inch 304^{SS} tubing.
- 6- Male Connectors, Swagelok SS-810-1-8.
- 3- Union Elbows, Swagelok SS-810-9.
- 9- tubing joints to be made up.

Vacuum System External To Glovebox:

- 65ft of 1 inch Sch 40, Carbon Steel pipe.
- 6- 90° ELBS, Std. Wt., Carbon Steel.
- 10- 1' weld joints (SW)

Scaffolding: 15 Linear feet of 10ft. high scaffolding will be required for Vacuum Line installation in Room 230C.

15ft of 15ft high scaffolding, w/ duct level.

Note: See Attached marked up drawings (designated Don-7).

Pipe Hangers: See Attached Sketch Don-5. Eight hangers required.

Glovebox Drawn Line:

- 60ft of $1\frac{1}{2}$ inch Sch 40 304L SST pipe.
 - 4- 90° ELBS, BW, Std. Wt. 304L SST.
 - 1- 150lb. RF, BW, 304L SST flange.
 - 10- $1\frac{1}{2}$ inch BW joints.
- B.3.14

} See Attached drawing
 H-2-16415

System DescriptionE4 Ventilation:

40 ft of 8 inch 304L SST pipe
10-90° ELBS, BW, STD. WT. 304L SST
22 - Weld joints.

Filtration System:

Type: Bag-In/Bag-Out

Manufacturer: Flanders Filters Inc.

Description: Top Entry Bag-In/Bag-Out filter system

End Connections: Flanged.

Housing Model No: G-1 IR CC-D

Number Required: 2

Scaffolding: 15 linear ft. of 10ft high scaffolding
will be required to install the E4 Ventilation system.

Note: See Attached Sketch for Hangers (designated
Don-11). Four of these hangers will be required.

Pipe Hangers: See Attached Sketch Don-5. 3 hangers
Required.

System Description

Glovebox Modifications:

See Attached Sketch A2 for Support Location and Configuration within the Glovebox.

Nelson Weld Studs shall be place on the glovebox walls and floor. Wall studs shall be used to mount Unistrut Channel from which the tanks may be mounted. Floor studs shall be used for direct Vessel/Tank Mounting.

All Unistrut Channel shall be 316SS (stainless steel). All Bolting and Nuting shall be stainless steel.

Floor Penetrations:

4 - 2 inch floor penetrations from Duct Level to operating areas.

System Description

Fire Protection System:

System is similar to Attached ECN 616052. Make estimate based on this ECN.

System Specification:

Fire Protection System shall be pre-engineered, fixed pipe, Total flooding, Automatic dry Chemical fire suppression system.

The system shall incorporate the use of a multi-purpose dry Chemical (MonoAmmonium Phosphate Based) Agent.

The system shall be ANSUL Model 101-30.

50ft of 1/2 inch Sch 40 304L SST pipe

12 - 90° Elbs, Thrd, 304L SST

2 - Glovebox Modifications as shown on detail 1, H-2-825066

(ECN 616052 pg#6)

PRETREATMENT OUTLINE SPECIFICATION

Material Estimates for Pretreatment gloveboxes

<u>Qty</u>	<u>Description</u>
HC-9B	
6	1/2" Swagelok unions
6	1/2" Swagelok elbows
20'	1/2" SST tubing
1	3/4" Teflon hose bib and clamp
HA-46	
46'	3/4" SST tubing
3	1" Electrical motor valves
1	1" 3 way valve
1	1" 3 way Electrical Motor Valve
4	1" pipe caps
2	1" pipe plug
30'	1" Kynar or SST pipe for drain connection to existing drain system.
10'	1/2" cygon tubing and hose bib
	Control/power wire for EMV valves
HC-7	
50'	3/4" SST tubing
10	3/4" Swagelok unions
7	3/4" Swagelok elbows
75'	1/2" SST tubing
15	1/2" Swagelok unions
15	1/2" Swagelok elbows
10	1/2" Tubing ball valves
5	3/4" Tubing ball valves
4'	6" Pyrex glass pipe
2	Top and bottom plates for column (to be built)
16	Square feet of 30 durometer neoprene for seals on existing vessels in glovebox.
2	pump (Already in spare parts. Price labor only.)
2	filter (Already in spare parts. Price labor only.)
227T	
20'	1/2" tubing
4	1/2" Swagelok unions
2	1/2" Swagelok elbow
2	1/2" Tubing ball valve
1	Magnum air driven pump (Have in stores. Price labor only.)
	Penetration to glovebox for transfer line

All tubing, fittings, and valves are assumed to be stainless steel material unless otherwise noted.

Max Rickards
 373-4567

8.4 DRAWINGS

8.4.1

VERTICAL CALCINER DRAWING LIST

SK-2-300303, Shts 1-8
 SK-2-300304, Shts 1-5
 SK-2-300305, Shts 1-14
 SK-2-300307, Shts 1-3
 SK-2-300308, Shts 1-5
 SK-2-300310, Shts 1-2
 SK-2-300311, Shts 1-3

<u>Page</u>	<u>Description</u>
8.4.3	Vertical Calciner (VC) P&ID, Sh. 1
8.4.4 thru 8.4.4a	VC P&ID, Sh. 2 and 3
8.4.5 thru 8.4.8	Glovebox VC Modifications
8.4.9 thru 8.4.11	VC Glovebox Arrangement Drawing
8.4.12 thru 8.4.21	VC Glovebox Plans/Elevations/Details
8.4.22 thru 8.4.25	VC Glovebox Equipment Arrangement
8.4.26	VC Glovebox Supports
8.4.27 thru 8.4.29	3D View's VC Glovebox
8.4.30	3D Equipment Arrangement
8.4.31	3D View VC Glovebox
8.4.32 & 8.4.33	VC Glovebox Plan View
8.4.34	VC Glovebox Northeast View
8.4.35	VC Glovebox Southeast View
8.4.36	VC Glovebox Equipment Plan
8.4.37	VC Glovebox Southwest View
8.4.38	VC Glovebox Equipment Support Arrangement
8.4.39 & 8.4.40	VC Product Path
8.4.41 & 8.4.42	VC Vent/Vacuum Lines
8.4.43 & 8.4.44	VC Off-gas, Scrubber Solution and Chilled Water Lines

NO.	DESCRIPTION	DATE	BY	CHKD.	APP'D.
1	REVISION				
2	REVISION				
3	REVISION				
4	REVISION				
5	REVISION				
6	REVISION				
7	REVISION				
8	REVISION				
9	REVISION				
10	REVISION				

U.S. DEPARTMENT OF ENERGY
 DIRECT DENITRATION
 P & I D

SD-CP-ER-043, REV. 0
 8.4.42

FOR CONTINUATION SEE SHEET 3

VERTICAL DENITRATION CALCINER STREAM PROPERTIES

Stream ->	CALCINER FEED	ATOMIZING AIR	CALCINER PRODUCT	CALCINER OFF-GAS	CAUSTIC TO SCRBR	SCRUBBER EFFLUENT	SPENT SCRUB SOLUTION	PHASE SEP TANK OFF-GAS
Phase	Liquid	Gas	Solid	Gas	Liquid	2-phase	Liquid	Gas
Batch Size	9 L max	n/a	800 g Pu	n/a	n/a	n/a	35 L max	n/a
Temp., [C]	25	25	1000	400	25	20	25	25
Pres., Est	50 psi	65 psi	40" H2O	120" H2O	2-5 psi	150" H2O	15 psi	180" H2O
Rate	2.40	0.00	0.00	0.00	4.09	0.00	6.44	0.00
SpG	1.58	0.00	0.00	0.00	1.22	0.00	1.23	0.00
Pu	2.51	0.00	2.51	0.00	0.00	0.00	0.00	0.00
Pu(NO3)4	2.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HNO3	16.53	0.00	0.00	16.53	0.00	0.00	0.00	0.00
H2O	84.13	0.00	0.00	84.13	204.77	305.43	305.43	0.00
PuO2	0.00	0.00	2.51	0.00	0.00	0.00	0.00	0.00
N2	0.00	113.46	0.00	113.46	0.00	113.46	0.00	113.46
O2	0.00	30.16	0.00	33.42	0.00	32.71	0.00	32.71
NO2	0.00	0.00	0.00	8.53	0.00	0.00	0.00	0.00
NO	0.00	0.00	0.00	1.51	0.00	0.08	0.00	0.08
NaOH	0.00	0.00	0.00	0.00	32.70	6.21	6.21	0.00
NaNO3	0.00	0.00	0.00	0.00	0.00	21.51	21.51	0.00
NaNO2	0.00	0.00	0.00	0.00	0.00	4.98	4.98	0.00

Note: All rates are in gram-moles per hour
 HNO3, NO2, & NO rates/compositions are idealized assuming high NOx removal rates

SCHEMATIC NOTES

1. Refer to WHC-SD-CP-ER-043 for details of the glove box.
2. Verify all electrical connections and wiring are correct before starting the system.
3. The glove box is designed to operate at a pressure of 1.0 psig.
4. The glove box is designed to operate at a temperature of 1000°F.
5. The glove box is designed to operate at a flow rate of 1000 L/min.
6. The glove box is designed to operate at a pressure of 1.0 psig.

Vertical Calciner Glove Box 230-C2

8.4.5

REVISIONS		DATE	BY	DESCRIPTION
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0
 

11-11-77
WHC-SD-CP-ER 043, Rev 0
See 7-11-77

Vertical Calciner Glove Box 230 C2

3 1 5

~~44~~
NHC-SD-CP-ER-043, Rev. 0
~~Rev 2-7-97~~

HMF
 MHE-SD-CP-ER-043, Rev 0
 Jan 7-17-87

Vertical Calciner Glove Box 230-C-2

848

REVISIONS									
NO.	DATE	BY	CHKD	DESCRIPTION	APPROVED	DATE	BY	CHKD	DESCRIPTION
1	10-17-86	HMF		DESIGN					
2	11-17-86	HMF		REVISED					
3	12-17-86	HMF		REVISED					
4	1-17-87	HMF		REVISED					
5	2-17-87	HMF		REVISED					
6	3-17-87	HMF		REVISED					
7	4-17-87	HMF		REVISED					
8	5-17-87	HMF		REVISED					
9	6-17-87	HMF		REVISED					
10	7-17-87	HMF		REVISED					
11	8-17-87	HMF		REVISED					
12	9-17-87	HMF		REVISED					
13	10-17-87	HMF		REVISED					
14	11-17-87	HMF		REVISED					
15	12-17-87	HMF		REVISED					
16	1-17-88	HMF		REVISED					
17	2-17-88	HMF		REVISED					
18	3-17-88	HMF		REVISED					
19	4-17-88	HMF		REVISED					
20	5-17-88	HMF		REVISED					
 					

RM 230C

425 15 CF TOT
73 63 SF TOT

181 8 CF
30 3 SF
6'-0" H

77 0 CF
12 83 SF
6'-0" H

133 02 CF
22 17 SF
6'-0" H

RM 234A

HC-3 CONVEYOR

33 33 CF
8 33 SF
4'-0" H

Vertical Calciner Glove Box 230-C-2

Hand
MHC-SD-CP-ER-043, Rev. 0
Jan 7-77-67

Vertical Calciner Glove Box 230 C-2

Hux
 HUG-SD-CP-ER-043, Rev. 0
 Jan-1941

Material: $\bullet \frac{3}{16}$ " 304L SST
 Glovebox en-
 closure
 $\bullet \frac{1}{4}$ " 304L SST
 Connecting
 Flanges

Conceptual Design for V.C.
 Glovebox to conveyor transition

8.4.12

HAF
WHE-SD-CP-ER-043, Rev. D
2-12-97

TRANSITION BASE
Conceptual Design for V.C G.B. 230-C-2
8.4.13

Half
SHE-SD-CP-ER-043, Rev. 0

N →

V.C. Base Plan 230-C-2
FOR TRANSITION

HAF
 SAC - SD-CP-ER-043, Rev. 0
 (04/20/97)

230-C-2 V.C. East View of Base Transition ^{0.4.15}

~~FILE~~
HMC-SD-CP-ER-043, Rev. 0
~~Ch. 12.12.12~~

2x16x $\frac{3}{4}$ wall

TRANSITION

V.C. North View of Base 230-C-2

442F
HMC-SD-IP-ER-043, Rev. 0
Flange Connection to exist glove box

TRANSITION--East View of Glovebox

Flange connection to ext glovebox

TRANSITION North View Glovebox

PLATE-SD-CP-ER-043, Rev. 0
2-1-1977

TRANSITION GLOVE BOX

HAIR
UNIT-SD-CF-ER-043, Rev. D
6/2/1997

TRANSITION BASE

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NAV
JAN-50-CP-ER-043, Rev. 0
JAN-57

3 DIM. VIEW OF G.B. 230-C-2 8.A.28

HWF
NHC-SD-CP-ER-043, Rev. 0
Rev 2/27/97

Part
HMC-SD-CP-ER-043, Rev. 0
3/20/14

230C-2 GLOVE BOX
BASE SUPPORT
BOTTOM VIEW

HEC
 HEC-SD-CP-ER-043, Rev. 0
 8-17-47

1406
 MIC-SD-CP-ER-043, Rev. 0
 20707

230-C-2 GLOVE BOX

1444
 WTC-SD-CP-ER-043, Rev. 0
 200-47

200-C-2 GLOVE
 BOX

HMF
 HMC-SD-CP-ER-043, Rev. 0
 10-7-07

Part
LINE-SD-CP-ER-043, Rev. D
8-2-44

230-C-2 GLOVE
BOX

HNF
 HNF-SD-CP-ER-043, Rev. 0
 2-11-47

230-C-2 EQUIPMENT
 ARRANGEMENT

HAF
HAF-SO-CP-ER-043, Rev. 0
n-47

250-C-2 GLOVE BOX

North East View
 B.4.34

230-C-2 GLOVE BOX

8.4.35

South East View

Plan

230-C-2 6100E
Box

230-C-2 GLOVE BOX

RECEIVED
 MATNG DEPT

MAY 08 1996

EST NO _____

* Waste Tanks Should be Vertical -
 See Pg 8 4 37 for Correct Orientation

230-C-2 Product Path

RECEIVED

MAY 09 1996

EST NO _____

* Waste Tanks Should be Vertical -
See Pg 8.4.37 for Correct Orientation

Vent & Vacuum

230-C-2

1/2" TANK 90
PART 2, 3, 1,
well 6, 5, 3, 10, 6, 6, 2
for 1, 1, 1

RECEIVED
FEDERAL DEPT.

MAY 09 1966

EST NO. VENT DRAIN

230-C-2

3/4" - 1" ±
+ 25%

* Waste Tanks Should be Vertical -
See Pg 8 & 37 for Correct Orientation

[Signature]
B 4 42

RECEIVED
 DT

WFA: 0 8 1996

EST NO _____

* Waste Tanks Should be Vertical -
 See Pg 8.4.37 for Correct Orientation

Off-gas, scrub solution & chilled water

230-C-2

-80 TUR OFF-94-

- 3" /
 - 6" /
 - 8" /
 EV-230-4
 1/2" 500g 3-600g 200 1/2" 1, 174
 1/2" 80 11/14 2/ 174

RECEIVED
FED DEPT.

MAY 09 1996

EST NO OFF 615 F CW

11/15/96 2, 25

230-C-2

3/4" = 1' 0" ±
 ADD 156

* Waste Tanks Should be Vertical -
 See Pg 3 & 37 for Correct Orientation

8444
 1070

PRETREATMENT DRAWING LIST

<u>Page</u>	<u>Description</u>
8.4.45a	Flow Diagram EFD PRETREATMENT SYSTEM, Sht 1
8.4.46	EFD RMC LINE HC-7, H-2-93504, Sht 3
8.4.47 thru 8.4.48	HF SCRUBBER SYSTEM P & ID, H-2-97813, Shts 1-2
8.4.49	EFD RMC LINE HC-98, H-2-93504, Sht 5
8.4.50 thru 8.4.51	EQUIP & PIPING ARRGT TOP SECTION HC-98, H-2-24426, Shts 2 and 4
8.4.52	EFD RMC LINE HC-227-S & HC-227-T, H-2-93504, Sht 2
8.4.53	EFD RMC LINE HC-7, H-2-93504, Sht 3 (New System 5/20/96)
8.4.54	HC-7 PIPING ARRANGEMENT PLAN, ELEVATION & SECTIONS, H-2-24554, Sht 1
8.4.55	ROOM AND DOOR NUMBERS (FIRST FLOOR), H-2-80249, Sht 2
8.4.56	ROOM AND DOOR NUMBERS (DUCT LEVEL), H-2-80249, Sht 3
8.4.57	CHEMICAL ADDITION AND SERVICE PIPING DUCT LEVEL RMC BUTTOM LINE, H-2-19251, Sht 1
8.4.58	PROCESS DRAINAGE, H-2-16416
8.4.59	PIPING DUCT SPACE PLAN, H-2-16475

1 HC-227S Load-in Batch

(Nominal Values)

8 PR Cans @ 200 g Pu/PR can

1.5 L 12 M HNO₃ /PR can

Batch size 75-80 L sol'n & 1600 g Pu

(BT-1 & BT-2 used in HC-227S)

2 Column Re-acidification

Nominal 10-14 L of 7.5 M HNO₃

(from recycling wash cycle raffinate from previous IX cycle)

(Flowrate 15-20 L/hr, downflow)

3, 3A Column Loading

Nominal 1600 g Pu/IX Cycle

20 g Pu/L & 7.0 (minimum) M HNO₃ by adding 12 M HNO₃ into ERAT, as required

(Flowrate 8-12 L/hr downflow)

4 Column Wash

7.0-7.5 M HNO₃

14-20 L Wash volume, with last

(10-14 L wash raffinate routed into ERAT/FPT for reacidification on next IX cycle)

(Flowrate 10-15 L/hr, downflow)

5 Concentrated HNO₃ Bun

12 M HNO₃

5-7 L/IX Cycle, added batchwise to ERAT

6 Column Elution

0.35-0.45 M HNO₃

20-30 L/IX Cycle

(Flowrate 10-25 L/hr, upflow)

7 Acidified Eluted Product

25-37 L/IX Cycle

45-65 g Pu/L

2.5 M HNO₃

Collected batchwise in ERAT & transferred to HC-227S for staging as VDC feed

8 Combined IX Cycle Raffinates

< 0.01 g Pu/L

7.0 M HNO₃

Approximately 105 L/IX Cycle, collected batchwise in TK-HF-6-1 or TK-HF-6-2

~~HC~~-SD-CP-ER-043, Rev 0

- PIPING IDENTIFICATION**
- INSTRUMENT PNEUMATIC LINES
 - ELECTRICAL LINES
 - AM ALUMINUM
 - DR DRAIN
 - FB FLAT ON BOTTOM
 - HF FLOOR/INSTRATOR OFF GASES
 - HI HIGH
 - IA INSTRUMENT AIR (30 PSI)
 - KOH POTASSIUM HYDROXIDE
 - LO LOW
 - LSW LOW SALT WASTES
 - NC NORMALLY CLOSED
 - NO NORMALLY OPEN
 - OVFL OVERFLOW
 - PW PROCESS WATER
 - RT RECEIVING TANK
 - SPL SAMPLE
 - SW SANITARY WATER
 - V VENT

- LEGEND**
- SYMBOL DEFINITION
- 1/1 BUTTERFLY VALVE
 - GATE VALVE
 - GLOBE VALVE
 - BALL VALVE
 - BALL VALVE (THREE WAY)
 - BALL VALVE (FOUR WAY)
 - CHECK VALVE
 - DIAPHRAGM OPERATED VALVE (DOV)
 - PRESSURE RELIEF VALVE
 - SOLENOID OPERATED VALVE
 - ELECTRIC MOTOR OPERATED VALVE (THREE WAY)
 - REDUCER
 - RESTRICTING ORIFICE
 - ROTAMETER
 - AGITATOR
 - CONDUCTIVITY ELEMENT
 - PRESSURE SWITCH
 - SPECIFIC GRAVITY
 - TEMPERATURE ELEMENT
 - LOCAL MOUNTED INSTRUMENT
 - PANEL MOUNTED INSTRUMENT
 - MOTOR CONTROL CENTER
 - PUMP
 - RADIATION ELEMENT
 - JET
 - SIGHT GLASS
 - PRESSURE INDICATOR
 - INTERLOCK
 - PLUG VALVE

- LEGEND**
- NEW
 - EXISTING
 - **** DEMO

THIS DRAWING SUPERCEDES DRAWING H-2-27349

ESSENTIAL DRAWING

IMPACT LEVEL 2

DRAWING APPROVALS		DATE		U.S. Department of Energy	
G. L. HARTING		12/82		Research Operations Office	
J. HARTING		12/82		Westinghouse Hazard Company	
BY	DATE	BY	DATE	HF SCRUBBER SYSTEM P & ID	
G. L. HARTING	12/82	G. L. HARTING	12/82		
J. HARTING	12/82	J. HARTING	12/82		
REVISIONS				NONE	
H-2-27349				234-52	
H-2-27349				7001	
H-2-27349				H-2-97813	
H-2-27349				12/82	

DRAWING TRACKABILITY LIST		REFERENCE DRAWINGS		NEXT USED ON		DRAWING STATUS	
NO.	DESCRIPTION	NO.	DESCRIPTION	NO.	DESCRIPTION	NO.	DESCRIPTION
H-2-27349	ENG FLOW DIAGRAM	H-2-27354	PIPING AND EQUIP. MOUNTING	H-2-97810		H-2-97810	
H-2-27349	ENG FLOW DIAGRAM	H-2-27354	PIPING AND EQUIP. MOUNTING	H-2-97810		H-2-97810	

WHE-SD-CP-ER-043, Rev 0
8.4.47

NOTE:
FOR LEGEND INFORMATION
SEE SHEET 1.

THIS DRAWING
SUPERSEDES
DRAWING
H-2-27350

LEGEND

- NEW
- EXISTING
- *** DEMO

ESSENTIAL DRAWING

H-2-27352		ORGANIC WASTE PIPING ARRANGEMENT IN 222		7		REDRAWN PER ECH 148673		U.S. DEPARTMENT OF ENERGY	
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NO.	DESCRIPTION	DATE
1	CRITICALITY SAFETY APPROVAL	10

IMPACT LEVEL 2

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1	CRITICALITY SAFETY APPROVAL	10

NO.	DESCRIPTION	DATE
1	CRITICALITY SAFETY APPROVAL	10

NO.	DESCRIPTION	DATE
1	CRITICALITY SAFETY APPROVAL	10

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NO.	DESCRIPTION	UNIT	QTY
1	CONCRETE	CU YD	1.00
2	STEEL	LB	100.00
3	BRICK	SQ YD	1.00
4	CEMENT	CU YD	1.00
5	GRAVEL	CY	1.00
6	SAND	CY	1.00
7	WATER	CU YD	1.00
8	PIPE	LB	100.00
9	VALVE	EA	1.00
10	FLANGE	EA	1.00
11	BOLT	EA	100.00
12	NUT	EA	100.00
13	WASHER	EA	100.00
14	CONCRETE	CU YD	1.00
15	STEEL	LB	100.00
16	BRICK	SQ YD	1.00
17	CEMENT	CU YD	1.00
18	GRAVEL	CY	1.00
19	SAND	CY	1.00
20	WATER	CU YD	1.00
21	PIPE	LB	100.00
22	VALVE	EA	1.00
23	FLANGE	EA	1.00
24	BOLT	EA	100.00
25	NUT	EA	100.00
26	WASHER	EA	100.00
27	CONCRETE	CU YD	1.00
28	STEEL	LB	100.00
29	BRICK	SQ YD	1.00
30	CEMENT	CU YD	1.00
31	GRAVEL	CY	1.00
32	SAND	CY	1.00
33	WATER	CU YD	1.00
34	PIPE	LB	100.00
35	VALVE	EA	1.00
36	FLANGE	EA	1.00
37	BOLT	EA	100.00
38	NUT	EA	100.00
39	WASHER	EA	100.00
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43	CEMENT	CU YD	1.00
44	GRAVEL	CY	1.00
45	SAND	CY	1.00
46	WATER	CU YD	1.00
47	PIPE	LB	100.00
48	VALVE	EA	1.00
49	FLANGE	EA	1.00
50	BOLT	EA	100.00
51	NUT	EA	100.00
52	WASHER	EA	100.00
53	CONCRETE	CU YD	1.00
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58	SAND	CY	1.00
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64	NUT	EA	100.00
65	WASHER	EA	100.00
66	CONCRETE	CU YD	1.00
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77	NUT	EA	100.00
78	WASHER	EA	100.00
79	CONCRETE	CU YD	1.00
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90	NUT	EA	100.00
91	WASHER	EA	100.00
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IMPACT LEVEL 2

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1. What is the purpose of the study?

1. What is the purpose of the study?

 

— 코팅이 가능 / 코팅 후 건조 시간 10~15분

7720 2024/01/10 10:00 AM
7720 2024/01/10 10:00 AM

1. THE STATE OF TEXAS, County of EL PASO, do hereby certify that JOSEPH A. GARCIA is the holder of a valid and subsisting license to practice as a REAL ESTATE BROKER in this State, under and by virtue of the authority conferred upon him by the State of Texas, and that he is duly qualified to perform the duties of said office.

INST. AIR

"ORIGINAL DWG
POOR QUALITY"

$$\underline{D_{11}C = \frac{5m + 6m}{2} = 5.5m}$$

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B.5 STATEMENT OF WORK

B.5.1

STATEMENT OF WORK

PROJECT C-226

PF3 SOLUTION STABILIZATION

OPERATING CONTRACTOR: Westinghouse Hanford Company

PREPARED BY: D. L. Koreis DATE: June 1996

1. OBJECTIVE

The operating contractor shall be responsible for providing daily project management services and operational support services for Project C-226 to the U.S. Department of Energy, Richland Operations Office (RL). The operating contractor project management responsibilities will include, but not be limited to, daily management of technical and construction efforts, overall planning, status reporting, implementation of an approved Quality Assurance (QA) program and documentation for all phases of the project. The operational support services will include, but not be limited to, engineering reviews, training requirements, maintenance requirements, operational testing and start-up.

II. TASKS - PROJECT MANAGEMENT

A. GENERAL

Act as a liaison with RL during the design, construction, and project closeout. Provide to RL project information to facilitate surveillance and evaluation of project execution.

1. Provide the daily management responsibilities for the project.
2. Provide to RL, as necessary, copies of all project correspondence, reports, design sketches, nonconformance reports, schedules, cost estimates, QA program, Engineering Change Notices, subcontracts, work orders, meeting minutes, test procedures, etc.
3. Provide to RL immediate notification of accidents, incidents, significant problems, work stoppages, etc.
4. Provide direction and assistance for efforts accomplished by onsite and offsite contractors.
5. Provide the administration of project baseline change control.
6. Act as a focal point for coordination among all contractors, as necessary.
7. Update all project documents, control media, reports, schedules, and cost summaries as new information becomes available.

8. Provide to RL timely notification of meetings, tests, final inspections, etc.
9. Prepare data for project reviews and reports.

B. DESIGN

1. Establish project files responsibilities and requirements.
2. Approve design schedules consistent with project requirements.
3. Provide or concur with engineering reports, as required.
4. Assure accurate as-built sketches are prepared.
5. Stress cost effectiveness in developing criteria, requirements, and controls during project design.
6. Provide technical direction and assistance for design accomplished by the Architect-Engineer (A-E).
7. Provide for a timely and thorough review of design media.
8. Assure the development and implementation of a comprehensive, integrated project QA/Quality Control/Inspection Plan.
9. Assure the preparation of a Fair Cost Estimate.
10. Coordinate the onsite construction contractor to assure constructibility.

C. PROCUREMENT

1. Initiate documentation to procure long lead and engineered equipment.
2. Assure procurement plans and schedule are consistent with project schedule requirements.
3. Assure procurement documents have the appropriate QA requirements and that comprehensive vendor surveys have been performed.
4. Coordinate the participation of QA and other cognizant project team personnel during procurement and in factory testing activities.

D. CONSTRUCTION

1. Approve construction schedules consistent with project requirements.
2. Provide and/or concur with construction reports, as required.
3. Participate and concur with final inspection and acceptance testing and accept completed facilities for operation.
4. Ensure industrial and nuclear safety at the construction site.
5. Issue excavation, drilling, tie-in, welding and cutting permits to the onsite construction contractor. Approve radiation work procedures, if required, initiated by the onsite construction contractor.
6. Provide technical direction and assistance, as applicable, on construction accomplished by the fixed-price contractor and the onsite construction contractor.
7. Provide coordination between existing facilities and construction forces to minimize interferences and facilitate construction work. Ensure user submittal review, as appropriate.
8. Review vendor submittals and provide comments to the A-E.
9. Prepare project closeout documents and obtain the required approvals.
10. Arrange for disposition and storage of project records.

E. ENVIRONMENTAL

1. Record of Decision for the Environmental Impact Statement was approved June 1996.
2. Ensure the preparation, coordination and approval of all local, State and Federal permits.
3. Ensure the design/construction complies with applicable National Environmental Policy Act/safety documentation/permits.
4. Assist in scheduling project status/information meetings with local, Federal and State environmental agencies.

III. TASKS - OPERATIONAL SUPPORT - OTHER PROJECT COSTS

1. Conceptual Design Phase

- Coordinate and manage conceptual design phase.
- Provide engineering studies.
- Provide Functional Design Criteria.
- Complete conceptual design.

2. Definitive Design Phase

- Provide technical services and reviews during definitive design.

3. Procurement

- Provide technical services and reviews.

4. Construction

- Provide facility engineering.
- Provide operations support.
- Provide Radiation Control Technician support.
- Provide Solid Waste engineering support.
- Provide work control.
- Complete Readiness Assessment.
- Provide Acceptance Test Procedure/Operational Test Procedure support.

5. Testing

- Pressure testing for glove box HC-227 T&S equipment/piping/glove box.
- Contamination reduction in HC-7 glove box.
- Pressure test HC-7 glove box.
- Pressure test HC-9B piping and glove box.
- Pressure test HA-46 glove box, piping and storage tanks.
- Vacuum test glove box transfer lines. Replace leaking transfer lines.

6. Provide planners for work control

ENGINEERING STATEMENT OF WORK

FOR TITLE I DESIGN

**PROJECT C-226 PLUTONIUM FINISHING PLANT
SOLUTION STABILIZATION**

**PREPARED BY : ICF KAISER HANFORD COMPANY AND WESTINGHOUSE HANFORD
COMPANY.**

DATE : JUNE 26, 1996

1.0 SCOPE

This statement of work addresses the engineering activities to be performed by the Westinghouse Hanford Company (WHC)/ICF Kaiser Hanford Company (ICKH) design team in the design of the direct denitration process to be installed at the Plutonium Finishing Plant (PFP) as part of the 94-1 program. The scope of work consists of installation of a new glovebox containing the denitration process in building 234-52 room 230C, installation of a new process liquid transfer line between glovebox HC-227-S and the new process glovebox located in room 230C, installation of a pretreatment system in gloveboxes HC-7C, HC-9B, and HA-46 (including the HA-46 mini canyon piping modifications), glovebox HC-227-T, HC-227-S and HC-7C seismic upgrades, installation of electrical power to the new denitration glovebox from an existing panelboard in room 235B, provision for instrument air, process vacuum, caustic solution, acidic solution and E-4 ventilation for the new process glovebox.

2.0 DESIGN BASIS

The design basis documents for the project and this statement of work are:

1. WHC-SD-CP-FDC-003, Rev. 0, Functional Design Criteria, PFP Solution Stabilization, April 1996.
2. WHC-SD-CP-ER-043, Rev. 0, Engineering Report, PFP Solution Stabilization, June 1996.
3. WHC-SD-CP-PHA-001, Rev. 1, Hazards and Operability (HAZOP) study, PFP Solution Stabilization, June 1996.
4. Drawing H-4-109252, 9 sheets, Rev. 2&3, Titled Receiving and Storage (44-01) Enclosure, September 1986.
5. Drawing H-4-109382, 2 sheets, rev. 0, Titled Receiving and Storage (44-01) Support Structure, March 1984.

3.0 SCOPE OF WORK

3.1 The defined scope of work for the mechanical design of the project is:

1. Preparation of Piping and Instrument Diagrams.
2. Preparation of glovebox 230-C-2 installation drawings.
3. Preparation of Encasement installation drawings.
4. Preparation of room 230C arrangement drawings detailing E-4 ventilation and service piping routing.
5. Preparation of Duct Level arrangement detailing service piping routing to room 230C.
6. Preparation of installation drawings for chilled water system.
7. Preparation of arrangement, elevation, section and detail drawings for process equipment installation into glovebox 230-C-2.
8. Preparation of arrangement, elevation, section and detail drawings for modification to existing systems and equipment installation into gloveboxes HC-7C, HC-9B and HA-4B.
9. Preparation of Seismic Upgrade drawings detailing recommended seismic restraints for gloveboxes HC-7C, HC-227-T and HC-227-S.
10. Preparation of Vessel/Tank fabrication drawings.
11. Preparation of Calciner fabrication drawings.
12. Preparation of Piping fabrication support drawings.
13. Preparation of fabrication drawings for structural modification of glovebox 230-C-2.
14. Preparation of glovebox seismic support analysis for gloveboxes HC-7C, HC-227-T, HC-227-S and 230-C-2.
15. Preparation of chiller, pump, and valve purchase specifications/data sheets.
16. Preparation of construction specification.
17. Preparation of PFP ECN's to install system.

3.2 The defined scope of work for the electrical/instrumentation design of the project is:

1. Preparation of elementary diagrams for Calciner controls.
2. Preparation of room 230C physical modification drawings for glovebox and building connections.
3. Preparation of room 235B panel board layouts and conduit routing.
4. Preparation of room 230A building connections and computer interface.
5. Preparation of room 230C terminal box and glovebox connection diagrams.
6. Preparation of room 235B relay panel connection diagram.
7. Preparation of room 230A terminal box connection diagram.
8. Preparation of HC-7C P&ID.
9. Preparation of HC-7C elementary diagram.
10. Preparation of glovebox HC-7C physical modification and conduit drawings.
11. Preparation of RMC control room physical modification drawings.
12. Preparation of Glovebox HC-7C modification connection diagram.

13. Construction specification input.
14. Component specification/data sheets.

4.0 DELIVERABLES

4.1 Deliverables for the project shall consist of the following:

1. Drawings in sufficient detail to allow component fabrication, facility modification and system installation of the denitration process into the PFP.
2. Specifications in sufficient detail to purchase equipment, fabricate components and assemble systems as required.
3. Analysis in sufficient detail to verify the design requirements as specified by the Functional Design Criteria.

8.6 MILESTONE TRP-9A-410 COMPLETION LETTER

CORRESPONDENCE DISTRIBUTION COVERSHEET

Author	Addressee	Correspondence No.
L. H. Rodgers, WMC	J. E. Mecca, RL	9651687

Subject: COMPLETION OF THE SOLUTION STABILIZATION DEVELOPMENT PROGRAM,
 MILESTONE TRP-96-410

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P.O. Box 1970 Richland, WA 99352

April 12, 1996

9651687

Mr. J. E. Mecca, Director
Transition Program Division
U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352

Dear Mr. Mecca:

**COMPLETION OF THE SOLUTION STABILIZATION DEVELOPMENT PROGRAM,
MILESTONE TRP-96-410**

Reference: Letter, E. C. Vogt, WMC, to J. E. Mecca, RL, "Completion Of Milestone TRP-96-415 Complete Engineering Study Of Vertical Calciner," 9650429, dated January 29, 1996.

Westinghouse Hanford Company (WMC) has completed the development testing of the solution stabilization program as described in milestone TRP-96-410. WMC finds that the plutonium solutions in the Plutonium Finishing Plant's (PFP) inventory can be stabilized through the use of a vertical denitrator/calciner. A prototype vertical denitrator/calciner has been tested and shown to easily produce an acceptable plutonium oxide product meeting the loss on ignition requirement in DOE-STD-3013. WMC is proceeding with the design and installation of a production model vertical denitrator/calciner at PFP to convert the approximate 4800 liters of solution to solid plutonium oxide.

The vertical denitrator/calciner development activity supporting the solution stabilization program was completed on April 4, 1996, with the final product loss on ignition test result available on April 8, 1996. The testing encompassed plutonium nitrate solutions with concentrations between 30 and 320 grams per liter. The product from the calciner was a dry, coarse and free flowing powder. The product exhibited loss on ignition (950°) values of less than 0.25% meeting the requirement of DOE-STD-3013. The topical summary report documenting these tests is provided as attachment 1. The testing demonstrated that the calciner can stabilize the wide range of solution concentrations in PFP's inventory. Based upon this testing PFP has selected the vertical denitrator/calciner as the stabilization method of choice and is proceeding with design. Installation and operation of this process will proceed consistent with ongoing National Environmental Protection Act activities.

As an alternative stabilization method to the calciner, precipitation tests were performed to evaluate magnesium oxide as precipitating agent for the plutonium solutions. The testing differed from the Los Alamos National Laboratory approach in that precipitation was performed using plutonium valance four solutions. The results of the testing is that adequate precipitant are formed in the valance four process. The oxyhydroxide precipitant was fired at 1000° and produced loss on ignition values of less than 0.5%. The topical summary report documenting these tests is provided as Attachment 2. The precipitation process was not selected as the prime stabilization method as it requires added handling and thermal stabilization in the muffle furnaces to produce a product meeting the DOE-STD-3013 requirement. The additional processing, induced worker exposure and costs provides no advantage over the denitrator/calciner process.

The calciner and precipitation processes require feed solutions that have little alkaline metals and ions as contaminants. Two approaches to the removal of these contaminants were tested, ion exchange and extraction chromatography. The primary differences between these two methods are the resin compositions and the elution agents with extraction chromatography using formic acid and ion exchange using nitric acid. Both processes produced product solutions in the 30 to 50 gram per liter concentration range. The equipment required for either process consists of a resin bed column, feed, waste, and product receiver tanks and connecting pipes and pumps. The extraction chromatography topical summary report is documented as attachment 3 and the ion exchange topical summary report is documented as attachment 4.

The production vertical denitrator/calciner is expected to stabilize the solution inventory within approximately one year of start up. PFP will continue to use the prototype vertical denitrator/calciner to demonstrate that the design modifications described in MHC-SD-CP-TA-009 (provided in the reference) perform as intended before the production design is brought on line. The prototype denitrator/calciner will also be run to provide operator training and finalization of the production flow sheet and procedures within PFP Safeguard and Security restraints.

PFP will evaluate discard of low assay solutions as a preferred approach to certain categories of solutions. PFP will provide the required documentation for your approval before the solution is discarded. Additionally, the production calciner installation schedule is being reviewed to determine where acceleration of discard activities can be obtained. The calciner and the feed preparation process installation schedule is being reviewed to determine areas of acceleration that permit conclusion of the solution stabilization activities well before the January 1999 milestone completion date.

Mr. J. E. Mecca
Page 3
April 12, 1996

9651687

If you have any questions regarding this matter, please contact
Louis H. Rodgers of my staff on 373-2185.

Very truly yours,

E. C. Vogt, Director
PFP Transition Projects

Ing

Attachments (4)

RL - R. Bocanegra
W. D. Seaborg
D. W. Templeton
A. H. Wirkkala

ATTACHMENT 1

9651687

EVALUATION OF THE VERTICAL CALCINER FOR STABILIZATION OF
PLUTONIUM NITRATE SOLUTIONS

Consisting of 10 pages, including coversheet

1408
SD-CP-ER-043, Rev. 0
100-7256

**EVALUATION OF THE VERTICAL CALCINER FOR
STABILIZATION OF PLUTONIUM NITRATE SOLUTIONS**

F. D. Fisher and J. A. Compton

1. INTRODUCTION

The mission for the Plutonium Finishing Plant (PFP) has changed from weapons production to stabilization of the remaining plutonium for storage. Methods to stabilize plutonium in solutions, primarily plutonium nitrate solution, are now being developed. One solution stabilization method being developed is a vertical calciner using the direct denitration process (master drawing SK-2-300303).

The vertical calciner maintains a heated, stirred bed of plutonium dioxide (PuO_2), upon which incoming feed solution is dispersed, thus avoiding the formation of very thick, sticky decomposing slurries. The direct denitration process minimizes waste by requiring no additional chemicals for the calcination step. Alkali metals must not be present in the feeds in gross amounts as their nitrates melt below the calciner operating temperature and may not decompose rapidly to solids at the calciner operating temperature. Where those are present in gross amounts, pretreatment to effect their removal may be necessary.

2. PURPOSE

The vertical direct denitration calciner has been tested to demonstrate that this equipment and process converts plutonium solutions to dry, storable PuO_2 powder while preventing the powder from entering the off-gas treatment system. The testing also showed that the chiller-scrubber successfully cools and removes essentially of the acid gases from the decomposition of the plutonium nitrate and aqueous nitric acid in the calciner feed.

3. SCOPE

Initial tests used non-radioactive cerous nitrate solution fed into a bed of ceric oxide. Current tests use plutonium nitrate solutions of varying plutonium and nitric acid concentrations and a starting bed of previously stabilized PuO_2 . The plutonium and acid in the feed are not controlled to any particular concentrations because the calciner feeds are limited to only the solutions available within the PFP and the acid concentration has minimal or no effect on calcination. Relatively pure plutonium nitrate solutions ranging from 30 to 321 g Pu/L have been processed to date.

4. SUMMARY

The non-radioactive tests showed that the calciner could be heated and operated at the intended temperature of 1000°C while converting the cerous nitrate solution to a dry ceric oxide powder. The scrubber operated as intended with little or no NO_2 visible in the final gas stream.

Tests with plutonium have shown that plutonium nitrate solutions are converted to a dense, dry PuO_2 powder that meets the required storage criterion of less than 0.5 weight percent loss on ignition (LOI). Processing rates have been lower than desired due to underpowered heaters; however, those heaters are being upgraded. There is very little visible NO_2 leaving the off-gas system. Plutonium concentrations in the spent scrub solution have been less than 1 milligram per liter (1 ppm).

5. PROCESS DESCRIPTION

This calciner is used to convert plutonium nitrate solution into stable, storable plutonium dioxide powder. The conversion is accomplished by heating to (1) boil off the liquids, (2) decompose the nitrate anion, leaving only oxide particles, and (3) improving the properties of those particles by heat treatment at appropriately high temperatures.

All salt nitrate materials undergo thermal decomposition to oxides at some temperature. The heavy metal nitrates undergo such thermal decomposition readily. The trick with those nitrates is to avoid permanent agglomeration during the conversion when solutions, molten nitrates, and oxides are all present. With plutonium nitrate solutions, as well as with uranyl nitrate and thorium tetranitrate, the conversion can be performed readily by assuring the absence of a continuous liquid phase at all times. In this vertical calciner, plutonium nitrate feed solution is injected at a controlled rate with a controlled flow rate of air into the bottom of the calciner. The calciner contains a pre-made bed of plutonium dioxide powder that has been heated to 1000°C while being agitated. The nitrate solution sprays onto the hot, moving particles of oxide in a thin layer. This layer quickly dries due to the high starting temperature and the close proximity of the heated calciner walls. The resulting layer of crystalline plutonium nitrate decomposes to oxide and NO_2 . The newly formed oxide increases the particle size and, eventually, the bed volume. The particles are moved around the annular section of the calciner by the agitator, which allows them (1) to receive new feed spray from the feed nozzle and repeat the growth and (2) to be heated to ever higher temperatures as the larger particles work their way upward in the bed. Eventually, the particles reach the top of the bed and fall into a tube leading to the product collector. Having no continuous liquid phase also almost eliminates corrosion of the calciner structural components.

The water vapor, nitric acid vapor, decomposition gases, and atomizing air flow upward through the bed and out the top of the calciner. These gases pass through sintered ceramic filter elements to remove any entrained plutonium dioxide powder, then are transported by vacuum into a chilled scrubber. The scrubber cools the gases to condense most of the water vapor and any nitric acid vapors. The scrubber uses a recirculating caustic solution to react with the decomposition gases, reducing most of them to soluble salts. Caustic solution is metered continuously into the scrubber to maintain the desired caustic concentration.

The scrubber is designed with an internal chimney-shaped "draft tube" to induce a recirculation pattern as the gases pass through. A liquid/gas mixture flows upward through the inside of the draft tube and downward on the outside with some of the gas bubbles still entrained. The draft tube is made from a single tightly coiled tube through which chilled

water circulates. The tight coiling minimizes the amount of scrub solution passing directly from the inside to the outside of the draft tube, which would decrease the recirculation effect. Gases and entrained scrub solution exit the liquid at an open area in the top of the scrubber, then pass out of the scrubber through an overflow tube along with part of the reacted scrub solution.

This gas/liquid mixture flows into one of two tanks where the phases separate. The gases exit continuously from the top of the separation tank and pass through a dedicated vacuum trap.

6. EQUIPMENT DESCRIPTION

The vertical calciner is built from high chromium, high nickel Type 310S stainless steel. The calciner has an annular design with a 6-inch sch. 10 pipe outer shell and an inner shell of 4-inch sch. 10 pipe. The top of the inner shell is a dome shaped pipe cap. Solids inside the calciner are mixed and moved by a 4-tine agitator that fits inside the annulus, covers the dome, and extends out the top center of the apparatus. A chain drive connects the top of the agitator shaft to a drive motor. The agitator shaft is supported in the top plates by two graphite bushings and a stuffing box gland. The volume available for powder inside the annulus is 1.0 L at the design powder overflow depth of 4 inches.

The calciner is heated by two heater elements. A small heater fits under the dome and next to the product outlet tube. This heater produces 1100 W to keep the inner wall of the annulus heated. The second heater fits around the exterior wall of the annulus like a doughnut, but in two separated halves. These heaters produce 6000 W.

The calciner's heated portion is insulated by the outer furnace insulation and a bottom mineral wool blanket. The upper barrel is insulated by dead air spaces contained between 17 concentric stainless steel cylinders.

The heaters are controlled by programmable proportional-integral-derivative controllers and silicon-controlled rectifiers. Input to the temperature controller is from a Type K thermocouple set against the calciner outer wall about halfway up the calcining chamber.

The calciner outer wall extends above the dome and contains 3 blow-back filter elements and a pressure relief device. The filters are sintered ceramic elements with a nominal 5-cm diameter and 30-cm length. The elements are designed to remove over 99 percent of particles larger than 2 micron diameter. A programmable timer controls pulses of 65 psig air through venturis to clean the elements individually by reversing the flow direction.

The scrubber uses a recirculating caustic solution to cool the gases from the calcining process while reacting and removing any acidic gases. Gases enter the scrubber at the top, flow down through a quartz glass tube, form bubbles at the base, and flow upward through the flowing scrub solution. The recirculating pattern of the scrub solution is sufficient to entrain some of the bubbles and recirculate them. Eventually, the non-reacted gases and the scrub solution overflow from the scrubber into tanks where the two phases separate. The scrubber

is 112 cm tall with a nominal diameter of 15 cm. A 10-cm-diameter "draft tube" made of tightly coiled tubing serves as the barrier between upward and downward flowing areas of the recirculating scrub solution. This coil is made of 1/2-inch tubing and also contains the cooling water that recirculates between the scrubber and a separate chiller.

7. NON-RADIOACTIVE TEST RESULTS

Table 1, "Non-Radioactive Test Results," lists the results from non-radioactive ("cold") testing. These tests were intended to confirm that the calciner would heat to its intended operating temperature of 1000°C and convert a feed solution into a dry powder.

Runs C1 and C2 were intended to heat the calciner gradually to an intermediate (450°C) and the (then) final operating temperature of 800°C to determine any mechanical problems before increasing the heat loading by adding feed. These runs were completed with only minor mechanical problems. The agitator shaft seized near the end of Run C1 when a silicon carbide bushing broke. The breakage was caused by higher than expected thermal expansion in the agitator shaft. This bushing was replaced by one with a larger internal diameter.

Run C2 heated the calciner to 800°C and maintained that temperature for one hour. The agitator was not turned on during Run C2 due to uncertainty in the new bushing's ability to maintain alignment with the larger clearance.

Runs C3A-C3C were three attempts to feed water into a bed of powder at 800°C. The first attempt (C3A) used a bed of magnesium oxide (MgO), which was too light. The air flowing into the calciner suspended a good portion of the powder. The suspended MgO and the steam combined to plug the off-gas filters. The steam was forced out the pressure relief cap whenever the blow-back system pulsed. The MgO was removed and the calciner and filters cleaned after that run. This run also revealed configurational problems in the calciner heating system. Runs to date used a thermocouple on the bottom plate of the calciner to control the heating system; this location was too distant from the heaters to allow quick reaction to heater outputs. The outer wall was heated to 925°C by the time the bottom plate reached 800° in Run C2. The control point was switched to a spot on the calciner outer wall after Run C3A. This change no doubt helped prevent severe overheating in the calciner walls when the normal operating temperature was raised to 1000° for Run C5 and subsequent runs. One other change after Run C3A was the agitator drive motor replacement, raising the input power to 1/4 hp from 1/12 hp.

Runs C3B and C3C used a bed of ceric oxide powder (CeO₂), which is significantly more dense than MgO but still not as dense as PuO₂. Run C3B had intermittent shaft rotational problems and ended when the agitator shaft seized at 800°C. After realigning the shaft, Run C3C was completed with no operating problems. Normal operating temperature of 800°C was maintained at a feed rate of 3.5 L/hr, which was higher than expected with the underpowered heaters at the time.

TABLE 1

NON-RADIOACTIVE TEST RESULTS

Run #	Operating Temp, °C	Feed Rate L/hr	Feed Type	Bed Material	Feed Con gm/L	Run Duration hr	Feeding Duration hr	Volume Fed, L	Mass Fed (Metal) gm	LOI wt. %
C1	500	N/A	None	None	N/A	6.57	N/A	N/A	N/A	N/A
C2	800	N/A	None	None	N/A	6.95	N/A	N/A	N/A	N/A
C3A	800	1	Water	MgO	N/A	4.35	0.17	0.17	N/A	N/A
C3B	800	1	Water	Ceric Oxide	N/A	2.7	0	0	N/A	N/A
C3C	800	1.5 - 3	Water	Ceric Oxide	N/A	3.8	1.0	3.0	N/A	N/A
C4	800	3	Cerous Nitrate	Ceric Oxide	54.6	1.12	1	3.91	213	0.571
C5	1000	1.5 - 3	Cerous Nitrate	Ceric Oxide	54.6	6.43	2.42	5.69	311	0.571
C6	1000	2.35	Water	Ceric Oxide	N/A	8.25	1.84	3.97	N/A	N/A
Totals	N/A	N/A	N/A	N/A	N/A	40.17	6.43	16.74	524	N/A

N/A
 MFC-SD-CP-ER-043, Rev. 0
 6/27/79

Run C4 commenced immediately at the end of Run C3C rather than allow the calciner to cool and reheat on another day. The introduction of cerous nitrate ($\text{Ce}(\text{NO}_3)_3$) solution had no new effect on the calciner compared to the water just processed. This run, too, was completed with no operating problems at a 3.5 L/hr feed rate.

After direction to change the normal operating temperature from 800° to 1000°, Run C5 used a varying feed rate between 1.5 and 3 L/hr and finished the available feed supply of cerous nitrate solution. The heating system would not maintain 1000°C at the starting feed rate of 3 L/hr. Experimental adjustments at the feed pump revealed that 1000° could be maintained at 2.44 L/hr but not at 2.56 L/hr. The CeO_2 product collected from Runs C4 and C5 was sampled and determined to have an LOI of 0.571 wt. percent. This LOI is higher than the allowable limit of 0.5 wt. percent; however, (1) the product was CeO_2 , not PuO_2 , and doesn't necessarily calcine identically and (2) the operating temperature during some of its production was 800°C, not the 1000° for Run C5.

Run C6 was performed to confirm the operation of a new agitator assembly. Roughly 4 L of water were fed into the CeO_2 bed for that run at a rate of 2.35 L/hr while maintaining 1000°C. No new operating problems were encountered.

8. RADIOACTIVE TEST RESULTS

The basic premise of the vertical calciner for direct denitration processing of plutonium nitrate solutions - viz. that various plutonium nitrate solutions can be injected into a very hot stirred bed of plutonium dioxide and thereon undergo evaporation, drying, and thermal decomposition to stable, storable plutonium dioxide powder - has been amply demonstrated. Table 2, "Plutonium Solution Calcination Results," shows the calciner has processed 3432 gm of plutonium from nitrate solution to storable oxide using feeds ranging from 30-321 gm Pu/L and briefly at more dilute concentrations. The feed in Runs Pu3A-C and Pu4A-B also contained significant quantities of solids that were handled successfully by the feed injection system.

Also demonstrated was the successful delivery of those powders to a cool product receiver in a readily handleable form - powder of moderate to high density ranging from 3.5 - 4.6 gm/cc, not dusty, free flowing, and exhibiting Losses On Ignition (LOI) at 950°C of 0.22 to 0.44 weight percent. The product with the LOI of 0.44 wt. % was old and had been resident in the calciner's unsealed product receiver for several months. The last powders collected in the product receiver vessel exhibited LOIs of 0.22 and 0.24 wt. %. The test conditions leading to these results are also shown in Table 2. Readers are cautioned, however, that the LOI values shown are not necessarily directly related to the run conditions listed. The extent of powder mixing within the calciner during operation is unknown and the calciner could contain 3500 to 4500 grams of plutonium at any time, depending on powder density. The powder delivered during any given run could be all from a previous run's feed or it might be a mixture from previous and current feed. The consistently low LOI values for all feeds indicate that the amount of mixing is probably moot.

TABLE 2

PLUTONIUM SOLUTION CALCINATION RESULTS

Run #	Operating Temp. °C	Feed Rate, L/hr	Feed Conc. gm Pu / L	Run Duration, hr	Feeding Duration, hr	Volume Fed, L	Pu Mass Fed, gm	LOI, wt. %
Pu1	1000	2	30	5.67	3.25	4.03	120	0.439
Pu2	1000	2	10-30	7.5	3.72	6.33	163	0.439
Pu3A	1000	2	117	1.17	0	0	0	N/A
Pu3B	1000	4	117	4	0.02	0.04	5	0.289
Pu3C	1000	4	117	0.08	0	0	0	N/A
Pu4A	1000	0	105	5	N/A	N/A	N/A	N/A
Pu4B	1000	0	105	6	N/A	N/A	N/A	N/A
Pu5A	1000	3.2	105	2.7	0.6	1.4	142	0.289
Pu5B	1000	3.2	105	3.5	1.2	3.8	400	0.289
Pu6	1000	3.2	125	5.6	3	9.5	1184	0.218
Pu7A	1000	4	321	2.5	0.3	0.5	160	Rained
Pu7B	1000	1 - 2	321	5.5	2.75	3.9	1258	0.243
Totals	N/A	N/A	N/A	49.22	14.84	29.5	3432	N/A

 HNF-SD-CP-ER-043, Rev. D
 8/6/13

Little product powder was delivered during early runs as the starter bed material, roasted RMC Line sludges with about 75 % PuO_2 , densified under the mechanical working and high temperatures in the calciner. The bulk density of the bed increased from 2.4 gm/cc to over 4 gm/cc with the bed shrinking accordingly to well below the product powder overflow height. Normal product deliveries began partway through Run 6.

The vertical calciner has experienced difficulties in three areas - the agitator drive, the feed nozzle, and the circumferential outside furnace. The agitator drive problem was traced to the two plates at the top of the calciner. The as-designed calciner top head and filter tubesheet flanges shifted relative to one another (about 1 mm) during operation, thus leading to binding of the agitator shaft in the misaligned penetrations through the two flanges. After the top flange was modified to allow it to be drawn down firmly onto the bottom flange, no further difficulties were experienced with the agitator drive. Two new flanges with positive alignment provisions and line-bored penetrations and bearing housings will further preclude problems with the agitator drive.

The feed nozzle has experienced problems from plugging due to both the feed solution and materials from the starting powder bed. Experience with the original external mix nozzle and with an internal mix nozzle both encountered plugging that backed pump feed solution up into the air supply line. In one case (Run Pu7A), the backed-up feed was introduced as a slug into the very hot calciner when the plug broke free due to working of the nozzle cleanout needle. That slug of feed vaporized rapidly, causing a pressurization of the calciner. The pressure was relieved through the pressure relief device, as designed, releasing steam, NO_2 , and a small amount of PuO_2 powder into the glovebox. The vapors and gases were removed quickly and safely by the glovebox ventilation system. The PuO_2 was recovered for transfer to the solids stabilization furnaces. A bubble-tight check valve and a rotameter have been installed in the air supply line near the feed nozzle to preclude introduction of feed into the air line. The nozzle proper has been returned to the original external mix configuration with a seize-resistant gland on the cleanout needle to allow its tip to be withdrawn below the feed injection point during operation and returned to the bottom of the powder bed whenever feed is not being introduced. Operation of the agitator only when the atomizing air is flowing has eliminated plugging of the nozzle with material from the powder bed.

The problem with the circumferential outer furnace has been breakage of the heater elements. This furnace uses rather small SuperKanthal resistance elements made of molybdenum disilicide (MoSi_2) ceramic that is very brittle when cold. The heat transfer characteristics of the calciner are such that to transfer enough heat into the calciner shell at 1000°C , the furnace elements operate at about 1600°C , which is the service limit. Most of the element failures have occurred at room temperature from mechanical damage; one occurred when elements shorted out to the calciner shell with a controller thermocouple probe; and one failure occurred when an element warped, contacting the calciner shell at a very high power level.

A great increase in furnace availability was effected by changing from the original two multiple hairpin elements to fourteen individually hung hairpin loop elements, where elements can be individually replaced or up to two can be shunted around. Currently, these individual hairpin elements are not anchored at their bottoms and may warp out to touch the calciner shell at very high power levels. A new furnace with light restraints on the bottoms of the individual hairpins is being prepared. That furnace is expected to operate at high power levels, although perhaps not high enough to process the full design feed rate of 4 L/hr at high availability.

The other factors in the design and operation of the calciner have performed well. The accessible surfaces are safely cool to touch. The blowback system has kept the off-gas filters open. The vacuum controller works well. The chiller-scrubber has done a better than adequate job. Both metering pumps work well and the feed metering pump has demonstrated its ability to handle considerable solids in the feed stream. The process controls and control panel have performed adequately.

9. CONCLUSIONS AND RECOMMENDATIONS

The vertical calciner is operating in an acceptable manner and producing product of acceptable quality. Losses On Ignition have met the long-term storage criterion of less than 0.5 weight percent in every batch of plutonium oxide produced to date. There has been no agglomeration of product within the calciner even after an accidental influx of a large amount of liquid. The agitator is operating flawlessly after initial flange alignment problems were corrected and after replacing the original coupling. Preproduction testing needs to continue to confirm that planned design changes improve operation as intended, especially for improving the allowable feed rate. These planned changes include modifications to the calciner head assembly, feed line assembly, and exterior heaters. Further testing is also desirable to help in determining operational life for the calciner and/or its parts and ancillary equipment.

Physical operation of the calciner has been a valuable instructional tool in determining how the equipment should run, where operational problems exist, and how those problems should be corrected. Operation of the calciner by Operations staff working with PPSL staff should be pursued as part of the Nuclear Operator training for the production version of the calciner.

ATTACHMENT 2

9651687

PRECIPITATION OF PLUTONIUM FROM ACIDIC SOLUTIONS USING
MAGNESIUM OXIDE AS A NEUTRALIZING AGENT

Consisting of 6 pages, including coversheet

PRECIPITATION OF PLUTONIUM FROM ACIDIC SOLUTIONS USING MAGNESIUM OXIDE AS A NEUTRALIZING AGENT

S. A. Jones

1.0 INTRODUCTION

The plutonium-containing liquids stored at the Plutonium Finishing Plant (PFP) are primarily nitric acid solutions. Because, plutonium(IV) is only slightly soluble in alkaline solutions ($K_{sp} = 7 \times 10^{-26}$), neutralization of the acid may be used to convert the plutonium to a solid. When sodium hydroxide or potassium hydroxide is added to acidic plutonium-bearing solutions, the Pu(IV) precipitates as a green, gelatinous plutonium hydroxide, $\text{Pu}(\text{OH})_4 \cdot x\text{H}_2\text{O}$, that is reported to be difficult to filter¹. Hydroxide precipitation is not selective for plutonium. Any element that is insoluble in alkaline solution will also precipitate with the plutonium.

Magnesium oxide (MgO) is a very fine, white, odorless powder. MgO combines with water to form magnesium hydroxide ($\text{Mg}(\text{OH})_2$).

Magnesium oxide can also react with hydrogen ions to neutralize the acid.

Magnesium hydroxide is an amorphous powder that is only slightly soluble in water ($K_{sp} = 1.3 \times 10^{-11}$). An aqueous solution saturated with $\text{Mg}(\text{OH})_2$ will theoretically reach a pH of 10.4 based on the solubility product. Due to the common ion effect, the maximum pH is 8.5 for saturated solutions.

Magnesium oxide and magnesium hydroxide are soluble in dilute acid. Addition of either of these solids to an acidic solution will result in dissolution of the solid with simultaneous neutralization of the acid. Neutralization with magnesium hydroxide has been reported to produce a plutonium solid that is more easily filtered than the plutonium hydroxide produced by neutralization with sodium hydroxide or potassium hydroxide¹. Magnesium oxide should work as well. It is important to note that magnesium oxide is added only as a neutralizing agent for the acid. There should be very little magnesium in the solid produced.

2.0 TEST METHOD AND TEST EQUIPMENT

Plutonium-bearing acidic solution was placed in a container and stirred using a Teflon[®]-coated magnetic stir bar and magnetic stirrer. Magnesium oxide was added slowly to the stirred solution until the acid had been neutralized (or until it appeared the solution had changed color and a precipitate had formed).

The solution was filtered by either gravity filtration using a conical filter or vacuum filtration using a Buchner funnel and 25 μ m filter paper.

The filtrate was sampled.

The precipitate was placed in a stainless steel crucible and fired at 1000 °C for two hours. The furnace was turned off. When the temperature dropped to about 300 °C, the crucible and fired precipitate were placed in a desiccator. The cooled precipitate was occasionally sampled for loss on ignition (LOI) analysis or in the production stages of testing, transferred to sludge stabilization for final disposition.

3.0 TEST RESULTS

Addition of magnesium oxide to acidic solutions neutralizes the acid and generates heat. Results of titrating 600 mL of PFP filtrate solution with 5 gram portions of magnesium oxide are presented in Figure 1. The equivalents were calculated by summing the amounts of plutonium, aluminum and iron in the solution. The titration was stopped when the solution turned to into a solid.

[®]Teflon is a trademark of E. I. DuPont deNemours and Co. Inc.

Figure 1. Titration of PFP Filtrate Solution with Magnesium Oxide.

Plutonium precipitates from acidic solutions that are neutralized using magnesium oxide. Americium and uranium also precipitate. The plutonium and americium remaining in solution after filtration were related to the pH of the solution. Concentrations of plutonium and americium remaining in solution after precipitation are presented in Figure 2

Figure 2. Concentration of Plutonium and Americium remaining in solution following neutralization with Magnesium Oxide and filtration.

Firing the precipitate at 1000 °C produces a residue that passes the loss on ignition criterion for vault storage.

CONCLUSIONS AND RECOMMENDATIONS

For converting plutonium from a solution form to a solid, neutralization with magnesium oxide is a simple effective method. The solid produced is easily filtered provided the total dissolved metals in solution are not too high. The amount of liquid waste produced is slightly less than the volume of original solution. The process is fast. Solution could be filtered almost immediately, although it appears additional decontamination factor is obtained by allowing solutions to age. Filtrate solutions that were allowed to stand for a week or more before samples were collected for analysis. All contained plutonium concentrations below the detection limit of the analytical laboratory and pH values between 8.24 and 8.51. It was assumed that an equilibrium is established with small amounts of magnesium oxide that remained in contact with the solution.

There is no purification of the plutonium. Americium was incorporated in the solids. Personnel exposure during subsequent handling of the solids will be higher than if some separation or selective precipitation of the plutonium could be accomplished. Most metal impurities will also precipitate thereby increasing the volume of solids requiring storage.

5.0 DISPOSITION OF TEST ITEM

Solids produced were transferred to sludge stabilization operations. Filtrate Solutions were transferred to Tank D-8.

6.0 REFERENCES

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ATTACHMENT 3

9651687

RESULTS OF TESTING EICHROM RESINS FOR PRETREATMENT OF
STORED PLUTONIUM SOLUTIONS PRIOR TO SOLIDIFICATION

Consisting of 10 pages, including coversheet

RESULTS OF TESTING EICHROM RESINS FOR PRETREATMENT OF STORED PLUTONIUM SOLUTIONS PRIOR TO SOLIDIFICATION

G. S. Barney

April 11, 1996

INTRODUCTION

The Plutonium Finishing Plant (PFP) received and generated plutonium-bearing solutions which have been stored for scrap processing. These solutions are highly acidic and are considered reactive and corrosive. The solutions contain a variety of components including various acids from laboratory waste, salts from processing [e.g. KNO_3 and $\text{Mn}(\text{NO}_3)_2$ from oxalate removal], etc. In order to store the plutonium contained in these solutions safely it is necessary to convert the plutonium to a solid form. The purpose of Eichrom resin testing is to develop the separation parameters required for large-scale processing of these (and similar) solutions. Separation of plutonium is required for solutions containing components that are incompatible with conversion of plutonium to a solid form.

Extraction chromatographic resins are used to selectively remove plutonium and other actinide elements from almost any acidic waste solution. This separation technique removes the reactive components from plutonium waste so that the separated plutonium can be solidified into a stable chemical form for long-term storage. The resin extracts plutonium from waste solutions as they are pumped through a resin bed. The concentrated plutonium is then removed from the resin by eluting with a solution containing a complexant such as formate or fluoride. The resulting plutonium solution can be solidified by calcination or precipitation of the plutonium from solution.

The results reported here were obtained from testing a concentrated oxalate filtrate solution containing 31.4 g/L plutonium with a column of UTEVA-Spec Eichrom resin. The solution was passed through the Eichrom resin column until the capacity for plutonium extraction was exceeded. This was repeated with diluted solutions as feed to the column to determine the plutonium capacity versus plutonium concentration in the feed. Other parameters measured were plutonium concentration in the raffinate during loading, plutonium concentration in the eluate product solution, and total volume of waste solution versus initial plutonium concentration in the feed.

DESCRIPTION OF TESTS

Feed Solution Composition

Approximately three liters of concentrated oxalate filtrate solution was received from PFP Operations for the ElChrom testing. The concentration of plutonium was determined to be 31.4 g/L. The solution was essentially a nitric acid solution with high concentrations of sodium, iron, potassium, and chloride. The detailed analyses of the solution are given in Table 1. The charge balance for these analyses is poor and suggests the presence of anions that were not analyzed. There were solids visible in the solution (<1 % by volume) and these were filtered out before passing the solution through the resin column. The isotopic composition of the plutonium in this solution is given in Table 2 and is used in converting the counting data to grams of plutonium per liter.

Table 1. Composition of the Concentrated Oxalate Filtrate Feed Solution

Component	Concentration, g/L	Concentration, M
Pu	31.4	0.131
Am	0.061	0.00025
U	0.18	0.00076
H ⁺	--	3.37
NO ₃	210	3.38
Cl	26.6	0.75
F	1.1	0.06
Fe	15.7	0.281
Na	12.8	0.557
K	6.5	0.17
Al	3.5	0.13
Cr	0.75	0.014
Ca	0.60	0.015
Ni	0.51	0.0087
Mg	0.48	0.020

Table 2. Isotopic Composition of Plutonium in the Feed Solution

Isotope	Weight %	% Alpha Activity	% Beta Activity
²³⁸ Pu	0.0269	6.04	0
²³⁹ Pu	93.545	76.05	0
²⁴⁰ Pu	6.020	17.90	0
²⁴¹ Pu	0.378	0.0117	100.0

ElChrom Resin Column Description

The UTEVA-Spec resin is an extraction chromatographic resin for the selective sorption of tetravalent actinides, such as plutonium and uranium (Dietz and Horwitz, 1993; Horwitz et al.

1992). It consists of a liquid extractant, diisobutyl methylphosphonate, adsorbed onto macroporous polymeric resin beads. The resin is an acrylic ester polymeric adsorbent. This material will not extract americium or the major metal ions or anions present in the feed solution. Very few metal ions interfere with the extraction of uranium and tetravalent actinides by this resin. Zirconium and ruthenium are extracted to a relatively small extent, but should not significantly affect actinide extraction. The presence of oxalic acid in the solution could affect the extraction of plutonium if the concentration of oxalic acid exceeds about 0.1 M. Extraction of plutonium increases as the nitric acid increases up to about 8 M HNO_3 . The resin can be regenerated by eluting the actinides with a complexant or reductant. The particle size range of resin beads to be tested is 100 to 125 μ .

The U/TEVA-Spec resin column used in these tests was a cylindrical glass chromatographic column (Spectrum) having Teflon and polypropylene fittings. The dimensions were 24.5 cm long by 2.5 cm diameter. The weight of dry resin in the column was 50.00 g and the volume of the resin bed was 120.3 mLs. The void volume was 74.8 mLs.

Method

The column was prepared by adding a weighed amount of resin (U/Teva-Spec) in a deionized water slurry. The resin was allowed to settle and fill the column to a depth of 24.5 cm. A precision metering pump (Fluid Metering, Inc., Model B-100-S-4) was connected to the bottom of the column with 1/16 inch high-pressure Teflon tubing. The flow rate of the pump was adjusted to 10 mLs/min using distilled water. The column outlet (upper end) was connected to a fraction collector (Avantec, model SF-2120) inside the hood. The fraction collector was set to change test tubes (15 mL polypropylene) so that 10 mLs will be collected in each tube. The resin in the column was pre-equilibrated with 200 mL of 2.0 M HNO_3 solution by passing this solution through the column. The test solution was pumped through the column at 10 mLs/min using the calibrated precision metering pump upflow through the column. The column effluent was collected in 10 mL fractions until the column was saturated (Pu concentration in effluent equaled that in the feed). Washed the column with about 100 mLs of 2.0 M HNO_3 solution by passing it through the column at 10.0 mLs/min. The effluent from the wash was collected in 10 mL fractions. After passing the wash solution through the column, the Pu and U was eluted from the resin using a 2.0 M formic acid solution with the pH adjusted to 5 with ammonium hydroxide. The volume of eluant solution was that required to remove the plutonium color from the resin. The effluent from the elution was collected in 10 mL fractions. The column was again washed with 100 mLs of 2.0 M HNO_3 .

Sampled the tubes in the fraction collector by removing exactly 10 μ L of effluent solution with a pipette and adding it to 10.00 mLs of 1.0 M HNO_3 then added 100 μ L of the diluted sample to ~ 18 mLs of Ultima Gold scintillation cocktail. Labeled the scintillation vial with the tube number and operation (load, elute, or wash). Counted the samples using the Packard Tri-Carb liquid scintillation counter.

This method was used for each of three different runs to obtain plutonium elution curves for the column. The effect of initial plutonium concentration on the loading capacity was

determined by passing the undiluted test solution through the column first (Run #1) and then two additional dilutions of the test solution (Runs #2 and #3) increasingly diluted with 3.0 M HNO₃.

RESULTS

The detailed counting results are given in the three spreadsheets (one for each run) attached to back of this report. Plutonium loading curves are shown in Figure 1 for the test solution and the two dilutions. The initial plutonium concentrations in these solutions were 31.4 g/L, 20.7 g/L, and 8.4 g/L, respectively for Runs #1, #2, and #3. The capacity for plutonium extraction was based on the amount of plutonium extracted before a 50% breakthrough was observed. These results are summarized in Table 3. As expected, the capacity of the column decreases as the feed concentration decreases. The highest capacity was about 85 g Pu/L of resin. The breakthrough curves are quite steep for each of the runs. This indicates that a sharp, well-defined plutonium band is developed in the column during these runs.

Figure 1. Breakthrough Curves for Plutonium During Loading of Concentrated Oxalate Filtrate Solution Containing 8.4 g/L Plutonium, 20.8 g/L Plutonium, and 31.4 g/L plutonium.

Table 3. Capacity of U/TEV-Spec Resin Column for Plutonium versus Feed Concentration.

Run No.	Pu Conc. in Feed, g/L	Capacity of Column	Capacity in g Pu/L Resin
1	31.4	10.4	85
2	20.7	7.5	62
3	8.42	6.0	50

The plutonium concentration in the raffinate during loading was quite small and shows that plutonium was extracted from the feed solution very completely. The concentrations before

breakthrough are given in Table 4. The relatively high concentration for Run #2 is due to incomplete elution of plutonium from the column during Run #2.

Table 4. Plutonium Concentration in the Raffinate before Breakthrough

Run No.	Pu Concentration in Raffinate, g/L
1	0.01
2	0.3
3	0.06

The plutonium extracted on the resin was eluted with 2.0 M formic acid. The pH of this solution was about 1.5 and was not adjusted to higher values in Run #1. This resulted in excessive tailing of the elution curve. In Runs #2 and #3, the pH of the formic acid solution was adjusted to 5 by adding ammonium hydroxide and this gave much more rapid elution of the plutonium. The elution curve for Run #3 is plotted in Figure 2. The peak plutonium concentration was about 120 g/L. The concentration of plutonium in the product solution is, of course, dependent on the desired recovery. The higher the recovery desired, the lower the plutonium concentration will be in the product solution. Table 5 shows the plutonium concentrations in the product solution from Run #3 for various desired recoveries. These are not optimized and could likely be improved by adjusting the pH or formate concentration.

Figure 2. Breakthrough Curves for Plutonium During Elution of the Column with 2.0 M Formate Solution (Adjusted to pH 5 with Ammonium Hydroxide).

Table 5. Plutonium Concentration in Product versus Percent Plutonium Recovery

Desired Percent Pu Recovery	Pu Concentration in Product (Eluate), g/L
80	50
90	38
95	33
99	25

The increases in the waste volume for this process are due to washing the column. If washing is only a displacement of the solution in the void volume of the resin bed, the percent of volume increase would be about 38% to 20%, depending on the plutonium concentration of the feed solution.

CONCLUSIONS

Three column tests were performed using a U/TEVA-Spec Eichrom resin bed to separate plutonium from an oxalate filtrate stored solution at the PFP. Each test used a different concentration of plutonium to determine the effect of concentration on resin loading capacity. The loading capacities were reasonably high with a capacity of 85 g Pu/L of resin with a feed concentration of 31.4 g Pu/L. Lower feed concentrations of plutonium resulted in lower capacities. Elution of the plutonium from the loaded resin with a 2.0 M formic acid solution at pH 5 was effective. Over 95 % of the plutonium on the column was removed in two column volumes of eluant solution. Plutonium concentrations in the product solution ranged from about 25 g/L to 50 g/L, depending on the fraction of plutonium recovery desired. The waste liquid volume increase due to processing with the Eichrom resin was due to the resin washing steps (two per load-elution cycle). This volume increase would be about 20 % to 38 %, depending on the plutonium concentration in the feed.

REFERENCES

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Stored Solution ElChrom Data (Run#E-1)

[illegible]

ATTACHMENT 4

9651687

EVALUATION OF REILLEX™ MPQ ANION EXCHANGE RESIN FOR PRETREATMENT OF
PF5 FILTRATE CONCENTRATE SOLUTION

Consisting of 6 pages, including coversheet

EVALUATION OF REILLEX™ HPQ ANION EXCHANGE RESIN FOR PRETREATMENT OF PFP FILTRATE CONCENTRATE SOLUTION

S. A. Jones

1.0 INTRODUCTION

Stabilization of plutonium in the Plutonium Finishing Plant (PFP) filtrate concentrate solutions will require some pretreatment. The filtrate solutions contain high concentrations of potassium that make it unsuitable for direct demitration calcination. The filtrate also contains high concentrations of aluminum and iron that would interfere with hydroxide precipitation.

Anion exchange can be used to separate plutonium from other metal ions because most metal ions show no adsorption onto the resin and no metal is as strongly sorbed as plutonium¹. Plutonium in nitrate solutions is apparently adsorbed on anion exchange resin as the hexanitrate complex, $\text{Pu}(\text{NO}_3)_6^{4-}$.

Reillex™ HPQ² anion exchange resin was selected for evaluation for its ability to separate plutonium from these stabilization interferences. S. F. Marsh³ has reported extensively on the Pu(IV) sorption kinetics and capacity of this resin. Reillex™ HPQ is a polyvinylpyridine resin. It has been shown to have superior resistance to attack by alpha irradiation and nitric acid degradation compared to conventional polystyrene resins⁴. When compared to five polystyrene anion exchange resins Reillex™ HPQ retained more of its initial weight and more of its initial capacity when irradiated by *in situ* alpha particles over the dose range of 500-1400 megarads.

Reilly Industries, Inc. technical information brochure states Reillex™ HPQ anion exchange resin is spherical beads with a strong base capacity of 3.3 equivalents/kg dry or 0.9 equivalents/liter wet. This translates to 108 grams plutonium per liter of wet resin.

Comparisons of the performance of the resin for PFP filtrate concentrate solution to that of pure plutonium solutions were made.

²Reillex is a trademark of Reilly Industries, Inc., Indianapolis, Indiana.

2.0 Description of the Test

Feed Solution Composition

Table 1. Composition of Concentrated Filtrate Solution as Received

Component	Concentration, g/L	Concentration, M
Pu	31.4	
Am	0.061	
U	0.18	
H ⁺		3.37
NO ₃		3.38
Cl		0.75
F		0.06
Fe	15.7	
Na	12.8	
K	6.5	
Al	3.5	
Cr	0.75	
Ca	0.6	
Ni	0.51	
Mg	0.48	

The highest distribution coefficient for loading plutonium onto the resin occurs when the feed solution is 7 M in nitrate. The PFP filtrate concentrate solution nitrate concentration was adjusted to 7 M by adding concentrated nitric acid. For adjusting the plutonium concentration of the feed, further dilutions were made with 7 M HNO₃. Samples of the feed after each adjustment or dilution were taken to verify the feed concentration.

Column Description

The resin is received in the chloride form. A two-step process was used to convert the resin to the nitrate form. Most of the chloride was replaced by nitrate by passing two bed-volumes of 0.7 M aluminum nitrate through the column. This was followed by four bed-volumes of 2 M nitric acid.

The column was a glass 2.5 x 30 cm column with Teflon^b end fittings and bed supports. The resin was transferred to the column as a slurry in 0.7 M aluminum nitrate.

Prior to loading feed onto the column, the resin was conditioned with two bed volumes of 7 M HNO₃. Marsh indicates preconditioning with 7 M HNO₃ may not be necessary except for feed solutions of 100 g/L or higher. The depleted feed solution travels ahead of the

^bTeflon is a trademark of E. I. DuPont de Nemours and Co. Inc.

plutonium sorption band and conditions the resin itself. Volume of waste could be reduced by avoiding the preconditioning step.

Upflow was used for loading and washing the column. Downflow was used for eluting plutonium from the column.

3.0 Results

One of the first results observed, upon examination of the analytical data, was a need for real-time monitoring of the effluent from the column. This feed material contained substantial quantities of stainless steel corrosion products. Visual examination of the raffinate indicated breakthrough had been achieved. The analytical data proved that not as much breakthrough as had been expected had occurred. Results are presented in Figure 1.

Figure 1. Breakthrough Curves for Various Plutonium Concentrations in Feed Solutions.

The total amount of plutonium loaded onto the column was used for comparison (although it is obvious from Figure 1 that the column was not fully loaded) of the capacities. Results are presented in Table 2.

Table 2. Plutonium loading as a function of feed concentration.

Feed Concentration, g/L	g Pu loaded/L resin	Percent breakthrough
24.50	79.2	3.5
13.38	71.0	0.2
13.07	94.3	31
8.43	72.3	0.52

The plutonium was eluted from the column using 0.5 M HNO₃. An elution curve is presented in Figure 2.

Figure 2. Elution Curve of Plutonium from Reillex™ HPQ Anion Exchange Column.

The concentration in the product solution was calculated based on the volumes and concentrations of samples collected to be 41 g/L plutonium.

3.0 Conclusions

The Reillex™ HPQ anion exchange column was verified to perform on PFP filtrate concentrate as has been previously reported for pure plutonium solutions. This technique will produce a solution free of interferences for either the vertical denitration calciner or hydroxide precipitation. Because the object is to produce solutions that can be stabilized but to do not necessarily contain very pure plutonium, the preconditioning and washing steps can be eliminated in order to minimize the waste produced in this pretreatment method. The increase in the amount of solution produced compared to the original volume of solution requiring stabilization would be the volume of acid required to adjust

the feed concentration to 7 M nitrate plus two to 2.5 column bed volumes

4.0 References

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- ²S. F. Marsh, "Evaluation of a New, Macroporous Polyvinylpyridine Resin for Processing Plutonium Using Nitrate Anion Exchange," Los Alamos National Laboratory report LA-11490 (April 1989).
- ³S. F. Marsh, "The Effects of In Situ Alpha-Particle Irradiations on Six Strong-Base Anion Exchange Resin," Los Alamos National Laboratory report LA-12055 (April 1991).

8.7 USQ EVALUATION PFP-06-14

8.7.1

Identification Number: PFP-95-14

USO EVALUATION

Page 2 of 5

Title: Production Vertical Calciner, Conceptual Design Report

DESCRIPTION: This evaluation of the Conceptual Design Report for the production vertical calciner is performed to determine if the installation of the solution stabilization process produces an increase in risk to the public or onsite personnel. The stabilization process will use a small vertical stirred bed calciner and an ion exchange column. The calciner will be installed in a new glovebox in room 230C of the 234-52 building. The calciner glove box will be connected to the RMC line through conveyors HC-3 and HC-2 to glovebox HC-18-8S. The ion exchange column will be installed in glovebox HC-7C in room 228A of the 234-52 building. Two other existing gloveboxes, HC-9B located in room 228A and HA-46 located in room 232 will house ancillary equipment to support the ion exchange operation. A new feed line from glovebox HC-227-S will provide feed to the calciner. Liquid waste streams from the calciner and the ion exchange column will be discharged to 241-Z using existing and new piping. Required chemical makeup area and delivery piping exist to all locations except room 230C. A new chemical line will be run to this room from the chemical makeup area.

Both the new glovebox in room 230C and the existing glovebox HC-227-S will be restrained to withstand the induced loads occurring in the DBE seismic event. This reduces the releases to within the facility during a seismic event. Existing WMC design practices will be used along with compliance to NRC-CH-4-29 "Nuclear Criticality Safety" to assure the process and equipment are critically safe. The process starts with loadin of plutonium solution into the blend and storage tanks in HC-227-S using existing authorized procedures. Upon completion of acceptance sampling the solution is transferred to the calciner feed tanks and then processed through the calciner to powder. The calciner is nearly identical to the calciner in the PPSL with upgrades to improve maintainability and reduce operator interaction. The calciner operates at 1000 °C, which decomposes the plutonium nitrate to plutonium oxide. The plutonium oxide powder is sampled and analyzed to demonstrate compliance with vault storage specifications and then moved in sealed containers to the 2736-Z vaults for long term storage. A portion of the plutonium solution inventory is made up of flush and filtrate solutions which must first be processed through the ion exchange column to remove the interfering metals and then transferred to the calciner for thermal stabilization and storage in the vaults. The waste streams from the two operations are sampled for composition and then transferred to the 241-Z Waste Treatment Facility. The primary chemicals of the processes are nitric acid and sodium hydroxide. All processing is controlled through a combination of specific written procedures and engineered controls.

1. Does the PROPOSED CHANGE, test, experiment or DISCOVERY increase the probability of occurrence of an accident previously evaluated in the AUTHORIZATION BASIS documentation?

☒ No ☐ Yes/Maybe

NASIS: Calclner Process

The primary hazard is a deflagration of butene gas generated from the decomposition of organic material that may be introduced into the calciner with the feed. The deflagration event analysis of glovebox MT-5 is applicable to this event. The seismically induced deflagration in MT-5 bounds the deflagration under normal operations and the same situation holds true for the calciner glovebox. The SAR analysis in WMC-SD-CP-SAR-021, Chapter 9, section 9.2.4B, assumes that a deflagration in MT-5, precipitated by an earthquake of 0.2 G magnitude, would occur at a probability of 1.9E-07, well beyond the credible range. The elements used to

Title: Production Vertical Calciner, Conceptual Design Report

calculate the probability of a seismically induced deflagration in MT-5 have corresponding elements in the calciner process, e.g., a DBE seismic event occurs during processing in the calciner, organic is present in the feed material, shutdown of the power to the heaters and feed pump is not carried out by the operators or the Building Emergency Director, and concurrently the plant lost all power and steam to the ventilation system and electrical to the 26 in. Hg vacuum pumps but not to the calciner heater and the solution feed pump. Probabilities for all of these elements are less than or equal to those considered in section 9.2.4B.1.3. The overall probability of a butane deflagration in the calciner glovebox is less than the value given for MT-5. Thus the existing analysis for MT-5 bounds the calciner operation.

The thermal aspects of the operation also pose a fire hazard. The calciner glovebox will be provided with fire detection and suppression. The bounding accident of a glovebox fire in RMC described in section 9.2.2A with a probability of $1.6E-10$ easily bounds any fire that can occur as a result of calciner operation.

The glovebox will be restrained to assure survival in a DBE seismic event, thus the bounding seismic event of WMC-SD-CP-SAR-021, 9.2.4A, is not challenged.

Liquid spills external to the glovebox area are bounded by the bounding analysis of the SAR section 9.1.1, which assumes a probability of 1.

Powder spills could occur during the handling of the product from the calciner. This event is bounded by the powder spill analysis described in section 9.1.3 and assumes a probability of 1.

Criticality Prevention Specification Limits will be adhered to, therefore the probability of a criticality, as discussed in WMC-SD-CP-SAR-021 section 9.2.3.4, is not affected by the calciner operation.

Ion Exchange Process

The resin in the pretreatment ion exchange column could exothermally react and create a significant quantity of steam in the column. The column will be designed with safety relief capability in excess of the projected steam generation rate of the exothermic reaction. If this did occur, some contents of the column could be ejected into room 228A. The seismic analysis, in section 9.2.4A.6.1.1.N assumes an inventory of 5,000 g of plutonium in glovebox HC-7, with 0.2 g the maximum released, which is within acceptance guidance. Burst disk safety relief devices have a failure rate of about $1.0E-4$, the same probability as the DBE seismic event, thus the indirect comparison of probabilities indicate that the probability of this event is no greater than that already analyzed for the DBE.

Liquid spills for the pretreatment process are bounded by existing analysis in section 9.1.1.

The glovebox structure and its attachment mode will not be modified, thus the seismic event of section 9.2.4A.6.1.1.N bounds the glovebox response during a seismic event.

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TITLE: Production Vertical Calciner, Conceptual Design Report

Criticality Prevention Specification limits will be adhered to, therefore the probability of a criticality, as discussed in WMC-SD-CP-SAR-021 section 9.2.3.4, is not affected by the pretreatment ion exchange process.

2. Does the PROPOSED CHANGE, test, experiment or DISCOVERY increase the consequences of an accident previously evaluated in the AUTHORIZATION BASIS documentation?

[X] no [] Yes/Maybe

BASED: Calciner Process

The calciner offgas deflagration is no different than that analyzed for MT-5. Section 9.2.4B describes the event that bounds this calciner event. The amount of exposed plutonium powder in the calciner glovebox will be much less than that used in the MT-5 analysis, therefore the consequences will be less.

The fire event of HC-18-B5 analyzed in section 9.2.2A also bounds the consequences of a fire in the calciner glovebox.

In the event of a DBE Seismic event the glovebox is restrained such that the plutonium inventory in the new glovebox is retained and does not contribute to the already analyzed event in section 9.2.4A.6.3.1.S.

The handling of liquids external and internal to the glovebox will be limited to match current assessments of section 9.1.1, thus these events are currently bounded.

The powder spill analysis of section 9.1.3 bounds the probability and no increase over the current value is projected.

Ion Exchange Process

Failure of the resin column from an exothermic reaction may cause a release from room 226A which is less than the previously analyzed seismic event. The seismic analysis, in section 9.2.4A.6.1.M assumes an inventory of 5,000 g of plutonium in glovebox HC-7, with 0.2 g the maximum released, which is within acceptance guidance. As the HC-7C plutonium inventory is limited by the criticality specification and by OSR table 5.22 to values less than this, there is actually a decrease in consequences from this exothermic reaction event.

Liquid spills for the pretreatment process are bounded by existing analysis in section 9.1.1.

The glovebox structure and its attachment mode will not be modified, thus the seismic event of section 9.2.4A.6.1.M bounds the glovebox response during a seismic event.

The consequences of a criticality, as discussed in WMC-SD-CP-SAR-021, Section 9.2.3.4, and Tables 9.2.3.1 and 9.2.3.2 would not be affected by the pretreatment ion exchange process. The criticality accident scenario is modeled on that given in NRC Regulatory Guide 3.39, which forms the bounding analysis.

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Facility: Production Vertical Calciner, Conceptual Design Report

3. Does the PROPOSED CHANGE, test, experiment or DISCOVERY increase the probability of occurrence of a malfunction of EQUIPMENT IMPORTANT TO SAFETY (ITS EQUIPMENT) previously evaluated in the AUTHORIZATION BASIS documentation?
☒ No ☐ Yes/Maybe
 BASIS: There is no EQUIPMENT IMPORTANT TO SAFETY involved in or affected by this activity.

4. Does the PROPOSED CHANGE, test, experiment or DISCOVERY increase the consequences of a malfunction of ITS EQUIPMENT previously evaluated in the AUTHORIZATION BASIS documentation?
☒ No ☐ Yes/Maybe
 BASIS: There is no EQUIPMENT IMPORTANT TO SAFETY involved in or affected by this activity.

5. Does the PROPOSED CHANGE, test, experiment or DISCOVERY create the possibility of an accident of a different type than any previously evaluated in the AUTHORIZATION BASIS documentation?
☐ No ☒ Yes/Maybe
 BASIS: Calciner Process

The possible accidents associated with the calciner process (deflagration, fire, seismic event, liquid and powder spills, and criticality) are no different than those described in the SAR. The seismic event does not release material and the butene deflagration is comparable to that previously analyzed.

Ion Exchange Process

Three possible accidents associated with the ion exchange process (liquid spills, seismic event, and criticality) are no different than those described in the SAR. The fourth possible accident, a resin bed exothermic reaction steam release, has a consequence that is less than the spillage event of the seismic DOE, but the mechanism to achieve the spillage is different and is not independently analyzed, thus the answer is YES/MAYBE. The resin bed exothermic reaction event assumed does not exist in the PFP SAR. This type of accident will have to be addressed in an approved Preliminary Safety Analysis Report (PSAR) for this project before installation of the ion exchange column.

6. Does the PROPOSED CHANGE, test, experiment or DISCOVERY create the possibility of a malfunction of ITS EQUIPMENT of a different type than any previously evaluated in the AUTHORIZATION BASIS documentation?
☒ No ☐ Yes/Maybe
 BASIS: There is no EQUIPMENT IMPORTANT TO SAFETY involved in or affected by this activity.

7. Does the PROPOSED CHANGE, test, experiment or DISCOVERY reduce the margin of safety as defined in the basis for any Technical Safety Requirements?
☒ No ☐ Yes/Maybe
 BASIS: There are no margins of safety defined in the current OSRs, therefore reduction is not possible.

8. Does the PROPOSED CHANGE, test, experiment or DISCOVERY require a new or revised Technical Safety Requirement?
☒ No ☐ Yes/Maybe
 BASIS: There are no new or revised TSRs required. Risks associated with this activity are sufficiently low and do not warrant or meet the criteria for establishing OSRs.

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Title: Production Vertical Calciner, Conceptual Design Report		
<p><u>The SAR descriptive information will need to incorporate the solution stabilization processes to accurately reflect the current operation of the PFP facility.</u></p>		
Used by <u>L. H. Rodgers</u> <div style="text-align: center; font-size: small;">(Print Name)</div>	Used by <u>L. E. Edvalson</u> <div style="text-align: center; font-size: small;">(Print Name)</div>	
Original signed <u>L. H. Rodgers</u> Date: <u>4/14/96</u> <div style="text-align: center; font-size: x-small;">Signature Date</div>	Original signed <u>L. E. Edvalson</u> Date: <u>6/14/96</u> <div style="text-align: center; font-size: x-small;">Signature Date</div>	
PRC REVIEW (If Required)		
Meeting No.: <u>PFP-96-04</u> Date: <u>5/21/96</u>		
PRC Chairman Concurrence: <u>Orig. signed R. O. Redakopp</u> Date: <u>5/21/96</u> <div style="text-align: center; font-size: x-small;">Signature</div>		
<p>The PRC concurred with the USO evaluation but starting ion exchange operations is not to proceed until a safety analysis for the project, submitted in the form of a Preliminary Safety Analysis Report, is approved by DOE.</p>		

B.8 DOE-5033.3B CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS

DOE-5633.3B/P

PREAMBLE: CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS
09-07-94

DOE-5633.3B
DOE-5633.3

CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS

U.S. Department of Energy
Washington, D.C.

ORDER
DOE 5633.3B
9-7-94

SUBJECT: CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS

1. PURPOSE. To prescribe the Department of Energy (DOE) minimum requirements and procedures for control and accountability of nuclear materials at DOE-owned and -leased facilities and DOE-owned nuclear materials at other facilities which are exempt from licensing by the Nuclear Regulatory Commission.
2. CANCELLATIONS.
 - a. DOE 5633.2A, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS: RESPONSIBILITIES AND AUTHORITIES, of 9-23-92.
 - b. DOE 5633.3A, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS, of 2-12-93.
 - c. DOE 5633.4, NUCLEAR MATERIALS TRANSACTIONS: DOCUMENTATION AND REPORTING, of 2-9-88.
 - d. DOE 5633.5, NUCLEAR MATERIALS REPORTING AND DATA SUBMISSION PROCEDURES, of 5-22-87.
3. APPLICABILITY/EXCLUSIONS/DEVIATIONS.
 - a. General. This Order applies to nuclear materials at Department of Energy-owned and -leased facilities and DOE-owned nuclear material at other facilities which are exempt from licensing by the Nuclear Regulatory Commission.
 - b. Application to Contracts. Except for the exclusions in paragraph 3c, the provisions of this Order are to be applied to covered contractors and they will apply to the extent implemented under a contract or other agreement. A covered contractor is a seller of supplies or services that is awarded a procurement contract or subcontract and either possesses, uses, or ships nuclear materials at DOE-owned or -leased facilities; or possesses, ships, or uses DOE-owned nuclear material at an offsite facility exempt from Nuclear Regulatory Commission licensing and regulation.
 - c. Exclusions. This Order does not apply to DOE-owned nuclear materials at Department of Defense facilities or foreign

facilities. To avoid duplicative or conflicting requirements, DOE facilities, projects, and programs under the cognizance of the Office of Civilian Radioactive Waste Management and subject to Nuclear Regulatory Commission regulation shall use the rules, standards, and criteria specified by the Nuclear Regulatory Commission or Nuclear Regulatory Commission Agreement State in lieu of this Order.

- d. Deviations. Deviations from the requirements prescribed by this Order shall be processed in accordance with DOE 5630.110, SAFEGUARDS AND SECURITY PROGRAM.
4. REFERENCES AND DEFINITIONS. See Attachment 1 for references. Definitions of commonly-used terms are provided in the "Safeguards and Security Definitions Guide," which is maintained by the Office of Safeguards and Security.
5. POLICY. The nuclear materials subject to this Order shall be controlled and accounted for in a graded manner consistent with the design basis threat and with their strategic and monetary importance. Where applicable, the site-specific safeguards and security planning document will contain the design basis threat requirements which may reflect some modifications to meet site-specific needs. Material control and accountability systems will provide accurate nuclear materials inventory information; control nuclear materials in order to deter and prevent loss or misuse; provide timely and localized detection of unauthorized removals of nuclear materials within specified limits; provide assurance that all nuclear materials are accounted for and that theft/diversion has not occurred; and assist in the prevention of radiological and/or toxicological sabotage involving nuclear materials that could adversely impact national security, the health and safety of employees, the public, or the environment. In addition, DOE will:
 - a. Assure that material control and material accountability measures are designed to facilitate, to the extent practical, cost effective integration of the operational mission of the program with environmental, health, and safety, and physical protection considerations.
 - b. Provide accountability and control data on a timely and uniform basis for nuclear material safeguards and nuclear materials management.
 - c. Assure that nuclear materials or equipment supplied to nations or persons abroad are subject to measures designed to assure that they are used for official purposes only, pursuant to an agreement for cooperation or other understanding with the United States.
 - d. Facilitate the development and implementation of foreign country and International Atomic Energy Agency safeguards systems.
6. RESPONSIBILITIES AND AUTHORITIES.
 - a. Heads of Headquarters Elements shall:
 - (1) Provide oversight for the implementation of material control

and accountability of nuclear materials for all DOE activities under their jurisdiction in conformity with the policies, procedures, planning, and other requirements set forth in the DOE 5630 series of directives, and set policies, procedures, and requirements for nuclear materials not specifically covered in the DOE 5630 series.

- (2) Ensure that responsibilities and authorities for materials control and accountability of nuclear materials are addressed in the Memorandums of Agreement and associated appendices between Heads of Headquarters Elements and Managers of Operations Offices.
 - (3) For matters under their cognizance, ensure that self-assessment offices conduct independent assessments of the adequacy of DOE and contractor performance of their responsibilities for material control and accountability of nuclear materials.
 - (4) For matters under their cognizance, ensure an individual(s) is (are) designated to be responsible for bringing to the attention of the contracting officer each procurement falling within the scope of this Order. Unless another individual is designated, the responsibility is that of the procurement request originator (the individual responsible for initiating a requirement on DOE F 4200.33, "Procurement Request Authorization").
 - (5) Through contracting officers require that:
 - (a) Each contractor and subcontractor under their jurisdiction who may use or possess nuclear materials as identified in Figure I-1, page I-2, is required by contract to develop and maintain current written procedures for safeguards control and accountability of nuclear materials.
 - (b) Each contract under which nuclear materials are to be supplied contains appropriate safeguards provisions consistent with DOE policy.
 - (c) Inventory and scrap levels of nuclear materials held by contractors and subcontractors under their jurisdiction are minimized to be consistent with operational needs and good safeguards practices.
 - (6) Ensure material control and accountability requirements are considered in all phases of design of new facilities/operations under their cognizance.
 - (7) Ensure appropriate actions are taken to correct safeguards deficiencies at facilities under their cognizance.
- b. Director of Nonproliferation and National Security through the Director of Security Affairs shall:

- (1) Establish DOE-wide policies, procedures, and standards for the material control and accountability of special nuclear material and other designated nuclear materials.
- (2) Submit reports to the Secretary on the status of the safeguards program in conjunction with the Annual Report to the President on the Status of Safeguards and Security of Domestic Nuclear Weapons Facilities.

c. Director of Safeguards and Security shall:

- (1) Develop, after coordination with appropriate Departmental elements, DOE-wide policies, procedures, and standards, and provide staff guidance for the safeguarding of nuclear materials.
 - (a) Develop and establish policies, procedures, and standards concerning the documentation of nuclear materials transactions, inventories, and material balances affecting DOE Headquarters and field elements, contractors, and subcontractors.
 - (b) Develop and establish policies, procedures, and standards for the submission of information on nuclear materials transactions, inventories, and material balances to the Nuclear Materials Management and Safeguards System.
 - (c) Ensure that DOE policies, procedures, and standards for special nuclear material safeguards are at least equivalent in their effectiveness to policies, procedures, and standards established by the Nuclear Regulatory Commission.
 - (d) Assure that the data documentation and collection policies, procedures, and standards of DOE with respect to nuclear safeguards are comparable to those of Nuclear Regulatory Commission.
 - (e) Provide technical advice, analyses, and recommendations in developing international safeguards policies and procedures.
 - (f) Ensure the maintenance and currency of the DOE 5633.3B GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION.
 - (g) Provide specific written guidance that would assist license-exempt contractors and subcontractors to design, evaluate, and validate materials control and accountability systems.
- (2) Conduct/participate in special investigations of activities of license-exempt contractors and other contractors possessing DOE-owned nuclear materials, as necessary. Coordinate these special investigations with the appropriate Heads of

Headquarters Elements and Operations Offices.

- (3) In consultation with Heads of Headquarters Elements, initiate and direct programs for providing required technology, equipment, and procedures to meet safeguards objectives and for assuring that Government and industry are provided with chemical and isotopic reference standards and calibration and test materials which are supportive of safeguards programs.
- (4) In connection with activities of license-exempt contractors and subcontractors, recommend to the responsible authority corrective action to assure compliance with overall safeguards policies, procedures, and requirements, and, as appropriate, recommend other courses of action.
- (5) Prepare reports and provide data for reports, through the Director of Security Affairs and the Director of Nonproliferation and National Security, to the Secretary on the status of the safeguards program.
- (6) In connection with the maintenance of records and data to support the implementation of nuclear material accountability, ensure:
 - (a) Collection and processing of data relative to nuclear materials for which the United States has a safeguards or management interest as required by directives, U.S. statutes, and international treaty and agreement provisions.
 - (b) Issuance of reports to support the nuclear materials safeguards needs of DOE, Nuclear Regulatory Commission, other Government organizations, and the International Atomic Energy Agency.
 - (c) Headquarters level overview of key materials control and accountability data including: materials control and materials accounting survey reports; inventory differences; and shipper/receiver differences.
 - (d) Maintain historical records of nuclear material transactions, material balances, and inventories in support of safeguards and other programs of the Government.
 - (e) Review and approve proposed methods for submission of nuclear materials data to the Nuclear Materials Management and Safeguards System by use of telecommunications systems in lieu of the required forms referred to in Chapter II, if the proposed methods satisfy all applicable requirements.
 - (f) Establish and deactivate Reporting Identification Symbols for organizations sponsored by Heads of Headquarters Elements and Operations Offices.

- (7) In connection with international agreements, recommend corrective action to assure compliance with overall safeguards policies, procedures, and standards.
- (8) Develop and implement materials control and accountability training programs for DOE and DOE contractor safeguards personnel. Ensure that minorities, women, and persons with disabilities are accorded equal opportunity to receive this training.

d. Director of Arms Control and Nonproliferation shall:

- (1) Manage programs for technical cooperation with the International Atomic Energy Agency as part of the Office of Arms Control and Nonproliferation's safeguards role in guarding against the diversion of nuclear materials and equipment which had been supplied for peaceful purposes to the manufacture of nuclear weapons, nuclear explosive devices, or any other military purpose.
- (2) Conduct onsite safeguards and security reviews of nuclear materials distributed abroad to the extent provided for in international, multinational, and bilateral agreements, and participate in international discussions regarding safeguards policies and procedures with other DOE organizations involved in international programs.
- (3) In coordination with Heads of Headquarters Elements, ensure compliance of DOE facilities with the terms of the "Agreement Between the United States of America and the International Atomic Energy Agency for the Application of Safeguards in the United States of America" and its associated Protocol.
- (4) In connection with international agreements, recommend corrective action to assure compliance with overall safeguards policies, procedures, and standards, and when appropriate recommend suspension of any agreements that do not meet DOE policy in regard to such arrangements.
- (5) Provide technical advice, analyses, and recommendations in developing international safeguards policies and procedures. Manage programs for technical cooperation with the International Atomic Energy Agency in its safeguards role in guarding against the diversion of nuclear materials and equipment to the manufacture of nuclear weapons, nuclear explosive devices, or any other military purpose.

e. Director, Naval Nuclear Propulsion Program shall, in accordance with the responsibilities and authorities assigned by Executive Order 12344 (statutorily prescribed by Public Law 98-525 (42 U.S.C. 7158, note)) and to ensure consistency throughout the joint Navy/DOE organization of the Naval Nuclear Propulsion Program, implement and oversee all policy and practices pertaining to this DOE Order for activities under the Director's cognizance.

f. Heads of Field Elements shall:

- (1) Implement material control and accountability of nuclear materials for all DOE activities under their jurisdiction in conformity with the policies, procedures, planning, and other requirements set forth in the DOE 5630 series, and set policies, procedures, and requirements for nuclear materials not specifically covered in the 5630 series.
 - (a) Require that a Material Control and Accountability Plan be developed for each facility possessing nuclear materials and approve that plan and subsequent changes. Require development and compliance with procedural directives implementing the Material Control and Accountability Plan.
 - (b) Assure cost-effective overall protection at each site, through integration, to the extent practicable, of materials control and accountability systems, procedures, and operations with the associated physical protection systems, procedures, and operations.
 - 1 Utilize the design basis threat guidance to formulate site-specific threat statements for inclusion in applicable site-specific safeguards and security planning documents.
 - 2 Assure vulnerability assessments are required for Category I special nuclear material locations and for Category II locations where rollup to Category I is credible.
 - 3 Approve a classified list of threats and targets developed by each contractor under their jurisdiction as appropriate for design and/or evaluation and validation of materials control and accountability systems.
 - 4 Develop procedures for the conduct and reporting of nuclear materials surveys in accordance with DOE 5634.10, FACILITY APPROVALS, SECURITY SURVEYS, AND NUCLEAR MATERIALS SURVEYS. Conduct oversight tests and evaluations of material control and accounting provisions of contractors' safeguards programs.
 - (c) Ensure the maintenance of records and issuance of periodic reports reflecting nuclear materials transactions and inventories under their jurisdiction.
 - (d) Ensure material control and accountability requirements are considered in all phases of design of new facilities/operations.
 - (e) Ensure appropriate actions are taken to correct safeguards deficiencies.
 - (f) Assure that system assessment requirements are identified and met for facilities possessing nuclear material.

- (2) Ensure that responsibilities and authorities for material control and accountability of nuclear materials are addressed in the Memorandums of Agreement and associated appendices between Heads of Headquarters Elements and Field Elements.
- (3) Monitor material control indicators and review and analyze reportable occurrences experienced in operations under their jurisdiction.
 - (a) Ensure that contractors and subcontractors under their jurisdiction analyze all nuclear material control indicators, determine the probable cause of all nuclear material alarms, and take such corrective action as is deemed necessary.
 - (b) Report malevolent acts and other reportable occurrences to the Office of Safeguards and Security and affected Heads of Headquarters Elements consistent with the requirements of this Order and DOE 5000.3B, OCCURRENCE REPORTING AND PROCESSING OF OPERATIONS INFORMATION.
 - (c) Require, as appropriate, each contractor, facility, and DOE Element under their reporting jurisdiction to determine the reasons for shipper-receiver differences, evaluate the significance of all such differences, and take appropriate corrective action.
- (4) Assure nuclear material control and accountability upgrade needs are identified, documented, and coordinated with affected Heads of Headquarters Elements consistent with budgetary schedules.
- (5) Provide materials control and accountability systems review and approval for all facilities prior to beginning new operations that might alter the performance of existing materials control and accountability systems.
- (6) Require each DOE contractor and DOE element under their reporting jurisdiction to:
 - (a) Prepare and distribute promptly the appropriate forms (see Chapter II), for documenting nuclear materials transactions, inventories, and material balances and for submitting the information to the Nuclear Materials Management and Safeguards System, in accordance with the DOE 5633.3B GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION.
 - (b) Prepare additional data and reports required by the field element in the performance of its mission.
 - (c) If notified of selection under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement, prepare and submit material balance reports (DOE/MRC F 742, "Material Balance Report") indicating the

sources of receipts shown on line 22 ("From Other Materials") and the destinations of removals shown on line 71 ("Degradation to Other Materials").

- (d) Assume that for exports other than for mutual defense, the receiver's copies of DOE/NRC F 741, "Nuclear Material Transaction Report", DOE/NRC F 741A, "Nuclear Material Transaction Report (Continuation Page)," the special preprinted version of DOE/NRC F 740M, "Concise Note", and other appropriate versions of DOE/NRC F 740M, as required, are included with the actual shipment.
 - (e) Assume that both shipper's and receiver's transaction data is provided to the Nuclear Materials Management and Safeguards System in those cases where the shipper or receiver is a foreign entity.
 - (f) Provide review of Nuclear Materials Management and Safeguards System output sufficient to verify data processed by the system.
 - (g) Assume that material balances held in contractors' systems are reconciled with corresponding Nuclear Materials Management and Safeguards System balances and that data corrections are implemented to bring the systems into agreement.
 - (h) Review proposed internal or computer-generated equivalent forms referred to in Chapter 11, and if the proposed equivalents are found to provide for all the information on nuclear materials transactions, material balances, and inventories in the proper format, approve their use in lieu of the specified forms.
 - (i) Assume that the appropriate reporting procedures are followed by contractors under their jurisdiction.
 - (j) Assume that all required data is provided to the Nuclear Materials Management and Safeguards System in accordance with the Instructions in the DOE 5633.38 GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION.
- (7) Assume that this Order shall be implemented under existing and new contracts for operating facilities under the scope of this Order. Designate an individual(s) to be responsible for bringing to the attention of the contracting officer each procurement falling within the scope of this Directive. Unless another individual is designated, the responsibility is that of the procurement request originator (the individual responsible for initiating a requirement on DOE F 4200.33).
- (8) Through contracting officers require that:
- (a) Each contractor and subcontractor under their

jurisdiction who may use or possess designated nuclear materials are required by contract to develop and maintain current written procedures for control and accountability of nuclear materials;

- (b) Each contract under which nuclear materials are to be supplied contains appropriate safeguards provisions consistent with DOE policy; and
- (c) Inventory and scrap levels of nuclear materials held by contractors and subcontractors under their jurisdiction are minimized to be consistent with operational needs and good safeguards practices.

(9) Review and approve deviations to requirements of this Order according to procedures contained in DOE 5630.11B, SAFEGUARDS AND SECURITY PROGRAM.

- g. Heads of Departmental Elements (the senior ranking official at a DOE office location) shall include in a procurement request package, for each procurement requiring the application of this Order, the following: (1) identification of the Order; (2) identification of the specific requirements with which a contractor or other awardee is to comply, or, if this is not practicable, identification of the specific paragraphs or other portions of this Order with which a contractor or other awardee is to comply; and (3) requirements for the flowdown of provisions of this Order to any subcontract or subaward. For application to awarded management and operating contracts, Heads of Departmental Elements may set forth this information in a written communication to the contracting officer rather than in a procurement request package.

- h. Manager, Oak Ridge Operations Office, in addition to the requirements specified in paragraph 6f, above, shall:

- (1) Forward applicable copies of Nuclear Regulatory Commission and "Agreement State" licensee nuclear material transaction reports promptly to other concerned DOE elements and to appropriate foreign entities. In addition, the Manager shall maintain records that document all transfers of U.S. nuclear material to and from foreign entities and issue required inventory reports.
- (2) Maintain sufficient records to document the transfer of any U.S.-supplied special nuclear material to foreign entities, the receipt of any U.S.-origin nuclear material into the U.S., and the transfer of any U.S.-origin nuclear material between foreign countries, including special nuclear material produced therein, in accordance with appropriate agreements. Retain all transfer documents, records, and reports for audit purposes.
- (3) Perform comparisons of U.S. export and import data with data supplied by foreign entities. Differences between foreign and U.S. data shall be investigated and reconciled by interacting with representatives of the relevant foreign entities and

domestic nuclear facilities.

- (4) Extract information from documents used to transfer U.S. nuclear material from one foreign country to another and submit such data to the International Nuclear Materials Tracking System (INMTS) in accordance with "INMTS Data Entry Procedures."
- i. Manager, Albuquerque Operations Office, in addition to the requirements specified in paragraph 6f, above, shall:
 - (1) Report inventory data on nuclear material transferred to the Department of Defense under 42 U.S.C. Section 2121(b), as amended, with the exception of material specified in paragraph 6j, below to be reported by the Pittsburgh Naval Reactors Office.
 - (2) Report inventory data on material loaned by the U.S. to a foreign nation under 42 U.S.C. Section 2121(c), as amended.
 - (3) Maintain memorandum inventory accounts for all transfers of nuclear material to the Department of Defense under 42 U.S.C. Section 2121(b)-(c), with the exception of Navy cores and associated items. The Manager shall provide guidance and instruction for the documentation and reporting, as necessary, to those offices making such transfers.
 - j. Manager, Pittsburgh Naval Reactors Office, in addition to the requirements specified in paragraph 6f, above, shall:
 - (1) Report inventory data on material transferred to the Department of Defense for nonweapons Naval reactor programs under 42 U.S.C. Section 2121(b), as amended.
 - (2) Maintain memorandum inventory accounts for transfers of nuclear materials in Navy cores and associated items to the Department of Defense under 42 U.S.C. Section 2121(b).
 - (3) Provide guidance, through the Director, Naval Reactors, for documentation and reporting of transfers to the Department of Defense of Navy cores and associated items under 42 U.S.C. Section 2121(b), as amended.
 - k. Manager, Schenectady Naval Reactors Office, in addition to the requirements of paragraph 6f, above, shall provide guidance, through the Director, Naval Reactors, for documentation and reporting of transfers to the Department of Defense of Navy cores and associated items under 42 U.S.C. Section 2121(b), as amended.
7. IMPLEMENTATION. This Order will be implemented within 60 days after the effective date.
8. ASSISTANCE. Questions concerning this Order should be directed to the Chief, Materials Control and Accountability Branch, at 301-903-2936.
- BY ORDER OF THE SECRETARY OF ENERGY:

ARCHER L. DURHAM
Assistant Secretary for
Human Resources and Administration

<ID> DOE-5633.38/A1
<TITLE> ATTACHMENT 1 - REFERENCES
<ISSUE-DATE> 09-07-94
<LAST-CHANGE>
<CHANGE-DATE>
<ORDER> DOE-5633.38 CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS
DOE-5633.3

<FORMS>

<TEXT>

REFERENCES

1. Title 42 U.S.C. 2011, et. seq., "Atomic Energy Act of 1954," as amended, which establishes a program for Government control of the possession, use and production of atomic energy and special nuclear material, whether owned by the Government or others.
2. Title 10 Code of Federal Regulations Parts 1 to 199, Nuclear Regulatory Commission Regulations, which contain the regulations applicable to Nuclear Regulatory Commission and "Agreement State" licensees involved in activities concerning nuclear materials not subject to DOE requirements.
3. DOE 1270.2B, SAFEGUARDS AGREEMENT WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY, of 6-23-92, which prescribes policies and responsibilities for compliance with the agreement, including the associated protocol, between the Federal Government and the International Atomic Energy Agency for the application of safeguards in the United States.
4. DOE 1360.2B, UNCLASSIFIED COMPUTER SECURITY PROGRAM, of 5-18-92, which establishes requirements, policies, responsibilities, and procedures for developing and sustaining a DOE unclassified security program.
5. DOE 5000.3B, OCCURRENCE REPORTING AND PROCESSING OF OPERATIONS INFORMATION, of 1-19-93, which establishes a DOE system for identification, categorization, notification, analysis, reporting, followup, and closeout of occurrence.
6. DOE 5400.1, GENERAL ENVIRONMENTAL PROTECTION PROGRAM, of 11-9-88, which establishes the environmental protection program for DOE Operations.
7. DOE 5480.1B, ENVIRONMENT, SAFETY, AND HEALTH PROGRAM FOR DEPARTMENT OF ENERGY OPERATIONS, of 9-23-86, which establishes the Department's environmental protection, safety, and health protection program.
8. DOE 5480.18A, ACCREDITATION OF PERFORMANCE-BASED TRAINING FOR CATEGORY A REACTORS AND NUCLEAR FACILITIES, of 7-19-91, which establishes a performance based training process for reactor and nonreactor nuclear

facilities in DOE.

9. DOE 5480.20, PERSONNEL SELECTION, QUALIFICATION, TRAINING, AND STAFFING REQUIREMENTS AT DOE REACTOR AND NON-REACTOR NUCLEAR FACILITIES, of 2-29-91, which establishes the selection, qualification, training, and staffing requirements for personnel involved in the operation, maintenance, and technical support of DOE-owned reactors and nonreactor nuclear facilities.
10. DOE 5484.1, ENVIRONMENTAL PROTECTION, SAFETY, AND HEALTH PROTECTION INFORMATION REPORTING REQUIREMENTS, of 2-24-81, which establishes the requirements and procedures for the investigation of occurrences having environmental protection, safety, or health protection significance for DOE operations.
11. DOE 5500.1B, EMERGENCY MANAGEMENT SYSTEM, of 4-30-91, which establishes overall policy and requirements for a system that will provide for development, coordination, and direction of Department planning, preparedness, and readiness assurance for response to operational, energy, and Continuity of Government emergencies involving DOE or requiring Departmental assistance.
12. DOE 5630.11B, SAFEGUARDS AND SECURITY PROGRAM, of 8-2-94, which establishes the policy and responsibilities for the DOE Safeguards and Security Program.
13. DOE 5630.13A, MASTER SAFEGUARDS AND SECURITY AGREEMENTS, of 6-8-92, which establishes Departmental policy, requirements, and authorities for the development of Master Safeguards and Security Agreements.
14. DOE 5630.14A, SAFEGUARDS AND SECURITY PROGRAM PLANNING, of 6-9-92, which establishes a standardized approach to protection program planning, prescribes DOE policy, objectives, responsibilities, and authorities for that planning process, and consolidates site and master plan requirements.
15. DOE 5630.15, SAFEGUARDS AND SECURITY TRAINING PROGRAM, of 8-21-92, which establishes procedures for standardizing and implementing the DOE safeguards and security training program for safeguards and security personnel, and prescribes the policy, responsibilities, and authority for that training program.
16. DOE 5630.16A, SAFEGUARDS AND SECURITY ACCEPTANCE AND VALIDATION TESTING PROGRAM, of 6-3-93, which establishes requirements for integrated performance testing of personnel, procedures, and equipment to demonstrate the adequacy and effectiveness of the safeguards and security performance requirements mandated under DOE directives.
17. DOE 5630.17, SAFEGUARDS AND SECURITY (S&S) STANDARDIZATION PROGRAM, of 9-29-92, which provides policies, procedures, responsibilities, and authority for the Safeguards and Security Standardization Program to ensure the most effective and efficient use and procurement of safeguards and security equipment and systems.
18. DOE 5631.6A, PERSONNEL SECURITY ASSURANCE PROGRAM, of 9-15-92, which establishes policies, objectives, procedures, responsibilities, and

authorities for a Personnel Security Assurance Program.

19. DOE 5632.1C, PROTECTION AND CONTROL OF SAFEGUARDS AND SECURITY INTERESTS, of 7-15-94, and DOE M 5632.1C-1, MANUAL FOR PROTECTION AND CONTROL OF SAFEGUARDS AND SECURITY INTERESTS, of 7-15-94, which establish Departmental policies and procedures related to the physical protection of DOE property and security interests.
20. DOE 5633.3B GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION, to be published concurrently with this Order, which details the data elements and procedures required to document and report nuclear materials transactions, material balances, and inventories to the Nuclear Materials Management and Safeguards System.
21. DOE 5634.1B, FACILITY APPROVAL, SECURITY SURVEYS, AND NUCLEAR MATERIALS SURVEYS, of 9-15-92, which establishes requirements for the conduct of onsite security or nuclear materials surveys of facilities with DOE safeguards and security interests.
22. DOE 5639.6A, CLASSIFIED AUTOMATED INFORMATION SYSTEM SECURITY PROGRAM, of 7-15-94, which establishes requirements, policies, and responsibilities for the development and implementation of a Departmental program to ensure the security of information stored in classified computer systems.
23. DOE 5700.6C, QUALITY ASSURANCE, of 8-21-91, which establishes quality assurance requirements for DOE.
24. DOE 5820.2A, RADIOACTIVE WASTE MANAGEMENT, of 9-26-88, which establishes policies, guidelines, and minimum requirements for managing radioactive and mixed waste.
25. DOE 6430.1A, GENERAL DESIGN CRITERIA, of 4-6-89, which provides subject criteria for use in the acquisition of Departmental facilities.
26. ANSI N15.19-89, "Nuclear Material Control - Volume Calibration Techniques" American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1989).
27. ANSI N15.36-83, "Nuclear Materials - Nondestructive Assay Measurement Control and Assurance," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1983).
28. ANSI N15.41-84, "Nuclear Facilities - Derivation of Measurement Control Programs - General Requirements," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1984).
29. ANSI N15.51-90, "Measurement Control Programs Nuclear Materials Analytical Chemistry Laboratory," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1991).
30. ANSI N15.54-90, "Instrumentation - Radiometric Calorimeters Measurement Control Program," American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018 (1991).

31. ASTM Standard C993-92, "Guide for In-Plant Performance of Automatic Pedestrian SNM Monitors," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (7-93).
32. ASTM Standard C1112-93, "Guide for Application of Radiation Monitors to the Control and Physical Security of Special Nuclear Material," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (6-93).
33. ASTM Standard C1169-92, "Guide for Laboratory Evaluation of Automatic Pedestrian SNM Monitor Performance," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (6-93).
34. ASTM Standard C1189-91, "Guide to Procedures for Calibrating Automatic Pedestrian SNM Monitor," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (7-91).
35. ASTM Standard C1236-93, "Guide for In-Plant Performance Evaluation of Automatic Vehicle SNM Monitors," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (6-93).
36. ASTM Standard C1237-93, "Guide to In-Plant Performance Evaluation of Hand-Held SNM Monitors," American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103 (6-93).
37. CG-SS-3, "Classification Guide for Safeguards and Security Information," of August 1994, issued by the Director of Declassification, which provides original classification determinations for National Security Information concerning nuclear safeguards and various aspects of security and to provide guidance for derivatively classifying documents and materials containing such National Security Information, Restricted Data, and Formerly Restricted Data.
38. "DESIGN BASIS THREAT POLICY FOR THE DEPARTMENT OF ENERGY PROGRAMS AND FACILITIES (U)," of 9-7-94, issued by the Director of Security Affairs, which identifies and characterizes the range of potential generic adversary threats to the Department's nuclear programs and facilities which could adversely impact national security or the health and safety of Government and contractor employees, the public, or the environment.
39. DOE/NRC F 741/741A, NUCLEAR MATERIAL TRANSACTION REPORT, Office of Management and Budget Control Number 1910-1800, of 10-88, which is used for reporting values to Nuclear Materials Management and Safeguards System for external transfers of nuclear material.
40. "Guidance on Meeting DOE Order Requirements for Traceable Nondestructive Assay Measurements," Department of Energy, Office of Safeguards and Security (5-94).
41. "Guide for Implementation of DOE 5633.3A," of 2-93, issued by the Director of Security Affairs, which provides guidance in the understanding of materials control and accountability requirements contained therein.
42. "Guide for the Implementation of Safeguards and Security Directives," Department of Energy, Office of Safeguards and Security, (11-26-93)

which itemizes standards and criteria that emanate from Safeguards and Security Program directives.

43. "Guide to the Evaluation of Selected Materials Control and Accountability (MC&A) Detection Elements," U.S. Department of Energy, Office of Safeguards and Security (5-94).
44. "Measurement Control Guide," U.S. Department of Energy, Office of Safeguards and Security (3-93) which provides guidance to assist in the implementation of measurement control requirements.
45. "Metal Detector Guide," U.S. Department of Energy, Office of Safeguards and Security (2-22-90).
46. "Safeguards and Security Definitions Guide," U.S. Department of Energy, Office of Safeguards and Security (12-20-93) which provides standardized definitions of terms used in the Safeguards and Security Program.
47. "Safeguards Seal Reference Manual," (9-91) DOE, Office of Safeguards and Security, which provides guidance to nuclear facility personnel in selecting, procuring, and applying the proper seals for safeguarding nuclear material.
48. "Sample Master Safeguards and Security and Vulnerability Assessment (Volume III - MSSA Verification Process)," U.S. Department of Energy, Office of Safeguards and Security (1991).

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CHAPTER I

BASIC REQUIREMENTS

- I. GENERAL. This chapter provides minimum requirements for the control and accountability of nuclear materials.
 - a. Special nuclear material shall not be received, processed, or stored at a facility until facility approval has been granted in accordance with the requirements of DOE 5634.10, FACILITY APPROVAL, SECURITY SURVEYS, AND NUCLEAR MATERIALS SURVEYS.
 - b. Nuclear materials (Figure I-1) shall be controlled and accounted for as required by this Order. A graded material control and accountability program shall be implemented by Managers, Operations Offices, using requirements for Category IV as the minimum for nuclear materials. See page I-9, paragraph 3c, for requirements for depleted uranium. The level of control and accountability shall be consistent with the economic and strategic value of these materials. Figure I-1 provides a list of nuclear materials and reportable quantities. Page I-6, paragraph 2b defines categorization of nuclear materials for implementation of DOE's graded safeguards program. Detailed information on reporting requirements for materials accounting data and information can be found on page II-19, paragraph 7.
 - c. A management official responsible for the control and accountability of nuclear materials shall be designated for each facility. This official shall be organizationally independent from responsibility for other programs. A Nuclear Materials Representative responsible for nuclear materials reporting and data submission to the Nuclear Materials Management and Safeguards System shall be designated for each facility or site having a Reporting Identification Symbol.
 - d. For each facility, facility management shall maintain documentation defining authorities and responsibilities for materials control and accountability functions (e.g., accounting system, measurements, measurement control, inventories, audit, material access controls, and surveillance). For each facility, there shall be a program to assure that personnel performing materials control and accountability functions are trained and qualified to perform their duties and responsibilities, and are knowledgeable of requirements and procedures related to their functions.

- e. A Materials Control and Accountability Plan shall be developed for each facility possessing nuclear materials (including facility review and frequency and change control), and approved by the cognizant Manager, Operations Office. The Materials Control and Accountability Plan may, at the option of the cognizant Manager, Operations Office, be a separate document or a part of an existing document such as a Site Safeguards and Security Plan.

MATERIAL TYPE	SNM, SOURCE, OR OTHER	REPORTABLE QUANTITY*	WEIGHT FIELDS USED FOR REPORTING		MATERIAL TYPE CODE
			ELEMENT	ISOTOPE	
Depleted Uranium	SOURCE	Kilogram	Total U	U-235	10
Enriched Uranium/1	SNM	Gram	Total U	U-235	20
Normal Uranium	SOURCE	Kilogram	Total U	-	81
Uranium-233	SNM	Gram	Total U	U-233	70
Plutonium-242/2	SNM	Gram	Total Pu	Pu-242	40
Plutonium-239-241	SNM	Gram	Total Pu	Pu-239+ Pu-241	50
Plutonium-238/3	SNM	Tenth of a Gram	Total Pu	Pu-238	83
Americium-241	OTHER	Gram	Total Am	Am-241	44
Americium-243	OTHER	Gram	Total Am	Am-243	45
Berkelium	OTHER	Microgram	-	Bk-249	47
Californium-252	OTHER	Microgram	-	Cf-242	48
Curium	OTHER	Gram	Total Cm	Cm-246	46
Deuterium	OTHER	Tenth of a Kilogram	D20	D2	86
Lithium-6	OTHER	Kilogram	Total Li	Li-6	60
Neptunium-237	OTHER	Gram	Total Np	-	82
Thorium	SOURCE	Kilogram	Total Th	-	88
Tritium/4	OTHER	Hundredth of a Gram	Total/3H	-	87

Figure I-1
Nuclear Materials

- * For reporting purposes: materials are reported to the nearest whole unit except for plutonium-238, deuterium, and tritium.

- /1 Uranium in cascades is treated as enriched uranium. For reporting purposes uranium in cascades should be reported as material type 89.
- /2 Report as plutonium-242 if the contained Pu-242 is 20% or greater of total plutonium by weight; otherwise report as plutonium 239-241.
- /3 Report as plutonium-238 if the contained Pu-238 is 10% or greater of the total by weight plutonium; otherwise report as plutonium 239-241.
- /4 Tritium contained in water (H2O or D2O) used as a moderator in a nuclear reactor is not an accountable material. For reporting purposes: if in the form of heavy water, both the element and isotope weight fields will be used; otherwise report isotope weight only.

- (1) Category I and II. For facilities possessing Category I and II quantities of special nuclear material, the plan shall reflect requirements for materials control and accountability program planning and management, threat considerations, performance criteria, the accounting system, physical inventories, measurement control, control limits, loss detection elements, training, response to nuclear material alarms, access control, anomaly resolution, containment, and surveillance.
 - (2) Category III and IV. For Category III and IV facilities, requirements for the scope and content of Materials Control and Accountability Plans are to be determined by the Manager, Operations Office.
- f. Planning for materials control and accountability shall consider the potential of an insider threat, as detailed in "DESIGN BASIS THREAT POLICY FOR THE DEPARTMENT OF ENERGY (DOE) PROGRAMS AND FACILITIES (U)", issued by the Office of Security Affairs. Planning shall address the theft and diversion of special nuclear material, and the unauthorized control of a weapon, test device, or improvise nuclear device, where appropriate. The materials control and accountability program shall support activities to mitigate sabotage.
 - g. For each facility, facility management shall have and require compliance with one or more current procedural directive(s) for implementing its Materials Control and Accountability Plan. These procedures shall be compatible with the physical protection and security requirements of DOE 5632.1C, PROTECTION AND CONTROL OF SAFEGUARDS AND SECURITY INTERESTS, to provide an effective integrated safeguards system. These procedural directives shall be transmitted to the cognizant Manager, Operations Office, when issued and when revised.
 - h. Reportable occurrences shall be reported in accordance with the notification and reporting requirements contained in DOE 5000.38, OCCURRENCE REPORTING AND PROCESSING OF OPERATIONS INFORMATION.
 - i. Facility emergency plans shall address conditions that indicate possible loss of control of special nuclear material. The

emergency plan shall be consistent with safeguards and security directives, and shall specify materials control and accountability measures to be taken prior to resumption of operations following emergency operations. Other requirements for facility emergency plans are specified in DOE 5500.10, EMERGENCY MANAGEMENT SYSTEM.

- j. For Category I facilities and for Category II facilities within the same Protected Area for which rollup to a Category I quantity is possible, each facility's safeguards and security system shall provide defence-in-depth to assure that the failure or defeat of a single component will not increase the level of risk for the system above an acceptable level. A part of the vulnerability assessment process shall be to determine the extent to which the failure or defeat of a single component increases this risk and if the increase in risk is acceptable. When the increase in risk exceeds an acceptable level, compensatory measures shall be immediately taken and upgrades to the system shall be initiated. The acceptability of the risk shall be documented as a part of the Master Safeguards and Security Agreement or Site Safeguards and Security Plan for the facility.
- k. For each facility a materials control and accountability program shall be established for all nuclear materials on inventory under a three letter Reporting Identification Symbol, including those designated as uneconomical to recover. For Attractiveness Level D or higher special nuclear material that has been removed from inventory as waste and for which a vulnerability resulting in an unacceptable level of risk has been identified, the Manager, Operations Office, or the cognizant Head of a Headquarters Element may require that applicable nuclear material safeguards measures as outlined in this Order be maintained and/or implemented. Otherwise, materials previously removed from inventory that meet all of the following conditions are exempt from the requirements of this Order:
 - (1) They have been declared as waste prior to issuance of this Order;
 - (2) They have been written off the materials control and accountability records; and
 - (3) They are under the control of a waste management organization.
- l. To terminate safeguards for nuclear materials currently on inventory and to exempt that material from the requirements of this Order, all of the following conditions must be met:
 - (1) If the material is special nuclear material, it must meet the definition of Attractiveness Level E material. (In some cases, it may be necessary to dispose of higher attractiveness level materials. Concurrence of both the appropriate Head of a Headquarters Element and Office of Safeguards and Security is required for termination of safeguards on materials which meet the definition of Attractiveness Level D or greater. Additionally, whenever termination of safeguards on a Category II or greater quantity of special nuclear material is being

considered, a vulnerability assessment must be conducted.)

- (2) The material must be determined to be discardable by the Manager, Operations Office in accordance with guidelines provided by the Office of Nuclear Weapons Management, the Departmental nuclear materials managers.
 - (3) The material must be written off the materials control and accountability books and removed from its nuclear processing area (or material balance area) to a storage or disposal area containing only discardable material.
- m. Identification of a facility for decommissioning, closure, or deactivation shall not exempt the facility from compliance with requirements stated in this Order. The facility's materials control and accountability program shall be maintained at a level appropriate to the category and attractiveness level of the nuclear material on inventory until a termination survey determines that there is no nuclear material remaining at the facility. Such a determination may be made if there is no material or the only material is waste material that meets the definition of Attractiveness Level E and that material has been written off the materials control and accountability books. Requirements for termination surveys are contained in DOE 5634.1B. After a facility has transferred all its nuclear material except waste to another facility, the inventory balance is zero, and the termination survey has been completed, DOE/MRC F 741, "Nuclear Material Transaction Report," may still be needed for reporting shipment of waste to offsite waste-handling areas. In such cases, the capacity shall be maintained for generating DOE/MRC F 741 for these shipments until the waste management program puts into use its own accounting system for transfers.
 - n. A vulnerability assessment shall be performed for each facility to evaluate the potential for unauthorized accumulation of a Category 1 quantity of special nuclear material from multiple locations within the same Protected Area through either a single occurrence or protracted diversion. The vulnerability assessment shall include consideration of the attractiveness level of the material and the credibility of the removal scenarios. For protracted diversion, the vulnerability assessment shall also include consideration of the number of removal events and the total elapsed time required to accumulate the target quantity during the inventory period. Credible accumulation scenarios shall be documented in DOE-approved Site Safeguards and Security Plans.
 - o. Procedures, techniques, and standards as promulgated by the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI) shall be used, when such standards exist, in developing the basis for nuclear material control, measurements and measurement control, accounting, and statistical methods that are employed by a facility for safeguarding of nuclear material, unless otherwise directed by DOE directives. Standards issued by the International Atomic Energy Agency and the Nuclear Regulatory Commission should also be used when appropriate and when consistent with DOE regulatory goals.

- p. Materials control and accountability requirements contained in this Order shall apply to all DOE facilities, including new and renovated DOE nuclear facilities. The planning, design, construction, and operation of new or renovated facilities should incorporate the latest materials control and accountability technologies, systems, and approaches. Using modern techniques and equipment to maximize material loss detection sensitivity and to increase the quality of accountability measurements will reduce the magnitude of inventory difference control limits calculated as a part of inventory difference evaluations and will increase the quality of other analyses. Performance requirements for inventory difference control limits for such facilities are contained on page I-10, paragraph 4.
 - q. The "Guide for Implementation of DOE 5633.3A" shall be considered in developing materials control and accountability programs. This guide does not establish or originate policy. Instead, it describes methods for meeting requirements of this Order.
 - r. Nuclear materials designated as radioactive waste are subject to the requirements of this Order unless exempted from its requirements by paragraphs 1k or 1 above. In addition to requirements of this Order, the handling, disposal, and management of nuclear materials designated as radioactive waste must be in compliance with DOE environmental and waste management regulations including DOE 5820.2A, RADIOACTIVE WASTE MANAGEMENT.
2. GRADED SAFEGUARDS. The following presents basic information and requirements for graded safeguards. Additional requirements will be found throughout this Order.
- a. Operations Offices and facilities shall establish and follow a graded safeguards program for nuclear materials. Graded safeguards is the concept of providing the greatest relative amount of control and effort to the types and quantities of special nuclear material that can be most effectively used in a nuclear explosive device. Categories of nuclear material for implementation of DOE's graded safeguards program are shown in Figure 1-2. The "Guide for Implementation of DOE 5633.3A" contains more descriptive guidance for material attractiveness and examples of category determination.
 - b. Determination of material category for a special nuclear material location (Materials Balance Area, Material Access Area, Protected Area, facility, etc.) is required for a variety of safeguards and security purposes. In many cases, the material category is determined directly from Figure 1-2. In cases where the material category determination requires consideration of multiple material types and attractiveness, directions for determining the material category are given in the following subparagraphs. When a facility can demonstrate that the accumulation of smaller quantities of special nuclear material from within a Materials Balance Area is not credible, the summation of these quantities need not be used to define the category quantity. Determination of category involves grouping materials by special nuclear material type, attractiveness level, and quantity. Material quantities are element weights for plutonium and U-233 and isotope weights for U-235. Procedures for

determining material category are as follows:

- (1) One Special Nuclear Material Type, One Attractiveness Level:
Sum the material in the attractiveness level and determine the category from Figure I-2.
- (2) One Special Nuclear Material Type, Multiple Attractiveness Levels, a Category III or greater quantity of B level material included:
 - (a) Determine the amounts of special nuclear material for materials in each of Attractiveness Levels B, C, and D.

FIGURE I-2
Nuclear Material Safeguards Categories

	Attractiveness Level	PURE U-233 Category (QUANTITIES IN KGS)				CONTAINED U-235 Category (QUANTITIES IN KGS)				OTHER NUCLEAR MATERIAL
		I	II	III	IV/1	I	II	III	IV/1	IV/2
WEAPONS Assembled weapons and test devices	A	All Quantities	N/A	N/A	N/A	All Quantities	N/A	N/A	N/A	N/A
PURE PRODUCTS Pits, major components, buttons, ingots, recastable metal, directly convertible materials	B	>=2	>or= 0.4<2	>or= 0.2< 0.4	<0.2	>or=5	>or= 1<5	>or= 0.4<1	<0.4	N/A
HIGH-GRADE MATERIAL Carbides, oxides solutions (>or=25 g/l) nitrates, etc., fuel.	C	>=6	>or= 2<6	>or= 0.4<2	<0.4	>or=20	>or= 6<20	>or= 2<6	<2	N/A

elements and assemblies, alloys and mixtures, UF ₄ or UF ₆ (>or= 50% U-235)										
LOW-GRADE MATERIALS Solutions (1-25g/l) process residues requiring extensive reprocessing, moderately irradiated material, Pu-238 (except waste), UF ₄ or UF ₆ (>or= 20%<50% U-235)	D	N/A	>or= 16	>or= 3<16	<3	N/A	>or= 50	>or= 8<50	<8	N/A
ALL OTHER MATERIALS Highly irradiated forms, solutions (>or= 1 g/l), uranium containing <20% U-235 (any form or quantity)	E	N/A	N/A	N/A	Reportable Quantities	N/A	N/A	N/A	Reportable Quantities	Reportable Quantities

/1 The lower limit for category IV is equal to reportable quantities in this Order.

/2 See paragraphs 3b and 3c for MCAA requirements for tritium and depleted uranium.

- (b) Calculate the "effective" quantity for Attractiveness Levels B and C by multiplying the quantity in Attractiveness Levels B and C by the appropriate factors in Figure I-3.
- (c) Sum the effective amounts in Attractiveness Levels B and C.
- (d) Compare the total effective amount as calculated in subparagraph (c) above to the amounts in Attractiveness Level B from Figure I-2.
- (e) Compare the amount of Attractiveness Level D to Figure I-2.
- (f) The material category is the highest level of material category determined in subparagraphs (a) through (d) or in subparagraph (e).

Attractiveness Level	Pu/U-233 Factor	U-235 Factor
B	1	1
C	1/3	1/4

Figure I-3
Effective Quantities

- (3) One Special Nuclear Material Type, Multiple Attractiveness Levels, less than a Category III quantity of B level material included:
 - (a) Determine the amounts of special nuclear material for all attractiveness levels.
 - (b) Compare the total amounts in each level to the amounts in Figure I-2.
 - (c) The material category level is the highest level of the material categories determined in subparagraphs (a) and (b).
- (4) Multiple Special Nuclear Material Types:
 - (a) Determine the category for each special nuclear material type following the above procedures.
 - (b) The category is that determined for the individual special nuclear material type that requires the highest level of protection.

3. MATERIALS CONTROL AND ACCOUNTABILITY REQUIREMENTS FOR SOURCE AND OTHER NUCLEAR MATERIALS.

- a. Except for tritium and depleted uranium, source and other nuclear materials shall be treated as Attractiveness Level E materials. Therefore, the requirements for a Materials Balance Area containing only source and other nuclear materials shall be that of Category IV. When source and other nuclear materials are present in Materials Balance Areas containing special nuclear material, only the special nuclear material is used to determine the category of the Materials Balance Area. However, source and other materials are subject to Category IV requirements.
- b. Tritium is a nuclear material of strategic importance; therefore, graded safeguards programs for tritium shall be established and followed equivalent to the following categorizations:
 - (1) Category III. Weapons or test components containing reportable quantities of tritium. Deuterium-tritium mixtures, or metal tritides that can be easily decomposed to tritium gas, containing greater than 50 grams of tritium (isotope) with a tritium isotopic fraction of 20 percent or greater.
 - (2) Category IV. All other reportable quantities, isotopic fractions, types, and forms of tritium.
- c. Depleted uranium is a material of limited strategic and monetary value, therefore, the requirements of this Order do not apply to depleted uranium except as follows:
 - (1) For Materials Balance Areas containing more than 10 metric tons of depleted uranium or having transactions of depleted uranium totaling more than 10 metric tons per year, the depleted uranium shall be treated as Category IV, Attractiveness Level E, material.
 - (2) For reporting identification symbols containing more than 10 metric tons of depleted uranium or having transactions of depleted uranium totaling more than 10 metric tons per year, documentation and reporting of depleted uranium transactions and inventories shall be in accordance with page II-19, paragraph 7.
 - (3) For depleted uranium not required to be handled as Category IV, Attractiveness Level E, material, the following minimum requirements apply:
 - (a) Procedures shall be developed and implemented to detect unauthorized internal transfers of depleted uranium.
 - (b) An accounting system shall be maintained that describes depleted uranium transactions and inventories.
 - (c) For external transfers, the shipper shall obtain written verification and maintain documentation that the intended receiver is authorized to accept the material before the material is transferred.
 - (4) Facilities selected under DOE 1270.2B, SAFEGUARDS AGREEMENT

WITH THE INTERNATIONAL ATOMIC ENERGY AGENCY, are required to meet requirements for depleted uranium defined in the Facility Attachment document. Additionally, transfers of depleted uranium involving either (a) exports or imports of depleted uranium or (b) movements of depleted uranium within the U.S. in which any part of the country control code represents a foreign country shall be tracked and reported in accordance with requirements on page 11-19, paragraph 7.

4. LOSS DETECTION ELEMENT EVALUATION.

- a. **Vulnerability Assessment.** Detailed vulnerability assessments identifying and evaluating the capability for detection of a loss of a Category I quantity of special nuclear material shall be developed by each Category I facility and approved by the head of the Operations Office materials control and accountability organization. Requirements for preparation of the Site Safeguards and Security Plan documents shall be used as the basis for these assessments. Vulnerability assessments shall cover the full threat spectrum specified in Office of Safeguards and Security guidance. Potential targets shall include all Category I areas and any Category II or III areas for which a credible scenario for unauthorized accumulation of a Category I quantity has been identified. Performance testing programs shall be developed to support and verify vulnerability assessments. Vulnerability assessments shall be reviewed annually and updated when system changes or new information indicate a potentially significant change in the risk of unauthorized removal of Category I quantities of special nuclear material. Results of reviews including changes in vulnerability assessments shall be documented and classified in accordance with CG-SS-3.
- b. **Performance Testing.** DOE 5630.16A, SAFEGUARDS AND SECURITY ACCEPTANCE AND VALIDATION TESTING PROGRAM, contains requirements for the design, planning, and documentation of performance tests. Materials control and accountability performance testing programs shall meet the requirements of DOE 5630.16A. For each facility, management shall establish and implement a documented testing program to verify materials control and accountability procedures and practices and to demonstrate that material controls are effective.
 - (1) These tests shall be designed to demonstrate that the system is functional and to assure that the system performs as specified and/or required. In addition, facilities shall:
 - (a) Identify those components of the materials control and accountability system that provide the greatest effectiveness against theft and diversion;
 - (b) Design, conduct, and document tests which substantiate component effectiveness; and
 - (c) Integrate the results of these component tests into safeguards and security vulnerability assessments.

- (2) Performance testing shall include not only those elements that can detect-in-time-to-prevent but also those elements that can effectively account for special nuclear material in order to provide assurance that safeguards and security systems are functioning properly.
 - (3) The design of the performance testing program shall be focused on testing individual detection elements. Elements identified in a vulnerability assessment that contribute to detection capability shall be tested on a frequency based on the level of threat/risk established by the vulnerability assessment.
 - (4) The design of performance tests should consider prudent judgment and use of resources.
 - (a) The scope and extent of testing should be based on the graded safeguards concept with the testing program including more testing for higher category facilities than for lower category facilities.
 - (b) Guidance for performing testing is contained in DOE's Master Safeguards and Security Agreement Verification Guide (Section 4.0, Performance Testing; Appendix F., Checklist for Performance Requirements; and Appendix G., Materials Control and Accountability Checklist). In addition, Office of Safeguards and Security has provided guidance for the evaluation of the detection elements of the materials control and accountability system which will facilitate the design and validation of the performance testing program in the "Guide to the Evaluation of Selected Materials Control and Accountability (MCA) Detection Elements."
 - (5) Testing data and results shall be classified in accordance with CG-SS-3.
 - (6) Corrective actions shall be taken for vulnerabilities identified during system testing.
- c. Materials Control and Accountability Performance Requirements. Minimum performance requirements for selected materials control and accountability system elements are given in Figure 1-4 on page 1-12. Validation of these system elements shall be accomplished by performance testing. Testing shall be established at a frequency which, at a minimum, shall be in accordance with DOE 5630.16A and shall be documented in the Materials Control and Accountability Plan. When these system elements fail to meet performance requirements, a corrective action plan shall be developed and where necessary compensatory measures shall be taken. Testing of access controls and material surveillance shall be facility-specific with the scope and extent of the testing documented by facility management and approved by the Manager, Operations Office. A sufficient number of items and tamper-indicating devices shall be tested to assure that on an annual basis the performance requirements for tamper-indicating devices and accounting records are met with 95% confidence for Category I and II items.

Confidence levels for Category III and IV items shall be approved by the Manager, Operations Office. Testing to assure that tamper-indicating devices are properly in place shall include checking to see that the tamper-indicating device has been properly applied and there is no indication that the integrity of the tamper-indicating device has been violated. (The testing for this requirement is not intended to require destruction of properly applied tamper-indicating devices whose integrity has not been violated.) Additional guidance for testing metal detectors is given in the "Metal Detector Guide." In the performance requirement for inventory differences, "throughput" means measured output including waste, and "active inventory" means those materials in the Materials Balance Area that enter into the limit-of-error calculation. Additional or more stringent performance requirements for system elements may be established by the Manager, Operations Office, or the responsible Head of Headquarters Element. Paragraphs 6d(2) of this Chapter; 2c(3) and 4a(1)(f) in Chapter II; 2b, 3b(1), and 5c in Chapter III of this Order contain requirements that can be readily performance tested. Testing of system elements associated with these requirements should be included as a regular part of the performance testing program.

Access Controls. Performance tests shall be designed and conducted to fully evaluate the effectiveness of access controls for Category I and II quantities of special nuclear material. In at least 95% of the tests conducted, the tests shall demonstrate the detection of unauthorized access to Category I and II quantities of special nuclear material.

Material Surveillance. Performance tests shall be designed and conducted to fully evaluate the effectiveness of material surveillance activities for Category I and II quantities of special nuclear material. In at least 95% of tests conducted, the tests shall demonstrate the detection of unauthorized actions related to the control of Category I and II quantities of special nuclear material.

Tamper-Indicating Devices. The tamper-indicating device record system shall accurately reflect the location and identity of tamper-indicating devices in at least 99% of the cases. The tamper-indicating device program shall assure that tamper-indicating devices are properly in place in at least 95% of the cases.

Portal Monitoring. In addition to performance testing necessary to verify that vulnerability assessment or Operations Office detection requirements are being met, testing of portal monitors (special nuclear material and metal) shall include all applicable tests described in American Society for Testing and Materials guides unless otherwise directed by Office of Safeguards and Security. When standards set in applicable American Society for Testing and Materials guides are not met, compensatory actions shall be taken.

Accounting Record Systems. The accounting record system shall accurately reflect item identity and location in at least 99% of the cases.

Inventory Confirmation/Verification Measurements. For Category I and II items, the acceptance/rejection criteria for verification measurements and where possible for confirmatory measurements shall be based on the standard deviation for the measurement method under operating conditions. The control limits for such criteria shall be set at no wider than three times the standard deviation for the method. The Managers, Operations Offices, should review and approve the control limits. When limits based on three standard deviations are unreasonably large, the Manager, Operations Office, may require tighter limits.

Inventory Difference Control Limits. Limits-of-error for inventory differences of processes in new Category I and II facilities shall be no larger than the smaller of a Category II quantity of special nuclear material or 2% of total throughput and active inventory.

Figure I-4

Performance Requirements for Materials Control and Accountability Elements

- d. **Performance Requirements Compliance Schedule.** Factors for determining when facilities must demonstrate full compliance with the materials control and accountability performance requirements include the following:
 - (1) Timelines for implementing performance testing requirements in DOE 5630.16A;
 - (2) Requirements for the development of and availability of testing data used to support the Site Safeguards and Security Plans/Master Safeguards and Security Agreements; and
 - (3) Effective and implementation dates that were established by DOE 5633.3A. That Order required the development of a document, within 9 months of 2-12-93, that specifies how the requirements in that Order and those specified by the Manager, Operations Office, are being met.

Based upon the above, facilities should be demonstrating compliance with performance requirements for those materials control and accountability elements that detect-in-time-to-prevent as of the effective date of this Order. For all other elements, compliance should be demonstrated no later than 11-12-94.

5. **OCCURRENCE INVESTIGATION AND REPORTING.** Each facility shall identify materials control and accountability loss detection elements for each Materials Balance Area and shall establish a graded program for monitoring these elements and associated data to determine the status of nuclear material inventories and to identify reportable occurrences. Reportable occurrences involving Category I, II, and III nuclear materials shall be reported as an Emergency, Unusual Occurrence, or Off-Normal Occurrence in accordance with DOE 5000.38. For reportable occurrences involving Category IV nuclear materials, the Manager, Operations Office, will define the extent of the investigation required to resolve the occurrence. When losses of Category IV nuclear materials

which have been identified as credible radiological sabotage targets or when radiological sabotage events involving Category IV materials have occurred, reporting and investigation under DOE 5000.3B may be required. The categorization of materials control and accountability occurrences are contained in DOE 5000.3B. In addition to the reporting required by DOE 5000.3B, the DOE facility representative, as defined in DOE 5000.3B, shall notify the head of the appropriate division within the cognizant Operations Office responsible for the implementation of this Order. The head of the appropriate Operations Office division is responsible for notifying Office of Safeguards and Security and the local office of the Federal Bureau of Investigation of reportable occurrences for which there is both an indication of a loss of nuclear material and evidence of a malevolent act. In addition, the Operations Office shall independently evaluate the occurrence based upon its significance. Information related to monitoring and assessment activities shall be documented and retained.

6. **ADMINISTRATIVE CONTROLS.** For each facility, management shall establish a graded program to ensure the integrity and quality of materials control and accountability systems and procedures, and to periodically review and evaluate these systems. This program shall be described in the facility's Materials Control and Accountability Plan and specifically address the following criteria:
 - a. Facility materials control and accountability procedures shall be reviewed and approved (prior to implementation) by facility operations management at a level of authority sufficient to ensure compliance by operations personnel. Procedures shall be consistent with the approved facility Materials Control and Accountability Plan, and procedures shall be distributed to all applicable organizations and individuals in the facility having materials control and accountability responsibilities.
 - b. For each facility, management shall establish procedures for emergency conditions and periods when materials control and accountability system components are inoperative. These procedures shall be designed to assure that access to or removal of special nuclear material would be detected during these periods.
 - c. For each facility, management shall establish controls that limit access to the accounting system and nuclear materials accounting data. For automated systems, controls shall be designed to deter and detect unauthorized access to the data bases and data processing systems that, through tampering, modification, or alteration could lead to defeat of the accounting system. Nuclear materials accounting data shall be protected in accordance with applicable classification, automated data processing, and computer security regulations.
 - d. The facility nuclear materials accounting system shall include checks and balances, and be structured to ensure:
 - (1) Identification of omission(s) of data for any reportable transaction.
 - (2) Timely detection (normally within 24 hours but in no case

later than the subsequent inventory reconciliation) of errors/ discrepancies in records associated with a Category I or II quantity of special nuclear material including where possible detecting falsified data and identifying the responsible person(s).

- (3) Detection of data discrepancies and errors to ensure that no discrepancies exist in control indicator accounts.
 - (4) The completeness of the nuclear materials accounting system records.
- e. For each facility possessing nuclear materials, facility management shall establish a program to periodically review and assess the integrity and quality of the materials control and accountability system. The assessment program shall address normal operations and emergency conditions. The frequency of these assessments shall be on a graded basis, consistent with requirements of DOE 5634.1B, and approved by the Manager, Operations Office. The results of all assessments shall be classified if appropriate, reported to facility management, and each noted deficiency shall be addressed and corrected. The assessment shall be performed by personnel who are knowledgeable in materials control and accountability. Assessments shall be on a graded safeguards basis; at a minimum, the assessment program shall address the following:
- (1) Identification of abnormal situations.
 - (2) Loss mechanisms, loss detection capabilities, and the localization of inventory differences.
 - (3) Selection, maintenance, calibration, and testing functions to assure proper equipment and system performance.
 - (4) Materials control and accountability system checks and balances, including separation of duties and responsibilities, that are used to identify irregularities and detect tampering with materials or materials control and accountability system components.
 - (5) Change controls, including authorization requirements, to detect unauthorized or inappropriate modification of system components, procedures, or data. The change control system shall address requirements for review, authorization, documentation, notification, and controls on equipment selection, procurement, and maintenance.
 - (6) Procedures and/or checks to assure the reliability and accuracy of materials control and accountability data and information.
 - (7) Performance testing conducted by the facility. This portion of the assessment should address the design of performance tests and the results obtained by the testing program since the last assessment.

- (8) Procedures for emergency conditions and for periods when materials control and accountability system components are inoperative.
 - (9) Material containment, material access, and material surveillance procedures.
 - (10) The physical inventory program and reconciliation practices.
 - (11) Accounting system procedures, capabilities and sensitivities.
 - (12) Identification of personnel with materials control and accountability responsibilities who should be included in the facility personnel security assurance program, consistent with national security requirements and DOE 5631.6A, PERSONNEL SECURITY ASSURANCE PROGRAM.
 - (13) Measurement control program.
 - (14) Tamper-indicating device programs.
- f. Reviews shall be conducted prior to startup of new facilities or operations, and whenever changes are made in facilities, operations, or materials control and accountability features that might alter the performance of the materials control and accountability system.
- g. In addition to the assessments in subparagraph f above, internal audits of the facility's materials control and accountability function shall be conducted by an organization independent of materials control and accountability to assess compliance with internal plans and procedures. The frequency of these audits shall be approved by the Manager, Operations Office.

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CHAPTER II

MATERIALS ACCOUNTABILITY

1. GENERAL. This chapter describes the requirements for nuclear materials accountability and shall be applied in a manner consistent with the graded safeguards concept. The chapter is subdivided into five functional areas: accounting systems, inventories, measurements and measurement control, material transfers, and material control indicators.

2. **ACCOUNTING SYSTEMS.** Each facility shall have a system that provides for tracking nuclear material inventories, documenting nuclear material transactions, issuing periodic reports, and assisting with the detection of unauthorized system access, data falsification, and material gains or losses. The accounting system shall provide a complete audit trail on all nuclear material from receipt through disposition. The Generally Accepted Accounting Principles, as promulgated by Financial Accounting Standards Board, shall be used in the design and operations of the nuclear material accounting system unless otherwise directed by DOE directives.

- a. **Accounting System Data Base and Procedures.** For each facility, procedures shall be maintained describing the structure and operation of the nuclear materials accounting system. The procedures shall accurately reflect current nuclear material accounting practices. Specific requirements for accounting procedures include the following:
 - (1) A description of the inventory data base, including procedures for updating the inventory data and reconciling the inventory data with the results of physical inventories, and a description of the required data elements for each applicable material type.
 - (2) Identification of the accounting reports and their frequency, distribution and timeliness, consistent with accounting requirements.
 - (3) Identification of the organizational responsibilities for the management and operation of the accounting system.
 - (4) Recording, reporting, and submission of data to the national database, Nuclear Materials Management and Safeguards System, by material type and reporting unit, as specified on page II-19, paragraph 7.
- b. **Account Structure.**
 - (1) A facility shall consist of one or more Materials Balance Areas established to identify the location and quantity of nuclear materials in the facility. For each facility, readily retrievable accountability data shall be maintained by Materials Balance Area that reflects quantities of nuclear materials on inventory, quantities of nuclear material received and shipped, and other adjustments to inventory.
 - (2) The Materials Balance Area account structure shall provide the capability to localize inventory differences and provide a system of checks and balances for verifying the accuracy of the accountability data and records.
 - (3) One individual in each Materials Balance Area shall be designated by management to be responsible for ensuring that materials control and accountability policies are implemented in that Materials Balance Area.

- (4) Material types, processes, and functions shall be considered in establishment of Materials Balance Areas. The number of Materials Balance Areas shall be sufficient to identify and localize inventory differences and their causes.
- (5) A Materials Balance Area boundary shall not cross a Materials Access Area boundary. Each Materials Balance Area should conform to the single geographical area concept and be an integral operation. If more than one geographical area is included in one Materials Balance Area, all of these areas must be under the administrative control of the same individual, and the activities in these areas must be associated with an integral operation.

c. Records and Reports.

- (1) For each facility, management shall maintain records, submit data, and issue reports as required by page 11-19, paragraph 7 and facility procedures. These reports shall accurately describe all nuclear material transactions and inventories. Inventory adjustments shall be identified by Materials Balance Area and shall be reported consistent with requirements of this Order, page 11-19, paragraph 7.
- (2) Nuclear materials records shall be updated only by authorized personnel, and the records system shall provide an audit trail for all transactions affecting the nuclear materials database.
- (3) The Materials Balance Area records system shall be capable of being updated daily or upon demand for all nuclear materials transactions. (This requirement is for the updating of records based on reports or information; it is not a requirement on how quickly a facility must be able to complete measurements.) In addition, the records system shall be capable of generating book inventory listings for all special nuclear material within 3 hours. For all other nuclear material, the timing for generation of book inventories shall be within 24 hours. Validating the accuracy of the accounting record system shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16A and applicable Department guidance. Performance requirements for accounting record system accuracy are contained on page 1-10, paragraph 4.

3. PHYSICAL INVENTORIES. Each facility's management shall implement a physical inventory program for nuclear materials consistent with the requirements defined below.

a. Periodic Physical Inventories.

- (1) Physical Inventories. Inventories shall be based on measured values and, where feasible, measurements or technically justifiable estimates of holdup shall be made so that holdup quantities can be used in determining inventory values or explaining the inventory difference. Process monitoring

techniques may be used for material which is undergoing processing and recovery operation but inaccessible for measurements by sampling. Process monitoring, in addition to material control procedures and specific action criteria, subject to the approval of the Manager, Operations Office, should be used routinely to track materials in process until operations permit an accountability measurement.

- (2) Conduct of Inventories. For each facility, there shall be documented plans and procedures defining responsibilities for performing inventories and specifying criteria for conducting, verifying, and reconciling inventories of nuclear material. Verification of the presence of items during inventories may be performed on a statistical sampling basis. Sampling plans shall be consistent with the graded safeguards concept. Parameters for statistical sampling plans and inventory stratifications used with statistical sampling plans shall be defined by the facility management and approved by the Manager, Operations Office.
- (3) Holdup Inventory. Holdup inventory shall be measured, where feasible, or estimated on the basis of throughput, process data, modeling, engineering estimates, or other technically justifiable factors as a regular part of inventory for facilities with Category I, II, and III quantities of special nuclear material and for facilities with Category IV quantities of special nuclear material that have more than 5 kilograms of special nuclear material as holdup on a regular basis. The method, justification, and supporting documentation should be included in the Materials Control and Accountability Plan.
- (4) Physical Inventory Frequencies. For each facility, physical inventories shall be performed for Category I and II Materials Balance Areas involving activities other than processing at a frequency determined by the Manager, Operations Office, but at least semiannually. For Category I and II Materials Balance Areas where processing occurs, physical inventories shall be performed at a frequency determined by the Manager, Operations Office, but at least bimonthly. Factors to be taken into consideration for frequency determination include personnel radiation exposure, the operational mode of the facility, and credible protracted diversion scenarios.

Category IV source and/or other nuclear material in Category I and II Materials Balance Areas shall be inventoried on a schedule defined by the Manager, Operations Office, but at least annually, except when the source and/or other nuclear material is a credible substitution material. In situations where substitution materials are collocated with special nuclear material, facilities shall inventory substitution materials with the same frequency as the special nuclear material and implement the use of inventory measurement methods that can distinguish between special nuclear material and source and other nuclear material.

In addition to the above requirements, inventory checks for Category IA items not in storage shall be performed weekly for physical count verification, and monthly for serial number verification. Inventory checks for stored Category IA items shall consist of a physical count whenever the storage area is accessed and a serial number verification on a monthly basis.

For each facility, physical inventories shall be performed for Category III and IV Materials Balance Areas at a frequency to be determined by the Manager, Operations Office, but at least biennially.

For facilities having multiple Materials Balance Areas with varied inventory frequencies, a simultaneous inventory of the complete facility shall be performed at least once biennially.

- (5) **Deviations to Inventory Frequencies.** Deviations to inventory frequency requirements described in subparagraph (4) above may be approved in accordance with DOE 5630.11B, for situations where alternative control mechanisms provide assurance that unreported changes in inventories would be detected. Inventory values shall be determined in time to provide for computation and reconciliation of inventories and determination of inventory differences, consistent with DOE reporting requirements stated on page 11-19, paragraph 7, and approved inventory frequencies. See "Guide for Implementation of DOE 5633.3A."
 - (6) **Physical Inventory Reconciliation Program.** For each facility, management shall implement a physical inventory reconciliation program designed to provide assurance that all nuclear material has been accounted for and that the facility's record system reflects the physical inventory. Upon completion of the physical inventory, the book inventory for each Materials Balance Area shall be compared with and, if necessary, adjusted to the physical inventory.
- b. **Special Inventories.** At each facility, management shall establish and implement procedures for conducting special inventories as a result of routine disassembly of critical assemblies, changes in custodial responsibilities, missing items, inventory differences exceeding established control limits, abnormal occurrences, or at the request of authorized facility personnel or the cognizant Operations Office.
 - c. **International Atomic Energy Agency Inventories.** Physical inventories performed during International Atomic Energy Agency inspections may, with the concurrence of the Manager, Operations Office, serve in place of a scheduled physical inventory.
 - d. **Inventory Verification/Confirmation Measurements.**
 - (1) At each facility, management shall establish and implement a system for performing measurements as part of a physical inventory. Verification measurements shall be made on special nuclear material items that are not tamper-indicating.

Confirmation measurements shall be made on items that are tamper-indicating. Such measurements are intended to detect diversion or theft of material and shall use a statistically-based sampling plan applied in a manner consistent with the graded safeguards concept. Separate sampling plans shall be implemented for verification and confirmation measurements to assure that a sufficient number of non-tamper-indicating items are measured. Parameters for statistical sampling plans and inventory stratifications used with statistical sampling plans shall be defined by facility management and approved by the Manager, Operations Office. The Manager, Operations Office, may establish a material quantity threshold for requiring inventory verification/confirmation measurements. It is recognized that certain materials are not amenable to verification measurements. Such materials shall be documented in the Materials Control and Accountability Plan and, for these materials, confirmatory measurements of two material attributes may be substituted for the verification measurement. Materials not amenable to measurement shall be identified as on page II-6, paragraph 4.

- (2) Documented acceptance/rejection criteria for inventory confirmation/verification measurements shall be established based on valid technical and, where technically feasible, on valid statistical principles. For Category I and II items, acceptance/rejection criteria shall be consistent with performance requirements for confirmation/verification measurements stated in Figure 1-4, page 1-12. A response plan shall be prepared and implemented for evaluating and resolving all verification/confirmation measurements that fail acceptance criteria. Items that fail the confirmation/verification measurement criteria shall not be processed prior to resolution of the discrepancy. Performance requirements for inventory confirmation/verification measurements are contained on page 1-10, paragraph 4.

4. MEASUREMENTS AND MEASUREMENT CONTROL. At all facilities possessing nuclear material, measurement and measurement control programs shall be implemented. The object of measurement and measurement control is to establish nuclear material values and to assure the quality of the data. Measurements programs used to determine Category I or II inventories of special nuclear material or used to determine a Category I or II special nuclear material throughput over a 6 month period shall address the topics identified in this paragraph and shall be consistent with facility-specific measurement program objectives. For other measurement and measurement control programs (those used only to determine Category III or IV inventories), the scope and content of the programs shall be approved by the Manager, Operations Office. For Category I and II facilities, these programs shall address the topics identified in this paragraph and shall be consistent with facility-specific measurement program objectives.

Materials not amenable to measurement by the site shall be identified in the facility's Materials Control and Accountability Plan. Inventory values for these materials shall be based on measured values made at other sites or technically justified estimates. Justification and

supporting documentation for these inventory values shall be included as part of the Materials Control and Accountability Plan.

Additional guidance on measurement control is provided in the DOE "Measurement Control Guide," (3-93).

- a. **Organization.** The measurement and measurement control program shall be organized to facilitate efficiency of operation and quality of performance and be independent from operations.
- b. **Selection and Qualification of Measurement Methods.** The objective is to ensure that measurement methods selected for use are capable of measuring the material in question to the desired levels of precision and accuracy, as approved by the Manager, Operations Office, and consistent with a graded safeguards approach. To this end, each facility's management shall select, qualify, and validate measurement methods capable of providing the desired levels of precision and accuracy. Selection and qualification of a measurement method shall be the responsibility of the facility management. Target values for the accuracy and precision of nuclear material measurements recommended and endorsed by recognized national and international nuclear organizations may be used by contractors and Operations Offices as guidance for desirable levels of accuracy and precision. The Manager, Operations Office, shall review the documentation of this process and shall approve the precision and accuracy goals. Each facility shall have procedures to ensure that only qualified measurement methods are used for accountability purposes.
- c. **Training and Qualification of Measurement Personnel.** The objective is to assure that the individuals responsible for performing measurements have sufficient knowledge to perform the measurements in an acceptable manner.
 - (1) **Training.** Each facility shall have a documented plan for the training of measurement personnel. The plan shall be reviewed annually and updated as necessary to reflect changes in measurement technology and shall specify training, qualification, and requalification requirements for each measurement method.
 - (2) **Qualification.** Each facility shall have a documented qualification program that ensures that measurement personnel demonstrate acceptable levels of proficiency before performing measurements, and that measurement personnel are requalified according to requirements in the training plan. For destructive analysis of nuclear material, this proficiency shall be demonstrated, at a minimum, once per day for each method that the individual will use that day.
- d. **Measurement Systems.** The objective of the measurement system is to provide nuclear material values for inventories and transactions.
 - (1) **Sampling.** The objective of the sampling program is to ensure that the small portion of bulk material taken for measurement is representative of the bulk material. Each facility shall

have documented sampling plans for each measurement point used for accountability purposes. The plans shall be based on valid technical and statistical principles and shall take into account material type, measurement requirements, and any special process or operational considerations.

- (a) The basis of the sampling plan shall be documented and validated through studies of the materials or items being sampled.
 - (b) The sampling plan shall specify at a minimum the sampling procedure, number of samples required, size of samples, mixing time and procedure (when applicable), provisions for retaining archive samples, and estimates of variance associated with the sampling method.
 - (c) Sampling procedures shall be documented and reviewed annually or whenever changes are made to the sampling process or in material type or composition of the material being sampled.
- (2) Measurement Methods. For each facility, measurement methods shall be developed, documented, and maintained for all nuclear material on inventory except for those materials not amenable to measurement. These methods shall be written to provide clear direction to the analyst or operator, and shall be validated initially and revalidated whenever changes are made.
- (a) In determining inventory values and consistent with the graded safeguards concept, the selection of the measurement methods shall assure that the contribution of the measurement error to the uncertainty of the inventory difference is minimized.
 - (b) Verification measurements, when used to adjust accountability records, shall have accuracy and precision comparable to, or better than, the original measurement method.
 - (c) For confirmatory measurements, the measurement method used shall be capable of determining the presence or absence of a specific attribute of the material, consistent with valid acceptance/rejection criteria.
 - (d) All measurement methods shall be calibrated using Standard Reference Materials, Certified Reference Materials, or secondary standards traceable to the national measurement base, and revalidated as necessary.
 - (e) Equipment and instrumentation used in performing measurements shall meet precision and accuracy requirements under in-plant conditions.
 - (f) Documentation of measurement data shall be maintained to provide an audit trail from source data to accounting records.

- e. **Measurement Control.** The objective of measurement control is to assure the effectiveness of measurement systems and the quality of measured values used for accountability purposes and to obtain precision and accuracy values for use in the determination of inventory difference control limits and shipper/receiver limits of error.
- (1) **Measurement Control Programs.** For each facility, measurement control programs shall be developed and implemented for all measurement systems used for accountability purposes. A measurement control program, as referred to herein, shall include at a minimum the following elements:
- (a) **Scales and Balances Program.** All scales and balances used for accountability purposes shall be maintained in good working condition, recalibrated according to an established schedule, and checked for accuracy and linearity on each day that the scale or balance is used for accountability purposes.
 - (b) **Analytical Quality Control.** Data from routine measurements shall be analyzed statistically to determine and ensure accuracy and precision of the measurements.
 - (c) **Sampling Variability.** The uncertainty associated with each sampling method, or combination of sampling and measurement method, shall be determined and maintained on a current basis.
 - (d) **Physical Measurement Control.** The precision and accuracies of volume, temperature, pressure, and density measurements shall be determined and assured.
 - (e) **Instrument Calibration.** Instrumentation shall be calibrated using appropriate standards, when available, or at a minimum, measurement values shall be compared with more accurate measurement systems values on a prescribed basis, with the frequency being defined by demonstrated instrument performance.
 - (f) **Reference Materials (Standards).** All calibration and working standards used in a measurement control program shall be traceable to the national measurement base through the use of standard reference materials or certified reference materials and shall have smaller uncertainties associated with their reference values than the uncertainties of the measurement method in which they are used. Working standards used in a measurement control program shall be representative of the type and composition of the material being measured when the material matrix affects the measured values. For additional information see "Guidance on Meeting DOE Order Requirements for Traceable Nondestructive Assay Measurements."
 - (g) **Sample Exchange Programs.** Each facility's measurement

control program shall include participation in appropriate interlaboratory control programs to provide independent verification of internal analytical quality control.

- (h) **Statistical Controls.** For each measurement method used for accountability purposes, control limits shall be calculated and monitored, and documented procedures shall exist to correct out-of-limits conditions. Control limits shall be established at the two sigma level (warning limits) and three sigma level (alarm limits). Control data exceeding the two sigma limits shall be investigated, and, when warranted, timely corrective action shall be taken. Whenever a single data point exceeds the three sigma level, the measurement system in question shall not be used for an accountability measurement until the measurement system has been demonstrated to be within statistical control. For measurement methods relying substantially on operator technique, control limits shall include uncertainties for each analyst/method combination. Statistical control limits shall be monitored to assure that they are consistent with target values agreed to by the facility management and the Manager, Operations Office.
- (i) **Measurement Method Qualification.** Each facility shall have a documented method qualification program that ensures that a measurement method shall demonstrate acceptable performance before being used for performing accountability measurements. For destructive analysis and nondestructive assay of nuclear material, this performance shall be demonstrated, at a minimum, once per day that each method is used. For nondestructive analysis measurement systems where meeting this requirement is impractical or unnecessary, the control measurement frequency shall be at least one of every five measurements, unless otherwise approved by the Manager, Operations Office.
- (j) **Measurement Control Procedures.** Documented measurement control procedures shall be developed at each facility for all measurement methods used for accountability, and each facility shall have a program to assure that measurement control procedures are followed.
- (2) **Statistical Programs.** Each facility shall have a documented program for the statistical evaluation of measurement data for determining control limits, calibration limits, and precision and accuracy levels for each measurement system used for accountability. The objective is to ensure the quality of measurement and measurement control data and to provide estimates of uncertainty on inventory and inventory control statements. The program, at a minimum, shall contain the following elements:
 - (a) Valid statistical techniques to determine the total

random error and the measurement biases generated for each measurement system or sampling/measurement system, and to determine control limits, rejection limits, and outlier criteria.

- (b) A valid statistical technique to develop sampling plans for inventory and measurement of nuclear material.
- (c) Analyses of measurement control data and reporting to the responsible organization at specified times and frequencies.
- (d) Documentation of all major assumptions made in each data evaluation process.

5. MATERIAL TRANSFERS. Each facility shall have a program to control and account for internal and external facility transfers of nuclear materials. This program shall include documented procedures that specify requirements for authorization, documentation, tracking, verification, and response to abnormal situations that may occur during transfer of nuclear materials. For additional details, see page II-19, paragraph 7. Page II-19, paragraph 7, provides specific directions for preparing and submitting DOE/NRC F 741, "Nuclear Material Transaction Report," and DOE forms required for documenting external transfers for materials accounting purposes.

a. External Transfers.

- (1) The shipper shall obtain written verification and maintain documentation that the intended receiver is authorized to accept the material before the material is transferred.
- (2) Transfers of nuclear material between facilities having different Reporting Identification Symbols shall be documented on DOE/NRC F 741. These shall be prepared and distributed to the principals of the transaction and the cognizant Operations Office, preferably on the day of the transfer but within 24 hours, or on the first workday after the transfer should it occur on a nonworkday. However, Managers, Operations Offices, may direct DOE contractors to discontinue the routine distribution of DOE/NRC F 741 to their offices.
- (3) Immediately after receipt, shipments shall be subjected to a transfer check. Transfer checks shall consist of confirmation of shipping container or item count, validation of tamper-indicating devices integrity and identification, and comparison with shipping documentation to provide assurance that the shipment was received intact. For purposes of transfer checks, receipt occurs whenever the transfer vehicle is unloaded or the transfer vehicle's integrity is breached (tamper-indicating devices removed or broken) at the receiving facility. Documented procedures shall specify actions to be taken in the event discrepancies are detected. Records of transfer checks shall be maintained and subjected to audit and shall be retained at least until the next annual DOE safeguards survey. (For accountability purposes, material in

transit at the end of a reporting period shall be included in the receiver's reported inventory, even though physical receipt of the material has not yet occurred.)

- (4) All unirradiated Category I and II quantities of special nuclear material transferred between facilities having different reporting identification symbols shall have independently measured values determined by the shipper and receiver except when the Reporting Identification Symbols are both located on the same site and have the same site contractor. The Manager, Operations Office, may require measured values for other categories of nuclear material transfers, consistent with the strategic and/or monetary value of the material, or as required for environmental, safety, and operational controls. Material received shall not be put into the process prior to completion of required accountability measurements, unless a deviation is approved or the criteria defined on page II-15, paragraph 5a(4)(g), apply. When accountability measurements are required and materials are to be put in the process prior to making the accountability measurements, an agreement should be reached between the shipper and receiver as to how significant shipper/receiver differences will be handled.
- (a) The shipper shall independently determine the measured values prior to shipment unless the integrity of the item and of the existing measured values have been assured. The shipper's measured values shall be documented on DOE/NRC F 741 and DOE/NRC F 741A, if applicable.
- (b) Receiver's accountability measurements for Category I and II quantities of special nuclear material transfers shall be accomplished in accordance with the requirements contained in Figure II-1. Receiver's accountability measurements for transfers involving other categories of nuclear material, where required by the Manager, Operations Office, (see paragraph 5a(4)), shall be performed in accordance with the requirements shown in Figure II-1. The Manager, Operations Office, may require that precision and accuracy goals be met for measurement of shipments and receipts. If receiver's accountability measurements cannot be accomplished consistent with requirements in Figure II-1, then confirmatory measurements as outlined in paragraph 5a(4)(f) below apply.
- (c) Shipper's values may be entered into the receiver's accountability records for nuclear material transfers when the shipper's values are more accurate than those which can be reasonably obtained by the receiver. However, the receiver must perform an accountability measurement within the timeframe specified in Figure II-1 to maximize loss detection sensitivity.

Material Category and	Material/1	Accountability/2
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Attractiveness Level	Confirmation	Measurements
IA	3 working days	Shipper's value
IB	5 working days	10 calendar days
IC, II	10 working days	30 calendar days
III	10 working days	120 calendar days or on input to process
IV	10 working days	On statistical bases within 180 days or on input to process

Figure II-1
Shipper/Receiver Measurement Requirements

- /1 Material Confirmation. Confirmatory measurement by nondestructive analysis and gross weight check and item count (if not done in transfer check). Confirmatory measurements are not required for all materials. Where confirmatory measurements are required, they shall be performed within the timeframes of this table. Amounts less than 50 grams fissile may be accepted at shipper's values.
- /2 Accountability Measurements. Quantitative determination of material quantities (generally within designated measurement uncertainty limits); resultant measurement values are entered into receiver's accountability records with the exception of those materials described in paragraph 5a(4)(c) above and 5a(4)(g), page II-15. Accountability measurements are not required for all materials. Where accountability measurements are required, they shall be performed within the timeframes of this table. Amounts less than 50 grams fissile may be accepted at shipper's values.
- (d) For shipments of unirradiated special nuclear material containing greater than 250 grams of a single special nuclear material type and for each discrete item exceeding 250 grams, limits of error at the 95 percent confidence level shall be assigned to their measurements by the shipper/receiver, for both the element and isotope values. Limits of error need not be reflected on the DOE/NRC F 741 for external transfers for which verification measurements cannot be performed (refer to paragraph 5a(4)). For other shipments, the shipper and receiver may estimate the limits of error. Limits of error are also required for all measurements of external transfers of tritium that exceed 2 grams except as noted above.
- (e) Shippers and receivers shall provide a system for performing confirmatory measurements on external transfers of special nuclear material. Whenever accountability measurements cannot be performed within timeframes specified in Figure II-1, confirmatory

measurements are required for all transfers of Category I and II special nuclear material and for any other materials for which the Manager, Operations Office, requires shipper/receiver accountability measurements. Documented acceptance/rejection criteria, based upon valid statistical principles, shall be established and used to evaluate confirmatory measurement data. A response plan for investigation and resolution of confirmatory measurements that fail acceptance criteria shall be developed and implemented; all outliers shall be investigated and resolved.

- (f) Where delays in completion of the receiver's measurement will result in a protracted delay in closure of the transaction, a confirmatory measurement may be used to effect a "safeguards closure" of the transaction, and documented by an "A-B" entry on the DOE/MRC F 741 and DOE/MRC F 741A, if required. Such a safeguards closure may be used when the integrity of the shipment is assured, and only accountability measurement differences are possible between shipper and receiver. When the receiver's accountability measurement performed subsequent to a safeguards closure indicates a shipper/receiver difference, the difference may be resolved by mutual agreement of the Managers of shipper's and receiver's Operations Offices, with an adjustment (correcting entry) to the DOE/MRC F 741 and/or DOE/MRC F 741A, if required. The safeguards closure may be applied only when all of the following conditions are met:
 - 1 No discrepancies are found in the verification of the piece count, identification number and integrity of the tamper-indicating devices, and gross weight of the items or containers received, and there is no evidence indicating theft or diversion of the material.
 - 2 The shipper's and receiver's confirmation measurements are performed using "comparable" methods and the results of the measurements are within the established limits of agreement. The term "comparable" here means that the methods measure the same nuclear material attribute and the results of the methods can be compared on a technically valid basis.
 - 3 A shipper/receiver agreement, approved by both Managers, Operations Offices, is in effect for the transaction, establishing the criteria for closing transactions based on confirmatory measurements.
- (g) Limited processing is acceptable for certain materials not amenable to non-destructive assay in order to perform a receipt measurement, as approved by the Managers of shipper's and receiver's Operations Offices with Office of Safeguards and Security concurrence. Limited

processing can include homogenization and dissolution. Materials not amenable to measurement shall be identified in the facility's Materials Control and Accountability Plan.

b. Internal Transfers.

- (1) Each facility's management shall provide a graded system of measurements and records to reflect the flow of material between Materials Balance Areas within that facility and between it and other facilities on the same site.
- (2) The facility control system shall be designed to monitor transfer activities and to deter and/or detect unauthorized removal of material during transfers. The system should flag abnormal situations, e.g., when inappropriate transfers of quantities and/or materials are made, when unauthorized personnel receive or ship materials.
- (3) Transfers shall be documented on nuclear material transfer forms, or an electronic equivalent, that contain required information, are prepared and distributed within established timeframes, and are signed by authorized custodians or their alternates.
- (4) Materials shall be subjected to a transfer check within one workday after receipt. These checks shall include verification of shipping container or item count, tamper-indicating devices integrity, and identification number. These transfer checks shall be compared to appropriate documentation. All irradiated special nuclear material requires only a transfer check.
- (5) If the isotope content of special nuclear material (excluding uranium enriched below 20 percent U-235) transferred between Materials Balance Areas is 50 grams (fissile) or more, the transfer shall be measured, or a confirmatory measurement made, by the receiver. Measurements are not required for transfers that:
 - (a) Consist of assembled components in which the special nuclear material is physically inaccessible;
 - (b) Are sent to laboratories or nondestructive analysis measurement areas for analysis or examination under conditions which provide adequate internal controls to maintain a continuous awareness of the location and integrity of the special nuclear material until it is returned;
 - (c) Are tamper-safe and contain only Category III or IV quantities of material; or
 - (d) Consist entirely of small items containing less than 25 grams each and for which unauthorized accumulation of a Category III quantity of material is not credible.

Measurements shall be accomplished in accordance with the schedules shown in Figure II-1. Materials not amenable to measurement may be subject to measurement requirements in accordance with paragraph 6a(4)(g).

- (6) Documented acceptance/rejection criteria shall be established and used to evaluate measurement data for internal material transfers. In addition, procedures shall specify notification and response requirements if material removal or another abnormal situation is detected. These requirements shall be consistent with page I-13, paragraph 5, and DOE 5000.38.
6. MATERIAL CONTROL INDICATORS. Each facility's management shall implement a program for assessing the material control indicators described below in order to provide assurance that losses and unauthorized removals of nuclear materials are detected. Each facility shall have documented plans specifying responsibilities and providing procedures for evaluating material control indicators.
 - a. Shipper/Receiver Difference Assessment. Each facility shall have written procedures for evaluating shipper/receiver differences, and for investigating and reporting significant shipper/receiver differences.
 - (1) A shipper/receiver difference is defined to be significant when:
 - (a) It involves a discrepancy in the number of items regardless of the quantity of nuclear material;
 - (b) It is statistically significant. (Determination of whether shipper/receiver difference are statistically significant is only required for those shipments for which accountability measurements are made by both the shipper and receiver.) A shipper/receiver difference is defined to be statistically significant when the magnitude of the difference exceeds either of the following:
 - 1 The limit obtained by a statistical combination of the valid limits of error for the shipper's and receiver's measured values; or
 - 2 The square root of two (approximately 1.4) times a single valid limit of error when either the shipper's or receiver's limit of error is not valid. (When both shipper's and receiver's limits of error are determined not to be valid, the limits of error must be recalculated and the statistical significance of the shipper/receiver difference must be reevaluated.)
 - (2) Shipper/receiver difference data shall be subjected to trend analysis to detect measurement bias and/or material loss. Analyses shall be designed to detect statistically significant cumulative shipper/receiver differences and to trigger

investigations whenever these differences are detected.

- (3) The receiver shall notify its Operations Office and the shipper of any shipper/receiver difference determined to be significant. Both shipper and receiver shall investigate their measurements and limits of error. Such investigations shall be completed within 30 working days after the receiver's accountability measurements unless a time extension is granted by mutual agreement of the involved Managers, Operations Offices. All investigations shall be documented.
- (4) Significant shipper/receiver differences involving a discrepancy in the number of items shall be reported in accordance with DOE 5000.38 and the requirements contained on page 1-13, paragraph 5.
- (5) When shipper/receiver differences are determined to be statistically significant, but the quantities and strategic or monetary values are insufficient to warrant an investigation and subsequent correction to transfer documents, and when the receiver is DOE or one of its contractors or subcontractors, the difference need not be investigated and each party shall record its own quantitative value. For the purposes of this paragraph, differences of less than 50 grams fissile or less than 5 grams of tritium are considered to be insufficient to require an investigation unless there are special circumstances. The authority to invoke the stipulations of this paragraph shall rest mutually with the Managers of the shipper's and receiver's Operations Offices.
- (6) Resolution of statistically significant shipper/receiver differences may be achieved through any of the following:
 - (a) If both shipper's and receiver's Operations Office obtain adequate assurance that the measurements and limits of error are valid, and the investigation indicates that theft or diversion has not occurred, then each facility shall record its own quantitative values; or
 - (b) If either the shipper or receiver agrees to accept the other's value, then the shipper or receiver shall prepare a corrected copy of the shipping document using the other's data; or
 - (c) If the results of the investigations do not result in a satisfactory resolution, the Office of Safeguards and Security shall arbitrate the matter and recommend the action to be taken; or
 - (d) In the case where contracts specify other procedures for arbitration, they shall prevail.
- (7) The receiving facility shall not process special nuclear material contained in a shipment involving an unresolved significant shipper/receiver difference unless a shipper/receiver agreement allowing this has been approved by both the

Managers of the shipper's and receiver's Operations Offices.

b. Inventory Difference Evaluation.

- (1) Each facility shall have a documented program for evaluating all special nuclear material inventory differences, including those involving missing items. Programs for evaluation of inventory differences for other nuclear materials may be established at the option of the Manager, Operations Office. Procedures shall be provided for establishing control limits and requiring investigation when those limits are exceeded. Warning limits will be set at the 95 percent confidence level. Alarm limits will be set at the 99 percent confidence level. All inventory differences exceeding warning or alarm limits shall be reported in accordance with DOE 5000.38 and page I-13, paragraph 5. Assessments of inventory differences shall include statistical tests (e.g., tests of trends and biases), and shall be applied, as appropriate, to both total inventory difference and actual inventory difference on an individual and cumulative basis for each processing Materials Balance Area.
- (2) Procedures for establishing control limits for inventory differences shall be based on variance propagation using current data. The data should reflect operating conditions for the material balance period of the inventory. Alternatively, other statistically-valid techniques may be used but must be justified on the basis of factors such as limited data, low transfer rates, categories, and major process variations. The methodology shall be approved by the cognizant Manager, Operations Office. Historical inventory difference data shall be evaluated for comparison with the statistically based limits, where applicable. Where the propagated or otherwise statistically based methods do not yield control limits consistent with historical data, efforts shall be made to resolve the discrepancies between the two.
- (3) Each facility shall have documented procedures for responding to and reporting missing items and inventory differences in excess of control limits. The reporting and investigation of inventory differences shall be consistent with the requirements specified on page I-13, paragraph 5.

c. Evaluation of Other Inventory Adjustments.

- (1) Each facility's management shall establish a documented program for evaluating all inventory adjustments entered in the accounting records. The program shall include written procedures including equations for applying radioactive decay and fission/transmutation adjustments. A program for holdup adjustments must be justified on the basis of measurements or other factors. Procedures shall be outlined for the statistical review of inventory adjustments using techniques such as tests of trends, biases, and correlation.
- (2) Procedures shall be implemented to assure that all inventory

adjustments are supported by measured values or other technically justifiable bases. The program shall include procedures for measuring/monitoring environmental waste such as stack effluents and liquid waste streams as required by DOE 5400.1, GENERAL ENVIRONMENTAL PROTECTION PROGRAM.

- (3) Procedures shall be established for reporting reviews of inventory adjustments, including abnormal situations, to the Manager, Operations Office.

7. **DOCUMENTATION AND REPORTING.** This paragraph establishes the policies for the documentation of nuclear materials transactions, preparation of periodic summaries and reports concerning the status of nuclear materials held in inventory, reporting of nuclear materials transactions, material balances, and other required inventory data to the Nuclear Materials Management and Safeguards System and establishes the basis for DOE 5633.38 GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION which provides required procedures for reporting and data submission.

Departmental Elements and contractors shall document all nuclear materials transactions, material balances, and inventories in accordance with the instructions provided in DOE 5633.38 GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION, and shall transmit this information to the national database, Nuclear Materials Management and Safeguards System.

The national database is used to accumulate and distribute information concerning nuclear materials transactions and inventories. The objective of the system is to achieve reporting of accurate and complete data as soon as possible after the events described by the data occur.

The national database shall provide nuclear materials information relating to safeguards, materials management and production, inventory quantities and valuations, and other programs requested or required by DOE or Nuclear Regulatory Commission.

The national database shall serve as the centralized reporting facility to provide the information required under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement.

- a. **Forms.** Those forms identified and described in the DOE 5633.38 GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION (or an equivalent form approved by the cognizant field element) shall be used for the documentation and reporting of nuclear materials transactions, material balances, and inventories in accordance with the instructions provided. A computer-generated or other approved equivalent must contain all information necessary for proper documentation and reporting of nuclear materials transactions, material balances, and inventories, as appropriate. The forms may be obtained through the DOE Oak Ridge Operations Office, Materials Control and Accountability Branch.

b. Procedures and Requirements.

(1) In addition to the instructions provided in this paragraph, specific procedures for completing each data processing form, and for submitting the data to the national database are contained in the DOE 5633.3B GUIDE OF IMPLEMENTATION INSTRUCTIONS FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS SYSTEM REPORTING AND DATA SUBMISSION.

(2) Documentation of Transactions.

(a) General.

- 1 Manual Method. All transfers of reportable quantities of nuclear material (see Figure I-1, page I-2) between organizations with different reporting identification symbols within the U.S., or between facilities in the U.S. and foreign entities, shall be documented on a Nuclear Material Transaction Report (DOE/NRC F 741 and DOE/NRC F 741A, if required). The procedures and requirements for documentation of transactions assure that accountability for nuclear materials is transferred from shipper to receiver.
- 2 Automated Method. Consenting Heads of Field Elements may elect to have transaction data automated and transmitted over appropriate telecommunications systems; thus eliminating the manual preparation of the required forms. If this method is used, all procedures and instructions of this Order shall apply except that signatures on the transaction documents no longer shall be necessary. Internal controls shall assure that the data transmitted have been properly authorized. The sender and recipient of such automated messages shall produce hard copies of the messages for use by all parties needing copies. The hard copies shall contain the information normally included on DOE/NRC F 741 and DOE/NRC F 741A, if required. The automated method of handling and transmitting transfer data shall follow all requirements of the Code of Federal Regulations (see Attachment I) for activities involving Nuclear Regulatory Commission or "Agreement State" licensees (i.e., commercial waste management sites and those parties with Reporting Identification Symbols beginning with the letters "X" through "Z").
- 3 Either Method. Material types, elements, and isotopes to be reported, and their respective reporting units, shall be as specified in Figure I-1. For each detail line of shipper/receiver data shown on DOE/NRC F 741 and DOE/NRC F 741A, if required, material quantities reported by assay may be summarized, but only within the individual assay

ranges (e.g., for enriched uranium, within 10.00 to 20.00% U-235 or within 80.00 to 92.00% U-235, as appropriate) required for reporting the Composition of Ending Inventory. Supporting documentation shall be attached to indicate individual quantities that have been summarized. Nuclear material transactions between facilities by both the automated and the manual method are required to have signatures on the transaction documents, however, signatures can be on either the automated or the manual copy.

- 4 Agreement of Transaction Data. Data sent to the national database shall agree, on a line-for-line basis, with data sent to the shipper or receiver party to the transaction on DOE/MRC F 741, or automated equivalent.

(b) Types of Transfers.

- 1 Physical Transfer of Material. The shipper shall either include copies of the transfer report intended for the receiver with each shipment, or dispatch the receiver's and other copies of DOE/MRC F 741 and DOE/MRC F 741A, if required, by other means no later than 1 workday following shipment of the material. The receiver shall prepare and distribute the receiver's sections of DOE/MRC F 741 and DOE/MRC F 741A, if required, no later than 10 calendar days following receipt of the material. Whenever a facility transfers material to a foreign entity, the shipper shall include with the shipment a copy of DOE/MRC F 741 and DOE/MRC F 741A, if required, containing the shipper's data and special preprinted version of the Concise Note, and shall prepare and distribute the receiver's sections of DOE/MRC F 741 and DOE/MRC F 741A, if required, within 1 workday of receipt of the necessary data. Additional guidance may be provided by the shipper's field element. Whenever a facility receives material from a foreign entity, the receiver shall prepare and distribute the shipper's sections of the form, or approved equivalent, no later than 3 workdays following receipt of the material. In those cases where the receiver uses DOE-284, "Nuclear Material Transfer Receipt," as an interim document to acknowledge receipt of nuclear materials pending independent determination of material content, DOE-284 shall be prepared and distributed within 10 calendar days following receipt of the material. If a DOE-284 is submitted, the receiver shall prepare and submit DOE/MRC F 741 and DOE/MRC F 741A, if required, within 1 workday after the receiver's measurement has been obtained. Transfers involving Department of Defense, except for transfers of nuclear material in Navy cores and associated items, shall be documented in accordance

with the instructions provided, as supplemented by the Albuquerque Operations Office.

- 2 Nonphysical Transfer of Material. DOE/NRC F 741 and DOE/NRC F 741A, if required, or an approved equivalent shall be used to record a change in project number, ownership status, or financial responsibility.
- 3 Other Types of Receipts and Removals. Various other types of receipts and removals including, but not limited to: production, transfers to and from other materials, sales, decay, losses and other inventory changes including inventory differences, shall be documented by using DOE/NRC F 741 and DOE/NRC F 741A, if required, or an approved equivalent. Such other types of receipt and removal data involving reportable quantities shall be documented and reported consistent with b(4)(a) and (e), page II-27.

(c) Special Requirements.

- 1 Notifying Receiver of Nuclear Material Shipments. Each shipper shall be responsible for advising the intended receiver of proposed shipments of nuclear material and for providing all pertinent advance information. Specific notification requirements applicable to individual facilities are contained in the "DOE Directory of Reporting Identification Symbols."
- 2 Reporting of Material in Transit for Domestic Shipments.
 - a The shipper shall provide all pertinent quantity information to the receiver for all material in transit at the end of a reporting period. This requirement may be satisfied through the use of automated telecommunications methods only if both shipper and receiver possess the necessary automated capabilities.
 - b Reportable quantities of radioactive decay shall be reported to the national database by the shipper and receiver.
- 3 Tracking of Material Within the United States. Each facility shall submit country control number information in accordance with instructions provided.
- 4 Reporting Units and Rounding.
 - a Reporting Units. Element and isotope weight shall be reported in the metric weight units

specified for each material type in Figure I-1, page I-2.

- b Rounding Policy. The quantity being transferred shall be reported as shown in Figure II-2, with fractions of 1/2 or greater rounded upwards and fractions of less than 1/2 dropped. Supporting documentation shall be attached to clearly indicate any rounding bias in the total material weight.
- c A transfer of multiple discrete items of 0.5 of a reporting unit or less, but of the same material type, shall be summed to a total weight of that material type before applying the criteria of Figure II-2.

QUANTITY (When Rounded)	ACTION
Equal to or greater than 0.5 of the reporting unit.	Report to the nearest whole reporting unit.
Less than 0.5 of the reporting unit.	Documentation not required on DOE/NRC F 741/741A.

Figure II-2
Reporting of Nuclear Material Quantities Transferred

- 5 Limits of Error on Transfers of Special Nuclear Material and Tritium. DOE contractors shall determine and notify DOE of limits of error on transfers of special nuclear material and/or tritium (except in the case of tritium in reservoirs), as specified on page II-11, paragraph 5. Such notification shall be made using DOE/NRC F 741 and DOE/NRC F 741A, if required, or an approved equivalent. Limits of error shall be stated on all copies of DOE/NRC F 741 and DOE/NRC F 741A, if required. The requirements for limits of error as contained in the Code of Federal Regulations (10 CFR 70.58(e)) also apply.
- 6 Amendments or Adjustments to Previously Issued DOE/NRC F 741 and/or DOE/NRC F 741A. When an adjustment is made by one party to a transaction, DOE field elements shall assure that contractors under their jurisdiction document the adjustment on DOE/NRC F 741 and/or DOE/NRC F 741A, if required, and transmit the completed form to the other party to the transaction within 24 hours, or by the close of the first business day after obtaining the adjustment data.
- 7 Transfers of Nuclear Material Between DOE

Contractors and Licensees.

- a Transfers to Licensees. DOE contractors who receive authorizations and requests for distribution of nuclear material to a licensee, pursuant to 42 U.S.C. Sections 2073, 2093, and 2111 (as amended), shall document such transfers using DOE/MRC F 741 and DOE/MRC F 741A, if required.
- b Transfers from Licensees. Transfer documents for nuclear material shipped to DOE for credit or service by a licensed facility are prepared and distributed by the shipper in accordance with the requirements of the Code of Federal Regulations. When such material is received it shall be documented by the receiver using DOE/MRC F 741 and DOE/MRC F 741A, if required.

8 Transfers of Nuclear Material Between the United States and Foreign Nations, Foreign Regional Organizations, or Supranational Organizations.

- a General. Foreign nations, foreign regional organizations, supranational organizations, foreign facilities (hereinafter referred to collectively as "foreign entities") may receive or return U.S. Government-owned or privately owned nuclear material, as applicable, obtained by sale, lease, grant, donation, or loan from DOE contractor facilities, or Nuclear Regulatory Commission or "Agreement State" licensees, pursuant to 42 U.S.C. Sections 2074 (as amended), 2094 (as amended), 2112, or 2121(c).
- b Documentation of Transfers. Transfers of nuclear material to and from foreign entities shall be documented using DOE/MRC F 741 and DOE/MRC F 741A, if required.

(3) Material Balance Report. Nuclear material balances shall be documented and reported in accordance with the instructions provided.

- (a) Material balance reports shall be submitted on or in the format of DOE/MRC F 742, "Material Balance Report."
- (b) A single material balance report shall be prepared for each material type to document the beginning and ending inventories, and all receipts and removals of nuclear material relevant to the reporting identification symbol being reported on by each facility. Inventory and transfer data shall be reported for all nuclear material, regardless of whether the material is held pursuant to a DOE contract, under private ownership, or under the

provisions of 42 U.S.C. Sections 2073, 2074, 2093, or 2094 (as amended).

- (c) Material types, elements, and isotopes to be reported, and their respective reporting units, shall be as specified in Figure 3-1, page 3-2. Each quantity shown on DOE/MRC F 742 shall be rounded to the proper whole reporting unit for the material type.
 - (d) Adjustments, amendments, or corrections to reports shall be made according to the instructions provided.
 - (e) Radioactive decay shall be reported on material balance reports on a quarterly basis when the decay has reached accountable quantities or at a more frequent reporting interval if required by the cognizant Operations Office.
 - (f) DOE F DP-742B, "Material Activity Schedule," shall be submitted in addition to the material balance report by facilities with reporting identification symbols beginning with the letters "A" through "QAA," if applicable. DOE F DP-742B shall be used for reporting information on DOE-owned loaned/leased nuclear material held for the account of another reporting identification symbol.
 - (g) Material balance reports shall be submitted:
 - 1 Semiannually as of March 31 and September 30, for all facilities; monthly or quarterly when directed by the cognizant field element.
 - 2 As Specified in facility attachments or transitional facility attachments for DOE facilities selected under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement.
 - 3 In Lieu of the Above, field element managers may request that the national database produce computer-generated material balance reports. After receipt of all necessary data, such reports shall be sent promptly to the concerned facilities. The facilities shall review the reports for content, note thereon any changes that are warranted, and sign and distribute the reports.
 - (h) Material in transit at the end of a reporting period shall be reported as if received within the reporting period by the intended receiver.
- (4) Inventory Reporting.
- (a) All inventories of nuclear material shall be reported to the national database on DOE F DP-733, "ADP Transcription Sheet for Inventory Data," DOE F DP-733A, "ADP Transcription Sheet for Inventory Data," or DOE/MRC F

742C, "Physical Inventory Listing," as appropriate.

- (b) Material types, elements, and isotopes to be reported, and their respective reporting units, shall be as specified in Figure 1-1, page 1-2. Each quantity shown on DOE F DP-733, DOE F DP-733A, and DOE/NRC F 742C shall be rounded to the proper whole reporting unit for the material type.
 - (d) Inventory reports shall be submitted:
 - 1 Quarterly, as of December 31, March 31, June 30, and September 30 for all facilities; monthly when directed by the cognizant field element.
 - 2 As Specified in facility attachments or transitional facility attachments for DOE facilities selected under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement.
 - (e) Material in transit at the end of a reporting period shall be included in the receiver's reported inventory as if received by the intended receiver within the reporting period.
- (5) Data Processing Procedures.
- (a) Transaction Data shall be submitted to the national database, using DOE F DP-740, "ADP Transcription Sheet Nuclear Material Transaction Journal," and DOE F DP-740A, "ADP Transcription Sheet Nuclear Material Transaction Journal," as soon as possible after the transaction occurs, but no less often than weekly. Data on all transactions occurring during a calendar month shall be submitted no later than 8 working days following the end of the month during which the transactions occurred.
 - (b) Inventory Data shall be submitted to the national database using DOE F DP-733, or for the facilities selected under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement, using DOE F DP-733A, as appropriate. Inventory data shall be submitted within 15 calendar days after the end of the reporting period.
 - (c) Material Balance Report Data shall be submitted to the national database using DOE F DP-735, "ADP Transaction Sheet for Material Balance Report Data," within 15 calendar days of the end of the reporting period for facilities selected under the provisions of the U.S./International Atomic Energy Agency Safeguards Agreement.
 - (d) Concise Note Data shall be submitted to the national database using DOE F DP-734 "ADP Transcription Sheet for Concise Notes," at the same time as the submission of the data to which the Concise Note refers.

- (e) Inventory Difference Explanation Data shall be submitted to the national database, using DOE F OP-740, within 1 workday after the explanation data are available, but no later than 8 working days after reporting the inventory difference.
- (f) Internal Project Transfer Data (within one Reporting Identification Symbol) shall be submitted to the national database using DOE F OP-749, "ADP Transcription Sheet Internal Project Transfers," no later than 8 working days following the end of the month in which the transfer occurs.
- (g) Confirmatory Receipt Data, when reported on DOE-284, "Nuclear Material Transfer Receipt," shall be submitted to the national database using DOE OP-740, as soon as possible after receipt of the material, but no less often than weekly. Data on confirmatory receipts occurring during a calendar month shall be submitted no later than 8 working days following the end of the month during which the transfers occurred.
- (h) Alternative Data Submission Methods.
 - 1 Machine-Readable Data. In lieu of the data processing forms specified, data may be submitted to the national database in machine-readable form (e.g., on diskettes or magnetic tape). Information submitted in machine-readable form shall include all data required on the appropriate form specified, and shall be in the format specified for that form by the Office of Safeguards and Security.
 - 2 Use of Telecommunications. With prior approval of the Office of Safeguards and Security, data may be submitted directly via the appropriate telecommunications system network to the national database in lieu of using the forms specified. Information submitted via a telecommunications system network shall include all data required on the appropriate form specified and shall be in the format specified by the Office of Safeguards and Security.
 - 3 In any case where data are submitted in machine-readable form or via a telecommunications system network, the timing requirements of paragraph (5)(a) through (g) above shall apply, as appropriate for the type of data submitted.
- (i) Correction Data. Data correcting previously submitted data found to be in error shall be submitted during the workday in which notification of the error is received.

<TITLE> CHAPTER III - MATERIALS CONTROL

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CHAPTER III

MATERIALS CONTROL

1. GENERAL. This chapter describes the requirements for material control. The chapter is subdivided into four functional performance areas: access controls, material surveillance, material containment, and detection/assessment. The graded materials control program shall be formally documented in the Materials Control and Accountability Plan. Requirements for the control of special nuclear material are stated in both DOE 5632.1C and this Order. Some requirements stated are in one Order but not both. All requirements shall be met regardless of the Order in which they appear.
2. ACCESS CONTROLS. Each facility shall have a graded program for controlling personnel access to: nuclear materials; nuclear materials accountability, inventory, and measurement data; and data generating equipment and other items/equipment where misuse or tampering could lead to compromise of the safeguards system. The graded access control system shall consider the quantity and attractiveness of the material in the area and impacts of threats, as well as other control systems that are in place and which may mitigate these threats. These access controls may range from extensive and complex access control systems for Category IA areas and materials to simple administratively controlled access systems for Category IV areas. For facilities that have Category III and IV areas containing Attractiveness Level B and C material outside of a Protected Area, the facility's management shall assure that these areas do not possess a Category I or II quantity of special nuclear material unless a vulnerability assessment demonstrates that an unauthorized accumulation of a Category I quantity of material from these facilities is not credible. Personnel security assurance programs shall be used as a component in the prevention of the theft or diversion of special nuclear material and shall be considered in assessments of vulnerability related to theft of Category I quantities of special nuclear material. Testing of access control systems and procedures shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.1GA and applicable Departmental guidance. Performance requirements for access controls are contained on page 1-10, paragraph 4.
 - a. Materials Access. Each facility shall have a documented program to ensure that only properly authorized personnel have access to nuclear materials. This program shall address procedures and mechanisms to detect/respond to access by unauthorized personnel. In order to minimize the potential for unauthorized access to nuclear material, the amount of material in use shall be limited to

that necessary for operational requirements, and excess material shall be stored in repositories or kept in enclosures designed to assure that access will be limited to authorized individuals. See DOE 5632.1C for additional access control and storage requirements for special nuclear material and DOE M 5632.1C-1, MANUAL FOR PROTECTION AND CONTROL OF SAFEGUARDS AND SECURITY INTERESTS, for access authorization requirements for special nuclear material categories.

- b. Data Access. Each facility shall have a graded program to assure that only authorized persons have the ability to enter, change, or access material control and accountability data and information.
 - c. Equipment Access. Each facility shall have a graded program to control access to data-generating and other equipment used in material control activities, thereby assisting in providing assurance of the integrity of equipment and data used for material control. Such equipment includes measurement equipment, data recording devices, and tamper-indicating devices. An access control program comparable to that required for classified computer systems may be required if such controls are necessary to assure the integrity of the data system.
 - d. Other Considerations. Access controls similar to those described in paragraphs 2b and c above shall be designed to protect against data/equipment falsification or manipulation and shall detect unauthorized activities during emergency or other unusual conditions.
 - e. Unclassified Computer Systems. Where materials control and accountability data and data-generating equipment involve unclassified computer systems, these systems shall meet the requirements of DOE 1360.2B, UNCLASSIFIED COMPUTER SECURITY PROGRAM.
3. MATERIAL SURVEILLANCE. Each facility's management shall establish a graded surveillance program for monitoring nuclear materials and detecting unauthorized activities or anomalous conditions and for reporting material and facility status. The objective is the detection and assessment of conditions that may adversely affect safeguards, e.g., to detect anomalies and to report alarm conditions. The surveillance program shall address both normal and emergency conditions, and shall provide for periodic testing. Testing for material surveillance systems and procedures shall be planned and documented in accordance with DOE 5630.16A. Performance requirements for material surveillance of Category I and II quantities of special nuclear material are contained on page 1-10, paragraph 4.
 - a. Material Surveillance Mechanisms. Specific material surveillance methodologies may include the following:
 - (1) Automated means (e.g., monitoring devices, sensors or other instrumentation) to detect anomalies and to report alarm conditions.
 - (2) Visual surveillance/direct observation (e.g., two-person rule,

monitoring by external personnel) to provide assurance that only authorized activities occur and to assess special nuclear material movements or inventory status. Visual surveillance requires reasonable assurance that activities are observable and that the observer will recognize, correctly assess and report activities that are unauthorized or are inconsistent with established safeguards requirements. There shall be documented procedures for implementing the two-person rule.

- (3) Process logs, inventory records, or other information to indicate anomalies and trigger investigatory actions.

- b. **Material Surveillance Programs.** Surveillance procedures shall describe the methodologies and operational/control points on which the program is based and shall provide for investigation, notification, and reporting of anomalies. Alternatives to the material surveillance requirements specified below may be approved in accordance with DOE 5630.11B for facilities that rely primarily on other materials control and accountability and/or security measures.

- (1) **Category I and II.** The material surveillance program for Category I and II quantities of special nuclear material shall assure that materials are in authorized locations and shall detect unauthorized material flows and transfers. Evaluations of Category I locations shall be performed to determine system capabilities to assess material losses from Materials Access Area and Protected Area boundaries. Evaluations of Category II locations shall be performed to determine system capabilities to assess material losses from the Protected Area boundary. Material surveillance procedures for all areas having Category I or II quantities of special nuclear material shall include the following:

- (a) Only appropriately authorized and knowledgeable personnel (i.e., individuals who are capable of detecting incorrect or unauthorized actions) shall be assigned responsibility for surveillance of special nuclear material.
- (b) Controls shall be sufficient to ensure that one individual cannot gain access to a secure storage area.
- (c) Procedures to ensure constant surveillance of all persons in secure storage areas (e.g., two-person rule or equivalent surveillance procedures) shall be in effect at any time the storage area is not locked and protected by an active alarm system.
- (d) Surveillance shall be sufficient to ensure that unauthorized or unaccompanied authorized personnel cannot enter the storage area undetected when the door is unlocked or open.
- (e) When two persons are assigned responsibility for maintaining direct control of the item(s) outside an alarmed storage area within a Materials Access Area or

Protected Area, either the two authorized persons shall be physically located such that they have an unobstructed view of the item(s) and can positively detect unauthorized or incorrect procedures, or there shall be a system of hardware, procedures, and administrative controls sufficient to ensure no unauthorized accumulation of a Category I quantity without timely detection.

- (f) Special nuclear material in use or process shall be under material surveillance procedures, under alarm protection, or with the approval of responsible Heads of Field Elements, protected by alternative means which can be demonstrated to provide equivalent protection.
- (2) Category III. The material surveillance program for Category III quantities shall assure that when materials are not in locked storage, they are attended, are in authorized locations, and are not accessed by unauthorized persons.
- (3) Category IV. The material surveillance program for Category IV quantities shall be site-specific and approved by the Manager, Operations Office.
- 4. MATERIAL CONTAINMENT. Each facility shall have a documented program to provide controls for nuclear materials operations relative to Materials Access Areas, Protected Areas, Materials Balance Areas, other authorized storage repositories, and processing areas.
 - a. Materials Access Area and Protected Area. The facility shall have controls to assure that Category I quantities of special nuclear material are used, processed or stored only within a Materials Access Area contained in a Protected Area and that Category II quantities of special nuclear material are used, processed, or stored only within a Protected Area. The containment program shall:
 - (1) Be formally documented;
 - (2) Comply with the graded safeguards concept;
 - (3) Identify authorized activities and locations for nuclear materials;
 - (4) Identify mechanisms used to detect unauthorized activities;
 - (5) Identify material types, forms, and amounts authorized to be removed from the Materials Access Area or Protected Area;
 - (5) Identify containment controls for normal and emergency conditions; and
 - (7) Require a periodic audit of the containment program to ensure compliance and system effectiveness.
 - b. Materials Balance Area. Each facility shall have controls to

ensure that nuclear materials used, processed, or stored within a Materials Balance Area are controlled in accordance with the graded safeguards concept. Additionally, these controls shall ensure that materials are removed only via authorized pathways/portals and are subject to transfer and verification procedures as identified on page 11-11, paragraph 5. The controls for Materials Balance Areas shall:

- (1) Be formally documented;
 - (2) Identify geographical boundaries and functions of the Materials Balance Areas;
 - (3) Identify material types, forms, and quantities permitted in each Materials Balance Area;
 - (4) Describe the administrative controls for each Materials Balance Area;
 - (5) Define custodial responsibilities for nuclear materials contained within a Materials Balance Area;
 - (6) Identify personnel authorized to receive/ship nuclear material;
 - (7) Identify the material flows into and out of the Materials Balance Area;
 - (8) Ensure that material transfer procedures are followed; and
 - (9) Ensure that material quantities transferred across Materials Balance Area boundaries are based on measured values consistent with page 11-16, paragraph 5b(5).
- c. **Storage Repositories.** The facility shall have controls for nuclear materials held in storage repositories consistent with the graded safeguards concept. The controls for storage repositories are contained in DOE M 5632.1C-1.
- d. **Processing Areas.** The facility shall have controls for nuclear materials being used or stored in processing areas. The controls for in-process areas shall:
- (1) Be formally documented;
 - (2) Describe activities and locations for storing material;
 - (3) Identify components used to detect unauthorized activities or conditions;
 - (4) Include procedures for moving material into or out of the processing area;
 - (5) Describe control procedures for both normal and emergency conditions;

- (6) Describe response actions to be taken in abnormal situations; and
 - (7) Provide for audit of the processing controls on a periodic basis to assure system effectiveness.
5. DETECTION/ASSESSMENT. Each facility shall have the capability to detect and assess the unauthorized removal of nuclear materials, consistent with the graded safeguards concept. The system shall be interfaced with the facility's physical protection and other organizational systems, as appropriate, and shall be able to detect removal of special nuclear material from its authorized location (theft/diversion/errors) and provide notification to the protective force and other organizations to respond when such events are detected.
- a. Tamper-Indicating Devices. The reliance on tamper-indicating devices as a safeguards measure is directly dependent on the environment in which the tamper-indicating device resides and the material being tamper-safed. Each facility shall have a documented program, administered by the materials control and accountability organization, for control of tamper-indicating devices and to assure that tamper-indicating devices are used to the extent possible to detect violations of container integrity. DOE-wide standardized tamper-indicating devices should be used when available through DOE standardized procurement (see DOE 5630.17, SAFEGUARDS AND SECURITY (S&S) STANDARDIZATION PROGRAM). Testing of tamper-indicating device integrity, location, and application and the tamper-indicating device record system shall be conducted according to testing methodology, testing frequency, and record maintenance requirements contained in DOE 5630.16A and applicable Departmental directives and guidance. Performance requirements for tamper-indicating devices are contained on page 1-10, paragraph 4, of this Order. The "Safeguards Seal Reference Manual," issued by Office of Safeguards and Security, can facilitate in the selection, application, and verification of tamper-indicating devices. The tamper-indicating device control program shall specify, as a minimum, the following elements:
 - (1) Acquisition/procurement/destruction;
 - (2) Types of tamper-indicating devices utilized;
 - (3) Assurance of unique tamper-indicating devices identification;
 - (4) Storage;
 - (5) Issuance;
 - (6) Personnel authorized to apply, remove, and dispose of tamper-indicating devices;
 - (7) Containers on which tamper-indicating devices are to be applied;
 - (8) Procedures for application of tamper-indicating devices;

- (9) Frequency and method of tamper-indicating devices verification;
 - (10) Response procedures for tamper-indicating devices violations;
 - (11) Assurance that tamper-indicating devices cannot be reused after violation;
 - (12) Frequency and method of internal program audits; and
 - (13) Procedures for reporting tamper-indicating device violations.
- b. **Portal Monitoring.** The minimum portal monitoring requirements are in DOE 5632.1C. In addition to those requirements, the detection level of the monitors shall be based upon detection of the typical special nuclear material product in the area and the credible number of removals associated with theft of a Category 1 quantity of material. All detectors and related calibration standards shall be maintained and controlled to ensure that portal monitors are capable of meeting detection requirements. Periodic performance testing of portal monitors shall be conducted in accordance with page I-10, paragraph 4b. Planning and documentation of performance testing shall meet the requirements of DOE 5630.16A. Performance requirements for portal monitors (both special nuclear material and metal) are contained on page I-10, paragraph 4. Controls shall be established to prevent unauthorized access to portal monitor instrumentation and cabling. A written response plan shall be prepared and implemented to provide evaluation and resolution of all alarm conditions, including requirements for notification in accordance with DOE 5000.38 (and the requirements contained on page I-13, paragraph 5,) in the event of unresolved alarms or malevolent actions. Controls shall be established to ensure detection capabilities during emergency conditions.
- c. **Waste Monitors.**
- (1) For purpose of detecting the theft or diversion of special nuclear material, all liquid, solid, and gaseous waste streams leaving an Materials Access Area shall be monitored for special nuclear material. (Additional monitoring may be required for environmental or waste management purposes. The additional monitoring should be performed in accordance with applicable environmental and waste management regulations.) Monitoring instrumentation may be semi-quantitative, provided that the monitors used are capable of detecting gamma/neutron radiation characteristics of the specified material type. The facility's waste monitoring equipment shall be maintained and controlled to ensure that the equipment is capable of detecting specified amounts of special nuclear material. Instrumentation used to monitor waste and equipment removed from a Materials Access Area must be able to detect, in combination with other detection elements, the removal of a Category 1 quantity of special nuclear material through a credible theft or diversion scenario.
 - (2) A response plan for evaluating and resolving situations

involving any discharge exceeding facility-specific limits approved by the Manager, Operations Office, shall be established and implemented. The plan shall provide for reporting in accordance with DOE 5002.38 and the requirements contained on page I-13, paragraph 5 of this Order, if the situation is not satisfactorily resolved or if there is an indication of malevolent action.

- d. **Daily Administrative Checks.** A facility-specific daily administrative checks program shall be implemented for each Category I Materials Balance Area (or multiple Materials Balance Areas where rollup to a Category I quantity of special nuclear material is credible). The scope and extent of the checks shall be determined and approved by the Operations Office based upon recognized vulnerabilities. The administrative checks program shall specify the detection objectives, performance procedures, documentation requirements, and response actions.
- e. **Other Detection/Assessment Mechanisms.** For each facility, systems capable of detecting and/or assessing special nuclear material removals shall be established consistent with the loss detection elements evaluation requirements on page I-10, paragraph 4. Detection/assessment mechanisms may be based on item identification, number of items, verification of intact tamper-indicating devices, confirmation that no access has occurred, process monitoring, near-real time accountability, control procedures for use and movement of material, or any other approved technique for identifying anomalies. These monitoring and control systems shall provide sufficient information to correctly assess the alarm, localize the removal, and estimate the quantity and form of the diverted or stolen material.

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