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MANAGEMENT PLAN FOR RESOLUTION OF THE SAFETY ISSUES ASSOCIATED WITH THE STORAGE OF PLUTONIUM

July 8, 1993
Revision 1

TRANSITION MANAGEMENT

ROCKY FLATS PLANT

APPROVED:

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Transition Management

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1. EXECUTIVE SUMMARY

There are 2409 items of plutonium being stored at the Rocky Flats Plant (RFP) that are potentially out of compliance with plant fire safety procedures. The non-compliance constitutes a violation of EG&G fire safety procedures, Health and Safety Practices Manual, Section 31.11 "Transfer and Storage of Pyrophoric Plutonium for Fire Safety", and results in an increased safety risk for the RFP. Certain items have a limited storage life, and by procedure, they have to be unpackaged in a controlled environment and visually inspected to determine if large quantities of plutonium oxide have formed on the plutonium during storage. The oxide and plutonium metal fines are considered pyrophoric until thermally stabilized, and may burn in an air atmosphere. Those oxides must be thermally stabilized utilizing established processes and equipment in Building 707.

When the problem of plutonium storage was first identified, immediate compensatory actions were taken. Those measures are identified in a letter from H. P. Mann to A. Pauole, HPM-225-93, dated May 21, 1993.

This version of the Management Plan includes the following recent, significant developments in the resolution of the safety issues associated with the storage of plutonium at Rocky Flats: 1) The Secretary of the Department of Energy has requested that an environmental assessment (EA) be performed on the plutonium material stabilization process in Building 707 before that process can be utilized to thermally stabilize any pyrophoric plutonium material, and 2) the plutonium metal that is in storage and in violation of HSP 31.11 shall be assessed, according to a formal Inspection Plan to establish the degree of pyrophoric oxide and metal fines existing from the stored items.

Fire safety engineers and plutonium metallurgical experts have evaluated the items in storage and have determined that, although there is a procedural noncompliance, the items do not present an unacceptable risk relative to fire safety concerns. Reference Appendix B for explanation.

Before final options are considered to bring the material back into compliance, a Material Inspection Plan will be implemented. A statistically significant number of containers that fall within a specific selection criteria will be inspected according to the Inspection Plan. The data provided by the inspection plan will be the basis for evaluating the follow-on options. Further explanation of the Inspection Plan is provided in Section 6.

Extensive Building Implementation Plans will be developed and required facility and administrative preparations will be performed in each of the buildings where plutonium items are stored before the items can be inspected. After plans and preparations have been completed, the activities identified in the respective plans shall commence. The activities will include: 1) removing the outer storage containers in a controlled environment, 2) bagging the inner container into a glovebox, 3) opening the inner containers, 4) brushing any oxide from the plutonium items, 5) weighing and repackaging the plutonium items and returning them to storage, 6) weighing the oxide and placing it in storage on heat detectors (1,000 grams per detector) or in an inert atmosphere.

If sufficient heat detector storage or inert storage (Nuclear Safety and Safeguards limited) capacity for the brushed oxide does not exist in the building where the inspection is performed, the oxide material may be packaged and transported to Building 371 for storage in the stacker/retriever. Transporting unstabilized oxide to 371 increases the risk to the workers and the public.

If it is determined that certain buildings can not inspect materials because of problems, such as no glovebox available due to limitations imposed by plutonium in the ducts, approval to transport to other buildings will be pursued. This also increases the risk.

To prevent recurrence of this problem, an administrative control system will be implemented to track the future storage of plutonium items and to report to storage custodians to ensure compliance. The specific actions will be defined following completion of the Root Cause Analysis.

2. PURPOSE

The purpose of this plan is to implement a strategy that will: 1) evaluate the risks associated with having plutonium stored in current non-compliant configurations and performing corrective actions; 2) prepare specific detailed plans to bring the material into compliance with the requirements specified in the EG&G Health and Safety Practices Manual, Section 31.11, *Transfer and Storage of Pyrophoric Plutonium for Fire Safety* (HSP 31.11) after technical reviews; and 3) establish an RFP infrastructure to prevent recurrence of the noncompliances.

3. STATEMENT OF PROBLEM

There are 2409 items of plutonium being stored at RFP that are potentially out of compliance with the storage requirements defined in HSP 31.11. The risk associated with the noncompliance of each container is dependent on the form of the stored plutonium (alloyed or unalloyed), the condition of the plutonium surface area at the time of storage, and the packaging configuration (in a sealed or unsealed can, plutonium in contact with plastic or metal), and age of the plutonium. A classified report has been prepared that specifically defines the nature of material and storage locations.

Based on a data review and analysis, Buildings 371, 707, 771, 776/777, and 779 have plutonium in storage that is potentially out of compliance with HSP 31.11.

In addition, the need to establish fire safety requirements for storage of electrorefined (ER) salt, impure salts from ER cell clean-out, and plutonium/neptunium (Pu/Np) ER salts as representing potential fire hazards because they include small particles of pyrophoric plutonium and other pyrophoric metals, have been investigated for possible revision of HSP 31.11. A risk analysis has been completed which specifically excludes these salts from the scope of this plan (refer to Table 3 Appendix A).

4. STATEMENT OF REQUIREMENTS

4.1 Fire Safety

RFP HSP 31.11 states the EG&G RFP requirements for packaging, transfer, and storage of pyrophoric plutonium. It applies only to pyrophoric plutonium or plutonium subject to forming pyrophoric materials, which are defined as "metal or plutonium compounds that may ignite spontaneously in air at a temperature of 150 degrees Celsius (°C) or below in the absence of heat, shock or friction." Ignition is defined as "a temperature excursion of 15 °C or more above the average sample temperature." These definitions are unique to RFP.

Storage of pyrophoric plutonium outside of an inerted glovebox or conveyor system shall not exceed specified time limits as identified in HSP 31.11, without the stored material being checked for condition, to determine the need for reprocessing, to ensure fire safety. The reprocessing consists of brushing off the pyrophoric oxide, repackaging the metal, and thermally stabilizing the oxide. Since November 1989, thermal stabilizing has been suspended by DOE/HQ Management. The technical requirements of HSP 31.11 have evolved throughout the history of RFP operations. These requirements are primarily based on operating experiences, knowledge of the principles of plutonium oxidation, continuous production operations stressing fire safety, and requirements for the most beneficial use and handling of plutonium. HSP 31.11 has been successful throughout the years in meeting RFP production needs and preventing plutonium fires.

HSP 31.11 contains requirements for the following forms of plutonium at RFP:

- Buttons and electrorefined metal
- Ingots
- Parts and subassemblies
- Unsealed units
- Unbriquetted machine turnings
- Briquettes
- Pyrophoric residues
- D-Test material

- Pyrophoric compounds
- Films and foils
- Metallographic samples
- Analytical samples and standards
- Miscellaneous plutonium

Forms or categories of plutonium exempt from HSP 31.11 include nonpyrophoric plutonium in the form of incinerator ash, thermally stabilized oxide, aqueous solutions, plutonium material in process, plutonium contained in pits which are completely sealed, registered sources, salts, plutonium oxide generated during inventory (with strict provisions), and pyrophoric duct remediation material (with strict provisions). The latter two exempt categories (inventory oxide and duct remediation material) were established during curtailment, and will continue to be exempt until Rocky Flats is permitted to thermally stabilize plutonium oxide. Strict guidelines were established for these two categories, including limits on the amount of plutonium, container arrangement, and placement of each container on a storage tray heat detector inside a Zone I confinement system.

HSP 31.11 also defines requirements for the transfer and storage for each specific type of plutonium. Additional requirements are also established for the transfer and storage of plutonium dependent on the location of the material. The locations are defined as: 1) in line, 2) outside line, 3) between process areas, and 4) off site.

Once a material is characterized and its location specified (in line or outside line), the specific material requirements are easily identified within HSP 31.11. These requirements include storage method (containers, wrapping, etc.), the length of storage (8 hours, 1 year, 5 years, etc.), atmosphere requirements (inert or noninert), and protection requirements (glovebox overheat detection or storage tray heat detection).

The primary fire-safety concern with the brushing and repackaging of plutonium metal is the potential for spontaneous ignition of any unburned oxide. The oxide is susceptible to ignition because it contains small pieces, or fines, of plutonium metal, which is pyrophoric. Thermally stabilized oxide is not pyrophoric.

To perform brushing and repackaging operations, the following fire protection requirements are to be in place, as specified in the building Operational Safety Requirements (OSRs) and HSP 31.11.

- The automatic sprinkler system in the areas where the operations are being performed is to be operational. The automatic sprinklers provide fire suppression and control outside the glovebox system, and contribute to the safety envelope of the building(s).

- The automatic and manual filter plenum deluge sprinkler systems protecting the exhaust filter plenums for the affected areas are to be operational. The automatic deluge sprinkler system provides a water curtain for the exhaust filter plenums in the demister stage of the plenums. The automatic deluge system is activated by heat detectors located within the inlet duct of each plenum. The manual deluge sprinkler system protects the first stage of High Efficiency Particulate Air (HEPA) filters and is activated only by the Fire Department if the automatic deluge sprinklers are not sufficient to control a fire.

- The glovebox overheat (GBO) detection system for the gloveboxes where the operations are being performed are to be operational. The GBO detection system provides early warning of a fire within a glovebox system. The detection systems are connected to the plant central alarm system which alerts both the Central Alarm Station (CAS) and the Fire Department.

- The storage tray heat detectors that will be utilized to hold the metal containers used for thermally stabilized oxide storage are to be operational. The storage tray detection system provides early warning of a fire within a container which is in contact with the storage tray detection device. The storage tray detection systems are connected to the plant central alarm system which alerts both the Central Alarm Station and the Fire Department.

- Glovebox entry carbon dioxide (CO_2) fire extinguishers also are to be available in the area of the operation(s). These extinguishers provide cooling in the unlikely event of a fire. The extinguishers can cool the outside of a glovebox and also can be used by trained personnel making entry into a glovebox to cool and extinguish normal combustibles ignited by burning plutonium.

Additionally, the following fire safety administrative controls will be required:

- The amount of combustibles in gloveboxes where operations are to be performed will be minimized.

- Brushing procedures will include steps to mitigate pyrophoric reactions involving the plutonium. These procedures are to spell out specific actions to be taken to prevent rapid oxidation and fires. The actions range from slowing the brushing operation to having the Fire Department commence cooling operations by using the glovebox entry fire extinguishers.

4.2 Facility/Operations Standards

Certain operations at RFP were curtailed pursuant to the 1989 curtailment order from the Secretary of Energy. During the period of curtailment, required SNM inventories, including brushing of plutonium oxidation products, were conducted in buildings that were subject to the curtailment order, since that activity was not considered to fall under the scope of the curtailment. Since that time, Building 559 has been restarted to conduct certain defined missions involving plutonium operations. It is the EG&G RFP position that the activities contained in this management plan fall into two categories relative to the curtailment:

- Non curtailed activities: handling, material movement, oxidation product removal, repackaging, and calorimetry
- Curtailed Activities: thermal stabilization of plutonium oxidation products

Building 707 has undergone Resumption of Plutonium Operations per commitments stated in the Federal Register March 4, 1991. Building 707 has completed activities required to conduct the thermal stabilization mission, pending an environmental assessment and Secretary of Energy approval to conduct operations.

All efforts and tasks required to prepare facilities, personnel, and management administrative control systems for conduct of the activities required to resolve the safety concerns will be carried out in accordance with existing infrastructure systems, Technical Assurance Procedure Group (TAPG) procedures, and occurrence reporting process. Included in these are the following:

- Readiness Evaluation
- Conduct of Operations
- Integrated Work Control Program (IWCP)
- Conduct of Engineering Program
- Unreviewed Safety Question Determination Procedure
- Training User's Manual
- Issues Management Procedure
- Commitment Management Procedure
- Readiness Review Procedure

Activities to be performed for this project will be described in the building implementation plans. Information such as equipment to be used, personnel to be trained, and descriptions of work tasks will be used as the basis for development of the Readiness Evaluation Plan and the development of documents responding to Defense Nuclear Facilities Safety Board (DNFSB) Recommendations.

Detailed schedules will be developed and maintained by the Task Force Organization, and will be used to assist EG&G and DOE/Rocky Flats Office (RFO) management in the execution of the project. Regular status meetings will be held between EG&G and DOE/RFO to raise and discuss issues and encourage concurrent resolution of these issues.

All project activities will be conducted in accordance with DOE Implementation Plans for DNFSB recommendations where applicable and all applicable federal, state, and local laws, regulations, agreements, and commitments.

4.3 Packaging

Packaging to minimize waste and storage volume and to minimize or eliminate packaging combustibles is required for use in the repackaging of pyrophoric plutonium. An evaluation will be performed by Product Packaging, in concert with Operations Management, Safeguards and Security, and other relevant organizations, to determine the best methodology for a sitewide packaging system. Results of this evaluation will be the basis for the Phase II and III activities described in this management plan. Currently used standards for packaging will be utilized; however, a more efficient packaging method for long-term storage is being evaluated as complex wide criteria is identified. Major items that will be considered in this evaluation include fire safety, safeguards limits, radiation exposure, security requirements, storage volume efficiency, operational efficiency and limitations, and the potential for interim and long-term storage.

A Packaging Plan will be completed as indicated in Appendix D.

4.4 Safeguards and Security

The processing operations defined in this plan to remediate the HSP 31.11 storage concerns are to be controlled to ensure that all of the material is properly accounted for and documented so that the Safeguards Accountability Network (SAN) inventory data base can be updated.

The processing operations will be performed in accordance with approved, established procedures and will follow approved activities and procedures used in the Management Plan for the 1990 Annual Physical Inventory. These activities and procedures provide for the weighing of items before and after remediation activities, and for measurements which will be used to update the SAN system. Refer to Appendix C.

EG&G Safeguards and Security and Wackenhut Services, Inc. (WSI) RFP completed baseline vulnerability assessments (VAs) for all buildings containing Category I and II SNM in the current consolidated storage configuration. These baseline VAs evaluate security risk by building and provide the physical protection requirements necessary to protect SNM inventories against theft, diversion, and radiological sabotage. The protection requirements in the baseline VA reduce the risk to an acceptable level. Currently, all Category I or II SNM items are stored within a vault or vault-type room. Maximum limits of material quantities have been established which will allow HSP 31.11 remediation activities to take place without any increase in Safeguards and Security protection requirements. Activities which will exceed these limits and/or the baseline storage configuration will require a reevaluation of the potential risk associated with removal of Category I and II SNM items from approved storage locations. Refer to Appendix C.

4.5 Nuclear Safety

Nuclear Safety Engineering (NSE) will support the resolution of safety issues associated with the storage of plutonium at RFP, including HSP 31.11 compliance, through actions such as performing hazards assessments and safety analyses, reviewing Nuclear Material Safety Limits (NMSLs) and Criticality Safety Operating Limits (CSOLs), revising or preparing new NMSLs or CSOLs, performing Safety Evaluation Screens (SESs), Unreviewed Safety Question Determinations (USQDs), and Justifications for Continued Operation (JCOs), and providing Operational Safety OSR interpretations, clarifications, and revisions.

NSE performed initial qualitative analyses to identify the significant risks associated with the current plutonium storage conditions and to assess whether these risks are bounded by the existing authorization basis. Additional safety analyses will be performed as needed to provide input to management decisions concerning appropriate corrective actions. These analyses may include a more detailed assessment of the risks associated with continued storage of plutonium in its current configuration, and evaluations of the safety implications of various alternatives for corrective action. NSE is contributing to a multi-year project to establish appropriate standards for the long-term storage of plutonium, which is being integrated by the Transition Packaging Organization.

NSE will provide additional support for the resolution of safety issues associated with the storage of plutonium upon request. The following types of support are anticipated:

- Review nuclear criticality safety limits for those operations and areas to be used for any proposed corrective actions. This review will identify and document which applicable limits are acceptable, which limits need to be revised, and which new limits need to be created to permit the corrective actions. Since the significant issues related to the present storage of plutonium involve fire and spill scenarios, and do not directly impact nuclear criticality safety, no criticality reviews are anticipated for the material in its current storage configuration.

  Revise existing nuclear criticality safety limits and create new limits as needed. These activities will be performed in accordance with 1-91000-NSM-03.03, 3-91000-NSPM-5B-01, and other related procedures as appropriate.

- Perform hazard or risk assessments to support Emergency Preparedness or other needs as required.

- Identify the vital safety systems or other controls which are needed to ensure the safety of personnel and public during current moratorium storage configuration and any proposed corrective actions. This will be based on the existing authorization basis documentation (e.g., safety analysis reports and operational safety requirements) and on an identification and characterization of the material in question Item Description Codes (IDCs), number of items, material weight, packaging type, age of packaging, storage location, storage conditions, etc.).

- Perform SESs, USQDs, JCOs, or prepare OSR interpretations, clarifications, or revisions as appropriate for any vital safety systems identified by Systems Engineering or Operations as not meeting their LCOs. SESs will be performed in accordance with 1-91000-NSM-04.03, USQDs will be performed in accordance with 1-91000-NSM-04.05 and 3-91000-NSPM-5C-01, and JCOs, OSR interpretations, clarifications and revisions will be performed in accordance with 2-80000-COEM-6.3.14, 2-80000-COEM-6.3.12, and 3-91000-NSPM-5C-02.

- Perform SESs and/or USQDs on any new procedures required for the performance of this project, and for any material to be moved between Material Access Areas (MAAs) in accordance with 1-63200-NMT-001.

- Perform additional safety analyses or evaluations upon request.

4.6 Radiation Protection

Development of an ALARA Radiation Protection Plan will include definition of the scope of operations and all elements of the material movement and the Inspection Plan. A detailed analysis of the actual steps of the operations will be completed to determine potential hazards. A radiological hazards analysis shall be performed for potential radiation exposures and airborne and surface contamination based on container inventories, baseline surveys, and individual steps of the work process. Each source of radiation will be addressed, and personnel exposures will be estimated. The results of this ALARA review will provide a basis for cost benefit determinations and work controls necessary in order to perform the work under ALARA requirements.

Actual work will be conducted by trained personnel in accordance with approved procedures, Integrated Work Control Package (IWCP) controls and Radiological Work Permits.

Radiological Engineering shall conduct an ALARA review in accordance with RE-1002 and, based on the results, provide recommendations for work controls.

An ALARA Plan will be completed as indicated in Appendix D.

4.7 Waste Requirements

Waste generated by the execution of this plan will fall into two broad categories: 1) low level waste (LLW) which includes low level and low level mixed waste, and 2) transuranic (TRU) waste including both TRU and TRU mixed waste.

The disposal site currently identified for the disposal of LLW is the Nevada Test Site (NTS). Document NVO-325, Revision 1, Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, outlines the waste acceptance criteria and requirements for transport and disposal of LLW at NTS.

DOE Order 5820.2A identifies the Waste Isolation Pilot Plant (WIPP) as the disposal site for TRU waste. Consequently, all TRU waste is to comply with the WIPP Waste Acceptance Criteria (WAC) specified in document WIPP/DOE-069, Waste Acceptance Criteria for the Waste Isolation Pilot Plant. Currently, only the TRUPAC-II is authorized to be used for offsite transportation of TRU waste. Requirements unique to the TRUPAC-II shipping container are specified in the Safety Analysis Report for the TRUPAC-II Shipping Package, Docket Number 71-9218, and WP-1900, Rocky Flats Compliance Plan for TRUPAC-II Authorized Methods for Payload Control (TRAMPAC).

All mixed waste/residue (both TRU and LLW) is to comply with applicable regulations of the Resource Conservation and Recovery Act (RCRA) pertaining to the generation, handling, labelling, storage, and treatment of RCRA-regulated material.

Procedure WO-4034, EG&G Rocky Flats Plant Radioactive Waste Requirements Manual, contains the basic requirements for segregation, packaging, and documentation of radioactive and mixed waste as specified by DOE, Department of Transportation (DOT), EG&G RFP, WIPP, Nevada Test Site, the Colorado Department of Health (CDH), the Environmental Protection Agency (EPA), and other applicable rules and regulations.

In addressing the safety issues associated with the storage of plutonium, the processing (i.e., thermal treatment) of mixed residues may result. RCRA treatment permits may be necessary for processing the mixed residues. If the final product is a mixed waste, it will follow all RCRA storage requirements. Mixed waste generated from this project will be stored in the current permitted storage areas allocated for newly generated mixed waste.

The storage of mixed waste tracks both low level mixed and TRU mixed waste against a Limiting Conditions of Operations (LCO) capacity. The current combined inventory is 2624 cubic yards. The LCO capacity is 3395 cubic yards. The remaining capacity is 771 cubic yards. Using projected generation rates, this capacity will not be exceeded until June 1995.

A Waste Management White Paper will be completed as indicated in Appendix D.

4.8 Industrial Hygiene and Safety

The scope of the activities of the plan involve usual processes included in existing Operational Safety Analyses (OSAs) and the Health and Safety Practices (HSP) Manual. Worker safety and health will be accomplished in accordance with the OSA and HSP Manual.

5. ASSUMPTIONS

Several assumptions are relevant to this project:

- A timely environmental assessment will be completed for Building 707 in support of thermal stabilization.
- An eventual DOE/HQ approval will be received for the resumption of limited plutonium activities in Building 707 in support of the thermal stabilization of pyrophoric plutonium materials.
- Pyrophoric plutonium materials that require stabilization will be thermally stabilized in Building 707.
- Sufficient and adequate resources will be available to support the performance of the activities described in this plan.
- Waste generated by the activities described in this plan can be dispositioned without causing major constraints on current storage commitments.

6. APPROACH TO RESOLUTION

The first step to resolve the non-compliance will be to inspect approximately 10% of containers that fall within the selection criteria established by the Inspection Plan. The Inspection Plan provides a significant statistical sample of containers to inspect based on certain criteria such as age, type, packaging configuration, historical problems, etc. A summary of the Inspection Plan design is as follows:

1) The inspection plan is designed such that the information gathered from the samples can be used to draw conclusions relative to the other stored material on the plant site.

2) Materials to be inspected will be taken from containers stored in each of the 6 buildings and from containers that fit into the selection criteria as identified in the

Inspection Plan.

3) Photos and videos will be required of all activities associated with the inspection, including transporting, unpackaging, brushing, sampling, weighing, repackaging, and back to storage.

4) The data from the Inspection Plan will be recorded as described in the Recurrence Control Plan, and will be included in an Inspection Plan Data Report to be completed after the inspection is complete. In addition, the report will summarize all activities, percent oxide, problems, issues, etc., to assure that important knowledge gained is not lost, and that plutonium experts can prepare technical papers associated with this activity.

5) Special instructions will be provided if required to supplement any procedures, or operations instructions.

6) Since this project was started, many predictions have been made by many different experts. If possible, these predictions will be documented to test our knowledge relative to long term storage of plutonium metal.

7) The priority sequence of buildings based on current readiness status will be 779, 707, 771, 776/777, and 371.

8) Building 779 is the first building because preparations have been under way for compliance activities for over a year. In addition a Building Implementation Plan has already been issued. The 779 plan also includes an internal inspection plan which will be used.

9) An inspection plan matrix will be provided to management for approval before any activities associated with this project are initiated.

As a minimum, the Inspection Plan is considered a hold point for further evaluation of options and risk in bringing the remaining material back into compliance with HSP Manual Section 31.11.

The general approach to the Inspection Plan implementation will be to remove the outer storage containers in a controlled environment, bag the inner container into a glovebox, open the inner containers, brush any oxide from the plutonium items, repackage the plutonium items and return them to storage, package the oxide, and store on heat detectors or in an inert atmosphere. If sufficient oxide storage is not available, the oxide will be packed and shipped to Building 371 for storage in the stacker/retriever. The flow diagram for this process is shown in Appendix F.

Because of the uncertainty relative to the individual status of each building's ability to meet plant standards and approval to resume specific operations, it is necessary to phase the implementation of plutonium storage compliance to ensure plant consistency, efficiency, and safety. The order of building implementation is 779, 707, 771,776/777, and 371.

Several options have been considered to resolve the storage issue for pyrophoric plutonium and to achieve compliance with HSP 31.11. The current option utilizes the availability of the interim storage capability (e.g., gloveboxes with contact heat detectors or inert atmosphere) that will allow immediate unpacking, inspecting, brushing, storing pyrophoric materials, and repacking of clean metal.

One option given consideration was to centralize the unpacking inspecting, brushing and repacking activity in one building, such as Building 707. This option, however, introduced the increased risk to the public from onsite transportation of containers that may have degraded and an increased risk to the worker by handling these containers. Moving the containers within the building creates the least risk to the public because any potential releases to the environment would be confined by the Zone I (4-stage) or Zone II (2-stage) HEPA filters. Moving the containers the shortest distance and minimizing the number of handling steps and glovebox operations, presents the least risk to the worker. Therefore, the initial unpacking, inspecting, brushing, and repacking operations will be performed within the building where the material is currently stored.

As indicated in the executive summary, the Inspection Plan implementation will provide the data required to make the final decisions for total compliance with HSP 31.11. For example, if the items inspected have very little or no oxide to brush, then storage capacity on heat detectors or inert atmosphere is probably not a problem. If large quantities of oxide are found, available storage capacity will be exceeded quickly, and additional heat detectors will have to be installed or the oxide must be further packaged and transported to building 371 for storage in the stacker/retriever, or no further inspections will be performed until Building 707 receives permission to thermally stabilize the pyrophoric oxide.

6.1 Risk Analysis

A qualitative and quantitative risk assessment has been completed to address the fact that stored metallic pieces of plutonium have exceeded established limits for storage and inspection. Both assessments conclude that there is no imminent risk to the public. Complete details on both studies are presented in Appendix B.

A schedule to prioritize inspection, repackaging, and thermally stabilizing the plutonium materials is being developed. However, until thermal stabilization is resumed in Building 707, generation of significant quantities of potentially pyrophoric plutonium powders would create a greater risk than leaving the material in its current state.

From a risk analysis evaluation the following factors should be considered to prioritize material targeted for inspection, cleaning, repackaging, and thermal stabilization:

- Age of materials

- Form of material (i.e., suspect hydrides, fines, small samples, parts, and bulk metals)

- Phase of plutonium (unalloyed or alloyed)

- Storage area atmosphere (air or inert)

- Packaging configurations (e.g., seal integrity, types of containers, number of barriers, plastics in direct contact with plutonium, etc.)

Other factors such as safeguards and security, ALARA, and equipment availability will be identified and integrated into the prioritization scheme.

6.2 Root Cause Analysis

The Standards, Audits, and Assurance organization of EG&G RFP is performing a root cause analysis of the noncompliance with HSP 31.11. The analysis will determine the root and contributing causes of the noncompliance with HSP 31.11 and recommend the corrective actions to be taken. Upon completion of the root cause analysis, it will be reviewed by the Associate General Manager (AGM), Transition Management, who will coordinate the implementation of any corrective actions.

This Root Cause analysis will be completed as indicated in Appendix D.

6.3 Phase I Activities

The Phase I activities prepare the facilities for implementation of the Inspection Plan. These activities will be specified in site and building specific plans. The material out of compliance in each specific building will continue to be stored in current configurations while site support and building implementation plans are being developed.

6.4 Phase II Activities

The Phase II activities will include the performance of the Inspection Plan in accordance with the respective Building Implementation Plans, which will inspect approximately 10% of the plutonium metal stored in each building. Data from the inspections will be analyzed and utilized to make decisions on further inspection activities.

6.5 Phase III Activities

The Phase III activities will include inspection and weighing of the remaining 90% of the plutonium metal according to HSP 31.11.

6.6 Recurrence Control

The basis for recurrence control will be the actions that are derived from the root cause analysis described in Section 6.2. At a minimum, the following will be completed:

Recurrence control will be managed by an administrative procedure which will define the scope of the project and designate responsible organizations. The procedure will outline steps to control transfer and storage of pyrophoric plutonium that is out of compliance with HSP 31.11.

Recurrence control will include creation of a material storage matrix corresponding to the storage and transfer requirements listed in HSP 31.11. When the material category matrix is established, the SAN will be equipped to track compliance with HSP 31.11.

Tracking will include the HSP 31.11 material category, packaging method, packaging date, total package weight, number of containers, and out-of-compliance date. Monthly HSP compliance reports will be generated by the SAN system and transmitted to Operations personnel. These monthly reports also will contain a list of items which will exceed the HSP 31.11 time limitations for packaging in the ensuing six-month period.

During the normally scheduled bi-monthly nuclear materials physical inventories, Operations personnel will also inventory those items requiring inspection as determined by the SAN HSP compliance report. Brushing and material repacking will be performed as required. Items will be inspected before they exceed the allowed compliance time which will prevent recurrence of the current situation. In addition to the inventories, an audit of HSP storage compliance will be conducted by an independent organization on a pre-determined basis. The audit will compare the SAN compliance report to inventory activities.

Other planned activities which will contribute to resolving plutonium storage issues in the future include: 1) developing alternate packaging methods to reduce/eliminate oxidation problems during storage, 2) consolidating SNM, and 3) stabilizing plutonium metal in other forms, such as plutonium oxide (with no metallic fines). These will be accomplished as part of the transition process.

A Recurrence Control Plan will be completed as indicated in Appendix D.

6.7 Stakeholders

To ensure that potentially affected people receive factual, ongoing information on the

Management Plan for Resolution of the Safety Issues Associated with the Storage of Plutonium and related activities, EG&G Community Relations will assume responsibility for stakeholder communications. Information will be initially provided through placement of the plan in each of the five regional reading rooms. On an as-needed basis, EG&G Community Relations will develop fact sheets, transmit news releases and community advisories to key stakeholders via the Community Fax, provide briefings to community and special interest groups, and arrange for ongoing articles in *The Paper* and *ER Update*

7. READINESS EVALUATION

7.1 Standards Development

Standards will be developed based on 1) the preparations and conduct of the 1990 Annual Physical Inventory, with additional justification provided in specific areas where activities differ and/or where special considerations are required, and 2) the completion of Activity Control Envelopes for each facility. These standards will be reflected in the Readiness Evaluation Plan.

Consistent with the Notice published in the Federal Register, March 4, 1991, sitewide support programs which have undergone Operational Readiness Reviews for the purpose of resumption of plutonium operations will not be re-evaluated during the Readiness Evaluation (RE) for this project. It is assumed, therefore, that an RE will focus on specific activities in the affected buildings. This concept will be reflected in RE checklists developed by EG&G.

Work required to meet the standards will be identified by members of the Task Force Organization, and included in the project schedule. Progress toward achievement of operational readiness will be monitored at regular status (punch list) meetings between EG&G and DOE/RFO. EG&G Transition Management will schedule and conduct these meetings, with concurrence from the RFO Assistant Manager for Facility Operations.

7.2 Readiness Evaluations (REs)

When sufficient progress toward operational readiness has been achieved, the AGM, Facilities and Operations Management, will notify the AGM, Transition Management, who will organize a team to conduct a readiness evaluation in accordance with established EG&G Readiness Review procedures.

WSI/RFP planning will parallel plant efforts and schedules following requirements mandated by protective force operations and planning. WSI/RFP will conduct performance testing of new procedures and/or training resulting from changes initiated by this plan or related vulnerability assessments. Schedules for implementation will be developed in concert with EG&G planning and scheduling efforts.

Following the review, a summary report, including a formal request to begin operations, will be prepared by the readiness evaluation team and forwarded to DOE/RFO. Any deficiencies noted in the EG&G RE will be identified in this report, along with corrective action plans and scheduled completion dates. This request, which will be known as the Readiness to Proceed Memorandum, will include the reports responding to applicable DNFSB recommendations.

DOE/RFO will then conduct an RE. Any further deficiencies noted during the RE will have corrective action plans completed and approved before the start of work. Action tasks which are to be completed before the start of work will be so noted, and will require independent verification by both EG&G and RFO.

7.3 Readiness Objectives

EG&G Readiness Objectives will be developed for three specific elements: equipment, personnel, and management administrative systems (including baseline documentation). Each of the elements will have specific checklists prepared, which will address the specific activities of the project, as defined below. These checklists will be used by the Evaluation Team to verify the adequacy of the efforts to prepare for performance of the plutonium operations described in this Program Management Plan.

The scope of the RE checklists is to examine those elements of equipment, personnel, and management administrative systems that execute the management plan or are in direct support of the execution of the plan. The depth and breadth of the evaluation will be sufficient to establish that the management plan can be safely executed. Sitewide programs that have already received extensive review during the Operational Readiness Reviews conducted in Buildings 559 and 707, will not be re-evaluated. Elements of those sitewide programs that must be adapted for implementation in each building will be reviewed to determine that an appropriate level of implementation has been achieved. For example, the evaluation will examine the level and degree to which Quality Assurance, Conduct of Operations, Emergency Preparedness, and other programs have been implemented in a building and whether this is sufficient to support the safe completion of the management plan.

A document cross-referencing these criteria will be developed. Although final preparation of these documents is dependent upon completion of building-specific plans, the readiness objectives will, as a minimum, address the following issues:

General:

- Mission equipment required to perform work
- Vital safety systems required to perform work

- Plutonium accumulation in glovebox ducts
- Startup Test Program

Personnel:

- Training
- Experience
- Staffing levels

Management Administrative Systems:

- Safety analysis and documentation
- Procedures
- Compliance issues review
- Occupational/industrial safety
- Nuclear Safety Controls
- OSR Implementation
- Support services and programs
- Radiation safety and protection
- Environmental regulation compliance
- Conduct of operations and management oversight
- Organization and administration
- Safeguards and security preparations
- Emergency Preparedness

A Readiness Evaluation Plan will be completed as indicated in Appendix D.

8. IMPLEMENTATION

8.1 Site Support Implementation Plan

A Site Support Implementation Plan will be prepared to ensure that the RFP site support services are ready to support the Building Implementation Plans described in Section 8.2. The subjects that will be addressed in the Site Support Implementation Plan will include, but are not limited to:

- The consumables that will be used during the execution of the plan. These will include gloves, packaging material, etc.

- Sources for the calorimetry that will be required following thermal stabilization of the oxides.
- Transportation authorization documents for moving the material between facilities.
- Transportation equipment that will be used for moving the material between facilities.
- Emergency Preparedness procedures for all of the affected facilities.

A Site Support Implementation Plan will be completed as indicated in Appendix D.

8.2 Building Implementation Plans

Building implementation plans for each building that describes the process flow, preparations, and process requirements will be written and approved by the AGM, Facility Management and Operations. The process flow will identify the path that the subject material will take from the original storage location, through cleaning, to the final storage destination. Process requirements will identify issues that are to be addressed during the processing evolutions.

Before a building can begin operations, numerous prerequisites must be satisfied. Building process equipment such as gloveboxes, gloves, downdraft tables, balances, canning equipment, and canning supplies must be available and operational. In addition to general items, equipment that is building specific, such as the stacker/retriever in Building 371, must be operational. Procedures for storage, movement, processing, and oxide dispositioning must be reviewed to ensure they are adequate to safely perform anticipated operations. The building shall be in compliance with applicable OSRs including alarm systems, NMSLs and/or CSOLs, and surveillances. ALARA reviews and facility engineering evaluations will be completed as well as reviews of applicable building Operational Safety Analysis (OSA) and criticality limits. The building implementation plans will be reviewed by the Environment and Waste Management organization to ensure that the plant remains within established environmental constraints.

The training and qualification of plant personnel, including minimum staffing and oversight requirements, will be included in the plan. Process planning will include a determination of personnel requirements for each craft. Qualified personnel will perform all operations in a safe and controlled manner. Training will be conducted in accordance with the Training Users Manual and will include walkdowns of all operations to integrate individual training segments. Data from the ALARA reviews will be incorporated into the training to ensure radiation exposures are kept to the lowest reasonable levels.

The processing requirements section of the plan will describe constraints and issues, such as waste generation, anticipated check points occurring as a result of converging processes, and the capacity to safely store oxide before final stabilization. Each implementation plan will address EG&G and DOE/RFO reviews as discussed in Section 7 of this document.

A Building Implementation Plan for each building will be completed as indicated in Appendix D.

9. COSTS AND SCHEDULES

As information on plan activities is developed by the various organizations involved in this project, the data will be assembled into the Work Breakdown Structure (WBS). A work package for the remainder of fiscal year 1993 will be developed and submitted to the Plant Change Control Board. It will be completed as indicated in Appendix D. The work package will include funding and resources required for the remainder of the fiscal year. A work package will be developed for fiscal year 1994 for the continuing work of this project as part of the normal budgeting process of EG&G RFP. This fiscal year 1994 work package will be developed and submitted in accordance with the fiscal year 1994 budget call. Estimates for fiscal year 1995 and out-year work packages will be developed for each succeeding budget call for activities to ensure compliance with HSP 31.11.

The first material to be inspected will be in Building 779 per its building specific plan which has been under development since the fall of 1992. Material movement in Building 779 is expected to begin in July or August of 1993. It is estimated that it will take one to two years to complete the activities in all of the buildings. A detailed schedule will be prepared following completion of the Site and Building Implementation Plans which are currently scheduled for July 16, 1993.

10. REFERENCES

1-10000-TUM, Training User's Manual, Revision 14, July 16, 1992

1-63200-NMT-001, Transfer of Nuclear Materials Between Access Areas, RFP Policy 7.25, Readiness Review

1-91000-NSM-03.03, Nuclear Criticality Safety Operating Limits

1-91000-NSM-04.03, Safety Evaluation Screen

1-91000-NSM-04.05, Unreviewed Safety Question Determination

2-80000-COEM-6.3.11, Engineering Operability Evaluation Preparation

3-91000-NSPM-5B-01, Nuclear Safety Procedures Manual, Criticality Safety Evaluation

3-91000-NSPM-5C-02, Review and Maintenance of Operational Safety Requirements

DOE Order 5820.2A, Radioactive Waste Management, 9/26/88

NVO-325, Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements, Revision 1

WIPP/DOE-069, Waste Acceptance Criteria for the Waste Isolation Pilot Plant

WP-1900, Rocky Flats Compliance Plan for TRUPAC-II Authorized Methods for Payload Control (TRAMPAC)

WO-4034, EG&G Rocky Flats Plant Radioactive Waste Requirements Manual

Federal Register, Rocky Flats Plant, Colorado, Operational Readiness Review; Agency Response, March 4, 1991

Health and Safety Practices Manual Section 31.11, Transfer and Storage of Pyrophoric Plutonium for Fire Safety

Residue Compliance Order No. 91-07-31-01
H. P. Mann letter to A. H. Pauole dated April 30, 1993, 93-RF-124E; Actions Regarding Stored Special Nuclear Material (SNM) That Is Not In Compliance With Health And Safety Practices (HSP)

11. APPENDICES

APPENDIX A - Material Out of Compliance White Paper

APPENDIX B - Risks of Pyrophoric Plutonium Storage at Rocky Flats Plant

APPENDIX C - Safeguards and Security White Paper

APPENDIX D - Separate Deliverables

APPENDIX E - Definition of Terms

APPENDIX F - Flow Charts

APPENDIX A

MATERIAL OUT OF COMPLIANCE WHITE PAPER

BACKGROUND

Before January 1,1990, the Rocky Flats Plant (RFP) produced nuclear trigger components which were shipped to the Pantex Plant in Amarillo, Texas for assembly into nuclear weapons in accordance with the National Defense Stockpile Memorandum. All nuclear material at RFP has been physically inventoried, with records maintained in an automated inventory database referred to as the Safeguards Accountability Network (SAN). Procedures were in place for routine brushing of metal and thermal stabilization of compounds. As of the December 1989 physical inventory, oxides and glovebox sweepings were thermally stabilized, measured, and placed in storage vaults/vault-type rooms or inside glovebox systems.

Since January 1, 1990, RFP has been operating under a Curtailment of Operations Order issued by the Secretary of Energy. Since the Curtailment of Operations Order, very little movement of the types of material (covered in the Management Plan) has occurred with the exception of physical inventories and material consolidation to assure the physical protection of the nuclear material during 1990 and early 1991. Prior to the December 1990 annual physical inventory, thermal stabilization of oxide was a curtailed activity. An exemption from curtailment was approved to brush metal during the December 1990 annual inventory and has been included in physical inventory plans since the December 1990 approval. The last time plutonium items were brushed was during material consolidation activities prior to, after, and during the December 1991 annual physical inventory, when some selected items were brushed. The storage requirements are defined in the Health and Safety Practices (HSP) Manual, Section 31.11.

Some items have been noted to be out of compliance with specific storage requirements in HSP 31.11 and an effort was initiated to define the scope of the noncompliance.

Approach

Given the conditions noted above and utilizing engineering judgement, the Data Gathering Team (DGT) developed a set of assumptions and facts which formed the basis for the identification of items potentially not in compliance with current storage requirements. The assumptions and facts are as follows:

HSP 31.11 Data Gathering Assumptions

1. All oxide generated prior to transition from Rockwell to EG&G was burned twice and is stabilized. This is based on process knowledge and technical engineering judgement.

2. After December 1989, the oxide was not stabilized, but stored in accordance with HSP

31.11. There is one item in the Building 371 stacker/retriever which may be out of compliance. This one is included in the data gathering analysis.

3. Surveillance units are assumed not to be sealed and are out of compliance.

4. Coating shields are not specifically addressed in HSP 31.11, however based on Engineering judgement, coating shields (199) were included in the same HSP 31.11 category as compounds, films, and foils due to the potential presence of pyrophoric metal.

5. Documented evidence does not confirm that metal buttons were not wrapped in plastic prior to canning for storage. Therefore, the assumption is that the buttons may be in contact with plastic and will be handled accordingly during the remediation activities.

6. The "create date" from the Safeguards Accountability Network was used as the generation date for all items included in this summary for purposes of applying the HSP 31.11 time limits for storage. All items located in out of line storage areas are over a year old. For items located inside glovebox lines, May 1, 1988 was used as the cut-off date for applying the 5 year storage limitation.

7. The item description codes (IDCs) used for the summary are those bound by HSP 31.11 and those which, although not specifically addressed in HSP 31.11, were determined to apply based on Engineering judgement.

8. The number of items selected by IDC for each building are conservative, in that the items may represent the upper bound of the problem (i.e. worst case scenario). The team preparing the data is highly confident that the number of items out of compliance will not be greater than the numbers represented. Items within IDC categories with questionable compliance were added into the totals and should be inspected to determine status of compliance with HSP 31.11.

9. HSP 31.11 defines an inert atmosphere as one that has been continually monitored to ensure oxygen levels below 5% (vol %). The Building 707 X Y retriever has not had an operable oxygen analyzer for approximately one year. Experience from the inventory conducted in December 1991 indicated very limited oxidation of plutonium. The oxygen analyzer is now fixed for the X-Y retriever and is awaiting approval from DOE/RFO to make the system operable.

10. The inerting system in the Building 371 stacker/retriever has failed repeatedly and experience has shown that stored material has experienced significant oxidation. Evaluations were made based on inert and non inert atmospheres in the Building 707 and Building 371 retrievers.

11. In order to identify an upper bound (i.e. worst case scenario), the items were assumed to be unalloyed plutonium until a detailed item-by-item technical engineering analysis can be performed before remediation activities.

12. Items in IDC categories selected for this analysis with zero plutonium weight have been

eliminated from the building summary.

HSP 31.11 Validated Issues

1. Retirement units are sealed and exempt from HSP 31.11 requirements.

2. Lean residues are nonpyrophoric; therefore, HSP 31.11 does not apply. Areas containing white 55-gallon drums were excluded.

3. IDC 913 (Non-WR Assemblies) are sealed and therefore, are exempt from HSP 31.11 requirements.

4. Process Salts:

   - Molten salt extraction salts, direct oxide reduction salts, salts from cell cleaning, and electrorefining salts are not specifically addressed in HSP 31.11 requirements.

   See later discussion on "Excluded Salts".

The items selected for inclusion in the HSP 31.11 compliance analysis were based on inventory information contained in the SAN. SAN is an online, near real-time accountability system maintained by EG&G Safeguards and Security for physical inventories of nuclear material. SAN was designed to provide information required to meet nuclear material inventory requirements in accordance with Department of Energy (DOE) Order 5633.3a, and therefore does not necessarily contain additional information required for HSP 31.11 compliance analysis. For example, SAN does not contain specific container information unless the container also happens to equate with the item. There are several instances where the item carried in SAN is actually an assembly of many smaller items (i.e., milliliter sample vials in a quart size can) and there are items in SAN which have been consolidated into a larger container for purposes of storage efficiencies and to meet building specific storage requirements (i.e., 4 liter bottles in a 55 gallon drum).

The Data Gathering Team used SAN to produce a classified inventory report of items to be included in the HSP 31.11 Management Plan. This list, which is a subset of the total inventory, is the basis from which EG&G will select items for further technical analysis and eventual remediation. The list of items is an upper bound (worst case scenario) of those items which are bound by HSP 31.11. The subset list excluded Material Balance Areas (MBA) which contained only solutions or white 55-gallon drums of waste and residues which are exempt from HSP 31.11 requirements, enriched uranium, and HSP 31.11-covered IDCs with zero weight.

The subset inventory report was used to produce a building-specific listing of IDCs which were bound by HSP 31.11. These IDCs were subsequently summarized in a matrix which reflects the total number of items by building within each HSP 31.11 category. This information is in a classified report which will be provided to DOE/Rocky Flats Office (RFO) under separate mailing (reference .CRF 00500969X, .CRF 00500970T, and .CRF 005009714). The Management Plan will include an activity to re-evaluate the technical basis for including an item in the HSP 31.11 matrix. If appropriate, technical decisions and rationale will be documented to exclude items from the HSP 31.11 remediation activities. An unclassified list of items potentially not in compliance with HSP 31.11 by building is included in this appendix (Table 1).

A set of the most probable packaging configurations was developed based on historical HSP requirements and interviews with personnel who have process knowledge and expertise. This set of packaging configurations was then applied to the IDCs listed in HSP 31.11, and a listing of typical packaging configurations for IDCs and definitions of the packaging configurations are included in this appendix (Table 2).

Excluded Salts

IDCs 411; Electrorefining (ER) Salt; 413, Salts from Cell Cleaning; and 654, ER Salts from Pu/Np, are not specifically covered by HSP 31.11 and are not included in the HSP 31.11 matrix. A preliminary analysis of these IDCs indicates a presence of small, potentially pyrophoric pellets in these salts. An unclassified list of IDC 411, 413, and 654 salts by building is also listed in this appendix (Table 3).

HSP 31.11 does not specify any fire safety requirements on salts which are generated by the Molten Salt Extraction (MSE), Electrorefining (ER), and Direct Oxide Reduction (DOR) processes. However, the need to establish fire safety requirements for storage of these salts was being investigated for possible revision of HSP 31.11. The previously identified concern is that some of these storage containers may have a small quantity of unreacted metals (i.e., small metal particles of plutonium, sodium, calcium, magnesium or potassium) mixed with the salts. The process of removing ("breaking out") the salt from the furnace oxidizes any exposed reactive metal. Less reactive metal entrapped by the salt could oxidize at a slower rate. However, the amount of heat generated is expected to be small and readily dissipated to the salt, container, or atmosphere. The salts were produced in Buildings 371, 771, 776, and 779, Currently, the salts are stored in these buildings in quantities ranging from one to a few drums (Buildings 771 and 779) to many drums or individual containers (Buildings 371 and 776/777).

RFP experience has not shown pyrophoricity to be a problem with the MSE and ER salts. However, the salts obtained from the DOR process usually contained non plutonium metal beads (usually calcium) and vaporized metal which coated the furnace interior. The reactive metals were oxidized during the crucible breakout operations. The operators dealt with this problem by reheating the salts with the furnace door open in order to react them with the glovebox air atmosphere. No breach of glovebox containment occurred during these ignition reactions.

The Buildings 771, 776/777, and 779 Final Safety Analysis Reports (FSARs) accident analyses are based on probabilistic risk assessment (PRA) techniques using realistic assumptions. In order to estimate the total risk to the workers and public, the PRAs grouped similar events into accident categories (e.g., fires). For each accident category, several accident scenarios were postulated by identifying an initiating event (e.g., fires initiated inside gloveboxes, fires initiated in rooms, fires on dock, etc.) and modeling the success and/or failure of mitigating systems (i.e., event tree analysis). The dominant risk accident sequences (i.e., paths through the event tree) were used to determine mean risk estimates and generate the risk curves which are presented in the FSARs.

The salts in storage were included in the Building 776/777 FSAR risk assessment of fires involving residue drums (Section 8.1.1.3). The accident model included initiation by a generic room fire in combination with failure of administrative controls, with sufficient combustibles to propagate the fire to the drums. The material-at-risk from the salts were averaged with other Pu residues. The salts in storage were also included in accident scenarios involving the breach of drums from impact events such as room explosions, dock spills, and extreme wind events. For Buildings 771 and 779, the salts were also averaged with other Pu residues in the FSAR analysis of room fires, or impact events.

For Buildings 771, 776/777, and 779, the dominant risk accident sequence frequency of occurrence and radiological consequence (i.e., maximum dose to the offsite individual) established the accident analysis authorization basis for determining whether a USQ exists, per the USQ procedure in the Nuclear Safety Procedures Manual, Evaluation of Unreviewed Safety Questions (3-91000-NSPM-5C-01). Using this USQ procedure and the expected consequences of a small fire as described earlier, no USQ would exist for Buildings 771, 776/777, and 779. The risk of fires from salts in storage would be bounded by the fire risks as presented in those FSARs. If a fire initiated in the storage area caused a breach of an SNM container, a more energetic reaction could be expected between the reactive metals and water (from the room automatic sprinklers) which could result in a greater initial source term from the container, but the total amount of Pu material-at-risk is small (compared to the analyzed room fire material-at-risk) and would not challenge the buildings' authorization basis.

The Building 371 FSAR accident analysis is based on a deterministic approach involving confirmation that the facility and vital safety systems will withstand design basis accidents (i.e., earthquakes, winds, tornados, fire) and that radiological consequences from maximum credible accidents (e.g., fires, explosions, spills, criticalities) are low. Most of the salts in this building are located in the Zone I inert stacker/retriever. For a fire to occur, the container seal must fail when inerting is not present and the expected heat release from the event should be insufficient to propagate to other storage containers. This event would also be filtered by the four-stage HEPA filters resulting in a negligible release. For drums in storage, the consequences of a salt fire (described for the other Pu buildings) would be small and would be bounded by the fire involving combustible Pu residues analyzed in the FSAR. Therefore, per the USQ procedure, no USQ would exist for Building 371.

From a perspective to minimize occurrences, the need to establish fire safety requirements for salts in HSP 31.11 will be considered with other transition planning. The ultimate disposition of these salts will be addressed by transition plans. From the FSAR perspective, the risk of salt fires is low and is bounded by the existing safety analysis. Therefore, these salts should not be included in the May 1993 "Management Plan for Resolution of the Safety Issues Associated with the Storage of Plutonium."

Excluded Uranium

Another metal excluded from this analysis is uranium. The fire loss prevention procedures for transfer and storage of pyrophoric metals other than plutonium are outlined in HSP 31.12, which contain a section for uranium. Metallic uranium and its alloys can also exhibit pyrophoric properties when subjected to excessive external heat or friction. For example, metalworking operations like machining or sawing of Depleted Uranium (not fissile) generate metal fines and turnings. If the heat generated by the cutting tool is significant, the fresh turnings can ignite and burn to oxide. However, uranium turnings and fines are not as reactive as plutonium, and can be handled in large quantities without concern of ignition if they are coated with oil and stored in approved metal containers. Massive chunks of uranium are not considered pyrophoric. Unalloyed uranium can also corrode to form a thick adherent black oxide, but the corrosion scale is not reactive. Uranium alloys containing niobium or titanium develop a very thin protective oxide surface which remains shiny like stainless steel, although it changes color and darkens over a several month period. These alloys do not produce a loose pyrophoric corrosion product.

Although pyrophoric uranium compounds exist at RFP the inventory of depleted uranium and its alloys poses only a negligible health risk to the worker, and sealed containers are not needed (unlike plutonium and weapons-grade enriched uranium). There are no time limits imposed by HSP 31.12 for depleted uranium packaging, which typically consists of metal drums and containers with tight-fitting lids. The integrity of this packaging is not of concern, and compliance issues with depleted uranium are excluded from this study.

Enriched uranium currently stored at RFP is in bulk metallic form and is not considered pyrophoric. Also, it has not been metalworked in recent years at RFP, although metal fines and turnings were generated during certain disassembly operations. Leftover metal fines were processed by thermal stabilization to oxide inside gloveboxes in a similar fashion to plutonium, and stored with plutonium inventories in accordance with similar packaging and criticality limits approved for plutonium. Currently, no pyrophoric enriched uranium is stored at RFP.

Table 1

Summary by Building for Items Potentially not in Compliance With HSP 31.11

Building	Outside Line	Not Inerted Inside Line	Surveillance(1) Pits
707	243	410	
779	58	13	79
777	375	27	
776	249	12	
371	513	189	
771	241	0	
559(2)	0	0	
TOTAL	1679	651	79 = 2409

NOTE: Number of items reflects discrete items listed on the nuclear material accountability system.

Number of items also assume the XY retriever and stacker/retriever did not maintain inert status for the last 5 years.

(2) All material located in Building 559 is in compliance with HSP 31.11.

(1) An Exemption Request is in progress to reduce from 79 to 14.

Table 2

Typical Packaging Configurations

Discussions were held with representatives and subject matter-experts from the various buildings to determine how material generated was typically packaged. There currently is no data base containing this information, so operational knowledge was the best alternative. Packaging of material to be identified was broken into IDCs that are consistent with categories listed in HSP 31.11. Those categories are as follows, with related IDCs:

Buttons and ER Metal

010	011	013	014
015	017	019	024
030	033	035	

Misc. Metal

020	025	027	029
050	051	150	151
152	153	171	

Pyrophoric Compounds

193	197	199

Parts and Subassemblies

160	161	173	180
185	186		

Analytical Samples/Standards

200	210	212	213
195	196		

Ingots

190	191	192

Units

911

The packaging data that follows is the way the material was handled. Unless the container is opened and physically inspected, there is no way to be certain of the packaging configuration.

Table 3

Summary of Building
Electrorefining Salts and Salts from Cell Cleaning
IDCs 411, 413, and 654

Building	Number of Items
707	0
779	2
777	7
776	558
371	3097-I 3248-NI
771	12
559	0
TOTAL	3676-I 3827-NI

NOTE: Number of items reflects discrete items listed on the nuclear material accountability system. A small number of items (white 55-gallon drums), particularly in the ER Salts column, may contain up to 14 individual items.

NI = Assumes the XY Retriever and Stacker/Retriever did not maintain inert status for the last 5 years.
I = Assumes the XY Retriever and Stacker/Retriever did maintain inert status for the last 5 years.

Building 371

Inline

BUTTONS and ER METAL, MISC. METAL, INGOTS

Material/Small Inner Stacker Can/Small Outer Stacker Can

PYROPHORIC COMPOUNDS

Material/Tall Inner Stacker Can/Tall Outer Stacker Can

ANALYTICAL SAMPLES and COMPOUNDS

Material/Vial/Small Stacker Inner Can/Small Stacker Outer Can

Outside Line

BUTTONS and ER METAL, MISC. METAL, INGOTS

Material/Sealed Produce Can/Bags/404 Can/8802 Can
Material/Pressure Cooker (PC)/Bags/8802 Can/PC/2030-1 (IDC 024)

PYROPHORIC COMPOUNDS

Material/Tall Stacker Can/Bags/Calm Shells/55-Gallon Drum

PARTS and SUBASSEMBLIES

Material/Pressure Cooker/2030-1

SAMPLES

Material/Vial/Bags/8801 Can/8802 Can

STANDARDS

There are numerous packaging configurations required to satisfy safeguards assay instrumentation calibration.

Building 707 Material

Inline

PARTS and INGOTS

Material/Part Carrier/Inline

BUTTONS, MISC. METAL, SAMPLES

Material/8801 Can/Part Carrier/Inline

Outside Line

MISC. METAL, INGOTS (Finger)

Material/8801/Bags/8802

SAMPLES

Material/Vial/Bags/8801 Can/8802 Can

STANDARDS

There are numerous packaging configurations required to satisfy safeguards assay instrumentation calibration.

UNITS

Material/On a Cart/In a Vault

Building 771 Material

Inline

SAMPLES

Material/Vial/8801 Can/Heat Head

Outside Line

BUTTONS and ER METAL, Misc. Metal

Material/Bags/404 Can/8802 Can

PYROPHORIC COMPOUNDS

Material/Plastic Bottle/Clam Shell/55 Gallon-Drum

PARTS

Material/Foil/Bags/8808 Can

SAMPLES

Material/vial/Bags/8801 Can/8802 Can

STANDARDS

There are numerous packaging configurations required to satisfy safeguards assay instrumentation calibration.

Building 776 Material

<u>Inline</u>

PYROPHORIC COMPOUNDS

Material/8801 Can

<u>Outside Line</u>

BUTTONS and ER METAL

Material/Sealed Produce Can/Bags/8801 Can

PYROPHORIC COMPOUNDS

Material/Plastic Bottle/Bags/55-Gallon Drum Material/8801 Can/Bags/8802 Can/55-Gallon Drum

MISC. METAL and INGOTS

Material/8801 Can/Bags/8802 Can

Building 777 Material

Inline

MISC. METAL

Material/8802 Can/Heat Head

PYROPHORIC COMPOUNDS

Material/Part Carrier (IDC 193 and 197)
Material/Film Carrier (IDC 199)

SAMPLES

Material/Vials/8801 Can/Heat Head

Outside Line

BUTTONS and ER METAL, MISC. METAL, INGOTS

Material/8801 Can/Bags/8802 Can

PYROPHORIC COMPOUNDS

Material/Plastic Bottle/Clam Shells/55-Gallon Drum

PARTS

Material/Foil/Bags/5105 Can

UNITS

Material/Cart/Locked Vault Room

Building 779 Material

Inline

SAMPLES

Material/Vial/8801 Can/Heat Head

Outside Line

BUTTONS and ER METAL

Material/8801 Can/Sealed Produce Can/Bags/8802 Can

MISC. METAL

Material/8801 Can/Bags/8802 Can
Material/8801 Can/Clam Shell (IDC 153)

PYROPHORIC COMPOUNDS

Material/8801 Can/Bags/Clam Shell
Material/Foil/Bags/Lobster Pots(IDC 193 and 197)

PARTS and SUBASSEMBLIES

Material/Foil/Bags/Lobster Pots

SAMPLES

Material/Vial/Bags/8801 Can/8802 Can

UNITS

Material/Shelf/Locked Vault Type Room

APPENDIX B

RISKS OF PYROPHORIC PLUTONIUM STORAGE AT ROCKY FLATS PLANT

INTRODUCTION

A technical definition for pyrophoric plutonium metal is that it will ignite spontaneously in air at a temperature of 150°C or below in the absence of external heat, shock, or friction [Stakebake 92]. The Health and Safety Practices (HSP) Manual, Section 31.11, *Transfer and Storage of Pyrophoric Plutonium for Fire Safety*, establishes requirements for packaging, transferring, and storing pyrophoric plutonium. These requirements include package types, methods of storage allowed, inspection requirements, and storage time limits for each plutonium form and packaging method. Various plutonium forms and materials in Buildings 371, 707, 771, 776/777, and 779 at the Rocky Flats Plant (RFP) are not currently in compliance with the HSP 31.11 time requirements for inspections and repackaging. The technical basis for HSP 31.11 included fire safety considerations over metal conservation considerations.

The purpose of this paper is to discuss the safety risks associated with storage of pyrophoric plutonium and compounds, considering that some of the containers of this material at RFP have exceeded their storage time requirements. Of particular concern are those materials which are not stored in an inert glovebox or Zone I (atmosphere in direct contact with plutonium) vault, and are not packaged in sealed containers.

There are many differences between pyrophoric metal fires and ordinary combustibles fires. One of the most significant differences is that the ignition of reactive metals is due to rapid oxidation of the surface area of the material, whereas solid combustibles involve pyrolysis (that is, thermochemical breakdown of the material and release of flammable gases). Ignition of bulk metal is usually more difficult. For example, the ignition of a 1000-gram plutonium button (solid bulk metal) requires heating 50 to 60 seconds with a welding torch, and it may take 10 to 15 minutes for the fire to spread over the button. A heat sink such as a metal surface under the plutonium can inhibit or extinguish the reaction. To the other extreme, plutonium metal powder can spontaneously ignite at room temperature in air due to its much greater surface area to mass ratio. Alloying plutonium with other metals can significantly increase the ignition temperature (although certain metals can decrease the ignition temperature; these alloys, however, are not currently being stored at RFP). [Stakebake 92]

PLUTONIUM HAZARDS

A hazard is defined as "a source of danger (i.e., material, energy source, or operation) with the potential to cause illness, injury, or death to personnel or damage to a facility or to the environment (without regard for the likelihood or credibility of accident scenarios or consequence mitigation)" [DOE 92]. Metallic plutonium and several of its compounds exist at RFP as a result of historical manufacture of nuclear weapons. Each form of plutonium exhibits material properties which can pose hazards.

The health hazards common to all plutonium metal and compounds include radioactivity (alpha, beta, gamma, and neutron), and high toxicity. These hazards are managed by the use of radiation shielding and confinement systems (containers, ventilation) which separate and protect the worker and the public from the material.

Different forms or compounds of plutonium exhibit different hazards, which include pyrophoricity, chemical reactivity with air, corrosion, dustiness or dispersibility, and the potential for degradation of containers.

Metallic forms of plutonium can react with water or hydrogen gas in sealed containers to form metal hydrides, which are highly pyrophoric and can ignite when the container is opened inside a glovebox which contains air. The ignition of hydride powder typically produces flames in air and a large amount of heat. This hazard is managed by converting hydride compounds slowly into oxides inside a nitrogen inert glovebox which has less than 5% oxygen. Most plutonium metal processing is performed in gloveboxes which contain 3 to 5% oxygen. A few high temperature operations like casting and welding are performed in a vacuum to prevent molten plutonium from reacting with air or nitrogen.

Metal fabrication processes typically generate metal fines and machine turnings, which are pyrophoric but not as reactive as hydride compounds. The use of gloveboxes with an oxygen content below 10% eliminates the possibility of fire involving ordinary combustibles (open flame burning is not allowed) and reduces the tendency for metal turnings and fines to spontaneously ignite. These metal pieces are typically recast into larger ones to minimize the pyrophoric hazard.

Other operations like inspection, cleaning, marking, and assembly are performed in gloveboxes which contain dry air because large pieces of plutonium are not very reactive. The metal oxidizes after prolonged exposure to air (for example, months) and the corrosion products can spark and release heat. The corrosion problem is common to all metals, but the pyrophoric hazard with plutonium corrosion compounds is not common. The reaction with oxygen produces suboxides, whereas the reaction with moisture produces hydrides and oxides.

In general, the corrosion rate is fastest for unalloyed plutonium metal in a humid air environment, and slowest in a dry environment which does not contain oxygen. Other factors affect the corrosion rate, also. For instance, certain alloys of plutonium corrode very slowly in comparison to unalloyed material. Placing the metal in sealed containers and decreasing the storage temperature (refrigeration) will also slow down the corrosion processes. Plutonium metal self-heats due to radioactive decay. As bulk metal builds up an oxide layer, the oxide insulates and increases the bulk metal temperature. This increase in temperature could result in an increase in the corrosion rate, depending on the degree of oxygen starvation provided by the oxide layer.

If the metal is in large chunks (greater than 50 grams each) and a small amount of corrosion compounds are present, the sparking from the corrosion products is minimal (lasts only a few seconds) and the large chunks will not ignite or react. If the metal is in small pieces, or fines less than 5 grams each, and a large amount of corrosion products is present, the heat generated by sparking may be enough to ignite one of the small metal pieces, which leads to more heat and ignition of the rest of the metal. This hazard is controlled by periodically separating the corrosion products from the metal and heat-treating them in a furnace, which converts them to a stable plutonium oxide (referred to as a thermal stabilization process). The heat-treated oxide is a fine powder which is not reactive, but has a tendency to migrate like dust because of the small particle size (that is, becomes more dispersible) and is controlled by confinement barriers.

OCCURRENCE HISTORY

RFP has a history of fires in the 1950s and 1960s due to the pyrophoric hazards associated with processing and storing plutonium. The Atomic Energy Commission (predecessor to DOE) reported the following concerning the cause of the 1969 fire [AEC 69]:

> The available evidence indicates that the fire originated on the lower shelf of the storage cabinet in Glovebox 134-24 (see figure 2) in the North Line. Plutonium briquettes (discs three inches in diameter and one inch thick of either pressed scrap metal or lathe turnings) and some loose scrap metal were stored in uncovered cans in the storage cabinet. The exact cause of ignition is unknown; however, plutonium in the form of chips or lathe turnings is a pyrophoric material. The heat from the burning plutonium metal evidently caused the storage cabinet, which was constructed mostly of cellulosic laminate material and plastic, to char and generate flammable gases which could have been ignited by burning plutonium. The heat of the burning gases could ignite other briquettes and initiate a slow burning of the storage cabinet materials, particularly in the cracks between the joined sections of the cellulosic materials.

The incidence of fires involving metal manufacturing, such as foundry and machining operations significantly decreased after revision of safety practices in the early 1970s. New practices included minimization of combustibles, inerting the atmospheres inside metalworking gloveboxes with nitrogen, replacement of combustible plastic-type radiation shielding with non-combustible materials, revision of fire safety requirements for plutonium transfer and storage, and adherence to practices which eliminate pyrophoric forms as much as possible.

RFP incident history from 1952 through 1989 was researched for events related to storage situations involving plutonium in containers. More than 20 events were identified which resulted in a fire or pressurization of the container. These releases of plutonium were confined by the building's Zone I glovebox or Zone II room ventilation and filtration systems. The form of plutonium involved ranged from finely divided materials (such as small metal fines or scraps), to compounds (wet oxides, hydrides, foreign organic materials), to bulk metals (such as buttons). The incident history data base is a short summary of the event and does not provide details to determine exact packaging configurations, and whether the material was stored inside an inert or air atmosphere glovebox line, or stored in additional containers in a vault or room.

At Hanford, 17 events from pre-1970 to 1984 involving produce cans (commercially available food-packed cans with crimped lids similar to RFP containers) of plutonium buttons, oxide, or scrap were reported. These events did not result in a fire, but did result in releases from the container. For buttons (which are similar to bulk metal stored at RFP) and scrap, leaky cans would allow metal to corrode to an oxide, which expanded in volume and resulted in a slow mechanical rupture of the can. Sealed cans of oxide can pressurize and rupture if the material is packaged wet or if gaseous products are generated by radioactive decay reactions. Based upon these experiences, Hanford developed specific packaging and storage criteria, and inspects the containers on a quarterly basis as a minimum [Hanford 92].

As a result of these RFP and Hanford incidents, HSP 31.11 (and its earlier versions since the 1970s) was periodically revised to prevent recurrences. These revisions included more stringent packaging requirement, procedural changes, and requirements that prohibit storage of certain materials outside the glovebox line unless they were thermally stabilized.

QUALITATIVE ASSESSMENT OF ACCIDENT RISKS

This section qualitatively discusses risks associated with accidents involving stored plutonium. Specifically, it addresses the release of plutonium from either a fire due to its pyrophoric properties, or from container rupture (caused by oxidation and expansion of contents).

Risk from an accident means "the quantitative or qualitative expression of possible loss that considers both the probability that a hazard will cause harm and the consequences of that event" [DOE 92]. Probability terms are usually expressed as a frequency of occurrence, either qualitatively (for example, anticipated or frequent, reasonably probable or occasional, unlikely or remote, extremely improbable, incredible or impossible) or quantitatively (for example, 1 x 10^{-6}/year, return period of once in one million years, or one chance in one million per year). The consequences from a plutonium release are quantitatively estimated as "radiological dose to an offsite individual, or latent cancer fatalities to the surrounding population." Consequences can also be qualitatively viewed as the magnitude of a plutonium release greater than routine annual emissions (which are less than established regulatory limits). Plutonium must be in a dispersible form and released in significant quantities in order to result in a consequence to a member of the public. As bulk metal reacts to an oxide or compound, it turns into powder and becomes dispersible, although only a small fraction becomes airborne during an accident. For a release of plutonium to occur, the packaging configuration must fail. The airborne fraction is filtered by several stages of High Efficiency Particulate Air (HEPA) filtration, which reduces or eliminates any public risk from operational accidents within the buildings. The following sections describe how the material is packaged, how an accident would be initiated, how it might propagate, and what controls would mitigate it.

Accident Initiation

Initiation of a fire accident involving plutonium can occur by external means, such as electrical shorts igniting transient combustibles or by direct initiation of pyrophoric plutonium compounds in the presence of materials which propagate a fire. Another category of accidents involves the loss of containment, or spill release. The type of packaging and the method of storage within a facility help prevent these accidents from occurring, although a surveillance program and periodic replacement of packaging is required. Typical packaging types and storage methods for various forms of plutonium are described below, along with a description of the commonly expected failure that could lead to initiation of an accident.

Bulk plutonium metal is stored in a Building 707 Zone I vault with an inert atmosphere. Items such as metal pieces and buttons are loaded into a Vollrath 8801 container (approximately 1-liter size), which is placed inside a part carrier that sits on the retriever pendant. Large casting sheets of plutonium and big parts are placed directly into the part carriers.

The Zone I Building 371 stacker/retriever vault storage methodology is similar, but uses nested Vollrath 8801 and 8802 cans (approximately 2 liters) within a hinged locking-type container that is placed in a water-walled (water-filled walls) storage cylinder. Some of the unalloyed metal and small pieces are sealed in produce cans with a crimped lid inside the Vollrath containers. Combustibles such as plastic bags and tape are minimized or eliminated from the packages that are stored in these vaults.

The metals that are not sealed into produce cans are exposed to the vault inert atmosphere, and slowly corrode due to the presence of a nominal 3% oxygen content (with the balance being nitrogen). Periodic special nuclear material (SNM) inventories have usually recovered a small amount of powders from bulk metals such as ingots. The corrosion products are dispersible, but pose no risk to the worker because they are confined within the Zone I glovebox heating ventilation, and air conditioning (HVAC)system. As long as inerting is maintained, no open-flame burning of the corrosion products can occur.

Should a fire occur in the inert vault when it is returned to an air atmosphere (a highly unlikely event), the heat generated by the reaction would be dissipated into the remaining bulk metal in the container and the metal racks/pallets that hold the container. These act as large heat sinks. The difficulty of igniting bulk metal when in contact with a heat sink was demonstrated by an experiment with an 1800-gram ingot on a stainless steel plate (good heat conduction) that would not ignite with a carbon-arc torch after 15 minutes; the unsuccessful endeavor was discontinued and the ingot was placed on a Transite insulating plate (poor heat conduction) where it ignited in two minutes [Felt 67]. Any potential release of plutonium would be to the Zone I vault atmosphere which is not a hazard to workers or the public (see section on Accident Mitigation).

Bulk plutonium metal storage outside the Zone I glovebox vault system is allowed, but the packaging requirements specify both a finite life for the package type and require multiple layers of containment. The packaging typically includes use of either sealed produce cans or inner cans with taped lids, surrounded by a plastic bag and additional outer cans with taped lids. Additional approved parts containers and outer shipping containers (drums) are required for some material types. These packages could then be stored in a Zone II (workplace area accessible by workers) vault-like room. Should all three barriers deteriorate and fail (that is, outer secondary container, plastic bag, inner primary container), an air leak into the inner packaging would allow the metal to corrode. The Vollrath 8802 container has sufficient volume to contain the expansion of the oxide. If the packaging were then handled, an accident involving spill release to the room or pyrophoric reaction as described above could occur. Radioactive contamination would be detected by the workplace radioactivity selective alpha air monitor (SAAM) system and would be confined by the room ventilation and filtration system.

If bulk plutonium metal was initially packaged in direct contact with plastic (for example, plastic bag-out bag) and then sealed inside a produce can or other container, hydrogen could be liberated due to radiolytic decomposition of the plastic. This type of packaging was historically used for in-process shipment of unalloyed buttons. Depending on the packaging configuration, the hydrogen gas could diffuse from the packaging and harmlessly dissipate to the storage area atmosphere. If contained, the hydrogen gas will react with the plutonium to form small amounts of pyrophoric hydrides. The amount of gas generated would be insufficient to significantly pressurize a sealed produce can and bulge the container. The formation of hydrides could also occur if humidity or water was present during the packaging operation. The plutonium hydride would ignite spontaneously upon subsequent exposure to an atmosphere and liberate a substantial amount of heat. The remaining plutonium metal is also likely to ignite and burn, making the container too hot to pick up. This was demonstrated by an occurrence at RFP on January 19, 1983 in which a controlled plutonium hydride fire in a glovebox resulted in the entire 3 kg metal cylinder reacting to an oxide (note: the hydride was formed during an experiment that immersed the doubly-contained cylinder in water and in-leakage occurred). Another incident recently occurred at the Los Alamos National Laboratory which involved plastic wrapped unalloyed plutonium buttons igniting in an air atmosphere as they were unpacked. Should this scenario occur outside the glovebox system, radioactive contamination would be detected by the SAAM alarm and would be contained by the room ventilation and filtration system. Failure of the undisturbed multiple containers in storage, which could result in a release to the room, is considered a low probability. Therefore, due to its low probability and filtered release to the environment, the risk to the public is negligible.

Another consideration involving bulk plutonium metal storage in leaking containers is the volume increase of the material as it oxidizes. The volume increase is caused by a density change as the metal is converted into the oxide. This could result in a volume increase equal to three to four times that of the original material [Felt 67]. If the container is not properly sized, the expansion of the material could rupture the container at the seams or seal. If the container is in a glovebox or Zone I vault, the spill and migratable contamination would be contained within the glovebox system. For containers in a process area or vault-like room, an accident involving spill release to the room could occur if the outer layers of containment failed, a low probability event. This would be detected by the SAAM alarm and would be contained by the room ventilation filtration system.

There are also other plutonium materials such as metal fines, machine turnings, small scrap pieces, samples, and plutonium residues with foreign materials such as organics (machining oils mixed with glovebox floor sweepings) that are more reactive than bulk metals. These materials are treated as higher-pyrophoric forms of plutonium until processed. These forms of materials were typically generated inside the gloveboxes when the manufacturing processes were active, and were processed into stable oxides or recast into bulk sizes within a few hours of being generated or collected. This practice minimized the quantity of pyrophoric materials present inside gloveboxes. Except for machine turnings, a small amount of this material has been generated since the January 1, 1990 curtailment of plutonium production operations. This recently generated material has been safely stored per HSP 31.11 in containers with less than 200 grams of material in a heat-sink container on contact heat detectors.

Accident Propagation

A fire initiated inside a container is not believed to generate sufficient heat to propagate to additional storage locations unless other combustibles are present. Assuming that the air in-leakage rate to the inner container is sufficient to sustain a rapid reaction, the conductive heat losses provided by the storage rack structure (that is, steel holders, water-walled holders, and steel shelves), and convective loss to the atmosphere, will prevent any adjacent material from becoming ignited. Therefore, it is not considered possible or credible for an event to propagate to additional storage locations.

Combustibles have historically led to propagation of a fire, as shown by the 1969 incident at RFP. Combustibles are now minimized or eliminated in accordance with plant procedures. Combustibles (excluding the inner plastic bag containment) are not allowed in storage vaults, except under controlled conditions for maintenance purposes.

Accident Mitigation

Significant improvements in fire safety have occurred at the RFP since 1970. These are discussed in the Final Environmental Impact Statement [FEIS 80]. Improvements include elimination of external ignition sources and ordinary combustibles, installation of safety systems (such as overheat detection, fire suppression, and ventilation and filtration control), and administrative controls.

Gloveboxes and vaults are provided with heat detection systems to monitor the atmosphere. Also, contact heat detectors are located in some gloveboxes for in-process storage of materials with the greatest pyrophoric hazard. These heat detectors alarm locally and to the Fire Department. Some of these materials are also stored in a metal heat sink container which is in contact with the heat detectors.

Rooms containing gloveboxes are protected by automatic wet-pipe sprinkler systems. Also, the exhaust plenums are equipped with automatic and manual water deluge sprinkler systems to protect the HEPA filters.

Any plutonium oxide release from a fire or container rupture inside the glovebox system is filtered by the glovebox or inert vault four-stage HEPA filters to ensure a negligible release to the environment. If the release occurred in a storage area outside the Zone I system, the release would be detected by a SAAM and filtered by the room two-stage HEPA filters to ensure a negligible release to the environment. Any release would be well within regulatory limits, and probably would not be detectable from measured routine emissions.

QUANTITATIVE ASSESSMENT OF RISKS

The plutonium facilities' Final Safety Analysis Report (FSAR) quantitatively addresses risk to the public. This information is used as part of the authorization basis for facility operations.

Based on the existing FSARs and other recent analyses, risk to the public from plutonium buildings at Rocky Flats Plant is dominated by earthquake and wind events. In view of this conclusion, Buildings 559, 707A, and 779 were structurally upgraded in the late 1980s to withstand the design basis earthquake and wind events. Building 371 was originally designed to withstand the design basis accidents. Most plutonium at Rocky Flats Plant is currently stored in vaults or vault-type rooms which provide greater protection from accidents or natural phenomena events than glovebox storage.

The operational accident scenarios (fires, explosions, spills, criticalities) and natural phenomena events (earthquakes, winds, tornadoes) were reviewed to determine the impact from fires, container pressurization, or more dispersible oxide forms produced by excessive corrosion buildup on metals which have not received adequate inspections or cleanup during storage. The plutonium storage issue represents an inadequacy in terms of the FSAR basis because the frequency of fires may be significantly increased, and because a greater total inventory of dispersible oxide exists. Under severe accident conditions (earthquake), an increase in the amount of oxide could result in an increase in radiological consequences to the public. These preliminary conclusions will be further evaluated based on the final actions developed to implement the Management Plan for Resolution of the Safety Issues Associated with the Storage of Plutonium. This inadequacy of the FSAR basis will be resolved in accordance with the DOE Orders 5000.3B [DOE (92b] and 5480.21 [DOE 89] processes.

The DOE requested a conservative estimate of the impact of more dispersible plutonium oxide on the recent risk assessment of Building 707 thermal stabilization mission. Risk to the public is dominated by a severe accident beyond design basis which could result in the collapse of the building (that is, an event more severe than a new facility would be built to withstand). Several conservative assumptions were made to estimate the total quantity of corrosion compounds (primarily suboxide) that may have formed during metal storage. This was used to estimate an increase in radiological consequences, which ranged from 50% to a factor of ten times (if all metal in the building was assumed to have converted to an oxide—which is an overly conservative, unrealistic assumption). These radiological consequences would not result in any predicted early fatalities, and the dose to an offsite individual would not exceed radiological siting criteria unless the total release increased by a factor of five or more. It is not believed that the current amount of metal has oxidized by this amount. It should be noted that the additional dispersible material due the HSP 31.11 issue is insignificant when compared to the site-wide dispersible material at risk (items such as stabilized oxide, residue, salts, etc.).

There is no imminent risk to the public from the current HSP 31.11 issue because the dominant risk (seismic collapse of the plutonium facilities), is a low probability event. Fire or a container rupture which releases plutonium contamination inside a plutonium facility is a more likely event, but the consequence to the public would be mitigated by vital safety systems, and would not result in a significant consequence to the public.

In the current storage locations, vaults and vault-type rooms, the risk to the worker from plutonium is managed by a low occupancy rate and workplace monitoring such as SAAMs. The dominant risk to the worker occurs during the transport of plutonium metals outside the glovebox system. The probability of a release increases with time due to normal packaging aging and degradation and the consequence increases with time because more dispersible powder is available for release. However, sufficient controls such as glovebox confinement systems, heat sinks, and personnel protective equipment are available to minimize worker risks.

RISK CONSIDERATIONS FOR POSSIBLE OPTIONS

Several options were considered to resolve the storage issue for pyrophoric plutonium and achieve compliance with HSP 31.11. An initial option considered the availability of interim storage capability (e.g., gloveboxes with contact heat detectors, etc.) that would allow immediate unpacking, inspecting, brushing, storing pyrophoric materials, and repacking of clean metal. It was concluded that neither sufficient storage capability was available, or that available equipment, idle since curtailment of plutonium production operations in 1989, may not be readily demonstrated to be operable.

The remaining options focused upon when (i.e., in what sequence) and where the necessary activities should be performed. These activities include:

- Transferring containers from their current storage location in an HVAC Zone I vault or Zone II vault-like room to suitable gloveboxes;
  - Containers in a vault-like room are transferred manually and introduced into the glovebox lines (either directly bagged into a glovebox, or placed into the glovebox line at a ventilation-controlled hood/B-box or other enclosure).
  - Material in shipping containers are usually opened in a Zone II room and then bagged into a glovebox. However, depending on the type of material and packaging configurations, some of the containers could be suspect, and should be opened in a contamination control cell or downdraft room.
- Unpacking the material for inspection;
  - Some material in Zone I vaults are in part carriers, while others are in one or more containers/barriers.
  - Material in Zone II vault-like rooms are in multiple containers/barriers.
- Brushing off any loose powders and metallic flakes, placing the material into a container, transferring it to be weighed or measured for plutonium content, (either within the Zone I glovebox line or bagged out into the Zone II room), and storing the container on contact heat detectors until thermally stabilized;
  - Required calorimetry equipment is not available in all buildings requiring onsite transportation via trucking, or manually transferring through interconnecting passageways.
  - The number of operable contact heat detectors in suitable gloveboxes is limited and would not support the expected quantity to be generated in all buildings.
- Repacking clean bulk metal, transferring it to be weighed or measured for

plutonium content (either within the Zone I glovebox line or bagged out into the Zone II room), and transferring it back to a storage vault;

- Required calorimetry equipment is not available in all buildings requiring onsite transportation via trucking, or manually transporting through interconnecting passageways.

- Vault-like room storage requires bagging out of the glovebox and packaging in additional containers.

- Based on a schedule to prioritize material for thermal stabilization, package and transfer (either manually via inter building passageways or via onsite transportation) pyrophoric material to Building 707;

- After thermal stabilization, transfer to calorimetry (either in Building 707 or Building 771) for plutonium measurement, and ship to Building 371 for storage via onsite transportation.

Time Consideration

The first consideration was how soon do the containers have to be unpacked for inspection, cleaning, and repackaging. It was concluded that leaving the material in its present location until approval for thermal stabilization in Building 707 is granted by DOE (assumed to be July, 1993) would result in the least risk to the workers and public. This conclusion is based on: 1) the belief that the probability of breaching containers (and risks) increases as the number and frequency of material movements increase; and 2) the current vault and vault-like room storage provides greater protection from natural phenomena events.

The assumption that risk increases in proportion to the number of handling steps is supported by the previous incidents within the DOE complex. Container failure due to the volume expansion of the plutonium oxides as they form on the metal has been aggravated during the handling of these containers. The additional mechanical energy due to handling has resulted in the breach of the inner and/or outer containers which resulted in releases of plutonium into the next confinement barrier (i.e., secondary container or Zone I or II atmosphere). Also, should the material be in the form of hydrides, mechanical energy due to handling degraded containers has resulted in spontaneous combustion of the material within the container.

If the outer container was breached, it could result in the release of plutonium into the Zone I or II atmosphere. If release occurred to the Zone II atmosphere, possible exposures of the workers could occur, but there would be no significant release to the environment due to the two stages of HEPA filters. If the release occurred during onsite transportation via trucking, an unfiltered release to the environment could occur (i.e., the On-Site Transportation Manual does not require DOT Type B shipping containers that withstand accident conditions such as a 30-minute fire and 30-foot drop test).

Therefore, risk is minimized by planning the least number of movements, glovebox bag-ins/bag-outs, and verification that the containers have not degraded. The containers will eventually have to be moved from their current storage location, but this should be planned to minimize the number of movements and special precautions when the outer container is opened. It also has the benefit of reducing exposures to the workers during handling and temporary storage which is consistent with the as low as reasonably achievable (ALARA) philosophy.

The RFP plutonium buildings' FSARs (and previous risk assessments such as the Long Range Rocky Flats Utilization Study) show that risk to the public is dominated by lower probability seismic and extreme wind events (that could breach the building structure and overcome vital safety systems which results in an unfiltered release of plutonium to the environment) rather than the higher frequencies of potential fires, explosions, and spills (that would be mitigated by vital safety systems). Currently, most of the pyrophoric powders and flakes are stored in Zone I vaults or Zone II vault-like rooms (with the material in multiple containers) which generally provide greater structural resistance to natural phenomena forces.

If containers were to be immediately unpacked and brushed, the pyrophoric powders would be stored in a single can in a heat-sink container on a contact heat detector in a glovebox until thermally stabilized. This increases risk to the public because more dispersible powders could be impacted by structural debris from natural phenomena forces. Material in the vaults would be better protected, requiring a much greater natural phenomena event to cause a release. Risk to the public will decrease after thermal stabilization when the oxide is stored in Building 371, which was designed to withstand the site-specific design basis earthquake and is stronger than all other buildings at RFP.

Location Considerations

The next consideration was the location that the material would be initially unpacked, inspected, brushed, and repacked. One option was to centralize this activity in one building, such as Building 707. This option however, introduced the increased risk to the public from onsite transportation accidents of containers that may have degraded and also increased risk to the worker by handling these containers that may have degraded. Moving the containers within the building is associated with the least risk to the public because any potential releases to the environment would be confined by the Zone I (4-stage) or Zone II (2-stage) HEPA filters. Moving the containers the shortest distance within the building from where they are currently located, and minimizing the number of handling steps and glovebox operations, also presents the least risk to the worker. Therefore, the initial unpacking, inspecting, brushing, and repacking operations should be performed within the building where the material is currently stored.

If approval to resume limited activities in Building 707 to thermally stabilize this material is not received in the next few months, then the option that would be considered is to unpack, brush, repack the powders, measure, bag-out of the glovebox, and package for shipment to the Building 371 stacker/retriever. This option however, increases risk to the workers and the public but these risks would be minimized by adding more restrictive controls. For example, requiring a DOT Type B shipping container could minimize the potential for releases during onsite transportation from spontaneous fires of the potentially pyrophoric material, or from impact-type accidents (e.g., material handling equipment). Special handling procedures may also be necessary to protect the workers during the packaging and unpacking of shipping containers, and to minimize their exposures from an ALARA viewpoint. The adequacy of the

Building 371 stacker/retriever would also have to be demonstrated. This includes demonstrating that the current elevated temperature of the stacker/retriever will not be increased by the additional pyrophoric powders (also considering the Building 991 SNM Phase II move), verifying that the water-walled storage configuration provides an adequate heat sink to prevent propagation of fires, ensuring the safety for personnel entry (e.g., if maintenance is required), and ensuring the reliability of vital safety functions (e.g., inerting, ventilation, filtration, effluent monitoring, SAAMS, criticality alarms, etc.). Another issue to be resolved is how to comply with the Operational Safety Requirement/Limiting Conditions for Operation Remedial Action requirement if inerting is not maintained.

CONCLUSION

The risk assessment supports the conclusion that there is no imminent risk to the public posed by the current non compliances with HSP 31.11 requirements. From the qualitative risk assessment, it was concluded that: (1) a fire or container rupture releasing plutonium to the inert vault or room vault is a low probability event; and (2) if a release occurred, it would be mitigated by vital safety systems. The quantitative risk assessment for severe accidents beyond design basis concluded that there would be no early fatalities, and dose to an offsite individual would not exceed radiological siting criteria.

There is no imminent risk to the worker because most plutonium is stored in vaults or vault-type rooms with SAAM coverage and minimal worker access.

The prudent course of action is to plan a schedule based upon prioritizing material for inspecting, repacking, and thermally stabilizing the powders and metal fines. However, until Building 707 thermal stabilization is resumed for limited operation, collection and consolidation of a large quantity of potentially pyrophoric plutonium powders from the bulk metals may create greater handling risks than leaving them in their current storage locations.

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APPENDIX C

SAFEGUARDS AND SECURITY WHITE PAPER

MATERIAL CONTROL AND ACCOUNTABILITY

The processing operations defined in this plan must be controlled to ensure that the material is controlled, properly accounted for, measured, and documented to provide the historical record for updating the Safeguards Accountability Network (SAN) inventory data base.

The processing operations will be performed in accordance with approved procedures listed below. The procedures provide instructions for weighing of items prior to and after remediation activities, material transfers, material control, use of Tamper Indicating Devices (TIDs) and for measurements which will be used to update the SAN.

- Nuclear Material Safeguards (NMS) MC-003, Item Weight/Number Discrepancies
- NMS MC-004, Two-Person Rule and Requirements
- NMS MC-008, Accessing Special Nuclear Material (SNM) Vaults and Vault Type Rooms
- NMS MT-004, Use of Nuclear Material and Drum Transfer Reports (NMDTRs)
- NMS MT-005, Nuclear Material Dock to Dock Transfers
- NMS MT-007, Inter/Intra Material Balance Area (MBA) Nuclear Material Transfers
- NMS MT-008, Use of the 771/776 and 777/779 Tunnels for the Movement of Nuclear Material or Equipment
- NMS MT-009, Nuclear Material Transfers between Buildings 707 and 777 via the 778 Guard Post
- NMS SM-002, Non Destructive Assay of Nuclear Materials for Accountability Purposes
- NMS SM-003, Weight Measurements of Nuclear Materials for Accountability Purposes
- NMS TID-003, Use of Tamper-Indicating Devices
- NMS TID-005, Application and Removal of Tamper-Indicating Devices
- NMS TID-006, Tamper-Indicating Devices Discrepancies/Anomalies and Required Response
- *Section* 3.1.3 of the Rocky Flats Inventory Plan for December 1990 Annual Inventory
- 1-63200-NMT-001, Transfer of Nuclear Material Between Material Access Areas

The procedures listed above are approved and are currently being used at the Rocky Flats Plant (RFP). The Material Access Area (MAA), Material Balance Area (MBA), and Material Control and Accountability (MC&A) Plans and Procedures for individual buildings will require updates to incorporate process control limits to be followed during this process. All balances that are to be used in this activity must be qualified, validated, and approved by the Department of Energy/Rocky Flats Office (DOE/RFO) for use.

In addition, the current range on the calorimeter Pu-238 heat source standards is 0.8 to 3.4 watts (300 grams to 1300 grams), which implies that oxide with plutonium content greater than 1300 grams cannot currently be measured. This range of standards will expire at the end of July 1994; without additional heat source standards, no measurement capability will exist for the calorimeter after this date. However, nine heat source standards at Mound Laboratories have been recertified and are awaiting shipment to RFP. These standards will provide a range for the calorimeter of 0.8 to 5.4 watts (300 grams to 2200 grams). This range will be adequate for the oxide containers generated from thermal stabilization.

SAFEGUARDS AND SECURITY

EG&G Safeguards and Security and Wackenhut Services,(WSI) RFP (WSI-RFP) have completed vulnerability assessments (VAs) for all buildings containing Category I and II (SNM) in the current consolidated storage configuration (i.e. all Category I and II discrete items are contained in approved vaults and vault-type rooms). These VAs identified baseline security by building, and included the protection system enhancements necessary to protect SNM inventories against theft and radiological sabotage. The protection system enhancements identified reduced the risk of theft and radiological sabotage to an acceptable level.

The proposed activities outlined for HSP 31.11 remediation could be initiated without affecting the risks identified in the April 1993 edition of the Site Safeguards and Security Plan (SSSP). If process control limits were initiated, which would limit the quantity of SNM in the process line in each building to less than Category I or roll up to Category I amounts, theft targets would be limited to those already analyzed in the SSSP. No change in the security envelope would occur and no additional analysis would be required. The following SNM limits have been established, which, if followed, will not require additional Safeguards and Security protection measures:

1. The total inventory of oxide within any MAA outside of vaults and/or vault-type rooms at any time must be less than 6 kg (i.e., in Building 771, cans of oxide in the calorimeters must be totalled with the oxide in the glovebox line to determine compliance with the 6 kg limit.)

2. The total inventory of metal outside an approved storage location within the entire MAA cannot exceed 2 kg.

   - Once the brushing operation is complete, the metal shall be repackaged and restored in a vault or a vault-type room.

   - Unstable oxide generated from the brushing operation can be stored in the Building 371 stacker/retriever (an in line vault-type room) and will not count against the 6 kg MAA limit. If stored in the glovebox line on heat detection, the freshly brushed oxide will be counted toward the 6 kg limit.

Any change to the established process control limits or to the current storage configuration, analyzed as a result of the SSSP process, will require a re-evaluation of the potential security risk associated with removal of Category I and II items (which increase the roll-up outside the vault/vault type room (VTR) to Category I) from approved storage locations. Prior to the removal of SNM from approved inline and/or out of line storage areas, and prior to the initiation of HSP 31.11 remediation activities, the following actions must be completed:

1. Building-specific plans for remediation of HSP 31.11 storage issues must identify the proposed quantity of SNM to be removed from approved vaults/VTRs, the location within the MAA where the remediation process will take place, and the procedures to be used to perform the operations.

2. The information identified above must then be compared with the completed VAs and, if necessary, a new VA must be performed to identify the security system enhancement requirements necessary to maintain the security risk at an acceptable level.

3. The new security system requirements, identified as enhancements as a result of the re-evaluation of the risk, may necessitate revision to EG&G building operations procedures/security plans and WSI procedures and orders. The new requirements may also mandate additional manpower resources from both EG&G and WSI to adequately protect the SNM during HSP 31.11 remediation activities.

4. When procedures, security plans, and orders have been revised, training of EG&G and WSI personnel involved in the HSP 31.11 remediation activities must be completed prior to initiation of those activities.

5. The Security Emergency Response Plan (SERP) study, which is currently in progress, must be completed prior to the brushing of Category I items. The results of the SERP study will aid in the protection of SNM and may reduce the Safeguards and Security requirements for each individual building during the HSP 31.11 remediation.

VULNERABILITY ASSESSMENT SCHEDULE

Security Operations Administration (SOA) has compiled schedules and related assumptions concerning the initiation and completion of limited VAs for Buildings 371, 707, 771, 776/777, and 779 in support of HSP 31.11 remediation activities. The start date for each VA schedule is dependent on information developed as part of building-specific implementation plans.

ASSUMPTIONS

- The schedules, as provided in Appendix D, are for each individual building and are predicated upon full involvement. Any deviation in resource commitment, alteration in the proposed HSP 31.11 remediation activities, or identified flaws in the documentation request will extend the analysis time.

- The information required to analyze the identified process and its associated risk must be complete prior to the initiation of the table top analysis.
- All work by SOA in support of other activities not connected to HSP 31.11 remediation activities will be postponed until the summary vulnerability analysis report (VAR) is published.
- The schedule and resulting resource impact on SOA will only support the analysis of three buildings in parallel at one time.

INFORMATION REQUIRED FOR ANALYSIS

- Draft building operations procedures and plans associated with HSP 31.11 remediation activities detailing process flow and activities.
- Process locations within the building to include proposed glovebox locations and interim storage locations for unstable oxide accumulated during HSP 31.11 remediation activities.
- Lists of items to be processed to include item description codes (IDCs), number of items per IDC, net gram weights, SNM weights, packaging configuration, Category, and Attractiveness Level.
- Numbers and job classifications of personnel directly involved in HSP 31.11 remediation activities.
- HSP 31.11 remediation activities schedules to include total project duration and daily work schedule duration.

APPENDIX D

SEPARATE DELIVERABLES

Number	Updated Section Title		Date
4.3	Packaging Plan		7/1/93
4.6	ALARA Plan		8/16/93
4.7	Waste Management White Paper		7/30/93
6.0	Inspection Plan		6/30/93
6.2	Root Cause Analysis		6/30/93
6.5	Recurrence Control Plan		7/12/93
7.	Readiness Evaluation Plan		6/15/93
8.1	Site Support Implementation Plan		6/30/93
8.2	Building Implementation Plans		7/16/93
	707		7/16/93
	771		7/16/93
	776/777		7/16/93
	779		6/26/93
	371		7/16/93
9.	FY93 Work Package		
	Revision 1		7/23/93
Appendix C	Safeguards and Security White Paper		
	Vulnerability Assessment (VA)	Compensatory	(VA)
	707	8/2/93	9/14/93
	771	8/2/93	8/27/93
	776/777	8/17/93	9/24/93
	779	5/31/93	5/31/93
	371	8/2/93	8/27/93

APPENDIX E

DEFINITION OF TERMS

1. CATEGORY I & II SPECIAL NUCLEAR MATERIAL

   A measure of attractiveness and quantity used to establish safeguards and security protection requirements. Refer to DOE Order 5633.3A for a complete discussion.

2. CENTRAL ALARM STATION

   A central location, Building 121, where fire and security alarms report electronically.

3. CLAM SHELLS

   A container used to hold a 1-4 liter plastic jug.

4. CONTAINER

   A container can have several meanings with respect to the nuclear material inventory at Rocky Flats Plant (RFP). The following are the most common examples of containers:

   (a) The innermost can containing the nuclear material, in which the nuclear material is in direct contact with the inside of the can.

   (b) A secondary can containing an inner can which contains the nuclear material. This can essentially serves as the secondary containment for purposes of transfer and storage outside of a glovebox system. This type of container can also be used to collect many items within a glovebox system (i.e., milliliter sample vials)

   (c) White 55-gallon drums used to collect process waste which is removed from glovebox systems in a plastic bag. They can also be used as a collection container for storing individual smaller items as listed in (1) and (2).

   (d) Ten-gallon cans used to transfer and store up to two smaller cans as described in (18) outside the glovebox system.

   (e) Tanks used to collect process solution. This can be either process waste or high level process residues.

5. CREATE DATE

   The date when material becomes identifiable, can be put into a container and weighed, can be assigned an accountability number, and is first entered into the nuclear material accountability system (SAN). Oxide brushed from plutonium metal and collected in a can becomes an identifiable, accountable item, the day it is collected in the can.

6. ELEMENT WEIGHT

The isotopic weight of the special nuclear material. In the case of this analysis, it is the actual weight of the plutonium contained within the net weight of the material.

7. ELEMENTAL COMPOSITION

These are a set of numeric codes which reveal the isotopic composition of items listed in the nuclear material accountability system (SAN). The element code for plutonium is 52.

8. ENGINEERING JUDGEMENT

Opinion of engineers who have worked at RFP have both technical expertise and operational experience, and are considered to be resident experts for making decisions relative to processing, packaging, and compliance with HSP 31.11.

9. ER UPDATE

A bi-monthly publication by the EG&G Rocky Flats Communications department.

10. INERT ATMOSPHERE

A nitrogen atmosphere with less than 5% oxygen by volume.

11. INLINE

Locations inside glovebox systems within Material Access Areas at RFP. This includes all locations regardless of whether or not the location is monitored by a heat head.

12. ITEMS

For purposes of this plan, an item is defined as each individual listing as it appears in the Safeguards Accountability Network (SAN). For inline items, an item equates to a container. For items outside the line, it is the immediate outermost container which is free from contamination. The majority of items outside the line also equate to containers. However, for storage efficiency, these items may be consolidated into another outermost container.

Better than 90% of these items fall into the following three categories:

(a) Two items may be stored in a 10-gallon drum; however they are listed in SAN as two individual items as defined above.

(b) Up to 14 ER Salts may be stored in a white 55-gallon drum, in which case it is carried as one item in the SAN.

(c) Several small milliliter-size sample vials collected and stored in a larger container within a glovebox system may be carried as one item.

13. ITEM DESCRIPTION CODES (IDC)

This is a three position alpha numeric code which refers to a discrete form of accountable material carried in the SAN inventory database.

14. LEAN RESIDUES

Any residue stored in a white 55-gallon drum, such as incinerator ash, salts, sand, slag, and crucible.

15. LOBSTER POT

A pressure cooker-like container without a pressure valve primarily used to store parts.

16. MATERIAL BALANCE AREA

A geographic area within a Material Access Area around which a material balance can be obtained for nuclear material accountability.

17. NET WEIGHT

The total weight of an item, including all impurities.

18. OUT OF LINE

Locations outside glovebox systems within Material Access Areas at RFP.

19. PRESSURE COOKER

A sealed, heavy-duty container with a pressure valve primarily used to store plutonium parts.

20. PRODUCE CAN

Commercially available, standard food-pack (tin or aluminum) with a mechanically sealed lid.

21. SHOE BOX

A stainless steel pan with a lid.

22. THERMAL STABILIZATION

To heat plutonium oxide in a furnace in the presence of oxygen for the purpose of complete oxidation.

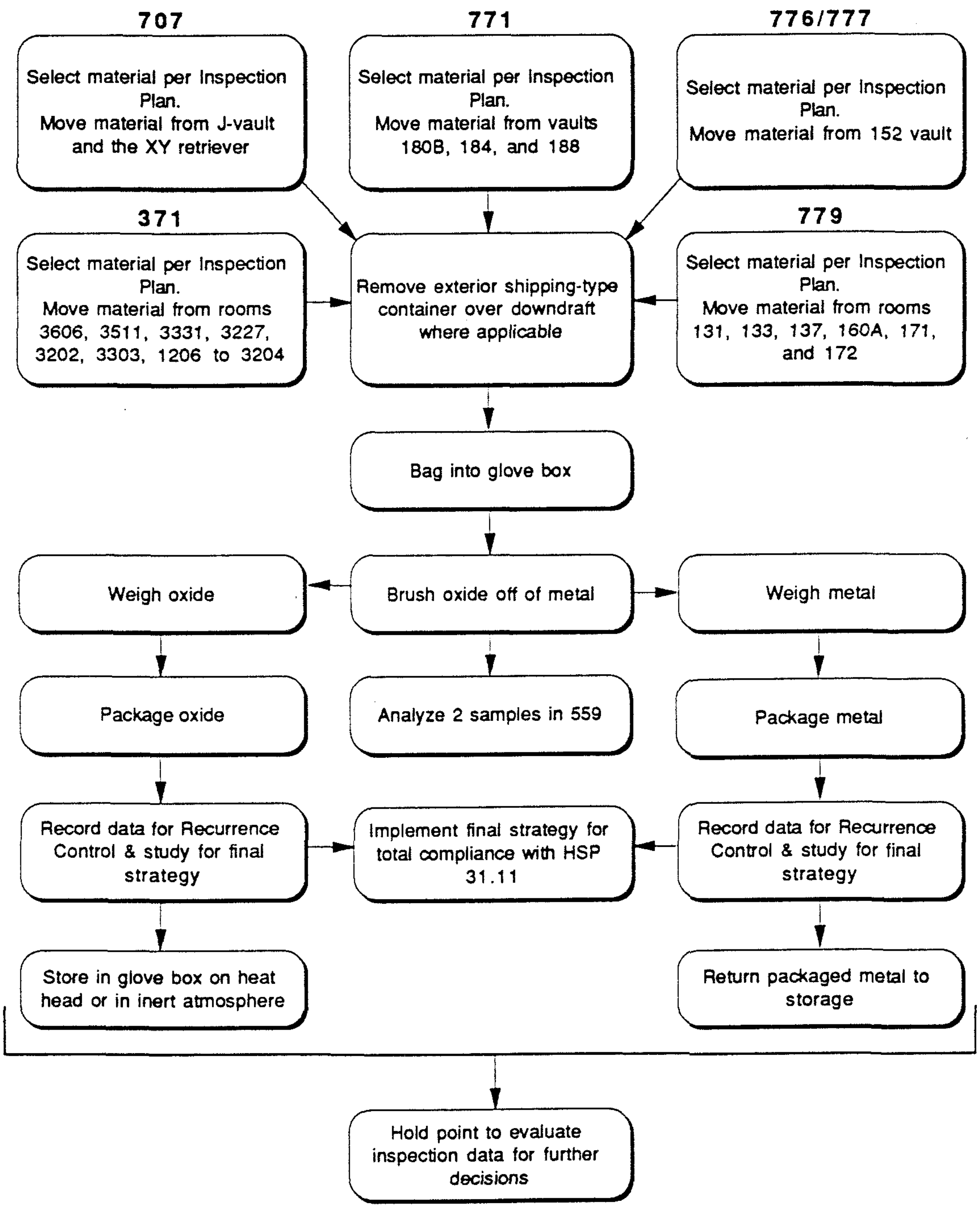
23. UNSEALED UNITS

New production, special order, test, or site-return units that are not sealed by welding, have been punctured for test purposes, or whose welds have been cut.

APPENDIX F

FLOW CHARTS

HSP 31.11 Compliance
Inspection Plan
General Site Flow Chart



HSP 31.11 Compliance

Overall Planning Flow Chart