Department of Energy

Washington, DC 20585

October 20, 1998

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

Dear Mr. Chairman:

Enclosed is a deliverable committed under the Integrated Program Plan (IPP) for Recommendation 94-3. This enclosure reports validation of safety upgrades to Rocky Flats Building 371. The Department has completed the actions identified under commitment 6-1 of the IPP, and proposes closure of this commitment. The validation and engineering design of upgrades are a contingency to assure adequate safety of storage for Rocky Flats plutonium should shipments off site be delayed. The Department continues its progress toward the accelerated closure of the Rocky Flats Environmental Technology Site, while planning and executing safety upgrades for interim plutonium storage on the site.

Sincerely,

James M. Owendoff
Acting Assistant Secretary for
Environmental Management

Enclosure
cc: Mark Whitaker, S-3.1

Building 371

Interim Storage Upgrades Validation Project

Mr. Terry Camilleri
Program Manager
August 18, 1998

BUILDING 371
INTERIM STORAGE UPGRADES VALIDATION PROJECT

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BUILDING 371
INTERIM STORAGE UPGRADES VALIDATION PROJECT

Executive Summary

Background
In September of 1994, the Defense Nuclear Facilities Safety Board (DNFSB) issued Recommendation 94-3 to address potential deficiencies in the capability of Building 371 to perform in its new plutonium consolidation mission. The Recommendation was based on the Department of Energy (DOE) position that Building 371 would be the plutonium storage facility until off-site shipment was complete (estimated as 2010 - 2015). In June of 1995, the DOE submitted the "Implementation Plan (Phase I) for DNFSB Recommendation 94-3 (IP)". The IP described a strategy that included a series of tasks whose objective was to determine action necessary to ensure Building 371 is capable of storing plutonium. These initial task analyses led to more detailed evaluations of Building 371 upgrade requirements. Task 3-2, Building 371 Interim Storage Report, was developed as one of these evaluations.

In the original DNFSB Recommendation 94-3 Integrated Program Plan (IPP) published in July 1996, the decision was made to install a series of priority upgrades in Building 371 to better ensure protection of public and worker safety as Building 371 assumes its plutonium consolidation mission. The IPP also required that other upgrades be validated and implemented to ensure safe interim storage through 2015. The DNFSB Recommendation IPP Revision 1, published in April 1998, further defined Interim Storage Mission requirements to include conduct of a validation study of proposed Interim Storage Upgrades previously identified. The enclosed validation report has been developed as required in the IPP Revision 1. Upgrades validated for implementation must be completed in time to meet the 2002 Interim Storage Mission for Building 371. The decision to suspend Interim Storage Upgrades installation can be made only if the criteria for off-site shipment defined in the IPP Revision 1 are met.

Validation Methodology
A team of technical experts was assembled including members who participated in the original IP Task Plans, and each assigned specific validation responsibilities. The team reported to the 94-3 Program Manager. A Validation Plan was developed (Attachment 1) which described the task organization and outlined the approach to be taken in conducting the validations. It also established the requirement to develop a set of "boundary conditions" which define the Site and facility conditions expected to exist during the Interim Storage Mission period. The boundary conditions serve as a starting point in validating upgrades. Each team independently developed their validation analysis using the guidelines contained in the Validation Plan. A technical support team and a technical advisory team made up of Building 371 engineering staff and management personnel, Kaiser-Hill (K-H) engineering staff members, safety analysists and Recommendation 94-3 Project Management personnel (Figure 4.5-1 of Attachment 1) were available to support validation efforts. In addition, a bi-weekly meeting with validation team lead members and technical advisory team members was held to ensure validation objectives were being met.

Validation draft reports, and associated conceptual design reports were reviewed as they were developed against a checklist (Attachment 2) designed to ensure projects were complete. Resources independent of the Site with related project experience participated in this review.

Boundary Conditions

To support the validation effort, key boundary conditions (Attachment 3) were identified for the site, the facility and the stored material in the facility. The anticipated Year 2002 boundary conditions were developed using current (March 1998) schedule data for the Rocky Flats Closure Project to project Year 2002 conditions and activities. Initiation of the installation of Interim Storage Upgrades presumes that off-site shipment of special nuclear material has not occurred as anticipated (scheduled 2002-2004). The boundary conditions assume that material, particularly residues, are removed from Building 371, as they are stablilized and packaged for off-site shipment either for further processing or disposal. Building 371 therefore serves as the designated storage facility for SNM metals and oxides. Building 374 processes low level liquid waste streams through 2004.

Validation Selection Criteria

Two fundamental criteria were used to determine recommendations for installation of upgrades. One is the Building 371/374 Complex Basis for Interim Operation (BIO) criterion of no more than 5-rem exposure to the maximally exposed off-site individual (MOI) at the Site boundary. Using this criterion and the boundary conditions expected to exist during interim storage, upgrades were reviewed in the facility safety analyses to ensure this criterion would be met, including analyzed events such as the Evaluation Basis Earthquake. The second, more restrictive criterion, was to ensure that the contribution to Site risk presented by Building 371 during seismic events was small (less than 16%) including the seismic event of a severity that collapses Building 371 (38,000 year median annual recurrence). Attachment 4 is an evaluation of risk reductions expected to be realized for selected upgrades.

Necessary upgrades were selected to ensure that material stored in Building 371 (SNM metal and oxides) and building holdup would be a minor contributor to Site risk even considering improbable, higher consequence events like the collapse earthquake.

The list of original Interim Storage Upgrades was included in the Task 3-2 report and expanded to include additional upgrades in the IPP Revision 1 (Attachment 5). To ensure conditions anticipated during the Interim Storage Mission were considered the bi-weekly project reviews discussed alternatives to existing upgrades and additional issues not previously considered. Additionally, the design for the Interim Storage Vault was reviewed against Building 371 conditions to determine if additional upgrades should be considered. The conceptual designs being considered for implementation address all of the same concerns used in the design for the Interim Storage Vault with the exception of security. The results of the validation effort have been delivered to the security department for inclusion in Site vulnerability assessments. Any security modifications will be addressed separately.

Validation Results

Attachment 6 is the list of upgrades and recommended actions for each upgrade as determined by the validation review. The risk analysis clearly established plutonium oxides as the dominant risk from seismic events. Other contributors, to a much smaller degree, are plutonium metals stored in vaults and holdup material in gloveboxes and ducting. Recommended upgrades involve providing secure storage for plutonium oxides in sub-basement vaults (1101, 1208) that have been modified to survive the 38,000 year (collapse) earthquake. Upgrades are recommended to reduce the Material at Risk (MAR) from glovebox holdup by removing the holdup, by containing the holdup within the gloveboxes (Fire Dam spray used in Building 779) or by reducing glovebox damage during a seismic event by strengthening components identified during equipment seismic walk-downs. Upgrades to reduce risk from fire include removal of the "pall rings" from the four ventilation system scrubbers and replacement of the first stage of HEPA filters in HVAC Systems 1 and 2. The Building 371 Emergency Plans/Emergency Operating Procedures should be reviewed and kept current with changing Site conditions.

A schedule with major milestones leading to installation of the recommended upgrades is included as Attachment 7. In order to ensure upgrade installation in time to support the Interim Storage Mission, it will be necessary for Site Programs to integrate interim storage milestones into schedules affecting Building 371 activities. The IPP commits to complete design of these upgrades in FY-99, to provide a firm procurement and construction schedule that can be implemented in time to ensure 2002 completion.

Conclusions

The upgrades for Building 371 recommended by the Validation Study will provide safe interim storage of plutonium metals and oxides through the Year 2015. The conceptual design packages included in the validation report provide sufficient initial design and cost estimate information to allow the complete design package and construction schedule to be developed in FY99. There is also adequate information in the report to allow scheduling the non- construction activities. The milestone schedule in Attachment 7 should be updated with more detailed information as design work is completed. The Recommendation 94-3 Program Manager will maintain responsibility for execution of the Interim Storage Upgrades Plan. Any change in responsibility for the Plan will be formally promulgated.

Attachment 1 – Validation Plan

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DEFENSE NUCLEAR FACILITIES SAFETY BOARD RECOMMENDATION 94-3

BUILDING 371 INTERIM STORAGE UPGRADE VALIDATION

BUILDING 371 INTERIM STORAGE UPGRADE VALIDATION PLAN

This document presents the plan to validate a set of interim storage upgrades for Building 371 at the Rocky Flats Environmental Technology Site in accordance with commitments made in the Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-3 Integrated Program Plan (IPP), as revised in February of 1998 (ref. 1). Validation involves the consideration of alternatives (including those alternatives selected in prior studies and identified in the IPP), the selection of projects, and the establishment of a firm scope of work for each selected project. Interim storage of the Site's special nuclear material (SNM) is a contingent mission for the facility that would extend from 2002 to ~2015 in the event that current efforts to ensure off-site shipping in time to obviate interim storage at the Site prove unsuccessful. This document complements the discussion of validation in the IPP by providing additional detail on the study boundary conditions, the criteria for selection, the alternatives to be considered, the task organization and staffing, and the specific milestones to ensure timely completion.

1.0 Background

As part of the Department of Energy's (DOE or the Department) response to DNFSB Recommendation 94-3, Building 371 is undergoing a series of upgrades to provide safe storage of the Site's plutonium metal and oxide for near-term facility missions (i.e., through approximately 2002). The near-term missions include storage, stabilization, and repackaging of the SNM in preparation for off-site shipment. The "priority" upgrades identified in Table 3-1 of the DNFSB Recommendation 94-3 IPP are nearing completion and a second series of upgrades related to the Basis for Interim Operations (BIO, ref. 2) and identified in Table 3-2 of the IPP is in progress for completion in FY-98 and early FY-99. The IPP further commits to perform additional upgrades to prepare the facility for a contingent interim storage mission extending from 2002 through ~2015. These "Interim Storage Upgrades" are to be selected in FY-98 through the validation study, which is the subject of this plan. They are to be designed in FY-99 and a construction schedule is then to be prepared which supports completion by 2002. These activities on interim storage upgrades are to proceed until the Go/NoGo criteria (IPP deliverable 6-5) for timely off-site shipment to obviate the interim storage mission are satisfied.

The original IPP (ref. 3) identified three sets of upgrades to support the interim storage mission. These upgrades were selected in a study (ref. 4) completed early in 1996 and were designated as "safety margin", "material relocation", and "security" upgrades. Their selection was based on scoping studies performed to support a decision on how best to prepare the Site for interim storage. In those studies a new interim storage vault (ISV) was concluded to afford significant additional safety margin at an anticipated lower cost than Building 371. The three sets of upgrades for Building 371 were selected using a cost/benefit screen that relied on preliminary subjective estimates of the benefit dimensions, including nuclear safety. With the three sets identified, the overall upgrade scope was judged to be reasonably representative of the cost of preparing Building 371 for interim storage.

Subsequent activities, including preparation of the BIO and development of a new Site closure plan, afford a new, more detailed and objective context for reconsideration of the appropriate interim storage upgrades. Such reconsideration is a logical extension of the systems engineering approach adopted for the original Recommendation 94-3 studies and embodied in the IPP. Thus, this validation process is to begin in March 1998 and be completed in August 1998 with a report of recommendations and their technical basis. The validation study will be conducted by Kaiser-Hill Company, L.L.C. (K-H) and Safe Sites of Colorado, L.L.C. (SSOC) engineers (including Building 371 representatives), with sub-contractor support.

2.0 Mission

The mission for Building 371 that warrants the interim storage upgrades is taken from the DNFSB Recommendation 94-3 Integrated Program Plan and is as follows:

To provide safe and secure interim storage of the Site's non-pit plutonium metal and oxide inventory including any oxide generated due to residue and solution stabilization activities, if off-site shipment is not realized in a timely manner. The interim storage mission is to begin in 2002 and continue until the inventory is finally shipped off-site (no later than 2015).

3.0 Scope

The IPP affords a separate statement that defines the scope of the validation program:

Engineering for the Interim Storage upgrades is being initiated in FY98, beginning with validation. The upgrades to be considered during validation and the specific validation requirements to be addressed for each one are given in Table 6-2. In addition, as part of the validation efforts, the scope, cost and schedule estimates will be updated for each validated upgrade. As part of this effort, studies needed to finalize the design concepts will be performed. The scope for the upgrades that are validated will be updated with sufficient detail to support completion of design in FY99 and to confirm that the total scope can be implemented by 2002.

4.0 Technical Approach

4.1 Summary

Each of the proposed modifications (IPP Table 6-2) was intended to provide a margin of safety or security for storage conditions expected to exist during the interim storage interval (2002 to 2015). The security upgrades, which may or may not be warranted for interim storage, are outside the scope of the IPP and will be removed from the validation effort for separate consideration by responsible personnel. In the current context provided by the evolving Site closure plan, each specific safety upgrade originally selected may no longer be the preferred alternative for achieving the underlying safety objective and each underlying safety objective may no longer warrant the priority it was originally given. Therefore, the function(s) each upgrade was intended to perform to increase the interim storage safety margin will be determined together with any interdependence on other upgrades to achieve the intended benefit. The importance of the potential improvement will then be assessed, based on the BIO safety perspective updated by considering the impact of changes in facility configuration expected by 2002. If the improvement warrants further study, the potential for more effective alternatives will be addressed, and the most effective project(s) will be identified. When the complete set of most-effective projects has been identified, the selection criteria will be used to determine which of them should be included in the set of projects selected to support interim storage. For the selected projects, any remaining concept issues will be resolved and a determination will be made as to whether or not prompt implementation is warranted to support the current facility mission.

4.2 Study Boundary Conditions

The IPP identifies two significant decisions incorporated in the Site closure plan that differ from early 1996 expectations and substantially affect the validation study: the current Site boundary and the Site fire department will be maintained while SNM is onsite. These examples illustrate the importance of forecasting such boundary conditions and the uncertainty involved in projecting four years ahead. Key boundary conditions must be identified for the Site, the facility, and the material. An initial task is planned to identify the significant boundary conditions, uncertainties affecting them, and timetables for resolution where available. For some uncertainties, ranges will be recommended that may require sensitivity studies for individual projects to ensure that the validation conclusions do not depend upon indeterminate items. This list will be updated if changes arise during the course of the study.

Additional Site boundary conditions of interest include the Site population and activity levels forecast in the vicinity of Building 371, the projected Site risk level and the key contributors to it, and the security boundary around Building 371. Key facility boundary conditions include the remaining facility missions, the hazardous inventory and its distribution in the facility (particularly the quantity and configuration of remaining holdup), the level of ongoing D&D activity (including plans affecting 374 or the support facility), and the facility population. Any significant reductions in building services anticipated during interim storage should also be identified (e.g., facility heat, ventilation in unused areas without dispersible material, CSV deinerted, etc.). The key SNM boundary conditions include the packaging (i.e., 3013s as previously assumed or produce cans if a decision is made not to install the packaging line on Site) and the temperature limit for packaged metal.

4.3 Criteria for Selection

The criteria for upgrade validation will be consistent with those used in earlier Recommendation 94-3 studies. In particular, the BIO criterion of 5 rem to the maximally exposed off-site individual (MOI) at the Site boundary will be a firm criterion that must be satisfied by the 2002 facility configuration using safety analyses comparable to those in the BIO. Upgrades sufficient to satisfy this criterion must be identified and validated. These upgrades will be considered necessary to ensure adequate safety and their selection will not depend upon cost benefit considerations (the least cost alternative to achieve the criterion may and will be preferred).

Further upgrades will be considered to reduce facility-operating risk commensurate with the projected Site risk level in 2002 or shortly thereafter as in-progress shipments and D&D activities are completed. These upgrades will focus on practical alternatives recognizing that Building 371 is an existing facility. Selection will consider cost benefit focused on safety only and relative to other activities completed or planned to achieve comparable Site risk reduction. The result will be a proposed residual risk level for Building 371 that is both acceptable in an absolute sense and relatively difficult to reduce further.

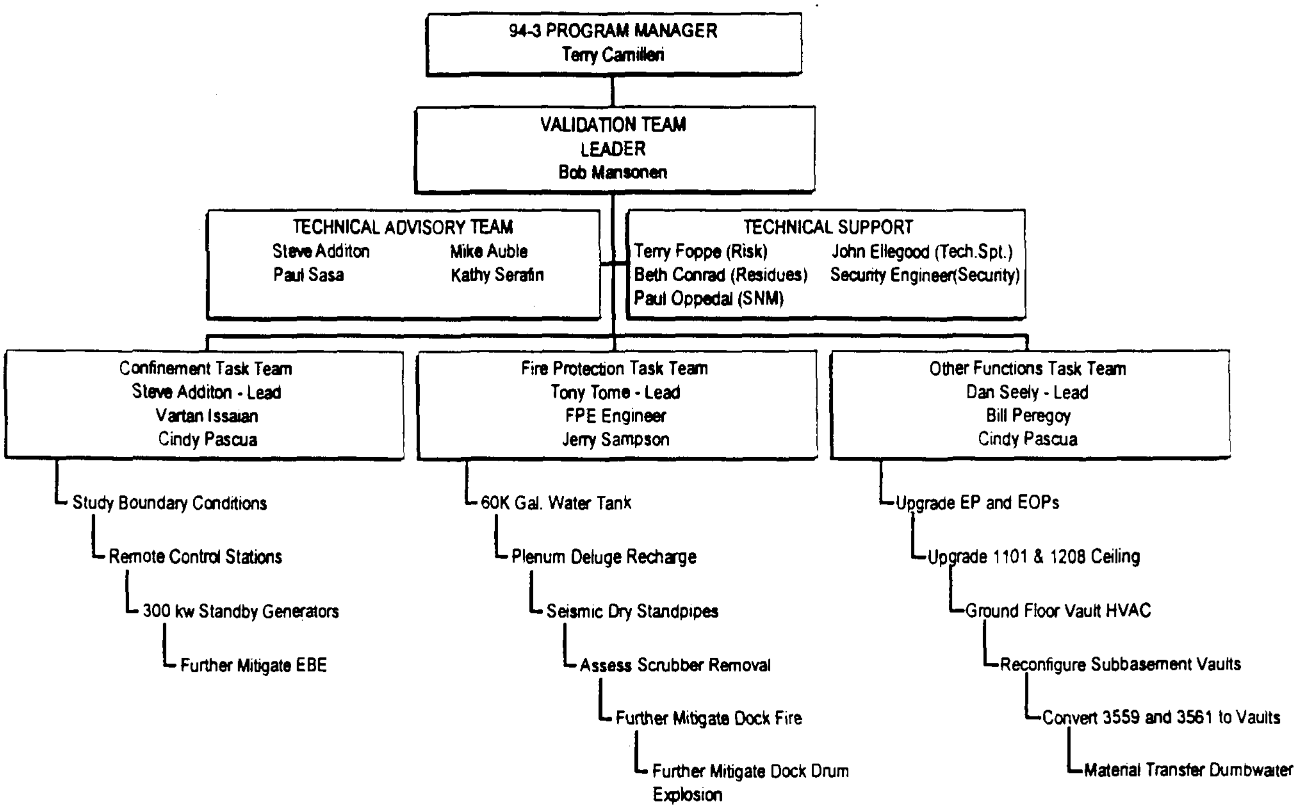
4.4 Alternatives to be Considered

The experience with system engineering at ICF Kaiser, Inc. has been that failure, when it occurs, is most often due to inadequate identification of alternatives. Thus, the validation of each upgrade will include a sub-task to identify alternatives for consideration that may afford significant advantages over the current upgrades while accomplishing comparable or even greater safety improvement. The task engineers will perform an initial evaluation and the Technical Advisory Team will critically review it, with iteration, if necessary, to finalize practical options. An alternative study will then be completed to select the most promising option(s).

4.5 Task Organization and Staffing

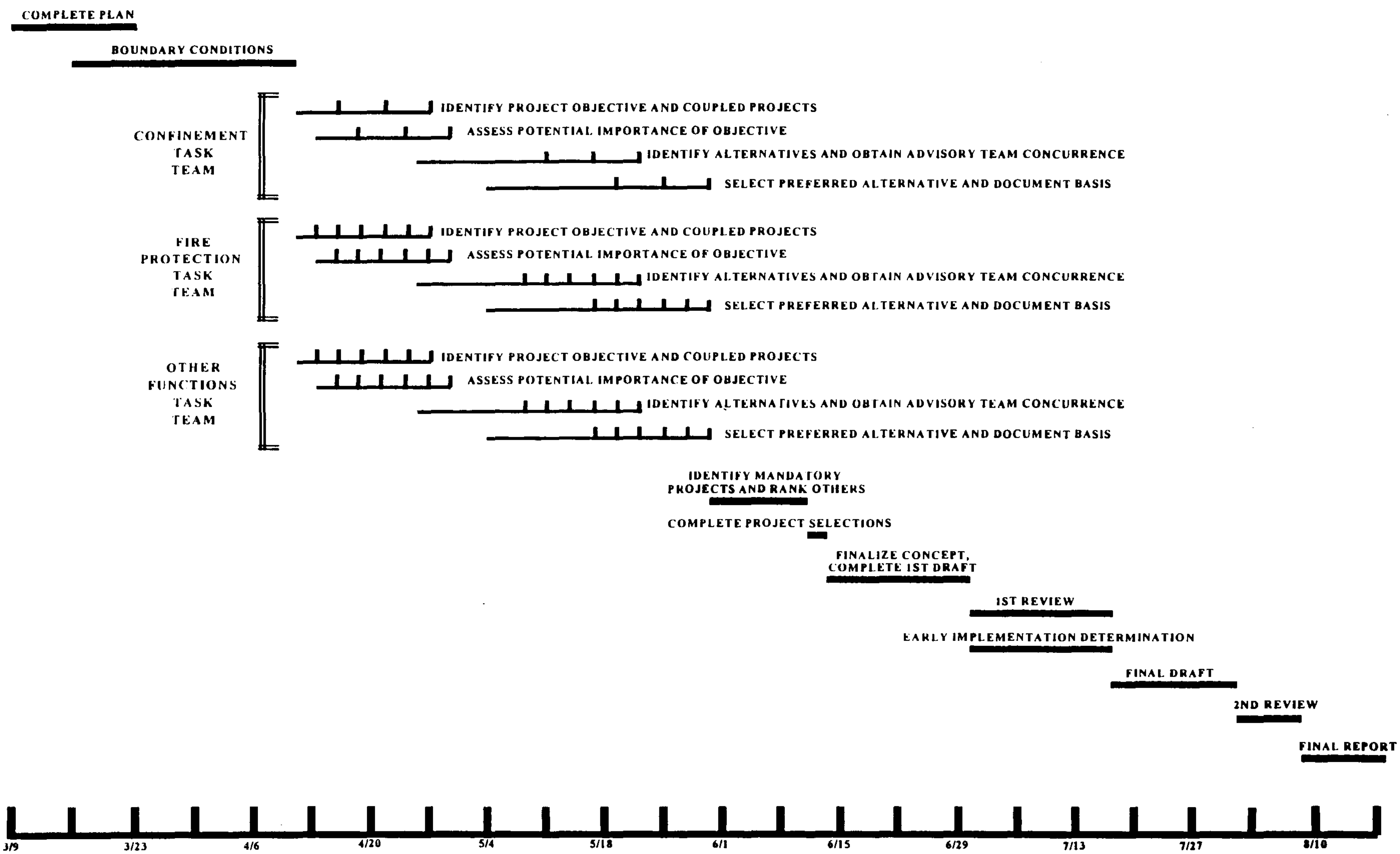
The project staffing and team organization in illustrated in Figure 4.5-1. The project sponsor is the Kaiser-Hill 94-3 Program Manager. The project will be managed by an appointed Validation Team Leader who will oversee and coordinate the individual validation activities. He will be responsible for maintaining the project on schedule, interfacing with technical and support resources in resolving project issues and will keep the project sponsor apprised of project status. He will contribute to specific project activities when available. Three Task Teams will perform the validation activities for specific projects. These teams will address key safety functions in Building 371, including Confinement, Fire Protection, and Other Functions (principally material forms, locations, and related interior requirements). The Other Functions Task Team will also establish and maintain the boundary conditions. Three individuals provide technical support to all teams on issues related to boundary conditions, program needs, and upgrade risk impacts. The Technical Advisory Team provides oversight based on Recommendation 94-3 history and facility management perspective.

Figure 4.5-1 94-3 INTERIM STORAGE UPGRADES VALIDATION TEAM



The sequencing of specific validation tasks is illustrated in Figure 4.5-2. Task Team organization and familiarization that will parallel the boundary condition definition task is not explicitly shown. This activity is important, however, to enable the overlapping sequencing of up to six projects per team to proceed as scheduled.

Figure 4.5-2 94-3 INTERIM STORAGE UPGRADES VALIDATION SCHEDULE



4.6 Milestones

The project runs from March to August 1998. The final product must be in a format that is suitable for presentation to the Department of Energy, Rocky Flats Field Office (DOE, RFFO). Individual projects scopes must be sufficiently defined to support firm design work scopes. Milestones to meet these objectives are as follows:

TASK OR DELIVERABLE	DATE DUE
• Assembly Project Team, Reviewed on Project Plan	Week of March 16
• Complete Validation Plan	March 23
• Complete Boundary Conditions Guidelines	April 10
• Project Status/Issue Resolution	Weekly
• Consolidated Project Status	Monthly
• Perform Evaluation Cycle for Each Project ⇒ Identify objective and coupled projects ⇒ Assess potential importance of objective ⇒ Identify alternatives and obtain advisory team concurrence ⇒ Select preferred alternative and document basis	All complete by May 28
• Identify mandatory projects and rank remaining preferred alternatives by benefit/cost ratio	June 9
• Complete project selections	June 11
• Resolve Concept Issues and Submit First Draft	June 30
• Determine if Early Implementation is Warranted	July 15
• Draft Review Complete	July 16
• Final Draft Submittal	July 31
• Final Draft Review Complete	August 6
• Project Report Submittal	August 18

5.0 References

1. U. S. Department of Energy, *Defense Nuclear Facilities Safety Board Recommendation 94-3 Integrated program Plan*, Revision 1, February 1998.
2. Kaiser-Hill, L.L.C., *Basis for Interim Operation Building 371/374 Complex*, Revision 2, Rocky Flats Environmental Technology Site, Golden CO, September 10. 1997.
3. Rocky Flats Environmental Technology Site, *Defense Nuclear Facilities Safety Board Recommendation 94-3 Integrated Program Plan*, Revision G, Golden CO, July 1966.
4. Kaiser-Hill, L.L.C., *DNFSB Recommendation 94-3 IP Task 3-2 Report, Building 371 Interim Storage Mission Summary Report*, Rocky Flats Environmental Technology Site, Golden CO, March 1996.

Attachment 2 – Building 371 Validation Review Checklist

VALIDATION QUESTIONS	YES	NO	COMMENTS
1) Is the project still necessary based on B371 Priority and Near Term Upgrades, BIO Hazards Analysis, and/or Boundary Conditions for Interim Storage Mission?			
What is the basis for improvement?			
Were tradeoff studies conducted? a. Safety margin b. Technical maturity/merit c. Cost, direct, life-cycle d. Schedule			
2) Is the project coupled to any other validation project? *(If yes, which?)*			
Has schedule been developed? a. Is it dependent on any other activity? b. Is it integrated with other tasks? Other RFETS activities?			
3) Have alternative projects been defined which achieve the same impact as the originally defined project but potentially at a lower cost? If not, are there alternatives? If yes, what are they?			
Are costs defined? a. Were alternatives costed out? b. What is the life-cycle cost? c. Have D & D costs been included?			
4) Does project meet criteria for selection?			
5) Will project require modification of existing system or facility upgrade?			
Are costs defined?			
6) Will project require modification of existing maintenance, operating, or emergency procedures?			
7) Will project require modification to SER, BIO, or TSRs? Is safety classification compatible with current BIO? AB?			
Will a revision be required?			
Has a detailed project description been developed? Include purpose and impact of the project, alternatives considered but rejected, impact on the facility or system,			

VALIDATION QUESTIONS	YES	NO	COMMENTS
interfaces with other validation projects, etc.			
8) Have conceptual drawings been developed? a. Have specifications been outlined/developed? b. What are the software requirements? c. Have state, local and national standards applicable to the work, operation and future disposal of this facility been defined? Can the facility meet the requirements of all such codes and standards? d. Have facility demands been matched with site utilities, roads and support facilities? What impact will this particular storage facility have on the level of demand placed on these resources over time?			
Will upgrades, modifications, and/or maintenance be required to meet new demands?			
9) Are design parameters known and specified, e.g., flow rates, power consumption requirements, seismic capacity, environmental conditions, HVAC, fire suppression, lighting, security, etc.?			
Does DOE Order 6430.1A apply (see DOE 430.1, paragraph 2, Implementation), and if so has it been used in developing the CDR?			
Do calculations exist to support conclusions?			
10) Are design criteria defined, e.g. Safety Category, Performance Category, Quality Assurance, Life Safety, Fire Protection, Building Codes, Industry Standards, DOE Orders, etc.?			
11) Are future maintenance and surveillance testing requirements defined?			
RAM considered?			
12) Does the project introduce new hazards not addressed by the current safety basis documentation (BIO, FSAR)?			
13) Have security concerns been factored into the design, e.g. security doors, grates, layout, wall, ceiling, floor thickness and reinforcement, lighting, etc.?			
Have safeguards and security requirements been considered in the development of the			

VALIDATION QUESTIONS	YES	NO	COMMENTS
CDR? *(If so, have they been reviewed and accepted? Risk?)*			
Cost of implementation?			
14) Will the project generate wastes? *(If so, what type and amounts?)*			
Have storage, disposal requirements been defined?			
15. Will Contractor support be required? RCTs, craft, engineering, building engineering, safety analyses, operations, etc.			
15 *continued*) Are implementing resources defined? Available? Any specialty required? Money? Time? Personnel? Equipment? Consumables? K-H, DOE, SSOC, other?			
Are management entities in concert?			
16. Has an estimate of time to project completion been determined? Schedule/Plan?			
17. What regulatory requirements were considered? a. Permits? CAA? b. EA / EIS / CX? Umbrella coverage? c. Inspections? Surveillance required? d. Compliance logs/reports? e. Transportation considered?			
18. Is the item considered active or passive? Is either criteria required? Can 2/1 be applied? Is seismic survivability required? Why?			

Attachment 3 – Boundary Conditions

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DEFENSE NUCLEAR FACILITIES SAFETY BOARD
RECOMMENDATION 94-3

BUILDING 371 INTERIM STORAGE UPGRADE VALIDATION

REVISION 0

BUILDING 371 INTERIM STORAGE UPGRADE VALIDATION BOUNDARY CONDITIONS

This document provides appropriate boundary conditions in support of the plan (ref. 1) to validate a set of interim storage upgrades for Building 371 at the Rocky Flats Environmental Technology Site. This plan is in accordance with commitments made in the Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-3 Integrated Program Plan (IPP), as revised in April of 1998 (ref. 2). Interim storage of the Site's special nuclear material (SNM) is a contingent mission for the facility. This mission would extend from 2002 to ~2015 in the event that current efforts to ensure off-site shipping in time to obviate interim storage at the Site prove unsuccessful. Validation involves the consideration of alternatives (including those alternatives selected in prior studies and identified in the IPP) and the selection of those projects either necessary for or cost effective in enhancing safety for the interim storage mission. To determine project safety impacts, an overall perspective on the facility contents, configuration, and activity level during the mission is required. These boundary conditions are intended to provide such a perspective, including firm plans and known significant uncertainties in a form amenable to revision during the continuing validation study.

1.0 Background

As part of the Department of Energy's (DOE or the Department) response to DNFSB Recommendation 94-3, Building 371 is undergoing a series of upgrades to provide safe storage of the Site's plutonium metal and oxide for near-term facility missions (i.e., through approximately 2002). The near-term missions include storage, stabilization, and repackaging of SNM in preparation for off-site shipment. The "priority" upgrades identified in Table 3-1 of the DNFSB Recommendation 94-3 IPP are nearing completion and a second series of upgrades related to the Basis for Interim Operations (BIO, ref. 3) and identified in Table 3-2 of the IPP is in progress for completion in FY-98 and early FY-99. The IPP further commits to perform additional upgrades to prepare the facility for a contingent interim storage mission extending from 2002 through ~2015. These "Interim Storage Upgrades" are to be selected in FY-98 through the validation study, which will utilize these boundary conditions. They are to be designed in FY-99 and a construction schedule is then to be prepared, which supports completion by 2002. These activities on interim storage upgrades are to proceed until the Go/No Go criteria (IPP deliverable 6-5) for timely off-site shipment are satisfied, thereby obviating the interim storage mission in Building 371.

The original IPP (ref.4) identified three sets of upgrades to support the interim storage mission. These upgrades were selected in a study (ref. 5) completed early in 1996 and were designated as "safety margin", "material relocation", and "security" upgrades. Their selection was based on scoping studies performed to support a decision on how best to prepare the Site for interim storage. The three sets of upgrades for Building 371 were selected using a cost/benefit screen that relied on preliminary subjective estimates of the benefit dimensions, including nuclear safety. With the three sets identified, the overall upgrade scope was judged to be reasonably representative of the cost of preparing Building 371 for interim storage.

Subsequent activities, including preparation of the BIO and development of a new Site closure plan, afford a new, more detailed and objective context for reconsideration of the appropriate interim storage upgrades. Such reconsideration is a logical extension of the systems engineering approach adopted for the original Recommendation 94-3 studies and embodied in the IPP. Thus, this validation process is to begin in March 1998 and be completed in August 1998 with a report of recommendations and their technical basis. The validation study will be conducted by Kaiser-Hill Company, L.L.C. (K-H) and Safe Sites of Colorado, L.L.C. (SSOC) engineers (including Building 371 representatives), with sub-contractor support.

The IPP identifies two significant decisions incorporated in the Site closure plan that differ from early 1996 expectations and substantially affect the validation study: the current Site boundary and the Site fire department will be maintained while SNM is stored onsite. These examples illustrate the importance of forecasting such boundary conditions and the uncertainty involved in projecting four years ahead. Key boundary conditions must be identified for the Site, the facility, and the material. This report identifies other significant boundary conditions, uncertainties affecting them, and timetables for resolution where available. For some uncertainties, ranges are recommended that may be bounded or addressed with sensitivity studies for individual projects to ensure that the validation conclusions do not depend upon indeterminate items. This report will be updated as significant changes arise during the course of the study.

2.0 Scope

Additional Site boundary conditions of interest include the Site population and activity levels forecast in the vicinity of Building 371, the projected Site risk level and the key contributors to it, site support systems, and the security boundary around Building 371. Key facility boundary conditions include the remaining facility missions, the hazardous inventory and its distribution in the facility (particularly the quantity and configuration of remaining holdup), the level of ongoing D&D activity (including plans affecting 374 or the support facility), and the facility population. The level of building services anticipated during interim storage is also pertinent (e.g., facility heat, ventilation in unused areas without dispersible material, CSV de-inerted, etc.). The key SNM boundary conditions include the packaging (i.e., 3013s as previously assumed or produce cans if a decision is made not to package all material on Site) and the temperature limit for packaged metal.

3.0 Key Boundary Elements

The following sub-sections summarize the recommended boundary conditions and their basis for both the Site and for Building 371.

3.1 Site Boundary Conditions

Site boundary conditions include those features of the site which are essential to the operation of Building 371 and the protection of the materials stored therein. Site security, fire protection, and utilities need to be provided while Building 371 is functioning for the interim storage mission.

3.2 Facility Boundary Conditions

Most activities planned in the facility are expected to be completed prior to 2002 (reference 7 and 8). Among the specific activities considered and the bases for this conclusion are the following:

- ⇒ A decision has been made to install the packaging portion of the PuSPS line in Building 371 and to provide separate furnaces for the Pu oxides. The current schedule supports the 2002 target date.
- ⇒ Sand, slag and crucible residue repackaging and shipment to SRS is scheduled for completion well before 2002. There will be no impact on the interim storage mission.
- ⇒ Combustible residue repackaging is to be completed in May 2002 in the baseline closure plan. Work is in progress to ship the plutonium fluorides to SRS for processing.
- ⇒ Dry residue repackaging under the accelerated proposal will be partially performed in Building 371 following SS&C repackaging. Completion is forecast for June of 2000.
- ⇒ CWTS operation continues through May of 2002 in the baseline closure schedule to process lab waste >6 g/liter from Building 559.
- ⇒ Wastewater treatment in Building 374 extends into 2004 in the baseline closure plan. If operation of Building 374 continues beyond the start of the interim storage mission of Building 371, it will contribute to the overall risk of the facility.

⇒ There will be no residues stored in Building 371 after 2002, since those remaining onsite, if any will be packaged in pipe components and drum overpack packages and stored for shipment.

⇒ These decontamination and deactivation activities possible during interim storage will be conducted from 2002 through 2004. These packages are to be stored in buildings pending shipment to WIPP in order to not impede D&D in Building 371/374 complex.

3.3 Material Boundary Conditions

The following boundary conditions represent the key assumptions regarding the requirements for storing SNM in the Building 371 vaults:

⇒ Site personnel have given a best estimate of the number of DOE-STD-3013 containers to be stored in Building 371. The numbers are 1250 containers of oxide, and 800 containers of metal. It is assumed that the material will be packaged and ready to store by the start of the interim storage mission in 2002.

⇒ A temperature limit of no less than 250° C will be imposed on the 3013 containers storing metals, in place of the 100° C limit in DOE-STD-3013. The change is based on an anticipated demonstration that cyclic loading to structural failure will not be possible from α/β phase transition. There will be no temperature limit on oxides.

⇒ The heat generation rate is assumed to be 3 watts per kg. . This is the lower value from reference 6. The lower value was chosen based on its use for other calculations and a general consensus of technical experts.

⇒ Access must be provided for periodic surveillance both for DOE and IAEA materials. Surveillance will consist of calorimetry, gamma spectrometer, weight measurements, and container inspection by radiography. The inspection rate is 10% per year for oxides and 5% per year for metals.

4.0 References

1. Letter, Gary Voorheis, Kaiser-Hill, to Keith Klein, DOE-RFFO, *Submittal of the Validation Plan for Building 371 Proposed Interim Storage Upgrades – GMV-124-98*, 98-RF-01454, March 23, 1998.
2. U. S. Department of Energy, *Defense Nuclear Facilities Safety Board Recommendation 94-3 Integrated program Plan*, Revision 1, February 1998.
3. Kaiser-Hill, L.L.C., *Basis for Interim Operation Building 371/374 Complex*, Revision 2A, Rocky Flats Environmental Technology Site, Golden CO, April 2, 1998.
4. Rocky Flats Environmental Technology Site, *Defense Nuclear Facilities Safety Board Recommendation 94-3 Integrated Program Plan*, Revision G, Golden CO, July 1966.
5. Kaiser-Hill, L.L.C., *DNFSB Recommendation 94-3 IP Task 3-2 Report, Building 371 Interim Storage Mission Summary Report*, Rocky Flats Environmental Technology Site, Golden CO, March 1996.
6. *Thermal Analysis of Plutonium Materials in British Nuclear Fuels, Ltd. Containers*, LANL Report LA-UR-97-1866.
7. PBD-9, *Pu Solid Residue Stabilization Project*, 7/31/98
8. Kaiser-Hill, LLC, Rocky Flats Closure Project, Expanded Management Summary Schedule, status date 3/22/98

Table 1: Summary List of Boundary Condition Assumptions

Schedule for the Building 371 Interim Storage Mission

The interim storage mission begins in December 2002 with the use of the building as a storage facility. The storage mission is projected to end in 2015. If the mission were extended beyond 2015, an evaluation of the facility considering aging effects of structures and systems would be performed.

Site Boundary Condition Assumptions

1. The site boundary is unchanged from its present location.
2. The site fire department will be maintained while SNM is onsite.

The site support infrastructure will continue to serve the facility (see Table 2).

Facility Boundary Condition Assumptions

1. Plutonium oxide and metal processing to meet DOE-STD-3013 is completed by May 2002.
2. All weapons grade materials have been removed from the facility by 2002.
3. CWTS operations are complete by May 2002. All tanks and process piping containing actinide solutions are drained and flushed.
4. Room 3189 contains no nuclear materials.
5. The combustible loading control program is maintained throughout the facility.
6. The facility docks will be used to stage nuclear material shipments.
7. All residues will be removed from the facility by 2002. The sub-basement vaults will be available for construction in time to support the interim storage mission.
8. The Central Storage Vault is being deactivated and will not be used for storage.
9. D&D activities possible during Interim Storage will be conducted 2002-2004.

Areas of the building that are deactivated will be locked and not routinely accessed. Combustibles will be removed during deactivation.

SNM Boundary Condition Assumptions

1. Plutonium oxide and metal processing to meet DOE-STD-3013 is completed by May 2002. All other nuclear materials (except holdup) will be stored in DOT approved shipping containers.
2. The Pu metal and oxide will be routinely accessed to perform the DOE-STD-3013 surveillance. The recommended surveillance frequencies of 5%/year for Pu metal and 10%/year for Pu oxide require that about 160 cans be handled annually.
3. The inventory is 1250 DOE-STD-3013 containers of oxide and 800 of metal.

Heat generated in the 3013 containers (or per Kg of Pu)is assumed to be 3 watts/kg The 3013 container temperature limits are no less than 250° C for metals and are not applicable to oxides.

Table 2: Systems Required for Storage Mission

These systems are required to maintain the nuclear safety envelope and/or to keep the building fully operational in support of its mission.

HVAC Systems	System 1 - Building HVAC System 2 - Building HVAC System 4 - Control Room System 5 - Ground Floor Support Facility System 6 - Switchgear Room Gloveboxes and Hoods - PuSPS (partial deactivation but not isolated from HVAC Zone 1)
Air Monitoring Systems	Selective Alpha Air Monitors (SAAMs) Fixed Air Heads Health Physics Vacuum Effluent Monitoring
Criticality Detection Systems	Criticality Detection and Alarm System Life Safety Disaster Warning System
Fire Protection Systems	Fire Detection and Alarm System Fire Water System Wet Sprinkler System Wet Standpipe System Plenum Deluge System Fire Extinguishers
Safeguards, IAEA, and Security Systems	NDA Equipment IAEA Security Systems Perimeter Intrusion and Detection System Facility Security Detection and Alarm System
Electrical Power and Support Systems	Normal and Alternate Power Turbine Generators Fuel Oil Supply System Emergency Air System Uninterruptible Power Supply Lightning Protection System
Support Systems	Main Control Room Heating/Cooling Water
Site Support Systems	Domestic Water System Electrical Distribution Sewerage System
Miscellaneous	Sub-surface Drain System Seismic Triggers on Water Supply to Attic and Nitrogen Supply Seismic Recording Instrumentation Attic Leak Detection System

Attachment 4 – Risk Reductions

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DEFENSE NUCLEAR FACILITIES SAFETY BOARD
RECOMMENDATION 94-3

BUILDING 371 INTERIM STORAGE UPGRADES
EVALUATION OF RISK REDUCTION STRATEGIES

REVISION 0

BUILDING 371 INTERIM STORAGE UPGRADES EVALUATION OF RISK REDUCTION STRATEGIES

1.0 Introduction

If SNM is not removed from the site on an accelerated schedule supportive of site closure by 2006, then Building 371 is assumed to serve as the storage vault from 2002 through 2015, the target set in the Rocky Flats Cleanup Agreement. The Defense Nuclear Facilities Safety Board (DNFSB) Recommendation 94-3 Integrated Program Plan (IPP) requires validation of proposed upgrades to the Building 371 to support the interim storage mission. This document provides the risk evaluation to support selection of B-371 facility upgrades. The evaluation addresses the reduction in facility and site risk.

2.0 Background

2.1 Facility Dose For Severe Seismic Events

Previously estimated radiological doses from Building 371/374 for postulated severe seismic events are summarized in Table 2-1. These are as reported in the Basis for Interim Operation (BIO) and DNFSB 94-3 Integrated Program Plan (IPP) Task 9-1 Report.

Table 2-1 Doses From Postulated Seismic Events

Event	Peak Ground Acceleration	Dose[1] To Collocated Workers (Rem CEDE)	Dose[1] To MOI (Rem CEDE)
NPH-1 (900 Year Return Earthquake) [2]	0.15g	193	2.4
EBE (2000 Yr. Return Period earthquake) [2]	0.25g	670	8.6
Collapse Earthquake (Mean Value) (38,400 Yr. Return Period earthquake) [3]	0.72g	50,000	510

NOTES:

1. Doses are with credited mitigative features. Contributions include 371, 374 and Support Facility.
2. Reference 1: Building 371/374 Complex BIO, Section 5.4 (Tables 5-50 and 5-54)
3. Reference 2: DNFSB 94-3 IPP, Task 9-1 Report (Appendix C, Spreadsheet 371.XLS)

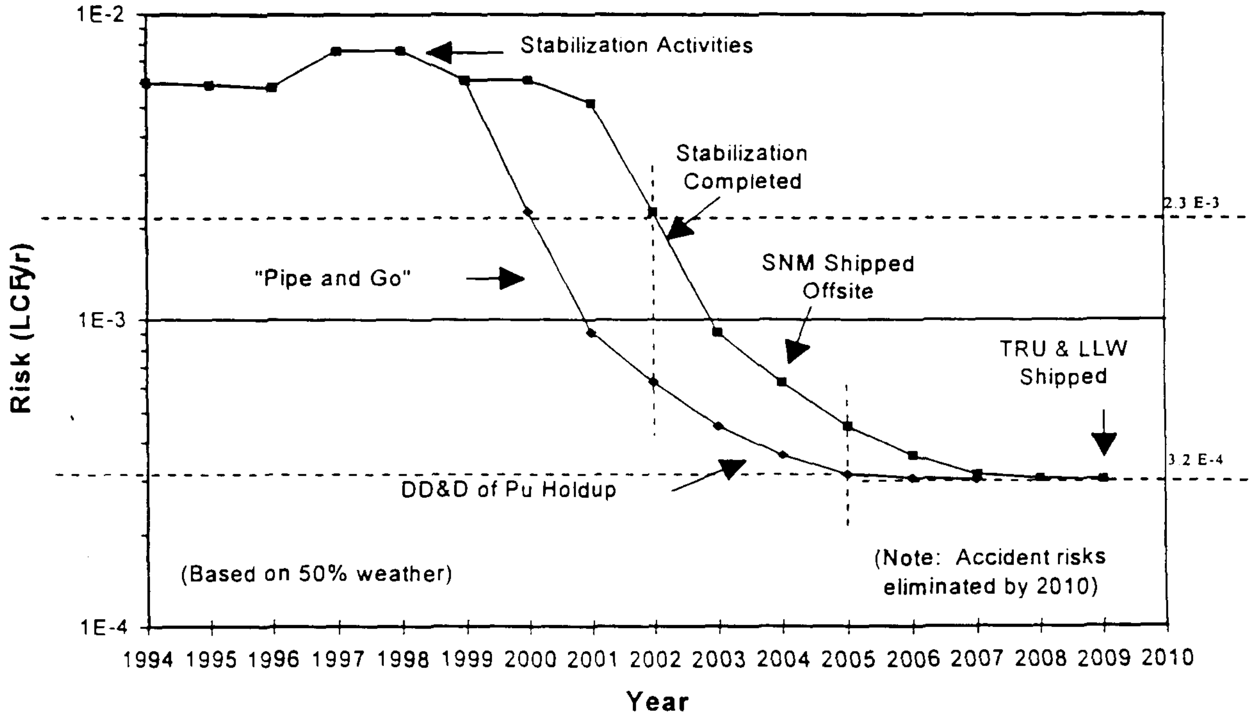
Analysis presented in these documents (i.e., the BIO and Task 9-1 Report) indicate that the EBE is expected to result in site doses exceeding the site dose criteria (5 rem), and the Collapse Earthquake results in high radiological doses to the public and collocated worker.

Note that the BIO and Task 9-1 Reports do not address risk reduction with estimated quantities of SNM and holdup quantities expected in 2002, or with implementation of upgrade alternatives. Therefore, potential risks from seismic events should be re-evaluated. To simplify the evaluation, only the EBE and mean level Collapse Earthquake are evaluated. Upgrades implemented to reduce risk from these events should also reduce the risk from the 900 year return period earthquakes.

2.2 Site Risk

Given maintenance of the present Site boundary throughout the interim storage mission, the estimated Site risk profile from a recent comprehensive study (reference 3) is provided in Figure 2-1. These results are based on the composite contributions from all significant accident sources considering all remaining Site facilities and ongoing D&D activities for the Site Closure Case and sensitivity of the "pipe and go" concept for residues.

Figure 2-1: Public Risk Profile Due to Accidents



The site risk profile indicates that the site risk reduces substantially between years 2000 and 2005, assuming off-site shipment is completed in this period. This profile does not provide the reduction in site risk if the proposed facility upgrades are implemented. Two targets are selected to reflect Site risk uncertainty and to gauge the relative importance of Interim Storage risks for Building 371: high target from the 2002 closure case (2.3E-3) and a low target from the 2005 "pipe and go" case (3.2E-4).

3.0 Proposed B-371 upgrades

The proposed upgrade alternatives for Building 371 considered for dose/risk reduction are:

a) Movement of oxides to seismically capable subbasement vaults
b) Enhanced passive confinement to reduce leakpath factors
c) Decontamination of facility Pu holdup, and/or

d) Installation of new diesel-generators to ensure confinement (negative building pressure).

The criteria applied in this evaluation for selection of upgrades are:

- Upgrades required to meet the Evaluation Guideline [5 Rem to the MOI] for evaluation basis seismic events [i.e., the EBE]
- Upgrades, which demonstrate substantial and practical risk reduction for beyond design basis events [i.e., the CPE].

4.0 Approach

To evaluate the facility and site risk reduction, the following evaluations are performed.

4.1 Evaluate Dose Reduction with Oxides/Metals on Ground Floor (Baseline Case 1)

At the start of the Interim Storage Mission, all material at risk (MAR) is expected to be removed except metals and oxides stored in DOE-STD-3013 containers and holdup. Determine the expected doses from the EBE and CPE events as follows:

- Eliminate MAR quantities expected in 2002 to be removed from that currently evaluated in the BIO and Task 9-1 Report. This includes residues, solutions and "in process" oxides.
- Change metals and oxide MAR quantities to those expected to be stored in DOE-3013 containers in 2002. Assume 1250 oxide containers and 800 metal containers, with 4.5 kg Pu per container.
- Determine new dose (Rem) values to establish a new base case.

4.2 Evaluate Dose Reduction with Oxides in Subbasement Vaults (Baseline Case 2)

Move Pu oxides to subbasement vaults (Rooms 1101 and 1208) and determine the expected site dose (i.e., eliminate dose contribution from oxide dispersions). Both the EBE and CPE are evaluated with this SNM storage configuration.

Reductions in dose (risk) to meet or exceed the selection criteria will indicate that movement of oxides to subbasement vaults is recommended.

4.3 Evaluate Dose Reduction Strategies Studies

For the recommended storage configuration identified in Section 4.2 above, evaluate the expected dose reductions following the EBE for each of the following strategies:

- *Holdup Removal*: Reduction in effective MAR due to selective removal or containment by application of a fixative of holdup in areas determined to be readily accessable. Assume 50% reduction in effective MAR.
- *Simple Active Strategy*: Ensure forced ventilation by installing Diesel-Generators to power one primary fan on each of HVAC systems 1 and 2. Conservatively assume one HEPA remains intact, which provides a LPF of E-03.
- *Enhanced Passive Confinement*: Enhanced passive confinement may be achieved by modifications to HVAC system and/or modifying tertiary confinement doors. For purposes of this evaluation, assume the building LPF is enhanced by a factor of 10.

Upgrades providing reductions in dose (risk) that meet or exceed the selection criteria will be recommended.

4.4 Evaluate Effect on Site Risk

To determine the impact of the proposed upgrades, the expected dose reduction is compared to the site risk profile presented in Section 2.2.

5.0 Results

5.1 Dose Contribution Following Severe Seismic Events

The results of implementing the facility upgrades in terms of dose reductions are provided in Table 5-1, Dose Evaluation Results. Detailed dose calculations are provided in Attachment A.

Table 5-1: Dose Evaluation Results

Scenario	Basis	Collocated Worker Dose (rem)	Public Dose (rem)
EBE	Current BIO Estimate (residues, metals, oxides, holdup, etc)	670	8.6
	2002 Baseline Case 1- Oxides & Metals in Ground Floor Vaults	72	0.9
	2002 Baseline Case 2: Oxides in Subbasement, Metals in Ground Floor Vaults	72	0.9
	Simple Active Approach (installation of Diesel-Generators, 1 HEPA)	23	0.3
	Enhanced Passive Confinement (LPF = 0.01)	28	0.4
	Holdup Removal/Containment In Selected Areas (Assume 50% MAR reduction)	35	0.5
CPE	94-3 IP Task 9-1 Report (residues, metals, oxides, holdup, etc)	50,789	510.3
	94-3 IP Task 9-1 Report (oxides and holdup only)	35413	354.6
	2002 Baseline Case 2: Oxides in Subbasement, Metals in Ground Floor Vaults	1,413	14.6

These results demonstrate that movement of the oxides to seismically capable subbasement vaults does not provide any reduction in dose for the EBE, but that there is a substantial reduction in dose following the CPE.

5.2 Site Risk Contribution

The reduction in site risk is obtained by converting the expected dose (rem) to risk in terms of latent cancer fatalities (LCF) and comparing to the site risk profile in Section 2.2. The results of this evaluation are provided in Table 5-2, Site Risk Reduction Results.

Table 5-2: Site Risk Reduction Results

Scenario	MOI Dose (rem CEDE)	MOI LCF	MOI Risk (LCF/yr.)
CPE B-371/734 Contribution From Table 5-1	14.6	2.3	6.1E-05
CPE B-371/734 Contribution From Table 5-1 with Oxides on Ground Floor (based on IP Task 9-1 report)	354.6	56.7	1.5E-3
CPE - Total Site Risk (Except SNM) from Figure 2-1 after 2005 with Pipe and Go Option	N/A	N/A	3.2E-04

Notes:
1. Conversion of rem CEDE to LCF is 0.16 (Based on Task 9-1 Report)
2. Conversion of LCF to LCF/yr is multiply LCF by the event probability (1/38,400 yr.)

The results show that Building 371 with oxides in the sub-basement constitutes only about 16% of the site risk from 2005 until the remaining plutonium facilities are removed in 2010. With oxides on the ground floor, Building 371 constitutes 82% of the site risk.

After 2010, Building 371 constitutes almost all the site risk if the other plutonium facilities are removed. Relocation of oxides to the sub-basement reduces that risk by about 95%.

6.0 Conclusions

The result of this evaluation support the following conclusions:

a) Movement of oxides to seismically capable subbasement vaults (Rooms 1101 and 1208) is recommended. This upgrade provides substantial site risk reduction following the Collapse Prevention Earthquake (CPE).

b) Other evaluated upgrades are not recommended. There is marginal benefit for installation of the diesel generators, providing enhanced passive confinement or holdup removal.

7.0 References

1. Rocky Flats Environmental Technology Site, "Basis for Interim Operation, Building 371/374 Complex", Revision 2, April 2, 1998.
2. Rocky Flats Environmental Technology Site, DNFSB 94-3 IPP, "Deliverable 9-1: Risk Assessment of Building 371 Baseline and Alternatives for Consolidation of SNM", December 11, 1995.

Attachment A – Dose Contribution Calculations

New Baseline
EBE After Consolidation - Oxides in Rooms 1101 & 1208

Comment	Removed by 2002	Removed by 2002	Removed by 2002	Removed by 2002	Same as EBE	Removed by 2002	Results 1101/1208	3013 Container Rm 3337	Removed by 2002	Removed by 2002	Net Credits	Net Credits	Net Credits		Removed by 2002	Removed by 2002	Removed by 2002		Removed by 2002	Removed by 2002	Assume Same HU		
Damage Ratio	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	1.0		
LPF	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	7.2 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	49.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.8	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	72.8 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.9 rem

New Baseline - EBE
With OGs (Forced Ventilation, 1stage HEPA)

Comment	Removed by 2002	Removed by 2002	Removed by 2002	Removed by 2002	MAR Same as EBE	Removed by 2002	Results 1101/1208	3013 Container Rm 3337	Removed by 2002	Removed by 2002	Net Credits	Net Credits	Net Credits		Removed by 2002	Removed by 2002	Removed by 2002		Removed by 2002	Removed by 2002	Assume Same HU		
Damage Ratio	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	1.0		
LPF	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	7.2 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	26.5 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	0.008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3 rem

New Baseline - EBE
Enhanced Passive Confinement (LPF = 0.01)

Comment	Removed by 2002	Removed by 2002	Removed by 2002	Removed by 2002	Same as EBE	Removed by 2002	Results 1101/1208	3013 Container Rm 3337	Removed by 2002	Removed by 2002	Net Credits	Net Credits	Net Credits		Removed by 2002	Removed by 2002	Removed by 2002		Removed by 2002	Removed by 2002	Assume Same HU		
Damage Ratio	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	1.0		
LPF	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	7.2 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	27.8 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	0.08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.4 rem

Baseline - EBE
Remove 50% Holdup, LPF = 0.1

Comment	Removed by 2002	Removed by 2002	Removed by 2002	Removed by 2002	50% of EBE Baseline	Removed by 2002	Results 1101/1208	3013 Container Rm 3337	Removed by 2002	Removed by 2002	Net Credits	Net Credits	Net Credits		Removed by 2002	Removed by 2002	Removed by 2002		Removed by 2002	Removed by 2002	Assume Same HU		
Damage Ratio	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	1.0		
LPF	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	3.7 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	35.3 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	0.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5 rem

New Baseline
CPE After SNM Consolidation & Oxides in Subbasement

Damage Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
LPF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	[illegible]	0.0	0.0	58.0	0.0	0.0	0.0	0.0	0.0	73.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.8 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	823.3	0.0	0.0	590.0	0.0	0.0	0.0	0.0	0.0	1,413.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,413.3 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	7.5	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6 rem

New Baseline
CPE After SNM Consolidation & Oxides on Ground Floor

Damage Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
LPF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	[illegible]	0.0	3,200.0	58.0	0.0	0.0	0.0	0.0	0.0	3,273.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,273.8 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	823.3	0.0	34,000.0	590.0	0.0	0.0	0.0	0.0	0.0	35,413.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35,413.3 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	7.5	0.0	340.0	7.1	0.0	0.0	0.0	0.0	0.0	354.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	354.6 rem

Attachment 6
Risk Comparison Spreadsheet
DNFSB Recommendation 94-3 IPP
Confinement Test Study

Legend: Effective MAR = Total MAR * Damage Ratio
LPF = Leakpath Factor

Scenario	B-371														Support Fac				B-374				
	Residues (Cat 1 NC)	Residues (Cat 2 C)	Residues (Solidified)	Ash/Ash Sand Soil	Dust/Room Holdup (residues)	Oxides in GBs	Vault Container Oxides	Metals wo containers	Metals from B next	Process Exp	Sublimate Criticality	Room Fire	Small Pu Fire	Totals	Rm 3100 CA	Rm 3100 Soil	Drum Soil	Totals	Drum Soil	Pu Sam Soil	Holdup	Totals	Combine Totals
BIO (Table 5-44 P&M Features)																							
EBE - Before SNM Consolidation																							
Damage Ratio																							
LPF (BIO pg 5-258)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR (kg)	30.0			98.0	7.0	14.0	0.0	0.0	0.0	10.0	4.6	0.0	3.0	166.8	0.0	10.0	2.0	12.0	2.3	1.0	0.2	3.5	182.3 kg
CW Dose Contribution	55.0			64.0	49.0	96.0	0.0	0.0	0.0	69.0	13.0	0.0	8.6	354.6	0.0	110.0	150.0	260.0	28.0	6.0	23.0	58.0	[illegible] rem
Public - MOI Dose Contribution	0.7			0.8	0.8	1.2	0.0	0.0	0.0	0.8	0.1	0.0	0.1	4.8	0.0	1.5	1.9	3.4	0.3	0.1	0.3	0.7	8.6 rem
Task 9-1 Report (App. C, 371.xls)																							
IPE After SNM Consolidation																							
Damage Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
LPF	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	1,100.0	43.0	750.0	12.0	0.0	10.0	3,200.0	68.0	0.0	0.0	0.0	0.0	0.0	5,184.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5,184.0 kg
CW Dose Contribution	12,000.0	450.0	1,200.0	39.0	310.0	2,100.0	34,000.0	690.0	0.0	0.0	0.0	0.0	0.0	50,789.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50,789.0 rem
Public - MOI Dose Contribution	120.0	4.6	13.0	0.4	3.2	22.0	340.0	7.1	0.0	0.0	0.0	0.0	0.0	510.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	510.3 rem
New Baseline																							
EBE After Consolidation - Metals & Oxides in Ground Floor Vaults																							
Comment	Removed by 2002	Removed by 2002	Removed by 2002	Removed by 2002	Same as EBE	Removed by 2002	1250 DOE-3013 Container Rm 3337	800 DOE-3013 Container Rm 3337	Removed by 2002	Removed by 2002	Not Credible	Not Credible	Not Credible		Removed by 2002	Removed by 2002	Removed by 2002		Removed by 2002	Removed by 2002	Assume Same HU		
Damage Ratio	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	1.0		
LPF	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		1.0	1.0	1.0		1.0	1.0	1.0		
Effective MAR	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	7.2 kg
CW Dose Contribution	0.0	0.0	0.0	0.0	49.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0	72.0 rem
Public - MOI Dose Contribution	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.9 rem

Attachment 5 – Tables

Table 3.7.1.2-1

Facility Upgrades For Interim Mission

(Ground Floor Vault Storage Option)

1	Structure	Ceiling Upgrades for new sub-basement storage vaults (Rooms 1101 & 1208)	$1,030
2	Fire Suppression	Install 60K Gallon Seismic Water Tank	$850
3	Program	Upgrade Emergency Plan and Emergency Operating Procedures	$333
4	Fire Suppression	Install seismically qualified plenum deluge system recharge piping	$1,260
5	Control	Install two remote control stations for primary fans and standby generators	$2,790
6	Fire Suppression	Install Seismically qualified dry standpipes	$1,940
7	Power	Install 300KW standby electric generators for primary HVAC fans	$5,480
Not Rated	HVAC 1 & 2	Install standby supply air fans to cool ground floor vaults	$1,640
Not Rated	Structure	Install security cages on roof doors	$170
Not Rated	Structure	Convert Room 1101 and 1208 to 3013 container storage vault. Includes security upgrades. (Room 1206 wall upgrades, HVAC security grating, etc.) Costs include stacker vault wall upgrades and subbasement vault rack upgrades)	$7,240
Not Rated	Security	Reduce PIDAS to Building 371 only	$10,070
Not Rated	Structure	Convert Rooms 3559 and 3561 to SNM storage vaults	$10,110
Not Rated	Structure	Upgrade Room 3606 Roof	$300
TOTAL			$43,213

Recommendation 94-3 Integrated Program Plan Revision 1

Table 6-2. Interim Storage Upgrade Validation

Upgrade	Upgrade Type	Validation Requirements
60K Gallon Water Tank	App. C – Safety Margin	Assess whether combustible control for interim storage conditions makes this upgrade unnecessary; if not, tie implementation timing to fire department closure
Upgrade EP and EOPs	App. C – Safety Margin	Verify that BIO-implementation lays groundwork for annual upgrades eliminating this future project
Plenum Deluge Recharge	App. C – Safety Margin	Cancel if scrubber removal is a more effective means of ensuring safety
Remote Control Stations	App. C – Safety Margin	Evaluate scope of required ventilation given vault and material locations; determine most effective implementation strategy
Seismic Dry Standpipes	App. C – Safety Margin	Assess whether combustible control for interim storage conditions makes this upgrade unnecessary; if not, tie implementation timing to fire department closure
300 kw Standby Generators	App. C – Safety Margin	Evaluate minimum scope given vault and material locations; determine most effective implementation strategy
Upgrade 1101 & 1208 Ceiling	App. C – Material Relocation	Verify that ceiling strengthening can follow material loading in vault below
Ground Floor Vault HVAC	App. C – Material Relocation	Update status of expected temperatures and safety significance of 100 degree centigrade limit for stored metals per STD-3013
Reconfigure Sub-Basement Vaults	App. C – Material Relocation	Evaluate practicality of early start for oxides in sub-basement vs. completion in time for start of interim storage
Convert 3559 & 3561 to Vaults	App. C – Material Relocation	Verify the pit shipment schedule makes these upgrades unnecessary
Security Cages on Roof Doors	App. C – Security *	Verify that security cages like PIDAS reduction can be decoupled from start of interim storage
Reduce PIDAS	App. C – Security *	Verify decoupling PIDAS schedule from start of interim storage
Upgrade 3606 Roof	App. C – Security *	Determine mission for 3606 vault for interim storage (e.g. contingency for HEU) and tie upgrade to mission
Material Transfer Dumbwaiter	App. C – Priority Non-Safety	Tie to material relocation and reassess need for frequent material transfers between floors
Assess Scrubber Removal	AB Required Study	Verify that removal prior to interim storage is more effective than deluge recharge piping (i.e., affords prevention vs. mitigation and improves non-earthquake safety as well)
Further Mitigate Dock Fire	AB Review Report App. B	During required review, assess whether new upgrades emerge that warrant completion for safe interim storage
Further Mitigate Dock Drum Explosion	AB Review Report App. B	During required review, assess whether new upgrades emerge that warrant completion for safe interim storage
Further Mitigate EBE	AB Review Report App. B	During required review, assess whether new upgrades emerge that warrant completion for safe interim storage

* The security upgrades are not the subject of Recommendation 94-3 and are only provided to present a complete list of upgrades possible for an interim storage mission.

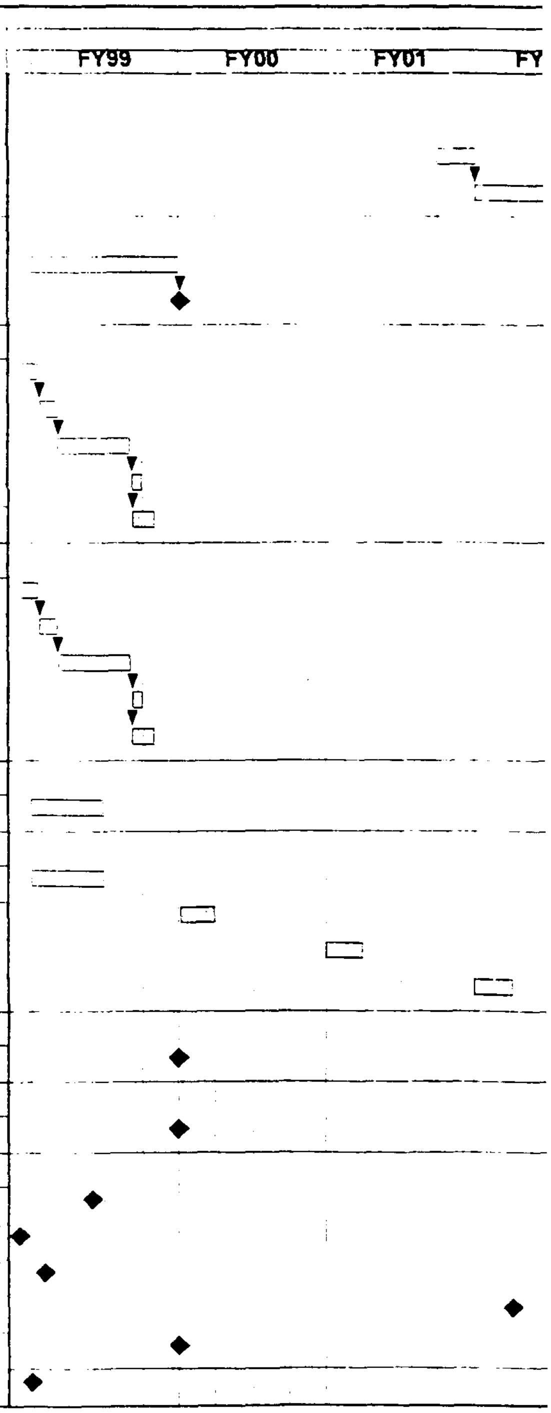
Attachment 6 - List of Considerations

Proposed Upgrade	Recommend Implementation	
	Yes	*No*
Remote Control Station		X
Stand By Generators • Simple active confinement		X
Mitigate EBE • SQUG Walkdowns • Seismic Trigger to isolate building power • Passive confinement • Containing holdup	*D&D Issue*	X
60K Tank		X
Plenum Recharge		X
Dry Standpipe		X
SQUG Walkdown of Wet Risers		X
Assess Scrubber Removal • Assess Material Properties of Scrubber/Pall Rings • Spark Size and Survivability • Demister Effectiveness • Combustible Controls • Fire Duration • Flashover • Exhaust Air Temperature Profiles	X	
Dock Fire		X
Dock Drum Explosion • Hydrogen Buildup in Waste Drums		X
Upgrade-BERO/EP • Seismic Response • Fire Response	X	
Reconfigure Sub-basement Vaults	X	
1101/1208 Ceiling	X	
Ground Floor/Subbasement HVAC		X
Convert 3559/3561 To Vaults		X
Dumbwaiter • NDA Requirements		X
HEPA Filters - Replace • Filter Plugging • Review Filter Tests	X	

BUILDING 371
INTERIM STORAGE UPGRADES VALIDATION PROJECT

Attachment 7 – Schedule Outyears

Activity ID	Activity Description	Orig Dur	Rem Dur	Early Start	Early Finish
INTERIM STORAGE MILESTONE SCHEDULE					
REPLACE HEPA FILTERS					
VALD0005	Conduct Deluge System Test	61	61	25JUN01*	27SEP01
VALD0010	HEPA's Removal/Replacement	113	113	01OCT01	28MAR02
REMOVE SCRUBBER PALL RINGS					
VALD0015	Develop Pall Ring Work Package	228	228	01OCT98*	30SEP99
VALD0020	Scrubbers - Decision When Rmv Pall Rings	0	0		04OCT99
RECONFIGURE VAULTS 1101 & 1208					
VALD0025	Prepare Statement Of Work	27	27	03SEP98*	15OCT98
VALD0026	Award Design Contract	30	30	19OCT98	04DEC98
VALD0027	Design The Upgrade	114	114	07DEC98	04JUN99
VALD0028	Review/Approve Design	18	18	07JUN99	02JUL99
VALD0029	Develop Construction Schedule	34	34	08JUN99	30JUL99
UPGRADE VAULTS 1101 & 1208 CEILINGS					
VALD0030	Prepare Statement Of Work	27	27	03SEP98*	15OCT98
VALD0031	Award Design Contract	30	30	19OCT98	04DEC98
VALD0032	Design The Upgrade	114	114	07DEC98	04JUN99
VALD0033	Review/Approve Design	18	18	07JUN99	02JUL99
VALD0034	Develop Construction Schedule	34	34	08JUN99	30JUL99
FIRE FIGHTING EQUIPMENT REVIEW					
VALD0035	Fire Equipment - Capability Review	113	113	01OCT98*	31MAR99
UPGRADE EP & EOP's					
VALD0045	Upgrade EOP's - FY98	113	113	01OCT98*	31MAR99
VALD0050	Upgrade EOP's - FY99	56	56	04OCT99*	31DEC99
VALD0055	Upgrade EOP's - FY00	56	56	02OCT00*	29DEC00
VALD0060	Upgrade EOP's - FY01	57	57	01OCT01*	31DEC01
RESIDUE STORAGE					
VALD0065	Residues-Confirm Plans Clear B371 By	0	0		30SEP99*
HOLDUP REMOVAL					
VALD0070	Holdup - Decision & Plan Holdup Reduction	0	0		30SEP99*
OFFSITE SHIPMENT MILESTONES					
VALD0075	Issue ROD For Pu Site	0	0		26FEB99*
VALD0080	Complete APSF Design	0	0		31AUG98*
VALD0085	Initiate APSF Construction	0	0		30OCT98*
VALD0090	Complete APSF Construction	0	0		31DEC01*
VALD0100	Complete Pits Shipment	0	0		30SEP99*
VALD0105	Sand/Slag/Crucible Shipment	0	0		30SEP98*



Attachment 8a – Confinement (Remote Control Station & 300 kw Standby Gen)

A SCHEDULE TASK NUMBER

AC-0210

B. BACKGROUND

In 1996, the DNFSB recommendation 94-3 report on Task 3-1 identified the installation new diesel-generators with the associated control stations as a potential upgrade supporting the interim storage mission. The purpose of the generators was to provide reliable, seismically capable, backup power to the building exhaust fans.

The existing backup power supply (turbine-generator system) was evaluated for seismic capability using the Seismic Qualification Utilities Group (SQUG) process. That evaluation could not demonstrate that the turbine-generator system, although inherently rugged, is capable of withstanding the Evaluation Basis Earthquake (EBE). Upgrading the existing system to withstand the EBE (Performance Category 3) was estimated to cost in excess of $20 million.

The proposed upgrade would enable confinement using a "simple active" approach. Installation of two new diesel-generators provide electrical power to one primary exhaust fan on each of the two HVAC systems (HVAC Systems 1 and 2) servicing plutonium operation and storage areas of Building 371. Providing power to the exhaust fans would ensure forced ventilation and a filtered exhaust flow path.

C. PROJECT OBJECTIVES

The objective of this project is to provide a seismically capable electrical power source to the primary ventilation fans. This would ensure confinement (building negative pressure and exhaust HEPA filtration) following loss of offsite power scenarios.

This scope of this project includes installation of:

1. Two (2) seismically capable diesel generators, fuel supplies and controls.
2. New electrical power cables routed to one of the existing primary fans on each of HVAC Systems 1 and 2.
3. Transfer switches for switching from the normal power bus to the diesel-generator supply, and modification to the associated fan damper actuators.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. Boundary conditions that are expected to affect this project (installation of the diesel-generators and controls) include:

- All special nuclear materials (SNM) are removed from the facility except oxides, metals, holdup. Residues and weapons grade materials will be shipped offsite prior to start of the interim mission, and all processing operations will be termined.
- All oxides and metals are stored in DOE-Standard 3013 containers and stored in seismically capable vaults (either ground floor vaults or subbasement vaults). The vault structure and container storage racks must be capable of withstanding the EBE.

These boundary conditions reduce the available material at risk (MAR) following station blackout and the evaluation basis earthquake (EBE). Reducing the MAR reduces the risk from these postulated accident scenarios.

E. COUPLED PROJECTS

Coupled interim mission upgrade projects include the following:

- **Further Mitigate the EBE:** Further mitigation of the effects of the Evaluation Basis Earthquake would reduce the need for the diesel-generators by reducing the risk and consequences of a release following an earthquake
- **Upgrade the Emergency Plans and Procedures:** Installation of the diesel-generators will require additional emergency operations procedures and training.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Do nothing (the no-action alternative). This action accepts the risk of loss active confinement (forced ventilation and filteration) following station blackout conditions (up to and including the EBE).
2. Installation of the Diesel-Generators and Associated Structures and Equipment. This includes design, construction and testing of diesel-generator power units, addition of seismically qualified control panels and cable runs, and modification of existing HVAC damper actuators.

G. RECOMMENDATION

The recommended alternative is the no action alternative (alternative 1 above). This is based on the following:

a) The risk evaluation performed as part of the DNFSB 94-3 IPP Validation Study (Reference H.5) demonstrated that installation of seismically capable power supplies to ensure simple active confinement following station blackout/EBE provides only marginal reduction in risk. For the interim storage mission, the MOI public dose is estimated at 0.9 rem for the EBE. The addition of seismically qualified power supplies is estimated to lower the MOI public dose to 0.3 rem. Both dose values are significantly below the 5 rem criteria. The most significant risk reduction comes from storage of SNM oxides in the subbasement vaults. Further risk reductions from the addition of seismically qualified power supplies are minor in comparison.

b) The existing turbine-generator is inherently rugged and may survive the EBE. Therefore, although it is not credited for mitigation of the EBE, it will provide backup power following other loss of power events. The existing system is credited in the BIO as a defense in depth (safety category 3) system.

c) Installation of diesel-generator units will require additional surveillances that increase annual operational and maintenance costs. With the small value in risk reduction, these costs reduce the value of project implementation.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 2-4 Report, "Building 371 Near Term Mission Report," Rev. 0, March 15, 1996 (Appendices A-15 and A-16).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, February 23, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, July 1998.
4. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev 0, March 15, 1996.
5. "Building 371 Interim Storage Upgrades Evaluation of Risk Reduction Strategies," Revision 0.

Attachment 8a – Confinement (Further Mitigate EBE)

A. SCHEDULE TASK NUMBER

AC-0310

B. BACKGROUND

In 1994, the DNFSB issued Recommendation 94-3 (Ref. H.1), which focused on determining the seismic capability appropriate for Building 371 in light of its new material storage mission. The DOE response to Recommendation 94-3 was provided by work performed in accordance with the Implementation Plan (IP) (Phase I) for DNFSB Recommendation 94-3 (Ref. H.2) and the Integrated Program Plan (IPP) (Ref. H.3). That response included defining the 2000-yr return period earthquake as the new Evaluation Basis Earthquake (EBE).

Structural analyses (Ref. H.4) prepared in response to DNFSB Recommendation 94-3 concluded that the structure would not collapse, but active confinement by the nuclear ventilation system would not be maintained due to the anticipated loss of electrical power to the building and an unqualified emergency power supply. Only a limited number of Safety Systems, Structures, and Components (SSCs) were found to demonstrate structural adequacy for the EBE.

The Evaluation Basis Earthquake (EBE) was analyzed in the Building 371 Basis For Interim Operation (BIO) (Ref. H.5). Crediting available engineering safety features and preventive measures, the consequences to a Maximum Exposed Offsite Individual (MOI) is 8.6 Rem. A criterion of the Safety Margin Upgrade Validation process is to reduce the consequences of any accident scenario below 5 Rem. Other activities are in progress to reduce the consequences to the MOI below 5 Rem as part of the Near Term Safety Upgrades.

C. PROJECT OBJECTIVES

The objective of this project is to identify methods to provide incremental risk reduction improvements for seismic events (EBE or CPE).

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.6. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371in 2002.
- All oxides are stored in vaults on the sub-basement level by the year 2002.
- All oxides and Pu metals are stored in 3013 containers in the building.
- All tanks and process piping are drained of liquid solutions.
- Flammable gases are controlled.
- All material is stored in a configuration to prevent criticality.
- Room 3189 contains no material.

In the year 2002, all materials will be stored in permanent storage containers, 3013's, and the dock will be used to stage materials for shipment off-site. These materials will be encased in 3013's that are within DOT approved shipping containers. The materials will be either stabilized oxides or Pu metals.

E. COUPLED PROJECTS

- **Reconfiguration of Sub-basement Vaults:** The reconfiguration of sub-basement vaults will address cooling, IAEA/security monitoring and controlled re-entry strategies. The subbasement vaults will be used to store Pu oxides.

F. ALTERNATIVES

1. Reduce the release from holdup remaining in the building during the Interim Storage Mission by:

    - Removing holdup for gloveboxes, piping, ducts, tanks, etc.
    - Fixing holdup in place.
    - Seismically qualify components containing holdup.

2. No action alternative. The no action alternative is based on the reduction in public consequences from the EBE accident scenario in B371/B374/Support Facility. The projected dose following an EBE from the Evaluation of Risk Reduction Strategies is 0.9 Rem (see Attachment 4). Holdup will be reduced through planned activities to drain tanks and process piping. The holdup within gloveboxes is a small contributor to the total risk and efforts in advance of planned D & D would not be cost effective from a risk reduction standpoint.

G. RECOMMENDATION

Because of the small increase in risk reduction gained by accessible holdup removal, no further action is required. However, decisions to remove or contain holdup should be made as a priority in planning D&D activities.

H. REFERENCES

1. DNFSB Recommendation 94-3, Rocky Flats Seismic and Systems Safety, Letter to O'Leary, H.R. from Conway, J.T., Defense Nuclear Facilities Safety Board, Washington, D.C., September 1994.
2. Implementation Plan (IP) (Phase I) for DNFSB Recommendation 94-3, Rocky Flats Environmental Technology Site, Golden, CO, June 21, 1995.
3. DNFSB Recommendation 94-3 Integrated Program Plan (IPP), Revision G, Rocky Flats Environmental Technology Site, Golden, CO, July 1, 1996.
4. Loceff, et. Al., 94-3 Task 6 of the Department of Energy Implementation Plan for the DNFSB Recommendation 94-3, Summary Report of the Structural Evaluation of Structures, Systems and Components for Natural Phenomena Hazards, Report ECS-SSA-95-0206, Westinghouse Savannah River Corporation, December 1995.
5. Basis For Interim Operation Building 371/374 Complex, Rev. 2, September 1997.
6. DNFSB 94-3, Building 371 Interim Storage Upgrade Evaluation Of Risk Reduction Strategies, [Draft], Revision A, July, 1998.

Attachment 8b - Fire Protection (Plenum Deluge Recharge)

A. SCHEDULE TASK NUMBER

AC-0508

B. BACKGROUND

In 1996, the B371 Fire Suppression system was reviewed as part of the DNFSB 94-3 Implementation Plan. As discussed in Attachment 9, System 20 report in the DNFSB 94-3 IP Task 8 Report (Ref. H.1), the fire suppression system was not designed to withstand the impact of an Evaluation Basis Earthquake (EBE). Upgrading of the plenum recharge system was selected as an interim safety upgrade (Ref. H.2).

The System 1 and 2, Zone I and IA HEPA Filter Plenums, FP-141, 142, 241, 242, and 243 are currently protected by a plenum deluge system. This system consists of spray nozzles upstream of the plenum demisters which are automatically activated on high air stream temperatures. A manually activated set of spray nozzles are located upstream of the first HEPA filter stage in the event of a filter fire.

The primary source of water for the deluge system is the domestic water supply through fire risers 371 B and 371C. Tanks D-710 and 711 provides a 30 minute seismically qualified source of backup water in the event that the domestic water supply is unavailable. The Domestic Water Supply is not seismically qualified.

At the time the Task 8 and Task 3-2 IP Reports were generated, the backup plenum recharge system was not seismically qualified. Upgrading of the plenum deluge system to withstand an EBE was completed as part of the Priority Upgrades as identified in the Integrated Program Plan.

C. PROJECT OBJECTIVES

The objective of this project is to provide long term protection of the HEPA filters following a seismic event.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

E. COUPLED PROJECTS

Coupled Priority and Near Term Safety Upgrade projects include:

- **Filter Plenum Demister Analysis and Inspections**: This project evaluated the effectiveness of the demister in removing sparks or hot embers that may be generated as a result of a fire. The analysis (Ref. H.4) concluded that sparks large enough to present a threat to the integrity of the HEPA filters would be captured by the demister. Sparks that may pass through the demister and impinge on the 1st stage HEPA filter would either burnup in transit or had insufficient thermal energy to present a threat to the filter.

- **Penetrations for Room 3206 Fire Wall:** This project upgraded the penetrations in Room 3206 reducing the possibility that a fire will spread beyond a localized area

- **Fire Doors:** This project inspected all of the fire doors credited within SER, Chapter 8 (Ref. H. 5). Repairs and modifications resulting from these inspections will ensure the integrity of fire barriers within B371, which will limit fire propagation.

- **Plenum Deluge System Modifications:** This project upgraded the plenum deluge system to withstand the impact of an EBE. This guarantees at least a 30 minute plenum deluge spray capability following a seismic event.

- **Basement Level Firewalls:** This project upgraded the basement level firewalls to ensure the integrity of the HEPA filters.

- **Inspect/Repair SC-3 Firewalls:** This project inspected the SC-3 credited firewalls and identified necessary repairs. The completion of repairs will ensure the integrity of credited one-hour firewalls which limits the propagation of fires.

- **Determine HVAC Scrubber Disposition:** This project was to conduct a feasibility study for early removal of the HVAC scrubbers and a Fire Hazards Analysis of the external and internal scrubber fire risks.

Coupling with other proposed validation projects:

- **60K Seismically Qualified Water Tank:** This project proposed the installation of a seismically qualified water supply for the plenum deluge recharge system.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Plan and implement the installation of seismically qualified piping to provide unlimited recharge capability to the plenum deluge. This includes an external connection to allow the transfer of water from a seismically qualified water tank.

2. Install a hose coupling in the seismically qualified portion of the plenum for manual makeup capability.

3. Incorporate isolation of the building from main power supply into emergency response procedures until a controlled startup of the facility can be completed. This eliminates an ignition source which can be present should power to the facility be recovered with electrical faults (hot shorts) still existing.

4. No action alternative. This alternative is justified by several activities that have occurred:

   - Current fire hazards analysis indicates that fire duration is less than 30 minutes with conservative assumptions regarding fire loads (Ref. H.6). Administrative controls should result in the removal of easily ignitable material and reduce combustion loads to a level less than that assumed in the current fire analyses.

   - The inspection and repair of credited fire barriers (doors, walls, penetrations, fire dampers) should ensure that fire duration and severity are minimized to ensure no credible threat to the integrity of the HEPA filters.

   - Analysis and evaluations (References H.4, H.7, H.8) indicate that there are no credible threats to the integrity of the HEPA filter plenums from sparks or hot embers. In Reference H.4, it was shown that sparks large enough to be a thermal threat to the integrity of the 1^{st} stage HEPA filter would be effectively arrested by the demister. Sparks which could pass through would burnup in transit or have insufficient thermal energy to threaten the integrity of the filter. In References H.7 and H.8, it was shown that there is no internal ignition source to result in combustion of the scrubber internal pall rings. Any threat would have to originate in a fire in a room, or glovebox serviced by the scrubber exhaust. It was demonstrated that fires in these areas would generate air stream temperatures that are at the ignition threshold of the scrubber pall rings. Sparks would be arrested by room and glovebox HEPA filters, would burnup prior to reaching the scrubber, be impinged on the walls of the exhaust ducts, or de-entrain due to low velocities in large diameter ducts.

G. RECOMMENDATION

The recommended alternative, Number 4, is not to install a plenum recharge capability. With the oxides stored in the sub-basement, the material packaged in 3013 containers, residues no longer stored in B371, the reduction of combustible materials in B371, improved administrative controls of combustibles and flammable materials; and reduced ignition sources, the fire risks from a seismic event in the year 2002 will be greatly reduced. Adopting improved emergency response to a seismic event further minimizes the impact of that scenario.

H. REFERENCES

1. DNFSB 94-3 Implementation Plan, Task 8 Report, "Assess Configuration & Performance of Safety Systems, Structures, and Components," Attachment 9, System 20 Report - Fire Suppression, Rev. 0, December 1995.

2. DNFSB 94-3 Integrated Program Plan, Task 3-2, Building Interim Mission Report, March 15, 1996.

3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.

4. Calc.-371-VEXH-000371, Building 371 Priority Upgrades Task A.1 - HEPA Filter Plenum Demister, September 1997.

5. EWP-371-FP-0371, B371 Fire Door Walkdown Package, February 1998.

6. Peak Fire Engineering, Building 371/374 Validation Support, July 29, 1998.

7. Position Paper, Internal Threats To The Scrubbers and the Integrity of the Exhaust Plenum HEPA Filters, Rev. 1, July 1998.

8. Process Fire Hazards Analysis, Exhaust System Scrubbers, Building 371, Rev. 0, July 1998.

Attachment 8b.1 – Building 371/374 Validation Study Support

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

BUILDING 371/374
VALIDATION STUDY SUPPORT

Prepared for:

Kaiser-Hill, L.L.C.

Prepared by:

Peak Fire Engineering, Inc.

TENERA Rocky Flats, L.L.C.

BUILDING 371
INTERIM STORAGE UPGRADES VALIDATION PROJECT

Executive Summary

Peak Fire Engineering would like to thank all Kaiser-Hill, Safe Sites of Colorado, and Tenera staff who assisted us in accomplishing this task. Specifically, B371 engineering staff, Tony Tomes (Tenera), Bob Mansonen (Tenera), Terry Camilleri (K-H), and Mike Auble were extremely helpful and available during all stages of this task. John Ayers (Tenera) provided escorting as necessary in support of this project.

This project provided direct support and technical consulting for the previously identified building upgrades, as described in Chapter 6 of the Defense Nuclear Facilities Safety Board Recommendation 94-3 and the Basis of Interim Operation (BIO) accident scenarios. Specifically, the following issues were addressed.

General Post Earthquake Fire Department Operations
Post Disaster Fire Department Triage
Flashover Potential
Anticipated Fire Duration
Storage of SNM in Vaults
General Combustible Loading
Outliers

This report examines the above issues and makes recommendations as to if they are valid *after* the year 2002. The fire hazard of the Zone I Scrubbers is being addressed by a separate Fire Hazards Analysis (FHA). The recommendations in this report are based on current codes, fire department operational procedures, B371 fixed fire protection systems. B371 fire wall configuration, Special Nuclear Material (SNM) vault construction, post-earthquake considerations, fire risk, combustible loading, SNM storage configuration, building staffing, configuration of storage, professional judgement, and information provided to us by B371 staff.

Additional technical support was provided to assist with the resolution of other Validation related upgrades/scenarios as follows.

60,000 Gallon Water Storage Tank (Seismically Qualified)
Filter Plenum Deluge Recharge System (Seismically Qualified)
Dry Standpipe System (Seismically Qualified)
Fire Hazard of Zone 1 Scrubbers
Large Drum Fire on Dock 18T
Drum Hydrogen Explosion on Dock 18T
Criticality in Sub Basement due to Fire Protection Water Discharge
Propane Explosion
Small Pyrophoric (Pu) Fire

Scope

The scope of this particular task was as follows:

1. Conduct fire protection engineering (FPE) and safety analysis of proposed upgrades to B371 systems to determine effect of current site conditions and site programs on the intent of the upgrade.
2. Recommend changes to existing upgrade proposals. Include justification determined in 1) above.

3. Interface as necessary with B371, Kaiser-Hill (K-H) and other site engineering and FPE organizations to gather technical data in performing task analyses.
4. Integrate with other validation team members in achieving the overall task objectives.
5. Develop technical documentation as specified by the task manager.
6. Perform other task related assignments as designated by the task manager

Deliverables

Based on the results of the analyses conducted of the identified issues provided by the K-H Technical Representative, support development of written reports that substantiate existing Interim Storage Upgrades to B371, or recommend modifications to the upgrades that may be implemented without affecting achievement of the intended safety function. Include calculations and analyses that support recommendations. Reports will be developed either independently or in coordination with other validation team members, as directed by the Project Manager.

Post Earthquake Fire Department Operations

Fire Department Operations Discussion

It is highly unlikely that the Rocky Flats Fire Department (RFFD) will ever use the proposed seismically qualified 60K Tank and Dry Standpipe System after a seismic event. Other recent serious seismic events (Loma Prieta, CA., Kobe, JP., Northridge, CA.) were examined and support the theory of very limited fire department operations immediately following a serious seismic event. Additional discussions were held with the RFFD to confirm these theories

The current RFFD fire station is not seismically qualified [19] and most likely sustain severe damage in an earthquake similar to the one that occurred in Northridge, California [12] A seismic event would most likely seriously damage the fire station. Therefore, the RFFD may not be able to respond to <u>any</u> type of event following a seismic event. In addition, all the firefighters sleep in the same general location in the fire station, increasing the possibility that a high number of them may be seriously injured/killed by a seismic event [8, 12, 13].

The roads on the RFETS site will most likely be obstructed following a seismic event. Down power lines, gas line breaks, breaks in the roadway, and building debris are just a few of the challenges the RFFD may face in trying to respond to any location.

Assuming that the RFFD fire station is unaffected by a serious seismic event, there would still be many other situations that would divert the RFFD away from any building response. The RFFD's first priority following a seismic event would be rescue and medical response. Generally, the RFFD would contact each facility to *determine if all staff was accounted for and then make any rescues as deemed necessary by the RFFD/RFETS command structure. During these search and rescue operations, building entry may be made. While in a building, RFFD firefighters may observe and ensure fires are isolated, but would not normally initiate any active fire suppressions efforts at that time [13].*

RFETS can expect little or no outside assistance following a serious seismic event. There are provisions for outside fire departments/similar agencies to provide mutual aide to RFETS in the event of a disaster. However, a serious seismic event would not be limited to the RFETS site. Therefore, these outside agencies would be busy dealing with rescue and fire suppression operations in their own communities [2, 13].

Once rescue operations are completed or under control, the RFFD would then respond to alarms and reported working fires. The RFFD would monitor smoke from any building fire to ensure that no radiation was being released into the air. Then depending on the injury/life risk to firefighters and the amount of radiation that was being released and possibly threatening the public, fire suppression efforts would be initiated. However, RFFD is highly unlikely to enter a building to suppress a fire unless it poses a risk to the public. The RFFD knows that B371 is highly compartmentalized with substantial building construction and fire separations and that any fire will most likely be of relatively short duration and most likely self-extinguish without intervention [13].

Even if fire suppression efforts are initiated in B371, a fire in the building will be difficult to locate. Building 371 is not equipped with a complete fire suppression or fire detection system. The RFFD would have to search entire sprinkler/fire detection zones to determine the location of any fire event. In addition, the highly compartmentalized nature of B371 would tend to keep smoke from spreading, making it even harder for the RFFD to locate a fire [13].

Recommendation

Eliminate the seismically qualified 60,000 gallon water tank and dry standpipe system from the list of future upgrades for the Building 371. Consideration should be given to upgrading the fire station to ensure that the RFFD is not completely disabled after a serious earthquake. In addition, a mobile All Terrain (AT) water truck that would be of more use to the RFFD after an earthquake and that would serve other RFETS buildings as well should be considered [26].

Flashover Potential and Anticipated Fire Duration

Flashover Overview

A typical compartment or room fire has three distinct stages; a growth period, fully developed, and a decay period. Flashover is a term used commonly to describe the beginning of a fully developed fire. The definition of flashover is generally the transition from a localized fire to the general conflagration within the compartment when all the fuel surfaces are burning [24].

The issue of if flashover can be attained is of particular interest since this is the beginning of the period when the fire is most intense. Fire walls, doors, sealed penetrations, fire dampers, and ducts, will be severely challenged (i.e., wall breach) in a fire that attains flashover and proceeds into the fully developed stage [24].

To attain flashover in a compartment or room fire, certain conditions are required. The presence of combustibles items or surfaces is necessary for a fire to grow to a stage where a flashover is possible. When no combustibles are present and the room is of a non-combustible nature, an assumed small fire would burn out or slowly smolder at a rate dictated by the availability of oxygen [24].

Flashover Discussion

Hughes Associates studied a theoretical drum liner fire in room 3501 to see if flashover could be achieved. Room 3501 is 49 feet long, 46.5 feet wide and 15 feet high (34,200 cubic feet) with the walls, ceiling and floors constructed of concrete. The theoretical drum liner fire (9) was assumed to produce a peak heat release rate of 9.23 MW. The growth of the fire was assumed to grow as the squared of time (t-squared) with a characteristic time of 100 seconds to reach a fire size of 1 MW. The results of this analysis (CFAST, Version 2) indicated that the maximum upper layer that would be achieved would be 480-600 degrees F. These maximum temperatures are well below those where temperatures (>842 degrees F) begin to present a danger of flashover [9]. It should be noted that the fuel load of 10 drum liners will not be present in storage vaults in 2002.

Drums will not be used to stored metals or oxides after the year 2002. Containers/cans (3013 Type) will be utilized for storage of all Special Nuclear Material (SNM) [15, 16] Handling of the cans will be limited to physical movement only, no cans will be opened or re-packed in a vault. If any opening of a containers is required, it will be over packed and shipped to another facility for opening and correction of packing/container problems

After the year 2002, all the SNM will be stored in vaults on the ground and sub-basement level in Building 371. The walls, floors, and ceilings in these vaults is heavy concrete construction. The fire rating of the vault "envelope" is a minimum of two hours. All penetrations into these vaults are properly fire stopped or in the case of ducts, equipped with approved fire dampers. The only exception are the return ducts that connect the vaults to the HEPA filter system which is designed to remove nuclear contamination before exhausting to the exterior of the building. Applicable codes [14] allow the omission of fire dampers in ducts such as these in areas critical to nuclear safety if an alternative means of protecting against fire propagation is provided.

No combustibles will be stored in the vaults. All of the SNM will be stored inside specially constructed, sealed (welded shut), heavy (3mm side wall, 10mm top, 9mm bottom) stainless steel containers [16]. These containers are of a heavier construction and significantly smaller than the currently used drums and have no combustible liner inside [16]. Even if a strong ignition source were accidentally introduced into a vault, there is literally nothing to be easily ignited. To cause a container to fail/breach [4] an intense heat source would have to be directed at a container. The current drum storage units (55 gallon type) were shown to withstand a heat flux up to 45kW/M2 before experiencing lid failure. The new containers are designed to withstand a overpressure of 864 psi which is 150% of theoretical maximum pressure [15,16]. Nothing is planned to be in the vaults after the year 2002 that is capable of exposing a significant amount of heat flux on a containers [8] It has also been shown that even if a old-style drum does fail due to an intense nearby heat source, it will most likely not spread to any adjacent drum [4, 8]

Recommendation

No action required. The danger of flashover in a SNM vault is almost non-existent. In addition, the danger of any significant fire in a vault is almost equally low. Of course, if administrative controls fail and any type of combustibles are allowed stored in a vault, the implications are quite serious. However, based on observations and knowledge of B371, it is anticipated that administrative controls will work very well. In fact, the opening/entering of any storage vault is not a casual event and is tightly controlled and only done when armed guards and a special authorized entry team is present [25].

Fire Duration Discussion

The actual duration any fire in building 371 is difficult to predict. Fire duration is highly dependent on fuel type, fuel configuration, ventilation, geometry of the room, and ignition source duration/characteristics. In the 1997 FHA, the most severe fire risk in B371 was considered to be the Zone 1 Scrubbers [4]. The computer fire model run by Hughes showed that when the room doors were closed, the fire duration was less than 15 minutes [4, 9]. This indicates that all other intense fires would most likely be less in duration, unless they were very small and of a smoldering nature. These potential small and/or smoldering fires are not seen as a serious threat to the SNM containers or B371 in general..

The danger of any vault fire is almost non-existent, as discussed in the above section on Flashover. Given the construction and storage configurations in the vaults, even a small fire were introduced into a vault would burn itself out. In general, the danger of any serious fire in Building 371 is extremely low given anticipated building conditions after the year 2002.

Recommendation

Characterize, list, and locate the current and future (after 2002) combustible loading levels/parameters in the building. Otherwise, no action is required.

Unresolved Outliers

Outliers Discussion

The items discussed here require removal from the building or some type of mitigation to eliminate a possibility of a serious fire. **It is very possible that these rooms present the B371's most serious fire risk, surpassing the utility scrubbers** [4]. Since, these rooms are highly contaminated, an adequate evaluation of the risk that they present to the building is unknown.

Currently, several areas have the potential for a serious fire with a possibly flashover. Information from B371 staff and video viewing of these areas indicates significant fire loading. Rooms of particular concern are 2327, 1117, 1125, and 1105. All of these rooms are provided with wet-pipe automatic fire sprinklers designed to control or suppress a high hazard fire [23]. Items viewed on video include the following: plywood, wood scaffolding, trash, plastic sheeting, hoses, tape, and unidentified containers of chemicals [22]. Obviously, the rooms contain a mix of combustible materials ranging from easily ignitable paper/plastic to heavy fuel loads such as stacked lumber and plywood.

Recommendation

A Fire Protection Engineering (FPE) analysis should be performed to calculate if flashover can be achieved given the fuel load, room configuration, and ventilation characteristics. In addition, the fire duration should be calculated. If flashover is achievable, the room should be examined to determine if any exhaust ducts or other room features provide a weak link that would allow the fire to breach the room or otherwise negatively affect the building.

Characterizing the fuel load in the subject rooms will be very difficult. Currently, these rooms are heavily contaminated and require breathing air to enter. In addition, due to the above requirements, a full inspection of the walls, doors and ceiling in these rooms is very difficult if not impossible. An organized, remote video inventory may provide much need information on the amount, configuration, and type of combustibles in these rooms.

If the FPE analysis indicates that the combustibles items present a serious threat to the Building, mitigation of the combustibles in rooms 2327, 1117, and 1105 will be required. One option is to gather up all the easily ignitable (paper, wood, plastics, etc.) and put them into sealed drums and allow them to remain in the room. This would eliminate the possibly that these easily ignitable items would be available to ignite the heavier combustible items such as stacked lumber and plywood, in turn significantly reducing the risk of fire in these rooms.

Other options include removing all combustible items from the rooms, changing the configuration of the combustible items in the rooms, or inerting the rooms with gas or foam to minimize the possibility of a serious fire.

References

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[3] DOE/RFETS, DNFSB Recommendation 94-3, Integrated Program Plan, 02/23/98, Revision 1

[4] Building 371 Fire Hazards Analysis, FHA-371-002, 12/22/97, Rev. 1

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[7] Fire Protection Validation Team, White Paper, A.E. Tome (Tenera), 04/06/98

[8] Building 371/374 Basis for Interim Operations (BIO), Revision 2, 09/10/97

[9] Building 371 Anaylsis of Flashover Potential in Room 3501, Hughes Associates, 07/14/97

[10] Kaiser-Hill Interoffice Memorandum (09/08/97), Particle Burnout in B371 in HEPA Filter Plenum JRG-303-97

[11] Position Paper, Internal Threats to the Scrubbers and the Integrity of the Exhaust Plenum HEPA Filters. A.E. Tomes (Tenera), 07/02/98

[12] Kaiser-Hill Transmittal (05/01/98), Earthquake Response Recommendations, Bill Peregoy (Tenera), GMV-190-98, 98-RF-02296

[13] Discussions with Rocky Flats Fire Department, 05/98

[14] National Fire Protection Association (NFPA) Standard 801, Facilities Handling Radioactive Materials, 1995

[15] DOE Standard. Criteria for Preparing and Packaging Plutonium Metals and Oxides for Long Term Storage, DOE-STD-3013-96, 9/96

[16] Drawings of Plutonium 3013 Storage Container, BNFL Engineering, M-4-12-1-246, Mod A, 7/5/96

[17] Scrubber Process FHA, Peak Fire Engineering, Inc., 7/98

[18] Loma Prieta, California Earthquake Emergency Response and Stabilization Study, Federal Emergency Management Agency (FEMA), United States Fire Administration (USFA), FA-103, 9/91

[19] Northridge, California Earthquake, Performance of Structures, Lifelines, and Fire Protection Systems, National Institute of Standards and Technology (NIST), 862, 5/94

[20] Kobe, Japan, Fire Investigation Report, National Fire Protection Association (NFPA), Earthquake Report, 1995

[21] Japan, Great Hanshin-Awaji Earthquake, Various Papers, Fire Research Institute and Building Research Institute, R9701575/77.

[22] Video Tape (Due Diligence) Supplied by Building 371 Staff, Steve Additon, 6/98

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[24] An Introduction to Fire Dynamics, Dougal Drysdale, 1985

[25] Observed Building 371 Vault Entry Procedures, 1998

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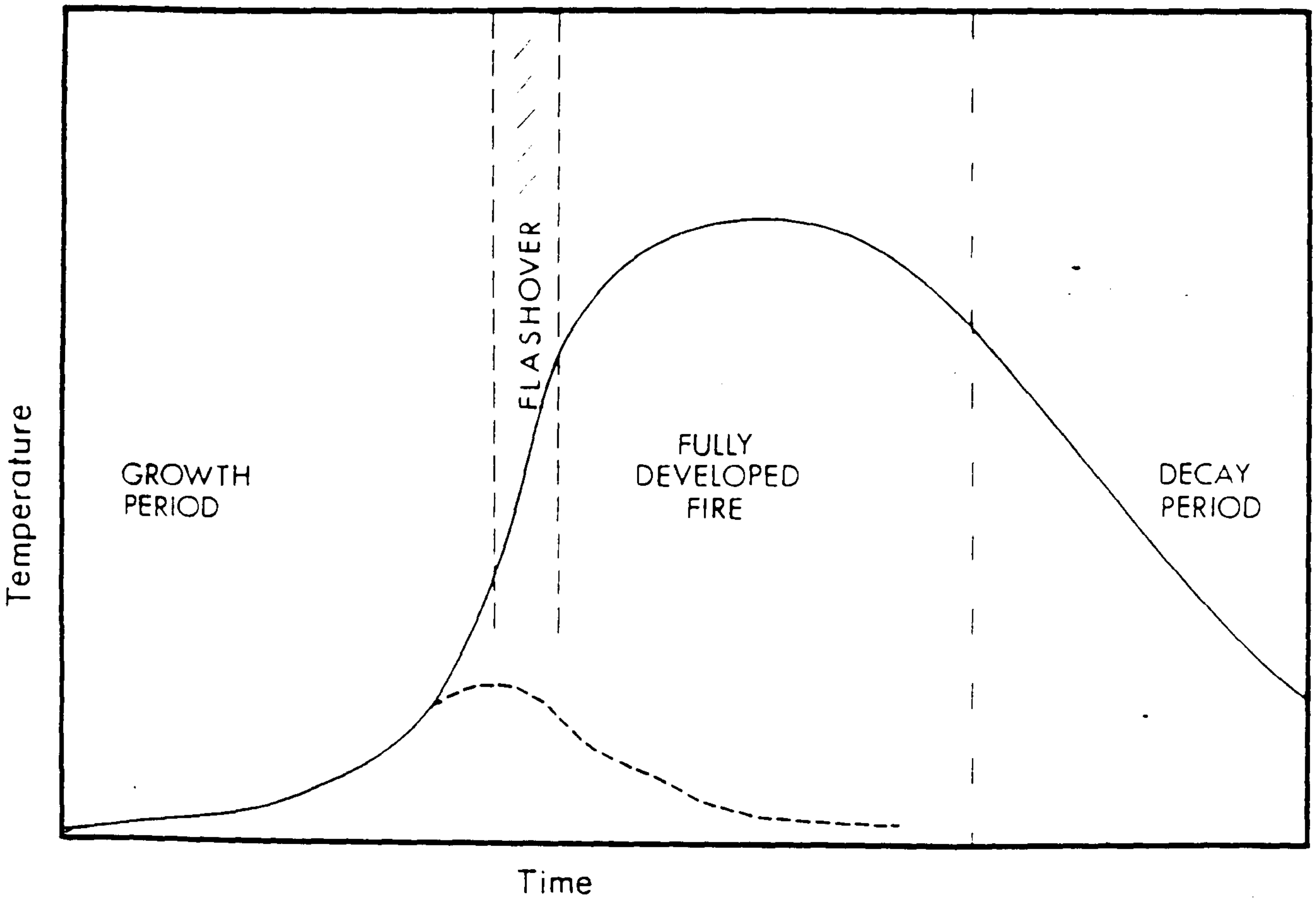
Appendix A [24]



Attachment 8 b - Fire Protection (Seismic Dry Standpipes)

A. SCHEDULE TASK NUMBER

AC-0608

B. BACKGROUND

In 1996, the B371 Fire Suppression system was reviewed as part of the DNFSB 94-3 Implementation Plan. As discussed in Attachment 9, System 20 report in the DNFSB 94-3 IP Task 8 Report (Ref. H.1), the fire suppression system was not designed to withstand the impact of an Evaluation Basis Earthquake (EBE). Installation of seismically qualified dry standpipes was selected as an interim safety upgrade (Ref. H.2).

Building 371 currently has four wet risers - 371A, 371B, 371C, and 374A - which provide water to the plenum deluge systems (the primary source), internal hose connections, and building sprinkler systems. The 374A riser provides water to the sprinklers on Dock 18T and to Room 3189, a RCRA storage area. These risers were designed to NFPA 13 criteria which is equivalent to the 900 year earthquake; however, they are not capable of withstanding the impact of an EBE.

C. PROJECT OBJECTIVES

The objective of this project is to provide increased capability to fight fires which may occur following a seismic event.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. The boundary conditions that impact this validation project are:

- There are no residues stored in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

E. COUPLED PROJECTS

Coupled Priority and Near Term Safety Upgrade Projects include:

- **Penetrations for Room 3206 Fire Wall:** This project upgraded the penetrations in Room 3206 reducing the possibility that a fire will spread beyond a localized area.

- **Inspect Fire Doors:** This project inspected all of the fire doors credited within SER Chapter 8 (Ref. H.4). Repairs and modifications resulting from these inspections will ensure the integrity of fire barriers within B371 which will limit fire propagation.

- **Basement Level Fire Walls:** This project upgraded the basement level firewalls to ensure the integrity of the HEPA filters.

- **Inspect/Repair SC-3 Fire Walls:** This project inspected the SC-3 fire walls and identified necessary repairs. The completion of repairs will ensure the integrity of credited one-hour fire walls which limits the propagation of fires.

- **Complete Any Additional SQUG Walkdowns:** This project is performing walkdowns of selected systems and components to determine their capability to withstand the impact of a seismic event. The walkdowns include the main fire risers - 371B and 371C - including the hose reel connections. Sprinklers are not credited as a mitigative system following an EBE. This project will identify the upgrades required to enable the risers and sprinkler system to withstand an EBE.

Coupling with other proposed validation projects:

- **60K Seismically Qualified Water Tank:** This project proposed the installation of a seismically qualified water supply for the dry standpipes.

F. <u>**ALTERNATIVES**</u>

Potential alternatives are as follows:

1. Plan and implement the installation of seismically qualified dry standpipes and hose connections. This includes an external connection to allow the transfer of water from a seismically qualified water tank.

2. Improve emergency response capabilities by prestaging sufficient large diameter hose (5 inches) to reach all areas of B371.

3. No action alternative. This alternative is justified by several activities that have occurred:

   - Current fire hazards analysis (Ref. H.5) indicate that fire duration is less than 30 minutes with conservative assumptions regarding fire loads. Administrative controls (Ref. H.6) should result in the removal of easily ignitable material and reduce combustion loads to a level less than that assumed in the current fire analyses.

   - The inspection and repair of credited fire barriers (doors, walls, penetrations, fire dampers) should ensure that duration of fires is less than the anticipated response time following a seismic event.

- Interviews with the site Fire Department indicated that they would be reluctant to enter the facility following a seismic event unless there was a serious threat to life or there were indications that the tertiary boundary was compromised. If they enter a facility to take life saving actions, they would ensure the integrity of fire barriers as a passive fire fighting measure. In the event that they enter the facility to attack a fire, they are unlikely to place their lives at risk depending upon a dry standpipe. They would most likely attack the fire using proven, reliable methods i.e., hose hook ups to a pumper truck.

G. RECOMMENDATION

The recommended alternative, number 3, is to not install the seismically qualified dry standpipes. With the oxides stored in the sub-basement, the material packaged in 3013 containers; residues no longer stored in B371, combustible materials removed form B371, improved administrative controls of combustibles and flammable materials, and reduced ignition sources, the fire risks from a seismic event in the year 2002 will be greatly reduced. Adopting improved emergency response to a seismic event further minimizes the impact of that scenario.

H. REFERENCES

1. DNFSB 94-3 Implementation Plan, Task 8 Report. "Assess Configuration & Performance of Safety Systems, Structures and Components," Attachment 9, System 20 - Fire Suppression. Rev. 0, December 1995.

2. DNFSB 94-3 Integrated Program Plan, Task 3-2, Building 371 Interim Mission Report, March 15, 1996.

3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.

4. EWP-371-FP-0371, B371 Fire Door Walkdown Package, February 1998.

5. Peak Fire Engineering, Process Fire Hazards Analysis, Exhaust System Scrubbers, Building 371, Revision 0, July 1998.

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Attachment 8 b - Fire Protection (60 Gallon Water Tank)

A. SCHEDULE TASK NUMBER

AC-0408

B. BACKGROUND

In 1996, the B371 Fire Suppression system was reviewed as part of the DNFSB94-3 Implementation Plan. As discussed in Attachment 9, System 20 report in the DNFSB 94-3 IP Task 8 Report (Ref. H.1), the fire suppression system was not designed to withstand the impact of an Evaluation Basis Earthquake (EBE). Installation of seismically qualified 60K gallon water tank to supply the plenum recharge and dry standpipes was selected as an interim safety upgrade (Ref. H.2).

C. PROJECT OBJECTIVES

The objective of this project is to provide a seismically qualified source of makeup to the dry standpipes and the plenum recharge.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation projects are defined in Reference H.3. There are no boundary conditions applicable to this project.

E. COUPLED PROJECTS

Coupling with other proposed validation projects:

- **Seismic Plenum Deluge Recharge System:** This project would have been supplied by the 60K water tank.
- **Seismic Qualified Dry Standpipes:** This project would have been supplied by the 60K water tank.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Prestage water tankers within the Protected Area to act as external water supplies in the event the domestic water system is lost during a seismic event. The tankers should be modified to allow the Fire Department hookup.

   Procure an ATV capable pumper/fire truck for the Fire Department which will be capable of accessing the Protected Area following a seismic event. This will allow it to be independent of roadways, which may be blocked by debris.
   Assess the survivability of the Fire Station. Fire Department assistance following a seismic event may not be possible if the Fire Station is unable to survive an EBE.
2. No action alternative. The rational is the same as that provided in Plenum Deluge Recharge and Seismic Dry Standpipes.

G. RECOMMENDATIONS

Alternative 1 to prestage water tankers in the vicinity of B371 is recommended. Prestaged water tankers can provide an independent, external water supply to allow the Fire Department to enter B371 as necessary to attack a fire in the event that the Domestic Water Supply is unavailable. Considerations for fire fighting equipment will be determined by March 31, 1999.

H. REFERENCES

1. DNFSB 94-3 Implementation Plan, Task 8 Report, "Assess Configuration & Performance of Safety Systems, Structures and Components," Attachment 9, System 20 - Fire Suppression, Rev. 0, December 1995.

2. DNFSB 94-3 Integrated Program Plan, Task 3-2, Building 371 Interim Mission Report, March 15, 1996.

3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.

Attachment 8 b - Fire Protection (Access Scrubber Removal)

A. SCHEDULE TASK NUMBER

AC-0704

B. BACKGROUND

System 1 and System 2 of the Zone I ventilation exhaust each contain two scrubbers. These scrubbers were designed to remove HNO_3 from the exhaust of selected gloveboxes and rooms of Building 371 processes. The acid was removed through absorption into a caustic solution which was sprayed countercurrent to the exhaust air flow. To maximize absorption, the surface area of the caustic solution was increased by running the solution through polypropylene pall rings. The solution was then collected in the bottom of the tank in an area filled with Raschig rings and then processed in the caustic waste treatment process.

The scrubber tanks have been taken out of service and a concern was identified that a fire in the internal pall rings could pose a threat to the integrity of the HEPA filters; thereby compromising filter integrity and possibly breaching tertiary confinement. The exhaust scrubber fire has also been identified as the Maximum Possible Fire Loss (MPFL) for Building 371 as reported in the Fire Hazards Analysis, Building 371/374 Complex (Ref. H.1).

The DNFSB 94-3 Integrated Program Plan (Ref. H.2) committed to a study of early removal of the scrubbers to reduce the threat to the integrity of the HEPA filters and to eliminate it as the MPFL in the FHA.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the risk presented by the scrubber to the integrity of the HEPA filters.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

E. COUPLED PROJECTS

Coupled Priority and Near Term Safety Upgrade projects include:

- **Filter Plenum Demister Analysis and Inspections:** This project evaluated the effectiveness of the demister in removing sparks or hot embers that may be generated as a result of a fire. The analysis concluded that sparks large enough to present a threat to the integrity of the HEPA filters would be captured by the demister. Sparks that may pass through the demister and impinge on the 1st stage HEPA filter would either burnup in transit or had insufficient thermal energy to present a threat to the filter.

- **Plenum Deluge System Modifications:** This project upgraded the plenum deluge system to withstand the impact of an EBE. This guarantees at least a 30 minute plenum deluge spray makeup capability following a seismic event.

Coupling with other proposed validation projects:

- **Seismically Qualified Plenum Deluge Recharge:** This project would provide long term, manual makeup to the plenum deluge system.

F. ALTERNATIVES

1. Remove the scrubbers. This alternative would completely remove each of the four scrubbers and reconnect the ventilation exhaust system.

2. Bypass the exhaust system, leaving the scrubbers in place. This project would eliminate any internal threat to the scrubbers by bypassing the exhaust flow around the scrubbers. The scrubbers would be capped off and left in place for scheduled building D&D.

3. Remove pall rings leaving scrubber shells intact as part of exhaust system. This alternative is based on the premise that the pall rings are the only potential threat presented by the scrubbers. By removing the pall rings all risk is eliminated.

4. No action alternative. This alternative can be justified by:

   - A calculation performed to demonstrate the effectiveness of the demisters as a spark arrestor (Ref. H.4) showed that sparks greater than 160 μm would not pass through the demister. Smaller diameter sparks would either burnup in transit to the 1st stage HEPA filter or had insufficient thermal energy to present a threat.

   - The exit of the scrubbers is located 190 feet from the inlet of the filter plenum. An independent fire hazards analysis of the scrubbers (Ref. H.5) verified the material of construction to be polypropylene. The combustible properties of the pall rings are a melt temperature of 330°F and an auto-ignition temperature of 694°F. A review of fire analysis for various rooms in B371 indicated maximum temperatures of 700 to 800°F. The volumetric flows out of a glovebox or room is small in comparison to the total flow in either exhaust System 1 or 2. By the time the mixed air stream reached the scrubber, the temperatures would be well below the auto-ignition temperature of the pall rings.

The evaluation of the scrubber in Ref. H.5 also confirmed that the ignition temperature of the fiberglass reinforced shell (Derakane 510 resin) is 910°F. Breach of the shell would only occur from an intense, direct flame impingement or high heat flux. This is precluded by combustible controls implemented by the BIO.

- Reference H.6 evaluated the potential for sparks or hot embers to be generated by a fire in the scrubbers. The conclusion was that the air stream velocities are too low, 365 fpm for System 1 and 330 fpm for System 2, to entrain sparks and hot embers into the filter plenum. Both Ref. H.5 and H.6 concluded that the pall rings are likely to melt and that the primary hazard is soot plugging of the HEPA filters.

- Reference H.7 looked at the plugging potential for a complete burn of all of the pall rings in one scrubber. Using the SER value of 10 inches W.C. without suffering structural damage (Ref. H.8), two filters would plug in FP-141 and three stages in FP-241. Emergency Operating Procedures have been developed to allow the SOEs to detect and respond to filter plugging without compromising tertiary confinement. These EOPs are documented in Reference H.9.

- Reference H.7 looked at the worst case fire scenario that could impact the scrubbers. The worst case scenario develops in a glovebox or room that is a short distance, exhaust duct distance, from the scrubber inlet. This showed the potential for sparks to reach the scrubbers. However, based on the other referenced evaluations this would likely result in pall rings melting and soot being generated.

  In addition, the gloveboxes have HEPA filters at the inlet and exhaust exits. The rooms also have HEPA filters at the exhaust exits. These filters are designed to the same robust characteristics as the filter plenum HEPA filters. They will provide a measure of protection for the exhaust ducts.

  The velocities in the rooms and in the gloveboxes are low. In most cases, the velocities will be too low to entrain large particles into the exhaust stream.

G. RECOMMENDATION

The recommended alternative is to remove the pall rings; this should be coordinated with D & D activities. Although the no action alternative is justifiable, there are benefits to be obtained from implementing recommendation 3. The benefits are the elimination of the only potential threat to the integrity of the scrubbers (albeit highly unlikely) and the HVAC HEPA filters.

H. REFERENCES

1. FHA-371-002, Fire Hazards Analysis, Building 371/374 Complex, Rev. 1, December 1997.
2. DNFSB 94-3 Integrated Program Plan, Revision 1, February 23, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.
4. CALC-371-VEXH-000371, Building 371 Priority Upgrades Task A.1 - HEPA Filter Plenum Demister, September 1997.
5. Peak Fire Engineering, Process Fire Hazards Analysis, Exhaust System Scrubbers, Building 371, July 1998.

6. Rick Sanchez to Dave Sprowls, Subtask A.1, Calculation Review/Comment Resolution Building 371 Priority Upgrades, July 15, 1997.
7. Internal Threats to the Scrubbers and the Integrity of the Exhaust Plenum HEPA Filters, July 2, 1998.
8. Building 371/374 System Evaluation Report, Chapter 2, HVAC, Page 49, Rev. 0, July 1997.
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Attachment 8b.2 – Process Fire Hazards Analysis

PROCESS FIRE HAZARDS ANALYSIS

EXHAUST SYSTEM SCRUBBERS

BUILDING 371

Revision: FINAL

BUILDING 371
INTERIM STORAGE UPGRADES VALIDATION PROJECT

Executive Summary

Peak Fire Engineering, Inc. conducted a Process Fire Hazards Analysis (PFHA) to evaluate the fire hazards related to the Scrubbers in the Zone I Exhaust Ventilation System. The scrubbers are located in Rooms 1105, 1210, 2217, and 2319. The degree of compliance of the entire building with the fire safety objectives outlined in DOE Order 420.1 and related engineering codes and standards is addressed in FHA 371-002 Rev. 2 prepared by Hughes Associates, Inc. in December, 1997.

This PFHA analyzes the four scrubbers installed in the Zone I exhaust ventilation system. Due to cessation of processing operations in the building, the scrubbers have been deactivated. Liquid flow to the scrubbers has been shut off, and the fill material is dry. Exhaust air from Zone I gloveboxes continues to pass through the dry scrubbers. Several fire scenarios were examined, each focusing on the pall rings. The polypropylene pall rings are the greatest fire risk in these rooms, due to the nature of the plastic, their dry condition in the deactivated scrubber, and the extremely high surface area-to-mass ratio.

Recommendations include strict adherence to combustible loading control recommendations and removal of the pall rings from the scrubbers.

Introduction

The objective of this analysis is to identify the fire hazards posed by the inactive scrubbers as identified in the Basis for Interim Operation (BIO), Section 5.3.4.7, Fire Involving Scrubber Tanks in Building 371, Fire 7, and the FHA Section 5.2.3.4.

This PFHA reviews the hazards posed by both external and internal fires that might pose a threat to the integrity of the scrubbers and addresses the risk that exists under its current configuration.

Methodology

The development of the PFHA included document review, review of facility drawings and site plans/documents, and consultation with site personnel.

Document review included the previous FHA [Hughes, 1997], the Basis for Interim Operation (BIO) [Kaiser-Hill, 1997], and various documents and records supporting the above reports. This review helped identify facility and equipment information and previously defined fire hazards.

A walkdown for Rooms 1210 and 2217 was conducted on May 4 and 5, 1998. Due to room contamination. Rooms 1105 and 2319 could not be directly viewed. A Due
Diligence videotape for Rooms 1105 and 2319, supplied by Building 371 personnel, was viewed on June 10, 1998.

Assumptions and Limitations

This PFHA evaluates the current fire protection features in the exhaust scrubber rooms. The types and quantities of combustible materials allowed in the BIO and observed during the walkthrough are assumed to be representative of the potential fire hazards in these rooms. All evaluations are based on information that was available to Peak Fire Engineering, Inc. at the time of this analysis.

This PFHA looks at those features (e.g. Construction, Fire Suppression, etc.) that are applicable to the scrubbers only. For a more indepth description, FHA-371-002, Revision 2 should be reviewed.

Facility construction, process, and equipment description

Building 371 is located at the west end of the protected area at the RFETS site. The area of the building is 22,538 m^2 (242,600 ft^2).

Room Construction

Building 371 is primarily a reinforced concrete structure. The walls of the scrubber rooms are poured-in-place reinforced concrete. Floors are poured-in-place, reinforced concrete. Ceilings are the underside of the concrete floor above. Part of the floor between the two levels is metal grate.

Each of the walls enclosing these rooms are designated fire barriers. Specifically, the north, south and west walls of Room 1210 are of 2-hour construction, and the east wall is 1-hour construction. The west wall of Room 1210 does contain a metal door that is unrated. The north wall of Room 2217 has a 2-hour rating, and the other three walls are 1-hour rated. The walls of Room 1105 are of 2-hour construction. The west wall and part of the south wall of Room 2219 are 1-hour rated. The remainder of the walls have a 2-hour rating.

Facility Operations and Processes

Building 371 is used primarily for the storage of Pu and U metal, oxide, residues, transuranic (TRU) wastes, low-level wastes (LLW), and Resource Conservation and Recovery Act (RCRA) regulated mixed wastes and residues. Special Nuclear Material (SNM) is stored in the Central Storage Vault (CSV), vault-type rooms, and other designated areas.

In support of the site activity of consolidating SNM, all Category I and II quantities of SNM are being moved to Building 371 for interim storage. Materials are to be processed and repackaged in Building 707 and Building 371. Current plans call for storage of SNM in Building 371 until a new SNM storage facility is constructed onsite or until the SNM is shipped off site. The storage mission includes storage of up to approximately 12.3 Metric Tons (MT) of Pu and 6.7 MT of highly enriched U. Inclusive in this mission is the stabilization and interim storage of some packaged Pu residues and TRU wastes until waste disposal facilities, such as the Waste Isolation Pilot Plant (WIPP), are opened.

Building 371 will also be used to perform related SNM handling activities and other activities to support material stabilization and area decontamination and decommissioning. A description of the functional areas and processes is contained in the BIO [Kaiser-Hill, 1997].

Radioactive materials, hazardous materials, and non-hazardous materials are routinely received, transferred, and stored in the building. Residues and wastes are stored in many areas. Storage location for drums and bottles is based upon permitted areas and approved criticality safety limit thresholds for fissionable materials. These thresholds are 200 g Pu for waste drums and up to 3 kg Pu for residue drums.

The rooms examined in this PFHA are being or potentially could be used for drum storage.

Essential Safety Class Equipment

Safety class items are systems, components, and structures, including portions of process systems, whose failure could adversely affect the environment or the safety and health of the public and are not necessarily limited to vital safety systems. The Technical Safety Requirements (TSR's) for the complex are established in Chapter 8 of the BIO. [Kaiser-Hill, 1997] In determining the Limiting Conditions for Operation (LCO), the BIO credits engineered safety features as appropriate to meet the DOE orders. The safety features, based on the TSR, that may relate to the scrubbers are the deluge systems that protect the demister portion of the HEPA filter plenum, two stages of exhaust HEPA filters and fans, automatic sprinkler systems in material storage areas, control of combustible materials and ignition sources, and building structure and fire barriers.

Heating, Ventilating, and Air Conditioning (HVAC)

The Heating, Ventilating, and Air Conditioning (HVAC) systems were designed to provide the following capabilities:

- To furnish air properly conditioned for personnel comfort.
- To provide air suitable for process operations.
- To provide for confinement of Pu within the controlled areas.

- To prevent the dispersion of radioactive aerosols, noxious fumes, and vapors into areas normally occupied by personnel.
- To prevent the release of radioactive aerosols from the building.
- To control the release of noxious fumes and vapors from the building.

The ventilation systems provide five zones of different relative pressures as appropriate to provide assurance that contamination will not migrate to less contaminated areas. The scrubbers, which are the subject of this report, are an integral part of Zone I.

Zone I provides the ventilation for the primary confinement where highly radioactive material is handled. Gloveboxes, canyons, and conveyer enclosures are served by this zone, which, is maintained at the lowest pressure, or greatest Differential Pressure (DP), in the building. Zone I exhaust ventilation is filtered through four stages of HEPA filters and discharged from the facility.

HVAC Systems 1 and 2 provide confinement by both airflow path and filtration and conditioned air. System 1 services the north half of Building 371, and System 2 services the south half. Each system has a very similar design, although the capacity of System 1 is much higher, and significant differences include areas ventilated and exhaust pathways.

The airflow through System 1 is 21,270 cfm and the airflow through System 2 is 10,370 cfm. In System 1, 14,070 cfm (66%) flows through the scrubbers and 7200 cfm (34%) flows directly to Plenum FP-141. In System 2, 9370 cfm (90%) flows through the scrubbers and 1000 cfm (10%) flows directly to Plenum FP-241.

Fire Protection features

Fire protection features include both active protection features (i.e., sprinkler systems, alarm and notification devices) and passive protection features (i.e., fire barriers and fire doors). This section describes the existing fire protection features in these rooms.

Suppression Systems

Building 371 is protected by three automatic wet-pipe fire sprinkler systems designed as Ordinary Hazard pipe schedule per NFPA 13 [1975], using 9.3 m^2 (100 ft^2) per head maximum spacing, and using primarily 74°C (165°F) ordinary temperature sprinklers.

Portable fire extinguishers are located throughout the building and are readily accessible.

Hose stations are located throughout. Fire hoses and nozzles have been removed in accordance with an exemption approved via letter by DOE.

Detection and Alarm Systems

There are heat detection systems consisting of 88°C (190°F), fixed temperature, rate-compensated heat detectors located in the gloveboxes and filter plenums. The sprinkler systems provide an alarm when water is flowing in the sprinkler system. All of these systems activate local alarms and transmit a signal to the sitewide fire alarm system.

Fire Hazard Analysis

This section identifies and assesses the fire hazards for Rooms 1105, 1210, 2217, and 2319. Fuel loading information is based on data gathered during the walkdown, on the combustible loading inspection program and on information obtained from the FHA and the BIO.

The fire scenarios discussed are based on the assumption that ignition will occur, in order to create worst case assumptions that provide a conservative analysis that bounds all other plausible fire scenarios.

Fire Area Description

A Fire Area is defined by DOE Order 5480.7A as a location bounded by construction having a minimum fire resistance rating of 2 hours with openings protected by appropriately fire-rated doors, dampers, or penetration seals. Since these rooms are not fully enclosed by 2-hour walls, they are considered part of a larger fire area. The tank openings between Room 1105 and Room 2319, and between Room 1210 and Room 2217 are penetrations through the floor/ceiling assemblies.

The scrubber tank openings between the basement and sub-basement levels are unprotected floor penetrations. The lower level rooms housing the tanks (sub-basement level) are not enclosed by SC 1 / 2 credited fire barriers. At the upper (basement) level, only Room 2217 is bounded by SC 1 / 2 credited fire barriers. A fire involving any of these rooms can spread fire and smoke throughout the connected rooms and areas.

Scrubber Construction

The scrubber are large fiberglass reinforced plastic (FRP) vessels with cast-in-place openings for the exhaust inlet and outlet, water distribution piping, and for packing removal and testing. Tanks D-131 A and B in Room 1105 are 7'-8" in diameter and 27'-0" tall. Tanks D-230 A and B in Room 1210 are 6'-8" in diameter and 26'-10' tall. The vessels were designed for use at 135°F, a pressure of 5.0 psig, vacuum of –2 psig, and 0.2g Horizontal and 0.13g vertical. The vessels have an encapsulated steel wear ring at the location they pass between the floors. There are two internal FRP grates to contain the packing (pall rings). The grates are approximately 9 ft and 17 ½ ft above the bottom of the scrubbers. Inlet air enters through a 20 inch diameter stainless steel duct on the side of the scrubber and exhaust air exits the scrubber at the top through a 30 inch diameter stainless steel duct. See page 9 for a generic illustration of this scrubber.

Metal-Cladding, Inc. of North Tonawanda, NY (presently the factory is located in Lockport, NY) manufactured the FRP scrubber using fiberglass cloth and a thermoset plastic resin. Each scrubber weighs a nominal 5200 pounds. By weight 31% (1612 pounds) is fiberglass cloth and 69% is a thermoset plastic (3588 pounds).

The thermoset plastic is a Dow Plastics epoxy vinyl ester resin, known as DERAKANE 510. This resin is used in the fabrication of FRP vessels where resistance to corrosive products is desired. If fire retardant additives, such as antimony pentoxide or Nyacol, were used the scrubbers would have a milky white color. The scrubbers have a brownish color. Both the vessel color and the manufacturer confirmed that fire retardant inhibitors were not used. The autoignition temperature of DERAKANE 510 thermoset plastic is 914°F.

Pall rings are used to increase the wetted surface area inside the scrubber. The specifications for the scrubbers indicate the pall rings are plastic with a diameter of 2", but no specific information on the type of plastic could be found. From discussions with pall ring manufacturers, the most likely material used, given the process conditions and age of the scrubbers, is polypropylene. This material was also assumed in the FHA analysis of the scrubber fire. The packing volume is 242 ft^3. Approximately 1070 pounds of pall rings are randomly packed in the scrubber between the FRP shelves.

Typical specifications for 2 inch polypropylene pall rings are a weight of 4.25 lb/ft^3, with a surface area of 33 ft^2/ft^3. The FHA reported that each scrubber contains 1070 pounds of pall rings. The surface area of pall rings in each scrubber exceeds 8000 ft^2. This large surface area is desired in an operational scrubber to increase its efficiency. This high surface area also increases the fire risk. Relevant properties of polypropylene include a melting point of 330°F and an auto-ignition temperature of 694°F. See page 9 for illustrations of typical packing material structures.

Borosilicate glass Raschig rings are in the bottom of the scrubber to prevent a criticality from waste nuclear material in water solution.

A search of standards used by national testing laboratories revealed no test standards for this specific type of tank construction. Tests involving fire resistance of a tank are a relatively recent development, and these tests, such as Multi-Hazard Standard SwRI-95-03 by Southwest Research Institute, have been used for fuel oil tanks. In order to pass the rigorous 4-hour fire tests, the tanks are protected by an insulating layer of concrete. The criteria the scrubber tanks would be required to pass in order to not be involved in the fires of the FHA fire scenario would involve a shorter duration of fire; however, since the tanks are not insulated it is unknown how the fiberglass tanks would react to any fire test.

Fuel Loading and Fire Hazard Potential of Scrubbers

Several fire scenarios were examined, each focusing on the pall rings. The polypropylene pall rings are the greatest fire risk in these rooms, due to the nature of the plastic, their dry condition in the deactivated scrubber, and the extremely high surface area-to-mass ratio. The pall rings have a surface area of approximately 8000 ft^2. Given there is approximately 1000 pounds of pall rings in the scrubber, the surface area per pound is 8 ft^2 /lb. This can be compared to the surface area of a PE drum liner which is about 0.5 ft^2 /lb. The pall rings have about 16 times the surface area of the drum liners. The different fire scenarios consist of varying points of origin for the fire, and the path it would take to the pall rings.

TYPICAL PACKINGS FOR SCRUBBERS - PICTURES

External Fire Threat to Scrubbers

Quantities of combustible materials are stored in these rooms due to the nature of operations. Combustibles have been observed to include unidentified liquids in containers less than 1 gallon, plastic sheeting, wood packaging materials, and electrical

Equipment in 1105/2319, and computer parts and surplus furniture in 1210/2217. Items in storage are in disarray. Conditions such as these, while not conducive to an intense, long burning fire, can result in rapid flame spread through an area should a fire occur.

These items should be widely separated in accordance with Administrative Controls so that the chance of a fire involving one item spreading to others is remote. A fire involving any of the aforementioned fuel packages is, however, expected to be easily controlled by the automatic sprinkler system. In relation to the rest of the building, the fire barriers are expected to contain fires within a given fire area, and to reduce the widespread distribution of the products of combustion.

Current FHA recommendations that apply to these rooms include:

371-97-015 The quantity of stored combustible materials in Rooms 1210, 1105, 2217, or 2319 should be kept as low as reasonably achievable.

371-97-016 Maintain at least 1.5 m (5 ft) separation distance between stored combustible materials and the scrubbers. Do not store any combustible materials in the area below the floor/ceiling opening to the Basement level, or within 1.5 m (5 ft) horizontally of the edges of the opening.

It is anticipated that if these recommendations are implemented in these room, that the fire external to the scrubber breaching the shell will not be a credible event. This is in agreement with the FHA, which states: "Currently, there is an automatic sprinkler system installed at the grated floor/ceiling in Room 1210 and at the ceiling in Room 2217. Given the rapid fire growth and resulting temperatures, sprinkler actuation can be expected in under 5 minutes. Since the two rooms are open to one another, sprinklers in both Rooms 1210 and 2217 will be effective in controlling the fire. Not only is the sprinkler system expected to control a fire involving the polypropylene, but, the sprinkler system would also likely control the initiating fire thereby preventing involvement of the scrubber tanks in the first place."

Internal Fire Threat to Scrubbers

Internal fire threats to the scrubbers are hot gases or sparks entering through the inlet duct. Hot gases that could come down the inlet ducts are diluted before entering the scrubbers. Even if the air is hot coming down the exhaust duct, it may not have the required energy to ignite the pall rings. The pall rings will melt before they will autoignite. Though these scenarios are highly unlikely, due to their high surface area and low melting temperature, pall rings could potentially rapidly plug the scrubber, with resulting loss of ventilation, negative pressure, and containment. The scrubber, which is constructed of a thermoplastic, will not melt.

In FHA-371-002, Revision 2, the scrubber fire is cited as the worst case situation because a fire involving the pall rings could potentially spread into other areas of the sub-basement and contamination could spread throughout the sub-basement and basement levels due to the floor opening in Room 2217. The peak heat release rate in this scenario is based on a hydrocarbon pool fire, and is only dependent on the surface area of the polypropylene involved in fire. The pall rings have a much higher surface area as compared to a pool fire, therefore a much higher heat release rate

The pall rings in the scrubber are considered to be a greater threat to the plenum than PE drum liners in a room. The pall rings have a direct path to the main plenum.

Peak Fire Engineering was also requested to examine the hazard potential of a flammable gas cylinder near a glovebox failing catastrophically and sending gas down the duct to the exhaust scrubbers. Acetylene welding units are typically located in a number of locations throughout Building 371. The acetylene cylinders each typically have a 150 ft^3 capacity. The use of acetylene does have the potential for a flammable gas explosion resulting from an accidental release of the acetylene. This scenario was investigated and deemed to not be a significant hazard. The cylinder was assumed to empty in one minute. If this entire amount of acetylene entered the exhaust stream at one point in System 2 with 9370 cfm entering the scrubber, the percentage by volume of gas would be 1.6 %, less than the Lower Flammable Limit of 2.5 %. Therefore, combustion could not be supported.

Consequences of Pall Ring Fire to Ventilation System

A fire that involves the pall rings will result in loss of exhaust air flow from all connected gloveboxes, and result in clogging of the HEPA filters in the connected filter plenums, FP-141 or FP-241, with soot. (Soot from burning polypropylene is similar in nature to that produced by flammable and combustible liquids.) As seen from the HVAC description, the predominant airflow in Zone 1 is through the scrubbers (66% in System 1 and 90% in System 2). While there are four banks of HEPA filters in these plenums, and only two are credited in the BIO, there is sufficient fuel in this scenario to clog all four filter banks. The potential for the products of combustion from a fire to clog the HEPA filters in the exhaust plenum is important because it provides a mechanism for contamination to spread to the outside. As the HEPA filters begin to clog, the pressure differentials maintained by the exhaust system are reduced. If negative pressure is lost in the facility, smoke and contamination can potentially spread to the outside through cracks and openings in the exterior containment shell.

Recommendations

FHA recommendations on fuel package spacing and clearances from scrubbers should be strictly followed in the scrubber rooms.

The pall rings should be removed from the scrubbers in the exhaust duct paths. Removal of the pall rings provides the greatest decrease in hazard potential for the effort spent.

Operational impacts of these recommendations are minimal. Combustible loading in these rooms will have to be monitored. Since the pairs of scrubbers operate in parallel and have shut-off capabilities, removal of the rings could be accomplished with no downtime of the exhaust system.

References

Kaiser-Hill (1997), "Basis for Interim Operation Building 371/374 Complex, Revision 1," Kaiser-Hill Company, Golden CO, June 16, 1997.

FHA, (1997), "Fire Hazards Analysis, Building 371 Complex," FHA-371-002, Issue 2, Rev. 1, Kaiser-Hill Co., Rocky Flats Environmental Technology Site, Golden, CO, December 22, 1997.

RFETS (1997), Fire Barrier Master Drawings, Fire Protection Engineering Department, Rocky Flats Environmental Technology Site, 1997.

ATTACHMENT 8b - Fire Protection (Further Mitigate Dock Fire)

A. SCHEDULE TASK NUMBER

AC-0808

B. BACKGROUND

A large drum fire on Dock 18T was analyzed in the B371 Basis For Interim Operation (BIO) (Ref. H.1). The event had high consequences (5.9 Rem exposure to a member of the public) because any release is directly to the atmosphere through the dock roll up door. This was a worse case analysis involving 6 drums of residue. A criterion of the validation project is less than 5 Rem exposure to the Maximum Offsite Individual (MOI) at the site boundary for any accident scenario.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the consequences of this scenario to less than the applicable criterion.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.2. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

In the year 2002, all materials will be stored in permanent storage containers, 3013's, and the dock will be used to stage materials for shipment off-site. These materials will be encased in 3013's that are within DOT approved shipping containers. The materials will be either stabilized oxides or Pu metals.

E. COUPLED PROJECTS

There are no coupled projects.

F. ALTERNATIVES

1. No action alternative. Based on the applicable boundary conditions, in particular - no residues stored in B371, the consequences of this scenario would be reduced to well below the applicable 5 Rem criterion and would become an incredible event.

2. Continue controls for materials on the dock (no greater than 200 grams per drum, dock attended during material activities) as prescribed in the current BIO. Continue evaluations of the use of fast acting sprinklers in the fire sprinkler system.

G. RECOMMENDATION

Alternative 2 is the recommended option. Controls established by the authorization basis document provide controls to mitigate effects of a dock fire.

H. REFERENCES

1. Basis For Interim Operations Building 371/374 Complex, Revision 2, September 1997.
2. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.

ATTACHMENT 8 b - Fire Protection (Further Mitigate Dock Explosion)

A. SCHEDULE TASK NUMBER

AC-0908

B. BACKGROUND

A hydrogen explosion in a drum on Dock 18T was analyzed in the B371 Basis For Interim Operation (BIO) (Ref. H.1). The event had high consequences (31 Rem exposure to a member of the public) because any release is directly to the atmosphere through the dock roll up door. This was a worse case analysis involving a drum of High Americium residue. A criterion of the validation project is less than 5 Rem exposure to the Maximum Offsite Individual (MOI) at the site boundary.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the consequences of this scenario to less than the applicable criterion.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.2. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

In the year 2002, all materials will be stored in permanent storage containers, 3013's, and the dock will be used to stage materials for shipment off-site. These materials will be encased in 3013's that are within DOT approved shipping containers. The materials will be either stabilized oxides or Pu metals.

E. COUPLED PROJECTS

There are no coupled projects.

F. ALTERNATIVES

1. No action alternative. Based on the applicable boundary conditions, in particular - no residues stored in B371, the consequences of this scenario would be reduced to well below the applicable 5 Rem criterion.

2. Continue controls, which are contained in the current BIO, for materials on the dock, These controls limit the sum to no more than 200 grams per drum and require attendance during material activities. Complete evaluations of drum explosion effects and determine corrective actions required.

G. RECOMMENDATION

Alternative 2 is the recommended option. Controls established by the authorization basis document and efforts to reduce the effects of a dock explosion provide adequate protection from a dock explosion.

H. REFERENCES

1. Basis For Interim Operations Building 371/374 Complex, Revision 2, September 1997.
2. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.

ATTACHMENT 8 b - Fire Protection (HEPA Filter Replacement)

A. SCHEDULE TASK NUMBER

NA

B. BACKGROUND

High Efficiency Particulate Air (HEPA) filters provide the final barrier to release of nuclear material to the environment and public. HEPA filters are specifically credited in the authorization bases of nuclear facilities at the Site for mitigation of the consequences of operational accidents and natural phenomena hazards.

In March 1994, the Site contractor declared an Unreviewed Safety Question (USQ) as a result of the discovery of only testing the final stage of a credited HEPA filtration bank. As a part of this USQ, filter service life was identified as an issue since there were no specific criteria to determine how long filters should remain in service before routine replacement. To resolve the issue, a HEPA filter service life study was performed to determine significant effects of aging on expected filter performance, particularly from challenging events such as fires. The study was completed and documented in Reference H.1.

Two of the principal conclusions drawn from the results of the study are:

- The data does not support the replacement of HEPA filters based solely on age, nor does it suggest age-specific service life criteria.

- Filter media that were completely wetted and allowed to dry experienced loss of tensile strength potentially significant to the expected performance under accident conditions.

These conclusions supported current Site practices regarding filter replacement; however, the conclusions raised new concerns regarding the containment capability, particularly under fire conditions, of first stage HEPA filters that are intentionally wetted during periodic plenum deluge system performance tests. Maintaining the containment function provided by HEPA filters is essential to protection of the public and the environment in the event of a fire, and is regarded as particularly significant in facilities where the first stage is credited and tested to provide an acceptable level of hazard consequence. Currently, the Building 371 BIO credits two stages of filters in each Zone I, IA, II, and III filter plenum. Zone II and III filter plenums only have two filter stages. This requires that the first stage be DOP tested.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the risk to the public during an accident scenario.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.2. The boundary conditions that impact this validation project are:

- There are no residues stored in drums in B371
- All oxides are stored in vaults on the sub-basement level
- All oxides and Pu metals are stored in 3013 containers in the building
- A combustible control program is in effect

E. COUPLED PROJECTS

Coupled Priority and Near Term Safety Upgrade projects include:

- **Filter Plenum Demister Analysis and Inspections:** This project evaluated the effectiveness of the demister in removing sparks or hot embers that may be generated as a result of a fire (Ref. H.3). The analysis concluded that sparks large enough to present a threat to the integrity of the HEPA filters would be captured by the demister. Sparks that may pass through the demister and impinge on the 1st stage HEPA filter would either burnup in transit or had insufficient thermal energy to present a threat to the filter.

- **Plenum Deluge System Modifications:** This project upgraded the System 1 and 2 plenum deluge systems to withstand the impact of an EBE. This guarantees at least a 30 minute plenum deluge spray makeup capability following a seismic event.

Coupling with other proposed validation projects:

- **Seismically Qualified Plenum Deluge Recharge:** This project would provide long term, manual makeup to the plenum deluge system.

F. ALTERNATIVES

1. Replace the first stage filters. This alternative would perform the next tri-annual surveillance of the manual plenum deluge and then replace the first stage of each of the Zone I, IA, II, and III filter plenums. Exemption from future testing of the manual deluge system would be requested.
2. Modify the manual deluge system to allow for dry testing to avoid wetting of the HEPA filters.
3. DOP testing of both stages of two stage filters ensures the particulate removal efficiency of the filter is maintained. However, this test does not ensure that the structural capability of the filter is maintained.

G. RECOMMENDATION

The recommended alternative is to replace the 1st stage filters after having tested the manual plenum deluge system. Steps taken to increase the reliability of accident mitigation for Building 371 in its role as the Interim Storage Facility must be carefully considered. Replacing the 1st stage HEPA filters will maximize the filter stage structural integrity and increase confidence in filter performance during accident conditions. This can be significant for Zones II and III where the filter plenums are two stage and both are credited in the BIO. Additionally, replacing filters after manual deluge testing provides additional assurance of system operability.

H. REFERENCES

1. RFP-5141, Evaluation of HEPA Filter Service Life, Rev. 0, July 14, 1997.
2. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [Draft], Revision A, July 1998.
3. CALC-371-VEXH-000371, Building 371 Priority Upgrades Task A.1 - HEPA Filter Plenum Demister, September 1997.
4. Peak Fire Engineering, Process Fire Hazards Analysis, Exhaust System Scrubbers, Building 371, July 1998.
5. Internal Threats to the Scrubbers and the Integrity of the Exhaust Plenum HEPA Filters, July 2, 1998.
6. Priority Upgrades, July 15, 1997 Rick Sanchez to Dave Sprowls, Subtask A.1, Calculation Review/Comment Resolution Building.

ATTACHMENT 8 c - Other Functions (Upgrade EP & EOPs)

A SCHEDULE TASK NUMBER

AC-1010

B. BACKGROUND

In 1996, the Building 371 Emergency Plan was reviewed as part of the DNFSB 94-3 Implementation Plan. As discussed in the DNFSB 94-3 IP Task 8 Report (Ref. H.1), the procedures did not adequately address response to severe NPH phenomena or station blackout scenarios. The proposed strategy for severe seismic events was to evacuate the facility, verify containment, and perform a controlled re-entry.

At that time, the B-371 EP was a high level document approved by DOE RFFO, EG&G, and Wackenhut Security Services. This document had not been upgraded following the transition of site management to the K-H team.

However, since the development of the original B-371 Interim Storage Vault report, several programs have been initiated to upgrade site EPs and EOPs. These include site response to seismic events (Ref. H.5) and fires in HEPA filter plenums (Ref. H.6). The IPP (Ref. H.3) also commits RFETS to modifying B-371 EP and EOPs to match the BIO/FSAR if the facility is used for the interim storage mission.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the risk by mitigating the consequences from postulated accident scenarios. Proper emergency planning and training (defined by EP/EOPs) will reduce economic liability (facility, product and environmental), and reduce the risk to the health and safety of the public, environment and worker. Proper emergency planning is also required by federal and state statutes, and required by DOE contract.

The process for selection of this project as an ISV upgrade should address adequacy of the existing procedures, and adequacy of training. The EP & EOPs must be consistent with the BIO.

The EP & EOPs should address the following:

- **Seismic Events**: The EOPs should implement the strategies for responding to seismic events. The strategy should be consistent with the BIO, the proposed site seismic response plan, and the HEPA filter implementation plan. Facility specific EOPs should consider:
    1) Potential evacuation of the facility including the main control room:
    2) Verification of confinement/containment;
    3) Controlled re-entry (including the potential for radiological contamination, criticality, nitrogen line breaks, acid lines, and other potential hazards);
    4) Response to fires including management of HEPA filters plenum deluge systems
    5) Station blackout:

6) Vault cooling during upset conditions;

7) Potential flooding of the attic and subbasement; and

8) Verification that the subsurface drain system is functioning.

As discussed in Reference H.5, site emergency response support is expected to be impaired in large seismic events.

- **Station Blackout**: Station blackout should address restart of the turbine-generator, restoration of power, and other required actions such as adequacy of vault cooling.
- **Tornadoes**: The response to tornadoes should include verification of failure of SSCs (e.g., structural, confinement, HVAC, power, etc.). Site emergency response support may also be impaired.
- **IAEA Monitoring**: The IAEA will have custody of their materials after they are repacked into DOE-STD-3013 containers. The monitoring functions may be disabled in severe events (e.g., station blackout, fires, and seismic events). Notification and post accident response actions should be defined.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.4. There were no boundary conditions identified that directly affect this project task (upgrade of the EP & EOPs).

Other boundary conditions such as the DOE-STD-3013 temperature limits and the number of metal and oxide containers will indirectly affect this project but are accounted for through the coupled projects described in Section E.

E. COUPLED PROJECTS

Coupled interim mission upgrade projects include the following:

- **Ground Floor Vault HVAC**: This project will determine if the metal and oxide storage vaults will require forced cooling to prevent degradation of DOE-STD-3013 containers or other vault components. If required, then emergency response actions should be consistent with these requirements.
- **Reconfiguration of Subbasement Vaults**: The reconfiguration of subbasement vaults will address cooling, IAEA/security monitoring and controlled re-entry strategies.
- **Fire Protection Upgrades:** The selected fire protection upgrades will have an impact on emergency plans and procedures.
- **Confinement Upgrades**: The selected confinement upgrades will have an impact on emergency plans and procedures.

Coupled site programs and projects include the following:

- **RFETS Site Earthquake Response Recommendations** (Ref. H.5): This plan addresses how facilities should respond to earthquakes. It does not provide specific actions for each facility.
- **RFETS Implementation Plan**, Nuclear Facility Ventilation and Plenum Deluge Operation During Fire (Ref. H.6). This plan addresses management of HEPA filters and fans during fires.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Plan and implement the project. This includes development of Emergency Plans, Emergency Operating Procedures, purchasing emergency equipment and supplies required to implement the procedures, and perform training. A reduced scope is recommended based on plan improvements implemented and/or planned since 1996.
2. Do nothing (the no-action alternative). This is acceptable only if the current plans, with committed upgrades, are adequate for the interim mission. If acceptable, the existing plans should be revised to identify the "tie" to DNFSB Recommendation 94-3.

G. RECOMMENDATION

The recommended alternative is to implement the project. The EP and EOP areas recommended for consideration below should be incorporated as part of Emergency Plan scheduled reviews and updates added if necessary. However, the scope of the original submittal should be reduced to account for the improved procedures that have been implemented or planned since the Task 3-2 Report was submitted in 1996.

The detailed plan should provide a cost estimate. The cost estimate should address procedure development, development of training modules and staff training.

Areas of improvement that warrant further review are:

- Seismic Response: includes changes for the confinement strategy and those recommended by the RFETS seismic response recommendations (Reference H.5). The confinement strategy (e.g., enhanced passive or use of EDGs) may require new procedures and training.
- Mission Changes: The current Building Emergency Response Operations (BERO) reflect today's facility mission and the BIO. This mission will change. The BERO and BIO should be consistent in terms of hazards and postulated accident scenarios.
- Fire Scenarios: The fire protection upgrades may result in changes to BERO procedures.

H. REFERENCES

1. DNFSB 94-3 Implementation Plan, Task 8 Report, "Assess Configuration & Performance of Safety Systems, Structures and Components," Rev. 0, December 1995 (pg. 10).
2. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev. 0, March 15, 1996 (Appendix B).
3. DNFSB 94-3 Integrated Program Plan, Revision 1, February 23, 1998.
4. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [draft], April 1998.
5. Kaiser-Hill Report, "Recommendation for Earthquake Response at Rocky Flats Environmental Technology Site," April 1998.
6. Kaiser-Hill Implementation Plan, "Nuclear Facility Ventilation and Plenum Deluge System Operation During Fires," Revision 0, March 1, 1998.

ATTACHMENT 8 c - Other Functions (Upgrade of 1101 & 1208 Ceiling)

A **SCHEDULE TASK NUMBER**

AC-1110

B. **BACKGROUND**

In 1995, the DNFSB 94-3 seismic studies (reference H.4) identified that a large earthquake with a median return period of 38,000 years (and a lower limit return period of 11,000 years) could result in structural collapse of Building 371. This event, referred to as the "Collapse Prevention Earthquake" (CPE) is expected to result in un-acceptable risks to the public in terms of latent cancer fatalities. The dominant contributor to the site risk was damage to DOE-STD-3013 containers with dispersible oxides stored in ground floor vaults in Building 371. These vaults are currently not capable of withstanding the CPE.

Therefore, to reduce the site risk from such a large event, reconfiguration of the subbasement vaults (Rooms 1101 and 1208) was selected as an interim storage mission upgrade (Ref. H.1). Use of those vaults required strengthening the vault ceilings to ensure the vaults remain intact thereby protecting the containers. The structural evaluation (reference H.1) showed that the vault walls would remain intact following the CPE and preliminary calculations demonstrated that the ceiling slabs had adequate strength to withstand the dead load from debris after a building collapse. A method was then needed to protect the ceiling slabs from the dynamic loads caused by falling debris.

This upgrade provides for installation of hexcel energy absorbing materials above the ceilings. The hexcel honeycomb matrix has substantial energy absorbing capability that would reduce the impact loads from a structural collapse on the existing ceiling structures. The material was to be installed in the basement rooms above subbasement vaults 1101 and 1208.

C. **PROJECT OBJECTIVES**

The objective of this project is to reduce the risk of a CPE by strengthening the ceilings of the subbasement vaults.

The number of DOE-STD-3013 containers to be stored in 10-gallon drums in the subbasement vaults is expected to be reduced from the original estimate of 1485.

The total B-371 inventory was originally estimated as follows (see Section 2.2.1 of Ref. H.1):

Pu Oxide containers	1000	Sub-basement
Pu Residue container	485	Sub-basement
Pu Metal containers	2060	Ground floor vaults

The current estimate is:

Pu Oxide containers	1250	Sub-basement
Pu Residue container	0	Sub-basement
Pu Metal containers	800	Ground floor vaults

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. Boundary conditions that may affect this project task (protection of the sub-basements for the CPE) include:

- **DOE-STD-3013 Container Inventory**: The number of DOE-STD-3013 oxides containers to be stored in subbasement vaults. Fewer containers may eliminate the need to upgrade both vaults.

E. COUPLED PROJECTS

Coupled interim mission upgrade projects include the following:

- **Reconfigure Subbasement Vaults**: Use of the subbasement vaults to reduce the risk drives the requirement for structural upgrades of the ceilings.
- **Ground Floor HVAC**: Upgrading the ceilings may reduce conductive heat transfer rates applied in the passive vault cooling calculations. The effect is expected to be minor due to the expected lower power generation of the 3013 containers, smaller inventory in subbasement vaults and conduction through the vault walls.

There are no identified site programs or projects affecting this proposed project.

F. ALTERNATIVES

Selected alternatives are as follows:

1. Do nothing (the no-action alternative). This action essentially accepts the risk of the oxide dispersion following the CPE.
2. Plan and Implement the Project (Hexcel Absorbers). This includes design and installation of the energy absorbing materials.
3. Strengthen the Vault Ceilings with Steel/Concrete. This alternative was considered in the original plan but was not selected due to difficulty in implementation. Installing rebar and steel may require welding (a fire initiator), and pouring concrete is difficult due to location (radiological controlled area, security, etc.).
4. Modify Containers to Withstand CPE: This option is considered risky due to the excessive forces exerted on the containers by blocks impacting the containers. Blocks from the structural collapse with enough energy to penetrate the vault ceilings are expected to penetrate everything but the most robust containers.

   If the 10-gallon containers were modified, the cost of container design, testing, and construction is expected to exceed the cost of the upgrade. Potential designs include "pipe and go" type containers packaged in strengthened 10-gallon containers. Design and testing considerations include heat transfer and impact testing.

G. RECOMMENDATION

The recommended alternative is to strengthen the vaults using the hexcel energy absorbing material (alternative 2). This appears to be the lowest cost alternative that will reduce the consequences of a CPE.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev 0, March 15, 1996 (Appendix B).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, April 28, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [draft], April 1998.
4. DNFSB 94-3 Implementation Plan, Task 6 Report, "Summary Report of the Structural Evaluation of Rocky Flats Building 371," December 1995.

ATTACHMENT 8 c - Other Functions (Ground Floor Vault HVAC)

A **SCHEDULE TASK NUMBER**

AC-1210

B. **BACKGROUND**

The DNFSB 94-3 Interim Storage Mission study identified a potential problem with cooling of DOE-STD-3013 containers with Pu metal in station blackout conditions. Station blackouts (loss of all AC power) are postulated in the lifetime of the facility. Severe NPH events (seismic and tornadoes) and switchgear room fires have the potential station blackouts exceeding several days in duration.

To assess the impact of loss of forced cooling, a heat calculation was performed (see Section 3.3.3 of Reference H.1). That analysis determined that, upon loss of forced ventilation, the DOE-STD-3013 containers with Pu metal in the 3337 vaults would exceed the upper limit (100°C) in approximately 7 days. The analytical model did not consider thermal stratification effects. Therefore, with thermal stratification, the limit may be exceeded in a much shorter time. Exceeding the limit was expected to result in repackaging affected cans and the potential for room contamination. Although this event would not exceed public dose criteria, it was judged to be an economic "disaster" due to costs imposed for facility cleanup, container repackaging, and waste disposal.

Therefore, installation of seismically qualified fans on the vault exhaust paths was selected as an interim mission upgrade. The fans were expected to be powered from the 300KW standby generators - a separate project recommended to maintain negative pressure in the facility.

C. **PROJECT OBJECTIVES**

The objective of this project is to reduce the risk of repackaging (an economic risk) following the loss of power events. The project should consider the following:

- **Container Inventory:** In the original study (see Section 2.2.1 of Ref. H.2), a total of 3550 DOE-STD-3013 containers were expected to be stored in the ground floor and subbasement vaults. The total number is expected to be reduced from that original estimate thereby reducing the total power generation in the vaults.
- **Container Power Generation:** In 1996, the original study (see Section 3.3.3 of Ref. H.1) assumed a power generation of 50 BTU/Hr per container. The generation rate was based on DOE-STD-3013-94. The power generation per container may be reduced based on current standards and/or reduction in americium content. Reduction in the power generation term will reduce the steady state temperature.
- **Vault Cooling:** The DOE-STD-3013 container temperature limit is expected to be increased from 100°C to 250°C. This limit is based on potentially breaching the 3013 containers with Pu metal. Containers with Pu Oxide only are of interest in terms of the thermal input to the vault heating because the oxide cans would not be compromised. However, excessive temperatures may require repackaging or may damage other vault equipment (see below).

- **Other Vault Limits**: The upgrade assessment must address thermal limits of other vault equipment. Possible adverse effects include concrete spalling, damage to monitoring equipment (fiber optic cables), damage electrical equipment (lighting, wires, etc.), and dumbwaiter lifting equipment.

D. <u>APPLICABLE PROJECT BOUNDARY CONDITIONS</u>

The boundary conditions for the IPP validation project are defined in Reference H.3. Boundary conditions that may affect this project task include:

- **DOE-STD-3013 container inventory:** The number of DOE-STD-3013 oxides containers to be stored in subbasement vaults. Fewer containers may reduce the requirement for mezzanine racks, or eliminate the need for rack installation.
- **DOE-STD-3013 container temperature limits**. The container limits (250°C) are expected to be applicable to metal containers. If a metal container exceeds this limit, the requirement for repackaging must be identified.
- **DOE-STD-3013 container power generation**. The container power generation will affect the vault cooling calculations.

E. <u>COUPLED PROJECTS</u>

Coupled interim mission upgrade projects include the following:

- **Upgrade of the Subbasement Vault Ceilings**: Use of the subbasement vaults to reduce the risk requires structural upgrades of the ceilings.
- **Reconfigure Subbasement Vaults**: The passive cooling requirements of the subbasement vaults must also be reviewed for similar issues. The effect is expected to be less due to the lower power generation of the 3013 containers, smaller inventory in subbasement vaults and conduction through the vault walls.
- **Emergency Plans:** The EP and/or EOPs should consider vault cooling during station blackout. potential impacts of subbasement vault flooding (potential criticality).

There are no identified site programs or projects affecting this proposed project.

F. <u>ALTERNATIVES</u>

Potential alternatives are as follows:

1. <u>Do nothing</u> (the no-action alternative). This action essentially accepts the risk of the consequences following loss of power/HVAC accidents.
2. <u>Plan and Implement the Project (Ventilation Fans).</u> This includes design and installation of the fans and electrical equipment, post-mod testing, and development of surveillance procedures.
3. <u>Install Passive Ventilation Paths.</u> This alternative would consider installation of other passive cooling devices. The most likely would be devices that enable natural draft convection in the event of a loss of HVAC. Examples could include:
   - A vent duct (e.g., spring-loaded backdraft dampers). The damper would be held closed by normal and alternate power - upon loss of power, the damper would open. A fire damper with a fusible link (possibly the same damper) would be required.

- Grated opening with a fusible link fire damper installed near the ceiling and floor of the vault. This would enable HVAC flow through the vent opening during normal operations.

The design would consider security issues, required convective flow rates and surveillance testing. Passive device surveillance testing would be visual inspections.

G. RECOMMENDATION

The recommended alternative is do nothing (alternative 1). This is because the heat transfer calculation demonstrated that, upon loss of forced cooling, the vault will not exceed 165°F and the container will be below DOE-STD-3013 limits (250°C for metals).

The difference from original estimates is primarily attributed to the following factors:

- The DOE-STD-3013 limit for Pu metal containers has been raised from 100°C to 250°C.
- The power generation term was reduced from 50w per container to 15w per container to reflect current information from LANL.
- The 1998 analysis included a more detailed model, which more accurately represented heat transfer paths.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev 0, March 15, 1996 (Section 3.3.3 and Appendix B).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, April 28, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [draft], April 1998.

Attachment 8 c - Other Functions (Reconfigure sub-basement Vaults)

A SCHEDULE TASK NUMBER

AC-1310

B. BACKGROUND

In 1995, the DNFSB 94-3 seismic studies (reference 4) identified that a large earthquake with a median return period of 37,000 years (a lower return period limit of 11,000 years) could result in structural collapse of Building 371. This event, called a "Collapse Prevention Earthquake" (CPE) would result in unacceptable risks to the public in terms of latent cancer fatalities. The dominant contributor to the site risk was damage to DOE-STD-3013 containers with dispersible oxides stored in unprotected (ground floor) vaults in Building 371. Therefore, to reduce the site risk from such a large event, reconfiguration of the subbasement vaults (Rooms 1101 and 1208) was selected as an interim storage mission upgrade (see Appendix B of Ref. H.1).

This upgrade required installation of storage racks similar to those in Room 3337. A total of 1250 3013 containers with oxides in 10-gallon drums would be stored in the rooms. Each vault would have a mezzanine and elevator system. Because the IAEA was to be the custodian of this SNM, SNM monitoring would also be required. Monitoring systems included in this upgrade are similar to those in the existing 3337 vault, and satisfy IAEA and US Government requirements. Additionally, because the Central Storage Vault (CSV) walls were only 8-inches thick and the CSV would be de-inerted, the potential for intruders accessing the subbasement vaults through the CSV was identified. Security experts recommended that the upgrade include increasing the wall next to the CSV to at least a 12-inch thickness and installation of security grating in the HVAC ducting.

C. PROJECT OBJECTIVES

The objective of this project is to reduce the risk of a CPE from dispersion of oxides. Based on the Boundary Condition Report (see Ref. H.3), the DOE-STD-3013 containers with oxides will be stored in the subbasement vaults to reduce the site risk for a large seismic event.

The project should consider the following:

- **Subbasement Vault Inventory and Container Surveillances:** The number of DOE-STD-3013 containers to be stored in the subbasement vaults is expected to be reduced from the original estimate of 1485.
- **Vault Cooling:** The DOE-STD-3013 container temperature limit is expected to be increased from 100°C to 250°C. This limit is based on metal expansion and oxide containers are not expected to be a driver. However, excessive temperatures may require repackaging or may damage other vault equipment. There are other possible adverse effects which should be addressed during the conceptual design phase. These potential effects include concrete spalling, damage to monitoring equipment (fiber optic cables), damage to electrical equipment (lighting, wires, etc.), and existing hoisting equipment.

- **Fire Barriers**: The upgrade must address whether the vault door should be replaced with a 2-hour rated door and a ¼ inch steel frame around the door. The fire rating of the concrete walls between the CSV and the subbasement vaults should be addressed.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

The boundary conditions for the IPP validation project are defined in Reference H.3. Boundary conditions that may affect this project task include:

- **DOE-STD-3013 container inventory**: The number of DOE-STD-3013 oxides containers to be stored in subbasement vaults. Fewer containers may reduce the requirement for mezzanine racks, or eliminate the need for rack installation.
- **DOE-STD-3013 container temperature limits**: The container limits (250°C) are expected to be applicable to metal containers. If a metal container exceeds this limit, the requirement for repackaging must be identified.
- **IAEA**: if the IAEA is not the custodian, then security monitoring requirements will be reduced.

E. COUPLED PROJECTS

Coupled interim mission upgrade projects include the following:

- **Upgrade of the Subbasement Vault Ceilings**: Use of the subbasement vaults to reduce the risk requires structural upgrades of the ceilings.
- **Ground Floor HVAC**: The passive cooling requirements of the ground floor vaults must also be reviewed for similar issues in the subbasement vaults. The effect is expected to be less due to the lower power generation of the 3013 containers, smaller inventory in subbasement vaults and conduction through the vault walls.
- **Scrubber Removal**: Removal of the scrubbers may remove all fire sources in the subbasement. If the fire scenario is not a concern, then the scope of the vault upgrade may be reduced. Specifically, an upgraded fire door and fire wall on the west side of Rooms 1101 and 1208 may not be required.
- **Emergency Plans**: The EP and/or EOPs should consider vault cooling during station blackout, potential impacts of subbasement vault flooding (potential criticality).

Other site programs or projects affecting this proposed project include the following:

- **Residue Stabilization**: The residue stabilization plan is considering use of the subbasement vaults to store residue drums. Storage of residues will affect the construction schedule and vault configuration. For example, if the residues are stored in 1208, the other vault (1101) may require installation of a mezzanine to hold the inventory. The projected schedules and inventories must be addressed.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Do nothing (the no-action alternative). This action essentially accepts the risk of Pu Oxides dispersing after the CPE. A technical basis would be required which would validate the assumptions (e.g., MAR, damage ratios, site boundary, etc.).

If the analysis demonstrates that the dose exceeds site dose criteria (5 Rem), then the project should be implemented.

2. Plan and Implement the Project (Reconfigure Vault). This includes design and installation of the racks, wall upgrades (security and fire barriers), electrical equipment, security/IAEA equipment, post-mod testing, and development of surveillance procedures. With the reduced total inventory, only one vault may be required. During conceptual design engineering will be completed with the intent of using both vaults.

Reconfiguring other 371 rooms into vaults (e.g., canyons, 3206, etc.) was considered but rejected because of the anticipated expense. Additional ground floor vaults would also not reduce the risk from oxide dispersions following the CPE.

G. RECOMMENDATION

The recommended alternative is to reconfigure the subbasement vaults. This appears to be the lowest cost alternative that will reduce the dose following the CPE. Initial layouts show that both vaults (1101 and 1208) will be required.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev 0, March 15, 1996 (Appendix B).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, April 28, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [draft], April 1998.
4. DNFSB 94-3 Implementation Plan, Task 6 Report, "Summary Report of the Structural Evaluation of Rocky Flats Building 371," December 1995.

Attachment 8 c - Other Functions (Convert 3559 & 3561 To Vaults)

A SCHEDULE TASK NUMBER

AC-1410

B. BACKGROUND

In 1996, the DNFSB 94-3 Implementation Plan reviewed storage requirements for SNM. At that time, the disposition of weapons grade materials for the interim mission (2002 - 2017) was not conclusive. Therefore, as discussed in the Task 3-2 Report (see Section 3.2.3 of Ref. H.1), storage strategies were developed that included shipment of weapons grade materials to other DOE sites (e.g., Pantex) or increasing the Building 371 storage capacities.

Storage of all DOE-STD-3013 containers (3550 metal and oxide containers) and weapons grade materials required reconfiguration of the 3559 and 3561 canyons.

C. PROJECT OBJECTIVES

This project enabled proper storage of weapons grade materials (pits) in Building 371.

D. APPLICABLE PROJECT BOUNDARY CONDITIONS

Pit Disposition

E. COUPLED PROJECTS

None.

F. ALTERNATIVES

N/A

G. RECOMMENDATION

Since the development of the original B-371 Interim Storage Upgrades, DOE has committed to shipping all weapons grade materials to Pantex. As discussed in the IPP (Ref. H.2), the shipments are in progress and scheduled for completion in 1999.

This upgrade should be cancelled. Shipment of weapons grade materials eliminates the requirement for these rooms to be converted to SNM storage vaults.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report." Rev 0, March 15, 1996 (Section 3.2.3 and Appendix B).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, April 28, 1998.

Attachment 8 c - Other Functions (Material Dumbwaiter Transfer)

A **SCHEDULE TASK NUMBER**

AC-1510

B. **BACKGROUND**

In 1996, installation of a material dumbwaiter was selected as an near term upgrade (Ref. H.1) and based on reduced operational and security costs.

The design would be similar to the drum hoist recently installed in Room 3337, but includes structural modification to floor slabs. The installation would enable material to be transported from the subbasement to the ground floor without the use of the shipping elevator. Use of the shipping elevator requires several security guards because the material transfer path exits the Building 371 Material Access Area (MAA). Use of the stacker retriever system is not recommended because of the potential for contamination of the containers, size limitations (10-gallon drums cannot be transferred) and the planned deactivation of the S/R.

However, since the development of the original B-371 Interim Storage Mission report, shipment of SNM currently stored in these rooms to other DOE sites has eliminated the need for this upgrade for the near term mission. The upgrade is now listed as a potential interim mission upgrade to enable material (e.g., DOE-STD-3013 cans) to be transferred to the ground floor for Non-Destructive Assay (NDA) or repackaging in the PuSPS line.

C. **PROJECT OBJECTIVES**

The objective of this project is to reduce operating and security costs for transferring SNM from the subbasement to the ground floor for NDA/surveillances. Based on the Boundary Condition Report (Ref. H.3), the DOE-STD-3013 containers with oxides will be stored in the subbasement vaults to reduce the site risk for a large seismic event. The project should consider the following:

- **Subbasement Vault Inventory and Container Surveillances:** The number of DOE-STD-3013 containers to be stored in the subbasement vaults is expected to be reduced to 1250 from the original estimate of 1485. The surveillance frequencies (see Section 3.3.4 of Ref. H.2) should also be reviewed to assess the number of expected transfers for NDA and integrity inspections.
- **Container Repackaging and shipping:** The number of DOE-STD-3013 containers expected to be repackaged in the ground floor PuSPS line, or transferred to other sites, should be considered in this assessment.
- **Surveillance Equipment**: As an alternative, the possibility for installing NDA equipment in the subbasement should be considered.

D. **APPLICABLE PROJECT BOUNDARY CONDITIONS**

The boundary conditions for the IPP validation project are defined in Reference H.3. Boundary conditions that may affect this project task (installation of the material dumbwaiter) include:

- The number of DOE-STD-3013 oxides containers to be stored in subbasement vaults.
- Frequency of expected container inspections and assay.
- Percentage of container inspections (e.g., 5% of total per year).

E. COUPLED PROJECTS

Coupled interim mission upgrade projects include the following:

- **Reconfiguration of Subbasement Vaults:** The installation of the material dumbwaiter is driven by the need to transport materials between the ground floor and the subbasement. If the subbasement is not used for oxide storage, this project is not needed. The existing elevator can be used for material transfer.
- **Scrubber Removal:** The original plan was to install the dumbwaiter in Room 1210. Removal of the scrubbers, which are located in this room, may affect the location of the proposed dumbwaiter and construction schedule.

There are no identified site programs or projects affecting this proposed project.

F. ALTERNATIVES

Potential alternatives are as follows:

1. Do nothing (the no-action alternative). This action essentially accepts the costs of security associated with 3013 container transfers.
2. Plan and Implement the Project (Install the Dumbwaiter). This includes design and installation of the racks, wall upgrades (security and fire barriers), electrical equipment, and post-mod testing. With the reduced total inventory, only one vault may be required.
3. Install NDA Equipment in Subbasement: This would still require movements for repackaging and shipments.

G. RECOMMENDATION

The recommended alternative is to install the NDA equipment in the subbasement (Alternative 3). This should be addressed in the vault upgrades design.

Further studies showed that NDA equipment (e.g., gamma spectroscopy, calorimetry, and scales) are now being purchased or already exist. The new calorimetry machines are air bath portable types, which are easily installed. The total cost of the NDA equipment is nearly zero.

The IAEA monitoring requirements are expected to be tamper indicating devices or fiber optic systems. These systems are required regardless of the locations. Assay required by the IAEA are expected to be the same as the DOE.

DOE 3013 surveillance equipment are currently indeterminate. The expected worst case scenario is radiography. The cost is expected to be clearly less than installation of a dumbwaiter.

H. REFERENCES

1. DNFSB 94-3 Integrated Program Plan, Task 2-4 Report, "Building 371 Near Term Mission Report," Rev 0, March 15, 1996 (Appendices A-15 and A-16).
2. DNFSB 94-3 Integrated Program Plan, Revision 1, April 28, 1998.
3. DNFSB 94-3, Building 371 Interim Storage Upgrade Validation Boundary Conditions, [draft], April 1998.
4. DNFSB 94-3 Integrated Program Plan, Task 3-2 Report, "Building 371 Interim Mission Report," Rev 0, March 15, 1996.