Department of Energy
Washington, DC 20585

April 12, 1999

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, N.W.
Suite 700
Washington, D.C. 20004

Dear John Chairman:

With this letter I am pleased to report on-schedule completion of several of the commitments found in the Department's 94-1 Implementation Plan. Closure packages for those commitments, as described in the Department's interface manual, Interface with the Defense Nuclear Facilities Safety Board (DOE M 140,1-1 A), are enclosed. The following commitments are proposed for closure:

107 Initiate oxide/MOX>50% stabilization - RL, Jan. 1999
112 Identify approach for ash stabilization - RL, Jan. 1999
101 Complete off-site transfer study - RL, Feb. 1999
102 Complete categorization of plutonium solutions - RL, Feb. 1999
103 Complete options analysis regarding magnesium oxide precipitation of plutonium solutions - RL, Feb. 1999
108 Complete analysis of use of Hanford Convenience Can as part of plutonium repackaging - RL, Feb. 1999
109 Complete options analysis for storage of unalloyed plutonium metal - RL, Feb. 1999
308 Complete characterization of specified residues - RF, Feb. 1999
309 Complete stabilizing ion exchange resins - RF, Mar. 1999

We continue to closely track progress on all Recommendation 94-1 commitments and will keep you and your staff apprised of our progress. If you have any questions, please contact me or have your staff callmeon(202)586-515 1.

Sincerely,

David G. Huizenga
Acting Deputy Assistant Secretary for
Nuclear Materials and Facility Stabilization
Office of Environmental Management

Enclosures

cc w/ enclosures:
M. Whitaker, S-3. 1

RL-F-1325.6 (02/98)

(137)

United States Government **Department of Energy**

memorandum

Richland Operations Office

DATE: JAN 141999

REPLY TO ATTN OF: TPD:LDR/99-TPD-077

SUBJECT DECLARATION OF READINESS TO RESUME PLUTONIUM FINISHING PLANT (PFP) THERMAL STABILIZATION

To: James C. Hall
Acting Manager

In accordance with DOE Order 425.1, "Startup and Restart of Nuclear Facilities," all necessary preparations have been made to ensure that PFP thermal stabilization of high purity plutonium (Product) oxides can be operated safely. AMF and PAD have verified successful closure of all prestart findings identified during the DOE Operational Readiness Review conducted on the thermal stabilization Product oxide activities. Therefore, it is recommended that FDH and BWHC be granted authorization to resume operations of the thermal stabilization activities through, but not beyond Hold Point 5 as set forth in FDH letter, L. J. Olguin to L. D, Romine, "Plutonium Finishing Plant Restart Plan **Revision,"** (FDH-9858642 **R3),** dated December 28, 1998.

Consistent with the recommendation in "Final Report for the Operational Readiness Review of the Plutonium Finishing Plant, Thermal Stabilization Operations at **Hanford," dated** December 24, 1998, AMF has verified closure of all contractor prestart findings with the concurrence **of** the Performance Assessment Division (PAD). In **addition,** PAD has verified **closure** of all RL prestart findings.

RL oversight of thermal stabilization activities will be conducted in accordance with the enclosed *DOE-RL Restart Plan for Plutonium Oxide Thermal Stab ilization at the Plutonium Finishing Plant Restart Phases 1-4*, dated January 14, 1999. Authorization is not **yet** recommended for thermal stabilization of feed materials other than Product oxides, pending successful closure of poststart findings DOE3- 1, OP 1-1, OP2- 1, and TQ1 -1.

In addition, the facility contractor will no longer be required to submit Management Oversight Plans for fissile material movements to RL Transition Program Division. This will enable the Facility Representatives to return to required Facility Representative Program oversight.

Peter M. Knollmeyer, Assistant Manager
for Facility Transition

Gerald M. Bell, Director
Performance Assessment Division

Enclosure

cc w/o encl:
R. C. Sorensen, EH-24

(112)

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

9950712
DC ISSUE: 02/01/99

99-TPD-094

FEB 1 1999

Mr. R. D. Hanson, President
Fluor Daniel Hanford, Inc.
Richland, Washington 99352

Dear Mr. Hanson:

CONTRACTOR NO. DE-AC06-96RL13200 - ALTERNATIVE ANALYSIS FOR DISPOSITION OF ASH RESIDUES

RL staff have reviewed the subject alternative analysis provided by BWHC letter, Arthur Clark to L. J. Olguin, same subject, dated January 29, 1999. The analysis recommends the pipe over-pack (similar to Rocky Flats "pipe and go") alternative for the baseline technical approach for ash residue disposition at PFP in lieu of cementation. For my conversation with Mr. Olguin of your staff, FDH supports this recommendation.

RL concurs with the analysis results that the pipe over-pack option has significant potential benefits and that the technical baseline includes pipe over-pack as the approach for ash residues.

RL also recommends that FDH consider this option for other PFP plutonium residues; however, the cementation option (used for other residue materials) will be retained as a back-up approach in the event the enabling assumptions prove to be false and prevent the use of pipe over-pack.

If any direction is provided to you by a Contracting Officer's Representative (COR) which your company believes exceeds the COR's authority, you are to immediately notify the Contracting Officer and request clarification prior to complying with the direction.

If you have any questions, please contact Mark R. Hulq of my staff, on (509) 373-9872.

Sincerely,

Larry Romine, Director
Transition Program Division

TPD:MRH

cc: A. Clark, BWHC
J. C Sinclair, BWHC
R. Martinez, FDH
L. J. Olguin, FDH

B&W Hanford Company
a McDermott company

P.O. 801 1200
Richland, WA 99352
(S09) 372-8100
Fax: (S09) 372-8131

January 29, 1999

BWHC-9950679

Mr. L. J. Olguin, Project Manager
Facility Stabilization Project
Fluor Daniel Hanford, Inc. L5-65
Post Office Box 1000
Richland, Washington 99352-1000

Dear Mr. Olguin:

CONTRACT NO. DE-AC06-96RL1 3200- ALTERNATIVE ANALYSIS FOR DISPOSITION OF ASH RESIDUES

Please find attached, a summary of the decision process and results for evaluating the pipe overpack option, referred to as the "Pipe and Go" alternative, for disposition of the residual Plutonium ash material currently stored at the Plutonium Finishing Plant in lieu of cementation. Upon evaluation, we have concluded that the pipe overpack alternative has significant potential benefits and few drawbacks. Therefore we have identified this disposition path as the new technical baseline for ash disposition and will utilize this approach in the Plutonium Finishing Plant rebaselining efforts currently underway.

This alternative evaluation and decision is the first of several committed to in the December 1998 update of the 'Department of Energy Revised Implementation Plan for the Defense Nuclear Facilities Safety Board Recommendation 94-1", Additional evaluations are currently under-way which will also bc used in the rebaselining effort due to be complete in April of this year.

If you have any questions on thins matter, please contact J. C. Sinclair at 373-73S3.

Sincerely,

Arthur Clark
President and General Manager

sms

Attachment

BWHC-9950679

ATTACHMENT

Alternative Analysis for Disposition
Of Ash Residues

Consisting of 18 pages,
including cover page

PFP DNFSB Implementation Plan
Decision Analysis Results for
"Pipe-and-Go" versus Cementation for Pu Ash Materials

Introduction:
The DNFSB 94-1 Implementation Plan (IP) update submitted in December 1999 identified a decision point for re-evaluation of the material disposition plan for Pu ash materials currently stored at PFP. The baseline at that time identified cementation of the 980 kgs of ash materials as the disposition path for processing. The cemented ash was to be shipped to the Hanford Central Waste Complex (CWC) for interim management prior to packaging into TRUPACTs for shipment to WIPP. The alternative disposition path identified for consideration would utilize a pipe-overpack configuration currently being used by RFETS for disposition of their Pu ash materials, commonly refered to as "Pipe-and-Go". This method of material disposition would require repackaging of the ash materials into the pipe overpack without cementation. It would then be stored on site until packaged into TRUPACT containers and shipped to WIPP. Either method of processing will require conformance with the WIPP-Waste Acceptance Criteria (WIPP/WAC) in order to meet the commitments of the DNFSB 94-1 recommendations

A contract was established with SAIC in late December 1998 to perform an analysis of the two options with assistance from the Hanford Plutonium "Critical Mass " group and PFP Project personnel. The results from this analysis were presented to a cross-section of personnel representing BWHC, DOE-RL and FDH on 1/28/99. This group then utilized a Kepner-Tregoe options analysis to evaluate the Pros and Cons of both methods of Pu ash disposition in order to formulate a recommendation for the processing of ash materials at PFP. This analysis identified the "Pipe-and-Go" method of material disposition as the preferred approach. On this basis, the "Pipe-and-go" approach will be utilized as the revised baseline for Pu ash disposition, and actions will be initiated to implement this processing methodology at PFP. Additionally, consideration of this method of materials disposition will be considered where appropriate for other PFP materials.

SAIC Technical Evaluation:
The SAIC approach to the technical evaluation of Pipe-and-go versus cementation at PFP included evaluation of data available from RFETS, and reviews with Hanford waste management, Safeguards and Security, and PFP technical, shipping, and Project personnel. Additionally SAIC and PFP personnel visited RFETS the week of 1/13/99 to examine container hardware, walk through the RFETS process, and hold a question and answer session with the RFETS contractor and DOE staff. Information gathered from these evaluations was developed to support a draft report of the technical, cost, safety, and schedule issues. This draft report was summarized in a presentation to assist with the decision analysis (Attached). The conclusions from this summary included:

- "Pipe-and-Go" is viable and cost effective option for PFP Pu ash materials
- ROM cost savings for Hanford are estimated to be approximately $4M
- Both processes are similar with respect to schedule
- Some "Pipe-and-go" implementation costs with be experienced with implementation
- Issues with the Pu ash material disposition to WIPP are common to both processing approaches
- Maximum benefit of the "pipe-and-go" process assumes that substantial gains can be realized by obtaining assistance/documentation from RFETS

One of the major benefits of Pipe-and-go involves the ability to ship greater amounts of Pu in single TRUPACTS (2800 gms versus 380gms) thus reducing the number of shipments to WIPP from 89 to 11 trips. Although the cost savings (estimated to be approximately $4M) do not directly benefit PFP, they do represent a cost savings to the U.S. Department of Energy. The simplicity of the pipe-and-go process results in reduced manhours at PFP, offsetting the cost of the specialized containers ($1800 each). Additionally, the Pipe-and-go methods appear to improve safety at PFP through reduced handling, radiation

dose, and glovebox processing, and reduces technical concerns associated with WIPP acceptance and characterization requirements for cementation.

The most significant drawback for PFP appears to be the potential need to store the Pipe-and-go drums within a protected area prior to loading into TRUPACs. This may require storage at PFP and additional coordination with Waste Management Hanford prior to shipment to WIPP. Additionally, Security Termination Limits (STL) variances will be required, and EIS revisions/updates may be required. These Pipe-and-go implementation costs at PFP are also offset by the reduced processing requirements, and should benefit from extraction of the available RFETS implementation information, including WIPP acceptance agreements.

Kepner-Tregoe Options Analysis:
On 1/28/99, a cross section of ten personnel representing BWHC, DOE-RL, and SAIC participated in a Kepner-Tregoe options analysis established for resolution of the DNFSB 94-1 decision commitments (attached). This analysis evaluated the Pipe-and-go versus cementation processes for Pu ash disposition by consideration of cost, schedule, technical risk, safety, and programmatic attributes. Results of the evaluations were determined by allowing each participant to assign weighting to each attribute, and then scoring the pro/cons of each processing method within these attributes. A summary of this approach indicated a preference of the Pipe-and-go approach by a total score of 128 to 95. Additionally, the scores indicated that the pipe-and-go method of processing was superior in each of the attribute categories, although the standard deviation statistics indicated that several of the attributes for comparison were statistically not different.

Conclusions:

1) The Pipe-and-go processing approach for Pu ash disposition at PFP is recommended to replace cementation as the technical baseline.
2) Several actions to support this approach should be addressed during the PFP rebaselining effort, and
3) Pipe-and-go should be considered for application to other PFP materials including Sand, slag and crucible residues, low Pu content oxides, and low Pu content oxides created during solutions processing

Pipe and Go Attendance January 28, 1999

Mark Hahn	RL
Dwayne Speer	BWHC
Richard Hoyt	BWHC
Lou Rodgers	SAIC
Roy Barker	SAIC
Joseph Teal	SAIC
Bill Peiffer	BWHC
Dennis Schmit	SAIC
Rick Martinez	FDH/PEC
John Sinclair	BWHC
Allison Wright	RL
Joe Cruz	SAIC
Dave Lini	SAIC

Rocky Flats Field Office Weekly Report
March 3, 1999

I. Manager's Schedule

Name: Jessie Roberson, Rocky Flats Field Office
Event: Introductory meeting with Jane Norton, new director of' the Colorado Department of Public Health and Environment
Location: Denver, CO
Date: March 10, 1999

II. Key Departmental News

III. Work on Secretarial Initiatives

Year 2000

Headquarters Help Needed (Rocky Flats): The Rocky Flats Field Office (RFFO) needs an additional $2.85 million in FY99 Y2K funding to continue acceleration of non-mission critical systems implementation. RFFO sent a formal request to EM-1 on January 28. EM provided $150K in the February financial plan, but has advised us that's all the FY99 Y2K funding available within EM. RFFO will now request funding relief directly from the CIO.

RFFO submitted an incentive plan to EM-64 January 15 requesting $350K incentive program funding for Rocky Flats Y2K workers. Although EM endorsed our plan, no final approval or funding has been provided. The Site has already started losing critical skilled Y2K workers. Last week we lost the manager and a staff member from the telecommunications team and a member of the test team in the Y2K Testing Center. Workers in these areas are continuing to receive recruitment calls daily offering from $50-$75 an hour for similar positions elsewhere. Urgent HQ action is needed to approve our Plan and fund it if it is *to* have any effect.

Accelerated Closure of Sites

Defense Nuclear Facilities Safety Board 94-1 Residue Milestone Completion (Rocky Flats): The milestone to complete the characterization of specified salts, combustibles, and item description code 368 to a 95% confidence level that no more thin-t 5% of the material would exhibit a high-risk hazard was met on February 24. The data generated from the sampling analysis is being evaluated, and several reports will be written hy the end of April to document the conclusions and results.

Building 729 Stack Removed (Rocky Flats): The steel stack associated with Building 729 was removed February 28 without incident. The stack will how be surveyed for radiological contamination and when confirmed clean it will be cut (o ribbons and the steel recycled as scrap.

Trench 1 (Rocky Flats): The Trench 1 excavation has been backfilled. Mounding of excess soil and grading of the area is expected to be completed early this week. The containment structure is to be reestablished to allow packaging of uranium hydride samples and of laboratory samples returned from Building 559..

Waste Isolation Pilot Project/Environmental Protection Agency (WIPP/EPA) Recertification Audit of Debris Transuranic Wastes (Rocky Flats): A combined WIPP/EPA team audit of Rocky Flats Environmental Technology Site debris is being conducted the week of March 1 for the purpose of annual recertification.

Iv. **Press Inquiries**

V. FOIA Requests

w . Grants, **Economic Announcements and Publication**

VII. Climate Change

VIII. Disaster Assistance

Jessie Roberson

Jessie M. Roberson
Manager

Rocky Flats Field Office **Week I y Report**
February 17, 1999

1. Manager's Schedule

Name: Jessie Roberson, Rocky Flats Field Office
Event: Initial meeting of the Rocky Flats Coalition of Local Governments
Location: Broomfield, CO
Date: February 25, 1999
Purpose: Courtesy visit with new Rocky Flats community **reuse organization**

Name: Jessie Roberson, Rocky Flats Field Office
Event: Introductory meeting with Jane Norton, new director of the Colorado Department of Public Health and Environment
Location: Denver, CO
Dale: March 10.1999

II. Key Departmental News

III. Work on Secretarial Initiatives

Year 2000

Year **2000 Funding Request** (Rocky Flats): Rocky Flats is in critical need of an additional $3M fiscal year 1999 Y2K funding in the next few weeks in order to maintain the momentum already achieved in accelerating implementation of all the Rocky Flats mission critical systems. A formal request was sent to EM-1 on January 28 justifying this need. Failure to provide this funding will have an unacceptable impact on the site closure activity schedules.

Accelerated Closure of Sites

Building 779 Decommissioning (Rocky Flats): One glovebox was removed in the last week bringing the total removed to 122 out of 134. Building 729 stripout is continuing with more than half of the' first stage **and** the heat chamber **of** the **zone 1** system **removed.** The **zone** 2 plenum and associated ducting are almost completely removed. A demolition date for Building 729 of the middle of March is realistic.

Building 771 Decommissioning Activities and Material Access A rea Closure Progress week of February 8 (Rocky Flats): Significant progress was made in the Room 184 Vault. The shield water was drained from all of the shielded storage containers, and all of the storage containers are removes.1 from the upper level storage area. Seventeen 55-gallon plastic drums of shield water are being held in plastic drums until the shield water is sampled. Equipment disassembly continued in Room 179.

Good progress was made with special nuclear material removal activities. Five of the 37 glovebox remediation locations were completed. By the end of February, the project is expected to be on schedule to support material access area closure in September.

Building 774 **Bottlebox Progress (Rocky Flats):** The last residue resin bottle was received from Building 371 the week of February 8. The final one of six batches of cement necessary to cement the residue resins was completed February 15. This accomplishes the Defense Facilities Nuclear Safety Board 94-1 milestone *for* stabilizing the residue resins by March 1999.

Fiscal Year 1999 Special **Nuclear Materials Shipments Status Against 2010 Baseline (Rocky Flats)**

Type	**Planned (FY)**	*Shipped*
Shipments of former War Reserve pits to Pantex	12	6
Shipments of HEU to Y-12	25	4
Sand, Slag & Crucible to SRS	2s	2

Iv. **Press Inquiries**

v. **FOIA Requests**

Request **for contracts and health and safety documents (Rocky** Flats): Rocky Flats received an attorney's request on February 11 for a copy of all the operating contracts at the site since it begun operations. Also requested were all of the policies and DOE Orders relating to health, safety, and industrial hygiene, as well as site surveys of health, safety, and industrial hygiene conducted by DOE and its predecessor agencies.

VI. Grants, Economic Announcements and Publication

VII. Climate Change

VIII. Disaster Assistance

Jessie M. Roberson
Manager

RL-F-1325.6 (02/98)

X

United States Government **Department of Energy**

memorandum

Richland Operations Office

DATE: MAR 31 1999

REPLY TO ATTN OF: TPD:MRH/99-TPD- 144

SUBJECT. PLUTONIUM FINISHING PLANT (PFP) COMPLETION OF DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB) RECOMMENDATION 94-1 IMPLEMENTATION PLAN (1P) REVISION 1 NEAR-TERM COMMITMENTS

TO: David G. Huizenga
Acting Deputy Assistant Secretary
for Nuclear Material and Facility
Stabilization, HQ, EM-60

All decisions and actions necessary to close the DNFSB Recommendation 94-1 1P Revision 1 near-term commitments have been completed. DNFSB Recommendation 94-1 Revision 1 identified six near-term commitments to be completed by February 1999, as a strategy to show interim progress in development of a high confidence baseline for plutonium stabilization activities at PFP. The commitment analysis decisions will be used to support the development of the rebaselining effort to be completed in April 1999. Attachments 1 and 2 provide concurrence of completion by the responsible manager for these commitments. These commitments are summarized as follows:

1P Number	Title Summary	Due Date
101	Complete Optimization Study for Shipping/Processing Offsite The study concluded that: 1) Processing of the poly-cubes should be completed at PFP in lieu of Pacific Northwest National Laboratory, 2) Plutonium (Pu)/aluminum alloys and fluorides should be shipped to SR for processing and final disposition, and 3) A select quantity of sand, slag and crucible should be shipped to SR for processing and final disposition, with the remainder to be stabilized at PFP.	February 1999
102	Complete Categorization of Pu Solutions	February 1999

	PFP has completed categorization efforts to identify those Pu solutions which demonstrate attributes that will allow disposition through processes not identified in the original technical baseline, and allow earlier mitigation of the hazards associated with these materials	
103	Complete Options Analysis of Vertical Denigration Calciner (VDC)/Ion Exchange (IX) Versus Magnesium Hydroxide (MgOH) Precipitation The analysis concluded that MgOH precipitation process will be used in lieu of VDC and IX for impure (those solutions which require pretreatment before they could be processed in the VDC) solution stabilization.	February 1999
108	Complete Options Analysis of Pu Packaging Hanford Convenience Cans (HCC) Versus Bagless Transfer System (BTS) The analysis has determined that both packaging options be pursued. The BTS-type system will be installed at PFP, and this system will require use of an HCC-type convenience container when implemented.	February 1999
109	Complete Options Analysis of Metal Oxidation Versus Brushing The analysis concluded that metal should be brushed and repackaged in lieu of being thermally stabilized.	February 1999
112	Complete Options Analysis of Ash Cementation Versus Pipe and Go The analysis concluded that the Pipe and Go (similar to Rocky Flats pipe over pack) option should be used for all ash residues and considered for other residues.	January 1999

Additionally, Attachment 3 provides detailed supporting documentation for each of the IP commitments for development of the commitment closure packages.

If you have any questions, please call me, or your staff may call Larry Romine, Transition Program Division Director, on (509) 376-4747.

Peter M. Knollmeyer, Assistant Manager
for Facility Transition

Attachments

cc w/attach:
A. Arango, S-3,1
C. A. Peabody, EM-4
J. S. Purvis, EM-65
C. J. Sink, Jr., EM-66

cc w/o attach:
A. Clark, BWHC
J. C. Sinclair. BWHC
L. J. Olguin. FDH

B&W Hanford Company

a McDermott company

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February 26, 1999

BWHC-9951296

Mr. P M Knollmeyer, Assistant Manager
Facility Transition
U.S. Department of Energy
Richland Operations Office
Richland, Washington 99301

Dear Mr. Knollmeyer

CONTRACT NO. DE-AC06-96RL13200 – CLOSURE OF PLUTONIUM FINISHING PLANT FEBRUARY 1999 NEAR-TERM COMMITMENTS IN THE IMPLEMENTATION PLAN FOR DEFENSE NUCLEAR FACILITIES SAFETY BOARD RECOMMENDATION 94-1 (REVISION 1)

The B&W Hanford Company (BWHC), in partnership with Fluor Daniel Hanford, Inc. (FDH), the U.S. Department of Energy (DOE), Richland Operation Office (RL), and DOE-Headquarters (HQ), has completed decisions and actions, outlined below, necessary to close all February 1999 commitments identified in the December 1998 Revision 1 of the *Implementation Plan (IP) for Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-1*.

During November 1998, efforts to build an integrated resource-loaded schedule for Plutonium Finishing Plant (PFP) identified various options to optimize disposition of the 94-1 plutonium (Pu) materials. These options required further technical and/or programmatic analysis to achieve a sound path forward to enhance our ability to complete the facilities material disposition mission with a high confidence schedule. Consequently, these options were identified as near-term commitments in Revision 1 to the IP. The commitment resolution process was initiated with development of viable alternatives. Each of these alternatives was then evaluated through trade studies, technical evaluation, and/or cost and schedule analyses. This information was provided to a multi-disciplined team of personnel with technical and programmatic expertise from a cross-section of the contractors and DOE, frequently utilizing recognized industry resources, for decision analysis. This analysis evaluated the information provided through a structured, multi-attribute Kepner-Tregoe (K-T) process to arrive at a recommended path forward for each decision. The recommended path forward was presented to the PFP Quartet and then to the Hanford Facility Transition Board of Directors for approval. These decisions will shape the technical baseline established to the PFP; however, PFP will continue to seek opportunities to accelerate completion of DNFSB 94-1 materials, and facility deactivation.

Note: A description of the attributes utilized for the K-T analyses (Attachment 1), and additional information on each commitment resolution is attached.

Commitment # 101, IP Appendix D (Attachment 2)
Commitment Statement: "Complete a programmatic optimization study for the shipping and/or processing of materials at alternate sites"
Section 5.4.1:
"PFP will complete a programmatic optimization study, identifying NEPA and Regulatory requirements, for shipping and/or processing of select 94-1 materials at alternate sites, e.g. polycubes, plutonium-aluminum alloys, fluorides, etc. This study will identify opportunities to accelerate the mitigation of hazards/concerns for continued storage of un-stabilized plutonium materials at PFP through utilization of current capabilities at other DOE sites. The study will be documented as a disposition plan and will identify ultimate disposition approaches necessary to meet DOE-STD-3013 criteria"

Deliverable:
PFP has completed an analysis of options for shipping select 94-1 Pu materials in their current forms to alternate sites for processing and/or final disposition. The primary focus of this process was to determine the path forward for disposition of Pu polycubes and Pu sand, slag and crucible (SS&C) materials. In addition, the Center for Risk Excellence (CRE) was utilized for review and critique of this analysis.

It concluded that:

1. Select SS&C (nominally 288 items) will be shipped to Savannah River Site (SRS) for stabilization and final disposition. The exact quantity of SS&C material that will be shipped to SRS will require an optimization study, determination of timing for PFP's ability to ship this material, and improved information with respect to the SRS SS&C processing schedule. However, The K-T process indicated that there was not a significant preference in alternatives evaluated (including: Processing all materials at PFP, and processing all material at SRS).

   Advantages:
   - Offers the most flexibility to optimize PFP and SRS resource utilization
   - The ability to integrate processing of SS&C at SRS without impact to their schedule and overall cost

2. Pu Polycubes be processed at PFP as opposed to processing at Los Alamos National Laboratory (LANL) or Pacific Northwest National Laboratory (PNNL).

   Advantages:
   - Significant avoidance of Programmatic risks associated with Regulatory and stakeholder concerns
   - Shorter schedules (approximately 1 year) for completion of stabilization

- Eliminates shipping uncertainties and associated costs and logistical issues
- Eliminates labor contract uncertainties

3. Pu alloys and fluorides will be shipped to the SRS for stabilization and final disposition. Recommendations for this decision were established during the November 1999 workshops.

   Advantage:
   - Eliminates the need to develop disposition processes at PFP for these materials

Commitment # 102, IP Appendix D (Attachment 3)

Commitment Statement:
"Complete categorization of plutonium solutions (with similar characteristics to facilitate stabilization)"
Section 5.4.1:
"PFP will complete a categorization approach to prioritize mitigation of the hazards/concerns for hydrogen generation, and the continued storage of plutonium solutions, by grouping of solutions with similar characteristics. The grouping may allow disposition directly to the Hanford Tank Farms, some cementation processing, utilization of other "small-scale" stabilization approaches. The categorization plan will also identify those solution populations that require characterization and the associated methodology"

Deliverable:
PFP has completed a categorization effort to identify those Pu solutions (by item) which demonstrate attributes that will allow disposition through processes not identified in the original technical baseline or alternatives considered, and allow earlier mitigation of the hazards associated with these materials. A portion of the impure solutions was determined to be suitable for disposal to the Hanford waste tanks without further processing. A nationally recognized Pu expert was utilized to support this effort

Commitment # 103, IP Appendix D (Attachment 4)

Commitment Statement:
"Complete an options analysis to determine if a magnesium (hydr)oxide precipitation should be used in lieu of an ion exchange pre-treatment prior to calcining"
Section 5.4.1:
"PFP will complete an options analysis to determine whether a magnesium (hydr)oxide precipitation process should be utilized in lieu of an ion exchange pre-treatment process for those solutions that cannot be processed untreated through the production vertical denitration calciner (VDC)"

Deliverable:
PFP has completed an options analysis and decision process for Pu solutions processing and determined that a Magnesium Hydroxide (MgOH) precipitation process will be

utilized for stabilization of those solutions that cannot be processed through the vertical denitration calciner without pretreatment. The precipitate will require thermal stabilization in PFP furnaces to meet the 3013 standard. A study was performed by the Cogema Engineering Corporation to support this analysis.

Advantages:

- MgOH provides a high confidence stabilization process for the full range of solutions when compared to the technical risks associated with dependence upon an ion exchange process combined with the VDC
- Approach avoids uncertainties with the VDC reliability

The opportunity to utilize the MgOH process for stabilization of all solutions was evaluated and considered to offer potential advantages given VDC design uncertainties at this time. PFP has concluded that VDC installation activities that support MgOH should be pursued expeditiously using a design that leaves the vertical denitration calciner in place during MgOH design efforts and a VDC design review. Further evaluation of this option offers a low technical risk and provides a satisfactory contingency opportunity to commence solution processing without delay. This will be significant in the event the engineering design evaluation efforts identify issues with either approach.

Commitment#108, IP Appendix D (Attachment 5)

Commitment Statement:
"Complete analysis of options for using the Hanford Convenience Can vice a welded seam repackaging system for plutonium prior to repackaging in a PuSAP packaging system"
Section 5.4.1:
"PFP will complete a cost benefit analysis to identify use of the Hanford Convenience Can (HCC) and/or a weld seam repackaging system (similar to the bagless transfer system employed at SRS) to satisfy the requirements of the long-term storage standard for plutonium prior to repackaging in a BNFL packaging system"

Deliverable
PFP has completed an analysis of the use of a HCC (or equivalent) and/or welded seam repackaging system ("bagless transfer") and has determined that both should be pursued This analysis was effectively modified during December 1998 when DOE-I-IQ directed that "Bagless Transfer System " (BTS) type packaging technology should be considered for installation at PFP in lieu of the British Nuclear Fuel Limited, Inc Plutonium Stabilization and Packaging (PuSAP) This evaluation has been sufficiently completed to determine that a BTS-type system will be installed at PFP, and that this system will require use of a HCC-type convenience container when Implemented. A convenience can will be required since the schedule for BTS installation requires that an HCC-type can be utilized until the BTS is available [Note This evaluation is documented in a separate transmittal] Additionally, studies indicate that the BTS can will support

subsequentpackaging into an outer container to meet a 3013 standard Fluor Daniel Northwest, Inc. (FDNW) supported this evaluation.

Advantages:

- Consistent with Program direction to evaluate packaging options to replace the PuSAP with a BTS, based on cost and scheduling
- Supports ongoing Pu oxide processing pending installation of the BTS

Commitment # 109, IP Appendix D (Attachment 6)

Commitment Statement

"Complete evaluation of options for mitigating hazards/concerns of stored unalloyed plutonium metal nitride and hydride formation"

Section 5.4.1

"PFP will complete evaluation of an option to mitigate the hazards/concerns of nitride and hydride formation of the stored unalloyed plutonium metal by repackaging as a metal once corrosion products have been removed by brushing. This option was recently identified as a result of PFP sponsored complex-wide workshops held during November 1998."

Deliverable:

PFP has completed an evaluation of the hazards associated with the formation of nitride and hydride corrosion products on stored Pu metals and has determined that the Pu metals should be brushed and repackaged in lieu of being thermally stabilized. This direction is supported by a DOE complex-wide workshop (attended by a variety of Pu experts) held during November 1998, and a Technical analysis prepared by FDNW and other independent technical experts. The corrosion products will be thermally stabilized. It is anticipated that some Pu metals will require thermal processing based on their condition.

Advantages:

- Schedule improvements as a result of brushing in lieu of thermal stabilization (10 to 25 weeks).
- Reduction in utilization [J1'tile critical path PFP furnace resources
- Reduces dose associated with Pu oxide handling

Summary:

The November 199S workshops originally captured the issues identified in these commitments through rigorous ire\'ie\\s of all PFP materials disposition plans and a critical evaluation of the existing baseline. These workshops solicited critical input from recognized specialists from a cross-section of personnel from the Hanford site, other DOE sites currently tasked with similar missions (including SRS, LANL, Lawrence Livermore National Laboratory and Rocky Flats Environmental Test Site) and DOE-HQ programmatic and technical experts

As stated in the closure descriptions, technical evaluations were utilized to support the K-T decision analyses workshops held during February 1999 to close commitments#101, #103, # 108, and #109 The approach captured the best available data for decision making and noted uncertainties for consideration during the process. The K-T workshops considered five key attributes during these workshops: safety risk, cost. schedule, technical risk, and programmatic risk. Records from these workshops have been documented, and the technical documentation supporting the evaluations will be submitted to DOE-HQ by the week of March 15. 1999

The key decisions identified in this letter, and the methodology with which they were addressed, provide PFP with credible programmatic direction Using this direction. PFP will establish high confidence Integrated resource-loaded schedules that have the strategic support necessary to assure success of our Materials and Facilities Stabilization mission. "

If you have any questions on this matter, please contact Mr. J. C. Sinclair at 37.3-7353

Sincerely,

Arthur Clark
President and General Manager
B&W Hanford Company

bjk

Attachments (6)

CONCURRENCE:

2-26-99
L. J. Olguin, Project Director
Facility Stabilization Project
Fluor Daniel Hanford. Inc

2-26-99
L. D. Romine. Director
Transition Program Division
U S. Department of Energy
Richland operations Office

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

99-TPD-094

FEB 1 1999

Mr. R. D. Hanson, President
Fluor Daniel Hanford, Inc.
Richland, Washington 99352

Dear Mr. Hanson:

CONTRACTOR NO. DE-AC06-96RL13200 - ALTERNATIVE ANALYSIS FOR DISPOSITION OF ASH RESIDUES

RL staff have reviewed the subject alternative analysis provided by BWHC letter, Arthur Clark to L. J. Olguin, same subject, dated January 29, 1999. The analysis recommends the pipe over-pack (similar to Rocky Flats "pipe and go") alternative for the baseline technical approach for ash residue disposition at PFP in lieu of cementation. Per my conversation with Mr. Olguin of your staff, FDH supports this recommendation.

RL concurs with the analysis results that the pipe over-pack option has significant potential benefits and that the technical baseline includes pipe over-pack as the approach for ash residues.

RL also recommends that FDH consider this option for other PFP plutonium residues; however, the cementation option (used for other residue materials) will be retained as a back-up approach in the event the enabling assumptions prove to be false and prevent the use of pipe over-pack.

If any direction is provided to you by a Contracting Officer's Representative (COR) which your company believes exceeds the COR's authority, you are to immediately notify the Contracting Officer and request clarification prior to complying with the direction.

If you have any questions, please contact Mark R. Hahn of my staff, on (509) 373-9872.

Sincerely,

Larry Romine, Director
Transition Program Division

TPD:MRH

CC: A. Clark, BWHC
J. C, Sinclair, BWHC
R. Martinez, FDH
L. J. Olguin, FDH

B&W Hanford Company
a McDermott company

P.O. Box 1200
Richland, WA 99352
(509) 372-8100
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March 281999

BWHC-9951296 R2

Mr. P. M. Knollmeyer, Assistant Manager
Facility Transition
U.S. Department of Energy
Richland Operations Office
Richland, Washington 99352

Dear Mr. Knollmeyer:

CONTRACT NO. DE-AC06-96RL 13200 – WHITE PAPERS SUPPORTING CLOSURE OF PLUTONIUM FINISHING PLANT FEBRUARY 1999 NEAR-TERM COMMITMENTS IN THE IMPLEMENTATION PLAN FOR DEFENSE NUCLEAR FACILITIES SAFETY BOARD (DNFSB) RECOMMENDATION 94-1 (REVISION 1)

References:
1) Letter, A. Clark, B WHC, to P. M. Knollmeyer, RL, same subject, BWHC-995 1296 R1, dated March 18, 1999.

2) Letter. A. Clark, BWHC, to L. J. Olguin, FDH, "Contract No. DE-AC-06-96RL 13200-Closure of Plutonium Finishing Plant February 1999 Near-Term Commitments in the Implementation Plan for the DNFSB Recommendation 94-1 (Revision 1)," BWHC-995 1296, dated February 26, 1999.

3) Letter, A. Clark, BWHC, to L. J. Olguin, FDH, "Contract No. DE-AC-06-96RL13200-Altemative Analysis for Disposition of Ash Residues." BWHC-9956079, dated January 29, 1999.

Note: This letter supersedes the prior submittal.

Please see attached, the summary evaluations developed to support workshop recommendations to close the January and February 1999 commitments identified in the December 1998 Revision 1 of the *Implementation Plan (1P) for Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-1* (Ref. 2 and 3). Additionally, a summary overview of the process to complete Commitment #l 02 is attached. Each of these evaluations will be subsequently re-fornatted as required for formalized record storage, in accordance with the applicable requirements and procedures.

These evaluations were prepared in draft form by Plutonium Finishing Plant (PFP) and recognized industry resources, to provide input to formalized Kepner-Tregoe decision anal yses conducted in January and February of this year. The B& W Hanford Company, in partnership with Fluor Daniel Hanford, Inc., the U.S. Department of Energy (DOE), Richland Operation Office, and DOE-Headquarters; utilized these evaluations, existing documentation, and the expertise of the analysis participants, to close each of the subject commitments. Subsequent revisions of several attached evaluations reflect input from these workshops where appropriate.

The following are those commitments that utilized, in part, the attached evaluations for closure input:

Commitment # 101, IP Appendix D (Attachments 1A and 1B)

An **analysis** of options for shipping select 94-1 plutonium materials in their current forms to alternate sites for processing and/or final disposition. It concluded that:

I. Select sand, slag, and crucible (SS&C) (nominally 250 items) will be shipped to the Savannah River Site (SRS) for stabilization and final disposition. The exact quantity of SS&C material that will be shipped to SRS will require an optimization study, determination of timing for PFP's ability to ship this material, and improved information with respect to the SRS SS&C processing schedule.
2. Plutonium polycubes will be processed at PFP as opposed to processing at Los Alamos National Laboratory or Pacific Northwest National Laboratory.
3. Plutonium alloys and fluorides will be shipped to the SRS for stabilization and final disposition. Recommendations for this decision were established during the November 1998 workshops. (Note: Does not include an attachment)

Commitment # 102, IP Appendix **D (Attachment 2- Summary provided-more detailed report available at PFP)**

A categorization effort was completed to identify those plutonium solutions (by item) which demonstrate attributes that will allow disposition through processes not identified in the original technical baseline or alternatives considered. This will support the potential for earlier mitigation of the hazards associated with these materials. The attachment provides a summary of the process utilized to complete this commitment. Appropriate personnel may view specific information at PFP.

Commitment # 103, IP Appendix D (Attachment 3)

This evaluation supported an options analysis and decision process for plutonium solutions processing that recommended that a Magnesium Hydroxide precipitation process will be utilized for stabilization of those solutions that cannot be processed through the vertical denigration calciner without pretreatment.

Commitment # 108, IP Appendix D (Attachment 4)

An analysis of the use of a Hanford Convenience Can (or equivalent) and/or welded seam repackaging system ("bagless transfer") has determined that both should be pursued. The potential utilization of a bagless-transfer system in lieu of a PuSAP for PFP packaging in a DOE-STD-3013 configuration effectively changed the need for this commitment. As a result, the evaluation focused on container leak rates and utilization of the HCC for storage prior to installation of a "bagless transfer" or PuSAP system at PFP. A series of Kepner-Tregoe workshops have been performed to evaluate the various bagless-transfer options and documented in other correspondence.

Commitment # 109, IP Appendix D (Attachment 5- Summary provided-more detailed report available at PFP)

Evaluation of the hazards associated with the formation of nitride and hydride corrosion products on stored plutonium metals has determined that the plutonium metals can be brushed and repackaged in lieu of being thermally stabilized. The attached evaluation and subject workshops did not address the actions necessary to open those cans that currently contain PFP metals, but the storage of the metals after they are removed from existing containers.

Commitment # 112, IP Appendix D (Attachment 6)

An options analysis determined pipe components should be used for direct packaging of ash residues for Waste Isolation Pilot Plant disposal. This option offers lower cost, less handling and exposure than previous baseline cementation process. This recommendation was made during the January 1999 workshops.

A significant quantity of information is available in each of the subject areas addressed, and questions were raised during the Kepner-Tregoe workshops that must still be addressed. However, these evaluations were targeted at providing a summary level review of the key issues identified as significant for making the decisions identified in the Implementation Plan. The content and format of each evaluation reflects the degree of existing information, complexity of the subject matter, and anticipated general understanding of the issues by those attending the workshops. The Kepner-Tregoe participants judged that risks associated with any unknowns were factored into their ratings during the decision making process.

If you have any questions on this matter, please contact Mr. J. C. Sinclair at 373-7353.

Sincerely,

Arthur Clark
President and General Manager
B&W Hanford Company

sms
Attachments 7

CONCURRENCE:

Date: 3/29/99
L. J. Olguin, Project Director
Facility Stabilization Project, FDH

BWHC-9951296-R2

ATTACHMENT 1A

Plutonium Finishing Plant
Sand, Slag, and Crucible (SS&C)
Stabilization Process Selection

Consisting of 12 pages,
including cover page

Plutonium Finishing Plant Sand, Slag, and Crucible (SS&C) Stabilization Process Selection

March 1999

Submitted by:

R. R. Leugemors, BWHC

J. McKibbin, WSMS

TABLE OF CONTENTS

1.0 INTRODUCTION

The Defense Nuclear Facilities Safety Board (DNFSB) 94-1 Implementation Plan for the Plutonium Finishing Plant (PFP) is scheduled to be completed before 2005. Stabilization and disposition of the plutonium inventory, including plutonium residues, is vital to the completion of the program. The Residues are a segment of solids including sand, slag, and crucible (SS&C), ash, compounds, oxide (<30% by weight), and other miscellaneous solids. The SS&C materials remaining to be processed represent the largest contingent, having an unprocessed bulk weight inventory of > 2000 kg.

The SS&C materials were generated as a result of the Plutonium Finishing Plant (PFP) operations to produce plutonium metal. In this operation, PuF_4 powder was loaded in a MgO crucible, which was then placed on a sand cushion inside an induction furnace. Excess elemental calcium (reducing agent) and iodine were also added and the system was fired to produce metallic plutonium along with a slag containing CaF_2, unreacted calcium, iodine, and small amounts of PuF_4.

As a result of these operations, PFP generated an estimated > 2000 kg bulk weight inventory of spent, sand, slag, and crucible. Of this inventory, approximately 200 kg have been processed and cemented. Approximately 1500 cans remain to be processed,

2.0 SCOPE

The scope of this report includes a review of two demonstrated processes and three options.

2.1 OPTION 1- CEMENT SOLIDIFICATION

The SS&C will be reacted with water followed by cement solidification to produce a stabilized cement product < 2% Pu by weight. This cemented form will be packaged into drums, and shipped to the Waste Isolation Pilot Plant (WIPP) for long term disposal. The water reaction step is required to eliminate elemental calcium to meet the Waste Acceptance Criteria (WAC) established by the WIPP. This final form meets the existing Department of Energy (DOE) requirements for disposal (Reference 4).

2.2 OPTION 2- DISSOLUTION AND PROCESSING AT SRS

The second processing option is to ship the SS&C to Savannah River Site (SRS) for processing to meet “F” Canyon requirements. Although partial repackaging is required at PFP (replace plastic bag with nylon bag), shipment to SRS will be performed without any processing or mixing. At SRS, the plutonium will be recovered and converted to metal. The remaining solids will ultimately be processed at the Defense Waste Processing Facility (vitrification) and/or Z Area (saltstone).

2.3 OPTION 3- DISSOLUTION OF -250 CANS AT THE SAVANNAH RIVER SITE AND THE BALANCE SOLIDIFIED AT PFP

A third option is a combination of the two processing options previously discussed. The high Pu content packages would be shipped to SRS for processing while the remaining low Pu content packages would be solidified via cement at the PFP and shipped to WIPP for final disposal. This is beneficial because approximately 20°A (by weight) of the SS&C contains approximately 50°A (by weight) of the plutonium. In addition, if the high assay cans were processed at PFP additional handling would be required to meet criticality and WIPP Waste Acceptance Criteria (WAC).

3.0 PURPOSE

The purpose of this document is to summarize information on options for disposition of plutonium bearing sand, slag, and crucible in inventory at PFP, Hanford Site, Richland, Washington.

The basic requirement is to develop a definitive path forward for stabilization of the SS&C. The DOE commitments in the Defense Nuclear Facilities Safety Board (DNFSB) 94-1 Implementation Plan is to place Pu-bearing materials in a form suitable for safe storage. The processing options discussed below will satisfy these requirements.

4.0 DESCRIPTION OF PROCESSING ALTERNATIVES

4.1 OPTION 1- CEMENT SOLIDIFICATION

The Hanford SS&C contains calcium metal as a result of excess stoichiometric elemental calcium that was added during plutonium button processing. This calcium metal is currently being identified as “reactive” under the definition in the Resource Conservation and Recovery Act of 1976 (RCRA) and therefore is characterized as “Waste Code D003”. WIPP can not accept DO03 waste codes (i.e., reactive material) under the provisions of their permits. As a result, PFP SS&C must undergo processing prior to shipment.

The proposed PFP plan is to react the SS&C material containing the calcium with water under controlled conditions thereby making the material suitable for cement solidification, shipping, and storage. In preparation for the reaction, the SS&C is ground (reducing particle size) to assure complete reaction. The calcium and water reaction is exothermic and produces hydrogen gas. The mixing rate is controlled to less than 50 grams/minute so that thermal and flammability concerns are maintained within design limits.

Following the water reaction, the SS&C is mixed with Portland Cement and solidified in billets (2.5 liters each) and loaded into Department of Transportation (DOT) Type A 55 gallon drums. These drums will be transferred to the Hanford Central Waste Complex (CWC) for interim storage pending shipment to WIPP. A detailed description of this process is provided in PFD-Z-200-001, Revision A-2 (Reference 5).

This process was previously utilized for cementation at PFP. 'The procedures exist (although minor revisions are anticipated) and this process does not introduce any new process not analyzed in the PFP Facility Safety Analysis Report.

An ALARA (As Low As Reasonably Achievable) Design Review Checklist has been completed, and indicates that the total dose expected from this operation is 75 person-rem (Reference 6).

Five percent loading by weight in cement is approved for safeguards termination by DOE (Reference 4). The actual loading in cement will be less than 1 %.

4.2 OPTION 2- DISSOLUTION AND PROCESSING AT SRS

In this processing option, the inner can (containing the SS&C) will be repackaged into a nylon bag and placed into a carbon steel overpack. This will be shipped to SRS for dissolution processing in the "F" Area Canyon.

This configuration will be shipped to SRS in DOT "6Ms" (Pu c-60 grams) or "9975" containers loaded in SST casks. When using the "9975" container, approximately 132 cans will be delivered per shipment. With the DOT 6M container, up to 288 cans may be delivered per shipment. This repackaging effort is covered by existing procedures and is addressed in the existing FSAR.

Once at SRS, the cans will be loaded into the dissolvers. The plutonium will be processed, recovered, and stored in accordance with SRS procedures. The remaining solid will be processed into glass or saltstone.

An ALARA review will be conducted if this process is selected. Initial dose estimates indicate 63 person - rem is anticipated for this option.

4.3 OPTION 3- DISSOLUTION OF -250 CANS AT THE SAVANNAH RIVER SITE AND THE BALANCE SOLIDIFIED AT PFP

This combination of the previously discussed options would ship the higher Pu loaded SS&C for processing at SRS and cement the balance. Shipping the material to SRS will require "9975" Containers and SST transport from Hanford to SRS. Although the number of cans to be shipped is flexible, the best estimate based on shipping constraints is -250 cans. This alternative benefits PFP in that the off-line blending and splitting of material is eliminated. In addition, since the grams of Pu per drum is the limiting factor, the number of drums delivered to WIPP will be reduced by approximately one-half. The small amount of SS&C shipped to SRS is not expected to create any schedule delays at SRS since the dissolvers are not presently at full capacity.

5.0 EVALUATION OF ALTERNATE PACKAGING FOR CEMENTED PRODUCTS

Cemented Plutonium materials must meet the following criteria:

Central Waste Complex Waste Acceptance Criteria (WAC)

Waste Isolation Pilot Plant WAC

Transuranic Package Transporter (TRUPACT)-II Requirements

Criteria of Attractiveness Level for Special Nuclear Material

RCRA/Part A Permit

Washington State Administrative Code (WAC) on Dangerous Wastes

Attachment 1 compares the container planned for use at PFP against the requirements in the "CWC WAC", the "WIPP WAC", and the "TRUPACT-II" requirements. It is a summary of the limiting conditions to indicate options that are available.

5.1 THE KEY ISSUES ARE AS FOLLOWS:

The CWC WAC has a 100-gram Pu limit that applies when the fissile material is contained in less than 20°/0 of the container volume. In the PFP cementation situation, the fissile material is contained in 5% of the container volume (55-gallon drum). The remaining volume will be packaging and dunnage.

The expected heat load is acceptable at approximately one-half of the limit for the CWC WAC, the WIPP WAC, and the TRUPACT-II drum.

If a pipe package is not used, the TRUPACT-II limit of 325 Fissile Gram Equivalents (FGEs) applies. Since each drum has 150 FGE then one or at most two drums can be shipped per TRUPACT-II. This may not be an issue if there are significant quantities of vety low level drums that require shipment and WIPP allows mixing material types.

The present requirements of the TRUPACT-II are that "all containers forming a payload within each TRUPACT-II shall belong to the same shipping category. Changes to the WIPP WAC that are presently under consideration include: (1) using carbon steel pipe to reduce the cost of the Pipe-and-Go, and (2) gaining approval for higher allowable Pu concentrations in cemented residues. These changes may not be achievable or could take in excess of one year to resolve.

There is a potential opportunity to improve schedule and safety by using the Pipe-and-Go system (in lieu of cementation) to ship SS&C to WIPP. Two limiting conditions require resolution prior to considering Pipe-and-Go as an option:

One issue is the unreacted calcium metal, which exists in the SS&C in excess of 8% by weight. The WIPP WAC states that reactive wastes as defined by 40 CFR 261 are prohibited from shipment to WIPP. The applicable portions of the WIPP WAC and the CFR follows:

DOE/WIPP – 069, Revision 5, Section3.4.5.3 Environmental Compliance Requirements, "No ignitable, corrosive, or reactive wastes as defined by 40 CFR 261.21, *261.22,262.23* respectively".

TITLE 40-PROTECTION OF ENVIRONMENT AGENCY (CONTINUED) PART 261–IDENTIFICATION AND LISTING OF HAZARDOUS WASTE–Table of Contents Subpart C-Characteristics of Hazardous Waste Sec. 261.23 Characteristic of reactivity. (a) A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties: (1) It is normally unstable and readily undergoes violent change without detonating. (2) It reacts violently with water. (3) It forms potentially explosive mixtures with water. (4) When mixed with water, it generates toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment. (5) it is a cyanide or sulfide bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment. (6) It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement. (7) It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure. (8) It is a forbidden explosive as defined in 49 CFR 173.51, or a Class A explosive as defined in 49 CFR 173.53 or a Class B explosive as defined in 49 CFR 173.88. (b) A solid waste that exhibits the characteristic of reactivity has the EPA Hazardous Waste Number of D003.[45 FR 33119, May 19, 1980, as amended at 55 FR 22684, June 1, 1990]

The pipe component has been demonstrated to maintain containment after drop, crush, and detonation tests (Reference 8). Water infiltration tests were also performed to demonstrate that "a scenario where sufficient water enters the drum and crosses all packaging barriers to reach the residues is not credible." Finally, the use of the pipe component in the TRUPACT-II container has been approved by the Nuclear Regulatory Commission.

The second issue associated with Pipe-and-Go is the Attractiveness Level provided in DOE Order 5633.3B.

The requirement of the WIPP WAC is that material shipped to WIPP must meet Attractiveness Level E on a scale of A to E under the "Safeguards and Security guidelines. In the present condition SS&C is considered an Attractiveness Level D material. SS&C material is considered "Recoverable" and must be below a 0.2°A concentration to reduce protection measures equivalent to Category IV requirements. By contrast, Ash is considered '(Extremely Difficult to Recover" and the present STL limits are set at 2.0°/0 (Reference 4).

In the cemented form, the SS&C has an Attractiveness Level of E. It is considered "Practically Non-recoverable", and can be as high as 5% concentration and still have protection reduced to measures equivalent to Category IV requirements. The cemented SS&C will have a cemented concentration of <1%.

The Pipe-and-Go process would be a worthwhile option if the reactive issues could be resolved and if the Safeguards Termination Limit (STL) could be increased. Rocky

Flats has received approval for a variance that allows "all Attractiveness Level 'D' plutonium bearing material with a plutonium content less than 10%" to be shipped to WIPP in the Pipe-and-Go component. PFP will continue to evaluate this packaging option for cemented plutonium residue.

5.2 ANALYSIS OF THE PROCESSING OPTIONS

A Kepner-Tregoe type decision process was used to rank the three options. The categories ranked included safety risk, technical risk, programmatic risk, cost, and schedule. In this, a statistical tie occurred between Options 1 and 3 (Reference 7). It should be noted that the conclusions reached mirror the results generated in a 1996 Trade Study performed for the SS&C. This serves to provide additional validation of the processes selected and the basis for those selections. The following table is a summary of the attributes evaluated:

Attribute	Option 1	Option 2	Option 3
Technical Risk	Low- >200kg of SS&C have been processed at PFP	Low - The SRS Canyon is an operational facility currently processing SS&C	Low -Both processes are low risk.
Cost	Low -Operation and shipping were estimated to be about $3.5 M	High - PFP Repackaging and shipping to costs were estimated to be about $3 M. SRS estimated costs of $0-$5M (see Note 1)	Low - A Trade Study performed in 1996 indicated that Option 3 resulted in savings of $1 M versus Option 1 (See Note 2)
Programmatic Risk	Low - The requirements for shipping to WIPP have been clarified. The cemented SS&C, as planned, meets the requirements.	High- A NEPA review is required - from a categorical exclusion to an environmental assessment (See Note 3). Canyon availability - canyon operations could be extended, a significant risk.	Low - The small quantity (-250 cans) of SS&C lowers the potential impacts on the NEPA as well as operations. Option 3 does not effectively add any risk since.
Safety Risk	Low - The primary risk is worker exposure, which is estimated at 73.8 person-rem.	Low - The primary risk is worker exposure, which is estimated at 68.3 person-rem	Low - The primary risk is worker exposure, which is estimated at 63.3 person-rem.
Schedule Risk	Low	Medium - based on SRS window of opportunity for processing (See Note 3)	Low - Increases later options

Notes:

(1) The estimate for processing at SRS varied from $0 to $60M based on shipping date (Canyon availability). The evaluation used a $5M value for comparison purposes with high uncertainty.

(2) This is consistent with elimination of blending and splitting which is required for the high Pu material.

(3) SRS can add some material to existing operating schedule without impact. Additional processing dependent upon timing of availability of PFP materials, and status on RFETS shipments

6.0 CONCLUSION AND RECOMMENDATION

Option 3 is recommended as the desired processing path, with Option 1 held as the contingency plan if the SRS “F” Area canyon is not available.

The processes exist and are demonstrated which provide low technical and programmatic risk for completion.

The cost of Option 3 is expected to be the lowest with potential for shortest schedules, especially if it allows use of a pipe-and-go packaging system for WIPP

7.0 POTENTIAL ISSUES

SRS will need to perform a National Environmental Policy Act (NEPA) review. With the low quantity of SS&C being added to their processing plans (-250 cans), SRS may be able to issue a Categorical Exclusion.

Additional documentation will be required to document the CWC WAC revision relative to Pu loading (i.e. 200 grams vs. 100 grams).

PFP will require a detailed review of the SRS packaging requirements. SRS stated during the review meeting that the inner carbon steel can would be acceptable for processing.

Use of the “9975” Containers will require approval by 7/99. The decision to order the containers prior to approval needs evaluation against the schedule.

A decision is required relative to using the pipe component to allow 14 drums per TRUPACT-II shipment.

8.0 REFERENCES

Reference 1 Final Safety Analysis Report, WHC-SD-CP-SAR-021, Revision O-H

Reference 2 Planning Data for Plutonium Finishing Plant Special Nuclear Material Inventory, WHC-SD-CP-TI-212, Rev. O

Reference 3 Sand, Slag, and Crucible Information, 15530-96-MLW-027

Reference 4 Memorandum from Office of Safeguards and Security (DOE), Subject: Additional Attractiveness Level E Criteria for Special Nuclear Material, From Edward J. McCallum, dated 7/22/96

Reference 5 Plutonium Finishing Plant Process Flow Document, Sand, Slag, and Crucible Cementation Process Flow Document, PFD-Z-200-001, Rev A-2

Reference 6 Evaluation of Cementation Item #22 on the Expanded Up Cementing and Discard Readiness Review Checklist Dated 7/30, 1996, 15530-96-WSL-085

Reference 7 Decision Outcome – Sand Slag and Crucible, PFP vs. SRS vs. PFP/SRS

Reference 8 Implementation Plan for the Accelerated Removal of Residues from Rocky Flats using the Pipe Overpack Container, RS-020-015, Issue A, 3/18/98

Attachment

Attachment 1: Comparison of PFP Packaging Plans and Current Packaging System Requirements

Attachment 1

Comparison of PFP Packaging Plans and Current Packaging System Requirements

Technical Requirements	PFP Planned Ref.	CWC WAC Note 2	WIPP WAC	TRUPACT Drum	PFP Planned (14 Drums)	TRUPACT II (14 Drums) No Pipe Note 3	TRUPACT II (14 Drums) w/ Pipe Note 4
1. Liquid Allowed	<0.23 liters	Note 5	2 liters	2 liters			
2. Weight of Drum in lbs.	<500	300 (500)	1000	1000	<7000	7265	7265
3. Thermal Heat Load (Watts per Meter Cubed)	<2	3.50	3.50	3.50			
4. Thermal Heat Load (Watts/Drum)	<0.5				5.20	40.00	40.00
5. Pu-239 Fissile Gram Equivalents (FGE)	140.00	100 (200)	200.00	200.00		325.00	2800.00
6. Total Dose Equivalent Curies (DEC)	>10 <15	35 (150)					
7. Pu-239 Equivalent Curies (PE-Ci)	>10 <15		1800.00	1800.00			
8. Exposure Rates on Contact	<10 mRem/hr	200 mRem/hr	200 mRem/hr	200 mRem/hr			
9. Reactive Constituents Allowed	No	No	No				
10. Drums of SS&C per TRUPACT Shipment						1	14

Notes

1. Weapons Grade Pu is assumed for SS&C (i.e. Pu-240 at 4 to 7%)
2. The 100 gram per drum limit applies if the fissile material volume is < 20% of the volume of the drum (which is the case)
3. Only one high Pu loaded drum (150 grams) can be shipped per TRUPACT shipment unless pipe is used
4. If a pipe configuration is used then 14 drums can be shipped in one TRUPACT
5. Liquids are allowed if packaged properly, No Issue for cementation
6. 150 grams of Pu per drum correlates to 141.3 FGE per drum for weapons grade Pu
7. Although identified with different names and correction factors, items 6 and 7 are measuring the same quantity.

BWHC-9951296-R2

ATTACHMENT 1B

Use of PFP or PNNL (Bldg. 325)
for
Pyrolysis of Polycubes
Evaluation

Consisting of 12 pages,
including cover page

Use Of PFP Or PNNL (Bldg. 325) For Pyrolysis of **Polycubes**

Evaluation

March 1999

Submitted by:

R. Bond, BWHC

J. McKibbin, WSMS

This Document is uNCLASSIFIED.
Work Performed under this requirement is
X UNCLASSIFIED
—CONFIDENTIAL —RD
—SECRET —DI

Signature 3/29/99 Date
AUTHORIZED CLASSIFIER

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EXECUTIVE SUMMARY

The Defense Nuclear Facilities Safety Board (DNFSB) 94-1 Implementation Plan for the Plutonium Finishing Plant (PFP) is scheduled to be completed before 2005, and stabilization and disposition of the plutonium inventory, including plutonium polycubes, is vital to the completion of the program. An Environmental Impact Statement (EIS) has been completed which evaluated various processes for treating the plutonium inventory. For polycubes, a pyrolysis process was recommended as the treatment.

A polycube is plutonium oxide in a polystyrene matrix. There are 3 sizes: 2"x2"x2", 2"x2"x1½", and 2"x2"X1 /2". They were used to conduct criticality experiments at the Hanford site. Due to radiolytic degradation, the cubes have become friable. PFP experienced a serious contamination incident as a result of moving the vented containers holding polycubes. It is unlikely that the polycubes could be shipped to Waste Isolation Pilot Plant (WIPP) in their current form because they would generate too much hydrogen. As a result, Hanford embarked on an effort with Los Alamos National Laboratory (LANL) to develop a process to stabilize this material. The process developed involves pyrolysis of the polycubes, which vaporizes the hydrocarbons. The hydrocarbon off gas then goes through a treatment process to convert it to carbon dioxide.

The pyrolysis system processes the material at desired rates and, coupled with off gas treatment, produces a non-hazardous discharge. The current design is to condense the hydrocarbon vapor and then revaporize at a controlled rate for treatment by the catalytic conversion unit. This process will produce a small amount (approximately 6 liters) of spent catalyst, which maybe a mixed hazardous waste.

The decision on polycubes addressed the location where they will be processed, not how they will be processed. Three options have been considered. Initially, shipping the material to LANL for processing was considered. Significant issues related to shipping the polycubes and the inability of LANL to support the schedule caused this option to be dropped from further consideration. The two options that underwent the Kepner-Tregoe analysis were(1) to locate the processing in PFP or (2) to ship the polycubes to Pacific Northwest National Laboratory (PNNL) Building 325 for processing. The Kepner-Tregoe analysis supported a recommendation that the processing of polycubes be performed at PFP.

1.0 INTRODUCTION

Plutonium currently stored at the Plutonium Finishing Plant (PFP) must be dispositioned by shipment to other sites for processing, stabilized and packaged for long-term storage, or dispositioned as waste and packaged for W] PP. The polycubes are >20% Pu in their current form and are expected to be off gassing hydrogen and hydrocarbons from radiolysis of the polystyrene. Both of these conditions would prevent the polycubes from being eligible for disposal to WIPP. Therefore, LANL was assigned the task to develop the technology to process the polycubes.

The pyrolysis process involves volatilization of the organic materials in the polycubes and treatment of the vapor using a catalyst to convert the organics to carbon dioxide and water. The volatilization of the organics takes place in a furnace that is operated at 750 degrees C. Operating at 750 degrees C is required to maintain the entire furnace at >350 degrees C to prevent condensation of the organics near the top of the furnace. Most of the organic vapors are condensed and fed at a controlled rate to a revaporize. The organic vapor then passes through the catalytic converter for treatment. Extensive testing at LANL has shown that the catalyst bed converts 99.5% of the organics. Two identical units are being purchased for Hanford and will be installed at the location chosen by this study.

The technical evaluation for polycubes does not involve the process, but the location where the process will be installed and operated. Shipping the polycubes to LANL for processing was previously considered as a viable alternative with a good likelihood for success. However, as this option was developed, the shipping of the polycubes was going to be a significant hurdle that would be difficult to overcome in the desired time frame. Additionally, LANL did not feel they would be in a position to ‘ support the desired schedule due to other priorities.

In order to pursue opportunities to process the polycubes in non-PFP facilities, PNNL was contacted about the potential utilization of Building 325 for this effort. Several tours of the facility were made to determine the suitability of the PNNL equipment. Several options were discussed including use of a hot cell, use of two mini-cells, and use of gloveboxes. The hot cell and mini-cells are the best options because they would significantly reduce exposure during processing. To use the mini-cells, the process would have to be split up with the furnaces going in one mini-cell and the off-gas treatment going into the other mini-cell. This worthy idea that should be applied at PFP as well. The plan for PFP was to install the process equipment in glovebox HC-15 A, B and C. This was of significant concern due to the amount of equipment that had to be removed. By splitting the process equipment between two gloveboxes, HC-I 3MD and HC-I 5, significantly less equipment removal is required.

PFP will install the furnaces in glovebox HC-I 5 and the off gas treatment system in glovebox HC-I 3 MD. These gloveboxes are shielded and the control room is behind a cell-like wall virtually eliminating radiological dose while in the control room. Feed will be brought in from the vaults and moved by conveyor to HC-I 5 for charging to

the furnaces. The char from the pyrolysis system is transferred on the conveyor to the thermal stabilization furnaces for final processing to 950 degrees C. The stabilized material will then be placed in a Hanford Convenience Can and returned to the vault. Movement of material to PNNL will require shipping the material to PNNL for processing and returning the processed material to PFP for thermal stabilization. All moves over site roads involve road closure and therefore must be done on off shifts. The cans will be placed in some sort of overpack prior to shipment to bring them up to the level of containment required for shipment.

The goal of this evaluation is to determine which location (PFP or PNNL) is preferred.

2.0 APPROACH

The selection process was initiated in January when a meeting was held with LANL Design Engineering, PNNL and PFP personnel. An initial draft of a MOU with LANL was written during this meeting, and development of cost and schedule for stabilization at the two sites was completed in early February. Additionally, a trip to LANL in early February discussed the current design specification being developed by Hanford. The effort was concluded when a decision meeting was held February 24. The Kepner-Tregoe analysis technique was used to compare processing polycubes at PFP or PNNL.

3.0 POLYCUBE INVENTORY

The current polycube inventory was manufactured at Hanford in the 1960's for the purpose of criticality studies. They are a mixture of plutonium and/or uranium oxide and a polystyrene (vinyl benzene) matrix, cast into the rectangular shapes. The cubes vary in size, typically 2"x2"x½" up to 2"x2"x2". The cubes were sealed with a coating of aluminum paint and/or tape. The cubes were packaged into vented food cans with 5 to 8 cubes per can. Approximatelyl 600 polycubes are estimated to be stored at PFP. Some polycube containers are suspected to contain loose material as well, left over from the forming process.

Polycubes have a fairly high Pu-240 content and present a challenge for handling, due to the 7 to 8 R contact dose rate. Significant hazards associated with unstabilized polycubes arise from the polystyrene matrix that generates hydrogen gas due to radiolysis. The current organic makeup of the polycubes is unknown as a result of 30 years of radiolysis. It is possible that all of the volatile organic compounds are gone and only long chain hydrocarbons remain. Two polycubes are being sent to PNNL for analysis. The data from these two cubes will provide key information for operation of the pyrolysis process. The PNNL analysis should reveal how friable the cubes are and how difficult the handling of the cubes will be.

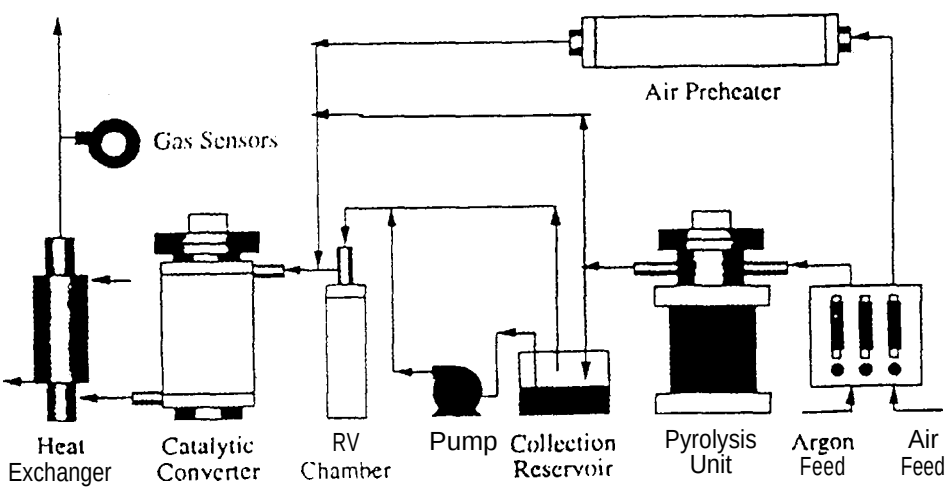
4.0 PYROLYSIS PROCESS

Due to their composition, the polycubes requires a stabilization process that decomposes and separates the polystyrene from the plutonium oxide, before or

during thermal processing. The polycubes will first be treated in a pyrolysis furnace to decompose and vaporize the polystyrene. The resulting char in the bottom of the furnace is removed and sent to thermal stabilization to oxidize the remaining carbon and thermally stabilize the plutonium oxide. The furnace portion of the pyrolysis process is similar to one previously used for polycube stabilization at Hanford. Polycubes were handled in the PFP miscellaneous treatment recovery process in the 1970's and 1980's. That process had significant exposure and off-gas treatment problems, which prevents its reuse without major modifications.

To deal with the off-gas problems, the pyrolysis process incorporates an off-gas treatment system. This system condenses most of the hydrocarbons coming off the furnace. The condensed hydrocarbons are pumped at a controlled rate to a vaporization chamber. Heated air vaporizes the hydrocarbons at a controlled rate (0.50 g/rein). The vaporized hydrocarbons then pass through the catalytic converter where > 99% of them are converted to carbon dioxide and water. Carbon builds up in the vaporization chamber which requires regular clean out. The carbon will be collected and transferred to thermal stabilization furnaces for complete oxidation. The catalyst will also require periodic changing (about every 150 cubes). The depleted catalyst will be a hazardous waste due to the presence of the heavy metal catalyst. It could also potentially be contaminated which could make the depleted catalyst a mixed hazardous waste. The material will be analyzed at PFP to determine the proper packaging and disposition of the depleted catalyst waste stream. Figure 1 shows the pyrolysis process equipment.

Figure 1 PYROLYSIS PROCESS FLOW DIAGRAM



5.0 PROCESSING LOCATIONS

5.1 PLUTONIUM FINISHING PLANT

The Plutonium Finishing Plant has the capacity and experience necessary to handle the pyrolysis of polycubes. Several existing gloveboxes and installation of a new glovebox were evaluated to determine the best location for this activity. Glovebox

HC-15 A, B and C was the location selected because it has more glovebox shielding, a shielded control room, and access to the conveyor. Glovebox HC-15 holds the furnaces used for the reduction to metal. The box contains 3 furnaces, 3 hydraulic lifts and structural steel. Removal of this equipment was of significant concern. The project team investigated possible alternatives and has recommended splitting the equipment from the pyrolysis units between HC-13 and HC-15. The two furnaces and associated equipment would be placed in HC-1 5 and the off-gas treatment would be in HC-13. This alternative results in minimal equipment removal from the two gloveboxes and supports ALARA since all work on the off-gas system can be performed well away from the high exposure of the furnaces. HC-I 1 and 16 are also available if it would be useful to have a charge make-up station away from the furnaces.

The polycubes will be removed from the vault and moved to 234-5Z on a cart. They will be sealed into the glovebox line, and placed into the furnace charge buckets – with a maximum of 3 cubes per bucket. The buckets are placed in the furnace and the furnace lid is closed. The furnace heaters are started and heated to around 700 degrees C, After about 2 hours, the cubes begin to off gas. At the beginning of the process, the off-gas is non-condensable, volatile compounds, which go directly to the off-gas treatment system. The furnace remains at temperature for 2-3 hours until the cubes are no longer off gassing. At this point, the furnace heaters are turned off and the furnace is allowed to cool. The condensed off-gas is fed to a vaporizer, which vaporizes at a rate of 0.5 g/rein. After vaporization, this gas is sent to the off-gas treatment system. It will take about 6 hours to feed the vaporized organics from the pyrolysis process to the off-gas treatment system. During this time the furnace is cooling down.

When the upper surface temperature of the furnace drops below 140 degrees F, it is opened and the old charge bucket removed. A new charge bucket is placed in the furnace and the cycle is repeated. The processed material (char) left in the bottom of the charge bucket is removed and put into a thermal stabilization pan. When the pan is full, it is transported via the conveyor to the thermal stabilization furnaces. The pyrolysis process will generate about 350 grams of Pu in the char a day. Assuming that the carbon content in the char is not significant, a thermal stabilization pan will be filled about every 3 to 5 days for charging into the thermal stabilization furnaces. After thermal stabilization, the product will be canned into either a Convenience Can or a welded bagless type can. The material storage container will be placed in the vault until it is shipped to Savannah River Plant to be dispositioned.

5.2 PNNL - BUILDING 325

PNNL was asked to determine if they had the capability to perform the pyrolysis operations for BWHC. They investigated three options: use of a hot cell, use of two mini-cells and use of gloveboxes. The proposal developed for cost estimates assumed the use of gloveboxes. To get the material to PNNL would require shipping from PFP. The polycube cans would first be overpacked so they could be shipped on site roads in an approved container. Shipments were assumed to contain 2 Kg

Pu or about 10 cans. After PFP had the cans packaged for shipment, the shipment would be scheduled for off-shift hours since the roads would require closure for several hours while the material was in transit.

The number of overpacks and trucks required for shipment has not been determined. If only one truck is used after processing begins, shipments would originate from PNNL to PFP due to the need to remove the inventory from PNNL before receiving additional material. If two trucks were used, both would leave about the same time heading in opposite directions. Upon receipt, PNNL would distribute the drums into several rooms through out the building so that room limits are not exceeded for storage of Pu. As material was needed for feed, the drum would be moved and placed into a cell where the charges would be made up. From the cell the furnace buckets would be moved into the glovebox and charged to the furnaces. Processing would be as described in PFP. PNNL also proposed to use two gloveboxes and split the process between furnaces and off-gas treatment. After treatment, the char would be canned and readied for return shipment. Upon receipt of the char from PNNL, PFP would seal in the material and thermally stabilize it. Since PNNL was only planning to run on a 1 shift basis, there would only be about 1 thermal stabilization charge every 2 weeks from their processing.

6.0 ANALYSIS

6.1 PROCESS

A workshop was held Wednesday, February 24, 1999 to evaluate options related to the location of the pyrolysis process for treatment of the polycubes. Two options were considered: (1) Locating the equipment in PFP in gloveboxes HC-13 and 15, and (2) Installing the equipment in Building 325 to be operated by PNNL. Using a Kepner-Tregoe assessment process, evaluators from DOE-HQ, DOE-RL, BWHC, PNNL and FDH evaluated these options. In addition, the Center for Risk Excellence was used to assist in the evaluation of these alternatives. The evaluations included five areas: cost, schedule, safety risk, technical risk and programmatic risk. Key points evaluated in the decision process for each of the five areas are discussed below.

A third option, shipping the polycubes to LANL for processing, was also considered. However, shipping the polycubes would require significant revision to an existing Safety Analysis Report for Packaging or certification of a new shipping container. These programmatic concerns precluded shipping to LANL from further evaluation.

6.2 RANKING DISCUSSIONS

6.2.1 Cost

The costs for performing the work were roughly comparable, with Building 325's costs being higher. Shipping the material to Building 325 to process would introduce a potentially significant unknown – the shipping costs. The estimated costs used

were for the minimum potential number of shipments. However, a change to the assumed shipping requirements, or Building 325's ability to handle up to 2 Kg Pu at a time, would cause the shipping costs to increase significantly (up to a million dollars or more).

6.2.2 Schedule

The schedule presented by PNNL for Building 325 operations was almost a year longer than the PFP schedule. The reason for this is that Building 325 plans to operate on a 1 shift a day basis, while PFP's schedule and costs are based upon a 3-shift operation.

6.2.3 Safety Risk

The primary discussion in this area focused on worker exposure. Since no dose estimate work associated with polycubes was available from either location, the analysis was subjective. Although it is expected the exposure received during processing will be lower at Building 325, it was felt that the additional exposure from shipping and handling largely off set that benefit. PFP will have to get a Notice of Construction which Building 325 apparently does not need because the modifications may be allowed under a general Notice of Construction they already have in place. There would be some industrial risk from drum handling and shipping, but it was not judged to be significant.

6.2,4 Technical Risk

Since both locations would be using the same process, technical maturity was not an issue. PNNL has personnel readily available to perform this work. PFP resources availability is not known because the requirements for all PFP activities have not yet been integrated. Equipment removal from the two gloveboxes will be required in PFP. Though PFP lacks recent experience in removal of equipment from gloveboxes, B&W has extensive corporate experience in decontamination and decommissioning (D&D) of nuclear facilities. Building 325 will have space available and routinely removes unused equipment from the cells to make room for the next project.

6.2.5 Programmatic Risk

This area of consideration revealed the most significant differences between the locations. There are three areas of concern:

Building 325 does not currently have National Environmental Policy Act (NEPA) documentation to permit this activity to take place. PFP has the EIS and Record of Decision (ROD) for residues is already in place, and was therefore, considered a lessor risk. There was concern that there would be negative public response to moving Pu processing activities from the center of the site to the site boundary near the public. DOE also has an initiative to get private industry into the 300 Area. Moving Pu into Building 325 could have a negative impact on this initiative. Building

325 needs to perform a vulnerability assessment. There is a concern that Building 325 will not be aHowed to store material without significant security and safeguards upgrades. Industrial Relations issues present further risks.

Any one of these issues could effectively preclude Building 325 from being a viable option and it will take several months to resolve these issues.

7.0 CONCLUSIONS

The results of the analysis showed that both locations have the capability to perform the pyrolysis work. PNNL offers the advantage of being able to free up PFP personnel for other critical path work. However, the programmatic issues related to trying to move the work to PNNL were judged to be substantial enough to rule out that option in lieu of processing at PFP.

Of particular concern was the need to perform a Supplemental Assessment to determine if a Supplemental EIS would be required. There was significant concern that the public response to moving Pu closer to the river and to town would be perceived negatively. It was also felt that a vulnerability assessment would probably not allow multiple cans of material in the building at a time. This would significantly increase the number of shipments between PFP and PNNL. The road closure and cost issues associated with increased shipments overwhelmed the benefits of processing at PNNL. Additionally, there were Labor Relations concerns that would have added further risk. Therefore, the recommended option is to locate the equipment in PFP.

8.0 RECOMMENDATIONS FOR PATH-FORWARD

- Proceed with preparation of gloveboxes HC-13 and 15 to install the pyrolysis equipment in PFP.
- Complete the hazard analysis, design specification, and other paperwork to allow LANL to complete the design and procure the equipment.
- Perform a design review of LANL design.
- Develop a schedule including performance milestones.
- Identify operating personnel to go to LANL to observe pyrolysis process.
- Complete criticality limit and procedures for operation.
- Obtain Notice of Construction from the state.
- Agree on method to ship from vault to Room 228B.
- Determine if operations will be 1,2, or 3 shifts.
- Include processing of Polycubes and the furnace char through thermal stabilization on the building integrated schedule.
- Issue Start-up Criteria against which readiness will be judged.

. Install the equipment in HC-I 3 and HC-15.

- Perform dry runs on equipment after installation.
- Complete Start-up Review.

9.0 REFERENCE

B.L Aftanas, WHC-SD-CP-FDC-006, Functional Design Criteria PFP Stabilization of Polycubes.

BWHC-9951296-R2

ATTACHMENT 2

Plutonium Solutions Inventory
Review

Consisting of 16 pages,
including cover page

Plutonium Solutions Inventory

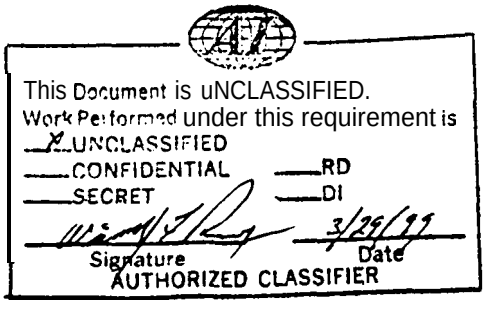
Review

March 1999

Submitted by:

A. Williams, PEC

J. McKibbin, WSMS



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1.0 INTRODUCTION

This report discusses the plutonium solutions presently in storage within the Plutonium Finishing Plant (PFP). Treatment options for stabilizing the plutonium into a solid form are provided, and discussed with respect to disposition options that are available. Previous reports, References 1 and 2, have been used as the primary source of information in obtaining details for most of the plutonium solution inventory. The PFP engineering files were also searched for additional information.

For each item in the solution inventory, there are at least two processes for conversion of the solution to a solid (one exception is the chloride solutions, where one option is selected). The final decision on which process to use will depend on further analysis of customer requirements (e.g., disposition to Immobilization, to Waste Isolation Pilot Plant [WIPP], or to the waste tank farm).

1.1 SUMMARY

The Plutonium Solution Inventory consists of 438 items. Along with the plutonium, other actinides present include depleted, normal and enriched uranium, and a few items contain thorium, One item was identified as high enriched uranium, and it is unknown if plutonium is present in that item. The inventory has also been divided by plutonium 240 content. The inventory consists of weapons grade, fuel grade and reactor grade plutonium.

1,1.1 Vertical Calciner and Ion Exchange

A portion of the inventory is sufficiently pure to be fed directly to the vertical calciner. These solutions are comprised of Plutonium-Uranium Extraction Facility (PUREX) nitrate feed and PFP nitrate feed. The remainder of the plutonium solution inventory will require pretreatment prior to feeding to the vertical calciner.

Chloride solutions may also be processed via ion exchange, if the chloride level in the feed is kept below 1 Molar (M). A feed adjustment step for acid concentration and valence may be necessary prior to processing by ion exchange.

1.1,2 Magnesium Hydroxide Precipitation

An alternative process to calcination is to precipitate all of the solutions with magnesium hydroxide, a process that is used successfully at the Rocky Flats Environmental Technology Site (RFETS). This process provides an impure oxide product, produces a waste stream that meets tank farm criteria, and a product that may be used by Materials Disposition (MD) in its proposed Immobilization process. However, the presence of magnesium has some detrimental effect on the production of the pyrochlore ceramic during immobilization, and blending with more pure oxide that does not contain appreciable quantities of magnesium or other alkaline earth metals may be necessary.

1.1.3 Waste Tank Farm

A small number of items containing 36 grams plutonium could probably be discarded to the waste tank farm, after some preprocessing within the PFP. These solutions contain <1 gm Pu/liter, however, they need to be treated to the 0.033 gin/liter limit set by the Waste Tank Farm (see discussion under paragraph A-3 of this document). These solutions can also be processed via magnesium hydroxide precipitation. Careful review of the plutonium solution inventory may result in a few additional items that could be discarded.

2.0 DISCUSSION

This section of the report first provides the criteria for any product from solution stabilization, then describes the proposed processes for accomplishing stabilization, and finally discusses each of the major categories of solution.

2.1 CRITERIA

The criteria provided here have been accumulated from the included references, and from discussions with Hanford personnel. Since the bulk of the plutonium will most likely be dispositioned to Plutonium Immobilization, acceptance criteria recently issued by the United States Department of Energy (DOE) is of most interest.

2.2 MATERIALS DISPOSITION CRITERIA

An acceptance criteria document was issued by the Department of Energy (DOE) in December, 1998, Reference 3. The criteria include general and specific materials criteria, packaging criteria, documentation criteria, and Quality Assurance requirements. Criteria of particular interest with respect to plutonium solution stabilization include the following:

a. Material shall be unclassified
b. Material shall contain weapons usable plutonium surplus to U.S. National Defense needs
c. Material shall comply with DOE-STD-3013
d. Resource Conservation and Recovery Act (RCRA) wastes are not acceptable
e. Package shall meet dose requirements for contact handling at the shipping site
f. Material in any container shall have an output wattage no greater than 19 watts
g. The total actinide content shall be >30 wt%

h. The data package shall contain the following:
   - Chemical and physical form
   - Best available elemental and chemical compositions
   - Quantity (mass) of material
   - Specific stabilization conditions
   - Source of the stored material
   - Other information that yield insight into chemical impurities
   - Americium mntent

i. Known impurities of concern are fluorine, carbon, and calcium

In discussions with Dr. Leonard Gray of Lawrence Livermore National Laboratory (LLNL), it was indicated that the presence of large quantities of magnesium has a detrimental effect on the immobilization process, Reference 4. Material high in magnesium content may need to be blended with pure oxides, if pure oxides are available at the time the magnesium rich materials are received.

2.3 WIPP CRITERIA

The Carlsbad Office of the Department of Energy provides WIPP criteria. In general, material containing relatively low levels of plutonium can be dispositioned to WIPP, however, in order to meet Safeguards Termination Limits (STL), the material must contain <0.10/0 plutonium.[5] Transportation requirements using Tranuranic Package Transporter (TRUPACT) containers may also limit the quantities of plutonium allowed per shipment.'

2.4 WASTE TANK FARM CRITERIA

Waste Tank Farm operations has prepared a Waste Compatibility Compliance Table that lists safety and operational criteria. These criteria include no organics, no energetic reactions, plutonium concentration of <0.001 gin/liter with no restrictions or <0.033 gin/liter for solutions with neutron absorbers, pH >8, and corrosivity with respect to nitrates and nitrites.

3.0 PROCESS FEATURES

Four process options have been identified for processing the plutonium solutions. These are 1) direct calcination using a vertical calciner for conversion of solutions to a stable oxide form, 2) purification of solutions containing impurities that do not allow direct calcination, and calcining the purified solution in the vertical calciner, 3) precipitation of plutonium and other actinides with magnesium hydroxide, and 4) disposal of dilute plutonium solutions directly to the waste tank farm. Each of these processes are discussed in more detail in this section.

3.1 DIRECT CALCINATION-VERTICAL CALCINER

The vertical calcination process has been described by Stubbs, Reference 7. Plutonium nitrate solution suitable for calcination in the vertical calciner is pumped and mixed with an

atomizing airflow into a preheated bed of plutonium oxide powder. The vertical calciner agitates the injected mixture to 1000^0C to form plutonium dioxide (PuO_2). Reaction products in the off-gas include nitrogen oxides, nitric acid, and steam. These reaction products are scrubbed with caustic, and non-condensables are released to the building ventilation system. The PuO_2 product and a portion of the scrubber solution are continuously removed at a rate to provide adequate residence time of the plutonium in the calciner, and maintain adequate caustic concentration within the scrubber.

The feed rate of 2-4 liters/Hr is limited by plutonium residence time within the calciner, and pressure drop across the off-gas filters.

The process has been demonstrated on a batch basis in the laboratory, and the full-scale unit has been constructed, but not installed.

Advantages:

1. Most of the development work has been completed, and the calciner is ready for installation. Processing of plutonium nitrate solution can proceed rather quickly, however, the calciner must be operated on a continuous basis (e.g., a day shift only operation is not practical for operation of this equipment).

2. The plutonium product will meet the U.S. Department of Energy (DOE) acceptance criteria for immobilization.

Disadvantages:

1. Capital costs for installing the equipment are high.

2. Availability of feed may be limited (the rate of emptying PR cans and filling the feed tanks may not meet the projected feed rate for the calciner). Intermittent operation of the calciner maybe inefficient.

3. The vertical calciner cannot process all plutonium solutions, since some solutions contain impurities that interfere with calciner operation. Most of these solutions contain lower concentrations of plutonium than the feed suitable for direct calcination.

4. The calciner product may not meet DOE-STD-3013 (See Reference 9) and may require an additional treatment to satisfy this standard.

3.2 ION EXCHANGE + DIRECT CALCINATION

Solutions containing impurities affecting calciner operation may first be purified by an ion exchange. Impurities consist of chlorides, alkali metals such as sodium and potassium, laboratory solutions and other solutions with unknown impurities, and containing low concentrations of plutonium (1 -10 gin/liter).

Plutonium is selectively sorbed onto an anion exchange resin, and impurities pass through in the effluent. Only the tetravalent plutonium species complexes with nitrate, and the

optimum nitric acid concentration for high loading onto the resin is 7.5N. A feed adjustment step for both valence and acid concentration may be necessary prior to feeding to the ion exchange system. The valence adjustment can be performed with a reductant such as hydroxylamine nitrate or ferrous sulfamate, followed by sodium nitrite to assure that any trivalent plutonium is oxidized to the tetravalent species. The effluent may then be discarded to waste. Uranium is weakly sorbed on to the resin, and is readily washed off during a wash cycle. See Reference 8. The purified plutonium solution will be low in acid (~1N HNO_3) and can be fed directly to the calciner. This ion exchange process is routinely used at LANL, Reference 9. Although the plutonium feed rate is less than the calciner design rate for plutonium nitrate solution, the feed rate will be limited by the pressure drop across the calciner off-gas filters.

Thorium is one of the few elements that is also complexed by nitrate, and will also sorb onto the resin, however, thorium in the product should not affect calciner performance.

The presence of chlorides in the feed stream should not affect overall ion exchange performance, however, chloride solutions will need a feed adjustment step. Chlorides in nitric acid can be processed if the chloride concentration is <1M however, the presence of chlorides may corrode process equipment (tanks, pipes, etc.)

Advantages:

1. The purified product will meet feed requirements for the vertical calciner.

2. The ion exchange process has been used routinely at LANL, and previously at RFETS and Savannah River Site (SRS) for many years.

3. All solutions, except organic solutions, can be processed through the vertical calciner.

Disadvantages:

1. The operation will require design and installation of a new system, at some undetermined cost. The system may require feed adjustment tanks, reagents for valence adjustment, and tanks for the feed adjustment reagents.

2. The safety issues associated with nitrated ion exchange resins need to be clearly understood, and operations conducted accordingly.

3. The feed adjustment step, if required, adds bulk to the waste sent to the tank farm.

4. Operation of the ion exchange system will need to be closely coordinated with the vertical calciner operation.

3.3 MAGNESIUM HYDROXIDE PRECIPITATION

The RFETS has been successfully operating a magnesium hydroxide precipitation process for approximately two years. This process has been used to convert plutonium in solution to

a solid form. During the first year, they treated greater than 5000 liters containing less than 100 kg plutonium.[10]

The process consists of first partially neutralizing the acidic plutonium solutions with sodium hydroxide (neutralize to IN acid, and then adding solid magnesium hydroxide to precipitate the plutonium. Process development was performed at LANL. Plutonium hydroxide is a gelatinous precipitate that is very difficult to filter and recover. The presence of the magnesium provides for improved filterability of the precipitate. The precipitate is filtered through a flat bed filter (called an R-6 filter at RFETS), where the bulk of the plutonium is removed. The filtrate is then passed through one micron porosity polishing filters. The filtrate from the polishing filters contains $3xl0^{5}$ gm Pu/liter, and the process is self-buffering at a pH of 8.5.

The presence of chlorides improves the filterability of the precipitate. Concentrated solutions were diluted to 25 gm Pu/liter prior to processing, although their criticality limits allow them to process solutions containing up to 40 gms Pu/liter.

The precipitate is dried and then calcined. So far, RFETS has not calcined any of the precipitate to meet theDOE-STD-3013 requirements, Reference 11.

The fired precipitate from rich plutonium solutions contains 65% plutonium, with the major secondary constituent being magnesium. The process may be performed in a batch mode, and remain simple in operation and equipment needs. Any uranium present would also precipitate, however, the immobilization process adds uranium, and its presence in the PFP precipitate is not considered detrimental. Valence adjustment may not be required to attain quantitative removal of plutonium, since both the trivalent and tetravalent plutonium species are very insoluble.

Advantages:

1. Process equipment requirements are simple and low cost, and the process requires minimal control.

2. The process may be operated on one shift or multiple shifts.

3. Filtrate from the process meets waste tank farm criteria.

4. The process can be used for treating additional liquid waste streams generated during terminal clean out operations.

Disadvantages:

1. The product may not meet DOE-STD-3013 requirements, which are also MD immobilization requirements.

2. The product may need additional treatment (e.g., dilution with higher purity oxide) to meet MD immobilization criteria.

3. Filter cakes that do not meet the >30% requirement for contained actinide may not have a disposition option (e.g., the only other disposition option is discard to WIPP, and the Safeguards Termination Limit for this material is currently O. I%), Reference 10.

[f RCRA constituents are present in the precipitate, it cannot be shipped to M D immobilization for disposition.

3.4 DIRECT DISPOSAL TO TANK FARM

Some solutions appear to be sufficiently dilute that once they are neutralized in PFP, they may be discarded to the tank farm. These solutions will most likely contain the necessary neutron absorbers to meet the higher limit set by the tank farm. Solutions containing >0.033 gm Pu/liter may also be discarded provided a detailed criticality safety analysis is performed. With additional criticality analyses, it is possible that additional solutions could be discarded to the tank farm. This is the simplest" of all the processes, but also the process with the greatest limitation.

Advantages:

1. Solutions may be treated and discarded to the tank farm using existing equipment.

Disadvantages:

1. Only a small amount of the plutonium inventory may be dispositioned via the tank farm.

2. Criticality safety issues need to be addressed for most solutions that could be dispositioned to the tank farm.

4.0 SOLUTION CATEGORIES

A summary of the plutonium solution inventory has been prepared. This summary provides an item description and ID. an estimated separation date for determining americium growth, the COEI and MTC code assignments, an allocation to one or more of the process alternatives for each item, the ^{240}Pu content for each item, a grouping of items according to the range of ^{240}Pu content (7% or less is weapons grade, 12% or less but >7% is fuel grade, and >~2% is reactor grade plutonium), and the uranium content for each item, if known. A comparison has also been made with Reference 1 to identify where inventory activity has taken place since 1996. *This summary is available for review at PFP*.

The solution inventory is discussed below

4.1 PRF PLUTONIUM NITRATE SOLUTIONS

These are purified solutions from the PRF solvent extraction system, and can be considered the same as PUREX nitrate. The solutions may be processed by direct calcination, or

diluted and processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.2 PUREX PRODUCT NITRATE SOLUTIONS

These are purified PUREX nitrate solutions. The solutions may be processed by direct calcination, or diluted and processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.3 PLUTONIUM NITRATE SOLUTION/ZR PICKLE SOLUTIONS

These items also appear to be purified PUREX nitrate solutions. The solutions may be processed by direct calcination, or diluted and processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.4 NONCONFORMING SOLUTIONS

This category is divided into 7 sub-categories, which are discussed below

4.4.1 Plutonium Nitrate Process

These are flush solutions, which normally contain impurities such as iron, potassium and manganese, and thus need to be treated prior to feeding to the vertical calciner. These solutions can also be treated by magnesium hydroxide precipitation. Two items in this lot contain 8 grams plutonium, and may be low enough in plutonium content to discard to the tank farm, after pretreatment. Details on these items can be found in Reference 2.

4.4.2 Plutonium Recovery Solution

These are flush solution from the Plutonium Recovery Facility (PRF). Flush solutions normally contain impurities such as iron, potassium and manganese, and thus need to be treated prior to feeding to the vertical calciner. These solutions can also be treated by magnesium hydroxide precipitation. One item in this lot contains 5 grams plutonium, and may be low enough in plutonium content to discard to the tank farm, after pretreatment. Details on these items can be found in Reference 2.

4.4.3 Lab Solution

These are also listed as lab nitrate, and may contain impurities from laboratory operations. If the solutions pure, they may be processed directly through the vertical calciner, however, they are an order of magnitude more dilute than the PUREX nitrate feeds. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.4,4 Critical Mass Lab Nitrate

These solutions also contain a slightly greater amount of uranium, which may be slightly enriched. No details are available on impurities present. Because of the relatively low plutonium concentrations, and knowledge of other solutions from the critical mass lab (e.g., item C-7), these solutions require purification prior to feeding to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.4.5 solutions 04

These solutions contain thorium, and because of their age (estimated separation date of 1975), plutonium content, and unknown impurities, they need to be processed by ion exchange prior to feeding to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4,4.6 Battelle Northwest (BNW) Pu and. Depleted Uranium (DU) Storage Only

This consists of 3 items, each containing 1 gram of fuel grade plutonium. The low plutonium content makes these items candidates for discard to the tank farm. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.4.7 Pu Conversion Solutions

This consists of 1 item which because of age (1975), and low plutonium concentration, it is assumed that the solution needs to be treated prior to feeding to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2.

4.5 FILTRATE AND GENERAL SALVAGE SOLUTIONS

This category contains filtrates from the oxalate precipitation process and flush solutions. The filtrate solutions likely contain potassium and manganese from the oxalate destruction step. All of these solutions would need to be purified prior to feeding to the vertical calciner.

The caustic solutions, if indeed they are caustic, should have the plutonium precipitated and settled to the bottom of the container. Simple filtration may be all that is required to ship these solutions to the tank farm. Sampling and analysis of these solutions can confirm the plutonium concentration in the solution, and the pH or alkalinity. If the solutions are indeed caustic, and the plutonium remains in solution, then strong completing agents are present which must be destroyed in order for the plutonium to be removed. Destruction of strong completing agents can be accomplished by exposure to hot strong nitric acid (>7N HNO_3).

The flush solutions may also be processed by magnesium hydroxide precipitation. The caustic solutions will need further characterization prior to any processing. Details *on* these items can be found in Reference 2.

4.6 PLUTONIUM CHLORIDE/LAB SOLUTIONS

All of these solutions are identified as chloride solutions from the laboratory. All chloride impurity needs to be removed prior to feeding to the vertical calciner. Processing by ion exchange can be accomplished rather easily if the adjusted feed contains less than 1 M chloride. Higher concentrations of chloride will result in excessive equipment corrosion.

The solutions may also be processed by magnesium hydroxide precipitation, where the presence of chloride enhances the process. Details on these items can be found in Reference 2. Details on these items can be found in Reference 2.

4.7 MISCELLANEOUS SOLUTIONS

This category consists of a group of miscellaneous solutions. These are identified in three sub-categories, which are discussed below;

4.7.1 Oil/Organic Solution

There are 2 items identified as organic. One item, can A-014 appears to be an acid solution. The solution has an estimated separation date of 1977. An analysis from a sample from this item is in the engineering files at PFP, Reference 2. The analyses show the solution to be sampled on C-61 11 and C-6088. The results show an acidity of 9.54N, 0% organic I0.2M nitric acid, and impurities of fluoride (0.071 M), phosphate (0.034 M), and chloride (0.02 M). This solution, assuming that the analyses are correct, *can* be processed by ion exchange prior to feed to the vertical calciner. The solution may also be processed by magnesium hydroxide precipitation. See Reference 9.

The second item, assuming that it is organic, will need to be characterized to determine the organic species. Assuming that the organic contains tributyl phosphate that has been degraded. there are known ways of treating the solution to remove the plutonium. After stripping the plutonium, disposal of the organic can proceed along with disposal of other organics from the PRF that contain trace quantities of plutonium.

4.7.2 Pu-Depleted Uranium Solution, Critical Mass Nitrate solution

These solutions are most likely quite pure and can be processed directly be the vertical calciner however, since there is some uncertainty, samples may be taken from a few of the containers to confirm solution purity. Since the plutonium content of each item is very similar, and the isotopic ratio is identical for each of these items, it may also be assumed that these 12 items come from the same lot. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2, and the uranium values found in the PFP uranium inventory. See Reference 9.

4.7.3 Pu-Depleted U Solutions-BNW Pu & DU Storage Only

Shipping papers for these items exist in the PFP engineering file. See Reference 3. These papers show that the material was shipped to PFP in September 1976. The analytical data from each report suggest that these items are all from one lot, The presence of boron in the solution may affect operation of the vertical calciner, and these solutions may be processed through ion exchange. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2, as well as the shipping papers located in the engineering files.

4.8 OTHER PLUTONIUM-URANIUM SOLUTIONS & PU-TH SOLUTIONS

This category consists of 50 items with the low plutonium values. These items would be processed by ion exchange prior to feeding to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. Details on these items can be found in Reference 2, and the uranium values found in the PFP uranium inventory. Shipping papers for the Pu-thorium solutions also are located in the PFP engineering files, Reference 14.

4.9 PLUTONIUM SOLUTIONS-CURRENT GENERATION

These solutions were not identified in any of the references, but are listed on the most recent PFP inventory. Discussions with J. Durnil identified these as solutions that have been transferred to the plant, and have lost their original identity. They can be identified as follows;

4.9.1 PUREX Nitrate in L-3 Containers

Since these items are identified as PUREX nitrate, and this category has shown some inventory activity. it is assumed that the solutions can be fed directly to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. The source of information is the PFP plutonium inventory and discussions with J. Durnil.

4.9.2 Training Run Solutions

The dilute nature of these solutions suggests that they need to be processed by ion exchange prior to feed to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. The source of information is the PFP plutonium inventory and discussions with J. Durnil

4.9.3 Mix Tank Leak Check and A-Lab Residuals

The dilute nature of these solutions suggests that they need to be processed by ion exchange prior to feed to the vertical calciner. The solutions may also be processed by magnesium hydroxide precipitation. The source of information is the PFP plutonium inventory and discussions with J. Durnil.

4.9.4 Tank 214 Pu Solution

This tank is assumed to contain purified PUREX nitrate solution. This solution can be fed directly to the calciner. The solution may also be processed by magnesium hydroxide precipitation. The source of information is the PFP plutonium inventory and discussions with J. Durnil.

4.9.5 Miscellaneous Solutions

There is one item of miscellaneous solution with no analytical data, containing 3 grams plutonium. The dilute nature of this solution suggests that it may be discarded to the waste tank farm. The solution may also be processed by magnesium hydroxide precipitation. The source of information is the PFP plutonium inventory and discussions with J. Durnil.

4.9.6 High Enriched Uranium (HEU) Solution

One item appears on the uranium. Plutonium contamination of this item is not known. The solution may be fed directly to the calciner, or processed by magnesium hydroxide precipitation.

5.0 REFERENCES

1. M. W. Gibson, "Planning Data for Plutonium Finishing Plant Special Nuclear Material Inventory"," WHC-SD-CP-TI-212, Rev. O, dated September 1996.

2. L.H. Rogers, Internal Report, "Disposition of PFP Solution Inventory," 1 5500-96-LI-lR-024, Rev. 1, dated May 1, 1996.

3. USDOE, "Acceptance Criteria for Plutonium Bearing Materials to be Dispositioned by Immobilization," dated December 1998, Rev. O.

4. Private communication, L. Gray to A. K Williams, February 19, 1999.

5. F. J. McCallum, "Additional Attractiveness Level E Criteria for Special Nuclear Material," memo to DOE program and field offices, dated July 22, 1996.

6. Waste Compatibility Compliance Table, from Ken Fowler, Waste Operations, undated.

7. A. M. Stubbs, "Plutonium Finishing Plant Process Flow Document - Calcination of Plutonium Nitrate Solution," PFD-Z-300-00l, Rev. A-O, dated January 30, 1997.

8. PFP Engineering File 5.6, letter to C. J. Mishko, 'Terminal Cleanout - Ion Exchange System," R83-0292, dated January 21, 1983.

9. S. F. Marsh, "Improved Recovery and Purification of Plutonium at Los Alamos Using Macroporous Anion Exchange Resin," IA-10906, dated May 1987.

10. Private communication, Richard Schmidt, RFETS, to A. K. Williams, February 8, 1999.

11. Private communication, J. Stakebake DOE-RF, to A. K. Williams, February 10, 1999.

12. PFP Engineering File 5.11.5.10. Inorganic Scrap Solution, undated.

13. PFP Engineering File, memo from W. F. Skiba to P. C. Doto, 65240-79-180, December 11, 1979.

14. PFP Engineering File, 5.11.5, five shipping/receiving reports 5819 dated 9-13-76, 5757 dated 9-3-76,5758 dated 9-3-76,6759 dated 9-9-76 and 5760 dated 9-9-76.

15. PFP Engineering File 5.11.5.3, memo C. R, Wilson to G Mishko, R-84-1186, March 30, 1984<

BWHC-9951296-R2

ATTACHMENT 3

Use of Magnesium Hydroxide Precipitation
or Ion Exchange to Treat
Impure Solutions
Evaluation

Consisting of11 pages,
including cover page

Use of Magnesium Hydroxide **Precipitation** or Ion Exchange to Treat impure Solutions

March 1999

Submitted by:

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EXECUTIVE SUMMARY

The Defense Nuclear Facilities Safety Board (DNFSB) 94-1 Implementation Plan for the Plutonium Finishing Plant (PFP) is scheduled to be completed before 2005, and stabilization and disposition of the plutonium inventory, including plutonium solutions, is vital to the completion of the program. An Environmental Impact Statement (EIS) has been completed which evaluated various processes for treating the plutonium inventory. For solutions, the EIS selected both Vertical Denigrator Calciner (VDC) process with ion exchange pretreatment and hydroxide precipitation. The EIS discussed use of hydroxide precipitation for caustic and chloride solutions – those solutions not suitable for the VDC.

PFP currently stores 431 items of plutonium-bearing solutions from a number of sources across the Hanford site. These solutions are stored in vented 10-1iter containers. Ninety-nine of these items are polybottles stored in thin-walled stainless steel containers. The remainder is in Product Receiver (PR) containers in which the solutions are stored in thick-walled stainless steel vessels. The primary concern with the storage of plutonium-bearing solutions is the radiolytic decay of the solution resulting in the formation of hydrogen. If improperly vented, the hydrogen could build up to within the explosive range and/or pressurize the container to the point it ruptures. The 431 items contain approximately 4800 liters of solution. Approximately 1400 liters of solution is “pure” or concentrated solution which could be fed directly to the VDC. The remaining 3400 liters is “impure” solution. This solution is primarily nitric acid based but there are approximately 150 liters of caustic and 150 liters of chloride solutions. There is also 1 container of organic solution. All of the ‘[impure” solution would require pretreatment through an ion exchange process prior to feeding it to the VDC. All of the “impure” solutions (other than the 1 organic bottle) could be fed to the magnesium hydroxide precipitation process. Only the caustic solutions might require any pretreatment.

A project to install a vertical calciner is partially complete. This is a new installation, so the gloveboxes are clean. An ion exchange process has been designed but no installation work has been performed. The proposed plan is to install ion exchange in an existing glovebox. The magnesium hydroxide process will be installed in the same gloveboxes as the VDC. An engineering evaluation to determine the effort required to install the hydroxide process is currently underway.

The decision on solutions deals with whether the “impure” solutions should be treated through an ion exchange process and sent to the VDC or treated using a magnesium hydroxide precipitation process. The “pure”, concentrated solutions are to be fed to the VDC.

1.0 INTRODUCTION

Plutonium solutions being stored at the Plutonium Finishing Plant (PFP) must be converted to a solid form, stabilized and packaged for long term storage. Though some of the product from the solutions muld end up less than 30% Pu, it is expected

that a significant percentage will be 50% or higher Pu concentration using either proposed method of treatment.

The current technical baseline for treatment of all Pu solutions is the VDC with an ion exchange (IX) pretreatment step when required. The 1400 liters of "pure" solutions can be sent directly to the VDC for treatment. The other 3400 liters of solution must be treated to remove impurities prior to introduction to the VDC. A series of anion exchange columns would be used to adsorb the Pu from the feed. When the anion exchange columns are loaded (full of Pu), they are flushed to remove any residual impurities. The plutonium is then leached from the anion resin. The resulting stream is a "pure", somewhat more concentrated stream. This type process has been used for years throughout the DOE complex.

PFP has been developing a VDC process to convert the *solutions* to a solid form. Solution is injected into the VDC that contains a bed of plutonium oxide at 950 degrees C. The nitric acid in the solution vaporizes and leaves the plutonium as a solid oxide. The nitric acid vapors are removed and neutralized using a caustic scrubber. The scrubber solution is disposed of via the liquid waste handling system. The calciner runs at 950 degrees C and is designed to produce a product that does not require further thermal stabilization. PFP has some experience running a prototype of the calciner. About 70% of the product from the prototype met the 3013 LOI limit. Lessons learned from the prototype operation have been applied to the installation of the new production VDC.

B&W Hanford Company (BWHC) has performed a technical review of the current Rocky Flats Environmental Technology Site (RFETS) Caustic Waste Treatment System (CWTS) to determine its usefulness in handling the PFP solutions. RFETS worked with Los Alamos National Lab (LANL) to develop a precipitation process to handle dilute Pu solutions that were being drained from their process tanks and lines. After looking at a number of options, it was determined that the addition of solid magnesium hydroxide provided the best results. RFETS has processed over 10,000 liters of solution using this process with good results. They have also expanded their planned operating range from O-5 g Pu/L to O-25 g Pu/L. The filtrate (treated solution) typically contains less than 0.0001 g Pu/L. The only solutions they have encountered any problems processing are solutions containing fluoride that hasn't been complexed.

The goal of this evaluation is to determine whether to use ion exchange pretreatment or magnesium hydroxide precipitation to handle the "impure" solutions.

2.0 **APPROACH**

This assessment began with a series of meetings to discuss the options, their benefits and constraints. COGEMA was subcontracted to provide an independent analysis of three options. A report was prepared which provides a detailed description of the process, flow sheets, and waste volumes. The VDC project was walked down to evaluate the suitability for use with the precipitation process. Design

and layout for the ion exchange process was completed. Procedures, hazards analyses, and other operating data for the CWTS were obtained from RFETS. The effort was concluded with a decision meeting held February 23, 1999 that used a Kepner-Tregoe analysis technique to compare the options.

3.0 SOLUTIONS INVENTORY

The current solution inventory dates from as far back as 1975. PFP has recently completed a detailed review of this inventory. This review titled, "Plutonium Solution Inventory" is provided as part of the decision package on Commitment #102 which committed to a Solution Characterization Study.

The solution is stored in 10 liter bottles that are in drum over packs. Most of the Pu in solution is Pu nitrate solution that came from a number of sources including: Plutonium Reclamation Facility (PRF) solvent extraction process, Plutonium-Uranium Extraction (PUREX) facility, and flush solutions from PRF. This is represents the 1400 liters of "pure" solutions. The 3400 liters of "impure" solutions is also mostly Pu nitrate but also contains some high chloride solution, caustic solution and a bottle of organic solution. These process solutions and filtrates came from PRF, PFP, laboratories, Critical Mass Lab, and the oxalate precipitation process.

4.0 TREATMENT OPTIONS

4.1 ION EXCHANGE TREATMENT OF "IMPURE" SOLUTIONS

The VDC is a stirred bed of plutonium dioxide powder in the annulus between two vertical stainless steel tubes. The bed is maintained at 1000 degrees C by electric heaters and a programmable controller. The hot powder is stirred by a mechanical agitator with tines that extend into the annulus. The feed solution is sprayed in to the bottom of the calciner with atomizing air. The plutonium feed *solution* forms a thin layer on the particles in the powder bed. The high temperature maintained in the calciner bed boils off the liquid and decomposes the plutonium nitrate to plutonium dioxide and gaseous nitrogen oxides (Nox). The additional plutonium dioxide layers increase the bed particle size. Agitation causes smaller particles to move toward the bottom of the bed while larger particles move upward. The powder is continuously agitated until the larger particles reach the top and fall in to a collection tube. As the collection tube fills, it is removed and dumped into a storage or transport container. The plutonium oxide produced by calcination is assumed to be a dry relatively dense, storable powder that meets loss-on-ignition (LOI) and packaging requirements of DOE-STD-3013-94.

The water vapor, atomizing air and NOx flow upward through the annulus and exit the top of the calciner. Sintered ceramic filters remove particulate matter from the off-gas stream. The vapors are sent through a condenser and then treated in a caustic scrubber to remove NOX. The treated scrubber solution is received in pairs of glass columns that are sampled when full. If the solution is low enough in Pu it is dropped to the waste tank system.

The ion exchange process takes place in a cylindrical glass column that contains a polymeric resin bed, through which the "impure" solution is fed. Typically four steps comprise a cycle. In the column-loading step, the resin selectively adsorbs plutonium and other tetravalent actinides from the solution while essentially all other cations pass through. The wash step removes non-adsorbed impurities from the column. An elution step then removes the adsorbed plutonium and actinides from the resin and washes them from the column. The final step is a reconditioning wash that promotes adsorption of plutonium and actinides in preparation for the next column-loading step. The purified plutonium nitrate stream resulting from the elution step becomes feed for the vertical calciner. The liquid waste stream from the ion exchange column results from the loading, wash and reconditioning steps.

Feed to the VDC and ion exchange will come from tanks in the feed make-up room. The product receiver tanks and bottles will be brought to the feed make-up room to be unloaded into larger tanks. When a tank is full, it is agitated and sampled. When the sample results are received, the material can be processed.

4.2 MAGNESIUM HYDROXIDE PRECIPITATION

The vertical calciner utilizes the same equipment described above. However, in this case, it is only used to process the "pure", concentrated solutions. The "impure" solutions will be fed directly to a magnesium hydroxide precipitation process like that used by RFETS. The ion exchange process would not be installed.

The precipitation process uses solid magnesium hydroxide powder as the precipitating reagent. Addition of magnesium hydroxide to acidic plutonium nitrate feed solution results in dissolution of the magnesium hydroxide and neutralization of the acid. Since plutonium is only slightly soluble in alkaline solutions, neutralization of the acid results in the precipitation of plutonium hydroxide. This slurry is then filtered to produce a plutonium hydroxide cake and a filtrate liquid. Any other elements present in the feed solution that are insoluble in alkaline solutions will precipitate with the plutonium.

Typically the feed is blended to the desired plutonium and nitric acid concentration. It was found that keeping acid concentrations below 3 M minimized foaming during acid neutralization. Criticality and Security and Safeguards issues combined to limit the feed concentration at RFETS to 25 g Pu/L.

The feed is pumped into cylindrical precipitation columns. Solid magnesium hydroxide powder and a small amount of flocking agent are added to the precipitate tanks by vacuum transfer. The column contents are then air sparged for 20 minutes. The precipitate is then allowed to settle. The precipitator column is then drained onto a filter. The filtrate columns are under vacuum and are used to suck the filtrate through the filter. Upon completion of the filtration, the cake is scraped off the filter and put into a pan for drying on a hot plate. The dried material is transferred to thermal stabilization for treatment. The filtrate will be sampled and transferred to the waste tank system.

Feed will be transferred from the feed make-up room as described in the VDC process description. Both the VDC and hydroxide precipitation may utilize the same gloveboxes. As a result much of the equipment will be shared. One of the precipitator columns will be the feed tank and a second will be a flush tank. A third will require replacement with the VDC scrubber. The spent scrubber solution tanks will serve as the filtrate tanks for precipitation.

5.0 PROCESSING LOCATIONS

The magnesium hydroxide precipitation process and the VDC are both planned to be located in the VDC gloveboxes. The VDC project has essentially all of its equipment installed. There are however a significant number of engineering changes that are outstanding that must be evaluated to determine the scope and schedule remaining. The conceptual design for a $Mg(OH)_2$ process is underway and is expected to be completed by the end of March. All of the equipment needed for the process can fit into the VDC gloveboxes.

[on exchange would be located in an existing glovebox. Design is complete for ion exchange, but no work has been initiated.

The bottles of solution will be unloaded in the feed make-up room. The feed will then either be sent through an encased overhead line to the VDC gloveboxes for processing or will be fed to the ion exchange columns and returned to the feed make-up room. The treated feed would then be pumped through the encased line to the VDC gloveboxes for processing.

Solids from the solution treatment process will be conveyed on conveyor HC-3 to thermal stabilization for final treatment. If the VDC is used, this step may not be required and the product could go directly to LOI testing. Material that passes the LOI will be placed in a Hanford Convenience Can or a welded inner container for interim storage in the vault.

5.1 ANALYSIS

5.1.1 Process

A workshop was held Tuesday, February 23, 1999 to evaluate the options related to solutions processing at PFP. Three options were discussed: (1) Use of the Vertical Denigration Calciner (VDC) with IX to treat the “impure” solutions, (2) Use of the VDC with magnesium hydroxide precipitation to treat the “impure” solutions, and (3) Use of magnesium hydroxide precipitation to treat all solutions. The third option was added to the original decision process to gain a perspective on how it mmpared to using the VDC for the concentrated solutions. Using a Kepner-Tregoe assessment process evaluators from DOE-HQ, DOE-RL, BWHC, and FDH evaluated these options. The evaluations included five areas: cost, schedule, safety risk, technical risk, and programmatic risk. Key points evaluated in the decision process for each of the five areas are discussed below. The consensus of the workshop is that magnesium

hydroxide precipitation of "impure" solutions should be used instead of ion exchange followed bv VDC processing. Use of the magnesium hydroxide to precipitate all of the plutonium solutions was favored over the option town the concentrated, "pure" plutonium solutions through the VDC and the "impure" solutions through the precipitation process.

6.0 RANKING DISCUSSIONS

6.1 COST

The magnesium hydroxide precipitation of all the solutions offered the lowest cost while the VDC with ion exchange had the highest cost. [t should be noted that the cost estimates only varied from $5.1 million to $5.9 million. Cost was viewed as an intermediate factor in making the decision.

6.2 SCHEDULE

The VDC/precipitation option offered the best schedule because it optimized the processing rates by putting the "pure" solutions through the VDC in about 10 weeks and the "impure" solutions through the precipitation process in about 11 weeks. The VDC processing rate is half that of precipitation on a volume basis (150 liters/week vs. 300 liters/week). Processing all solutions through precipitation was rated worst on schedule.

Solution Type	VDC-IX	VDC-$Mg(OH)_2$	$Mg(OH)_2$
Impure Solutions (> 3000 L)	Rate: 150 L/w Sch. 22 wks	300 L/w 11 wks	300L/w 11 wks
Pure Solutions (> 1500 L)	Rate: 150 L/w Sch: 10 wks	150 L/w 10 wks	30 Ltw* 50 wks
Total Process Time	32 wks	21 wks	61 wks
Start-up Time	12 wks	20 wks	8 wks
Total Schedule	44 wks	41 wks	69 wks

* $Mg(OH)_2$ rates are based upon a 10 to 1 dilution of the "pure" solutions. Rates could be increased by a factor of 2 to 3 (or more)

[Note: $Mg(OH)_2$ processing rates are based upon a 1 shift operation. VDC is based upon a 3 shift operation.]

6.3 SAFETY RISK

The evaluation team felt there was a higher as low as reasonably achievable (ALARA) risk for the precipitation operation than for the VDC because there is more hands on activity. However, the evaluators felt that this was probably off set by the higher likelihood of exposure from maintenance on the VDC. Though the precipitation process will produce more solids than VDC, it was felt the handling of the few extra boats of material would not add substantially to the overall exposure for the processing. Ion exchange was felt to have a worse exposure potential due to the fact that it was being installed in a contaminated glovebox. It was felt the VDC had a somewhat higher industrial safety risk because of its thermal and hot nitric acid vapor hazards. It was not felt any of the options had a significantly higher impact on the environment than the others. Overall, the IX/VDC and $Mg(OH)_2$/VDC options were rated essentially equal. Processing all material through the precipitation process was viewed as having a somewhat lower safety risk than the other two options.

6.4 TECHNICAL RISK

The greatest differentiator was the general sense that the VDC was not a mature process and thus had a higher technical risk. Several design issues were also discussed relative to the current VDC installation. Because of these concerns, even though there is no PFP specific design yet for the magnesium hydroxide precipitation process, it was felt that precipitation could be made ready in the same time frame as the VDC. Though ion exchange is a well proven process, the fact that this option required the VDC to successfully operate for an additional 5-6 months had it rated as a significantly higher technical risk than the magnesium hydroxide and VDC.

6.5 PROGRAMMATIC RISK

No significant programmatic differentiators were identified among the options. Ion exchange was viewed as having somewhat higher programmatic risk than magnesium hydroxide precipitation,

7.0 CONCLUSIONS

The results of the analysis showed that both ion exchange and hydroxide precipitation are mature processes. However, the fact that the ion exchange option has no contingency in the event there are operational problems with the VDC, caused it to be rated significantly lower than magnesium hydroxide precipitation. With the hydroxide precipitation option, you have the capability of using hydroxide precipitation for all of the material if the VDC fails. The best option from a schedule standpoint is the VDC/$Mg(OH)_2$ option because you are using maximum processing rates for the “pure” and “impure” streams. The recommended option was to use magnesium hydroxide precipitation rather than install ion exchange to treat the ‘(impure” solutions. The use of magnesium hydroxide precipitation for all solutions is also being evaluated.

8.0 RECOMMENDATIONS

Proceed expeditiously with the conceptual design for installing magnesium hydroxide precipitation in the VDC gloveboxes.

Complete an engineering evaluation of open engineering changes to determine what will be required to make the VDC operational.

Obtain cost estimates for the Mg $(OH)_2$ modifications and the VDC engineering evaluation upgrades. Decide if parallel path still makes sense.

Send operators and supervisors to RFETS to observe operation of their precipitation system, which is scheduled to shutdown in June 1999.

Evaluate options to expedite bottle unloading and use of larger feed tanks to reduce the number of samples required and increase feed availability.

Evaluate the need for filtrate hold tanks to expedite processing and reducing the number of samples required by a factor of 4 or 5.

Start-up the prototype calciner. Evaluate modifications to make a more continuous operation possible.

Request LANL to run some tests to determine the effectiveness of Mg $(OH)_2$ at higher Pu solution concentrations.

Obtain test data from LANL or RFETS with respect to effectiveness of thermal stabilization on the precipitate. Also, determine the rate at which moisture is reabsorbed by the treated precipitate versus the rate at which treated oxide will reabsorb moisture.

BWHC-9951296-R2

ATTACHMENT 4

Evaluation of the Hanford Convenience Can and
the Bagless Transfer Can for
Storage of Plutonium Oxide

Consisting of 8 pages,
including cover page

Evaluation of the Hanford **Convenience** Can and the **Bagless Transfer** Can **for** Storage **of Plutonium** Oxide

March 12,1999

Submitted by:

Fluor Daniel Northwest, Inc.

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1.0 INTRODUCTION

Information about and evaluations of the Hanford Convenience Can (HCC) and the Bagless Transfer System (BTS) welded can are needed to determine options for storing stabilized plutonium materials.

1.1 BACKGROUND

Due to the cessation of DOE's production of nuclear weapons and an ongoing reduction in the military nuclear weapons stockpile, a large surplus of plutonium must be stored safely and securely (Savannah River Site - SRS 1998).

DOE-STD-3013-96 and the latest unpublished version (draft) of this standard require that impure Pu compounds with >30wt% Pu be stabilized at 950°C for 2 hours. At this temperature most of the impurities and moisture are driven into the off-gas. The effectiveness of the stabilization is checked by performing a loss on ignition (LOI) test at 1000°C for 1 hour. Storable PuO_2 is required to have a residual adsorbate level (primarily moisture) less than 0.5 wt % as determined by LOI analysis (DOE-STD-3013-96, Section 4.1 .3).

The packaging system must maintain the stabilized material below the 0.5 wt% limit from time of stabilization through final packaging. Since the impurities are essentially gone after stabilization, the only method for the stabilized material to fail the limit is to adsorb moisture after packaging. The following describes the packaging systems to be evaluated.

Following stabilization and LOI testing, the stabilized PuO_2 is put into the Hanford Convenience Can (HCC) material can which is a food pack can that is crimp sealed shut. A second crimp sealed can is placed over the first can. The two can package is bagged out of the glovebox using a plastic bag to preclude spread of any contamination that may be on the outside of the can. Then the bagged package is over packed in two other cans and taken to the vaults for storage. This process results in a package of four nested crimp sealed food pack cans and a plastic bag.

The SRS has developed a welded packaging system for storage of Pu metal and PuO_2 referred to as the bagless transfer system (BTS). The purpose for development of the BTS was for repackaging and long-term storage of nuclear materials. The BTS removes radioactive materials from glove boxes directly into a sealed, all metal, leak tight container free of external transferable contamination. The BTS canister is an all metal (304 L stainless steel) corrosion resistant container with no organic materials and an average burst strength over 2000 psi.

2.0 PURPOSE

The purpose of this report is to evaluate the ability of these two packaging system to provide storage of thermally stabilized PuO_2 for two to four years in a condition that would preclude a need to re-stabilize or re-can prior to final packaging in a 3013 compliant container. .

3.0 EVALUATION APPROACH

For the purposes of this report, a worst case scenario will be used that assumes the moisture reaching the PuO_2 will be absorbed and remain with the PuO_2. Therefore, the main focus of this study was to determine the amount of moisture that could enter the cans over a storage period.

Moisture in the storage vault air entering the cans through tiny leaks is the postulated path for the BTS. Moisture from the decomposing Polyethylene bag (HNF-2062) and the moisture in the storage vault air entering the inner cans through tiny leaks is the postulated path for the HCC.

For one set of calculations the driving force for transfer of air and moisture into the cans is assumed to be pressure fluctuations in the atmosphere; i.e., barometric pressure variations. This model may be described as a “breathing” mechanism. When the barometric pressure goes up, the moist air is breathed into the can; when the barometric pressure goes down, the air is breathed out of the can.

The other two sets of calculations use leak rates to calculate the amount of moist air (from the vaults and plastic bag for the HCC) that could enter the cans over the 4 year period. The calculations use this amount of moisture entering the can as the maximum that could adsorb onto the PuO_2.

4.0 BASIS AND **ASSUMPTIONS**

The following basis and assumptions were used:

Adsorption of moisture on high fired (950°C) PuO_2 is a reversible equilibrium process. After high firing, the sites available for water adsorption are reduced. If a shallow pan of high fired PuO_2 is left open for more than four hours in a room with 50°A relative humidity (RH), it will pickup 0.2 mass % moisture (Haschke and Rickets). At low RH exposed high fired PuO_2 will lose moisture to the air. Also as water breaks down to form hydrogen and oxygen, some of this material reforms as water in the can and some of the hydrogen or oxygen leaves the can through the leak paths that allowed vault air into the can. Oxygen and nitrogen will sometimes tie up sites that water could have adsorbed on.

At these temperatures and pressures (atmospheric), moist air and water vapor behave as an ideal gas.

WHC-SD-TRP-067 reports a calculated leak rate over periods of about 15 years for food pack assemblies similar to the HCC (the outer two cans are the same diameters and material of construction as the HCC) of 5E-6 ml/see. The calculated leak rate reflects a nested can assembly and the degradation of the plastic seal out bag. The calculated leak rate was assumed to be at standard temperature and pressure (STP) which is the most conservative assumption when calculating the number of moles leaking into the cans.

Typical leak rates of 1 E-9 cc/sec atm are measured (using a Varian 947 Multi-test Leak Tester) on the BTS containers. The acceptance criterion for the BTS containers is a leak rate of 2.7 E-7 cc/see atm which was used in the calculations.

The net annual average barometric movement at the Hanford site, near the area where the plutonium storage vaults are located, is reported as 125.5 cm (49.40 inches) of mercury (Hunter and Crippen). The average atmospheric pressure of the storage vaults (223 m or 733 ft above sea level) is 74.3 cm (29.24 inches) of mercury.

A can loading of 3.75 kg of PuO_2 (wattage limited) was the basis used for all water adsorption calculations which corresponds to the maximum acceptable quantity of PuO_2 made from Pu metal ingots that will meet the 19 watts per container limit. A can loading of 5.00 kg of PuO_2 is the mass limit in accordance with DOE-STD-3013-96, Section 4.1.3.

The annual average temperature of vault air was taken as 27 "C (80 °F).

The moisture content of the vault air was assumed to be at 100% RH. This is conservative as the conditioned air in a vault is expected to have a relative humidity in the range of 35 to 45%. In addition to the moisture from the vault air, decomposition of the Polyethylene bag will contribute water to the gas leaking into the product can. Therefore, the gas leaking into the cans after the PE bag is assumed to be water vapor.

It was assumed that moist air leaked into the cans at the measured leak rates.

The breathing model and the BTS calculation assumed 5 wt% moisture in the air.

5.0 EVALUATION RESULTS

For the HCC, the breathing model calculates a quantity of water breathed in and assumed adsorbed by the PuO_2 as 0.071 g water per year. After storage for 4 years, the amount of water adsorbed would be 0.28 g. Therefore, the moisture content of the PuO_2 after 4 years would increase by 0.0075 wt% which is not likely to increase the total amount of moisture to over the 0.5 wt% limit.

For the Bagless Transfer welded can with a leak rate of 2.7 E-7 cc/see over 4 years, the mass of water ingress is 1.91 E-4 g. This is a gain of 5.1 E-6 wt%, which is an acceptably small increase to the total amount of moisture (<0.5 wt%) in the container.

For the HCC with a calculated leak rate of 5E-6 cc/sec and assuming pure water vapor entering the final can due to the decomposition of the PE bag, the following table give the values for the percentage of weight gain for different time periods.

Time Period (years)	Moisture inleakage (g)	Weight gain (wt%)
1	0.13	0.003
2	0.25	0.007
3	0.38	0.010
4	0.51	0.014
5	0.63	0.017
6	**0.76**	0.020
7	0.89	0.024

Although these calculations are conservative for the HCC, they indicate that acceptably small amounts of moisture ingress from the vault atmosphere and decomposing PE bag would be expected over a 4-year storage period.

6.0 **RECOMMENDATION**

The HCC or the BTS can be used to store to PuO_2 for a minimum of 4 years without re-stabilization prior to shipment to SRS.

7.0 REFERENCES

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ATTACHMENT 5

Metals Stabilization Options
Evaluation

Consisting of 6 pages,
including cover page

Metals **Stabilization** Options Evaluation .

March 11,1999

Submitted By:

PFP Engineering and

Fluor Daniel Northwest

(This is a highly detailed analysis of the processes for metal brushing and thermal stabilization and as such is classified. A copy can be made available to appropriate individuals upon specific request- In the interim a Summary is included for general information.)

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SUMMARY

1.1 OVERALL RESULTS

Issues associated with the comparison included personnel exposure, processing schedule, shipping efficiency, estimation of number of items that would need to be oxidized regardless of a decision to brush, pre-process characterization, post-process NDA, and processing considerations, among others. Processing considerations included whether one or two oxidation cycles would be needed, the assumption of having to re-brush unless the brushed metal is placed in welded cans, and the number of furnaces available. In addition, the handling and process steps were identified in detail for both brushing and thermal oxidation. This detail was used to assess differences in processing schedule, personnel exposure, and cost considerations for the two processes.

The two scenarios that logic-ally evolved based on considerations of exposure, schedule, cost, and other issues above were:

1. Oxidation Scenario - Thermal oxidation in the near term and placement of the product in crimp seal cans. This could require subsequent testing of the product for moisture before eventual packaging for shipment. Some fraction of the oxidized material may need to be re-oxidized due to moisture adsorption while in storage.

2. Brushing Scenario - Radiography and weighing of the material in the near term during which those items that are judged to be substantially degraded would be thermally oxidized. The remaining items would be maintained in storage until a welded can system becomes available, at which time they would be brushed to remove corrosion products and packaged. The brushings would be thermally oxidized.

In general, results of quantitative assessments are that a single campaign of oxidation would take from 2 to 5 times greater than brushing depending on the number of furnaces available. The personnel exposure from oxidation was approximately 50% greater than brushing for whole body exposure and a factor of 2.5 greater for extremities. The additional cost for shipping and additional evaluations and procedures for brushing is balanced by the cost of the increased schedule and post-storage examination for thermal oxidation.

1.2 QUANTITATIVE RESULTS, NOMINAL ASSUMPTIONS

The results of the quantitative analysis are shown in Table 1.

TABLE 1 - KEY RESULTS, NOMINAL ASSUMPTIONS

Subject	Brushing	Thermal Oxidation
Schedule, Process Time	12 to 15 weeks	26 weeks with 5 ovens 63 weeks with 2 ovens
cost	Additional Up Front Cost of about $103 to $133 K	Additional Schedule cost: $350 K with 5 ovens $1,270 K with 2 ovens
Dose	20 rem Whole Body 2,341 rem Extremity	29.5 rem Whole Body 5,471 rem Extremity
Transportation		9975 or SAFEKEG Efficiency: If PuO_2 product is wattage limited, then 3 fewer SSTS would be required which would lower costs compared to metal by approximately $375,000. Mass PuO_2 limited (blended with low wattage PuO_2 - uncertain) would require 5 fewer SSTS lowering costs by $625,000.

1.3 POINTS REGARDING SCHEDULE

TABLE 2- OTHER SCHEDULE **IMPACTS**

Schedule Impact Area	Time required to Implement	Affects Brushing	Affects Thermal Stabilization	
Processing Time		9 to 11 weeks		18 or 44 weeks
			Near-Term*	Long –Term**
Bagless Transfer System	18 months	Yes	No	Yes
NDA	9 months	Yes	No	Yes
Safety Analysis	6 months	Yes	Yes	Yes
Processing Procedures	2 months	Yes	No	No

* Near – Term indicates start processing in approximately 6 months.

**Long - Term indicates to start processing in over 18 months.

1.4 POINTS REGARDING DOSE RATE

Most of the whole body and extremity dose (about 75% for thermal stabilization and 90% for brushing) comes from transportation of the packages from the vault to the process line and from the process line to the vault.

The extremity dose for removing Pu from the processing line and transporting it to the vault is much larger for the thermal stabilization process than it is for the brushing

process as oxide is being moved, not metal. The dose rate from" oxide is more than 3 times as great as it is for metal.

There is very little dose in the '[process line" of the brushing process as there is very little activity other than brushing the ingots.

There is a greater percentage of the dose in the "process line" of the thermal stabilization process as both metal and oxide are moved back and forth (e.g., "double firing). In addition, much of the time the material is oxide which has a higher dose rate.

If the less conservative assumptions of dose rate from a metal can would have been used in this analysis, the ratio of the extremity dose in Thermal Stabilization to that in Brushing would have been close to 1.5:1 instead of 2.5:1 as shown Section 7. The whole body doses would also have been very close to 1:1 instead of 1.5:1.

BWHC-9951296-R2

ATTACHMENT 6

Pipe-and-Go vs. Cementation
Evaluation

Consisting of 27 pages,
Including cover page

Pipe-and-Go vs. Cementation Technical Evaluation

February 17, 1999

Submitted to:

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EXECUTIVE SUMMARY

Plutonium bearing materials are currently stored at the Plutonium Finishing Plant (PFP). Those materials not designated to be dispositioned by immobilization by the Materials Disposition (MD) Program will be disposed as waste to the Waste Isolation Pilot Plant (WIPP). The category of materials currently proposed to be disposed as waste to WIPP include: sand, slag and crucible (SS&C), incinerator ash, and plutonium oxides <30 weight percent (wt%) plutonium (previously the plutonium content category was designated as <50 wt %). The residues will be treated, as required, and packaged at PFP. The packaged waste will be transferred to the Central Waste Complex (CWC) for interim storage. The CWC will sort, repackage as necessary, certify the waste to WIPP criteria, and load the drums of transuranic (TRU) waste into the TRUPACT-II for shipment to WIPP.

The current PFP technical baseline for treatment and/or packaging of the residues for WIPP disposition is cementation using Portland cement. The cemented product is loaded in cans that have a nominal volume of 3.4L (0.9 gallon). Currently, cemented ash will be packaged in 55-gallon drums to a maximum plutonium loading of -60 fissile grams equivalent (FGE) minus twice the measurement error. These drums will be transferred to the CWC for loading into the TRUPACT-II container (to maximum plutonium loading of 325 FGE). Current regulations prohibit the mixing of waste types, which may require the unused space in the TRUPACT-II container to be filled with empty drums as dunnage.

This technical evaluation addresses an alternate approach to meet the requirements for storage, transfer and disposal at WIPP of the incinerator ash residue category, namely the Pipe-and-Go approach being implemented at the Rocky Flats Environmental Technology Site (RFETS). There are three elements to the RFETS approach for their applicable plutonium bearing materials. One essential element of this alternate strategy is the utilization of the Pipe Overpack Container (POC). The POC was designed to optimize shipments of high plutonium content TRU wastes from RFETS to WIPP; allowing an increase in drum loading to -200 FGE minus twice the measurement error and an increase of -2,800 FGE in each TRUPACT-II. A second key element of the RFETS strategy was approval of a "variance" to the safeguards termination limits per DOE Order 5633.3B from the Department of Energy's (DOE) Office of Nonproliferation and National Security, Office of Safeguards and Security. The "variance" raised the STL for Attractiveness Level D material to 10 weight percent plutonium. The third element of the RFETS strategy was to identify residue categories that meet the WIPP WAC without any additional treatment and could be blended, as required, and packaged at the <10-wt% level directly into the POC.

Recent Congressional legislation relating to the "FY 1999 Energy and Water Development Appropriations" bill (HR 4060 Section 308) states:

"None of the funds in this Act maybe used to dispose of transuranic waste *in WIPP which contains concentrations of plutonium in excess of 20 percent by weight for the aggregate of any material category on the date of enactment of this Act, or is generated after such* date."

This should not bean issue for incinerator ash stored at Hanford. The incinerator ash at Hanford has average plutonium content of less than 13 wt %.

This evaluation found that Pipe-and-Go is a viable and cost effective alternative to cementation for ash residues. Following RFETS model, PFP can implement the process, take advantage of the work already completed, and benefit from their experience. Based on a conservative estimate, significant cost savings (at least ~$4M) will result from fewer drums being shipped and placed at WIPP. However, most of these savings are outside the existing PFP budget (shipping and placement costs at WIPP are not part of the PFP budget). Processing costs will likely be similar due to the decrease in labor hours offsetting the increased package cost. According to RFETS, storage of the material must be in a protected area and safeguards maintained until the POCS are sealed in a TRUPACT-II.

The recommendations resulting from this evaluation are:

1. Initiate the planning and scheduling necessary to implement Pipe-and-Go for ash.
2. Pursue STL variance to allow disposition of materials having up to 10 wt% plutonium
3. Evaluate other plutonium bearing materials at PFP that may be cost effectively dispositioned using Pipe-and-Go
4. Initiate Tri-Party Agreement negotiations to accommodate Pipe-and-Go without jeopardizing PFP's flexibility.

There are several areas of risk associated with Pipe-and-Go:

1. The concentrations of the plutonium may require that POCs be stored in a protected area pending shipment. Additionally, placement within the PFP protected area may impose special storage requirements.
2. Storage alternatives, including the concrete shell used for IAMPREY fuel, may need consideration to facilitate timely transfer of POCS to CWC.
3. Other issues relating to regulatory agencies and stakeholders may create additional costs.

1.0 INTRODUCTION

Plutonium bearing materials are currently stored at the Plutonium Finishing Plant (PFP). Those materials not designated to be dispositioned by immobilization by the Materials Disposition (MD) Program will be disposed as waste to the Waste Isolation Pilot Plant (WIPP). The category of materials currently proposed to be disposed as waste to WIPP include: sand, slag and crucible (SS&C), incinerator ash, and plutonium oxides <30 weight percent (wt %) plutonium (previously the plutonium content category was designated as <50 wt %). The residues will be treated, as required, and package at PFP. The packaged waste will be transferred to the Central Waste Complex (CWC) for interim storage. The CWC will sort, repackage as necessary, certify the waste to WIPP criteria and load the drums of transuranic (TRU) waste into the TRUPACT-II for shipment to WIPP.

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As shown below, this should not be an issue for incinerator ash stored at Hanford. The incinerator ash at Hanford has average plutonium content of less than 13 wt %.

This technical evaluation investigated the Pipe-and-Go ash packaging method as an alternative to the baseline cementation process and summarizes the results of a Kepner-Tregoe analysis session held on January 28, 1999.

2.0 APPROACH

The assessment was conducted starting in mid-January, 1999 and finishing in early February. A data package provided by RFETS to PFP was reviewed to gain an understanding of the technical approach. Based on available data, an estimate of the applicable ash inventory was developed. Hanford Safeguards and Security and Waste Management organizations were contacted. During the third week in January, team members traveled to RFETS to discuss issues with the responsible personnel and gather additional data and reference materials. Based on the results of the data gathering, a session to perform a Kepner-Tregoe analysis for the comparison was held on January 28,1999.

3.0 PFP INCINERATOR ASH INVENTORY

The incinerator ash category contains about 544 items containing about 81 Kg of plutonium. Three components comprise the incinerator ash category:

- incinerator ash items generated at Hanford's 232-Z incinerator and;
- ash items generated at Rocky Flats
- ash items received from the Pacific Northwest National Laboratory (PNNL).

There are -40 Kg of plutonium in the Hanford 232-Z incinerator ash. The majority of these items are in lard cans and the net weight of the ash was not recorded in the accountability database. The Hanford incinerator ash is packaged in inner cans within the lard can. The incinerator ash items from Rocky Flats (41 3 items) comprise -39 Kg of plutonium and are stored in food pack containers. The remaining 17 items containing about 1Kg of plutonium are items received from PNNL. The average plutonium content of incinerator ash for which there is net weight data available is 12.3 wt % plutonium. Only 13 items are recorded as having a Pu^{240} content greater than 7%.

The incinerators were used to process combustible residues that were generated by plutonium processing and recovery operations. The combustible residues were burned to reduce volume and destroy volatile constituents. Incinerator ash is the furnace product that was generated in the residue recovery incinerators at both PFP and Rocky Flats Plant (RFP). The resulting ash was to be treated to

recover the plutonium. Ash is a mixture of coarse, granular, fine and very fine particulate. The ash is not homogeneous and may contain bits of incompletely burned feed materials and carbon from the incomplete oxidation of some feed materials. Rocky Flats incinerator ash may be characterized as RCRA hazardous by the derived-from rule. The hazardous constituents include F-listed wastes, chromium (D007) and lead (D008). Leaded gloves must have been burned during early RFP campaigns because "old" ash contains more than 50 wt % lead, Hanford generated incinerator ash is not expected to contain target levels of hazardous materials as the incineration of leaded gloves was not a practice at Hanford.

As indicated above, 544 items comprise the incinerator ash category. Net weight data is currently available for only 409 of those items. This subset contains 40.4 Kg of plutonium having average 12.3 wt % plutonium. The items range from a high of 384 g and 53 wt % plutonium to an item with 4 g and 0.8 wt % plutonium. A breakout of the items in terms of weight fraction and weight percent plutonium is shown in Table 1.

Table 1. Applicable PFP Ash Inventory

Category	Item Count	Pu wt (Kg)	Ave Pu (g)	Ave Wt%	Range Wt%
>200g	29	6.7	229	20.1	53-15
150-2oog	38	6.7	176	17.4	33-14
1 00-15og	97	11.4	118	*13.6*	*21-9*
50-4 00g	169	13.2	78	11.3	18-5
<50g	70	2.1	30	7	20-.8
< 10 Wt %	118	6.4	54	6.9	
<7.5 Wt %	52	2.	39	47	

The quantity of plutonium that can be packaged for WIPP is limited by:
. terms of wt %-Pu by safeguards termination limit (STL)
. grams-Pu by TRUPACT-II SAR, CWC Acceptance Criteria and WIPP Acceptance Criteria.

The STL is based on weight percent plutonium. Guidance for high fired incinerator ash allows 2,0 wt % SNM for Attractiveness Level E with physical protection equivalent to Category IV (5 wt % SNM for cemented material) and greater than 2.0 and up to 7.5 wt % SNM as "retained waste" (greater than 5.0 up to 10.0 wt % for cemented materials). Retained waste is defined as SNM generated by processing activities that is deemed not currently recoverable. The physical protection of the retained waste must be commensurate with the category of material. RFETS has an authorized STL for certain residues at 10 wt % plutonium. The REFTS authorization is contingent upon using the POC and providing proliferation resistance controls.

4.0 REVIEW OF CURRENT CEMENTING PROCESS AT PFP

The current PFP baseline for cementation only addresses SS&C material that will be cemented. Flowsheets, cement formulae, and blend plans have not been developed for disposition of the incinerator ash category, In addition, the ability to accurately measure the plutonium content of the cemented waste form has not been adequately determined.

Residue is declared a waste when it enters the cementation process glovebox (HA-20MB). Cementation is "permitted" as a treatment process, and the resultant waste product must meet Resource Conservation and Recovery Act shipping requirements as well as the U.S. Department of Transportation and NRC shipping requirements.

Currently, the maximum plutonium loading for a drum using the cemented waste form and non-filtered bags is -60 g of Pu. PFP is planning on using filtered bags. The use of filtered bags could increase the Pu loading by a factor of three (-167 g of Pu). However, this configuration has not been analyzed and the TRUPACT Content (TRUCON code) has not been approved. These changes should positively impact the allowable loading for the cemented ash waste form in the TRUPACT-IIs.

Cementation of SS&C is attractive because it resolves the reactive metal issue. Unreacted calcium requires stabilization to meet WIPP-WAC criteria. Water is used to convert calcium metal to calcium hydroxide and the excess liquid water is absorbed using dry cement powder. Cementation also results in a material having a lower attractiveness class; allowing safeguards to be terminated and reducing the dispersible plutonium fraction.

Incinerator ash is considered inert, non-pyrophoric, non-flammable, non-explosive and non-shock sensitive and contains no free liquids or gases. The ash residue meets all material form requirements as promulgated by the WIPP/WAC and Interim Safe Storage Criteria (ISSC) requirements.

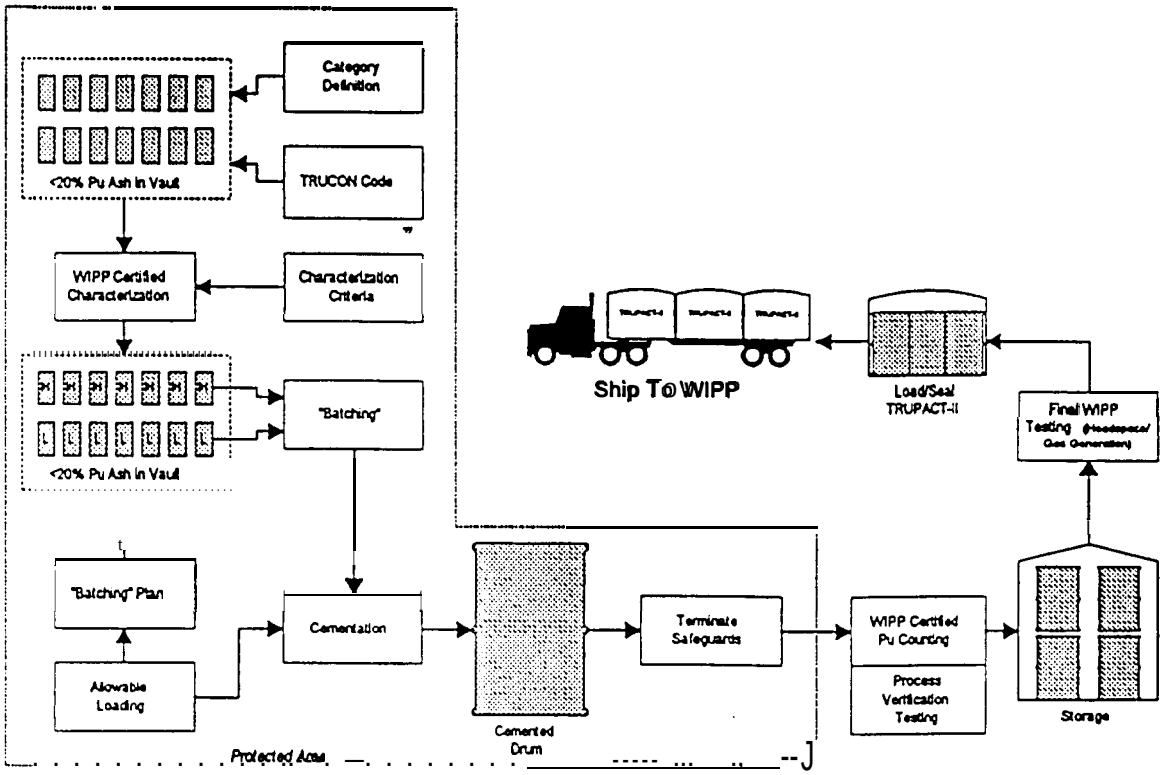

Figure 1. Cementation Process

5.0 PIPE-AND-GO PROCESS

Currently, RFETS has a large inventory of POCS ready to load into TRUPACT-IIs for shipment to WIPP. RFETS expects to start shipping material to WIPP in March 1999. RFETS resolved a number of major issues to obtain approval for the POC approach. Some important and time-consuming issues included:

. Increasing of the Safeguards Termination Limit (STL) to 10 weight percent (wt %) for Attractiveness Level D materials.

. Increasing of the fissile gram equivalent (FGE) loading of the TRUPACT-II from 325 FGE to 2,800 FGE.

• Characterization of the Plutonium materials.

. Qualification and integration of the POC into the TRUPACT-II specification.

• Process development for preparation and loading of the materials.

5.1 Process Diagram

The Pipe-and-Go process is similar to the cementation process up to the point at which the water and cement are added (i.e. Step 4 in the following process description).

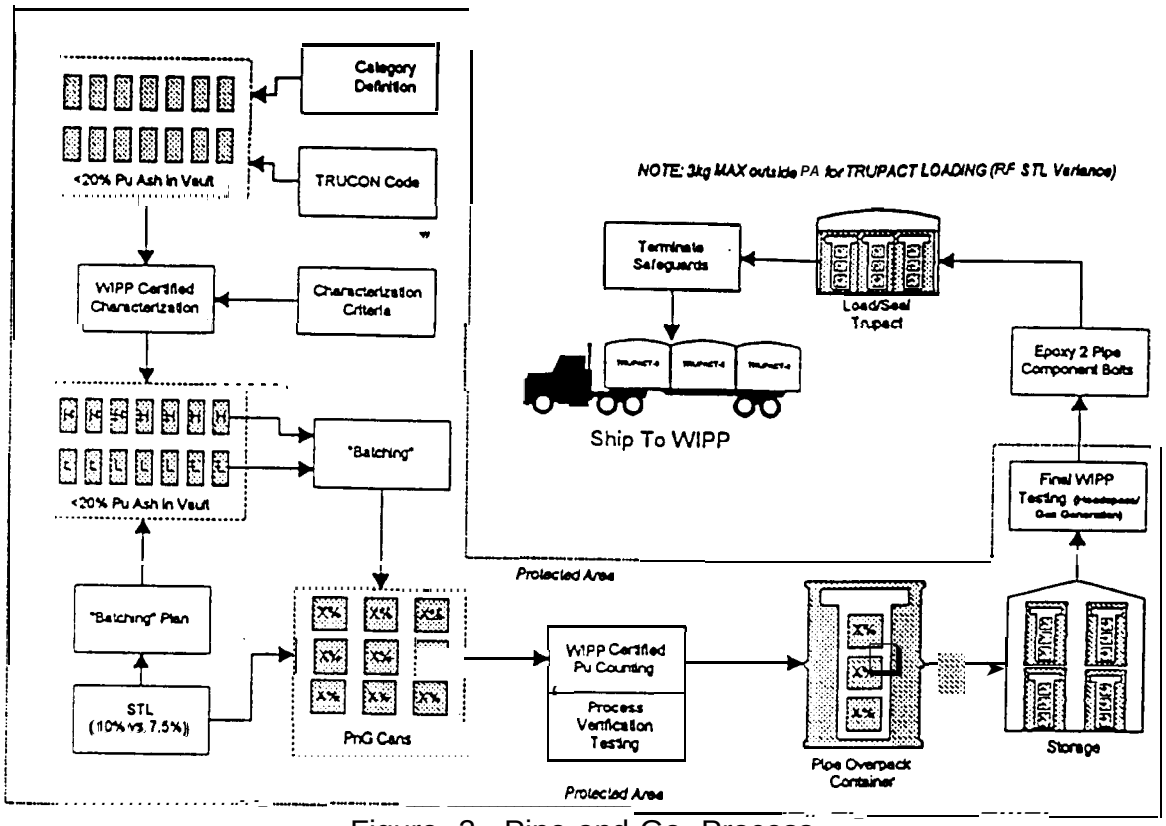

Figure 2. Pipe-and-Go Process

1. The category definition and TRUCON codes are mapped to develop an applicable inventory of items having an average concentration of less than 20 wt % plutonium. A WIPP certified characterization and process/packaging methodology program is completed for the applicable items

2. After development of a WIPP certified characterization program, the applicable inventory is characterized to meet WIPP requirements. The characterization likely includes elemental composition, reactivity testing, and shock sensitivity testing. Following RFETS example, the characterization program must have a 95% probability of detecting a condition that occurred in only 5% of the items.

3. A "batching" plan based on the desired/approved STL is developed to combine inventory items. The plan would select higher concentration cans and lower concentration cans that would result in a net concentration below the approved STL.

4. Items identified in the plan would be "batched" and repackaged into the POC can/bag configuration. RFETS is using manual (cake pan and spoon) mixing operations.

5. The bagged-out items are placed in the pipe component. The pipe component is handled in the pipe overpack.

6. The mixed and repackaged items are subjected to WIPP certified plutonium counting and any process verification testing required as part of the WIPP certification.

7. POCS are stored within the protected area (PA) in a tent or metal building.

8. Prior to transport, each POC is subject to WIPP Certified headspace and gas generation testing.

9. Two bolts on the pipe component are disabled (using epoxy) as the POC is closed.

10, The POCS are loaded into the TRUPACT-II (maximum of 2,800 FGE)

11. After the TRUPACT-II is sealed, safeguards are terminated. As part of RFETS STL variance, up to 3,000g of plutonium can be moved outside the PA for TRUPACT-II loading.

12. Three TRUPACT-IIs are loaded on each truck before departing to WIPP. if each POC contains -170 FGE and each TRUPACT contains -2,800 FGE, approximately 42 drums will be included on each truck to WIPP.

5.2 Pipe Overpack Container

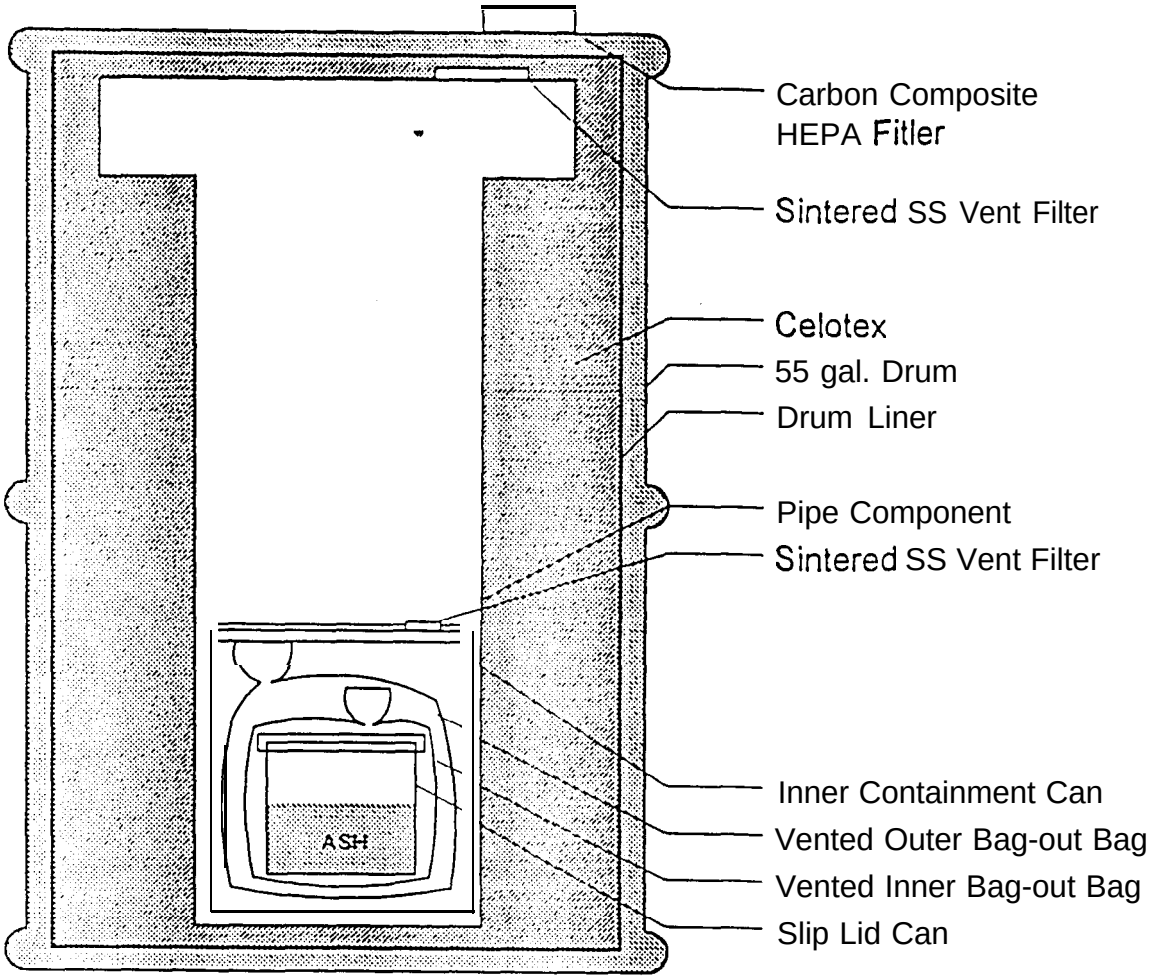

Figure 3. Pipe Overpack Container

The pipe component is the major element of a complete storage and shipping package system known as the POC developed at RFETS. The system consists of a pipe component positioned by dunnage within a 55-gallon drum with a rigid liner, The pipe component was designed in two sizes: 6 inch and 12 inch in diameter, each with a nominal length of 25 inches. The usable volumes are approximately *12* liters and 48 liters, respectively. The weights of the 6-inch and 12 inch pipes are 70 Kg and 182 Kg, respectively. The 6-inch version is constructed of Schedule 40 304L stainless steel. The 12-inch model is fabricated from Schedule 20 stock. The minimum wail thickness in both cases is 0.25 inches. The bottom end of the pipe is closed with a 0.75-inch thick weld cap. The top end of the pipe is fitted with a 150-lb weld neck flange, which accommodates a 1-inch thick bolt-on lid, The flange is machined to incorporate a l/8-inch diameter ethylene propylene (EP) o-ring, ensuring containment of particulate materials. Incorporated into the lid is a sintered stainless steel HEPA filter. pipe Components are to be placed within standard DOT-117C Type A 55-gallon drums with rigid drum liners. Celotex® and plywood are used as spacers

and serve to preclude damage to the pipe on impact and function as thermal insulation. The drum lid is fitted with a polyethylene-housed carbon composite HEPA filter and is secured to the drum with a locking ring.

For RFETS application, the packaging configuration is a function of the IDC residue type. Generally, the residues are contained in a slip-lid stainless steel can and sealed with a double wrap of PVC tape. The can does not qualify as a contamination barrier. During bag-out, the can is placed in 10-roil thick polyvinyl chloride plastic bag. This package is placed into a secondary polyethylene bag, 3 roils thick. Both bags are vented through HEPA filters. The can within the two plastic bags is placed inside of an 1 l-gauge stainless steel can with a threaded lid fitted with a HEPA vent filter (a contamination barrier). Two of the inner contamination barrier cans are placed inside of the Pipe Component whose lid is fitted with a HEPA vent filter. The Pipe Component qualifies as a contamination barrier. The Pipe Component is placed inside of a DOE-17C Type A 55-gallon TRU waste drum. The drum qualifies as a third layer of contamination control provided by the POC.

During testing and certification of the pipe component it was shown that the pipe component has sufficient mass and heat capacity to accommodate the heat generated by the maximum credible exothermic event postulated for the RFETS residues. Also the ability of the POC to survive a maximum credible hydrogen explosion has been demonstrated by structural calculations and verified experimentally. Vent filters are essential elements of the pipe component. Vents on the inner contamination barrier cans, bags, and the 55-gallon drums prevent the accumulation of flammable gases from either radiolytic or chemical means.

The complete POC packaging system provides multiple layers of contamination control as required by the IS SC. Nearly inert nature of the residues and durability of POC provides a total package to provide sufficient inherent stability to ensure worker and environmental and public safety,

5.3 RFETS Residue Compliance Agreement

Based on discussions with RFETS personnel, the Residue Compliance Agreement (RCA) provided a compliance mechanism negotiated with the State of Colorado regulatory authority, The RCA was developed after a court case where the State of Colorado sued the Department of Energy over the declaration that the stored residues were “in process” vs. “waste”. The court declared the material to be waste and forced the RFETS and the State of Colorado to negotiate an agreement. The resulting agreement allowed RFETS to store the material with certain conditions so long as progress was being made to disposition the material. RFETS’S schedule is used to monitor progress.

6.0 SHIPPING AND PACKAGING **LIMITS**

The PFP disposition activity to send SNM material to WIPP is a function of two plutonium limiting criteria. One is the Safeguards Termination Limit (STL). The STL is based on weight percent plutonium. The other is shipping and packaging limits in terms of grams of plutonium per 208-L drum, The gram limits also include a factor to address the measurement error in the method used to determine the plutonium content. The single largest source of cost savings identified for Pipe-and-Go is based on the increased plutonium content that can be loaded in each drum (POC).

The shipping and packaging limits arise from fissile gram equivalent (FGE) criticality limits, wattage limits and dose-equivalent curie limits (DE-Ci) imposed by the CWC and embodied in the TRUPACT-II SAR and the WIPP-WAC. Acceptance criteria for the CWC and the Waste Receiving and Processing Facility (WRAP) include a 35 DE-Ci per container dose-equivalent curie limit and a fissionable material content limit of 177 FGE for 208-liter (55-gallon drum) where:

- the fissile material is contained in 20% or more of the container volume and;
- a 100 FGE limit if the fissile material is contained in less than 20% of the container volume.

The TRUPACT-II criticality limit is 325 FGE per shipment for 208-L drums and 2800 FGE for pipe overpack containers. The WIPP-WAC limit for plutonium in a 208-L drum is 200 FGE. The TRUPACT-II SAR also imposes a wattage limit. The maximum wattage for a TRUPACT-II load is 40 watts. However, this wattage limit is also a function of the material type and packaging considerations to control hydrogen formation and accumulation during shipment. The TRUPACT-II SAR and WIPP-WAC include a requirement to include measurement uncertainty in calculating the FGE and the wattage limits. Twice the measurement error must be included in arriving at the FGE limit and one times the measurement error must be included in determining the wattage limit, The current TRUPACT-II also does not allow mixing of waste material types (e.g. does not allow mixing of type 1.1 with 1.2) within a TRUPACT-II load of 14 drums. A revision has been submitted that would allow mixing of drums of a given waste type (e.g. type I.1 can be included with type I.2 but not waste type II). If this revision is not approved, it will prohibit "spiking" TRUPACT-IIs with cemented ash drums up to the 325 FGE limit.

6.1 Wattage Limit

A waste type and waste package are identified for each TRUPACT-II payload. For each waste material type a thermal wattage limit is calculated as a function of payload containers and layers of confinement. The two payload containers of interest to this study are 55-gallon drum (notation A) and the 55-gallon drum configured as an overpack for one pipe component (notation E). The analytical payload shipping categories of interest are 1A, IIA, or IIE. Layers of confinement are multiple layers of plastic and/or metal cans that act as layers of confinement

for radionuclides during waste handling. The payload safety analysis considers layers of confinement as barriers that impede, but do not preclude, the release of gases from inside the layers of confinement. The more layers of non-vented confinement, the lower the wattage limit for the payload. Layers of confinement in the drum payload container are of three types - liner bag, inner bag, and filtered bag. Drums, pipe overpacks, and pipe components must have a minimum of one filter vent.

There are two limits for decay heat (wattage):
- the total decay heat from the radioactive decay of the radioisotopes within the individual waste container and
- the total decay heat from all payload container in a TRUPACT-II.

Table 2. Decay Heat Wattage Limits per 55-gallon Drum

Cementation (concreted inorganic particulate waste)		Pipe-and-Go (solid inorganic material in metal cans)	
Configuration	**Limit**	**Configuration**	**Limit**
Two layers of confinement (one being the drum liner)	0.6375 w	Solid inorganic material in metal cans	40.0 w
Three levels of confinement (one drum line and two plastic bags)'	0.1863 w		

1- More typical configuration

As noted earlier, the Pu^{240} content of essentially all the incinerator ash is less than 7 wt%. Based on eak and current power estimates, the current specific power for 4-7 wt% $Pu^{2\$}$ is 2.48 watts/kg and the peak specific power is 2.6 watts/kg. Giles prepared a supporting document to show transuranic loading limits of containers of solid waste that could be shipped to WIPP for disposal. Giles described loading limits in terms of FGE, equivalent plutonium activity (PE-Ci) limits, decay heat limits and the effects of measurement uncertainty. The packaging configuration, especially the use of plastic bag closures has a severe impact on the quantity of plutonium allowed in a waste drum. Revisions to the equivalent plutonium activity limits have essentially removed PE-Ci as a limiting criterion. Venetz updated and expanded the earlier work and included the DE-Ci limit. Giles focused primarily on organic-containing waste (which constitutes approximately two thirds of the total Hanford TRU waste volume) and showed that due to decay heat limits the plutonium loading per drum are very low (-13 g) for solid organic waste with up to two plastic bag closures. For cemented waste in the currently analyzed cases, the range of plutonium loading is from 20 FGE, in the case of a 325 FGE criticality limit criterion, to 64 FGE, in the case of a wattage limit. Based on available data, the use of filtered bags could increase the Pu loading by a factor of three (-167 g of Pu). However, this configuration has not been analyzed and the TRUPACT Content (TRUCON code) has not been approved. If the anaysis is favorable and the TRUCON code is approved,

the changes should positively impact the allowable loading for the cemented ash waste form in the TRUPACT-IIs. In the case of the two bag configuration, wattage is not limiting (245 g).

A new waste code RH 114C has been analyzed and submitted as an analytical shipping category waste. The waste is described as cemented SS&C in a slip-lid can in a filtered bag, which is then placed into a 55-gallon drum. The maximum allowable wattage per payload container depending on the filter used is 0.6627 or 0.8261, In this configuration, wattage would not be limiting and FGE criticality constraints will be limiting.

6.2 Criticality Limits **in terms of Fissile Gram Equivalents**

The shipping and packaging limits arise from fissile gram equivalent (FGE) criticality limits as well as wattage limits and dose-equivalent curie limits (DE-Ci). Acceptance criteria for the Central Waste Complex (CWC) and Waste Receiving and Packaging Facility (WRAP) apply a fissionable material content limit of 177 FGE for 208-liter (55-gallon drum), where the fissile material is contained in 20% or more of the container volume and a 100 FGE limit if the fissile material is contained in less than 20% of the container volume. The TRUPACT-II criticality limit is 325 FGE per shipment for 208-L drums and 2800 FGE for pipe overpack container. The WI PP-WAC limit for plutonium in a 208-L drum is 200 FGE. Giles calculated a FGE (g/g) net factor of 0.944 to 0.940 for weapons grade plutonium (5.75 wt % Pu^{240}). Venetz calculated a FGE limit for 4 to 7 wt % Pu^{240} at a 10 wt % measurement error of 170 FGE. If the WRAP criticality limit for fissile material in less then 20% of the drum is limiting then the plutonium loading limit is reduced in half.

Currently, cemented waste in 208-L drums is constrained by the 325 FGE TRUPACT-II limit and the restriction not to mix waste material types, Venetz calculated that at 10% error measurement level a maximum limit of 20 FGE at the 4-7 wt % Pu^{240} level applies.

It was reported in a Plutonium Residues Task Force Report that the Carlsbad Area Office (CAO) has commissioned a study to support a request to the NRC for increasing the fissile gram loading from 325 to 2,800 for the TRUPACT-II for transporting cemented waste forms. The CAO will analyze the consequences of the increase for several waste forms. If the solidified waste forms can be shown to maintain the critical geometry during a worst case accident, the NRC will be petitioned to raise the TRUPACT-II criticality limit from the current 325 FGE to 2,800 FGE for certain cemented/solidified waste forms. At this time there is no estimate of when this study might be concluded, what the results will be, what waste forms might be approved and when the NRC would approve them. It is not apparent this change would be in time to impact disposition activities at PFP.

6.3 Dose-Equivalent Curie Limits (DE-Ci)

The shipping and packaging limits arise from dose-equivalent curie limits (DE-Ci) as well as wattage limits and fissile gram equivalent (FGE) criticality limits. WMH acceptance criteria for the Central Waste Complex (CWC) and the Waste Receiving and Processing Facility (WRAP) include a 35 DE-Ci/drum limit. DE-Ci is a method of normalizing the exposure risk of various radionuclides. The Venetz data for DE-Ci limit for 4 to 6.99 wt% Pu indicated a plutonium limit (at 10% error) of -190 FGE. Calculations performed for this evaluation indicate -420 g/drum for 35 DE-Ci per drum – if this is correct, DE-Ci is not a limiting factor.

7.0 **COST** COMPARISON

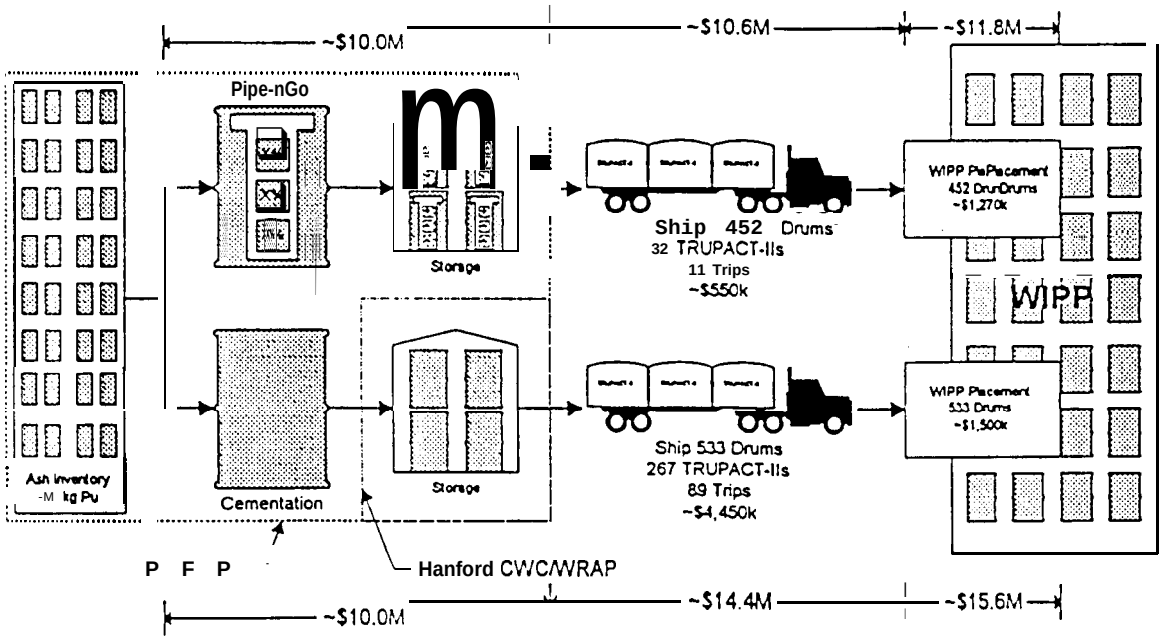

Figure 4. Cost Comparison

Detailed cost data on cementation process and Pipe-and-Go was not available during the course of this evaluation. The costs shown above were developed based on prior experience. Based on available information, the most significant form of cost savings are the result of fewer drums produced and the corresponding reduction in handling, testing, storage, transportation, and disposal. Specific issues relating to cost are discussed in Section 9.2.2.

8.0 **RFETS SAFEGUARDS TERMINATION** LIMIT REQUEST

RFETS "variance" to the safeguards termination limits per DOE Order 5633.3B was approved by the Department of Energy's (DOE) Office of Nonproliferation and National Security, Office of Safeguards and Security. The 'variance" raised the STL for Attractiveness Level D material to 10 weight percent plutonium. The variance was approved on the condition that all of the processing and packaging

activities described in the variance are performed prior to removing the residues from the protected area. The activities include blending of the residues to below 10 wt % plutonium and placing the blended residues in the pipe overpack containers, Termination of safeguards will occur when the TRU waste management organization, Rocky Mountain Remediation Services (RMRES), places the drums in the TRUPACT-II vessel and the TRUPACT-II lid secured. The approval was also contingent on the requirement that two bolts on the pipe component be made inoperable.

9.0 ANALYSIS

9.1 Process

Participants were briefed on the options and provided an overview of the available information and findings. Following a question and answer session with the authors, each of the ranking criteria were discussed. Using the Kepner-Tregoe method, the Pipe-and-Go and Cementation options were examined " against the following five major criteria as defined by PFP: Technical Risk, Cost, Schedule, Safety Risk, and Programmatic Risk. The participants assigned a numeric score of 1-10, 10 being most desirable, to both options for each major criterion. Each major criterion was assigned a weight of 1-5, 5 being most important to the analysis. Attachment 1 is a summary of the group notes and rankings. Section 9.2 is a discussion of specific issues for each major criterion in the decision.

9.2 Ranking Discussions

Numbers shown in each of the 9.2.1-5 subsections are from the criteria descriptions in Table 3.

Table 3. Criteria Descriptions

Criteria	Descriptio
Technical Risk	Reflects the maturity of the process, complexity of the operations, and various logistical issues that could be involved.
cost	Cost considerations include both life-cycle costs and the cost profile.
Schedule	Schedule considerations include the start date, completion date, and the impacts on the overall PFP schedule.
Safety Risk	Safety considerations should include all aspects of nuclear and operational safety as well as ALARA and environmental considerations.

Criteria	Description
Programmatic Risk	Programmatic risk considerations. include policy, regulatory, stakeholder commitment and complex integration.

9.2.1 Technical **risk**

9.2.1.1 Non-destructive Assay (NDA)

Pipe-and-Go is likely better. Plutonium in a can should allow more accurate measurement compared to plutonium in dense concrete (cement will cause shielding). Homogeneous ash in a pipe centered in a drum will be a better geometry to count than billet cans randomly placed in a drum. WRAP has already indicated a concern over being able to measure the plutonium in cemented waste billet in a drum.

9.2.1.2 WIPP Process/ Laboratory Certification

9.2.1.2.1 Plutonium Content

Pipe-and-Go is better since the FGE loading is 2800 for TRUPACT-II versus the 325 FGE for TRUPACT-II for cement in a drum

9.2.1 .2.2 Waste Type

Ash should meet the WIPP-WAC in its current form, so no advantage to Pipe-and-Go or cement. However cement will have water in the final form, which will result in hydrogen gas formation and the necessity for headspace analysis even if packages are vented. The presence of free water in cement is less desirable then a dry, inert diluent.

9.2.1.3 Diluent development

Cementation is judged better than Pipe-and-Go because cementation has been demonstrated at PFP, but a formulation will need to be developed to minimize the effect of halides in the ash. In TRUPACT-II SAR there is limit on the amount of free water that can be contained in cemented waste. This has not been addressed in the procedures for cementing of SS&C. There is no blend plan for ash. Although RFETS is blending, development is required to devise a blending procedure to ensure that the resulting product is adequately blended and that the plutonium cannot be easily separated from the ash and diluent mixture. This is a requirement of the RFETS STL variance. The average plutonium content of PFP's ash inventory is -12.3 wt %. PFP will be required to blend using diluent to meet the plutonium content required for Pipe-and-Go.

9.2.2 Cost

9.2.2.1 Implementation Cost

For sequential operation, implementing cementation is favored if cementation of ash is performed in the same glovebox and with same equipment as used for cementation of SS&C. Blending of ash will require changes and modifications to glovebox and equipment to implement. Since ash blending is a new processing operation for PFP, documentation, readiness review, contractor assessment, etc. will be required. If ash processing is done concurrently with SS&C cementation, then equipment and installation costs will be similar for both alternatives.

9.2.2.2 Processing Costs

Pipe-and-Go is favored over cementation. Ash blending requires fewer steps, doesn't require curing, less probability of rework, produces less product cans, less handling, fewer number of product cans to NDA and fewer number of drums to certify and ship to Central Waste Complex. While the packaging configuration is more expensive (by approximately -$1700 for each POC) the labor savings should offset this cost.

9.2.2.3 NDA

Pipe-and-Go results in fewer products package to count. The ash can packaged in a pipe, in a drum should be a better geometry to count.

9.2.2.4 Storage

Favors cementation. Cemented cans in drums can be shipped to Waste Management for interim storage. Ash in the POC possibly can go to Waste Management but a vulnerability analysis will be required to ensure adequate physical security is present and upgrades could be required. Otherwise, a separate storage area may be required in the PFP, or equivalent, protected area. However, it is reasonable to assume if WIPP opens on schedule and sufficient shipping capability exists, material stored in POCS should be shipped from the PA well before PFP is deactivated.

9.2.2.5 Shipping

Shipping favors Pipe-and-Go because higher FGE are allowed for the POC and the POCS will be shipped in dedicated TRUPACT-II shipments. There will be more drums of cemented waste due to the lower allowable FGE, which means more shipments. Currently, drums of waste containing different waste materials can not be shipped in the same TRUPACT-II. Changes to the TRUPACT-II SAR may allow mixing of drums within the same waste material types but not between waste types. The cost of POCS is likely 2 to 3 times the cost for the less expensive, but higher quantity of 55-gallon drums.

9.2.3" Schedule

9.2.3.1 **Implementation Schedule**
Implementation schedule is approximately equal for both options.

9.2.3.2 Processing schedule
Pipe-and-Go has fewer steps and generates fewer product cans. In addition, ash blending does not require curing. Depending on how long it takes to get reliable NDA data on the final product can or drum; the processing schedule slightly favors Pipe-and-Go. The overall PFP schedule will not be materially affected.

9.2.4 **Safety Risk**

9.2.4.1 ALARA
ALARA is approximately equal **for both** options.

9.2.4.2 **Nuclear**
No advantage to either option. It should be noted that cementation requires introduction of water to the **process, increasing risk.**

9.2.4.3 **Industrial**
Industrial safety risk is approximately equal for both options. Pipe-and-Go has fewer chemicals and fewer drum-handling operations, but each drum will be heavier.

9.2.5 **Programmatic Risk**

9.2.5.1 WIPP
Advantage to Pipe-and-Go. TRUPACT-II shipments of ash in POC will contain the same type of drums. Cemented waste, if loaded to maximum allowable FGE, will result in shipments with empty drums or drums with different waste materials. Both options will require development and approval of TRUCON codes. The higher FGE permitted in the POC is an advantage over the lower allowable FGE in 55-gallon drums. While there is talk of certifying a cemented waste package at a higher allowable FGE, it is too speculative at this time to factor in the analysis.

9.2.5.2 Washington State Department of Ecology **(WDOE)** and Resource Conservation and Recovery Act **(RCRA)**
Cementation is favored over Pipe-and-Go. Addition of cement will lower the concentration of hazardous constituents; blending of cans of ash will not. However, cement does contain water, which results in the generation of hydrogen, whereas ash is high fired/sintered material. Cemented residue will be classified as waste at the time of cementing. It is less clear when blended ash is classified as waste, especially if using the higher STL allowed **for "retained waste". Permitting requirements have already** been addressed for cemented

waste, but have not been addressed for any permitting requirements for blending and storage of ash.

9.2.5.3 National Environmental Policy Act (NEPA)
NEPA requirements are in place for the cementation of residues. The EIS addressed cemented waste in the POC but not the specific case of blending and POC. Cement is favored for this attribute.

9.2.5.4 Defense Nuclear Facilities Safety Board (DNFSB)
The DNSFB are already aware of the fact that the PFP base case is cementation and are in concurrence. [f PFP were to change its base case for ash, the DNSFB should be notified.

9.2.5.5 Safeguards and Security
Cementation is favored. Cementation of ash will result in an Attractiveness Level E material. The concentration of plutonium will be below the STL by design. A vulnerability assessment should have been done at the 2 Wt % plutonium loading level for interim storage in the Central Waste Complex. Ash blending and POC will require a STL variance and vulnerability analysis if blended to the same plutonium concentration as used by RFETS. The higher STL for blending and disposal as permitted by current DOE orders will require vulnerability analysis and possibly physical protection upgrades. At the highest STL permissible pu levels, an alternate interim storage location could be required.

9.3 Results

Table 4. Kepner-Tregoe Analysis Scoring Summary

Participant	Option		High Score	Δ
	Pipe-and-Go	Cementation		
Participant 1	119	95	Pipe-and-Go	24
Participant 2	138	110	Pipe-and-Go	28
Participant 3	85	84	Pipe-and-Go	1
Participant 4	137	67	Pipe-and-Go	70
Participant 5	84	70	Pipe-and-Go	14
Participant 6	156	131	Pipe-and-Go	25
Participant 7	173	118	Pipe-and-Go	55
Participant 8	108	87.	Pipe-and-Go	21
Participant 9	160	114	Pipe-and-Go	46
Participant 10	121	76	Pipe-and-Go	45
'Average'.	128	95	Pipe-and-Go	33
Standard Deviation (σ)	30.4	22.0		20.7

All applicants scored the Pipe-and-Go option scored higher than cementation. The average scores are 128 for Pipe-and-Go and 95 for Cementation. Individual scoring sheets are included in Attachment 1.

10.0 CONCLUSIONS

The review of available data and meetings held with PFP, DOE-RL, Waste Management, and RFETS personnel indicates that the Pipe-and-Go packaging method is a viable and cost effective packaging method for PFP. Current Safeguards and Security Orders permit the placement of <7.5% plutonium ash into a P&G container if treated as retained waste. Richer ash would require dilution to <7.5% plutonium before packaging.

There would be cost savings, primarily in the packaging and shipment cost areas, if <7.5% plutonium ash were to be packaged in the Pipe-and-Go configuration when compared to the expense incurred for the currently planned cementing process. Blend down costs to achieve <7.5% plutonium for the richer ash are estimated to be similar to costs currently incurred when the cementing process is utilized for Sand, Slag and Crucible (SS&C) stabilization. Added savings could be achieved if the same plutonium concentration level as RFETS has obtained could be utilized at PFP. This is due to the glovebox operations required for blend down. Concurrent with the handling cost reduction it is estimated that a 20 mrem exposure savings will be obtained for each item placed directly into the P&G configuration.

Implementation costs for Pipe-and-Go appear similar to cementation. This is primarily a result of up front material characterization costs and WIPP certification of the packaging process and methods. Cementation could use the equipment established for SS&C processing.

While cementation of the PFP ash residue remains a viable disposal process, it requires added handling both in processing and packaging for shipment when compared with the POC packing method. Additional transport costs for approximately 78 additional WIPP shipments would be incurred. For these reasons, Pipe-and-Go can be recommended as the primary disposal path for ash.

11.0 RECOMMENDATIONS

The recommendations resulting from this technical evaluation are

1. Initiate the planning and scheduling necessary for packaging the ash into the Pipe Overpack Container. At a minimum, the planning should address:
   - Characterization of the ash residue inventory and plutonium measurement to WIPP requirements,
   - Process glovebox selection and ancillary equipment identification,
   - Safeguards termination criteria development,
   - Early identification of Safeguards upgrades and implementation activities related to storage and possibly testing,
   - Certification of the ash processing and packaging method to WIPP requirements,
   - POC specific training requirements,
   - POC hardware fabrication vendor selection and qualification,

. ALARA considerations and upgrades,
- NEPA and SAR updates,
. Funding cycle requirements,
. DOE expected authorization to proceed date,

2. Pursue increase of plutonium concentration to RFETS level of 10 %
3. Evaluate other PFP residues that maybe cost effectively dispositioned using Pipe-and-Go.
4. Initiate Tri Party Agreement negotiations to accommodate Pipe-and-Go (determine regulatory strategy for the blending, packaging, and interim storage of the ash) without jeopardizing plant flexibility.

12.0 RISK ASSESSMENT

Areas of risk associated with Pipe-and-Go that should be considered include:

. The concentration of plutonium in the POC may require the packed POC to remain in a Protected Area pending shipment. Additionally, placement within the PFP Protected area may impose special storage restrictions.
- Storage alternatives, such as the concrete shell used for LAMPREY fuel, may need consideration to facilitate timely POC transfer to the CWC to maintain compliance with dangerous waste requirements.
- Other issues related to regulatory agencies and public interest groups may create added costs.

13.0 REFERENCES

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ATTACHMENT 1: KEPNER-TREGO ANALYSIS DISCUSSIONS AND SCORING

Discussion Summary

Pipe-and-Go Cost Attribute	
Pro	Con
Shipping 10 WIPP (> $4 M savings) WIPP Certification "is enhanced Operations costs are lower Characterization costs are lower (fewer drums)	Cost of package is higher Higher storage costs Implementation costs (cementation process glovebox exists for SS&C) Safety basis update EIS/Fonsi required for Pipe-and-Go Safeguards Termination Limits (Pipe-and-Go package contains much higher Pu content)
Pipe-and-Go Schedule Attribute	
Pro	Con
Higher throughput Can perform concurrent with Cementation May be shipped to WIPP sooner May not require placement in " -5 " Schedule: < 6 months (vs. 12 months for cementation)	Glovebox is available/in use for cementation Cementation safety basis and procedures are in place EIS follow-on will take time
Pipe-and-Go Safety Attribute	
Pro	Con
No Liquids are introduced Enhances overall criticality safety Lower cumulative dose Less handling by workers Simpler cleanup of glovebox will result in lower cost Less gas generation	Increased potential for Pu dispersion during processing
Pipe-and-Go Technical Risk Attribute	
Pro	Con
Just like Rocky Flats (consistency) No chemical conversion in the process steps Reduced NDA when compared to Cementation Concerns associated with gas generation (Hydrogen, etc.) are reduced	PFP has cementation experience Cementation doesn't require facility modification . . ..Pipe-and-Go may
Pipe-and-Go Programmatic Risk Attribute	
Pro	Con
Consistent with RFETS WIPP acceptance is closer for P-n-G than cementation Can reverse the approach if sending to WIPP requires something unforeseen at this time (cementation almost impossible to reverse) Can ship to somewhere other than WIPP (SRS, etc.) if WIPP requirements become too difficult to overcome	Potential need for a TSD area at PFP Requires State of WA (Ecology) input... and NEPA documentation Could delay movement of ash from PFP Safeguards (P-n-G package could contain up to 200 g/drum) Need to obtain STL approval (like RFETS)