DOE/EA-1039

**ENVIRONMENTAL ASSESSMENT
and
FINDING OF NO SIGNIFICANT IMPACT**

**Actinide Solution Processing
at the Rocky Flats Environmental
Technology Site**

**United States Department of Energy
Rocky Flats Environmental Technology Site
Golden, Colorado**

April 1995

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REVIEWED FOR CLASSIFICATION/UCNI:

Date 5-7-95

Finding of No Significant Impact

U.S. DEPARTMENT OF ENERGY
FINDING OF NO SIGNIFICANT IMPACT
ACTINIDE SOLUTION PROCESSING
AT THE ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

SUMMARY: The Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-1039, for radioactive solution removal and processing at Rocky Flats Environmental Technology Site, Golden, Colorado. The proposal for solution removal and processing is in response to independent safety assessments and an agreement with the State of Colorado to remove mixed residues at Rocky Flats and reduce the risk of future accidents.

Monthly public meetings were held during the scoping and preparation of the EA. The scope of the EA included evaluations of alternative methods and locations of solution processing. A comment period from February 20, 1995 through March 21, 1995 was provided to the public and the State of Colorado to offer written comment on the EA. Comments were received from the State of Colorado and the U.S. Environmental Protection Agency. A response to the agency comments is included in the Final EA.

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PUBLIC AVAILABILITY: Copies of the EA or further information on the DOE NEPA process are available from:

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Proposed Action: DOE proposes to remove radioactive solutions from current storage containers, remove the radioactive (actinide) solids from the solutions, and convert the solids into a safe form suitable for storage. Approximately 30,000 liters of actinide solutions, which are stored in Buildings 371, 559, 771, 774, 777, and 779, would be processed, primarily in Buildings 371 and 771. Processing would consist of solution neutralization, separation, filtration, and calcination. Solutions which meet waste acceptance criteria would be processed as waste in Buildings 374 and 774 using existing carrier precipitation and cementation techniques. Additionally, the proposed action consists of removing spent ion-exchange resins from eight ion columns within gloveboxes in Building 771, and storing the material in drums until they can be

processed for final disposition. Most of the solutions consist of plutonium nitrate and are stored in tanks and piping in Buildings 371 and 771.

Solutions in Building 371 not meeting waste acceptance criteria would be transferred to the Caustic Waste Treatment system (CWTS) which uses a precipitation and filtration process to remove plutonium from solutions. The solutions containing plutonium hydroxide precipitate would be filtered in a glovebox and routed to holding tanks. The filtered solutions in the holding tanks would be sampled again to determine the actinide concentration, and the filtering process would be repeated as needed. Filters from the glovebox would be collected when they become loaded with precipitated actinides, the actinides would be mechanically removed, and the filters would be replaced for reuse. The precipitated actinides would be heated on a hot plate within a glovebox which would convert the material to an oxide form suitable for safe storage. The dried precipitate would be stored in stainless steel cans in a vault-like storage area in Building 371.

Processing activities in Building 771 would consist of draining tanks and piping, packaging and transferring the solutions to the processing area, separating bottles of nitrate and chloride solutions, and precipitating actinides using hydroxide (for chloride solutions) or oxalate (for nitrate solutions) reagents. Also included in process activities is heating the solid precipitates to oxidize them, sampling to ensure that the solid material has been fully oxidized and stabilized, and safely storing the solids.

Degraded ion-exchange resins would be removed from ion columns, which are in gloveboxes in Building 771. Resin removal includes both the removal of the residual plutonium liquid and the degraded resin beads. The solutions would be drained into 4 liter bottles and the beads would be placed in 30 liter cardboard tubes. Each of the 8 columns would generate approximately 10 liters of solution and about one storage tube for each column's resin beads. The wet resins would be dewatered using filtration, loaded into 15 liter cardboard tubes, removed from the glovebox, assayed for plutonium content, and stored in drums in Buildings 771 until they could be processed for permanent disposition. Solutions recovered from the resins during the filtration process would be drained into 4 liter polyethylene bottles, placed into 55-gallon drums, and transferred by truck to Building 774 for waste treatment.

Environmental Impacts: Since the proposed action would not require any construction activities, and because any facility modifications would be inside existing facilities, there would be no increase in impacts to the natural environment in comparison to the no action alternative. As a result, there would be no adverse impact to water resources, flood plains, wetlands, threatened or endangered species or critical habitat, cultural resources, or other Site features.

Nonradiological air emissions would be maintained below the reporting thresholds required by the State of Colorado, so there would be no increase in adverse health effects from nonradiological air emissions. Since safety procedures and requirements for storing wastes at the Site are in place, the low-level and transuranic wastes generated by the proposed action would be stored at Rocky Flats in existing, approved waste storage areas, and are not expected to result in increased environmental effects.

Radiological, chemical, and industrial hazards were assessed in Integrated Safety Assessments (ISA) for Buildings 771 and 371. The analyses concluded that overall risk of chemical and physical hazards to the worker and the public is extremely small due to low concentrations of corrosive solutions. Exposures to the immediate worker from chemicals of concern would be maintained below occupational exposure limits.

Radiological exposures to the immediate worker from processing operations and postulated accidents would be maintained below DOE's limit for annual routine exposure (5.0 rem) and the Site Administrative Control Level of .75 rem because of engineering and administrative controls. Potential radiological exposure to the public from processing operations is expected to be less than 1 percent of the annual limit for public exposure. Radiological risk to the public from accidents is low because of the relatively small amount of plutonium involved.

Alternatives Considered: DOE considered in detail the no action which is the continued storage of actinide solutions in their present storage containers and configuration in tanks, piping, bottles, and ion-exchange columns in Buildings 371, 559, 771, 774, 777, and 779. The only activities that would be conducted in these buildings relative to liquid stabilization are routine maintenance activities and activities required to maintain the current status of the buildings. These activities include maintenance to vital safety systems. Wastes would continue to be processed from other Site facilities in Buildings 374 and 774. The no action alternative was determined to be unacceptable, since it would not meet the requirement of removing mixed residues from existing storage containers and reduce the increasing risk to workers and the public from radiological contamination.

Alternatives considered but eliminated from further analysis were: solution transfer and deferral; dilution and cementation; direct denitration; vitrification; polymer encapsulation; processing in Buildings 559, 707, or 779; and off-site shipment of solutions.

DETERMINATION: Based on the information and analyses of impacts in the environmental assessment, DOE has determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of the NEPA. Therefore, preparation of an environmental impact statement is not required. DOE is approving this environmental assessment and issuing this Finding of No Significant Impact for the proposed action.

Signed in Golden, Colorado, this 25 day of April, 1995.

Mark N. Silverman
Manager
Rocky Flats Field Office
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Environmental Assessment

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LIST OF ABBREVIATIONS AND SYMBOLS

ACL	Administrative Control Level
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
APEN	Air Pollutant Emission Notice
CAQCC	Colorado Air Quality Control Commission
CDH	Colorado Department of Health (name changed to CDPHE)
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CWTS	Caustic Waste Treatment System
DOE	Department of Energy
DOT	Department of Transportation
EA	Environmental Assessment
FSAR	Final Safety Analysis Report
Haz-Mat	Hazardous Material Team
HEPA	High Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air-conditioning
ISA	Integrated Safety Assessment
LATO	Los Alamos Technology Office
LCF	Latent Cancer Fatality
LDR	Land Disposal Restrictions
LS/DW	Life Safety/Disaster Warning
NCRP	National Council on Radiation Protection
NMSL	Nuclear Material Safety Limit
OSHA	Occupational Safety and Health Act
PEL	Permissible Exposure Limits
RCRA	Resource Conservation and Recovery Act
SAAM	Selective Alpha Air Monitor
TLV	Threshold Limit Values
TRU	Transuranic
TWA	Time-weighted Average
UPS	Uninterruptible Power Supply
WIPP	Waste Isolation Pilot Plant

g	acceleration of gravity
g/l	grams per liter
l	liter
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to

EXECUTIVE SUMMARY

The Department of Energy (DOE) proposes to remove radioactive, or actinide solutions from tanks, piping, and plastic bottles at the Rocky Flats Environmental Technology Site (the Site) located near Golden, Colorado. Actinides are a series of heavy radioactive metallic elements. At the Site, actinide solutions typically contain concentrations of plutonium and americium, or plutonium and uranium.

This Environmental Assessment addresses the potential environmental impacts associated with the proposed action of removing radioactive solutions from current storage containers. Since the curtailment of plutonium operations was announced at the Rocky Flats Environmental Technology Site (the Site) in late 1989, these solutions have been left in place in process lines, tanks, and other containers. At that time, it was believed that the curtailment would only amount to a temporary delay in processing and production activities. The mission of the Site has since changed to one of environmental remediation and waste management. Because of the prolonged storage and the acidic nature of the solutions, the storage containers, pipes, and valves are degrading. Thus, the immediate risk to workers and the public from radiological contamination is increasing with time.

The proposed action is to drain radioactive solutions from existing storage containers, remove the radioactive solids from the solutions, and convert the solids into a safe form suitable for storage. Approximately 30,000 liters (l) of these solutions, which are stored in Buildings 371, 559, 771, 774, 777, and 779 would be processed, primarily in Buildings 371 and 771. Processing would consist of solution neutralization, separation, filtration, and calcination. Solutions which meet waste criteria would be processed as waste in Buildings 374 and 774 using existing carrier precipitation and cementation techniques. Additionally, the proposed action consists of removing spent ion-exchange resins from eight ion columns within gloveboxes in Building 771, and storing the material in drums until they could be processed for final disposition.

Several alternatives to the proposed action were considered, including no action, solution transfer and deferral, dilution and cementation, direct denitration, processing in Buildings 559, 707, or 779, and off-site shipment of solutions. Due to the high amounts of waste generated, extremely high costs, lengthy schedule for completion, human health risk level, or other reasons, only the proposed action and no action alternatives were considered reasonable and carried forward for detailed analysis.

The potential environmental effects from ionizing radiation and hazardous chemicals in the radioactive solutions currently being stored at the Site are of primary concern. Important issues related to the proposed action include potential air emissions, waste generation, and human health risks. Potential impacts to the natural environment are not expected to increase because the proposed activities would take place within existing facilities. Therefore, except for air quality, resources related to the natural environment were identified as not requiring an analysis of environmental consequences. Nonradiological air emissions would be maintained below regulatory reporting thresholds, thus no adverse health effects would result from these emissions. Waste generation would be increased under the proposed action, but would be maintained within approved storage capacity limitations.

Potential human health effects associated with the proposed action were compared with the no action alternative for workers at the Site and the public. Results of the analysis indicate a short-term increase in potential radiological and chemical exposure to the Site workers and the public, followed by a decrease in risk to levels below the current risk.

1.0 INTRODUCTION

In November 1989, DOE curtailed plutonium operations at the Site to address safety concerns and to conduct the annual plutonium inventory. The curtailment was extended until an analysis of plutonium operations could be completed and safety problems identified during the inventory could be corrected. Between November 1989 and January 1992, decisions regarding the future mission of Rocky Flats have precluded resumption of processing operations in support of nuclear weapons production in any of the Site facilities, including Buildings 371 and 771. In January 1992, the Site mission was changed to one of environmental remediation and waste management. As a result, approximately 30,000 liters (l) of actinide solutions remain in bottles, tanks, and piping. Actinide solutions are contained in three types of containers: bottles, piping, and tanks. Bottles are currently stored in six different buildings on the Site including Buildings 371, 559, 771, 774, 777, and 779. Tanks and pipes are contained in two buildings including Buildings 371 and 771.

There are approximately 30,000 l of solution contained in bottles, piping, and tanks that require removal and processing. Ion-exchange column solutions are also included. These solutions are of various total actinide concentrations, acidity, and chloride concentrations. Each of these factors, along with the location of the solution, dictates the principal process for each solution, if any, and the waste treatment process or processes. Table 3.1-1, Bottled Solution Inventory, and Table 3.1-2, Tank and Piping Solution Inventory, show the volumes and the locations of various types of solutions.

The volumes in piping and tanks have been estimated using various methods. An engineering low-point study was conducted for the piping where volumes were estimated based on the diameter of the pipe, the length of the pipe, and the lowest gravitational point of the length of pipe. Tank data have been derived from sight-glass readings and density scanning. Bottle volumes have been inventoried visually. The tanks and piping volume inventory is estimated and is expected to change as systems are drained. Additional volume studies are currently being conducted for tanks.

Most of the processes that were used to recover plutonium and uranium from solids, impure metals, and residues involved the use of acids. When operations ceased, the acidic solutions in Buildings 371, 559, 771, 774, 777, and 779 were left in place. Due to the corrosive nature of these solutions (and decomposition in the case of plastic bottles), the existing storage containers, including fittings, valves, and piping, are degrading, and are causing safety concerns.

A safety assessment was performed in January 1990 which concluded that the solutions represented no immediate hazards (EG&G, 1990b). However, due to the extended duration of the curtailment, DOE commissioned the Los Alamos Technology Office (LATO) to perform an independent safety assessment in February 1991 (DOE, 1991). The report resulting from the independent assessment indicated that no imminent safety hazard existed, but recommended that safety concerns be addressed in Buildings 771 and 371 as soon as possible. The first plan to address the concerns in Building 771, published in March 1992, called for processing of waste actinide solutions in Building 771 to eliminate potential hazards.

Following DOE's decision to permanently cease production at Rocky Flats, a revised LATO report was issued in October 1993 (DOE, 1993). It concluded that (1) continued storage of actinide solutions is not advisable; (2) liquids should be converted to a safe, compact, storable form promptly, or shipped to another site; (3) tank deterioration and piping degradation would increase with time; and (4) if conditions remain the same, the number of contamination incidents would increase.

In April 1993, DOE entered into an agreement with the Colorado Department of Public Health and Environment (CDPHE, formerly the Colorado Department of Health [CDH]) to drain the Site tank systems containing both hazardous and radioactive components (that is, mixed residues). Actinide solutions are a part of the Site's mixed residue inventory. This agreement, entitled Settlement Agreement and Compliance Order on Consent No. 93-04-23-01, defines certain actions that DOE must perform in order to comply with federal and state hazardous waste regulations (CDH, 1993).

This Environmental Assessment was prepared to analyze and assess the impacts from the actions required to remove and process actinide solutions from the tanks, bottles, and pipes in Buildings 371 and 771. In addition, the proposed action serves as the preferred method to eliminate the risk of releases or leaks in the future.

2.0 PURPOSE AND NEED FOR ACTION

The purpose and need for this Environmental Assessment (EA) is to address transportation, storage, and disposal of actinide solutions resulting from previous operations at the Site. When plutonium operations were curtailed at the Site in 1989 for inventory and safety upgrades, more than 30,000 l of actinide solutions were left unprocessed in tanks, piping, and containers for short-term storage, awaiting resumption of plutonium operations. These solutions have now been stored in the same containers for 5 years. Since production curtailment, building operations have been limited to only those activities that are necessary to safely operate the building and keep vital safety systems operable.

Since the change in mission of the Rocky Flats facility, resumption of Buildings 371 and 771 plutonium processing operations in support of nuclear weapons production has been terminated. The actinide solutions are causing concern for worker safety because the acid has corroded storage containers and caused several small leaks in tanks and piping. The leaks have been repaired; however, continued degradation of the existing storage containment would result in an increased frequency of leaks and/or spills. The slurried resins within the ion-exchange columns, in their current form, also pose a potential fire hazard if allowed to dry out. Since 1989, the ion-exchange columns have required periodic additions of solutions to minimize the risk of fire.

A revised independent safety assessment was prepared by LATO to identify any safety hazards that might exist in relation to the stored solutions and resins (DOE, 1993). It concluded that continued storage of actinide solutions is not advisable and if solution storage conditions remain the same, the number of contamination incidents would increase. The overall recommendation by the independent safety assessment was to place the solutions in a solid form suitable for long-term storage or ship to another site for processing, if feasible, and as soon as possible. Furthermore, the solutions should be converted to a suitable waste form, or precipitated and calcined and stored in vaults. The study indicated that this would reduce the risk of future accidents.

The proposed action to remove and convert actinides to a safe form would aid in meeting the terms of an agreement between DOE and CDPHE to drain mixed residue tank systems at the Site. The April 1993 Settlement Agreement and Compliance Order on Consent No. 93-04-23-01 requires processing of all stored mixed residues so that they could be shipped or disposed of as expeditiously as possible (CDH, 1993). The estimated 30,000 l of actinide solutions which require removal are a portion of the mixed residues. As a result, it is necessary for the DOE to take action to remove actinide solutions from tanks, pipes, and bottles in Buildings 371, 559, 771, 777, and 779, and ion-exchange resins from columns in Building 771.

3.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

Eleven alternatives were initially considered for removing and processing the actinide solutions described in Section 2.0, Purpose and Need for Action. Seven alternatives, which were identified for processing actinide solutions, include the proposed action, no action, solution transfer with deferral of processing, dilution and cementation, direct denitration, vitrification, and polymer encapsulation. Three additional alternatives were considered as location options for processing the actinide solutions, and include processing in Buildings 559, 707, and 779 at the Site. One additional alternative considered was off-site shipment of solutions. A more detailed description of the alternatives is presented below.

3.1 Proposed Action

The proposed action is to drain actinide solutions from current storage containers and tank systems, remove the actinides from the solutions, and convert the actinides into a safe, storable form suitable for storage until final disposition is agreed upon. Most of the solutions consist of plutonium nitrate and are stored in tanks and piping in Buildings 371 and 771. Tanks and piping containing uranium solutions with varying amounts of plutonium also exist in Building 771. Polyethylene bottles containing plutonium nitrate, plutonium chloride, and uranium solutions are stored in Buildings 371, 559, 771, 774, 777, and 779. Ion-exchange resin columns exist in Building 771 and contain both solution and resin. Table 3.1-1, Bottled Solution Inventory, and Table 3.1-2, Tank and Piping Solution Inventory, show the volumes and the location of various types of solutions and the expected processing destinations under the proposed action.

The processes that would be used to treat the solutions or waste are processes that have been used at the Site for many years and were either curtailed in 1989 or continue today. There are three principal precipitation processes that would be used to treat solutions contained in bottles, piping, and tanks including oxalate, hydroxide, and the Caustic Waste Treatment System (CWTS). Specific parameters for processing would be developed at Los Alamos National Laboratory and at the Site. The processes would be permitted through the Colorado Department of Public Health and Environment (CDPHE) via modifications to the existing Resource Conservation and Recovery Act (RCRA) Part B Permit. A RCRA Part B Permit is the general operating permit for a hazardous waste treatment, storage, or disposal facility. The proposed stabilization processes would be performed in Buildings 371/374 and 771/774 depending on the actinide concentration and constituents, and the location of the solutions.

Highly concentrated solutions would be processed through one of the three principal precipitation processes using new and/or existing equipment in Buildings 371 and 771. Processing would consist of solution neutralization, actinide precipitation, filtration, and calcination. Less concentrated solutions would be processed using one of the waste treatment processes in Buildings 374 or 774. Some minor modifications to existing equipment within these buildings would be required to implement the primary processes.

Table 3.1-1 Bottled Solution Inventory

Current Building Location	Number of Bottles	Estimated Volume (liters)	Total Actinides	Processing Destination
371	48	171.5	waste < 0.0245 g/l	774/374 carrier precipitation 774 bottle box for cementation 771 processing
	11	22.0	to be blended	
	3	12.0	> 6.0 g/l	
559	8	32.0	> 0.0245 < 6.0 g/l	774 bottle box for cementation 774/374 carrier precipitation 774 bottle box for cementation 771 processing
	127	496.0	waste < 0.0245 g/l	
	8	18.5	to be blended	
	11	42.0	> 6.0 g/l	
771	97	358.5	> 0.0245 < 6.0 g/l	774 bottle box for cementation 774/374 carrier precipitation 774 bottle box for cementation 771 processing
	89	340.5	waste < 0.0245 g/l	
	99	200.0	to be blended	
	60	283.5	> 6.0 g/l	
774	28	108.0	waste < 0.0245 g/l	774/374 carrier precipitation 771 processing
	12	50.5	> 0.0245 < 6.0 g/l	
777	385	1544.0	> 0.0245 < 6.0 g/l	771 processing batching 774 bottle box for cementation
	1	2.0	to be blended	
779	23	41.0	to be blended	774 bottle box for cementation 771 processing
	12	39.0	> 6.0 g/l	

TOTAL BOTTLES 1022 3761.0

Figure 3.1-1, Building 371 Actinide Solution Process Flow Diagram, and Figure 3.1-2, Building 771 Actinide Solution Process Flow Diagram, show general process flow diagrams of the proposed primary processing in Buildings 371 and 771, respectively.

Table 3.1-2 Tank and Piping Solution Inventory

	Number of Tanks	Estimated Volume (liters)	Total Actinides	Processing Destination
Building 371 Tanks	80	10,548	<1.5 g/l	batching/371 CWTS Processing
	1	120	>1.5 g/l to be blended	371 CWTS Processing
Actinide Piping	N/A	4,855	average 1.0 g/l to be blended	batching/371 CWTS Processing
Nonactinide Piping	N/A	3,182	reagent acids and bases	batching/371 CWTS Processing
Total 371		18,705		
Building 771 Tanks	12	944	<6.0 g/l	774 bottle box for cementation
	3	700	<0.0245 g/l	774/374 carrier precipitation
	72	2,516	>6.0 g/l	771 Oxalate Processing
	4	129	uranium >1.5 g/l and chloride >1.0 g/l	771 Hydroxide Processing
Resin Column Liquids	N/A	100	acid rinse liquid	774 bottle box for cementation
Actinide Piping	N/A	1,800	>6.0 g/l	771 Oxalate Processing
Nonactinide Piping	N/A	1,356	reagent acids and bases	batching/771 Processing
Total 771		7,545		

TOTAL TANKS AND PIPING 26,250

The schedule objectives are to eliminate, by draining, all actinide aqueous solutions in Building 771 by December 1997 and to eliminate all actinide aqueous solutions in Building 371 by June 1999. The draining activities, the primary precipitation processes, and the waste treatment processes which are already operational, would be conducted simultaneously such that draining, processing, and waste treatment are performed in logical sequence. The total estimated cost for the proposed activities in this assessment is \$120 million.

Figure 3.1-1 Building 371 Actinide Solution Process Flow Diagram

Figure 3.1-2 Building 771 Actinide Solution Process Flow Diagram

3.1.1 Preparation of Solutions for Processing

The solutions in bottles, piping, and tanks are not all the same; thus, different types of solutions must be processed differently. Following is a characterization of solutions which dictate the processing or waste treatment for the solution:

- Total actinide concentration
- Higher levels of chloride
- Higher levels of uranium
- Acids and bases with no actinide contamination

Batching or blending is simply mixing two or more solutions together. The reason for batching is to mix solutions which may not be within the desired range for a process, so that the resulting mixture is in the range and can be introduced into the desired process. For example, if a small amount of a high-level actinide solution is drained, it could be batched with a low-level solution so that the resulting solution can be fed into the Building 371 Caustic Waste Treatment System (CWTS) for processing. The CWTS operates best on low-level solutions; or, lower-level solutions can be batched so that the resulting solution can be fed directly into the Building 774 bottle box cementation. The objective is to drain the liquids from their degrading containers and prepare them as a safe waste form as quickly as possible. Final processing decisions are made as draining occurs based on the laboratory analyses showing the exact chemistry of the solution. Batching occurs at the beginning of the process that has been chosen for a particular solution.

When solutions are sampled and subsequently analyzed in the laboratory, the result is the generation of laboratory solutions. Therefore, additional volume would be generated over the life of this project from laboratory waste associated with this project, and additional volume would be processed along with the original volumes.

3.1.2 Parameters of Processes

There are five waste treatment processes ancillary to the principal processes which include: Building 774 bottle box cementation and carrier precipitation; and Building 374 carrier precipitation, saltcrete cementation, and evaporation. These five ancillary processes are currently operational. Processes, both principal and ancillary, would be performed only in Buildings 371/374 and 771/774. Bottles would be transferred to and processed only in Buildings 771/774.

Each of these processes are designed to operate under certain parameters that dictate which solutions may be introduced into the process. Following is a list of the processes and the operating parameter that dictates the solutions it can handle.

PRINCIPAL PRECIPITATION PROCESSES

Process	Parameters
Building 771 oxalate	high total actinides (not uranium/chloride)
Building 771 hydroxide	high uranium and chlorides
Building 371 CWTS	<1.5 g/l total actinide

WASTE TREATMENT PROCESSES

Process	Parameters
Building 774 bottle box cementation	<6.0 g/l total actinide
Building 774 carrier precipitation	<0.0245 g/l total actinide
Building 374 carrier precipitation	<0.0040 g/l total actinide
Building 374 evaporator and saltcrete cementation	<2.0 x 10 ⁻⁷ g/l total actinide

A brief discussion of each process is discussed in the following sections.

Building 771 Oxalate: Liquids containing plutonium with a total actinide concentration >6.0 g/l would be processed through oxalate precipitation in Building 771. This process could not accept solutions with a chloride concentration that is >1.0 g/l, nor could it accept solutions with uranium contamination which is detectable at >0.013 g/l.

Building 771 Hydroxide: Liquids containing >1.0 g/l chlorides and/or uranium with a total actinide concentration >6.0 g/l would be processed through hydroxide precipitation.

Building 371 CWTS: All solutions contained in Building 371 that exceed the waste transfer shipping limit (0.004 g/l Pu) for Building 374 receiving tanks would be processed through the CWTS in Building 371. The CWTS uses a hydroxide precipitation and filtration process to remove plutonium from solutions. High-level actinide solutions would be batched with low-level actinide solutions to attain an optimum total actinide concentration for the solution to be processed at a range of 0.004 g/l to 6.0 g/l.

Building 774 Bottle Box Cementation: Liquids containing up to 6.0 g/l total actinide can be processed through the direct cementation process in Building 774. Bottles of liquid are transferred into a glovebox. The liquids are drawn by vacuum into a mixing tank where they are adjusted for pH through the addition of sodium hydroxide. The liquids are then drained into a 55-gallon drum already containing a dry mixture of Portland cement and Ramcote® insulating cement. The cement mixture is stirred and allowed to stand until it has set up properly. The drum is then closed and removed from the glovebox. This resulting waste form is a Transuranic (TRU) waste that has been demonstrated to meet Land Disposal Restrictions (LDR) under RCRA.

Building 774 Carrier Precipitation: The Building 774 carrier precipitation process criteria for acceptance of liquids is 0.0245 g/l total actinide. This is based on Nuclear Safety limitations within Building 774, driven by the configuration of process tanks. Solutions are vacuum-transferred into the first stage batch precipitation tanks where they are mixed with sodium hydroxide, ferric sulfate, calcium chloride, magnesium sulfate, and a flocculating agent. Mixing of the solutions with the reagents causes a precipitate to form, carrying the actinides down into a sludge. The remaining liquid is vacuum-transferred to the second stage of carrier precipitation, where the process is repeated. The sludge would be stored until an approved treatment process is available.

Building 374 Carrier Precipitation: The Building 374 carrier precipitation process is basically the same as the process in Building 774. The criteria for acceptance of liquids is 0.004 g/l total actinide. Building 374 carrier precipitation remaining liquid is transferred to the Building 374 evaporator. Remaining liquid from Building 774 carrier precipitation and from the CWTS in Building 371 would be transferred to Building 374 carrier precipitation via pipeline for further processing.

Building 374 Evaporator and Saltcrete Cementation: The Building 374 evaporator and saltcrete cementation process is part of the Building 374 carrier precipitation. The evaporator accepts the carrier precipitation remaining liquid, and heats the liquid to produce steam which is collected, cooled, and recycled for process make-up water. The residual brine is collected and cement is added forming saltcrete, a low-level waste.

The principal processes are discussed technically and in greater detail in Section 3.1.3, Building 371 Processing, and Section 3.1.4, Building 771 Processing. The combination of different solutions, different principal precipitation processes, and waste treatment processes result in numerous solution draining, batching, and processing scenarios.

Reagents would be added to the actinide solutions so that precipitation of the actinides would occur. Different reagents would be used including sodium hydroxide, potassium hydroxide, magnesium hydroxide, sodium nitrite, hydroxylamine nitrate, and oxalic acid. A reagent(s) is introduced into the solution in either a liquid form or dry form, depending on the reagent, to prepare for or cause precipitation. The amount of each reagent required for each batch of solution would vary depending on chemical parameters; the amount added to each batch would be calculated based on the exact chemistry as defined by the laboratory analyses. The total volume of reagents to be used would be small, relative to the total volume of solution to be processed, and would not drastically alter the anticipated final waste form volumes.

3.1.3 Building 371 Processing

An estimated 18,705 l of solution is contained in tanks and piping in Building 371 as shown in Table 3.1-2, Tank and Piping Solution Inventory. Under the proposed action, the solutions would be transferred by tubing, 4-l bottles, or portable tanks to the Caustic Waste Treatment System (CWTS) holding tanks in the sub-basement of Building 371. The tanks and/or pipes would be tapped and drained into appropriate containers. Large volume tanks would be drained into portable tanks or CWTS holding tanks using thick-walled Tygon tubing. The use of Tygon tubing would require the penetration of walls and/or floors in Building 371 to permit routing to one of the four CWTS holding tanks. The flow of solutions would be initiated and maintained by gravity or a vacuum system. Small-volume tanks (tanks which size or other factors make the use of Tygon tubing inappropriate) would be drained into portable tanks and transferred by cart to a glovebox for vacuum transfer to a CWTS holding tank. Remaining (small volume) liquids would be consolidated into 4-l plastic bottles and transferred by cart to a glovebox for vacuum transfer to a CWTS holding tank.

Liquids in tanks and piping in Building 371 would be sampled to determine their actinide concentration and hazardous RCRA constituent content. After sampling, all solutions would be held in holding tanks pending processing through the CWTS, as described below. Solutions that are less than the waste transfer shipping limit of 0.004 g/l, as well as caustic, would be pumped from the holding tanks directly to Building 374 for waste treatment. Additional solutions with no actinides (44 reagent tanks and an estimated 2,450 l of reagent in piping, along with an additional 680 l of water) would be transferred to Building 374 for waste treatment.

Caustic Waste Treatment System

The CWTS, located in the sub-basement of Building 371, is comprised of seven annular (ring-shaped) tanks: four collection tanks, two filtrate receiver tanks, one waste shipping tank, and three gloveboxes. Associated equipment includes pumps, mixers, filters, and digestors.

The CWTS uses a precipitation and filtration process to remove plutonium from solutions. Solutions would be collected in four waste collection tanks; pumped and mixed with a chemical reagent (for example, magnesium or sodium hydroxide) to adjust the pH level (reduce the acidity) to greater than 6 to cause the plutonium to precipitate out of the solution as a solid; filtered, and the filtrate collected in holding tanks. The solution containing plutonium hydroxide precipitate would be filtered within a glovebox and routed to holding tanks. The filtered solutions in the holding tanks would be sampled again at this point to determine the actinide concentration. If the actinide concentration is below the 0.004 g/l waste transfer shipping limit, the solution would be transferred to the basic waste transfer tank and then to Building 374 for further waste treatment. If the actinide concentration is greater than or equal to the waste transfer shipping limit, the solution would be transferred back to the waste collection tanks for reprocessing.

Filters from the glovebox would be collected when they become loaded with actinide precipitate, the precipitate would be mechanically removed, and the filters would be replaced for reuse. The precipitate would be calcined on a hot plate within a glovebox which would convert the material to an oxide form suitable for safe storage. The dried precipitate would be stored in stainless steel cans in a vault-like storage area in Building 371. Although a specific heating temperature has not been established, it is anticipated that a temperature of approximately 600° Celsius would be used. For waste minimization, filters would be reused until degraded, then air-dried and placed in cans for storage in Building 371.

3.1.4 Building 771 Processing

An estimated 7,545 l of solutions are present in Building 771 in tanks and piping. Approximately 3,761 l of solutions that are contained in plastic bottles in various buildings would be consolidated in Building 771 for processing. Processing activities would consist of draining tanks and piping, packaging and transferring the solutions to the processing area, separating bottles of nitrate and chloride solutions, and precipitating actinides using hydroxide (for chloride solutions) or oxalate (for nitrate solutions) reagents. Also included in process activities is calcining the precipitate, and sampling the material for analysis. A detailed description of the actinide stabilization process for solutions is discussed below.

Oxalate Precipitation Processing for Nitrate Solutions

Plutonium-bearing nitric acid solutions with an actinide concentration ≥ 6.0 g/l would be processed with oxalic acid to precipitate plutonium oxalate from the solution. The plutonium oxalate would be filtered, dried, and heated in a muffle furnace. The batching operation would be performed in a precipitation vessel located in a glovebox.

Actinide solutions would be transferred to the precipitation vessel by a vacuum system. Prior to precipitation, a reagent would be added to the actinide solution to reduce acidity. A reducing agent would then be added to reduce the plutonium valence [that is, reduce Pu(IV) to Pu(III)]. Since Pu(III) oxalate is less soluble than Pu(IV) oxalate, less plutonium would remain in solution. Oxalic acid would then be slowly added to this solution to precipitate the actinides. Air would be drawn into the bottom of the tank during the process to provide mixing. Following the precipitation process, the oxalate precipitate would then be recovered by vacuum filtration, air-dried, and placed in a muffle furnace where it would be heated to a stable plutonium oxide form suitable for safe storage. The filtrate would be returned to the precipitation vessel, treated to eliminate remaining reducing agent, and magnesium hydroxide would be added to precipitate plutonium remaining in solution as the hydroxide. The hydroxide precipitate would be recovered by vacuum filtration, air-dried, and heated in the muffle furnace to a stable plutonium oxide for storage. The hydroxide filtrate would be transferred to Building 774 for carrier precipitation.

Hydroxide Precipitation Processing for Uranium, Plutonium-Uranium, or Actinide-Chloride Solutions

Approximately 300 l of solution have been identified for hydroxide processing. A maximum of 7.5 l of solution would be processed in each batch. Solutions with total actinide concentrations ≥ 6.0 g/l would be processed with a hydroxide reagent to precipitate actinide hydroxides from the solutions. The batching operation would be performed in an open 4-l precipitation vessel located in a glovebox in Building 771. The amount of hydroxide used to precipitate the actinides would depend on the acid concentration of the solution. Temperatures in the precipitation vessels would be maintained at less than 80° Celsius to preclude boiling and spattering. Following the precipitation process, the solution would be poured off the precipitate and the resulting sediment transferred to a filtration apparatus to separate the hydroxide precipitate cake from solution. The filter cake would then be dried on a hot plate to convert the hydroxide to a stable oxide form suitable for safe storage.

Ion-exchange Resin Removal

Ion-exchange is a process that was used in Building 771 during the past 40 years to recover and purify plutonium from waste residues. The process equipment included ion-exchange columns and a resin material. Resins (a soft, permeable plastic material) are beads that vary in size, but are generally about 1/32 inch in diameter. These beads fill an ion-exchange column that is a glass cylinder 6 inches in diameter and 3 or 4 feet in height. During recovery operations, plutonium solutions were introduced into the columns where plutonium nitrate will absorb on the resin beads. The pure plutonium nitrate could then be washed from the beads thereby recovering the pure plutonium product. Resin beads degrade with use and have to be replaced during processing.

Currently, there are eight ion-exchange columns which contain solution and degraded resin beads. Twelve additional columns, six of which were leaking, have been drained and the resins removed. Resin removal includes both the removal of the residual plutonium liquid and the degraded resin beads. The solutions would be drained into 4-l bottles and the beads would be placed in 15-l cardboard tubes. Each of the eight remaining columns would generate approximately 10 l of solution and about one storage tube for each column's resin beads.

Degraded ion-exchange resins would be removed from ion columns, which are located within gloveboxes in Building 771. The wet resins would be dewatered using filtration, loaded into 15-l cardboard tubes, removed from the glovebox, assayed for plutonium content, and stored in drums in Buildings 771 until they could be processed for permanent disposition. All equipment necessary for resin removal would be contained within the gloveboxes. Cardboard tubes would be consolidated into drums in accordance with Nuclear Material Safety Limits (NMSLs) at the Site.

Solutions recovered from the resins during the filtration process would be drained into 4-l polyethylene bottles and temporarily stored in gloveboxes. During temporary storage, the bottle contents would be sampled and analyzed. Subsequently, the bottles would be placed into 55-gallon drums and transferred by truck to Building 774 for waste treatment.

3.1.5 Transportation of Solutions

Bottles of solutions from Buildings 777 and 779 would be transferred for processing using a manual drum-handling cart pushed through connecting tunnels and enclosed passageways directly to Building 771. Bottled chloride solutions from Building 371 and bottled chloride and nitrate solutions from Building 559 would be placed in 55-gallon drums for transfer between buildings by truck. Rigid polyethylene liners would be placed in the drums to provide an additional barrier against the release of radioactive material, and to protect the drum from the attack of corrosive liquid if a bottle leaked. All 55-gallon drums would meet manufacturing and testing requirements of U.S. Department of Transportation (DOT) 17C. All on-site movements would be accompanied by qualified operators, nuclear material control personnel, and safeguards and security personnel, in accordance with approved Site procedures.

3.1.6 Transportation and Storage of Solids

The oxalate and hydroxide precipitation processes would produce a stable actinide powder, which would be placed in containers (cans) up to a maximum of 2,500 gm per container in accordance with NMSLs. Following removal from the glovebox, the canned actinide powder generated in Building 771 would be transferred onto approved transfer carts to the Building 771 analytical laboratory for gamma spectrometry (to determine isotopic content) and calorimetry (for nuclear accountability). After calorimetry, the actinide powder would be moved to a vault in Building 771 for safe storage. Likewise, actinide powder generated in Building 371 would be analyzed in the Building 371 laboratory and moved to a Building 371 vault. All handling, storage, and movement of fissile material would be in accordance with existing procedures and NMSLs.

3.2 No Action Alternative

The no action alternative has been proposed pending development of new technology that would simplify solution processing. This alternative would allow continued storage of actinide solutions in their present storage containers and configuration in tanks, piping, bottles, and ion-exchange columns in Buildings 371, 559, 771, 774, 777, and 779. The only activities that would be conducted in these buildings relative to liquid stabilization are routine maintenance activities and activities required to maintain the current status of the buildings. These activities include maintenance to heating, ventilation, and air-conditioning (HVAC) systems and other vital safety systems. Routine radiological surveys would continue within all buildings.

Inspections of tanks, bottles, and piping would continue in accordance with RCRA requirements. No tanks or bottles of actinide solutions would be drained unless required to eliminate an immediate threat to the human environment. Actinides would not be stabilized by processing them into solid forms. No additional wastes would be generated beyond those required to maintain the current status of the buildings.

Although waste would continue to be processed in Buildings 374 and 774 from routine operations and current programs at the Site, the no action alternative is not expected to generate any additional waste. Ion-exchange resins would be removed from leaking columns and the glovebox, assayed, and stored in drums, as described in Section 3.1.4, Building 771 Processing. Ion-exchange column solutions would be stored with other liquids in a glovebox for further processing. It should be noted that this alternative does not meet the terms of the agreement between the DOE and the CDPHE to drain mixed residue tanks and process them into a shippable and/or storable form as expeditiously as possible. A decision to extend the commitments made in the agreement would require renegotiation with CDPHE.

3.3 Alternatives Considered, But Not Analyzed

In addition to the proposed actinide solution processing and the no action alternatives analyzed in this EA, nine other alternatives were considered, but were eliminated from further analysis. These alternatives include processing in Buildings 559, 707, and 779 at the Site, off-site shipment of solutions, solution transfer and deferral, direct denitration, dilution and cementation, vitrification, and polymer encapsulation. A brief discussion of each alternative is presented below.

3.3.1 Other Process Buildings

Three location alternatives were considered and consisted of processing the solutions in buildings other than Buildings 371 and 771. The alternatives included Buildings 707, 559, and 779 which were not originally designed to process highly corrosive solutions nor house liquid actinides, and would require substantial modifications to the heating, ventilation and air-conditioning (HVAC) and security systems. The cost for these modifications would be excessively high (greater than \$750 million for each location) with no compensating advantages (EG&G, 1993a). Therefore, these alternative locations were considered to be unreasonable and were not analyzed in detail.

3.3.2 Off-site Shipment of Solutions

Off-site shipment of actinide solutions was also considered to reduce health risks associated with continued storage of actinide solutions at the Site. Although shipping plutonium solutions is allowed, only 20 curies per package may be shipped in accordance with the terms of 10 CFR 71.63. The only certified shipping container available allows only 1 l of exclusively uranium solution to be packaged inside a 55-gallon drum.

If it were possible to certify a similar container for shipment of plutonium solutions, approximately 30,000 containers would be required, and it would be economically infeasible to ship approved containers to another site. Also, transportation of these containers would result in risks to the public. In addition, no other facility is equipped with approved tanks to accept the solutions. Therefore, this alternative was considered to be unreasonable and was not analyzed in detail.

3.3.3 Vitrification and Polymer Encapsulation

Vitrification and polymer encapsulation are actually waste processing options which are in various stages of research and development within the DOE complex. Neither would be able to process the high-level mixed residues currently requiring removal. Therefore, these two alternatives were dismissed from further consideration.

3.3.4 Solution Transfer and Deferral

The solution transfer and deferral alternative would allow actinide solutions to be drained from their current storage containers and transferred to new tanks within Buildings 371 and 771. This alternative implies that a permanent solution to the existing problem of deteriorating tanks and piping systems would be deferred. Although the potential hazards from bottle storage would be eliminated by draining into new tanks, this alternative only postpones the inevitable processing of the solutions. The deferral of processing by re-tanking does not necessarily decrease the risks and exposure which is inherent to the processing of the solutions. The long-term implication of the implementation of this alternative would be the accumulation of risks and exposure associated with the transfer of solutions into new tanks, in addition to risk and exposure commensurate with that for the proposed solution processing.

Existing unused tanks at the Site would provide longer-term storage for about only 8,000 l. The procurement of approximately 44 additional 500-l tanks would be required in order to store the remaining 22,000 l of solution. Raschig ring tanks are no longer acceptable because of the inability to meet American National Standards Institute (ANSI) standards and safety concerns. As a result, ring-shaped annular tanks would be required, which contain less volume than Raschig ring tanks. Since more tanks would be required, the cost of this alternative would substantially increase.

The potential exposure to workers and the public would be slightly less with this alternative than for the proposed action in the short term because, although identical methods of solution transfer would be used, handling and processing the precipitated actinides would not be done. However, this may be offset by an increasing risk of exposure to workers during storage of the solutions in tanks. This risk would be higher with this alternative than for the proposed action because the solutions would be stored for at least 6 years before a new processing technology could be implemented. The amount of time required for procurement, installation, and certification of new tank systems at the Site would take about 5 to 6 years to complete and 1 to 2 years to install. New tank systems would require permitting by CDPHE. Physical space is limited; thus, the decontamination and decommissioning of an existing area at the Site that could accommodate the new tank systems would be required. The amount of time required for implementation of this alternative would not meet the terms of the agreement between DOE and CDPHE to drain mixed residue tanks and process them into a shippable and/or storable form as expeditiously as possible. A decision to extend the commitments made in the agreement would require renegotiation with CDPHE.

This alternative offers only a temporary means to resolve the current actinide solution configuration and storage problem. If a new or more favorable processing technology is not found within a reasonably short period of time, the risk of radiological and chemical exposure to workers at the Site would increase. For these reasons, this alternative was considered to be unreasonable and was not carried forward for detailed analysis.

3.3.5 Dilution and Cementation

The dilution and cementation alternative would allow actinide solutions to be diluted until concentrations are low enough to permit transfer to a cementation process, such as the Building 774 bottle box, for cementation. In order to meet waste acceptance criteria at the Waste Isolation Pilot Plant (WIPP), where long-term storage is anticipated, actinide solutions would be required to be diluted such that no more than 70 gm of plutonium or 108 gm of uranium are contained within 60 l of neutralized liquid in each drum of cement.

The solution would be transferred by bottle to a holding tank in Building 774, then neutralized with sodium hydroxide, and cemented with 197 kilograms (approximately 438 pounds) of cement for each 55-gallon drum. The cementation process, which is an existing approved process at the Site, is performed in 55-gallon drums with a maximum of 60 l of neutralized solution plus 9 l of solution to flush the system. As a result, this process would generate approximately 2,470 drums of waste and would require approximately 10 to 20 years to complete, at a cost of \$118 million for processing (EG&G, 1993b). This cost does not include building operating costs, which exceed processing costs.

Because a greater volume of higher-level solutions would be handled to meet waste transfer limits, the risk of radiological exposure to workers at the Site would be higher for this alternative than for the proposed action. In addition, the risk of radiological exposure from accidents would also be higher due to increased potential for spills. There would be no measurable exposure to the public because all handling, transferring, and processing activities would be conducted within existing radiologically-controlled buildings in accordance with approved safety procedures.

While this technology is known and has been used at Rocky Flats for decades, an excessive volume (2,470 drums) of solidified transuranic (TRU) waste would be generated and would have to be stored onsite until the WIPP is approved for waste acceptance in 1998. Since storage space is not currently available for the number of waste drums that would be generated, additional storage space may need to be constructed. This would require additional funding approval from Congress and several years to complete. Due to the potentially long lead time for construction of additional storage space, the excessively high cost of cementing the waste, and the generation of a large amount of additional TRU waste requiring storage, and without any offsetting benefits, this alternative was not considered a reasonable means for processing actinides from stored solutions at the Site and was not carried forward for further analysis.

3.3.6 Direct Denitration

The direct denitration alternative would allow actinide solutions containing nitrates to be processed by direct denitration, utilizing microwave energy or thermal mechanisms. However, chloride solutions could not be processed. This process involves evaporating plutonium and uranium solutions into nitrate forms, which are then heated to 300° Celsius. Nitrogen oxide gases are driven off during heating; the remaining solids include stabilized plutonium solids and/or uranium oxides. The oxides would be packaged and stored.

The equipment and/or expertise for a thermal denitration process does not currently exist at the Site, although thermal denitration has been used for uranium solutions at other DOE facilities. The process would have to be built, tested, and implemented to stabilize actinides in solution. In addition, capital equipment would have to be procured, requiring Congressional funding appropriation. As a result, it could take 6 to 7 years for this process to become operational. During this time, the frequency of leaks from tanks, lines, and bottles would be likely to continue to increase, with associated risk increases to the Site workers, the public, and the environment. Some microwave denitration equipment is available at the Site, but the equipment has not been installed and set up for operation. Microwave denitration is not as well developed as thermal denitration and more process development would be required.

The direct denitration thermal process would minimize waste because reagents are not added. This process has been used successfully for uranium separation operations; however, it has not been used for plutonium separation. Due to the time required for equipment procurement and process development, the high cost to become operational, and the inability to process chloride solutions, this alternative was not considered reasonable for processing actinides from stored solutions at the Site and was not carried forward for detailed analysis.

4.0 AFFECTED ENVIRONMENT

This section describes the Site location and its potentially affected environmental resources. The environmental elements that were considered for analysis include threatened or endangered species, wetlands, floodplains, cultural resources, water resources, air quality, waste generation and storage, and human health. The elements that are expected to be potentially effected include air quality, waste generation and storage, and human health effects.

4.1 Natural Environment

The Site is located on 6,550 acres in rural northern Jefferson County, Colorado, 16 miles northwest of downtown Denver as shown in Figure 4.1-1, Location of Rocky Flats Environmental Technology Site. The developed area of the plant occupies approximately 400 acres in the middle of the Site. The remaining 6,150 acres is a buffer zone around the active part of the Site. The Site's buffer zone provides a distance of more than 1 mile between the developed portion of the plant and any public road or private property.

Approximately 291,000 people live within 10 miles of the Site, over 1.1 million within 20 miles, while the entire metropolitan Denver area, with a population of over 2.1 million, is within 50 miles of the Site (EG&G, 1992). Population centers are generally to the east and southeast of the Site with the Boulder metropolitan area within 10 miles to the North of the Site.

Land uses adjacent to the Site are agricultural to the west, agricultural with some industrial to the south, agricultural and very low-density residential to the east, and agricultural/open space to the north.

The climate at the Site is characterized by dry, cool winters with some snow cover and warm summers. The average annual precipitation for the area is 15 inches. Winds are predominantly out of the west and northwest. The average wind velocity is 8 to 9 miles per hour. Wind gusts exceeding 60 miles per hour occur frequently throughout the year and gusts exceeding 100 miles per hour occur occasionally. Peak gusts are usually associated with the winter months.

Figure 4:1-1 Location of Rocky Flats Environmental Technology Site

The greater Denver area, including the Site, has been designated a nonattainment area for three (carbon monoxide, ozone, and particulate) of the six criteria air pollutants covered by the National Ambient Air Quality Standards. The Site air emissions are within permitted limits for all nonradiological pollutants for which there are standards. Radionuclide emissions from the Site are limited by Clean Air Act regulations to the amounts that would result in the public receiving a dose of not more than 10 millirem (mrem) per year (40 CFR 61 Subpart H). The dose of radionuclide emission to the public from the Site in 1993 was 1.6×10^{-3} (0.0016) mrem from point, diffuse, and fugitive sources (EG&G, 1994d).

Surface drainage from the Site is to the east. The developed area of the Site is drained by Woman and Walnut Creeks, while three other streams drain portions of the buffer zone. Ponds on Woman and Walnut Creeks store stormwater runoff from the Site and from the Site sewage treatment plant. The contents of the ponds are analyzed to ensure that they meet the standards of the Colorado Water Quality Control Commission prior to release downstream. Scattered wetlands exist throughout the Site including three small wetlands in the drainage between Buildings 371 and 777 (ASI, 1990).

The Site buffer zone provides habitat potentially suitable for the Ute Ladies'-Tresses, an orchid listed as threatened by the U. S. Fish and Wildlife Service. However, no individuals of the species were found on the Site in the first or second of three consecutive annual sitewide surveys (ESCO, 1993). The buffer zone harbors several animal species of State concern, including the Preble's Meadow Jumping Mouse, which is also a Federal Category Two candidate species. However, there is no habitat for wildlife species currently listed as threatened or endangered by the U. S. Fish and Wildlife Service (USFWS, 1991).

4.2 Site Environment

The buildings at the Site are grouped in the center of the 6,550-acre site and are located as shown in Figure 4.2-1, Location of Buildings at the Site. The draining of actinide solutions from tanks, bottles, and piping, as well as processing of these solutions to recover the actinides, would be performed in Buildings 771 and 371. Buildings 559, 777, and 779 also currently store some actinide solutions for processing. After actinide removal from these buildings, the liquids would be treated in Building 374 or 774.

Figure 4.2-1 Location of Buildings at the Site

4.2.1 Building 371

Building 371 is a four-level facility with approximately 186,000 square feet of floor space. The sub-basement contains a large plutonium storage vault and the Caustic Waste Treatment System (CWTS). The vault has an inert atmosphere, and storage bins are mounted against the walls on either side of the vault. The vault is serviced by a computer-operated shuttle called the stacker/retriever.

4.2.2 Building 374

Building 374 is an aqueous waste treatment facility located on the east side of Building 371. Liquid wastes that meet waste transfer shipping limits are received from Buildings 371, 559, 707, 774, 776/777, and 779. A network of underground piping, which has secondary containment, connects on-site buildings with Building 374. The waste treatment process includes carrier precipitation, evaporation of liquids, and sludge solidification. Solid wastes generated are packaged and stored in an approved on-site storage location.

4.2.3 Building 559

Building 559 houses the Organic and Inorganic Analytical Laboratories. The building consists of approximately 32,000 square feet of floor space, with the laboratories comprising about half of that amount. The laboratories are equipped with various analytical instruments and safety systems appropriate for handling plutonium. Actinide solution, consisting of laboratory waste contained in bottles, is generated and stored for a short time in this building.

4.2.4 Building 771

Building 771 is a two-level facility with approximately 151,000 square feet of floor space, and was previously used for plutonium processing operations. Building 771 is currently used to store plutonium in various metallic and nonmetallic forms and plutonium residues in hardened vaults. The first (main) floor contains equipment for process and research operations. The second floor contains the mechanical equipment for the heating, ventilation and air-conditioning (HVAC) and other utility systems vital to the operations. In addition, a chemical preparation room is located on the second floor, allowing prepared chemicals to be transferred by gravity to the first floor process areas.

Building 771 is connected by a tunnel to Building 777. The tunnel between Buildings 771 and 777 is constructed of concrete and is connected to a four-stage high efficiency particulate air (HEPA) filtration ventilation system. Building 771 contains both the hydroxide and oxalate processing equipment, including gloveboxes.

4.2.5 Building 774

Building 774 is a four-story liquid waste treatment facility with approximately 25,000 square feet of floor space, and is located directly east of Building 771. A network of process waste pipelines connects Building 774 to many other on-site buildings, including Buildings 374, 707, 771, 777, and 779. In Building 774, liquid process wastes are chemically treated (acid neutralization and precipitation). Liquid wastes <0.001 g/l actinides are pumped to Building 374 for evaporation to brine, and the brine is cemented (saltcrete). The sludge from Building 774 carrier precipitation is being stored in a holding tank in Building 774 for future waste treatment.

4.2.6 Building 777

Buildings 776 and 777 adjoin one another by means of a common wall, but contain separate activities. The buildings have two stories and a total of 156,000 square feet. Building 777 contains bottles of actinide solutions requiring draining and stabilizing in Building 771. Building 777 is connected to Building 779 by an enclosed hallway, to Building 771 by a tunnel, and to Building 707 via Building 778.

4.2.7 Building 779

Building 779 houses research and development equipment. The building consists of approximately 68,000 square feet of floor space on two floors and a small basement. A relatively small number of bottles containing actinide solutions to be stabilized are currently stored in Building 779. The building is connected by tunnels, either directly or through other buildings, to Buildings 777, 707, and 771.

4.3 Safety Systems

Throughout the solution removal and treatment process, existing safety systems would be in place to protect the Site workers, the public, and the environment. These safety systems include vital safety systems, as well as design features on gloveboxes. Worker safety is further enhanced by personal protective equipment and other requirements in accordance with the Occupational Safety and Health Act (OSHA) and other applicable regulations. Administrative safety procedures also enhance the safe conduct of operations.

Early spill control and response are achieved by spill containment measures such as secondary containment, employee ability to recognize spill events and follow procedures that initiate response, a structured emergency response plan, and a highly trained and fully equipped Hazardous Material (Haz-Mat) Team. In the unlikely event that a spill goes undetected or is of too great of a volume to be handled by standard Haz-Mat Team methods, spill control will be handled by the engineered surface water control system that includes ditches, from which flow can be diverted, and spill control ponds that are managed for contingent spill control. Appropriate use of the ditches and ponds can prevent the off-site release of spills and can also allow the Site to take appropriate remedial actions for the treatment or mitigation of the spill.

Vital safety systems are designed to detect and/or mitigate potential accidents. The vital safety systems have surveillance testing requirements and limits for operations that are documented in the Operational Safety Requirements specified in the Building 771 Final Safety Analysis Reports (FSAR) (EG&G, 1994i), the Building 371 FSAR (EG&G, 1990a), the Building 774 FSAR (EG&G, 1994h), and the Building 374 FSAR (EG&G, 1994g).

Table 4.3-1, Vital Safety Systems in Buildings 371, 374, 771, and 774, lists the vital safety systems in Buildings 371, 374, 771, and 774 that are designed to help ensure safe operation of the solution removal and treatment process. Brief descriptions of these systems are provided below. More detailed descriptions of vital safety systems can be found in the referenced Building 371, 374, 771, and 774 FSARs.

In addition to vital safety systems, there are a number of features utilized to enhance the safety of glovebox operations. Gloveboxes are totally enclosed structures that are made of steel and leaded glass and that are accessed by gloveports. Working through the gloveports ensures that the Site workers do not have direct physical contact with plutonium. Gloveboxes used for actinide processing are equipped with an exhaust high efficiency particulate air (HEPA) filter that prevents accumulation of plutonium in exhaust ductwork.

Table 4.3-1 Vital Safety Systems in Buildings 371, 374, 771, and 774

Vital Safety System	Description
Ventilation Systems	<p>Maintain negative pressure in gloveboxes</p> <p>Filter all exhaust through HEPA filters</p> <p>Provide some gloveboxes with inert atmospheres</p>
Selective Alpha Air Monitors	Monitor room and emission exhaust for airborne contamination
Fire Protection Systems	<p>Provide detection and suppression capabilities for fires in gloveboxes, plenums, and rooms</p> <p>Fire mitigation design features are designed into Buildings 371 and 771</p>
Life Safety/Disaster Warning Systems	Provide transmission of audio alarms and safety announcements through numerous speakers
Criticality Alarm Systems	Detect and provide alarms of any criticality
Emergency Power Systems	<p>Provide emergency diesel generators to back up normal and alternate utility electrical power</p> <p>Provide uninterruptible power for sensitive electrical loads upon loss of normal and alternate power</p>

The Site workers are also provided with personal protective equipment to enhance personal safety. Throughout actinide processing activities, operators are equipped with appropriate protective clothing, as determined by job reviews, and documented on a radiation work permit. Each operator is trained on the safety equipment required for each activity of the job. Each person involved in an activity is required to read and follow the requirements of the radiation work permit. The normal equipment required for plutonium operations includes coveralls, external radiation dosimeters, safety glasses, and safety shoes. Many of the operations also require using two pairs of surgical gloves. Workers use alpha detectors to check for plutonium contamination each time they exit a gloveport. If contamination is found, work stops until the cause is identified and corrected.

4.3.1 Ventilation Vital Safety Systems

Many of the processing activities described in Section 3.0, Description of the Proposed Action and Alternatives, would be conducted within the confines of gloveboxes. Ventilation systems maintain the gloveboxes at a negative pressure. If any breach were to develop (for example, a glove develops a hole), the flow of air would be from the room to the gloveboxes, thus preventing the spread of significant contamination.

Exhaust from gloveboxes must pass through at least four stages of HEPA filters prior to being exhausted to the atmosphere. Each filter stage provides a particulate removal efficiency of at least 99.8 percent. Multiple stages of HEPA filtration multiplies the efficiency to 99.97 percent. The use of HEPA filters prevents airborne radioactivity from reaching the atmosphere.

4.3.2 Selective Alpha Air Monitors Vital Safety Systems

Selective Alpha Air Monitors (SAAMs) monitor and detect the presence of airborne contamination in rooms and plenums. The detectors are subjected to daily operational checks, monthly performance testing and calibration for airflow, and an annual radioactive source calibration to maintain sensitivity and reliability. Monitors alarm automatically if any out-of-tolerance conditions are detected. The system provides audio alarms and visual beacon alarms.

4.3.3 Fire Protection Vital Safety Systems

Fire protection vital safety systems provide fire detection and suppression capabilities in all buildings containing radioactive material. Gloveboxes and exhaust plenums are equipped with glovebox overheat detectors, which sound an alarm should ambient temperature in the system rise. Alarm indication is provided locally and to the Site fire department. Fire detection systems are provided with circuitry that sounds an alarm should a short occur within the system.

Exhaust plenums are protected by a deluge suppression system, which sprays water prior to the first stage of HEPA filters should a plenum overheat alarm be detected, thus protecting the integrity of the HEPA filters. Additional fire suppression capability is available through the use of fire hoses and fire extinguishers.

4.3.4 Life Safety/Disaster Warning Vital Safety System

The Life Safety/Disaster Warning (LS/DW) vital safety system is a public address system that provides a means for audio transmission of alarms and safety announcements over numerous speakers located in all buildings. Site workers can take appropriate responses to alarms and announcements.

4.3.5 Criticality Alarm Vital Safety System

The criticality alarm vital safety system detects any criticality accident through the use of numerous detectors. The system provides audio alarms and visual beacon alarms.

4.3.6 Emergency Power Vital Safety Systems

Vital safety systems are powered by a normal and alternate power supply from the Public Service Company of Colorado. Emergency diesel generators provide backup power capabilities should both normal and alternate power be lost. An uninterruptible power supply (UPS) system provides continuous power for more sensitive vital safety system electrical loads upon the loss of power. The fire detection panels, the LS/DW system, and the criticality alarm system each have a dedicated backup battery or UPS system.

5.0 ENVIRONMENTAL EFFECTS

The analysis below evaluates the environmental impacts associated with the proposed actinide solution removal and processing in comparison with the no action alternative. The specific tasks or activities for each of these alternatives have been described in Section 3.0, Description of the Proposed Action and Alternatives. The analysis initially presents environmental impact conclusions, which are then supported by the subsequent assessment. This comparative approach uses the impacts associated with the no action alternative as a baseline for measurement of environmental impacts of the proposed action.

Potential effects to human health are considered to be of primary importance, because of the toxicity and radioactivity of the actinide solutions. The activities in the proposed action and the no action alternative are not expected to adversely affect the health of the Site workers or the public. However, since the activities involve actinide solutions, some health risk does exist. In recognition of this, the discussion of environmental effects is an assessment of health risk. The probability of adverse health effects in combination with their severity constitutes risk. These elements are probability and consequence, respectively. In this evaluation, the consequence is the probability of a latent cancer fatality (LCF). In the assessment of risks to workers and the public, anyone located on the Site property is considered a worker, while anyone located beyond the Rocky Flats property boundary is considered a member of the public.

5.1 Assessment of Radiological and Chemical Effects

This assessment compares the health risks of the proposed action to the health risks of the no action alternative, and is organized according to the risk to the Site workers and the public. For each population, there is an assessment of the difference between risks arising from normal operations and risks arising from accidents.

5.1.1 Comparison of Radiological and Toxicological Health Risks to the Site Workers

Health concerns include both risk to workers who would be involved in processing activities, and risk to other workers on the Site. Worker risk is derived from exposure to ionizing radiation and hazardous materials during normal activities. As in any industrial setting, there is also a potential for accidents. This assessment compares the risk of all these possibilities. Figure 5.1.1-1, Risk to the Site Workers for Proposed Action and No Action Alternatives, shows the changes in risk to workers associated with the proposed action and the no action alternatives over time. The time dimension in Figure 5.1.1-1 extends from the start of the proposed action to well beyond its completion (that is, the treatment of waste and/or storage of solid radioactive material). Risk of the proposed action is greater than the no action risk during implementation of the proposed action; and then decreases below the no action risk for the remainder of time to a very low, relatively constant level. The overall risk for the proposed action is substantially less than that of the no action alternative.

5.1.1.1 Worker Exposure to Radiation from Normal and Maintenance Operations

During normal operations, workers at the Site are routinely exposed to ionizing radiations at levels that are maintained As Low As Reasonably Achievable (ALARA). ALARA is the approach to radiation protection to manage and control exposures to the work force and to the general public to as low as is reasonable taking into account social, technical, economic, practical, and public policy considerations. Worker doses at the Site are maintained below regulatory and contractual limits. The Occupational Radiation Protection regulatory limits are risk-based and apply to individual workers (The Code of Federal Regulations [CFR], Title 10, Part 835). The contractual limits with the Department of Energy (DOE) for individual workers are limits described in the Radiological Control Manual and are set significantly lower than the regulatory limits (DOE, 1994).

Current regulatory limits are consistent with the 1987 National Council on Radiation Protection (NCRP) recommendations. These recommendations for occupational exposure limits were based on comparable risks with the intent of limiting radiation worker risk to a level that is reasonable and acceptable with respect to the value of the work being performed. The current regulatory limit (10 CFR Part 835) for effective dose equivalent is 5.0 rem annually. The current contractual limit with DOE is 2.0 rem annually. The Site currently has an Administrative Control Level (ACL) of 0.75 rem annually. The ACL is a tool that helps ensure that ALARA exposures are maintained for workers. Individual worker doses are maintained below this ACL. Based on the radiogenic cancer assumptions behind the 1987 NCRP recommendations, workers receiving the ACL dose of 0.75 rem, in combination with the annual nonradiation fatal accident rate, have a total fatality risk of approximately 1 in 10,000, which is the industry average.

Risk to the Site Workers for Proposed Action and No Action Alternatives

NOTE: These curves qualitatively represent the relative risk of exposure to the site workers from the proposed action compared to the no action alternative.

Figure 5.1.1-1 Risk to the Site Workers for Proposed Action and No Action Alternatives

Proposed Action

During the performance of the proposed actinide solution stabilization activities, individual worker doses would not exceed the applicable limits. An increased work activity level in the presence of radioactive materials would cause the total dose received by the involved workers, and the associated risk, to be temporarily elevated during the performance of the proposed action.

Normal operations during the performance of the proposed action would include both the proposed activities and the baseline activities required to support them. Direct support activities include radiation monitoring of the involved process systems and safety surveillance and maintenance. These support activities would need to be performed with greater than the current frequency in order to support the performance of the proposed action. The proposed Building 771 activities include activities analyzed in the Building 771 Integrated Safety Assessment (ISA). The proposed Building 371 activity is the operation of the Caustic Waste Treatment System (CWTS), which was analyzed in the Building 371 ISA. The analyses contained in the ISAs resulted in the prescription of engineering and administrative radiological controls necessary to maintain routine ALARA radiation exposures for involved workers.

Routine exposures would be received primarily from external sources by the occupational radiation workers performing and directly supporting the proposed actinide solution stabilization activities. The external exposures received by this immediate worker population would dominate the total worker population risk. In addition, very small routine internal exposures would potentially be received by all workers. Since the efficiency of respiratory protection equipment is not 100 percent, unmeasurable intakes by occupational radiation workers would occur when the equipment is required during normal operations. In addition, the efficiency of high efficiency particulate air (HEPA) filters in the building exhaust paths is 99.97 percent, resulting in unmeasurable routine releases to the atmosphere. The doses from these potential routine internal exposures are negligible with respect to the doses from routine external exposures received by the immediate worker population. Therefore, the contribution from routine internal exposures to the total worker population risk is negligible. ALARA radiation exposures would be maintained during the performance of the proposed action.

Based on the conservative worker dose estimates documented in the ISAs, the total dose received by all workers performing the proposed action is expected to be less than 7.0 rem. Because the workers in Building 771 would be most affected by the proposed action, dosimetry data was collected and analyzed for workers in Building 771. The data indicated an annual total dose of approximately 32 rem over an average of 235 workers for 1994. This annual exposure results in a total fatality risk, combined with the annual nonradiation fatal accident rate, of 40 in 1 million. The addition of 7.0 rem to the dose received by this worker population would increase their total fatality risk to 43 in 1 million, which is still within the safe range for industries (less than 100 in 1 million). The increased risk would be associated with an increase of 7.5 percent in the probability of work-related fatalities per year during the proposed action.

Individual worker risk from normal operations is not expected to increase appreciably because the ACL and current work practices, according to procedures, would continue to be enforced. The increase in the worker population total risk from normal operations would be temporary and minimal and would not remove the population from the safe-industry range. In addition, following the performance of the proposed action, the radioactive material would be in an oxide form that would be contained and stored in vaults. This configuration requires less surveillance and maintenance than storage of the actinides in a solution form. This reduces risk and the number of workers and worker dose, which, in turn, reduces the probability of work-related fatalities with respect to current expectations as illustrated in Figure 5.1.1-1, Risk to the Site Workers for Proposed Action and No Action Alternatives.

No Action

Individual worker doses would not exceed the applicable dose limits during the maintenance and surveillance activities for the no action alternative. Due to ongoing degradation of the solution storage systems, an increasing number of workers and an increasing work activity level in the presence of radioactive materials would occur over time. This would cause an increase in the total dose received by the involved workers over time with respect to the doses currently being received.

Normal operations under the no action alternative would be similar to the activities currently being performed. These activities primarily include surveillance and maintenance activities related to solution storage. These activities are required to safely store the actinide solutions. Direct support activities, including radiation monitoring and surveillance, and maintenance of safety systems, are also required. As the solution storage mechanisms degrade, both the no action alternative activities and the support activities would need to be performed with greater frequency in order to maintain safe-storage configurations. In addition, leaks and/or spills would cause more exposure due to required clean-up activities.

Routine exposures would be received primarily from external sources by the occupational radiation workers performing and directly supporting the no action alternative activities. The external exposures received by this immediate worker population would dominate the total worker population risk. In addition, small, routine internal exposures would be potentially received by all workers. Since the efficiency of respiratory protection equipment is not 100 percent, unmeasurable intakes by occupational radiation workers would occur when the equipment is required during normal operations. In addition, the efficiency of HEPA filters in the building exhaust paths is 99.97 percent, which results in unmeasurable routine releases to the atmosphere. The doses from these potential routine internal exposures are expected to be small in comparison with the doses from routine external exposures received by the immediate worker population. The contribution from routine internal exposures to the total worker population risk is expected to be negligible. ALARA radiation exposures would be maintained during the performance of the no action alternative activities. However, due to the expected degradation of the storage systems, the dose from these small internal exposures would be expected to increase as indicated in Figure 5.1.1-1.

The group of workers in Building 771 would be greatly affected by the no action alternative. Dosimetry data for workers in Building 771 indicates that over the past 10 quarters, the collective dose has increased by approximately 0.3 rem per quarter, or 1.2 rem annually. This data also indicates an increase in the number of workers assigned to the Building 771 worker population of approximately 5 persons per quarter, or 20 per year. These increases result from the degradation of the storage systems associated with the no action alternative. The dose for 1994 is approximately 32 rem over an average of 235 workers. This annual exposure is consistent with a total fatality risk, combined with the annual nonradiation fatal accident rate, of 40 in 1 million. Due to the much larger worker population, the probability of work-related fatalities for the year 2004 would be 67 percent higher than the probability for 1994.

Over time, for the no action alternative, individual worker risk from normal operations would not be expected to increase because the ACL and current work practices would continue to be enforced. No increase in total risk from normal operations would be expected and the population risk would remain in the safe-industry range. However, worker exposure would increase due to the degradation of the storage systems, resulting in a larger total dose. Also over time, as illustrated in Figure 5.1.1-1, the larger worker population would experience a larger risk than is currently expected due to normal operations.

5.1.1.2 Worker Exposure to Radiation from Accidents

Radiation exposure from accidents is possible for workers at the Site. Radiological controls minimize the frequency of such events while mitigation and detection systems are provided to minimize the consequences. The mitigation and detection systems in conjunction with the radiological controls reduce exposures from potential accidents to ALARA levels. The Site ACL of 0.75 rem sets a standard for maintaining individual doses below the regulatory and contractual limits in the event of radiation exposure from accidents.

Accident Types

Seven limiting accidents were identified and are discussed in more detail in the following sections. Risk determinations for the proposed action and the no action alternative for each of the seven limiting accidents are shown in Table 5.1.1.2-1, Alternative Risk Determinations. Limiting accidents are those accidents in each category which represent the greatest risk to the public. These accidents and their associated risks are evaluated in detail in the Solution Stabilization Risk Analysis Technical Support Documents for Buildings 371 and 771 (EG&G, 1994a and EG&G, 1994b).

Fire: Two limiting fire possibilities were identified. The first is ignition of combustible material inside a glovebox caused by removing a hot object from a furnace. Sufficient combustible material may exist inside the glovebox to result in sufficient fire propagation to compromise containment ability of the glovebox and release a significant amount of radioactive material to the room. The second possibility is the potential spontaneous combustion of plutonium oxide in storage containers. Exposure of workers and the public from either possibility would be minimized by the HEPA filters in the building exhaust.

Explosion: The limiting explosions are auto-ignition of contaminated ion-exchange resin and a potential oxygen-acetylene explosion. An ion-exchange resin explosion would require failure of administrative controls to maintain the resin in a safe, wetted condition, or initiation by chemical or mechanical shock. An oxygen-acetylene explosion could result only by failure of safety feature(s) and administrative controls. The frequency for the combination of these occurrences is low. An explosion from either source would presumably create a significant plutonium aerosol in the room containing the material, thus requiring the HEPA filtration system to remove the plutonium particles before they could be released.

Spills: The highest-consequence accident is a potential spill on the loading dock, resulting from a handling accident. The contents of an individual drum, if spilled, could release a fraction of the contained plutonium to the atmosphere. If the spill occurred on the loading dock, only minimal filtration of the plutonium aerosols would take place. Despite the minimal fraction of material dispersed from the loading dock, consequences are above the minimal threshold.

Table 5.1.1.2-1 Alternative Risk Determinations

Scenario Type	Scenario	Frequency/Consequences		Qualitative Risk	
		Proposed Action	No Action Alternative	Proposed Action	No Action Alternative
Fire	Fire in noninerted gloveboxes	M/VL	VL/H	L	L
	Room fires involving gloveboxes	L/L	L/VL	L	L
	Fire in drum storage area or on docks	VL/VL	VL/L	L	L
	Spontaneous combustion in storage containers	H/VL	H/VL	L	L
Explosion	Ion-exchange resin explosion	M/VL	M/VL	L	L
	Glovebox explosion	M/L	M/L	L	L
	Acetylene explosion	H/VL	M/VL	L	L
Spills	Spill on loading dock	VL/L	VL/L	L	L
	Spill in glovebox	H/VL	H/VL	L	L
	Room solution spill	H/VL	H/VL	L	L
	Powder spill in glovebox	H/VL	NA	L	L
	Powder spill in room	M/VL	NA	L	L
Criticality Event	Solution criticality	M/L	M/L	L	L
	Metal criticality	L/L	L/L	L	L
Transportation Accident	Truck collision	VL/L	VL/L	L	L
	Truck fire	VL/M	VL/M	L	L
	Criticality	VL/L	VL/L	L	L
	Drum failure	VL/VL	VL/VL	L	L
	Drum breach	VL/VL	VL/VL	L	L
Aircraft Crash	Aircraft crash into Building 771/371	L/M	L/M	L	L
Natural Phenomena	0.14 g earthquake	H/L	H/L	L	M
	0.18 g earthquake	M/M	M/L	M	L
	High wind/tornado	NA/VL	NA/NN	L	L
	Tornado generated missiles and snow loading	M/L	L/VL	L	L

H = High M = Medium NA = Not Applicable
L = Low NN = Negligible g = acceleration of gravity
V = Very

Criticality Event: A criticality event involving the assemblage of a critical mass of plutonium from solution transfer or movement resulting in a fission event producing up to 1×10^{19} fissions can be postulated. The frequency of occurrence of such an event is low.

Transportation Accident: A limiting transportation possibility involves a truck collision on the Site with resultant loss of containment of one or more drums loaded on the truck. Despite the potential for release of plutonium from a transportation accident, the low frequency of occurrence assures that the risk from this source would be low.

Aircraft Crash: An aircraft crash affecting Room 114 of Building 771 or the processing areas of Building 371 causing catastrophic fire and penetrating the building structure, and releasing radioactive material, can be postulated.

Natural Phenomena: The limiting natural event is postulated to be an earthquake with a bedrock acceleration of 0.18 g.

Proposed Action

During the performance of the proposed action alternative, the greatest risk of radiation exposure from accidents would be to the immediate workers. Other workers at the Site, not located in the processing buildings, would experience risk similar to that for the general public. As a result, the risk to the total worker population from accidents is negligible. An increased work activity level in the presence of the actinide solutions and an increased solution inventory in some areas during the proposed action alternative would temporarily increase the anticipated accident frequency and the consequences.

The accident events with the highest anticipated frequency would release inhalable radioactive aerosol directly into the workers' immediate environment. These events include solution spills, which present the greatest risk for the worker population. Radiological controls, including gloveboxes and other secondary containments, are required for activities where these events are anticipated, thus minimizing the frequency of releases to the workers' immediate environment.

The radiological controls and detection and mitigation systems required for the actinide solution stabilization activities were prescribed through the Integrated Safety Assessment (ISA) process. Detection and monitoring systems include Selective Alpha Air Monitors (SAAMs) and room air ventilation. SAAMs notify workers when airborne radioactive material is present and process areas are ventilated so that air is continuously filtered. The ISAs demonstrated that, even for the required detection and mitigation systems, the maximum anticipated spill would not result in an individual dose exceeding the regulatory limits. In the event of an accident that is not immediately observed, these systems maintain accidental ALARA exposures.

Provided the prescribed radiological controls and required detection and mitigation systems are in place, a worker dose would be maintained below the Site ACL. The worker would not be expected to receive an intake from an anticipated accident that would cause the workers' annual dose to exceed the applicable regulatory limits associated with acceptable risk. Since these radiation exposure events are accidents with anticipated frequencies expressed in terms of one event per 100 years of building operation, the expected contribution to the worker population total dose, including routine exposures from normal actinide solution stabilization operations, is minimal, and would have a negligible effect on the number of work-related fatalities expected for this population. Following actinide solution stabilization, the frequency and consequence of accidents in the involved areas would decrease with respect to current levels.

No Action

During the performance of the no action alternative, the greatest risk of radiation exposure from accidents would be to the immediate workers performing the activities associated with maintaining a safe actinide solution storage configuration. Other workers on the Site, not located in the processing buildings, would experience risk similar to that for the general public. The contribution of these accidents to the total worker population risk is negligible. Over time, the degradation of the solution storage systems would lead to an increased accident frequency and their resulting consequences.

The accident events with the highest anticipated frequency would release radioactive material directly into the workers' immediate environment. The events presenting the greatest risk for the worker population primarily include solution leaks caused by storage system failures and solution spills during maintenance. Additional radiological controls would be required over time for specific anticipated maintenance activities where these events are anticipated to minimize the frequency of releases. Selective Alpha Air Monitors (SAAMs) and room air ventilation would continue to be required detection and mitigation systems. Additional safety assessments would be required to maintain adequate radiological controls and detection and mitigation systems for the safe storage of actinide solutions supporting the no action alternative.

The safety of the workers' environment would be maintained at great cost for the no action alternative so that anticipated accidents would not result in an individual dose that, when added to the Site ACL, would produce a result that exceeds the regulatory limits. The process areas would still need to be ventilated with eight room air volumes exchanged per hour. SAAMs would still be required to notify workers when airborne radioactive material is present. In the event of an accident not immediately observed, these systems would serve to maintain accidental ALARA exposures.

Provided the necessary radiological controls are added and the maintenance of the detection and mitigation systems are maintained, a worker dose above the Site ACL would not be expected. This intake from an anticipated no action alternative accident would not cause the workers annual dose to exceed the applicable regulatory limits. Since these radiation exposure events would be accidents with anticipated frequencies expressed in terms of one event in as many as 100 building years of operation, the expected contribution to the worker population total dose, including routine exposures from normal operations, is minimal, and would have a negligible effect on the number of worker-related fatalities expected for this population.

5.1.1.3 Worker Exposure to Chemicals from Normal Operations and Accidents

The qualitative assessment of relative industrial safety and occupational health risk relies exclusively on existing process hazards and area safety assessments for transition activities in Buildings 371 and 771. The Building 771 ISA, Building 371 CWTS ISA, Operational Safety Analyses, and industrial hygiene and safety process hazard assessments provide baseline data regarding employee exposure potential and identify known occupational safety and health hazards associated with each process. The hazard assessment documentation also contains mandatory requirements for implementation of control strategies to minimize or reduce occupational exposures to hazardous substances and prevent industrial accidents.

The industrial hygiene and safety process hazard assessments within the ISAs indicate that the overall risk of chemical and physical hazards to the worker is extremely small. This is true for both the proposed action and the no action alternative. Under the proposed action, occupational exposure risk is expected to increase slightly, in the short term, and then diminish as planned activities are completed. Under the no action alternative, short-term exposure consequences would decrease while the long-term exposure risks and the frequency of anticipated accidents would increase.

Overall risk of immediate worker injury or illness resulting from an exposure or interaction with a chemical or industrial safety hazard, both under the proposed action and the no action alternative, is extremely small. Potential short-term risks to workers' industrial hygiene and safety would be slightly higher for the proposed action than for the no action alternative. However, long-term exposure risks and the frequency of anticipated accidents would increase if the no action alternative is selected and the actinide solutions remain in the buildings in their current configuration as illustrated in Figure 5.1.1-1, Risk to the Site Workers for Proposed Action and No Action Alternatives.

Proposed Action

Health and safety standards are typically grouped into hazard categories (for example, contact with nitric acid). Hazards identified for a particular activity, such as glovebox operations, were considered to be identical for all similar glovebox operations. For example, exposure to nitric acid resulting from a spill during the removal of material from a glovebox is similar to a hazard for operations involving the removal of nitric acid, regardless of the nature of the activity or the location. This is especially applicable to this analysis because almost all of the processes and activities for the proposed action have similar hazard category designations as those for the no action alternative.

This analysis separates actinide solutions, such as plutonium nitrate, uranium nitrate, plutonium chloride, etc., into their individual chemical components. Hazards associated with exposure to the radioactive component(s) of these mixtures are described and evaluated in separate sections of this Environmental Assessment, as are the chemical component(s). Table 5.1.1.3-1, Occupational Exposure Limits, identifies the chemicals of concern and associated occupational exposure limits for chemical substances involved within processing of actinide solutions. The occupational exposure limits are the Occupational Safety and Health Act (OSHA) Permissible Exposure Limits (PELs) and the American Conference of Governmental Industrial Hygienists Threshold Limit Values (TLVs) for these substances. The quantities of chemicals used in the proposed action are not expected to exceed the PELs and TLVs. Specific information regarding chemical quantities and their expected exposures is in the Building 371 and 771 ISAs (EG&G, 1994e and EG&G, 1994f).

Numerous safety systems and redundant containment structures are in place to prevent occupational exposure (for example, inhalation, dermal contact, ingestion, injection) to both airborne radioactivity and chemical hazards. The use of isolated systems (storage tanks, piping, and rigid plastic containers), administrative controls (limiting hazardous chemical inventories), and engineering controls (gloveboxes, downdraft tables, and multi-tiered local exhaust ventilation systems) would provide control of these substances. The release of hazardous chemical vapor, mist, or aerosols into the work environment would be prevented and unavailable for interaction with the immediate worker. Therefore, under the proposed action, expected exposure to the immediate worker resulting from chemicals of concern would be maintained below the occupational exposure limits. Only as a result of an upset condition (for example, an accident), failure, or operator error does the potential for exposure or contact with chemical hazards exist.

Table 5.1.1.3-1 Occupational Exposure Limits

Chemical Name	Occupational Exposure Limits(a)	
	PEL-TWA(d) (mg/m ³)	TLV-TWA(e) (mg/m ³)
Nitric Acid	5	5.2
Hydrochloric Acid	C7 (b)	C7.5(b)
Potassium Hydroxide	NA	C2 (b)
Sodium Hydroxide	2	C2 (b)
Oxalic Acid	1	1
Chromium (c)	0.5	0.5
Lead (c)	0.05	0.15
Cadmium (c)	0.01	0.01 Total Dust 0.02 Respirable Dust
Sulfuric Acid	1	1

(a) OSHA 29 CFR 1910.1000 - Subpart Z

(b) C = Ceiling Limit

(c) Trace amounts of lead, chromium, and cadmium may be present in Tanks (T-83, -84, -85) as a result of ash dissolution. However, the concentration of these contaminants is extremely low and does not represent a health risk to the immediate worker.

(d) PEL-TWA is a time-weighted average of airborne concentration of substances which shall not be exceeded in any 8-hour work shift of a 40-hour week as specified by 29 CFR 1910.1000.

(e) TLV-TWA is the time-weighted average airborne concentration of substances for a normal 8-hour day and a 40-hour week, to which nearly every worker may be repeatedly exposed, day after day, without adverse effect.

Handling, processing, and transporting actinide solutions under the proposed action would slightly increase the overall exposure risk to the immediate worker. Actinide solutions, corrosive chemicals, and filter precipitate (for example, plutonium hydroxide) would be handled on a daily basis, and would increase the likelihood that personnel may come into contact with these corrosive substances. Human error is expected to be the principal cause of chemical interaction with personnel. These exposure events, should they occur, would be limited to dermal contact only. Exposure to personnel by inhalation is not likely to occur. Safety showers and eye wash stations are within a minimum of 100 feet from the handling or transportation of corrosive chemicals, and personal protective equipment would reduce the potential risk of personnel injuries.

Implementation of the proposed action would reduce the overall exposure risk to workers as a result of the reduction in inventory of stored toxic and hazardous chemicals within each facility. Inventories of potentially hazardous chemicals would be eliminated upon completion of the proposed action.

No Action

Human error or mechanical system failure does not necessarily equate to an exposure exceeding the Department of Energy (DOE) exposure limit. In fact, personnel exposures are not expected to exceed specified safe exposure limits even in the event of a chemical spill. According to occupational exposure projections, only small quantities of hazardous material are handled by employees at any one time (at the most would be 4 l [approximately 1 gallon]), and the primary hazardous characteristic associated with these solutions involves dermal contact and not inhalation. However, the ISAs predict that the risk of mechanical failure and the failure of containment structures would accelerate with the passage of time. Therefore, if no action is taken to process existing inventories of actinide solution, the risk of occupational exposures to chemical hazards would increase.

5.1.2 Comparison of Radiological and Toxicological Health Risks to the Public

Risk to the public results from exposure to ionizing radiation and hazardous chemicals escaping from the Site. Extremely small emissions of radioactive and hazardous materials occur routinely during normal operations. There is also a potential for accidents. Both routine and accidental emissions may affect public health. This section compares the magnitudes of such emissions. Figure 5.1.2-1, Risk to the Public for Proposed Action and No Action Alternatives, represents the level of risk to the public associated with the proposed action and no action alternatives.

5.1.2.1 Public Exposure to Radiation from Normal and Maintenance Operations

Public health risks for the population outside of the Site include the risk of radiological exposure from normal operations. Radiological risk to the public from the proposed action and the no action alternative is directly related to the potential for public exposure to plutonium aerosols. The aerosols can be generated as a result of normal operations (or from accidental release events) within Buildings 771 and 371, or in the transport of material between buildings for processing. Public radiological exposure from normal operations has been evaluated, according to the maximum quantity of material to be processed and the 40 CFR 61, Appendix D.

Risk to the Public for Proposed Action and No Action Alternatives

NOTE: These curves qualitatively represent the relative risk of exposure to the public from the proposed action compared to the no action alternative.

Figure 5.1.2-1 Risk to the Public for Proposed Action and No Action Alternatives

Proposed Action

Public radiological exposure from the proposed action directly relates to the increase in radioactive material inventories in areas where solution processing would be conducted. Workers at the Site, the public, and the environment are protected from exposure to the radioactive material in the solutions by containment and air filtration systems. The air filtration system removes 99.97 percent of airborne radioactive material.

The maximum amount of material that the public would be exposed to under proposed action conditions is a combination of the increased quantities of radioactive material from the proposed action and the nominal amount released under routine releases in 1993 (Osborne, 1994). Routine public exposures from the proposed action would be less than 1 percent of the annual limit for public exposure.

No Action

An air emissions compilation from the potential release points, as discussed in the proposed action section above, was completed for 1993, using the continuous radionuclide air effluent monitoring systems (Osborne, 1994). It is assumed that yearly emissions from potential release points would continue at these levels under the no action alternative.

The annual releases equate to less than 1 percent of the releases projected for the proposed action. This difference represents the maximum difference in public radiological exposure between the two alternatives. Since releases under the proposed action are worst-case estimates, the actual difference between alternatives is likely to be significantly smaller. It should be noted that the magnitude of even the worst-case proposed action releases are very close to the limit of detectability and do not represent an exposure distinguishable from natural background levels.

5.1.2.2 Public Exposure to Radiation from Accidents

Accident probability and consequences for potential releases have been evaluated based on historical precedence. Consequences of events are based upon the amount of radioactive material released, which is determined from a description of the processes, the systems, and structures in place for mitigating a release, as well as implementation of appropriate atmospheric dispersion and dose conversion calculations. The evaluation results indicate that neither the proposed action nor the no action alternative represent a substantial risk to the public. The overall risk over a 10-year period is lower for the proposed action than for the no action alternative.

The determination of the impact of radiological accidents follows the identification. The Building 771 Final Safety Analysis Report (EG&G, 1994i), the RFP Final Environmental Impact Statement (DOE, 1980), the Long Range Rocky Flats Utilization Study (DOE, 1982), and accident analyses in support of solution stabilization activities in Buildings 771 and 371 (EG&G, 1994c) suggest various potential accidents. These documents include both risk evaluations of processes and hazards intrinsic to the operations of the facility within its natural environment, and aid the evaluation of existing routine operations in Building 771 and 371 to characterize the risks associated with both alternatives. The documents also defined the limiting set of accidents for comparing the alternatives. The limiting accident analyses for the no action alternative and the proposed action are identical. Due to the uncertainty of information associated with the limiting set of accidents, qualitative frequencies and consequences determine the relative risks of the two alternatives.

Proposed Action

The proposed action would increase activity levels, thus affecting the probability of fires, explosions, spills, transportation accidents, and criticality events. While potential for spills increases during the proposed action, long-term potential for spills in the no action alternative is greater due to deteriorating containers and containment systems. The increased levels of radioactive material at risk increases the consequences of most accident categories.

Overall risk of accidents related to the proposed action is low. This is consistent with the nature of the activities to be performed and the relatively small amount of plutonium placed at risk. The cumulative risk for the set of limiting accidents does not identifiably increase in comparison with the overall operation of the facility.

No Action

Since the no action alternative includes only the activities necessary to maintain solution and ion-exchange resin storage, the risk of accidents, particularly short-term, would be low. The risk analysis confirmed this supposition. The results above show the magnitude of the no action alternative risk in the short term to be insignificant in comparison with the proposed action risk. However, as indicated above, over the mid- and long-term, the risk of accidents from the no action alternative, especially leaks and spills, is much greater than under the proposed action.

As described in Table 5.1.1.3-1, Occupational Exposure Limits, the highest risk contributor for both alternatives is a seismic event. Since the contributions to the overall risk are equal to each other in the comparison of alternatives, the other risk contributors dominate the comparison.

The overall accident risk to the public for the proposed action is low, despite the potential increase in both frequency and consequence for the limiting accidents. Although not apparent in the categorization of risk, small changes in risk are intuitively present due to the nature and frequency of the proposed operations and the long-term changes in solution containment integrity. While not changing individual risk categories, the incremental changes are cumulative and impact the overall risk for each alternative. The relatively short duration of the proposed action activities and the small increases in radioactive material at risk are the principal reason for this result. The long-term risk (the period following completion of the proposed action) diminishes substantially due to the decrease in spill risk, the decrease in overall inventory of radioactive materials in areas other than vault storage, and the decrease in maintenance of solution containment systems. Some decrease in criticality risk is also realized due to the removal of solutions from the tanks and process areas.

Activities that would occur under both alternatives tend to involve a greater quantity of radioactive material under the proposed action than under the no action alternative. Though small in comparison with total building inventory, this fact would be significant in the processing areas, especially the processing areas that otherwise would have a small inventory of radioactive material. The larger amount of radioactive material in the process areas may be sufficient to increase risks in these locations. Thus, each accident category under the proposed action has an incrementally higher risk than under the no action alternative.

The frequency of some accident categories also increases in the proposed action. Increased activity inherently increases the potential for process-related accidents, particularly fire, transportation, and other operationally-induced events. Similarly, criticality risk is incrementally higher for the proposed action due to the increase in the probability of criticality while moving solutions with relatively high and nonrigorously characterized fissile material content. Conversely, long-term spill potential in the no action alternative, due to the failure of piping and tanks, increases with time until problems related to long-term storage of solution are resolved. Increased long-term maintenance is necessary to counteract system and component degradation by corrosive solutions.

The composite risk curve, as illustrated in Figure 5.1.2-1, Risk to the Public for Proposed Action and No Action Alternatives, compares relative risks of the proposed action and the no action alternative over a 10-year period. Both curves start at the beginning of solution processing. The risks for both alternatives are essentially equal at this point. Under the proposed action, risk begins to rise as radioactive material is brought into the process area of the building, raising the radioactive material quantities. Furnace operation and increased handling and maintenance of the solutions increase the probability of spills, fire, and to a lesser degree, criticality. The risks remain at the higher level during solution processing. The risk associated with the no action alternative remains essentially constant in this short time period.

The risk increase under the proposed activity is partially offset by the steady decrease of solutions awaiting stabilization. Following the final transfers and processes, the liquid spill risk decreases. The risks from the proposed action would decrease and fall below the no action alternative risk curve as the actinide solutions are processed. The risk would continue to decrease and remain below the no action alternative risk curve as these hazardous materials are placed in a safe-storage configuration. The decrease is due to various factors, including (1) lack of solution in tanks and piping; (2) lack of bottled solutions in drums and gloveboxes; (3) removal of oxides to vault storage; and (4) decrease in the overall activities in the building, particularly for surveillance and inspection of tanks, piping, and ion-exchange resin.

The ongoing degradation of containment vessels and pipes causes a slow rise in long-term risk for the no action alternative. This is due to the increase in probability of spontaneous spills or leaks from the tanks and piping, hydrogen buildup, and embrittlement of the plastic containers for the solutions. Maintenance activities must continuously counteract the inevitable system degradation if the solutions remain.

In conclusion, the risk over a period of 10 years or more would be higher for the no action alternative than for the proposed action. Eliminating stored resins and solutions decreases risk in the long-term, offsetting the short-term increase in risk during processing. The proposed action would prove beneficial as it would eliminate the necessity of maintaining the integrity of the confinement systems and prevent the inevitable increase in leakage.

5.1.2.3 Public Exposure to Chemicals from Normal Operations and Accidents

The overall risk to the worker and the public due to chemical accidents or interactions is low under both the proposed action and the no action alternative. Potential risks associated with the proposed action, in the short term, are slightly higher than under the no action alternative. This is due primarily to the inherent risk of conducting any activity. Long-term exposure and frequency of possible spills would increase for the no action alternative. Existing analyses from the perspective of chemical exposure to the public demonstrate that the proposed action would present lower risks to the public than the no action alternative.

All of the corrosive solutions currently stored and planned for processing under the proposed action are at low concentrations. These concentrations do not generate noxious or toxic vapors. The accident analyses in the Integrated Safety Assessments (ISAs) consistently predict that the risk of mechanical failure and the failure of tank containment (tank corrosion) would increase with time. If no action is taken to process the currently stored actinide solutions, the risk of chemical exposures to the Site workers and the public would increase proportionately.

Some of the significant operations, such as oxalate precipitation of nitrate solutions with actinide concentrations ≥ 6.0 g/l and hydroxide precipitation of chloride solutions with actinide concentrations ≥ 6.0 g/l, could potentially generate chemical air pollutant emissions, even though they would occur in closed systems. However, these emissions are not enough to warrant concern for the worker or the public.

Handling, processing, and transportation of actinide solutions under the proposed action would only slightly increase the overall risk of exposure to the Site workers and the public. Actinide solutions, corrosive chemicals, and filter precipitates would undergo handling daily, and increases the likelihood of human error. These exposure events, should they occur, would only affect the immediate worker. Worker and subsequent public exposure, through inhalation above DOE-prescribed exposure limits for corrosive chemicals, is not likely.

Proposed Action

The Building 771 ISA identified, described, and analyzed the proposed action. This multi-disciplined safety assessment documented and identified the administrative and engineered controls required to ensure safety to the public, the environment, and the worker. The Building 371 Caustic Waste Treatment System (CWTS) ISA provided the same analyses for the proposed action in Building 371.

Actinide solutions were separated into their chemical component parts and analyzed individually. The reagent chemicals that would be used in the proposed action are also analyzed. Results of the analyses indicate that there would be an exceedingly small chemical exposure to the public.

Under the proposed action, the overall risk to the public resulting from exposure to chemical hazards at or above DOE-prescribed exposure limits is predicted to be extremely low. Numerous safety systems and redundant containment structures are in place to prevent public exposure from both airborne radioactive and chemical hazards. The use of closed systems, such as storage tanks, piping, and rigid plastic containers, as well as engineering controls, such as multi-tiered exhaust ventilation systems and transportation speed governors, would provide sufficient control of these substances to prevent accidental release and resulting exposure to the public. With hazardous chemicals adequately contained and unavailable for interaction with the environment, the risk of public exposure resulting from the performance of routine activities is virtually nonexistent. Even if there was a catastrophic release, there would not be enough of any of the chemicals to pose a threat to the public even under the worst conditions. Handling, processing, and transportation of actinide solutions under the proposed action is predicted to only slightly increase the overall exposure risk to the public.

No Action

The no action alternative would defer processing of actinide solutions in Buildings 371 and 771. Even if advanced treatment technologies are developed within a reasonable time, the actinide solutions stored within these buildings would need draining, consolidation, and processing in the future. This would place the worker and the public at an exposure risk level that is greater than or equal to the risk predicted for the proposed action because the solutions would have to be handled more often.

The processing, piping, and containment in Building 771 has exceeded or soon would be exceeding its service life. Continued material degradation and leaking at threaded connections or flanges is predicted to continue in the future at an accelerated rate. If the commencement of the proposed action is delayed, routine surveillance and spill clean-up activities would continue for several years. Consequently, the Site workers and, therefore the public, would be subject to potential chemical exposures over an unnecessarily prolonged period.

As discussed in the ISAs, an accidental release or spill does not necessarily equate to an exposure exceeding the DOE-prescribed exposure limit. These public exposure projections are based primarily on the fact that small quantities are involved in these activities. Accident analyses contained in the ISAs also predict that the risk of mechanical failure and the failure of containment structures would increase with the passage of time. Therefore, if no action is taken to process existing inventories of actinide solutions, the risk to the public to chemical hazards is likely to increase incrementally.

5.2 Summary of Effects

Since the proposed action would not require any construction activities, and because any facility modifications would be inside existing facilities, there would be no increase in impacts to the natural environment in comparison to the no action alternative. As a result, there would be no adverse impact to water resources, flood plains, wetlands, threatened or endangered species or critical habitat, cultural resources, or other Site features. A tabular comparison of the proposed action and the no action alternative is shown in Table 5.2-1, Comparison of Alternatives.

Table 5.2-1 qualitatively compares these alternatives with the proposed action and the no action alternatives.

Table 5.2-1 Comparison of Alternatives

Alternative	Waste Produced	Normal Conditions Worker Exposure	Normal Conditions Public Exposure	Accident Risk	Implementation Time *
Proposed Action	244 drums (69 cement, 175 soft waste); 49 boxes of saltcrete	Less than 7.0 rems total to all workers	Less than 1% of annual allowable limit (short-term).	Increasing in short-term; decreasing to negligible (See Figs. 5.1.1-1 and 5.1.2-1)	7 years
No Action	None above routine operation	Increasing by 1.2 rems annually	Less than 1% of proposed action (similar to background)	Increasing over time; higher than proposed action	None

* Time required to complete implementation of alternative

** Chloride solutions could not be processed

5.2.1 Nonradiological Air Quality

Proposed Action

An assessment was done for potential nonradionuclide air emissions for the proposed action which identified air emissions inventory reporting and permitting requirements as required by the Colorado Air Quality Control Commission (CAQCC) Regulation No. 3 for any new source or modification to an existing source of air pollutants (Kalivas, 1994). This assessment indicated that the majority of the proposed activities would not generate nonradionuclide air emissions; and for those activities that would generate emissions, the annual estimated uncontrolled quantities are below inventory reporting and air permitting thresholds (less than 1 pound per year for nitric acid and less than 100 pounds per year for hydrochloric acid). As a result, no Air Pollutant Emission Notices (APENs) or Air Permits are required in accordance with CAQCC Regulation No. 3. Because nonradionuclide air emissions would be maintained below the reporting thresholds, there would be no adverse health effects from air emissions resulting from the proposed action.

No Action

Although existing solution storage containers would prevent uncontrolled releases of nonradiological air pollutants, the possibility exists for minimal quantities to be released in the event of a leak or spill. However, these quantities are expected to be below inventory reporting and air permitting thresholds. As a result, there would be no adverse health effects from nonradiological air emissions resulting from the no action alternative.

5.2.2 Waste Generation and Storage

Proposed Action

The proposed action would increase the amount of low-level and transuranic (TRU) waste from the amounts currently being generated (that is, the no action alternative) at the Site. Low-level waste contains 100 nanocuries per gram or less of TRU elements, while TRU waste exceeds that concentration.

Processing the solutions in tanks and piping in Buildings 771 and 371 would generate a total of approximately 69 drums of cemented sludge or filter sludge (direct waste), 46 drums of combustibles, gloves, etc. (indirect or soft waste), and 44 boxes of low-level saltcrete. Processing the solutions in stored bottles would generate an estimated 63 drums of direct waste, 66 drums of indirect waste, and 0.14 boxes of saltcrete. Therefore, the estimated total waste from all solution stabilization activities would be approximately 244 drums of TRU waste and 44 boxes of low-level saltcrete (Conner, 1994). These wastes would be stored onsite in existing, approved waste storage areas. The storage of both types of waste would only have a minor effect on the waste storage capacity. Since safety procedures and requirements for storing wastes at the Site are in place, the low-level and TRU wastes generated by the proposed action are not expected to result in increased environmental effects. In addition, wastes generated from the proposed action and the no action alternative would be in compliance with federal or state laws and guidelines affecting the generation, transportation, treatment, storage, or disposal of hazardous and other waste.

No Action

Although Rocky Flats is limited by regulation in the amount of mixed waste that can be stored at the Site, there is no regulatory limit on the quantity of low-level or TRU waste that can be stored. No additional wastes would be generated beyond those required to maintain the current status of the buildings at the Site. All generation, storage, transportation, treatment, or disposal of hazardous and other waste would be in compliance with existing federal or state regulations.

5.2.3 Health Risk Comparison of the Proposed Action to the No Action Alternative

This section compares the risk and potential consequences of the proposed action and the no action alternative. Existing analyses at the Site provide safety assessments of the proposed action described in Section 3.0. The assessment discussed in Section 5.1, Assessment of Radiological and Chemical Effects, references these analyses. The Integrated Safety Assessments (ISAs) for both Building 771 and the Building 371 CWTS are of primary importance. These ISAs are activity-specific assessments that ensure that effective administrative and engineered safety measures are in place protecting the worker, the public, and the environment from adverse effects. A multi-disciplined team of experts assessed radiological, chemical, and industrial hazards in the ISAs.

Proposed Action

A health risk resulting from the proposed action has two components, risk from normal operations, and risk from accidents. For each component, risk can result from exposure to ionizing radiation and chemical hazards. Normal operations proceed according to a predetermined plan.

Public exposure from the proposed action directly relates to the increase in radioactive material inventories during processing. Isolation by gloveboxes and building containment and air filtration systems protect the public and the environment from radioactive exposure. The air filtration systems remove all but an extremely small fraction of the airborne radioactive material; however, some minimal emissions would occur during normal operations. Additional public exposure from the proposed action would be less than 1 percent of the annual allowable limit of 10 mrem per year (Osborne, 1994). Worker and public radiological risk diminishes after completion of the proposed action because the actinide solutions are eliminated and the radionuclides have been placed in appropriate storage.

The overall risk of chemical hazards to the public and the worker is extremely small. Potential short-term toxicological risks to the public and the Site workers would be slightly higher for the proposed action than for the no action alternative. However, under the no action alternative, long-term chemical exposure risks and the frequency of anticipated accidents would increase if the actinide solutions remain in their current storage containers. Risk from chemical hazards decreases after completion of the proposed action because of the reduction in inventory of stored toxic and hazardous chemicals within each facility.

No Action

Leaving the material undisturbed avoids the temporary increase of risk imposed by the proposed action. However, degradation of tanks and piping systems would accelerate with the passage of time. Embrittlement of plastic containers holding actinide solutions would also occur, thereby increasing the probability of leaks. Maintenance must continue to counteract the inevitable system degradation. Therefore, if no action is taken to process the existing inventories of actinide solutions, the risk of worker and public exposure to radiological and toxicological elements would continue to increase. Selection of the no action alternative would delay the consolidation and processing of actinide solutions in Buildings 371 and 771. However, the actinide solutions would still need to be drained and processed in the future. This inevitable delay in processing would place the Site workers and the public at greater overall risk than that predicted for the proposed action.

6.0 AGENCIES AND PERSONS CONSULTED

The following state agency was consulted during preparation of this document as the regulatory authority for the RCRA Part B Permit Modification. No other outside agencies were consulted during the preparation of this document.

Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division

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APPENDIX A

**Response to Comments
Received from the State of Colorado and
The U.S. Environmental Protection Agency**

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

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Colorado Department
of Public Health
and Environment

Colorado Department of Public Health and Environment Comments on

*Draft Environmental Assessment, Actinide Solution Processing
at the Rocky Flats Environmental Technology Site, USDOE,
March 1995*

#1 Air Emissions

This environmental assessment should state that HEPA filters only control particulates. The actinide solution processing will create some gaseous emissions that are not controlled.

#2 Spill Control

There is no discussion of the specific details of the spill prevention, containment and control plans (SPCC) describing the interaction and evaluation of the actinide solution processing activities for each building and transfers between buildings. The relationship of scheduled activities to the available capacity and current status of retention and treatment capability is not discussed let alone the routine and emergency response procedures.

Neither the risk of spills nor the consequences and prescribed response activities are discussed. The risk of doses to workers was discussed but the response to preclude releases to soils and waters of the state and nation in the industrial area where the work is scheduled was not discussed. The SPCC and status of features to respond to normal execution of these activities and incidents, should they occur, must be in-place and in sync with the operations to preclude a release to soils and water.

No description of the system to monitor the capacity of the components of the SPCC plan at any point in time is discussed. Some of the features possibly cited for use may also be used for other purposes on site, such as the building 374 treatment facilities.

- #3 ● What retention facilities and what capacity would be needed and available up to and including a fire, where water is added and must be contained very locally and stored until treatment can be completed?
- #4 ● What is the present usage of the treatment capacity in building 374 and the plan over the life of these proposed activities? (page 4-5 section 4.2.2)

CDPHE Comments
Draft EA of Actinide Solution Processing
Page 2

- #5 • What is the status of hazardous materials, raw product and waste, in each building? Inventory and management of this material in relationship to an accident involving the actinide solution processing should be discussed. (page 4-5&6 all buildings)
- #6 • What is the current status of the vault/stacker/retriever and Caustic Waste Treatment System in building 371? Are these facilities fully functional now? If not, when? (page 4-5 section 4.2.1)

Questions or clarifications on these comments should be directed to Steve Tarlton, manager, Rocky Flats Program, 692-3013, or Jeb Love, Rocky Flats Program, 692-3511.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

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Ref: 8HWM-FF

Gary Schuetz
Operations and Waste Management Division
US Department of Energy Rocky Flats Field Office
P.O. Box 928 - T124A
Golden, co 80402-928

Dear Gary:

This letter is to provide you with EPA Region VIII's comments on the draft Actinide Solution Processing Environmental Assessment (EA), an activity to be conducted at the Rocky Flats Environmental Technology Site. Our assessment of the document was done to determine technical consistency. EPA has reviewed the document and concurs with its proposed solution.

#7 However, during the review of the document EPA has wondered if consolidation of the processes into one building has been considered. In light of recently announced budget constraints, EPA believes DOE should consider the use of one building to house these proposed treatment processes. DOE has indicated that it intends to pursue "mortgage" reduction activities. Consolidating actinide treatment into as few buildings and process facilities as possible would facilitate "mortgage" reduction. We believe that the EA must consider an alternative that facilitates "mortgage" reduction through both the treatment of the solutions and consolidation of buildings and facilities utilized.

Originally there were 11 possible alternatives that were considered for removal and processing the actinide solutions. Three additional alternatives were considered as location options for processing the actinide solutions. One additional alternative considered was off-site shipment of solutions. However, all but two of the solutions were determined to be; too expensive, high risk to the public or environment, not long range solutions, time line not practical and/or process not compatible with high-level mixed residues.

The two solutions that were deemed reasonable are: 1) NO ACTION and 2) LIQUID STABILIZATION (the proposed action).

The first of the two solutions, No Action, is inconsistent with the terms of the agreement between the DOE and the CDPH&E to drain mixed residue tanks and process them into a shippable and/or storable form as expeditiously as possible. For this action to be a viable action conditions made in the agreement

would require renegotiation with CDPH&E.

The other solution identified, Proposed Action, seems to be the best alternative listed and would aid in meeting the terms of an agreement between DOE and CDPH&E to drain mixed residue tank systems at the Site. The April 1993 Settlement Agreement and Compliance Order on Consent No. 93-04-23-01 required processing of all stored mixed residues so that they could be shipped or disposed of as expeditiously as possible.

Although in general agreement with the solution presented, proposed action, EPA has some concerns (attached) that need to be addressed in the final document.

If you have any questions regarding these comments please feel free to contact Mark Aguilar of my staff at (303) 293-0954.

Sincerely,

Martin Hestmark, Manager
Rocky Flats Project

Attachment

ATTACHMENT

General

- #8 What protocol is in place in the case of a catastrophic accident?

Figure 5.1.1-1 and Figure 5.1.2-1 Risk to Site Workers and the Public

- #9 Without a quantitative scale it makes the curves on this diagram meaningless. A log-log, semi-log or normal straight scales would significantly alter the meaning of these diagrams. The scale should be defined and related to exposure scenarios relevant to the proposed action; (ie. normal, small accident and large accident.)

Section 5.1.1.1 Worker Exposure to Radiation from Normal and Maintenance Operation

In paragraph 2 there is discussion regarding the annual rem values that are reasonable and acceptable with respect to the value of work being performed. In paragraph 3 it was determined that the proposed actinide solution stabilization activities would not exceed the applicable limits for individual workers.

- #10 Q1) What model(s) were used to determine that the exposure limits would not be exceeded?
- #11 Q2) What scenarios were used? 1) normal working conditions
2) Small accident conditions, 3) large accident conditions?
- #12 Q3) What happens if DOE's 2.0 rem is exceeded?
- #13 Q4) What happens if the regulatory limit (10 CFR Part 835) 5.0 rem is exceeded?

In paragraph 6 of this section there is discussion of the annual total dosage and that dosage is averaged over the total work force.

- #14 Q5) For clarity, how many workers will be performing proposed action tasks in building 771? and does this change the exposure results?

Section 5.1.3 Worker Exposure to Chemicals from Normal Operations and Accidents

Paragraph 5 discusses exposure limits, outlined in Table 5.1.1.3-1 Occupational Exposure Limits, that are acceptable under the Permissible Exposure limits (PELs) and the Threshold Limit Values (TLVs).

- #15 Q6) What are the expected exposure levels? Under normal working conditions, possible small accident and large accident scenarios?
- #16 Q7) What model(s) were used to arrive at the above mentioned expected exposure levels?

The above mentioned table should be revised to show these estimated working exposure limits.

Section 5.1.2.1 Public Exposure to Radiation from Normal and Maintenance Operations

- #17 Paragraph 3 of this section discussions routine public exposures from the proposed action would be less than 1% of the annual limit for public exposure.
- Q8) What model was used to determine this exposure limit?
- #18 Q9) At what distances were these exposure limits identified? 10 mi. radius, 20 mi. radius, or 50 mi. radius? Were high wind speeds taken into account with regard to exposure limits?
- #19 Q10) Have the laminar flow questions been answered?

**COMMENTS RECEIVED FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH
AND ENVIRONMENT (CDPHE)**

Comment #1:

This environmental assessment should state that HEPA filters only control particulates. The actinide solution processing will create some gaseous emissions that are not controlled.

Response:

Section 4.3.1, Ventilation Vital Safety Systems, states that, "Each filter stage provides a particulate removal efficiency of at least 99.8 percent... The use of HEPA filters prevents airborne radioactivity from reaching the atmosphere." All subsequent references to HEPA filtration in the document are used in this context.

Uncontrolled gaseous emissions from actinide solution processing were analyzed and the results were well below reporting thresholds as discussed in Section 5.2.1, Nonradiological Air Quality. The estimated emissions, which are less than 1 pound per year for nitric acid and less than 100 pounds per year for hydrochloric acid, have been incorporated into Section 5.2.1 for clarification.

Comment #2:

There is no discussion of the specific details of the spill prevention, containment and control plans (SPCC) describing the interaction and evaluation of the actinide solution processing activities for each building and transfers between buildings. The relationship of scheduled activities to the available capacity and current status of retention and treatment capability is not discussed let alone the routine and emergency response procedures.

Neither the risk of spills nor the consequences and prescribed response activities are discussed. The risk of doses to workers was discussed but the response to preclude releases to soils and waters of the state and nation in the industrial area where the work is scheduled was not discussed. The SPCC and status of features to respond to normal execution of these activities and incidents, should they occur, must be in place and in sync with the operations to preclude a release to soils and water.

No description of the system to monitor the capacity of the components of the SPCC plan at any point in time is discussed. Some of the features possibly cited for use may also be used for other purposes on site, such as the Building 374 treatment facilities.

Response:

Although the storage tanks discussed in the EA do not fall within State applicability requirements for preparation of SPCC Plans (7 CCR 1101-14), tanks at Rocky Flats are identified as a general group of equipment subject to Best Management Practices (BMP) under 40 CFR 125 and the Clean Water Act § 304. The BMPs are incorporated into the current Spill Prevention, Control and Countermeasures, and Best Management Practices Plan. A brief discussion has been added to Section 4.3, Safety Systems, to describe spill response activities.

All operations would be conducted inside gloveboxes; draining activities, where tapping is the method used for small volumes, would be performed inside temporarily installed glovebags. Liquids would be drained into bottles which provide initial containment. The glovebox and/or glovebag provide a second level of containment. Tanks and piping are provided with secondary containment (as defined by RCRA) designed to contain the volume of liquid equal to the capacity of the tank system. Rooms containing tanks are bermed, in addition to tank farms. The buildings themselves serve as an environmental barrier.

For normal operations defined within the EA for tank draining and processing, specific hazard assessments have been performed and evaluated. The assessments are documented in Integrated Safety Assessments (ISAs) and Safety Evaluation Reports (SERs) which describe the proposed activities and the building infrastructure, respectively. ISAs are activity-based, graded commensurate with the risk of the activity, integrated with all safety disciplines, and auditable. SERs provide a documented review of the building systems' ability to support proposed activities. Integration of all safety disciplines ensures that a common set of hazards and postulated events are consistently evaluated. Functional assessments have been performed to demonstrate that the systems, structures, and components are capable of performing the required functions, as identified by the ISAs. Specific administrative and engineering controls required to maintain the nuclear safety envelopes have been defined and include technical operating requirements and surveillances as acceptance criteria for the functional requirements.

The maximum volume for each activity has been determined and the containments have been evaluated as sufficient. In the event of a spill, building vacuum systems will be used to pick up larger releases (greater than 50 liters) of solutions into a holding tank; also available are portable vacuum units which can be used to pick up smaller releases (less than 50 liters) of solution into portable tanks. Again, all of these spill activities would occur well within the building boundaries. Spills of actinide solutions that are greater than 100 liters must be reported to EG&G's Surface Water Division. Surface Water Division personnel are included in the notification and response activities to ensure that potential environmental contamination is contained and/or mitigated.

Comment #3:

What retention facilities and what capacity would be needed and available up to and including a fire, where water is added and must be contained very locally and stored until treatment can be completed?

Response:

Buildings are constructed with fire water deluge systems that include sprinkler systems for plenum fire suppression and sufficient tank capacity for fire deluge water should such an event occur. The resulting liquids would be analyzed and dispositioned according to analytical results.

Comment #4:

What is the present usage of the treatment capacity in Building 374 and the plan over the life of these proposed activities? (page 4-5 Section 4.2.2)

Response:

The design treatment capacity of Building 374 is 18 million gallons per year and the present usage is approximately 5 million gallons per year. The total scope of processing approximately 30,000 liters and added reagents is less than 2 weeks of Building 374 processing capacity. Because of the required processing time for all actinide solutions (up to 5 years), the volumes being processed daily or weekly are relatively small.

Comment #5:

What is the status of hazardous materials, raw product, and waste, in each building? Inventory and management of this material in relationship to an accident involving the actinide solution processing should be discussed. (page 4-5&6 all buildings).

Response:

All hazardous materials are inventoried and segregated from work spaces within controlled storage spaces appropriate for the level of hazard of the material. Only the chemicals needed to conduct solution processing operations are contained within the work spaces. The maximum quantities for material at risk, which can include hazardous materials, raw product, or waste from various bounding scenarios are provided in the ISAs. Hazardous materials, raw product, and waste which are not part of the proposed processing in each building, have a very low potential for significant impact to human health. As a result, these elements were not identified as issues requiring detailed analysis in the EA.

Potential exposure to the workers and the public from hazardous materials (hazardous chemicals and radioactive materials), associated with the solution processing from accidents, is analyzed in Sections 5.1.1.2, 5.1.1.3, 5.1.2.2, and 5.1.2.3 in the EA. The accident scenarios used represent the greatest risk to the workers and the public and would result in low or extremely low overall risks. More detailed analysis of the accident risk to the workers and the public may be found in the ISAs and technical support documents for Buildings 371 and 771. These documents may be obtained by contacting Community Relations at (303) 966-7050.

Comment #6:

What is the current status of the vault/stacker/retriever and Caustic Waste Treatment System in Building 371? Are these facilities fully functional now? If not, when? (page 4-5 Section 4.2.1)

Response:

Currently, the stacker/retriever is considered to have limited operability. While it is not fully functional, it can be used now for storage. Preliminary repairs have been completed to provide limited operability. While sufficient vault storage capacity exists for the anticipated actinide product that would result from solution processing activities, the stacker/retriever is scheduled for completion of repairs by 1996. Currently, the CWTS is not operational and is being modified as part of normal operations for Building 371. Modifications to include a vacuum system and acid neutralization are scheduled for completion in September 1995.

COMMENTS RECEIVED FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII OFFICE

Comment #7:

In light of recently announced budget constraints, EPA believes DOE should consider the use of one building to house these proposed treatment processes. DOE has indicated that it intends to pursue "mortgage" reduction activities. Consolidating actinide treatment into as few buildings and process facilities as possible would facilitate "mortgage" reduction. We believe that the EA must consider an alternative that facilitates "mortgage" reduction through both the treatment of the solutions and consolidation of buildings and facilities utilized.

Response:

The EA considered consolidating all processing activities into an existing building at Rocky Flats (Section 3.3.1, Other Process Buildings). Consolidation of processing in Building 371 was initially considered, but rejected because chloride solutions could not be processed, transfer by bottles creates about 100 extra drums of waste, substantial increase in health risk from transportation, inability to meet CDPHE commitments, among other reasons which are delineated in the Actinide Solution Disposition Study (ASDS), (EG&G 1993a). DOE is committed to reducing costs at Rocky Flats and believes that the proposed action would provide the most cost-effective alternative with the least potential for exposure to the workers, the public, and the environment.

Conversely, consolidating all processing activities in Building 771 would require over 18,000 liters of actinide solution to be drained into bottles, overpacked in shipping drums, transferred to Building 771 by truck, unpacked, processed, and stored. Because of the high cost, the length of time to implement, and a significantly increased health risk, this would not meet the purpose and need for DOE to immediately remove the solutions from current storage containers and ultimately reduce risk to the workers and the public. The proposed action balances the elements of cost, implementation time, waste generation, and health risk. The ASDS may be obtained by contacting Community Relations at (303) 966-7050.

Comment #8:

What protocol is in place in the case of a catastrophic accident?

Response:

The Rocky Flats Emergency Operations Center would be activated, local authorities would be notified, and the Site Emergency Response Plan would be implemented.

Comment #9:

Figure 5.1.1-1 and Figure 5.1.2-1 Risk to Site Workers and the Public

Without a quantitative scale it makes the curves on this diagram meaningless. A log-log, semi-log or normal straight scales would significantly alter the meaning of these diagrams. The scale should be defined and related to exposure scenarios relevant to the proposed action; (i.e., normal, small accident and large accident).

Response:

The purpose for development of the risk curves was to illustrate the comparison of public and worker exposures associated with the conduct of the proposed action to the baseline (no action alternative) risks for the facility. The technical basis documents for the EA provide either the quantitative information or references for the quantitative information that support this conclusion. The exposure scenarios and related consequences are specifically delineated in the references provided in the technical basis documents. These documents may be obtained by contacting Community Relations at (303) 966-7050.

Comment #10:

Section 5.1.1.1 Worker Exposure to Radiation from Normal and Maintenance Operations

What model(s) were used to determine that the exposure limits would not be exceeded?

Response:

Dose assessments performed in the Integrated Safety Assessments (ISAs) for the related activities provided the basis for determining that worker exposure limits would not be exceeded. The ISAs employed the potential intake model from NUREG - 1400, Air Sampling in the Workplace, where appropriate, and other mathematical models and calculations derived for specific conditions described in the ISA documents for internal exposure. External exposures were assessed based on survey data and calculated dose rates using primarily Radiation Shielding Information Center (RSIC) codes.

Comment #11:

What scenarios were used? 1) normal working conditions 2) small accident conditions, 3) large accident conditions?

Response:

Scenarios that were assessed included normal working conditions and anticipated accidents both large and small. Anticipated accidents were those with frequencies determined at $\geq 1\text{E-}2$ events/year. These events were in general smaller than those with lower frequencies. Refer to Table 5.1.1.2-1, Alternative Risk Determinations, for a listing of the limiting scenarios considered.

Comment #12:

What happens if DOE's 2.0 rem is exceeded?

Response:

If the DOE limit of 2.0 rem is exceeded, then an occurrence report per ADM 16.01 would be filed. This notifies DOE headquarters of the incident. In addition, a formal critique would be held to determine the root cause and action required to prevent recurrence.

Comment #13:

What happens if the regulatory limit (10 CFR Part 835) 5.0 rem is exceeded?

Response:

In addition to the procedures followed for doses exceeding 2.0 rem; doses exceeding 5.0 rems would result in a Notice of Violation from the regulatory authority.

Comment #14:

For clarity, how many workers will be performing proposed action tasks in building 771, and does this change the exposure results?

Response:

The current building work force of approximately 235 persons should be able to support the proposed activities with little change. It is expected that about 25 process workers would conduct most of the work with much of the remaining work force performing support activities. Variations in work force magnitude are small and would not affect the exposure results.

Comment #15:

Section 5.1.3 Worker Exposure to Chemicals from Normal Operations and Accidents

What are the expected exposure levels? Under normal working conditions, possible small accident and large accident scenarios?

Response:

A qualitative approach was used in the performance of baseline process hazard assessments described in the EA. These assessments rely on physical walkdowns, process knowledge and history, previous industrial experience, and evaluations of all available toxicity/hazard information on chemicals used and/or associated with each process. Engineering controls, administrative controls, and personal protective equipment employed to control worker exposures are also considered in the qualitative assessment of occupational exposure potential.

Based upon these qualitative analyses, occupational exposure to chemical hazards, under the proposed action and no action alternative, are predicted to be negligible during normal working conditions. In the event of a chemical spill (such as nitric acid, hydrochloric acid, potassium hydroxide, sodium hydroxide, or oxalic acid), occupational exposures are predicted to be limited to acute skin and minor respiratory effects. Controls (such as contaminants, ventilation, personal protective equipment, etc.) are in place to minimize employee exposures during spill remediation.

The inclusion of Table 5.1.1.3-1, Occupational Exposure Limits, is intended merely to provide the reader with a means of reference for current occupational exposure limits which are deemed acceptable for those chemicals associated with actinide solution processing activities.

Comment #16:

What model(s) were used to arrive at the above mentioned expected exposure levels?

The above mentioned table (Table 5.1.1.3-1) should be revised to show these estimated working exposure limits.

Response:

Quantitative mathematical (that is, model) predictions of employee exposure were not employed in the performance of baseline process hazard assessments in the EA or the referenced Building 371/771 ISAs.

Comment #17:

Section 5.1.2.1 Public Exposure to Radiation from Normal and Maintenance Operations

Paragraph 3 of this section discussions [sic] routine public exposures from the proposed action would be less than 1% of the annual limit for public exposure. What model was used to determine this exposure limit?

Response:

To determine compliance with the EPA air emissions standards, measured airborne effluent radioactivity emissions are entered into the EPA-approved atmospheric dispersion/dose calculation computer code, CAP88-PC, version 1, for calculation of the maximum dose that an individual in the public could receive from the air pathway only.

Comment #18:

At what distances were these exposure limits identified? 10 mi. radius, 20 mi. radius, or 50 mi. radius?

Were high wind speeds taken into account with regard to exposure limits?

Response:

The nearest off-site receptor, located at the corner of Indiana St. and 96th Ave., was utilized in the CAP88-PC dispersion model for this project. The distances from the various building vents identified in the project range between 4000 and 4500 meters to the receptor. Annual emission dose assessments are calculated out to a 50-mile radius.

The CAP88-PC model utilized Rocky Flats Site wind rose data measured at the Site's 61-meter meteorological tower located northwest of the industrial area. The wind rose data are gathered by wind direction frequency (percent) by four wind speed classes. Therefore, high wind speeds were taken into account with regard to the exposure limit.

Comment #19:

Have the laminar flow questions been answered?

Response:

Laminar air flow was not an issue identified for analysis in this EA.

GLOSSARY

This Glossary is provided to aid in the understanding of technical terms used in this Environmental Assessment (EA). Alternate definitions may exist that are not applicable to the intended usage in this document. Also provided are conversions from Scientific International (SI) units to the American units to aid in understanding various units of measure.

Actinides: A set of elements on the chemical periodic chart that are radioactive. The actinides that are the subject of this assessment include plutonium, uranium, and americium.

Adsorb: To collect on a surface by either physical or chemical forces.

Batching/Blending: Adding two or more solutions together in order to create a mixture that meets a particular processing parameter.

Calcine: To convert a metal or compound to an oxidized form by heating. Plutonium is stabilized when it is heated in air, forming plutonium oxide. The heating or oxidizing occurs by placing the solid plutonium material on a hot plate or muffle furnace and heating to about 500° Celsius.

Carrier Precipitation: A batch process that neutralizes acidic wastes and removes heavy metals, including actinide material.

Concentration: A measure of the amount of dissolved substance contained in a given volume of liquid (example: 1.0 gram of plutonium per liter of solution = 1.0 g/l).

Criticality: An accidental, self-sustained atomic chain reaction.

Curie: A unit quantity of any radioactive nuclide in which exactly 3.7×10^{10} disintegrations occur per second. A disintegration is the emission of an alpha, beta, or gamma particle. (See nanocurie).

Effluent: A liquid stream flowing from a process; this is the waste material from which actinides have been removed.

Filter cake: Collected precipitate that has been removed from the filter.

Filtrate: The remaining liquid stream that has been passed through a filter to remove the solid material.

Filtration: The act of passing a liquid through a filter to retain the product solids on the filter and let the liquid pass through.

Glovebox: A containment structure that is about 3' deep by about 6' to 24' long and has openings fitted with gas-tight gloves for which certain radioactive or other special materials may be safely handled.

grams to ounces: There are 28.35 grams per ounce; there are 16 ounces per pound.

Hot plate: An electrical unit with a flat surface that heats to about 600° Celsius and which a container may be placed for on heating. The hot plate is used within a glovebox.

liters to gallons: One liter of liquid equals 0.2642 of a gallon, or, each liter is about one quart.

Mixed Waste: Waste containing both radioactive and hazardous components, as defined by the Atomic Energy Act and Resource Conservation Recovery Act (RCRA).

Muffle furnace: An enclosed electrical unit into which a container may be placed for heating, much like an oven, and which is used within a glovebox.

Nanocurie: nano means 10^{-9} ; (see curie). Nanocurie equals 10^{-9} curie.

Neutralize: In aqueous (water) solutions, it is the reaction between hydrogen ions from an acid and hydroxyl ions from a base to produce water. A neutral solution is one with no excess hydrogen or hydroxyl ions and has a pH of seven.

Permissible Exposure Limit (PEL): A time-weighted average of airborne concentration of substances which shall not be exceeded in any 8-hour work shift of a 40-hour week as specified by Code of Federal Regulations (CFR) Title 29 CFR 1910.1000.

Plenum: The main exhaust duct into which minor exhaust ducts feed. The plenum is monitored for air contaminants and filtered by High Energy Particulate Filters.

Precipitate: The resulting solid material from a precipitation process.

Precipitation: The act of converting a dissolved material in solution to a solid form that falls to the bottom of the liquid.

Process Make-up Water: Water that is used in the steam-generation plant that provides power for heating at the Site.

Process or Processing: A particular procedure or series of activities that treats solutions to render them less harmful and place them in a safer configuration.

Radioactive: Spontaneous nuclear transformation. The energy of the process is emitted in the form of alpha, beta, and neutron particles or gamma rays.

Reagent: A substance that, because of the reactions it causes, is used to create a chemical change.

Risk: The chance, or probability of injury or loss of life by exposure to a hazard. This EA deals with injury to health and loss of life caused by radioactivity and hazardous chemicals.

Sparging: Drawing or forcing air into a liquid to create a mild bubbling; this activity mixes a solution.

Threshold Limit Value (TLV-TWA): The time-weighted average airborne concentration of substances for a normal 8-hour day and a 40-hour workweek, to which nearly every worker may be repeatedly exposed, day after day, without adverse effect.

Transuranic: Those elements on the chemical periodic chart that have element numbers higher than that of uranium. These elements include plutonium and americium.

Vital Safety Systems: Those systems that are relied upon to detect or mitigate the radiological consequences of an accident, including criticality.