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Title

Data Report for Plutonium Conversion Facility

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DATA REPORT FOR

PLUTONIUM CONVERSION FACILITY

02/14/96

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PREFACE

The Department of Energy (DOE) is examining options for placing weapons-usable nuclear materials in a form or condition that is substantially and inherently more difficult to use in weapons. The Department determined that potential decisions and their implementation regarding the long term storage and disposition of this surplus material could have a significant impact on the environment. Therefore, DOE implemented a comprehensive plan to consider a range of reasonable alternatives in a Programmatic Environmental Impact Statement (PEIS). This report details the specific response to a request by DOE through Tetra Tech, Inc. for a preconceptual facility design to convert and /or stabilize surplus plutonium. The design data is intended to provide a basis for estimating the environmental effects associated with the construction and operation of a plutonium conversion facility.

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1. Plutonium Conversion Facility -- Missions and Assumptions

1.1. Plutonium Conversion Facility Missions

The Plutonium Conversion Facility provides plutonium handling, processing, and interim storage of surplus plutonium to reduce the nuclear danger associated with the long term disposition and vulnerability while managing waste generation in an optimized and environmentally acceptable manner. The goal of this facility is to recover and package this surplus material in a form suitable for long term storage and a composition suitable for other final disposition alternatives.

1.2. Plutonium Conversion Facility Assumptions

The facility design is based on project guidance and assumptions provided by the FMDP Integration Team Guidance, including feed types, throughput, time frames, and compliance requirements. Process technologies and facility sizing are based on current recovery processes being developed and/or applied at the National Laboratories and the resultant waste and product forms.
The Plutonium Conversion Facility conceptual design is based on several assumptions relative to feed forms and quantities. The first assumption is that scrap and surplus materials are pretreated to meet DOE Interim storage and DOT shipping regulations. The second assumption is recovering materials with current technology be economically viable or meet the intent of "proliferation resistance." The facility design is flexible enough to provide additional or reduced processing with minor process changes, such as increasing metal dissolution capacity for conversion to oxide, adding americium extraction, oxidation furnaces, or nitrate processing to meet additional alternative feed pretreatment requirements as they are better defined.

1.2.1. Facility Capacity and Capability

The Plutonium Conversion Facility would process approximately ***0.4*** metric tons (MT) of plutonium annually to a form that meets long term storage, nuclear fuels feed, or immobilization feed criteria. The long term storage criteria is based on DOE Standard material specification-*Criteria for Safe Storage of Plutonium Metals and Oxides*, DOE-STD 3013-94, dated December 1994. This capacity is based on the following quantities and distributions of surplus materials, each type requiring some level of recovery processing, repackaging, and product characterization.

7.9 Metric Tons (MT) of surplus plutonium are distributed in the following approximate quantities as plutonium.

4.2 MT of metal.

1.1 MT of compounds.

2.6 MT of scrap (residues).

The recovery processing capacity is also dependent upon the bulk material quantities and forms as shown in Table 1-1. Of the bulk values the stable rich scrap, from the various processing sites, accounts for more than 50% of the bulk feed material. The form and plutonium concentration determine the extent and recovery process applied.

Table 1-1 Feed Summary

Process	Pu Quantity	Pu Percent of Total	Bulk Quantity	Bulk Percent
Oxidation / Wash	2.25 MT	28.5%	36.8 MT	65.4%
Separation	5.65 MT	71.5%	19.5 MT	34.6%
TOTAL	**7.9 MT**		**56.3 MT**	

Functional capabilities would include, as a minimum, shipping and receiving, processing, repackaging and interim storage, and waste management. These capabilities are described in greater detail in Section 4.0, Process Descriptions.

1.2.2. Facility Operating Basis

The following projected schedule is based on a facility design intended to meet the various disposition alternatives or long term storage criteria.

1.2.2.1. Research and Development Plan

Start 10/95 - Complete 9/2000

The emphasis is on assessment of conversion and characterization technologies to confirm accordance with storage criteria and waste minimization goals.

1.2.2.2. Permitting and Licensing

Start 10/97 - Complete 9/01

Compliance and regulatory requirements will be addressed during this phase. The major requirements include:

Clean Air Act - Airborne emissions permit.

Clean Water Act - National Pollutant Discharge Elimination System permit for liquid effluents.

Resource Conservation and Recovery Act - EPA permit for treatment, storage, or disposal of hazardous and nonhazardous waste.

1.2.2.3. Construction

Start 10/01 - Complete 9/06

Construction schedules are based on physical construction and startup testing. Preliminary cost estimates, conceptual design, and preliminary designs will occur concurrently with the permitting phase.

1.2.2.4. Operating

Start 10/06 - Finish 9/26

The facility operating schedule of 20 years is based on the estimated quantity of qualified surplus material and the proposed operating times for the "final disposition alternatives". An approximate ten years overlap in operating schedules is proposed in order to optimize facility designs and the schedules for transportation and construction. This schedule also assumes one 10 hour shift per day at 200 days per year. Operating schedules provide a structure such that one day per week be set aside for safety system surveillance and major system maintenance and testing.

1.2.2.5. Decommissioning and Decontamination

The presumed life cycle for facilities of this type are typically in the range of 30 to 50 years and that the nuclear weapons stockpile support program will continue to generate some scrap as will the various disposition alternatives or the Decommissioning and Decontamination (D&D) of existing facilities. Therefore, this facility and its proposed mission most likely will continue to provide processing support past the initial scope of twenty years. The final D&D method will involve complete dismantlement and environmental restoration of the site. The implementation for D&D is a separate project in itself, involving at a minimum, planning, characterization, hazards analysis and risk assessment, and implementation.

1.2.2.6. Conversion Options

As mentioned in section 2.2, the mission for this facility may continue with various options for continuation or conversion. The following options should be considered.

Characterization, testing, and analytical services for Long Term Storage materials and containers. This involves a QA program with random sampling and testing, as well as MC&A functions.

A reactor fuel "head-end" processing facility: providing metal conversion, americium and gallium extraction, or pretreatment (sintering, grinding, pressing, etc.) for metals and oxides not meeting feed requirements. Metal Conversion capability is not included in the "head end" processing for fuels or immobilization. It is the only form for which some conversion capability or capacity is not specifically included in the alternatives. However, if scheduling permits, the proposed aqueous recovery capability could convert and purify this material as well..

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1.2.3. Compliance

The facility is designed to comply with site specific design criteria and DOE Orders covering design, construction, and safety of nonreactor nuclear material handling facilities. Facility layout incorporates the safety, security, and environmental protection considerations, including post-processing decontamination, demolition, and renovations.

Minimum regulatory requirements are provided in the FMDP Integration Team Guidance.

1.2.3.1. Rules, Regulations, Codes, and Guidelines

Draft, Surplus Fissile Material Control and Disposition Project Guidance

DOE-STD 3013-94, Criteria for Safe Storage of Metals and Alloys

DOE Order 5700.6C Quality Assurance

CFR 173, Packaging and Transportation

1.2.3.2. Safeguards and Security

DOE Order 5630, Physical protection, control and accountability of special nuclear material, and the protection of classified equipment and information.

1.2.3.3. Environmental, Safety, and Health (ES&H)

Environment

DOE Order 5400.1, General Environmental Protection Program.

Effluents

CFR 20.1301.a.1

DOE Order 5400.5, Radiation Protection of the Public and Environment

CFR 61 National Emission Standards for Hazardous Air Pollutants

Safety and Health

DOE Order 5400.5, Radiation Protection of the Public and Environment

CFR 61

DOE Order 6430.1B

DOE Order 5480.11

OSHA

NFPA 101

DOE Order 5480 7A

Orders

DOE Order 5400.1

DOE Order 5400.3

DOE Order 5420.2A

Resource Conservation and Recovery Act (USC 6901 et seq.).

2. Plutonium Conversion Facility - Description

2.1. General Facility Description

Plutonium received from existing interim storage sites is processed, packaged, and placed into "lag" storage on-site. The material is then repackaged for shipment to a facility for final disposition or long term storage. The facility consists of the buildings and infrastructure for process operations, waste management, shipping and receiving, maintenance, utilities, administration, and safeguards and security.

2.1.1. Functional Description

The purpose of the plant is to convert weapons-usable surplus plutonium material into a form that meets the disposition feed or long term storage criteria.

The Plutonium Conversion Facility is composed of shipping and receiving, material management, four primary processing operations, waste management, and the necessary facility infrastructure and utility support functions as shown in Figure 2-1, *Facility Flow Diagram.* The primary processing operations; oxidation/wash, aqueous separation, calcination, and repackaging are applied according to the feed type. The processing operations each have a separate flow sheet, process description, and list of the general functions in section 4.0.

2.1.2. Plot Plan

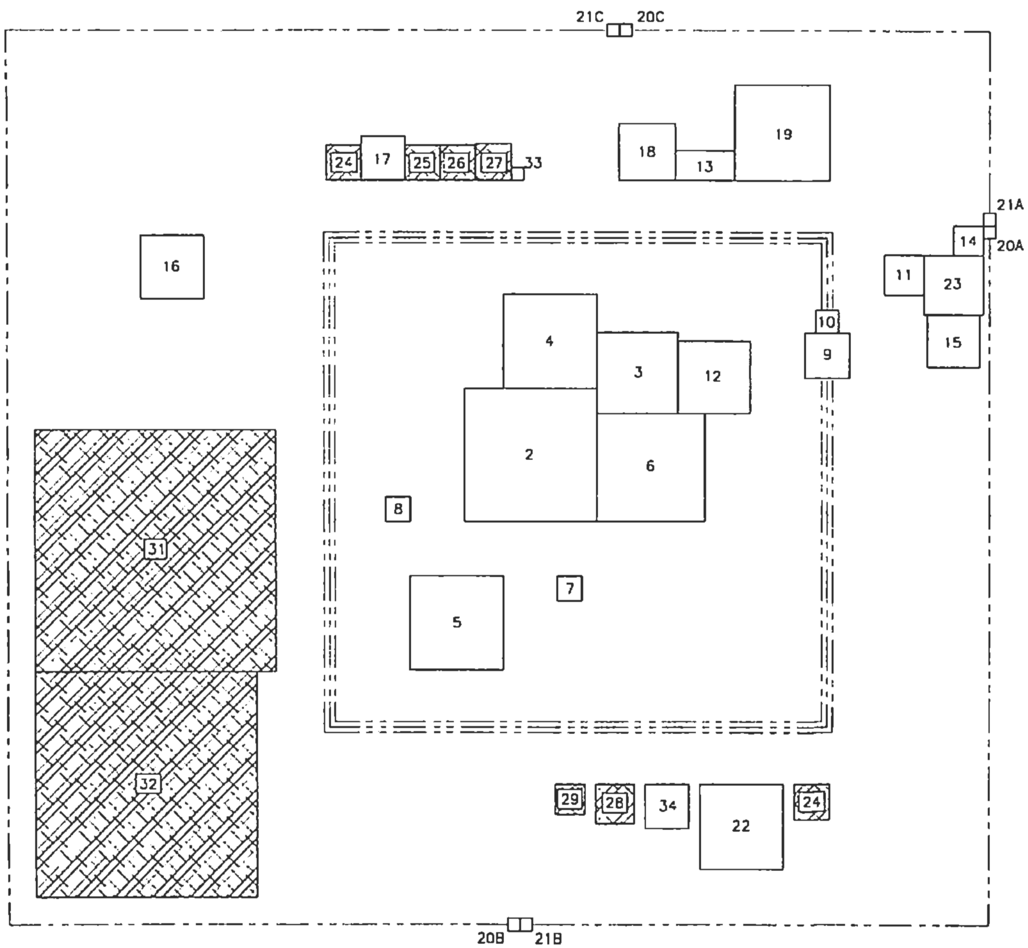
The plot plan, shown in Figure 2-2, indicates the general layout of a typical facility for the purpose of establishing area requirements, safeguards and security components, and support function relative locations. The plot plan also provides a basis for initial evaluations of environmental impact and cost estimates based on space requirements.

Note: The size, number, and arrangement of facility buildings is conceptual and can change significantly as the design progresses.

2.1.3. Building Descriptions

The following buildings compose a self-contained and self-sufficient facility for the above scope and purpose. Demolition, decontamination, renovations, and construction activities are TBD because they are too dependent on the specific site.

FIGURE 2-2
PLUTONIUM CONVERSION FACILITY
PLOT PLAN



KEY

PLOT PLAN REF. #	BUILDING NAME	NUMBER OF LEVELS
2	PROCESS BUILDING	2
3	COLD SUPPORT BUILDING	2
4	HVAC COLD SUPPORT/MAINT.	1
5	WASTE TREATMENT FACILITY	1
6	STAGING/STORAGE FACILITY (FEEDS)	1
7	SOURCE CALIBRATION BLDG.	1
8	EMERGENCY GENERATOR BILDG.	1
9	SECURITY PORTAL – PEDESTRIAN	1
10	SECURITY PORTAL – VEHICLE	1
11	SECURITY CENTER	3
12	ADMINISTRATION – PROCESS FACILITY	3
13	FIRE STATION	1
14	TRAINING/VISITOR	3
15	ES&H SUPPORT LAB/BLDG.	1
16	LONG-TERM WASTE STORAGE	1
17	SANITARY WASTEWATER TREATMENT	1
18	UTILITY SUPPORT	1
19	CENTRAL WAREHOUSE/SHIPPING/RECEIVING	1
20 A,B,C	SECURITY PORTAL – LA/PEDESTRIAN – (3)	1
21 A,B,C	SECURITY PORTAL – LA/VEHICLE – (3)	1
22	MAINTENANCE SHOPS	1
23	ADMINISTRATION – GENERAL	3
24	FIRE WATER STORAGE/PUMP – (2)	
25	POTABLE WATER STORAGE	
26	PLANT WATER SUPPLY STORAGE	
27	COOLING WATER – TOWER/PUMP	
28	LIQ/COMPRESSED GAS FACILITY	
29	BULK CHEMICAL DISTRIBUTION FAC.	
30	STORM WATER PONDS – (4)	
31	SANITARY/INDUSTRIAL LANDFILL	
32	LOW LEVEL WASTE DISPOSAL	
33	RAW WATER SUPPLY	
34	VEHICLE MAINTENANCE FACILITY	

LEGEND

- = AREAS
- = LIMITED ACCESS
- = PROTECTED ACCESS

2.1.3.1. Process Building

The Process Building provides the space for handling and processing surplus fissile material into the accepted long-term storage form. This building also provides the necessary utility support functions, material control and accountability, safety systems, waste management, repackaging, and assay and analysis. Conversion and stabilization operations include aqueous separation, oxidation/wash treatments, and calcination. Support operations include waste handling, material handling, analytical, and the vault for lag storage.

Feed materials are transferred from the Staging Building to the Material Handling rooms where they are removed from the transfer container, introduced into the glovebox system, and prepared for processing. The feed is then transferred via a trolley system to the appropriate processing area for separation and recovery or bagged-out and sent to the vault awaiting analytical results or cognate feed processing.

2.1.3.2. Cold Support Building

The Cold Support Building provides change rooms, a cafeteria, laundry/decontamination, general delivery/storage areas, laboratories, and offices.

2.1.3.3. HVAC Cold Support/Maint.

The HVAC Cold Support and Maintenance building provides space for noncritical utility support equipment, such as HVAC water pumps, and maintenance shops.

2.1.3.4. Waste Treatment Facility

Liquid wastes collected from processing areas are neutralized, precipitated, and volume reduced via evaporation. The sludge is immobilized and packaged for disposal, while evaporated water is recycled for use in the utility systems. Solid wastes are segregated, size reduced if necessary, counted, and appropriately packaged. In addition the building contains maintenance facilities, laboratories, utility systems, HVAC equipment, and other functions to support waste operations.

2.1.3.5. Staging/Storage Facility (Feeds)

The Staging/Storage Building houses all shipping and receiving functions for feed material received from off-site and products being shipped off-site. Shipping packages are received, unloaded, and contents confirmed. The primary containers in which the SNM items are contained and stored are removed from the shipping packages, assayed for accountability, radiographed, and prepared for storage. In addition, the building contains utility systems, HVAC equipment, offices, and other support facilities.

The Staging Support Building is immediately adjacent to the Staging Building and provides areas required to support operations within the Staging Building. The building contains change rooms, maintenance and storage areas, laboratories, control rooms, computer facilities, laundry facilities, offices, a personnel break room, and HVAC equipment.

2.1.3.13. Training/Visitor

The training center provides the facilities required for plant personnel training, plant operations and production training, and maintenance and material handling training. The center includes computer based training areas, classrooms, lecture area(s), cold mock-up stations, and simulators, as required. This building provides the main entrance to the facility at the site boundary. It includes a visitor reception and badging area, as well as a vehicle control point.

2.1.3.14. ES&H Support Lab/Bldg.

The Environmental, Safety, and Health Building contains several laboratories and offices supporting the following functions: radiation protection and measurements, occupational safety, bio-assay, industrial hygiene, health physics, and environmental surveillance, impacts, and restoration.

2.1.3.15. Long-Term Waste Storage

The Long-Term Waste Storage Building provides 90 days staging for hazardous and low level radioactive waste (LLW). The hazardous waste is transported to an approved RCRA disposal site, and the LLW is sent to on-site low level waste disposal. The building also provides a three-year storage capacity for low level mixed waste. The building can be expanded as needed to provide continuous storage of mixed waste for the life of the plant.

2.1.3.16. Sanitary Waste Water Treatment

The Pu Plant utilizes an activated sludge type waste water treatment. Sanitary waste water is separated from all process waste waters and normally contains no radioactive wastes from the plant. The plant routinely monitors sanitary waste effluent for radiological contaminants. Upstream and downstream holding tanks ensure system availability and provide surge capacity during an operational upset. The treated waste water is recycled to the cooling tower and used as makeup water.

2.1.3.17. Utility Support

The Utility Building houses the following utility functions: steam and condensate system, plant water treatment, potable water treatment, the plant and instrument air system, and the chilled water system. The products such as steam, potable water, plant air, and instrument air are delivered via utility lines to the users at the Process Building, Staging Building, Waste Management Building, and other support facilities.

2.1.3.18. Central Warehouse/Shipping/Receiving

The central warehouse provides flexible staging/storage capacity for all classified and non-classified, nonnuclear materials required to support daily plant activities. Functions include inventory control and management, procurement/purchasing, receiving and delivery

system is required to be safety class, then one of these buildings must be hardened and one storage tank must be designed to withstand a design basis earthquake.

2.1.3.26. Potable Water Storage

A potable water storage tank supplies potable water for domestic and process use and contains a two-day emergency reserve.

2.1.3.27. Plant Water Supply Storage

A plant water storage tank provides a continuous supply of plant water for all water users. The storage tank design provides a minimum of two days of continuous supply in the event of a disruption in the water supply.

2.1.3.28. Cooling Water - Tower/Pump

The tower cooling water facility supplies cooling water to the refrigeration condensers, closed loop cooling water systems used in the process buildings, and various utility users.

2.1.3.29. Liq/Compressed Gas Facility

The liquefied gas supply area stores liquid argon and nitrogen in cryogenic tanks. Liquid argon and nitrogen are vaporized and delivered to process users through distribution piping. The compressed gas supply area provides space to store compressed gas tube trailers containing argon, nitrogen, oxygen, and helium.

2.1.3.30. Bulk Chemical Distribution Facility.

The bulk chemical storage area contains the following liquid chemical storage tanks.

1. Hydrochloric Acid (HCl)
2. Potassium Hydroxide (KOH)

The tanks in this area serve as the Pu Plant primary storage tanks. The chemicals are piped to users within the process buildings and support systems as required. Dikes surrounding each tank contain chemicals in the event of a spill.

2.1.3.31. Diesel Fuel Storage

Diesel fuel is the fuel supplied to the evaporators in process waste water treatment. Diesel fuel also provides fuel to the emergency generators and serves as a back-up fuel supply for the steam plant boilers. Diesel fuel is stored in two diked tanks.

2.1.3.32. Storm Water Ponds - (4)

Storm water ponds detain storm water runoff. The ponds allow for ES&H monitoring and controlled release.

2.1.3.33. Sanitary/Industrial Landfill

The sanitary/industrial landfill area receives approved waste/refuse for burial on-site, using local dense clays for lining the landfill and providing landfill cover.

2.1.3.34. Low Level Waste Disposal

The low level waste disposal area ultimately provides a 50-year capacity for low level radioactive waste (LLW). Initial construction provides a five-year capacity aboveground. Additional modules will be added as necessary. Each module is designed with a double lin leak detectors, concrete base, berms, and a concrete cover.

2.1.3.35. Raw Water Supply

The raw water supply area uses well pumps that pump water from underground aquifers an transfers it to the Water Treatment Facilities in the Utility Building.

2.2. Design Safety

The following sections identify some important safety considerations to be incorporated in the desi of DOE Complex-21 facilities. Performance goals commensurate with the associated hazard will b selected for all structures, systems, and components (SSCs). The term "hazard" is defined as a source of danger, whether external or internal. Natural phenomena such as earthquakes, extreme winds, tornadoes, and floods are external hazards to SSCs, whereas toxic, reactive, explosive, or radioactive materials contained within the facilities are internal hazards. Usage Category will be as established by DOE management. Guidelines for Usage Category (Performance Category) and the corresponding performance goals are given in Chapter 2 of UCRL-15910.

2.2.1. Earthquake

All new plant structures, systems and components (SSC's) shall be designed for earthquake-generated ground accelerations in accordance with *Design and Evaluation Guidelines for DOE Facilities Subjected to Natural Phenomena Hazards*, UCRL- 15910, with applicable seismic hazard exceedance probability of 2×10^{-3} for General Use (Performance Category 1), 1×10^{-3} fo Low and Moderate Hazard (Performance Category 2 & 3), and 2×10^{-4} for High Hazard (Performance Category 4) SSCs.

Seismic design considerations for Performance Category 3 and 4 SSCs will include provisions for such SSCs to function as hazardous materials confinement barriers, and also for adequate anchorage of building contents to prevent their loss of critical function during an earthquake. I essence, design considerations avoid premature, unexpected loss of function and to maintain ductile behavior during earthquakes.

Characteristics of the lateral force design are as important as the magnitude of the earthquake load used for design. These characteristics include redundancy; ductility; the combining of elements to behave as a unit; adequate equipment anchorage; considering the behavior of nonuniform, nonsymmetrical structures or equipment; detailing of connections and reinforced concrete elements; and the specified materials and construction.

In addition to structural safety, operation of emergency systems during and after an earthquake is essential. The fire protection system, emergency power, water supplies, and controls for the safety class equipment are examples of plant systems that must be available following an earthquake. As stated in Chapter 4 of UCRL-15910 under Survival of Emergency Systems, "earthquake-resistant design considerations extend beyond the dynamic response of structures and equipment to include survival of systems that prevent facility damage or destruction due to fires or explosions."

2.2.2. Wind

All new plant structures, systems, and components (SSCs) will be designed for wind or tornado load criteria at specific DOE sites in accordance with UCRL-15910 and the corresponding facility usage and performance goals. Wind loads shall be based on the annual probability of exceedance of 2 x 10^{-2} for the General and Low Hazard (Performance Category 1 & 2), 1 x 10^{-3} for the Moderate Hazard (Performance Category 3) and 1x10^{-4} for the High Hazard (Performance Category 4) SSCS. The sites for which tornadoes are the viable wind hazards shall be designed for the annual probability of exceedance of 2 x 10^{-5} as defined in Table 5-3, UCRL-15910.

Wind design criteria will be based on annual probability of exceedance, importance factor, missile criteria, and atmospheric pressure change as applicable to each performance (usage) category as specified in Table 5-2, UCRL-15910.

As stated in UCRL-15910, characteristic safety considerations will be reflected in the design of the system in that, "the main wind-force resisting system must be able to resist the wind loads without collapse or excessive deformation. The system must have sufficient ductility to permit relatively large deformations without sudden or catastrophic collapse. Ductility implies an ability of the system to redistribute loads to other components of the system when some part is overloaded."

2.2.3. Floods

All facilities and buildings should preferably be located above the critical flood elevation (CFE) from the potential flood source (river, dam, levee, precipitation, etc.) or the site/facility shall be hardened to mitigate the effects of the flood source such that performance goals are satisfied. Emergency operation plans shall be developed to safely evacuate employees and secure areas with hazardous, mission dependent or valuable materials. The extent of the flood hazard will be determined using the appropriate usage (performance) category for determining the "Annual Hazard Probability of Exceedance" 2 x 10^{-3} for General Use (Performance Category 1), 5 x 10^{-4} for Important or Low Hazard (Performance Category 2), 1 x 10^{-4} for Moderate Hazard (Performance Category 3), 1 x 10^{-5}, for High Hazard (Performance Category 4) facility as

All fire sprinkler water that has been discharged in process areas during and after a fire will be contained, monitored, sampled, and if required, retained until it can be disposed.

2.2.5. Safety Class Instrumentation and Control

The safety classification of instrumentation and controls will be derived from the safety functions performed. This safety classification is based on DOE 6430.lB and DOE 5481.1B.

Safety class instrumentation will be designed to monitor identified safety related variables in safety class systems and equipment over expected ranges for normal operation, accident conditions, and for safe shutdown. Safety class controls will be provided, when required, to control these variables.

Suitable redundancy and diversity will be used when designing safety class instrumentation to ensure that safety functions can be completed, when required, and that a single point failure will not cause loss of protective functions. Redundant safety class signals must also be physically protected or separated to prevent a common event from causing a complete failure of the redundant signals. IEEE 379 and IEEE 384 are the design basis for redundancy and separation criteria. Safety class instrumentation will be designed to fail in a safe mode following a component or channel failure. Safety class UPS power will be provided when appropriate.

2.2.6. Nuclear Criticality

Where potential for nuclear criticality exists, the design of the plant will include the basic controls for assuring nuclear criticality safety. Designs will satisfy the double contingency principle, i.e., "'process designs shall incorporate sufficient safety factors so that at least two unlikely, independent, and concurrent changes in process conditions must occur before a criticality accident is possible" from DOE 6430.1B. Basic control methods for the prevention of nuclear criticality include

1. provision of safe geometry (preferred),
2. engineered density and/or mass limitation,
3. provision of fixed neutron absorbers,
4. provision of soluble neutron absorbers, and
5. use of administrative controls.

Although geometric controls are used extensively wherever practical, there are cases where geometric control alone cannot practically provide assurance of criticality safety. In these cases, engineered controls can be used to control moderation, nuclear poisons, mass, and density.

2.2.7. Ventilation

The HVAC system design for new facilities will meet all general design requirements in accordance with DOE 6430.lB, Section 1550, and ASHRAE guides.

while Category I quantities are present. The first option will increase the cost of construction, the second will increase operating expenses by increasing the protective force manpower requirements.

2.3.2.2. Material in Transit

Protection requirements for external shipments/receipts of Category I and II quantities of SNM are implemented by the Transportation Safeguards Division (TSD) of DOE–AL.

Controls for internal transfers of SNM are described in section 2.4.3.4..

2.3.2.3. Access Control

Access to the PA and MAA is restricted to personnel with a need to enter. Entry/exit points to the PA and MAA are equipped with SNM and metal detectors and X-ray scanning equipment as required to detect and prevent unauthorized introduction of contraband items or removal of SNM. All personnel, packages, and vehicles entering/exiting the PA/MAA are subject to searches.

2.3.2.4. Intrusion Detection and Lighting

Intrusion detection systems will be installed at all PA/MAA boundaries, vaults, and vault-type rooms to assure that attempts to penetrate the areas are detected. Lighting will be provided to allow assessment of boundary area alarms.

2.3.2.5. Alarm Assessment

All security alarms will be received and assessed in a central alarm station (CAS). A separately located secondary alarm station (SAS) is required to provide defense-in-depth. The CAS and SAS will be located within the PA.

2.3.3. Material Control and Accountability

2.3.3.1. Accounting System

A single accounting system will be employed for the S&C facility. The system will be computerized database management system employing double entry accounting. The system will have the capability for recording external receipts and shipments, and internal transfers between and within Material Balance Areas (MBAs). The record system will categorize NM by material type, composition, and location. The system must be capable of tracking NM throughout the facility, including each of the processes used to perform S&C activities. For material in storage, the system must be capable of locating items by specific storage locations.

MBAs are established to identify the location of NM in the facility. The MBA structure for the facility must be designed to provide the capability to localize inventory differences. Each MBA should be a single geographical area and contain an integral operation. On the basis of DOE requirements, there will be a minimum of two MBAs for the S&C facility, the shipping/receiving building and the processing plant. Additional MBAs may be desirable to separate accountability for storage areas and the various chemical processes that will operate. An alternative to multiple MBAs in the processing building is to have a single MBA with multiple sub-MBAs. This alternative allows drawing material balances for the various activities, but avoids some of the requirements for transfers of nuclear material across MBA boundaries.

MC&A data is protected at the highest classification level for data in the system. Access to MC&A data is limited on a need-to-know basis. MC&A data stored on the computer system must be backed up daily to supplementary disk files which are stored in a separate location. Data and reports are retained in accordance with the requirements of DOE directives.

2.3.3.2. *Accountability Measurements*

Space and equipment will be provided for the performance of accountability measurements. Quantities of NM on inventory and involved in external/internal transfers are verified and/or confirmed through standardized measurement, sampling, and analytical techniques. The same techniques are used in the performance of plant physical inventories. Various measurement methods are employed, depending upon the type and form of the material, and the purpose of the measurement. Measurements performed for accountability in the S&C facility include mass, volume, nondestructive analysis (NDA), and destructive (chemical) analysis (DA).

2.3.3.3. *Physical Inventories*

Physical inventories are required to be performed at specified intervals to verify the accuracy of the SNM records for each MBA. DOE requires inventories of Category I and II MBAs, other than those MBAs in which processing is performed, every six months. Category I and II MBAs in which processing occurs must be inventoried every two months. An exception to the minimum inventory frequency for storage areas may apply when additional S&S measures above the baseline requirements provide increased assurance of the continuing presence and integrity of the material. Longer inventory intervals are possible provided certain criteria can be met. It has not been determined if the storage areas in the S&C facility can be designed to qualify for extended inventory intervals. The process area will have to meet the two month interval requirement. More specific information of material surveillance measures is contained in section 2.4.3.5.

2.3.3.4. *Material Transfers*

External receipts at the S&C facility will consist of plutonium in the form of metal, oxide, other compounds, and stable residues. Shipments from the S&C facility will be plutonium al Dispositi

- PA entry control points will utilize an automated access control system which does not require the presence of protective force personnel.
- A protective force position staffed 24 hours a day, seven days a week.

2.3.6. Material Control and Accountability

It is anticipated that MC&A functions will be performed on a day shift only schedule, except for unusual circumstances. Estimates for MC&A manpower are as follows.

Nuclear Material Accounting	4 FTEs
Measurement & Measurement Control	4 FTEs
Nuclear Material Control	6 FTEs
Computer Support	2 FTEs
Training	2 FTEs
Administrative/Clerical	2 FTEs
Total	**20 FTEs**

3. Site Map and Land Use Requirements

3.1. Site Map

The site map is represented by Figure 2-2, *Plot Plan* at this point, since this report is based on a generic site.

3.2. Land Area Requirements During Operation

Land area requirements are projected to encompass approximately 3,500 acres with the one mile buffer zone. The actual disturbed land requirement for the facilities is approximately 70 acres, with approximately 20 acres for the actual processing facility (PA).

3.3. Land Area Requirements During Construction

Land area requirements for construction are projected to encompass approximately 20 acres. This land provides space for construction material laydown, warehousing, and parking areas.

4. Process Descriptions

The following process descriptions detail the basic processes associated with the conversion and stabilization processing facility. The basic functions are comprised of shipping and receiving, material management, oxidation/wash, aqueous separation, calcination, repackaging, and waste management as indicated in Figure 4-1, *Process Block Flow Diagram*. The repackaging operation is basically a subset of material handling functions. Primary wastes generated from each process is listed individually. Wastes common to all processes are listed in *Section 4.7, Waste Management*.

4.1. Shipping and Receiving

4.1.1. Shipping and Receiving Function

Receiving provides for unloading feed off transports, removing the items from the shipping containers, confirming the contents and handling abnormal packages. Shipping provides packaging, safety confirmation of containers from the lag vault, and truck loading.

The shipping package staging function includes interim storage of shipping packages awaiting material confirmation, unpackaging, and shipping operations.

The abnormal package handling function includes decontamination of contaminated shipping packages, unpackaging of these shipping packages, and packaging of damaged primary containers for transfer to the plutonium processing facility. The handling of contaminated item is expected to occur on an infrequent basis. The contaminated items are handled in shielded gloveboxes equipped with dismantling tools and decontamination equipment. Most of the abnormal package handling functions are performed manually.

The accountability measurement function includes equipment needed to perform nonintrusive nondestructive assay (NDA) of the primary containers. Any intrusive analysis required of the primary containers is performed in the collocated plutonium processing facility material management areas.

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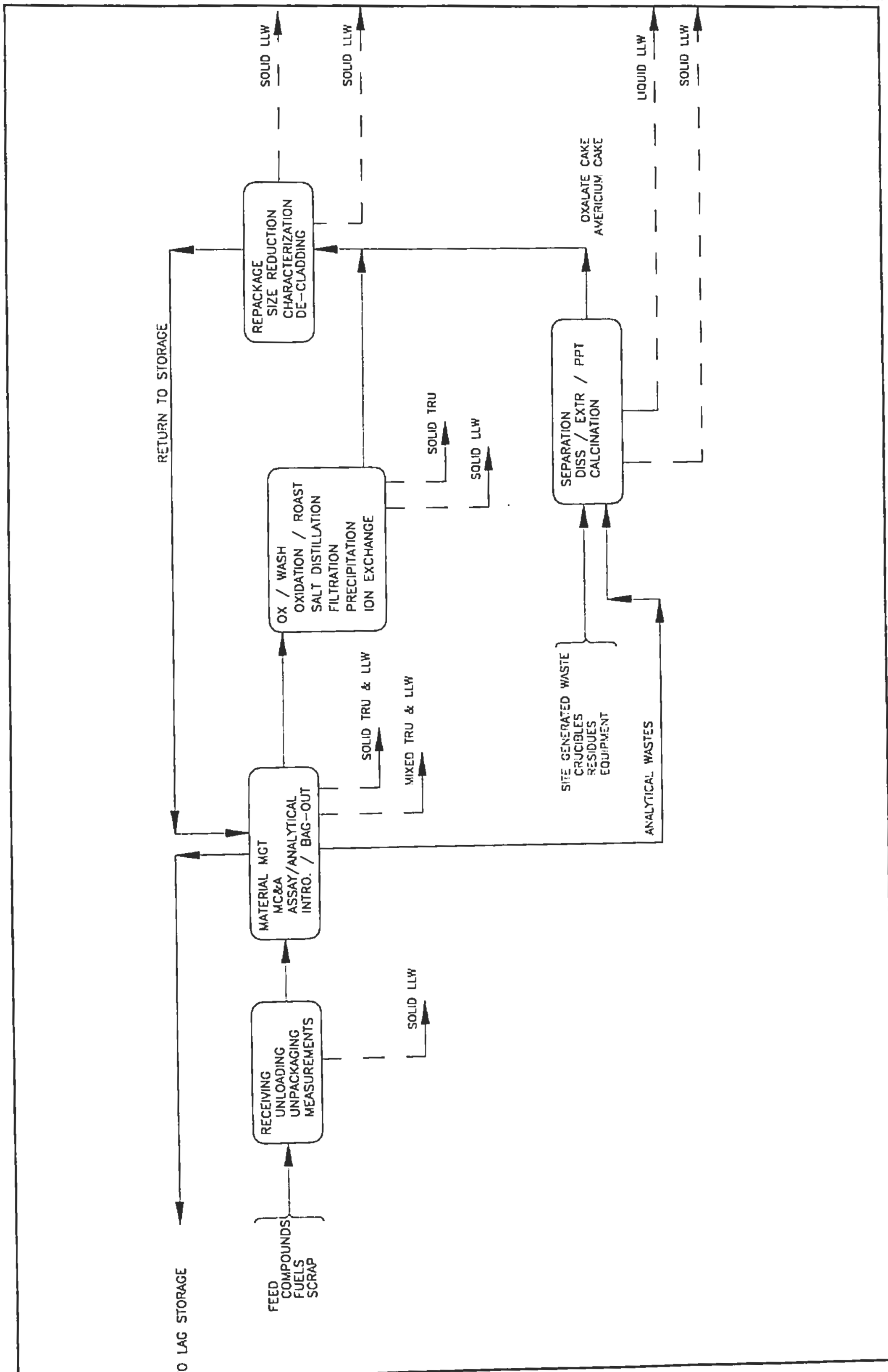
FIGURE 4-1
PLUTONIUM CONVERSION FACILITY
GENERAL PROCESS BLOCK FLOW DIAGRAM



contamination and to protect personnel. Appropriate shielding is required for assay equipment to eliminate the effects of background radiation. Stable temperature and humidity control are needed in some areas for proper functioning of instruments. Outgoing waste and empty shipping packages require monitoring to assure safeguarding of SNM. Viewing capability is required in unpackaging/packaging, accountability measurement, and final vault preparation areas of the facility.

4.1.7. Shipping and Receiving Waste Generated

4.1.7.1. Primary Waste

The primary waste stream sources are described in the functional section. These include:

Damaged secondary containers	Damaged overpack materials
Decontamination solutions	Process wastewater
Lubricants	Hydraulic fluids

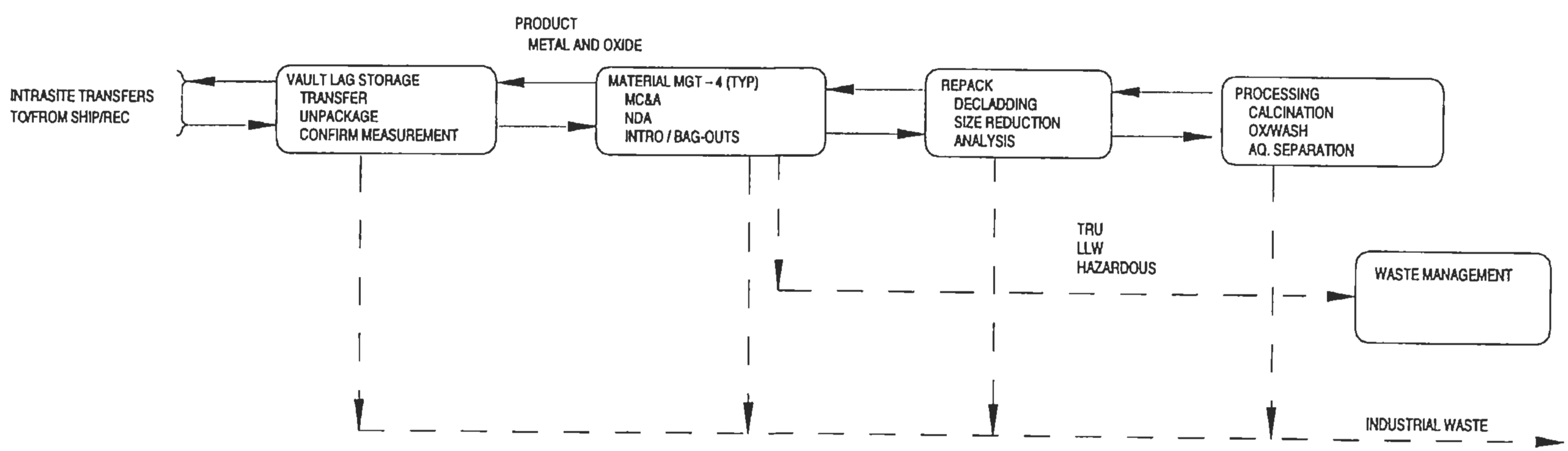
4.2. Material Management

4.2.1. Material Management Function

Material management provides the interface between receiving and processing, and repackaging and storage. Feeds and products are assayed and then stored in short-term "lag" storage (limited to receipt of assay results and normal hold-up for process or shipping schedules) as shown in Figure 4-2, *Material Management Block Flow Diagram.*

Material Management also provides MC&A functions, sampling, NDA, feed segregation, and feed and product preparation. It also provides introduction, bag-out, and various other glove box operations. These functions are required to characterize, verify, and prepare the feeds and products for storage, and control the flow and quality of material into and out of the glove box operations. Material management operations will also require extensive analytical support, with both in-line and remote sample analyses.

FIGURE 4-2
PLUTONIUM CONVERSION FACILITY
MATERIAL MANAGEMENT BLOCK FLOW DIAGRAM



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4.2.2. Material Management Feeds

The material management feeds include the entire feed list for the facility as well as some chemicals and processing materials requiring introduction into the glove box lines. There are, however, separate material management areas for the processing operations.

4.2.3. Material Management Products

Products include the metal and oxide removed from the glove box line ready for transfer to vault storage or the shipping and receiving area. Containers are presumed to be double seal welded steel containers.

4.2.4. Material Management Utilities Required

Electricity - Lighting
HVAC
Sanitary Water
Instrumentation
Glovebox Ventilation

4.2.5. Material Management Chemicals Required

Decontamination Chemicals (Solvents see list sect. 5.1.2)

4.2.6. Material Management Special Requirements

Special requirements include instrument and equipment for weighing, assaying, characterizing, and verifying materials in containers. Vault items must be remotely handled by automated storage and retrieval equipment.

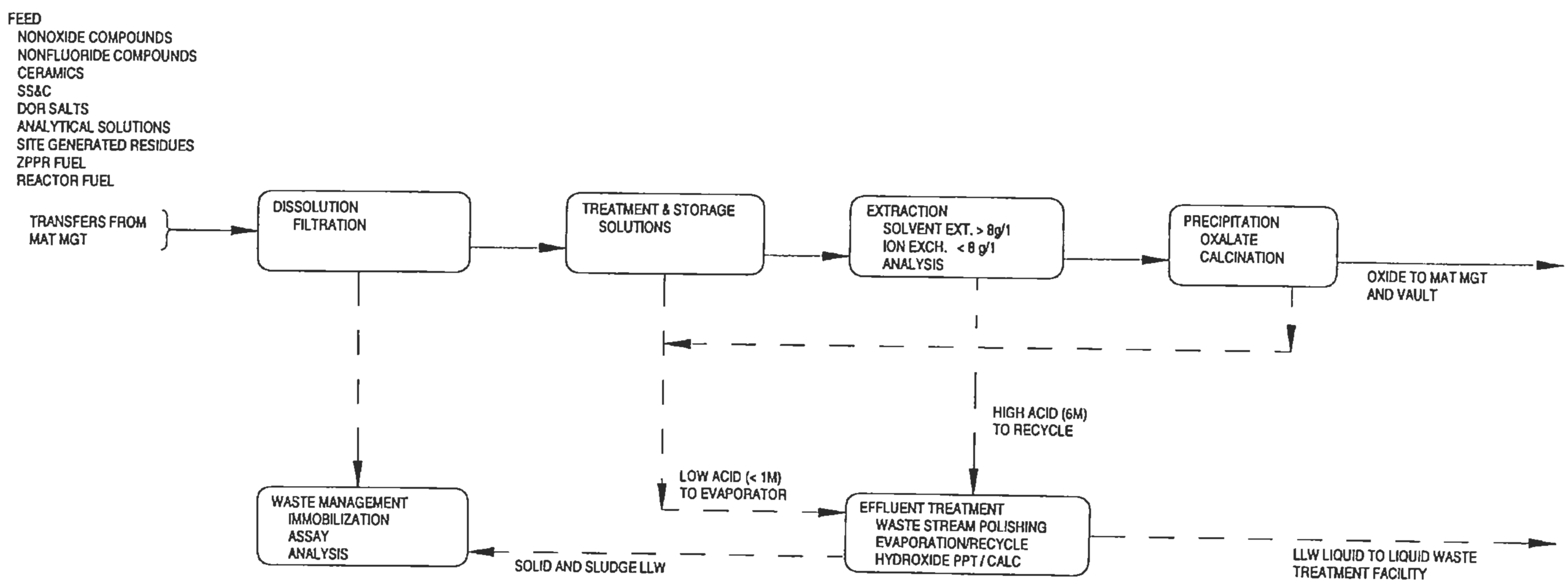
4.2.7. Material Management Waste Generated

4.2.7.1. Primary Waste

The primary waste stream sources are described in the functional section. These include:

Damaged primary containers
Decontamination solutions
Lubricants
Damaged packing materials
Process wastewater
Hydraulic fluids

FIGURE 4-3
PLUTONIUM CONVERSION FACILITY
AQUEOUS SEPARATION BLOCK FLOW DIAGRAM



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4.3.3. Separation Products

Products will be an impure oxide with better than 50% plutonium by weight and a projected recovery better than 90 % of the original plutonium in the feed.

4.3.4. Separation Utilities Required

Plant Water	Dry Air
Demineralized/Distilled Water	Low Pressure Steam
Instrument Air	Condensate Return
Plant Air	Dry Vacuum
Breathing Air	Wet Vacuum
Potable Water	Fire Water
Closed Loop Cooling Water	Electricity
Positive Pressure Chilled Water	

4.3.5. Separation Chemicals Stored Onsite

Aluminum nitrate	Formic acid
Calcium chloride	Hydrochloric acid
Calcium fluoride	Hydrogen peroxide
Hydrofluoric acid	Hydroxylamine nitrate
Nitric acid	Octanol
Calcium carbonate	Potassium hydroxide
Sodium chloride	Dodecane
Sodium chlorite	Liquid nitrogen
Sodium nitrite	Nitrogen
Tributyl phosphate	Oxygen
Magnesium oxide	Argon
Resins	Chlorine
Oxalic Acid	

4.3.6. Separation Special Requirements

Fluoro-polymer lined gloveboxes, coated local ventilation system, point source off-gas scrubbers, and fluoro-polymer or other corrosion resistant process equipment. Special shielded enclosures and remote handling for high exposure items.

4.3.7. Separation Waste Generated

Volumes of all waste are to be minimized, and reagents are to be recycled wherever possible. Radioactivity, toxicity, reactivity and health hazards associated with all wastes are to be low, and operations must be accomplished without adversely impacting the safety of employees or the public.

Treatment of liquid effluents by controlled hydroxide precipitation has historically been the final operation for HCl operations, prior to transferring solutions to Radioactive Liquid Waste Treatment for additional treatment as waste. This has been partially due to the corrosive nature of HCl, which requires that all effluent solutions containing significant chloride be made neutral or basic prior to transfer to Radioactive Liquid Waste Treatment. The inherently corrosive nature of HCl is in fact why it is the media of choice for dissolving many residue matrices. Hydroxide precipitation, combined with a filtration step, also recovers a fraction of actinides from process solutions in the form of a hydroxide cake. There are several problems, however, with hydroxide precipitation as a generic effluent treatment process: 1. many other metal hydroxides coprecipitate creating large cakes; 2. chloride salts can be entrained in the hydroxide matrix, particularly in the case of molar HCl or high chloride salt effluents, causing corrosion concerns for long-term vault storage of the hydroxide cakes; 3. many metal hydroxides are gelatinous, leading to slow filtration and high gamma exposure from americium (Am-241) in this hands-on operation; 4. the filtrate from neutralization remains moderately high in activity, and requires special treatment at Radioactive Liquid Waste Treatment producing more transuranic (TRU) solid wastes; 5. almost all of the chloride from HCl operations is presently lost in the liquid effluent, causing the Radioactive Liquid Waste Treatment outfall to the environment to approach/exceed recommended NPDES limits for chloride concentration.

Hydroxide precipitation remains a good choice for recovery of actinides from some specific processes, but it is not an acceptable choice as a generic treatment for all HCl effluents. Waste minimization efforts have progressed using the strategy of developing specific treatments for individual waste streams. Greatest effort has been expended on actinide decontamination of high molar HCl effluents including anion exchange effluents and solvent extraction raffinates. The chemical makeup of these streams includes all the americium in the process solutions (significant amounts in many residues), small amounts of plutonium lost from purification, about 90% of the total amount of HCl used, and the soluble chloride salts of alkali, alkaline earth, and some transition metals. Americium is often the larger problem in waste streams, due to much higher alpha activity than most plutonium isotopes, and an associated 60 KeV gamma. Efficient recovery of the actinides in high acid effluent streams will have a large impact on processes and wastes from HCl operations.

Decontamination of Pu and Am (as measured by alpha activity) from anion exchange effluents and solvent extraction raffinates varies from 90 to 99% per run. Repeated treatment can reach up to 99.99% overall alpha decontamination. The plutonium and americium are readily stripped from the resins with small elutriant volumes, providing relatively pure solutions. The actinides can then be recovered by oxalate or hydroxide precipitation, followed by calcination, to provide concentrated residues suitable for long-term vault storage.

The decontaminated acid solution is feed for HCl recycle operations, which will further reduce activity, volume, and chloride content of waste effluents. Treatment by extraction chromatography prior to acid recycle operations would result in low activity "evaporator bottoms" for fixation or further treatment. Removal of americium from the processing stream as early and as efficiently as possible has the added benefit of reducing exposure in all subsequent effluent handling and treatment steps. The decontaminated effluent solutions are neutralized, prior to transfer to Radioactive Liquid Waste Treatment, producing relatively small cakes of an activity level that should allow fixation and discard as TRU or LLW waste.

4.3.7.1. Primary Waste

The primary wastes stream sources are described in the functional section. These include off-gas streams, liquid waste, furnace crucibles, evaporator bottoms, and hydroxide filter cakes which are processed as discussed in Section 4.5 Waste Management. The secondary and tertiary wastes are listed in *Table 4-3.*

4.4. Oxidation/Wash

4.4.1. Oxidation/Wash Function

Oxidation/Wash consists of oxidizing carbonaceous components in scrap feeds, such as ash and graphite, providing additional size reduction, and leaching the plutonium from the insoluble residue as indicated in Figure 4-4, *Oxidation/Wash Block Flow Diagram*. The plutonium is then recovered by ion exchange and oxalate precipitation. In addition, each module will incorporate point source effluent treatment including acid recycle, waste stream polishing, and off-gas scrubbing. The feeds to this process are residues containing combustible materials, such as, ash, graphite, insulation, and filters. With graphite feed, all the carbon is oxidized leaving PuO_2 and oxides of impurities in the graphite or mold washes such as erbia. The oxidation of the remaining feed materials produces PuO_2 combined with other metal oxides such as silica or alumina typical of ash. This ash is sent to the wash (leach) process to separate the plutonium from other materials. Offgases are scrubbed and released and salt solutions produced in the scrubbing process are sent to aqueous waste management for disposal. The processing rate of this feed is roughly 116 kg/yr of Pu.

4.4.1.1. Salt Distillation

Salt distillation is included in this function since the unit operations are similar. Sodium and potassium chloride based salts are partitioned from the actinide oxides by temperature controlled distillation of the molten salt and concurrently oxidizing any residual metal. The salt vapors are vacuum extracted to a condenser, solidified and disposed of as a LLW.

4.4.2. Oxidation/Wash Feeds

Table 4-2 ***Oxidation/Wash Feeds***

Material Category	Sub-Category	Description	Rate (kg/yr Pu)
Residue	Ash	Silica, carbon, & various oxides	52.6
Residue	Chloride Salts	ER, MSE Salts	40.9
Residue	Filters & Insulation	HEPA and Insulators	6.3
Residue	Graphite	Graphite heels and particles	9.3
Residue	Sludge	Ferrite, cutting solvents, filter sludge	3.3

4.4.3. Oxidation/Wash Products

Same as Separation. (Section 4.3.3.)

4.4.4. Oxidation/Wash Utilities Required

Plant Water
Demineralized/Distilled Water
Instrument Air
Plant Air
Breathing Air
Potable Water
Closed Loop Cooling Water
Positive Pressure Chilled Water
Dry Air
Low Pressure Steam
Condensate Return
Dry Vacuum
Wet Vacuum
Fire Water
Electricity

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FIGURE 4-4
PLUTONIUM CONVERSION FACILITY
OXIDATION / WASH BLOCK FLOW DIAGRAM

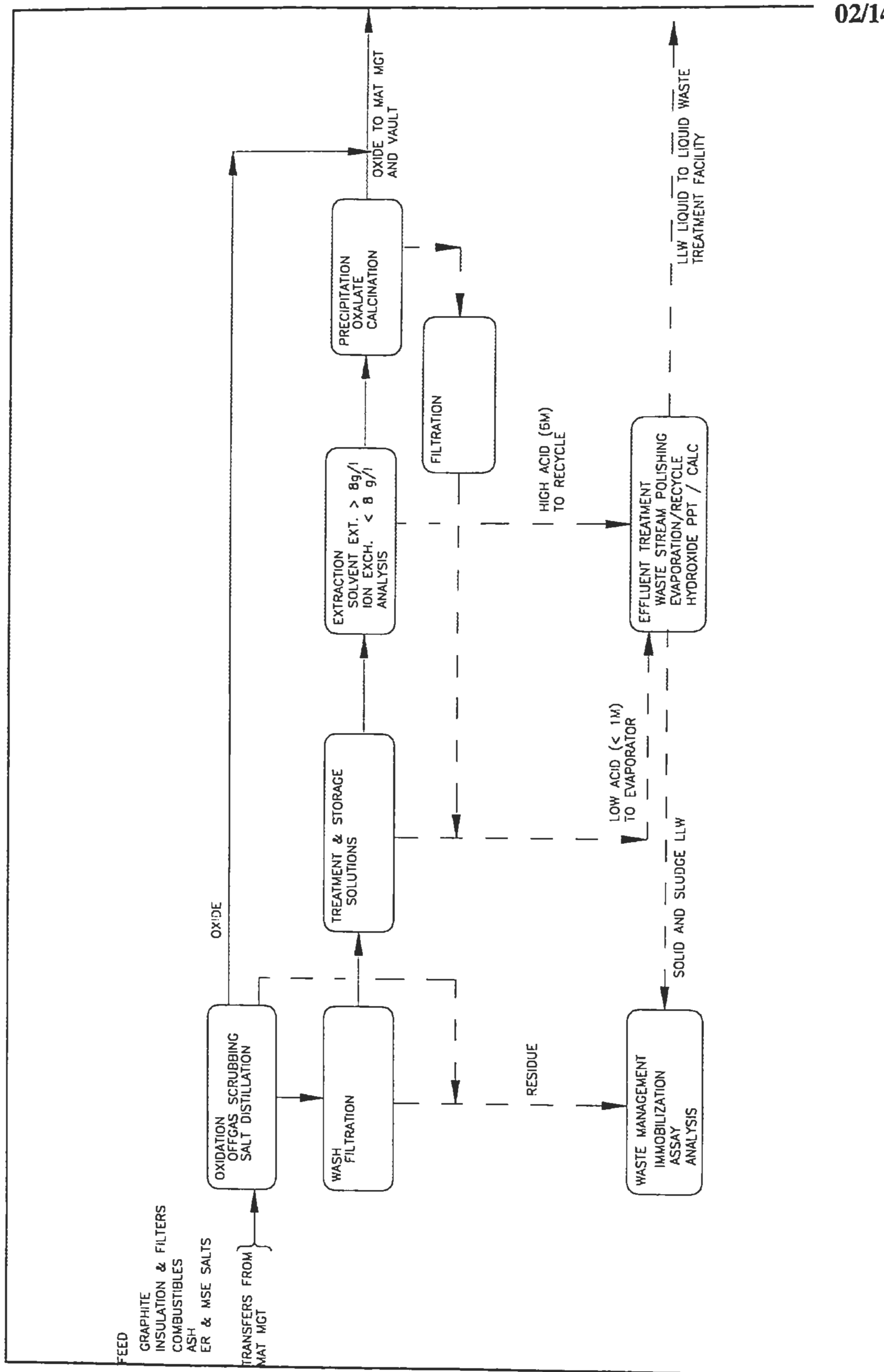


Table 4-3 *Waste Management Secondary and Tertiary Wastes*

Waste	Description	Waste Type
Secondary Waste		TRU
Leaded Gloves	Glovebox gloves	TRU Mixed
Filters	HEPA and pre-filters	TRU Combustible
Plastic	Plastic bags and bottles	TRU Combustible
Glass	Changing windows	TRU Non-Combustible
Rubber	Window gaskets	TRU Combustible
Metal	Tools, Failed equipment	TRU Non-Combustible
Combustibles	Rags, paper wipes	TRU Combustible
Solutions	Decon. sol'n, Hyd. fluids	TRU Liquids
Tertiary Waste		LLW
Surgeon Gloves		LLW Combustible
Room Trash		LLW Combustible

4.5.1. Waste Management Function

The Waste Management System involves the collection, assaying, sorting, treatment, packaging, storage, and shipment of radioactive, hazardous, and mixed wastes from plutonium conversion and hazardous and nonhazardous waste from the support facilities.

a. Initial sorting of solid waste (TRU, LLW, hazardous, mixed, etc.) is performed at the generation source. Solid wastes are treated by a variety of processes to ensure that they are in compliance with EPA, RCRA, and DOE requirements. The treatment processes include thermal treatment for combustibles and passivation for reactive metals. Waste products are immobilized and packaged to meet DOT and DOE requirements. Liquid organic wastes are separated and dispositioned, along with solid organics.

b. Radioactive liquid wastes (aqueous chloride, aqueous nitrate, and laundry waste) are neutralized, filtered, precipitated, concentrated by evaporation, immobilized, and packaged for appropriate disposal. Radioactive liquid waste will be processed and recycled to the maximum extent possible at the point of generation.

c. Mixed LLW is stored either before or after treatment until delisting allows disposal as radioactive waste. Mixed TRU wastes are handled as other TRU wastes.

d. Nonhazardous, nonradioactive solid, aqueous and gaseous wastes are treated in conformance with standard industrial practice. Solid wastes are either disposed of on-site or sent to a commercial recycle center. Aqueous wastes are discharged to natural drainage channels. Gaseous wastes are released to the atmosphere.

A block flow diagram depicting the Waste Management System is shown on Figure 4-5.

4.5.4. Waste Management Utilities Required

4.5.4.1. Plant water

Demineralized/distilled water	Closed loop cooling water system
Positive pressure chilled water	Cooling water
Low pressure steam	Condensate
Fire water	

4.5.5. Waste Management Chemicals Stored Onsite

Portland cement	Hydrogen peroxide
Diatomaceous earth	Hydrochloric acid
Sodium sulfite	Sulfuric acid
Aluminum sulfate	Phosphoric acid
Bentonite	Sodium hydroxide
Iron (Ferrous sulfate)	Nitrogen
Magnesium (Magnesium sulfate)	
Calcium (Lime)	
Potassium hydroxide	

4.5.6. Waste Management Special Requirements

Operations handling radioactive TRU waste are carried out in enclosed rooms with remote equipment; some operations are conducted in gloveboxes and are provided with scrubbers to clean gaseous effluents.

5. Resource Needs

5.1. Materials/Resources Consumed During Operation

5.1.1. Utilities Consumed

Table 5-1 *Utilities Consumed During Operation*

Utilities	Annual Average Consumption	Peak Demand[1]
Electricity	21,000 MWh	5 MW
Diesel Fuel	10,500 gals.	
Natural Gas[2]	154,000,000 scf	
Raw Water	21,260,000 gals.	

1. Peak demand is the maximum rate expected during any hour.

2. Standard Cubic Feet measured at 14.7 psia and 600F.

5.1.2. Chemicals Consumed

Solid, liquid, and gaseous chemical requirements are listed in Table 5-2. In addition to the chemicals listed in Table 5-2, the analytical laboratories require one to two thousand chemicals (mainly organic), that are used in small quantities.

Table 5-2 *Chemicals - Maximum Onsite Storage Capacities*

LIQUID CHEMICALS	Capacity (l)	SOLID CHEMICALS	Capacity (kg)
Hydrochloric Acid (12M)	10000		
Sulfuric Acid (98 %)	500	Oxalic Acid	25
Formic Acid	500	Calcium Carbonate	60
Hydrogen Peroxide	100	Calcium Fluoride	12
Hydroxylamine Hydrochloride	200	Magnesium Oxide	40
Hydrofluoric Acid	50	Ferrous Ammonium Sulfate	3
Nitric Acid	2000	Sodium Carbonate	12
Potassium Hydroxide	10000	Sodium Chloride	3
Dodecane	40	Sodium Chlorite	5
Liquid Nitrogen	100 (lbs)	Sodium Nitrite	5
Ammonia	100	Sodium Hydroxide	25
Octanol	40	Resin	10
Tributyl Phosphate	20	Silver Nitrate	4
Phosphoric Acid (50%)	300	Diatomaceous Earth	1200
GASEOUS	Trailers	Portland Cement	50000
Argon	4	Bentonite	100
Hydrogen (P10)			
Nitrogen	2		
Oxygen	1		
Helium	8		

Cleaning solvent will be selected from the following list of nonhalogenated liquids.

Ashland 140-Solvent-66	Diglyme
Pensolve L1060	Tetradecane
Dodecene	Butyl Lactate
Spartan TH-9-33A	De-solv-it without surfactant
1-Hexanol	Diacetone
3-Methlcyclohexanol	Methyl acetoacetate
1-Octanol	Actrel 1960 L
2-Butoxyethanol	Actral 3360 L

5.2. Materials/Resources Consumed During Construction

Table 5-3 indicates the materials/resources consumed during construction.

Table 5-3 ***Materials/Resources Consumed During Construction***

Materials / Resources	Total Consumption	Peak Demand
Utilities		
Electricity		0.5 MW Peak
Water	3,736,000 gals	6,000 GPD
Solids		
Concrete	48,000 cu. yd.	
Steel	4,500 tons	
Liquids		
Fuel	250,200 gals	
Gases		
Industrial Gases	700,000 scf[1]	

1. Standard Cubic Feet measured at 14.7 psia and 60 F.

6. Employment Needs

6.1. Employment Needs During Operation

Staffing requirement estimates for the Plutonium Plant are shown in Table 6-1, *Employment During Operation*. The data presented in Table 6-1 includes employees from the management and operating (M&O) contractor, support organizations, and DOE. The estimates are reported by labor categories described in Section 6.1.2.

Table 6-1 ***Employment During Operation***

Labor Category	Number of Employees
Officials and Managers	110
Professionals	300
Technicians	150
Office and Clerical	45
Craft Workers	160
Operatives	180
Laborers	17
Service Workers	60
TOTAL EMPLOYEES	1022

6.1.1. Badged Employees at Risk of Radiological Exposure

Employees who are assigned to, or routinely enter, and work in the material access areas would be expected to receive some radiological exposure. It is estimated that these employees would represent 56 percent of the plant population, or 572 employees. In addition, a small fraction of badged visitors may enter the radiological area, but this is envisioned to be on a nonroutine basi

6.1.2. Labor Category Descriptions

The labor categories used in Table 6-1 are defined in the following sections. These categories are standard Equal Employment Opportunity (EEO) categories. The definitions have been adapted from those used at the Y-12 Plant in Oakridge, TN.

6.1.2.1. Officials and Managers

Occupations requiring administrative and managerial personnel who set broad policies, exercise overall responsibility for execution of these policies, and direct individual departments or special phases of a firm's operations. Included in this category are officials, executives, middle management, plant managers, department managers and superintendent salaried supervisors who are members of management, and purchasing agents and buyers.

6.1.2.2. Professionals

Occupations requiring either a college degree or experience of such kind and amount as to provide a comparable background degree. Included in this category are accountants and auditors, architects, artists, chemists, designers, editors, engineers, lawyers, librarians, mathematicians, natural scientists, registered professional nurses, personnel and labor relation specialists, physical scientists, physicians, social scientists, and teachers.

6.1.2.3. Technicians

Occupations requiring a combination of basic scientific knowledge and manual skill which can be obtained through two years of post high school education, such as is offered in many technical institutes and junior colleges, or through equivalent on-the-job training. Included in these occupations are computer programmers, drafters, engineering aides, junior engineers, mathematical aides, licensed, practical or vocational nurses, photographers, radio operators, scientific assistants, surveyors, technical illustrators, and technicians (medical, dental, electronic, physical science).

6.1.2.4. Office and Clerical

This category includes all clerical-type work, regardless of level of difficulty, where the activities are predominantly nonmanual, though some manual work not directly involved with altering or transporting the products is included. Included in this category are bookkeepers, collectors (bills and accounts), messengers and office helpers, office machine operators (including computer), shipping and receiving clerks, stenographers, typists and secretaries, telephone operators, and legal assistants.

6.1.2.5. Craft Workers (skilled)

Manual workers of relatively high skill level having a thorough and comprehensive knowledge of the processes involved in their work. Exercise considerable independent judgment and usually receive an extensive period of training. Included in this category are the building trades, hourly paid supervisors and lead operators who are not members of management, mechanics and repairers, skilled machining occupations, compositors and typesetters, electricians, engravers, painters (construction and maintenance), and pattern and model makers.

6.1.2.6. Operatives (semiskilled)

Workers who operate machine or processing equipment or perform other factory-type duties of intermediate skill level which can be mastered in a few weeks and require only limited training. Included in this category are apprentices (auto mechanics, plumbers, bricklayers, carpenters, electricians, machinists, mechanics, building trades, metalworking trades, printing trades, etc.), operatives, attendants (auto service and parking), blasters, delivery workers, furnace workers, laundry operatives, milliners, motor operators, oilers and greasers (except auto), painters (manufactured articles), photographic process workers, stationary firefighters, truck drivers, welders and flamecutters, electrical and electronic equipment assemblers, inspectors, testers and graders, and handpackers and packagers.

6.1.2.7. Laborers (unskilled)

Workers in manual occupations which generally require no special training who perform elementary duties that may be learned in a few days that require the application of little or n independent judgment. Included in this category are garage laborers, car washers and greasers, groundskeepers and gardeners, stevedores, laborers performing lifting, digging, mixing, and loading and pulling operations.

6.1.2.8. Service Workers

Service Workers includes both protective and nonprotective service occupations. Included i this category are attendants (hospital and other institutions, professional and personal servic including nurses' aides, and orderlies), cooks, counter and fountain workers, elevator operators, firefighters and fire protection, guards, doorkeepers, stewards, janitors, police officers and detectives, recreation facilities attendants, guides, and public transportation attendants.

6.2. Employment Needs During Construction

Employment needs during construction are presented in Table 6-2.

Table 6-2 ***Number of Construction Workers Needed by Craft and by Year***

Employees	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Craftworkers						
Carpenter	36	70	67	36	22	22
Electrician	6	14	25	42	45	25
Ironworker	17	45	39	11	8	8
Concrete Mason	6	8	6	3	3	3
Laborer	25	39	31	11	11	11
Pipefitter	6	17	36	39	36	14
Operator	6	14	17	11	8	6
Sheet Metal Worker	3	8	17	17	8	3
Sprinkler Fitter	3	6	8	8	6	3
Teamster	3	3	3	3	3	3
Other Craftworkers	3	6	8	14	11	3
Total Craftworkers	**115**	**232**	**260**	**202**	**168**	**104**
Construction Management and Support Staff	42	87	98	78	64	36
Total Employment	**157**	**319**	**358**	**280**	**232**	**140**

7. Wastes and Emissions From the Facility

7.1. Wastes and Emissions During Operation

7.1.1. Emissions

Emissions released from the Pu Plant during operations are made up of various gases used or otherwise generated as a result of the various activities involved in the plutonium conversion operations. However, all gaseous effluent streams coming from the Pu Plant are thoroughly scrubbed and/or filtered to remove or reduce the amount of undesirable particulates before they are released to the vent streams. The analytical laboratories may contribute additional emissions in very minute quantities. A majority of the chemicals, mainly organic compounds, are used as standards, typically at the 1,000 ppm level. By the time any volatile or semi volatile components of the standards and other chemicals join the exhaust streams, they are expected to be at the sub ppb level.

The emissions to the atmosphere are shown in Table 7-1. The laboratory emissions, with the exception of methanol, are not shown in this table.

Table 7-1 *Annual Emissions During Operation*

Description	**Quantity** (kg)
Chlorine	7.5
Hydrogen Chloride	12
Hydrogen Fluoride	0.8
Hydrazine	< 1
Ethanol	20
Nitric Acid	3
Phosphoric Acid	< 1
Sulfuric Acid	< 1
Dodecane	0.1
Octanol	0.1121
Lead	TBD
VOC (Volatile Organic Compounds)	TBD

Table 7-1 ***Annual Emissions During Operation continued***

Carbon Monoxide	4,000(2)
TSP (Total Suspended Particulates)	12
Oxides of Nitrogen	4,500(3)
Sulfur Dioxide	10(2)
Hydrogen	16
Ammonia	10
Tritium	< DT
TBP (Tributyl Phosphate)	0.1
TCE (Trichloroethylene)	450
Cleaning Solvent	100(4)
Cement (Particulates)	< 50
Diatomaceous Earth (Particulates)	< 2
Oxalic Acid (Particulates)	< 1
Plutonium Oxide (Particulates)	64×10^{-8} (18.0 uCi/yr)

(1) Below detectable level

(2) Combustion product only

(3) Combustion and process emission

(4) Cleaning solvent will be selected from the following list of RCRA-approved liquids.

Ashland 140-Solvent-66 Diglyme
Pensolv Ll 060 Tetradecane
Dodecane Butyl Lactate
Spartan TH-9-33A De-solv-it without surfactant
1-Hexanol Diacetone
3-Methlcyclohexanol Methyl acetoacetate
1 -Octanol Actrel 1960 L
2-Butoxyethanol Actrel 3360 L

7.1.2. Solid and Liquid Wastes

7.1.2.1. Radioactive Wastes

Radioactive wastes generated from the plant are made up of Transuranic Wastes (TRU), Transuranic Mixed Wastes, Low Level Waste (LLW), and Low Level Mixed wastes. No High Level Wastes (HLW) are generated. Most of the radioactive wastes (TRU, LLW, and Mixed) are generated by the process units in the Pu Processing and Manufacturing functions. During normal operation, no radioactive wastes (TRU or mixed TRU) are expected to be generated in Pu Storage since normal receipts of incoming materials are free from contamination and no container leakage will normally occur within the storage vault. Low level liquid wastes generated in Pu Storage are liquid wastes from solutions that are used during infrequent decontaminations of containers and from laboratory solutions, scrubber solutions from stacks and exhaust systems. Low level mixed wastes can originate from potentially contaminated lubricants and hydraulic fluids used for material handling equipment. Low level solid wastes are made up of packaging materials, HEPA filters, glovebox parts, protective clothing, decontamination materials (swipes, mops, etc.), and damaged equipment. Low level solid mixed wastes may originate from wipes laden with contaminated oils and hydraulic fluids.

All radioactive wastes generated from the Pu Plant are discharged from the facility in solid form only. Solid radioactive wastes produced are treated and then packaged/immobilized in the solid waste treatment area, while the radioactive liquid wastes are concentrated and then immobilized and packaged in the liquid waste treatment area. LLW would be disposed of in an onsite or offsite DOE approved LLW disposal facility. Mixed wastes are temporarily stored in the plant site until the permanent disposal method is determined. TRU and TRU-mixed wastes are transported to WIPP. Radioactive waste quantities are shown in Table 7-2.

7.1.2.2. Hazardous Wastes

Hazardous solid waste materials generated from the Plutonium conversion operation consist of nonradioactive materials such as lead packing and wipes used in Pu Storage and materials contaminated with oils, lubricants, and cleaning solvents that are used for equipment outside the main processing units in Pu Processing and Manufacturing. Hazardous solids are compacted and sent to an authorized RCRA disposal site. Hazardous waste quantities are shown in Table 7-2.

Hazardous liquid wastes generated from the Plutonium conversion operation include cleaning solvents, cutting oils, vacuum pump oils, film processing fluids, hydraulic fluids from mechanical equipment, antifreeze solutions, and paint. All hazardous liquid wastes are collected in DOT-approved containers and shipped to an authorized RCRA disposal site. Waste quantities are shown in Table 7-2.

Rainwater runoff from the property is discharged directly to the natural drainage channels. Runoff from the PA and the LA are collected in storm water ponds and then sampled and analyzed before discharge to the drainage channels. If the runoff is contaminated, it is treated in the process water treating system.

7.2. Wastes and Emissions Generated During Construction

This section presents the significant gaseous emissions and wastes generated by the Plutonium conversion operation during construction.

7.2.1. Emissions

Air pollutants are emitted during Plutonium conversion operation construction. The principal sources of such emissions are fugitive dust from land clearing, site preparation, excavation, and other construction activities; exhaust from construction equipment; and vehicles delivering construction materials and carrying construction workers. The peak annual emissions generated during construction are shown in Table 7-3.

Table 7-3 *Emissions During a Peak Construction Year*

Chemical	Emission (tons)
Sulfur dioxide	4
Oxides of nitrogen	40
Volatile organic compounds	12
Carbon monoxide	65
Particulate matter (10 microns and smaller)	20
Total suspended solids	45

7.2.2. Solid and Liquid Wastes

The solid and liquid wastes generated during construction include concrete and steel constructi waste materials and sanitary waste water. The steel construction waste material will be recycl as scrap material before completing construction. No radioactive or mixed wastes are generat during construction. The total quantities of solid and liquid waste generated during constructi are shown in Table 7-4.

Table 7-4 ***Total Wastes Generated During Construction***

Waste Category	Quantity
Nonhazardous Solids	
Concrete	5,150 cu yd
Steel	380 tons
Nonhazardous Liquids	
Sanitary	20,017,000 gals.

8. Design Process For Accident Mitigation

8.1. Operational, Design Basis, and Beyond Design Basis Bounding Accidents

The experience gained in the design, construction, modification, and decommissioning of the facilities of the existing nuclear weapons complex will be utilized in the design process for the Plutonium Conversion Facility. This information will also be employed in the safety assessment to better estimate performance and improve the safety of the new Plutonium Conversion Facility.

Safety analysis reports and DOE Defense Production safety surveys provide information from which bounding accident scenarios for plants of the existing complex, relevant to this facility, have been selected. Bounding accident scenarios are those accidents of a class involving a particular hazard and that result in the largest potential consequence for a particular accident initiator. These selected scenarios provide a vehicle for explaining how the application of current safety assessment methodologies, design criteria, and industry consensus codes and standards will be used to provide a modern facility with design features that prevent or mitigate the consequences of these accidents. It is emphasized that the design process for the facility will be comprehensive and will evaluate a broad spectrum of hazards and accident initiators as well as design approaches to risk reduction. The safety analysis will include deterministic accident analysis as well as probabilistic risk assessment.

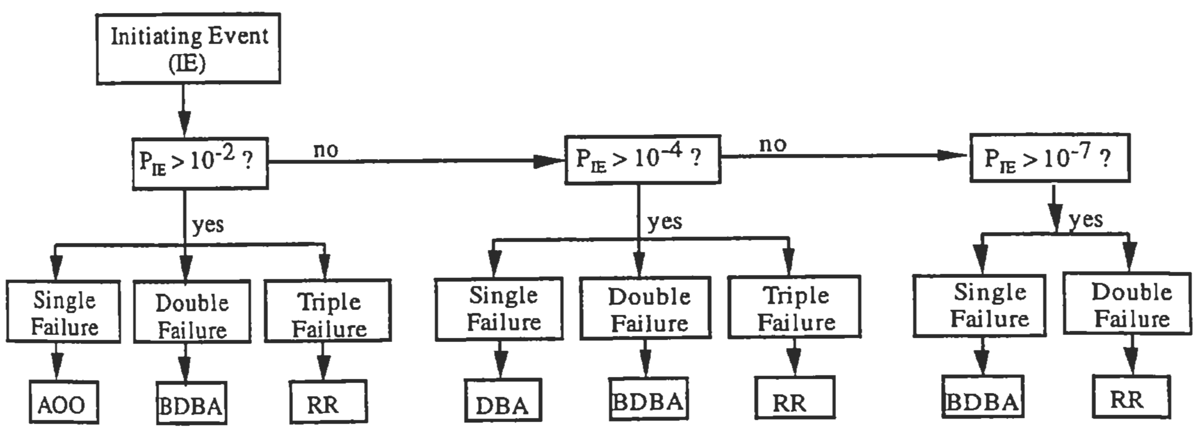
DOE orders require that special safety equipment be redundant and be able to withstand a single failure. DOE order 6430.1A, section 1300-3.3 states: "The design shall ensure that a single failure . . . does not result in the loss of capability of a safety class system to accomplish its required safety functions. To protect against single failures, the design shall include diversity to minimize the possibility of concurrent common mode failures of redundant items."

Also: "Safety class items are systems, components, and structures, including portions of process systems, whose failure could adversely affect the environment or the safety and health of the public. Specifically, safety class items are those systems . . . whose failure would produce exposure consequences."

In the accident scenario descriptions that follow, the systems of particular relevance include the confinement system, which is defined as a composite of the structure and its associated ventilation systems and the fire protection systems. These must remain "fully functional following any credible design basis accident (DBA)." This requires that accident scenarios that would disable such systems be reduced in probability, as determined by PRA, to beyond design basis accident (BDBA) levels through a combination of appropriately engineered systems and administrative controls.

In safety analysis reports, detailed hazards analyses are utilized to determine which potential accidents to analyze deterministically. To determine event catagories, probabilities can be determined for the sequence of events leading to a potential accident as identified as part of an event tree analysis. Materials at risk and potential dispersal mechanisms are identified to determine areas with the potential for accidents with radiological material release. In this report, there is insufficient information to determine sequences of events. Rather, processes believed to have the most material at risk were identified and potential accidents assumed. To categorize accidents as operational and design basis or beyond design basis, given the lack of accident frequency information, a methodology developed by the USNRC (unpublished) was used. Figure 8-1 illustrates this methodology. An estimate for the probability of the initiating event is required but the probabilities for other failures are not required. Systems are assumed to be safety class systems with sufficient redundancy that a single failure would not disable the system. This methodology was developed f nuclear reactors but is a reasonable tool for similar preliminary determination of event categories f nonreactor nuclear facilities. In estimating accident probabilities, accidents classifications were determined based on this methodology and probability estimates assigned based on similarity to published accident analyses and the limitations of the event category. If the assumption is made th the plutonium at risk is from pit disassembly, a typical isotopic concentration is <0.01 wt % Pu-23 <6 wt% Pu–240, < 0.8 wt% Pu-241 with the balance being Pu-239.

Figure 8-1 Accident Classification Methodology Diagram



P_{IE} - probability of occurrence of initiating event (per year)

AOO - anticipated operational occurrence

DBA - design-basis accident

BDBA - beyond design-basis accident

RR - residual risk (sufficiently small to represent negligible public risk)

Single Failure - 1 single active component failure or 1 operator error

Double Failure - 1 system failure, or 2 component failures, or 2 operator errors

Triple Failure - more than Double Failure

DATA REPORT FOR
PLUTONIUM CONVERSION FACILITY

02/14/96

Several accident scenarios have been identified as likely to have credible relevance for the facility. These potential accidents have been identified based on operating experience at Los Alamos National Laboratory's Plutonium Facility. Because of the enormity of the analysis that would be required to study all credible accidents, only accidents of particular interest are quantified for analysis of their frequency and contribution to risk. Such accidents are invariably those that are not often observed. In fact, at the Los Alamos Plutonium Facility the frequency of occurrence over the 15 yr operation history of the plant has been zero. The most likely accidents at the Los Alamos Plutonium Facility have been identified as those which involve plutonium solutions.

A more formal accident analysis was performed for the Los Alamos Plutonium Storage Facility. The results of this analysis have been considered and pertinent results are examined and reported in the following paragraphs.

In all cases, three major types of accidents have been identified. These are fire, explosions, and leaks/spills of nuclear material.

To analyze these postulated accidents, the methodology in reference 8-4 was used. The source term is estimated by

MAR x DR x ARF x RF x LPF

where:

MAR	= Material-at-Risk (curies or grams),
DR	= Damage Ratio,
ARF	= Airborne Release Fraction (or Airborne Release Rate for continuous release),
RF	= Respirable Fraction, and
LPF	= Leakpath Factor.

To estimate source terms using this equation, the material-at-risk (MAR) was estimated from a knowledge of the processes to be employed. The damage ratio (DR) was assumed to be one. The airborne release fraction (ARF) and (RF) were estimated utilizing the reference material in reference 8-4. For operational and design basis cases the leakpath factor (LPF) was based on two stages of HEPA filtration with efficiencies assumed to be 0.999 and 0.998. For one of the BDBA accidents, the methodology of reference 8-5 was used to calculate a LPF. For the others, LPF was taken from similar cases in safety analysis reports.

8.1.1. Operational and Design Basis Accidents

Operational Accidents are those accidents in the facility that may reasonably be expected to occur within the lifetime of the facility or at a similar facility. This includes accidents such as spills of chemical or radioactive material, and small fires. Downtime following an operational accident should be small. DBAs are more severe but still credible accidents. These accidents are not expected to occur during the lifetime of the facility. The facility design, engineered safety systems, and administrative controls/standard operating procedures are based on minimizing the likelihood of a DBA or more severe accident and also mitigating the consequences of a DBA should such an accident occur.

8.1.1.1. Design Basis Fires

Facility design and administrative controls assure that flammable material loadings are minimized in the plutonium processing areas. Only small quantities of flammable liquids and gases are allowed as needed for processing. Typically the bottles for gases are located outside the process cells so that a wall capable of withstanding a large scale explosion is located between flammable gas bottles and process cells. Also, the gloveboxes are maintained with an inert atmosphere. Large sources of flammable gases and liquids are located well away from the plutonium processing building. Natural gas goes only to the heating plant located a sufficient distance from the plutonium building to prevent damage from a natural gas explosion. Hot water and process steam, if necessary, are piped to the plutonium processing facility. Large quantities of flammable liquids, i.e. diesel for the backup generators, are also located well away from the plutonium processing facility.

The manufacturing building will be designed with passive fire rated barriers to withstand the maximum possible fire, and contain the fire within the given compartment in the event of failure of all fire detection and suppression systems.

The automatic sprinkler systems located in the plutonium processing areas will be safety class to insure their operability and to minimize the possibility of a release due to fire. In the event the loading dock system is taken out of service, compensatory measures would be implemented. In addition to automatic sprinkler systems the plutonium processing areas would have smoke detection equipment installed throughout the facility.

A typical bounding fire is a fire on an open loading dock caused by welding, cleaning solvents, electrical shorts, or other miscellaneous causes. Typically, a loading dock would b an enclosed part of the CAT-I structure and this scenario would require a significant failure follow at least administrative controls. A single drum of combustible waste is involved in t fire. The material at risk is 18 g of plutonium. An ARF of 4.3 x 10^{-3}, (reference 8-4) an R of 1, and LPF of 1 results in an initial source term of 0.8 g of plutonium. We estimate the probability of this event as approximately 10^{-3} to 10^{-4} per yr. We assume that 4 people are in the vicinity of the fire as it starts. We also assume that there are 250 total workers at the site.

A bounding DBA fire case for a fire inside the facility was determined by combining assumptions from several Los Alamos Plutonium Facility safety analyses and applying the equation given above. It is assumed that a process cell contains a glove box used for millin plutonium powder. The gloves have become coated with a layer of plutonium dust. Estimates place this glove loading at < 2 g per glove. For this analysis the MAR is assume to be 2 g of Pu dust on each of 12 gloves for a total of 24 g of Pu. It is further assumed that the gloves are stowed outside the glovebox. A flammable cleaning liquid such as acetone or isopropyl alcohol is brought into the process cell in violation of operating procedures, spills and ignites. The initial extent and intensity of the fire are sufficient to completely incinerate the gloves. The sprinkler system activates and protects the glovebox from further damage. Examination of pertinent cases in reference 8-4 shows ARFs < 0.1. Consequently the ARF is taken as 0.1 and the RF as 1.0. We assume for purposes of calculating a bounding source term that the sprinkler system does not remove any of the airborne plutonium. Air flows from the room into the glovebox so it is assumed that no plutonium beyond the material originally on the gloves gets into the room. The ventilation system with HEPA filters continues to function through the accident. An LPF of 2×10^{-6} is therefore used. The net source term for plutonium released from the stack is 4.8×10^{-6} g. We estimate that the probability for this accident is in the range of 10^{-3} to 10^{-5} per year. Again, we assume that 4 people are in the vicinity of the fire as it starts and that there are 250 total workers at the site.

8.1.1.2. Design Basis Explosion

Explosives are not allowed in the plutonium processing areas of the facility. The only explosives allowed within the site protected area will be DOT Class "C" explosives. Examples of Class "C" explosives are squibs used to activate mechanical devices and ammunition for firearms. The only Class "C" explosives (other than ammunition carried by physical security personnel) are confined to the area where transport vehicles are unloaded. These explosives are associated with physical security devices located in the transport vehicles. These devices are completely enclosed and the hazardous effects are contained if the device is activated.

Materials such as hydrogen and oxyacetylene are used in the facility. Natural gas lines are not present in the process areas and bottled gasses are used instead. The design process will include a comprehensive assessment of possible accident scenarios involving material at risk. Mitigating design features will be incorporated, as required by the safety analysis.

The facility will only accept material that has been certified as being chemically stable before shipment to the plant. Several steps are being considered for assuring the long-term stability of stored Pu and, therefore, minimizing the likelihood of an over-pressurization incident. Parameters for safe storage, such as chemical form and concentration of impurities, will be defined. Storage conditions necessary to ensure safe long-term storage will be defined and the vault designed to maintain these conditions.

A bounding DBA explosion is a conflagration of a flammable gas mixture inside a glovebox. Normally, gloveboxes operate with an inert atmosphere. Small quantities of hydrogen may be used in processing. It is assumed that through some unforeseen set of failures, a combustible gas mixture accumulates inside a glovebox and is ignited, possibly by an electrical spark from an operating electrical device. The glovebox identified as having the most material-at-risk contains the milling operation where plutonium oxide is milled to a fine powder. The criticality limit for plutonium oxide in a dry atmosphere is assumed to be 10 kg (taken from a Los Alamos TA-55 standard operating procedure). The conflagration blows out the HEPA filter from the glovebox ventilation system exit. Gloves may also be blown out. The room volume and duct system volumes are sufficient to attenuate the pressure wave to levels below the approximately 2 psi needed to damage the building ventilation system HEPA filters for the conflagration of a credible build-up of a flammable gas mixture in a glove box. Reference 8-4 does not contain any cases that correspond exactly to this situation. An ARF of 0.1 bounds most of the cases that have some common features with the postulated situation. We believe that an ARF of 0.1 is conservative because the openings to the room are small relative to the size of the glovebox. The plutonium oxide particle size distribution is unknown at this time. For this analysis an RF value of 0.5 is assumed. As in the previous case the building HEPA filters and ventilation system continue to operate yielding an LPF of 2×10^{-6}. The release from the stack is then 1×10^{-3} g of plutonium. We estimate that the probability for this accident is in the range of 10^{-3} to 10^{-5} per year. We assume that 4 people are in the vicinity of of the glovebox and that there are 250 total workers at the site.

8.1.1.3. Leaks or Spills of Nuclear Material

The most catastrophic case of leak or spill of nuclear material would result from a fork lift or other large vehicle running over a package of nuclear material and breaching the containment. Attention to procedures by skilled operators would obviate the placement of nuclear material where it could get run over, however; in the unlikely event that this happens the following accident scenario results. According to an accident examined in detail in Reference 8-2, it was estimated that if a 4-kg package of PuO_2 was run over, 0.4 g would become airborne. This corresponds to a material-at-risk x damage ratio of 4000 g x 0.25 with an airborne release fraction of 4×10^{-4}. This calculation also assumed that cleanup operations result in the resuspension of 0.04 g for a total airborne release to the room of 0.44 g of plutonium. After three stage HEPA filtration of the facility exhaust, the total release to the environment was estimated to be 1.7×10^{-3} µg. The probability calculated from the event tree for this scenario is 4.5×10^{-5} per year. we assume that 4 people are in the immediate vicinity and that there are 250 total workers at the site.

8.1.2. Beyond Design Basis Accidents

Beyond design basis accidents (BDBAs) are characterized as coupling multiple, independent failures of safety grade systems with an initiating event. Single failure events only lead to BDBAs when coupled with very low frequency initiating events. This is illustrated by Figure 8-1. Safety systems are designed to preclude common mode failures for all but cataclysmic events. Facility design, engineered safety features, and administrative controls ensure that credible failure sequences result in, at worst, design basis accidents. The facility design, engineered safety features, and administrative controls ensure that more severe accidents fall into the BDBA category. That is, no credible sequence of events can be postulated that leads to one of these more severe accidents. Even for these more severe accidents, though consequences may be greater than consequences for most DBAs, off-site consequences can still be small.

8.1.2.1. Criticality Accident

Operating history of plutonium facilities has shown that although very unlikely, criticality accidents are most likely to occur with plutonium solutions. There will be sufficient quantities of plutonium solutions at the Plutonium Conversion Facility to (if mishandled) cause a criticality accident. The most likely cause of a criticality incident involving plutonium oxides would be improper accidental stacking of items. Plutonium facilities are designed so that more than two operator errors/equipment failures must be postulated for a criticality accident to occur. It is estimated that the probability for a plutonium facility is $<10^{-7}$ /yr.

Operating history has shown that a criticality accident has never occurred because of improper stacking or handling of bulk nuclear material. The combination of many factors, including a conservative approach to material spacing, packing density, manner and type of containment, and maximum quantities of fissile material contribute to reducing the risk of a criticality accident. Multiple violations of procedure would have to occur to result in a criticality event at this facility. A criticality event over the lifetime of the facility is extremely unlikely.

Solution criticality hazards are reduced by a tiered approach of geometrically safe storage, engineered safety systems, and administrative controls. Geometrically safe storage designs consider equipment shape, volume, and fixed spacing. Engineered safety systems typically comprise neutron poisons, interlocked shutdowns, check valves, and limited volume utility systems. Administrative controls also apply, such as operating procedures, independently verified material access and transfers, and location specific criticality limits on the amount of SNM. Criticality limits for solution operation are much more restrictive than those for solids, with the typical amount allowed in any one location restricted to less than 2080 grams. Typical double failure scenarios considered for design basis accidents include exceedance of double batch limits combined with glovebox flooding or interaction with another vessel. A beyond design basis scenario event could then be postulated to include concurrently exceeding double batch limits, combined with glovebox flooding, and an earthquake that affects the spacing of vessels. The resulting consequences from this scenario would have the greatest impact on the workers but a much lower probability of release than that postulated for a dry powder plutonium criticality because of the better containment of solutions and lower amounts of material at risk.

Although a criticality accident is very unlikely, an analysis has been presented here for illustrative purposes. Data for this analysis were taken from References 8-1, 8-2, and 8-3. In the worst case scenario, it is assumed that there is no barrier between the operator and the criticality event. It is assumed that the criticality incident would not exceed 5×10^{17} total

Table 8-2 Important Nuclides Released from Powder Plutonium Criticality

Nuclide	Ci Produced	Airborne Release Fraction (ARF)	Ci Released
Kr-83m	5.5	0.5	2.75
Kr-85m	3.5	0.5	1.75
Kr-85	4×10^4	0.5	2×10^{-4}
Kr-87	21.5	0.5	11
Kr-88	11.5	0.5	6
Kr-89	650	0.5	325
Xe-131m	5×10^{-3}	0.5	2.5×10^{-3}
Xe-133m	1×10^{-1}	0.5	5x10-2
Xe-133	1.5	0.5	0.75
Xe-135m	165	0.5	85.0
Xe-135	20.5	0.5	10
Xe-137	2450	0.5	1225
Xe-138	550	0.5	275
I-131	0.5	5×10^{-2}	2.5×10^{-2}
I-132	60	5×10^{-2}	3
I-133	8	5×10^{-2}	0.4
I-134	215	5×10^{-2}	11
I-135	22.5	5×10^{-2}	1.0

Heat generated in a criticality accident may be sufficient to ignite combustibles in the immediate area, however, the spread of a fire or a fire of large magnitude is not credible because of the minimal quantities of flammable material or combustibles on hand. Any fire that did start would be put out by the automatic sprinkler system.

8.1.2.2. Beyond Design Basis Fire

A typical fire with coincident failures of two or more major safety systems constitutes a BDBA fire. The bounding DBA fire case for a fire inside the facility presented in 8.1.1.2 forms the basis for the release to the processing cell. It is assumed that a process cell contains a glove box used for milling plutonium powder. The gloves have become coated with a layer of plutonium dust. Estimates place this glove loading at < 2 g. For this analysis the MAR is assumed to be 2 g of Pu dust on each of 12 gloves for a total of 24 g of Pu. It is further assumed that the gloves are stowed outside the glovebox. A two hour fire is postulated. The initial extent and intensity of the fire are sufficient to completely incinerate the gloves. The ARF is again taken as 0.1 and the RF as 1.0. It is assumed that the ventilation system and the sprinkler system are inoperable. Thus there are two major independent system failures. It is assumed that the glovebox, though damaged, still contains

1. design to current DOE structural and safety criteria,

2. smaller throughput, batch size and inventories of hazardous materials, and

3. elimination of some hazardous materials.

This will reduce potential off-site health effects if a significant accidental release were to occur.

The facility will be designed to comply with current federal, state, and local laws, DOE Orders, and industrial codes and standards. This will provide a plant that is highly resistant to the effects of severe natural phenomena, including earthquake, flood, tornado, and high wind, as well as credible events as appropriate to the site, such as fire and explosions, and man-made threats to its continuing structural integrity in the event of any credible accident or event, including aircraft crash, if such an accident is credible at that site.

The facility will be designed and operated to reduce the accumulation of Pu-bearing scrap, Pu feed stock processed components, and contamination wastes during manufacturing operations. This reduces the material available for involvement during accident scenarios.

The design process for the facility will comply with the requirements for safety analysis and evaluation in DOE Orders 4700.1 and 5480.23. These orders require that the safety assessment be an integral part of the design process to ensure compliance with all DOE safety criteria by the time the facility is constructed and in operation.

The safety analysis process begins early in conceptual design with identification of hazards having the potential to produce unacceptable safety consequences to workers or the public. As the design develops, failure mode and effects analyses are performed to identify equipment or human failures, external events, with the potential to release hazardous materials. The events include industrial explosion, fire, earthquake, tornado, flood, spills, and aircraft crash. These potential events become focal points for design changes or improvements to prevent, or lessen the likelihood of, undesirable accidents. These analyses continue, as the design process progresses, and eventually event tree and fault tree analyses are generated to better understand the estimated frequency of the need for safety class equipment to mitigate the effects of the accident scenarios and to asses the performance of this equipment in accident mitigation. Eventually, the safety analyses are formally documented in a safety analysis report. This report will be used to document the frequency versus consequence for an entire spectrum of accidents which will help identify design improvements that can be made to maintain the risk envelop within acceptable bounds.

The first Safety Analysis Report (SAR) is completed at the conclusion of conceptual design, and includes identification of hazards and some limited assessment of few, enveloping design basis accidents. This analysis includes deterministic safety analysis and failure modes, and effects analysis of major systems. The preliminary safety analysis report is finished by the completion of de design and provides a broad assessment of the range of design basis accident scenarios and t performance of equipment provided in the facility specifically for accident consequence miti

The safety review of this report will be completed, safety issues resolved, and commitments before initiation of facility construction. A final safety analysis report (FSAR) will be produ includes documentation of safety-related design changes during construction, and the impact changes on the safety assessment. It will also include the results of any safety-related researc development that has been performed to support the safety assessment of the facility. Final a of the FSAR is required before the facility is allowed to begin operation.

8.3. Safety Goal

The facility will provide a level of public health and safety superior to that of the facilities of existing nuclear weapons complex. DOE has adopted two quantitative safety goals to limit tl of fatalities associated with its nuclear operations. These goals are the same as those establisl nuclear power plants by the NRC, and like the NRC, goals should be viewed as aiming point performance. The goals are:

1. The risk to an average individual in the vicinity of a DOE nuclear facility for prompt fatalities that might result from accidents should not exceed one-tenth of one percent (of the sum of prompt fatalities resulting from other accidents to which members of th population are generally exposed. For evaluation purposes, individuals are assumed t located within one mile of the site boundary.

2. The risk to the population in the area of a DOE nuclear facility for cancer fatalities th result from operations should not exceed one-tenth of one percent (0.1%) of the sum c cancer fatality risks resolution from all other causes. For evaluation purposes, individ assumed to be located with ten miles of the site boundary.

8 4 Chapter 8 Referene s d G 8nP

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