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Rev. 0

Data Quality Objectives Summary Report for the 224-T Plutonium Concentration Facility

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Fluor Hanford
P.O. Box 1000
Richland, Washington

Contractor for the U.S. Department of Energy
Richland Operations Office under Contract DE-AC06-96RL13200

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CR Haas, Fluor Hanford

March 2004

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Fluor Hanford
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Data Quality Objectives
Summary Report
For the 224-T Plutonium Concentration Facility

Prepared by:

3-8-04

C. R. Haas — Date
Central Plateau D&D, Environmental Protection

Approvals:

3/9/04

J.M. Stevens, Director — Date
224-B/T D&D Projects

3/8/04

J. R. Hilliard, Manager — Date
Central Plateau Waste & Chemical Management

3/9/04

D. S. Mantooth — Date
Central Plateau D&D, Radiation Protection

EXECUTIVE SUMMARY

This data quality objective (DQO) summary report establishes the data needs and defines the sampling and analysis requirements to characterize the facility and waste materials that will be generated during decontamination and demolition (D&D) of the 224-T building. This D&D project is a CERCLA non-time critical removal action defined in the 224-T Engineering Evaluation/Cost Analysis (DOE-RL, 2003). The D&D work will be performed per a removal action work plan subsequent to publication of an action memorandum. The purpose of the D&D activities is to safely dismantle the facility and dispose of the demolition waste in a manner that is protective of human health and the environment, as well as cost-effective.

The DQO process uses information from historical files, deactivation files, facility inspection records, process knowledge, and other relevant sources to identify a list of the contaminants of concern from the facility. The list of contaminants of concern is used to develop anticipated waste streams and the anticipated sampling and analysis needed to support safe demolition activities and proper disposition of the waste materials.

The DQO process proposes a characterization strategy to provide the necessary information to support D&D activities, as well as to facilitate RCRA closure of the permitted treatment, storage, and/or disposal (TSD) unit within the 224-T building. Samples will be collected from specific worst-case contaminant locations and used to establish the bounding contaminant concentrations and waste designation information.

Finally, this DQO includes the requirements for collection of specific, limited data on subsurface soil under and near the 224-T facility foundation. Samples and data requirements are defined to allow information to be gathered to support advanced planning efforts for the final site remediation, which is beyond the scope of the non-time critical removal action for the 224-T facility.

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1.0 STEP 1 – STATE THE PROBLEM

1.1 INTRODUCTION

The 224-T Facility was used to purify and concentrate the plutonium nitrate product from the 221-T separations facility. Operations ceased in 1956 and no further processing was performed at the facility. Operational reports from late 1956 and early 1957 indicate the process was shut down normally, and that process equipment and lines were flushed and drained. Besides radionuclide contamination, residual amounts of process chemicals, acids and caustics may remain in the facility. Although the equipment and lines may have been flushed, the remaining inventory of radionuclides and process chemicals has not been well established.

The preferred alternative for the disposition of the facility is to remove equipment and materials from the building, then demolish the structure to a slab on grade condition.

Problem Statement

The volume and concentrations of chemicals and radionuclides are not well defined but are needed to allow execution of the preferred alternative for facility disposition.

1.2 OBJECTIVE

The scope of the 224-T D&D Data Quality Objectives (DQO) process is to identify the sampling and analytical requirements to support the selected non-time-critical removal action for the disposition of the facility under the CERCLA process. The proposed removal action is to remove waste and equipment that will not meet the Environmental Restoration Disposal Facility (ERDF) waste acceptance criteria (WAC) from the building. The remaining structure and components will be demolished to a slab on grade condition and disposed at ERDF. Therefore the scope of this DQO process encompasses the former processing operation equipment/systems, facility support systems, and the systems above the slab level, structures and components in the 224-T facility.

The key objectives are to determine sufficient information about the facility to make informed decisions on the disposition of the waste streams from the D&D tasks, to protect human health and the environment, and to allow selection of the optimum D&D methods for each step of the decontamination and demolition process. The nature and extent of chemical and radionuclide contamination within the equipment and structure must be determined to a level adequate for decision making. This confidence level must be established prior to preparing a Sampling and Analysis Plan (SAP) that provides the specifics of the required sample gathering and analytical work. The required confidence level may be satisfied by sampling to verify existing data, by selecting representative equipment or areas for sampling, and/or by more extensive sampling plans.

1.3 PROJECT MILESTONES AND DATA QUALITY OBJECTIVE TEAM MEMBERS

The major project milestone is completion of an FH Performance Incentive PI S-5 by September 30, 2006, to demolish the 224-T structure to a 'slab on grade' condition.

Tables 1-1 and 1-2 identify the individual members of the DQO team and the key decision-makers. Some DQO members may or may not have participated directly in the planning sessions but offered expertise

throughout the process. These tables also identify the organization that each DQO team member or key decision maker represents, as well as their technical area of expertise.

Table 1-1. 224-T DQO Team Members.

Name	Organization	Role and Responsibility
C. R. Haas	Polestar	224-T DQO Project Lead
G. J. LeBaron	FH	Project Environmental Lead
I. D. Jacques	CHI	DQO Facilitator
J. W. Hasson	FH	Waste Management
D. L. Moder	FH	Waste Management
G. G. Hopkins	BHI	Waste Interface w/ERDF
D. B. Encke	CHI	Historical Subject Matter Expert
D. S. Mantooth	FH	Radiological Engineer
D. L. Klages	FH	Project Environmental Lead for 224-B
M. W. Gibson	FH	Project Engineer for 224-B
M. R. Morton	Polestar	Characterization/NDA Lead

BHI = Bechtel Hanford, Inc.
FH = Fluor Hanford Company
CHI = CH2M Hill Hanford, Inc.

Table 1-2. DQO Key Decision-Makers.

Name	Organization
Rick Bond	State of Washington Department of Ecology
Greta Davis	State of Washington Department of Ecology
Craig Cameron	U.S. Environmental Protection Agency
Paul Valcich	U.S. Department of Energy
Larry Romine	U.S. Department of Energy
Ellen Dagan	U.S. Department of Energy

1.4 PROJECT ASSUMPTIONS AND ISSUES

The project assumptions and issues described below are based on project team discussions from regular meetings and input during the DQO document review. Also, interviews with the key decision makers were held to provide a forum for eliciting ideas and issues for inclusion in the DQO process.

1.4.1 Project Assumptions

1. The project has extensive historical characterization data associated with the chemical processing operations during the time the facility was in operation. The data will be adequate to establish the primary sources of contamination to support the generation or revision of waste profiles for structural features and residual materials in vessels/equipment within the scope of this project.

2. The project has extensive historical design data associated with the construction of the facility. This data, along with data from item 3 below, will be adequate to establish the primary sources of contamination to support the generation or revision of one or more waste profiles for all structural features in the scope of this project.

3. The project has extensive non-destructive assay (NDA) data, radiological survey data, and analytical data from samples taken during a recent entry into each of the 224-T process cells. It is anticipated that this characterization data, coupled with the data listed in items 1 and 2 above, will be suitable to assist with waste designation. Based on existing data, additional characterization samples should be minimal.

4. For the purpose of this DQO summary report, the footprint of the building is bounded by the exterior walls and the slab on grade. The pit in Cell C and the pipe chase under the building slab are also included. A limited amount of sampling under the slab or adjacent to the building foundation is proposed to provide advance information to the decision process for future site remediation, however remediation of these areas is beyond the scope of the 224-T removal action. This will assist in continuity to accomplish a path forward to site disposition.

5. The final disposition of the facility site is not within the scope of this DQO summary report. Interim and final disposition of the facility site will be handled in subsequent documentation prepared for the Decommissioning Project or Remedial Action Project.

6. A limited amount of sampling will be performed in the building foundation on the gallery side of the building only. This sampling, requested by the State of Washington Department of Ecology, will facilitate closure of the RCRA permit. The specific sampling locations will be outlined in the SAP.

1.4.2 Global Issues

There are three global issues identified by the U.S. Department of Energy, Richland Operations Office (RL); the U.S. Environmental Protection Agency (EPA); and the State of Washington Department of Ecology (Ecology).

- Scope of sampling needed, specifically in regards to data from areas outside of the building structure and below the slab on grade end state boundary

- Path forward planning for the 224-T site after this action is complete and integration with future area closure activities

- Nearby waste sites that may impact the 224-T building

1.4.3 Project-Specific Technical Issues and Resolutions

The technical issues identified for this project are described below:

1. *The use of radiological surveys and swipes to provide field screening for determination of TRU vs. non-TRU materials needs to be established.*

Resolution: The DQO will provide for NDA sampling that can be correlated with radiological samples and laboratory results to set a conservative level where material can be determined to meet criteria for non-TRU waste disposition paths.

2. *Disposition of tanks and process equipment without size reduction, using appropriate stabilization methods to meet shipping and waste acceptance criteria, needs to maximized for ALARA and cost/schedule reasons.*

Resolution: The DQO will specify that engineering calculations along with specific sampling may be used to meet the applicable WAC. Operators of the waste disposal site(s) will be contacted and a consensus developed on the methods needed to ship and dispose of large tanks and equipment without size reduction.

1.5 EXISTING REFERENCES

The documents identified in Table 1-3 were used to support the description, process history, deactivation activities and previous sampling/analysis of points in the facility addressed in this DQO process.

Table 1-3. Existing References Used for DQO Scoping Process.

Reference	Summary
224-T Nondestructive Assay of Tanks in Cells A thru F, G. Mapili, PNNL to G. Chronister, FH, January 31, 2002.	Nondestructive assay data for 21 tanks and boxes in the 224-T process cells. This data is summarized in Table 1-9.
RC01757, RC01644, RC0995, RC0802, RC0836, RC01592, RC01149, RC01359, RC01403, RC01343, RC01091, RC01508, RC01476, RC01425, RC01439, RC01017, *Radiological Survey Reports for the 224-T Building.*	Radiological Survey Reports for the 224-T Process Cells detailing extensive surveys performed during the 2001/2002 cell entries. This data is summarized in Table 1-10.
GE, 1951, *Flowsheets for Precipitation Processes*, HW-23043	Detailed process flowsheets of chemical constituents, material balances, and process parameters.
Environmental Restoration Disposal Facility Waste Acceptance Criteria, BHI-00139, Rev. 4 (BHI 2002)	Provides land disposal restriction limits and the chemical and radiological concentration limits in the wastes to be disposed at ERDF.
Hanford Site Solid Waste Acceptance Criteria, HNF-EP-0063, Rev. 8 (FH 2003)	Provides waste acceptance criteria for storage at the CWC.

1.6 PROCESS HISTORY AND FACILITY DESCRIPTION

1.6.1 Historical Description

The 224-T Building is located in the 200 West Area of the Hanford Site, about 45.7 m (150 ft) to the south and parallel to the T Plant (221-T) canyon. Completed in 1944 and originally designated the 224-T Bulk Reduction Building, its purpose was to concentrate the plutonium nitrate solution produced in the first major step in the plutonium recovery process conducted at T Plant. It operated in this capacity from January 16, 1945 until early 1956, when T Plant was retired from active service as a chemical processing building.

The 224-T Building was idle for several years before being modified in 1975 to meet the requirements for storing plutonium-bearing wastes. In 1985 the building became the 224-T Transuranic Waste Storage and Assay Facility (TRUSAF) and operated in that capacity until the late 1990's. Although not currently storing waste, the TRUSAF remains an active RCRA storage unit.

1.6.2 Physical Description

The facility description is based on historical documents, drawings, and observations. The as-built condition of the building and equipment has not been systematically established. The descriptions and illustrations are considered to be general information and are used for illustrative purposes only.

Layout of 224-T

The 224-T Building is a three-story, reinforced concrete structure containing 21 rooms (in its original configuration) and five process cells, with a large operating gallery located on the third floor. A sixth process cell was provided in 1950 to boost production. The first and second floors have outside dimensions of approximately 60.0 m (197 ft) by 18.3 m (60 ft). The third floor is 44.2 m (145 ft) by 18.3 m (60 ft). A 30 cm (12 in.) thick concrete wall divides the building into two main sections. Offices and operating galleries were originally located on the northwest side of the dividing wall. The walls, floors, and ceiling are constructed of reinforced concrete. The process cells are located on the southeast side of the dividing wall and have been sealed from the northwest section for over 25 years. Figure 1-1, *Layout of the 224-T Building,* shows the current layout of the building.

As documented in Atlantic Richfield Hanford Company (ARCHO) 1972, *Design Criteria Supplement No. 2, Additional Modifications to 224-T Building,* the 224-T Building was upgraded to provide tornado resistance. The modifications were as follows:

- Steel beams were attached horizontally to the original reinforced concrete walls and supported at column lines so that these walls were braced adequately to withstand a 280 km/hour (175 mph) wind and a 53 g/cm^2 (0.75 lb/in.^{2}) negative pressure transient.

- Shields over the exterior ventilation openings were provided to protect the containers stored in the building from tornado-generated missiles.

As noted in ARCHO 1971, *Design Criteria Structural Modifications 224-T Building,* the 224-T Building was also upgraded to provide seismic resistance. The modifications were as follows:

- Six vertical concrete buttresses were installed on the northeast side and five concrete buttresses were installed on the southeast side.

- Un-reinforced block walls were removed and replaced with reinforced concrete.

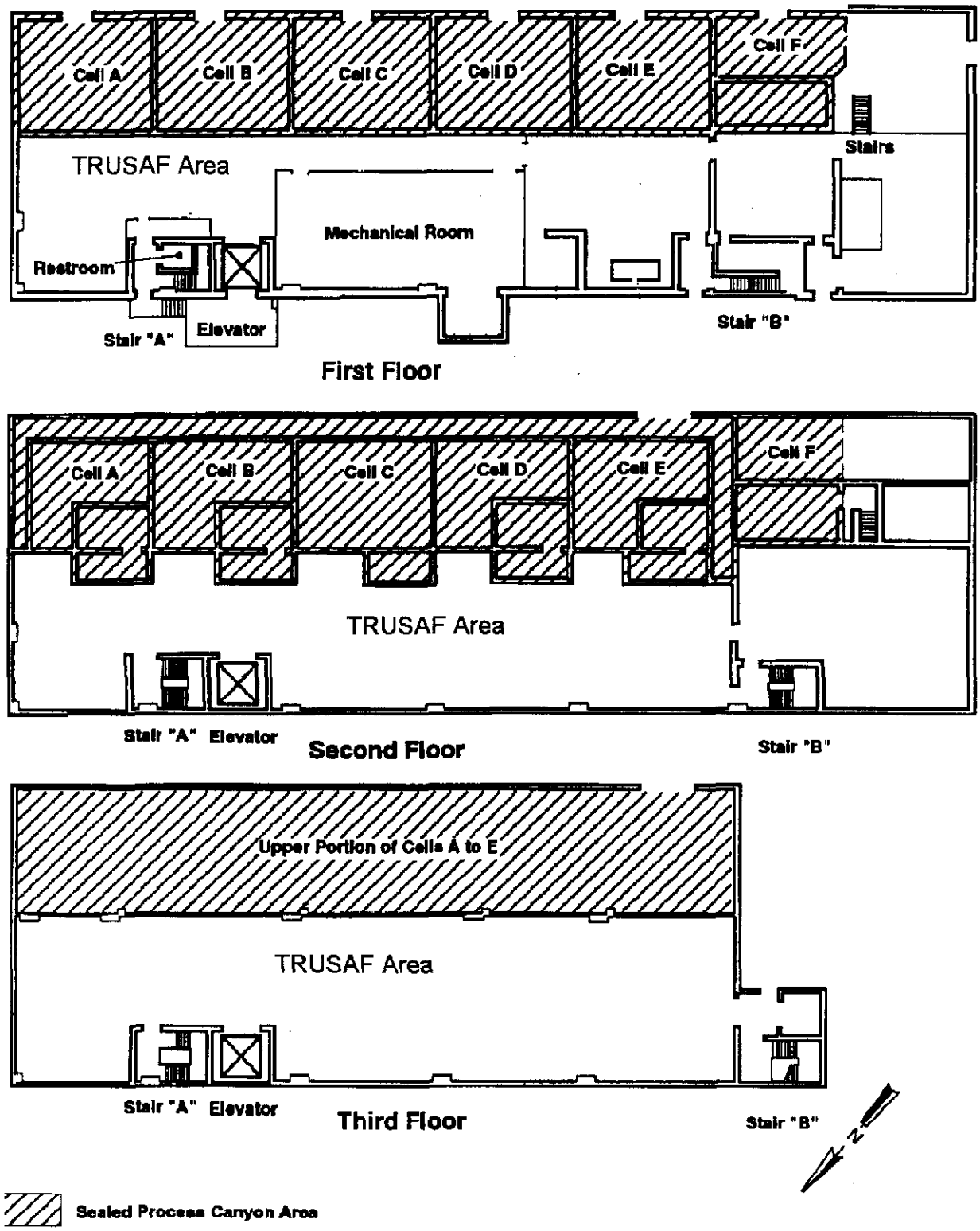

Figure 1-1. Layout of the 224-T Building.

A-Cell

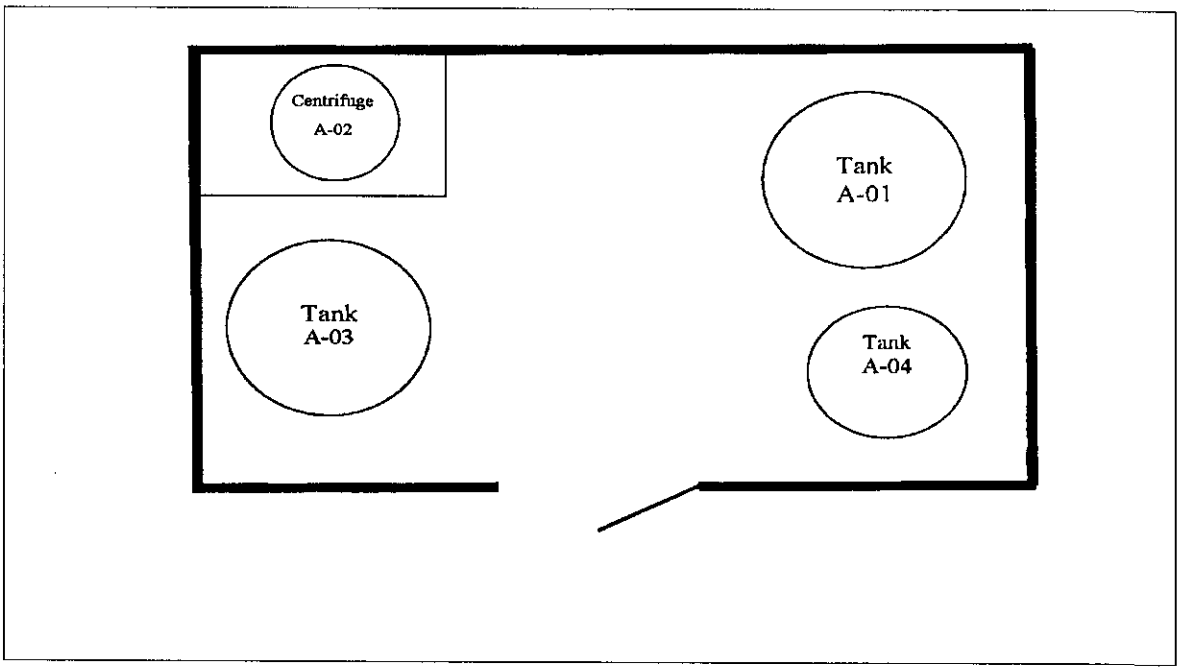

Figure 1-2. Cell A.

B-Cell

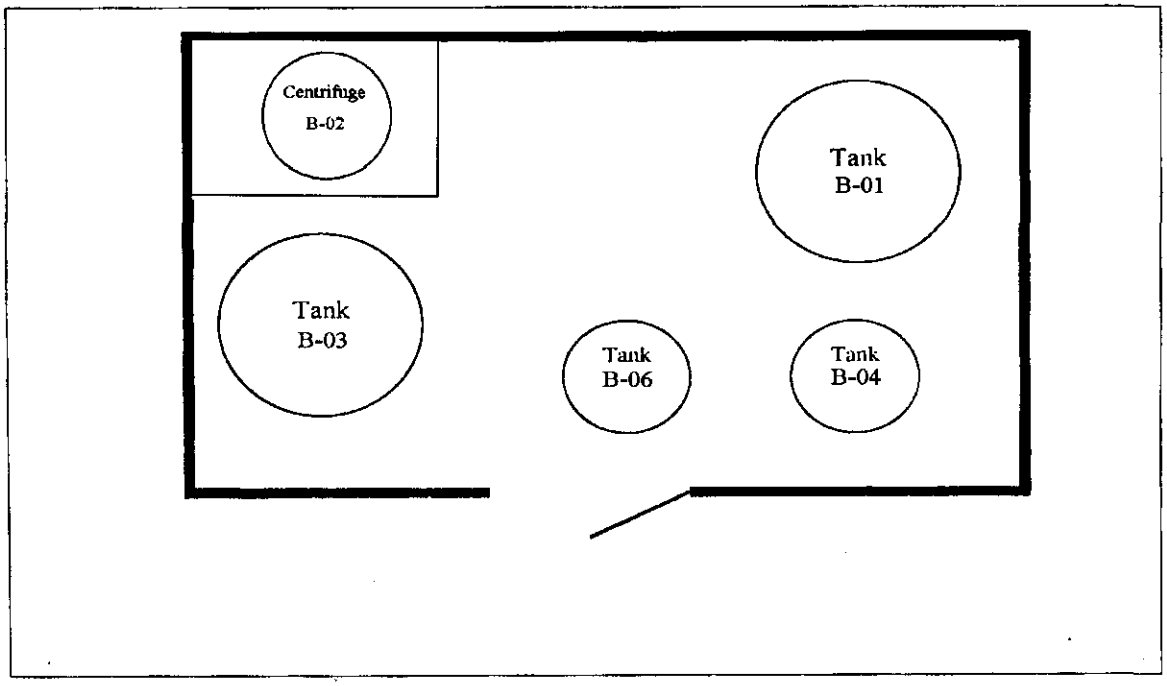

Figure 1-3. Cell B.

C-Cell

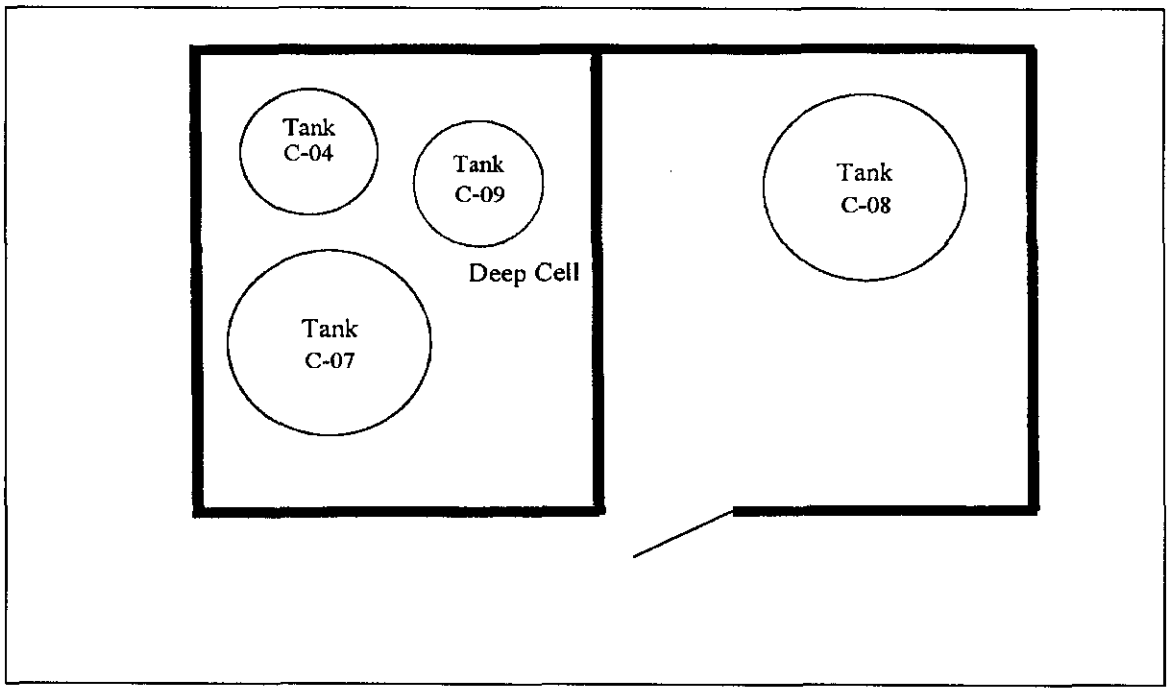

Figure 1-4. Cell C.

D-Cell

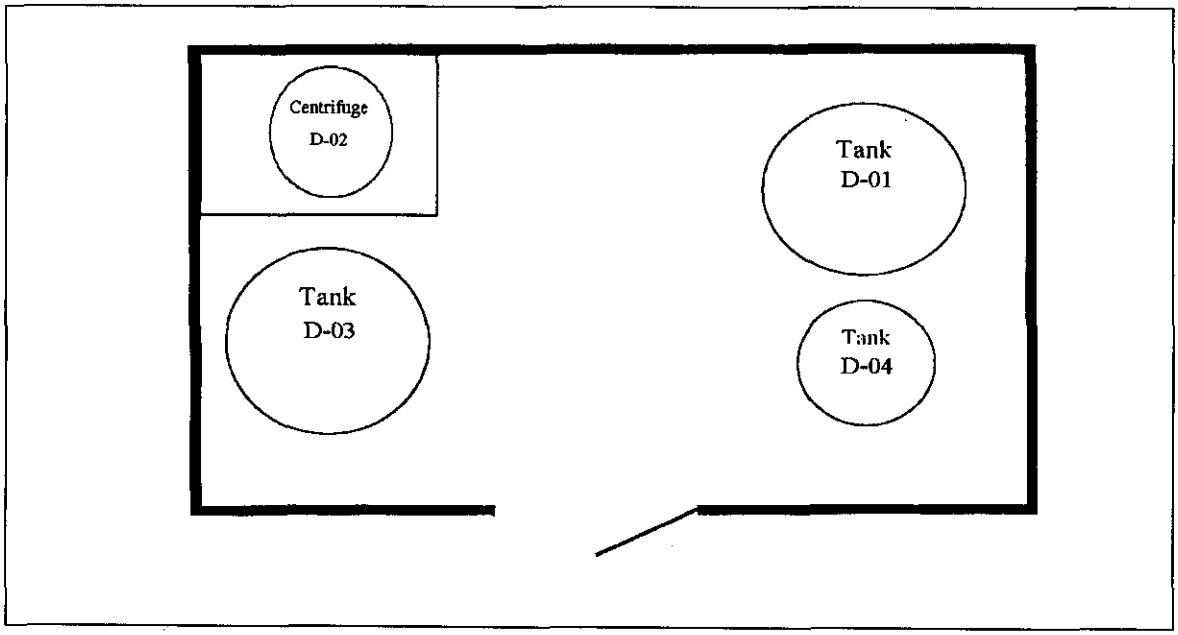

Figure 1-5. Cell D.

E-Cell

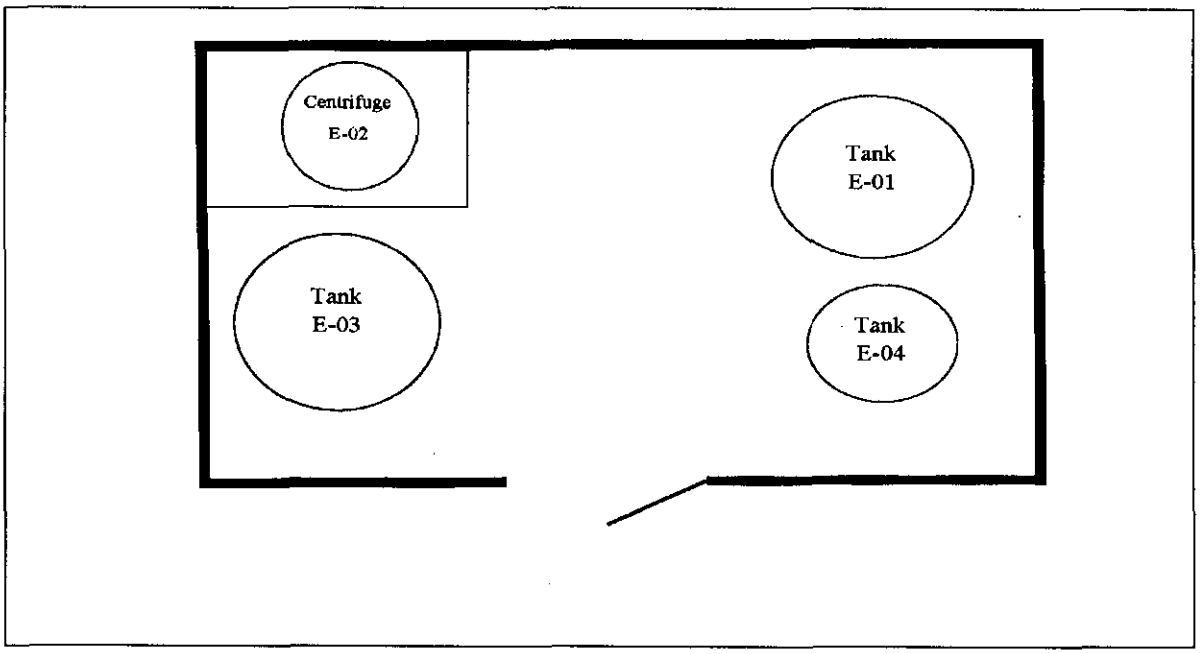

Figure 1-6. Cell E.

F-Cell

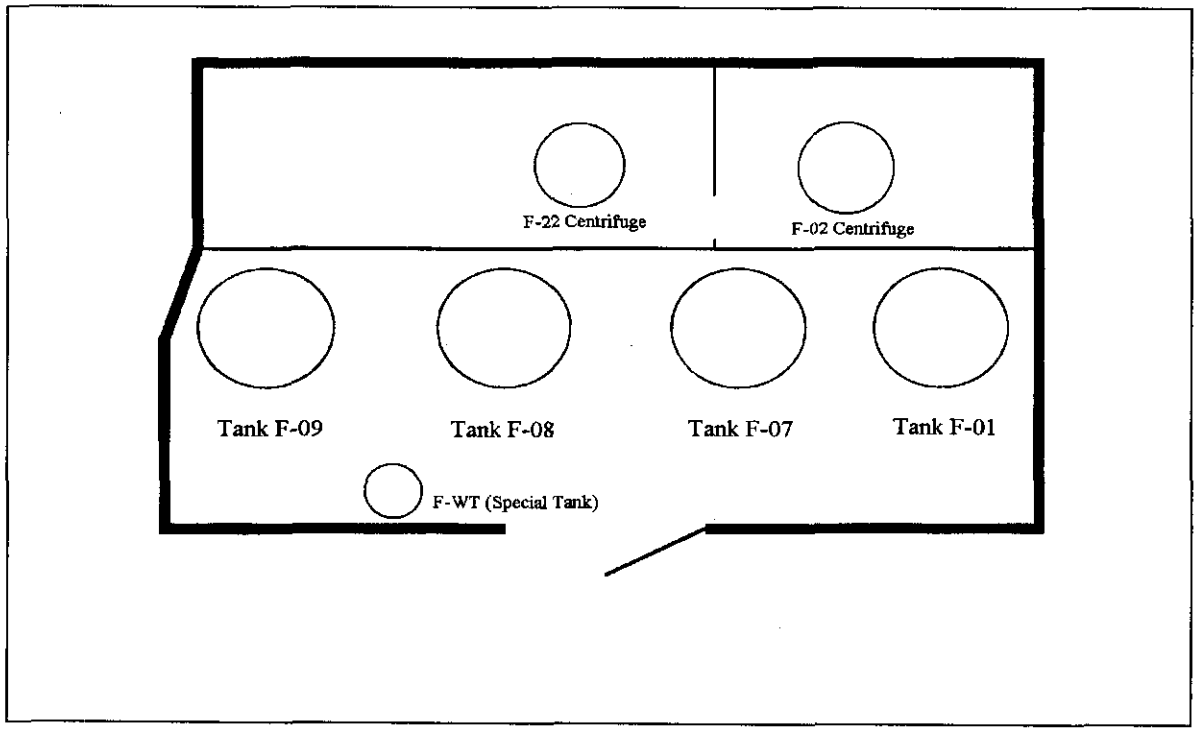

Figure 1-7. Cell F.

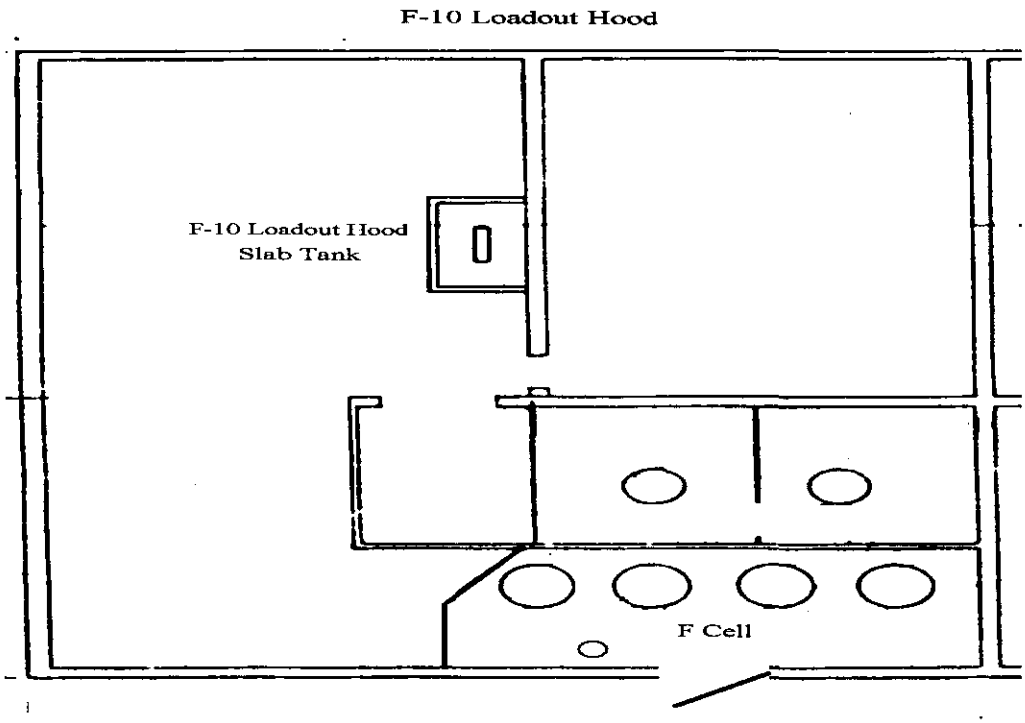

Figure 1-8. F-10 Loadout Hood.

Gallery Side

The first floor of the office and gallery portion of the building is 13 ft high and contains vacant offices and a restroom, change room, lunchroom, and mechanical room. The mechanical room housed the air supply equipment and the motor control centers for the process equipment. A room at the west end of the building was used as a product (plutonium) loadout area.

A 4-in.-thick by 3-ft-wide by 2.67-ft-high stainless-steel slab tank (F-10 weigh tank) enclosed in a loadout hood (also known as the process hood) is located along the east wall of the loadout area. Exterior joints and doors were taped and sprayed. The stainless-steel frame, reinforced-glass viewing windows, piping, and connections to the ventilation header appeared to be intact.

Following deactivation of the 224-T Building, the loadout area was converted to a regulated workshop. The loadout hood was isolated from the loadout area by a plywood enclosure. A large roll-up door was installed in an outside wall of the loadout area.

The 12-ft-high second floor of the gallery side of the building is a pipe gallery for cells A through E and an operating gallery for F cell. Aqueous makeup, steam and water piping, instrument and air tubing, and electrical conduit pass through the 1-ft-thick concrete wall from the pipe gallery to cells A through E. The east side of F cell is separated from the office area by a 1-ft-thick concrete wall, and the west side is separated from the loadout area by a metal partitioning wall. The piping passes through "windows" that were left in the wall when the wall structure was poured. Following installation of the piping, the "windows" were cemented over to seal the cells from the gallery. Essentially all of the piping, instrumentation, and other process equipment were removed from the gallery side to make room for the storage missions.

A sample room for each of cells A through E was located in the second-floor pipe gallery. This room also served as an airlock to an operating deck in A, B, D, and E cells. During building modifications in the 1970's, the sample rooms were sealed with concrete. The west end of the second-floor gallery was the operating area for F cell. This area contains panel boards and viewing windows into the cell. Pumps and aqueous makeup tanks for F cell originally installed in this gallery have been removed. The piping into the cell has been blanked on the gallery side of the metal partitioning wall that isolates the cell. The wood-frame and drywall walls in the pipe gallery and F cell operating gallery define these rooms.

The third-floor gallery was the operating gallery for cells A through E and contained aqueous makeup tanks, scales, pumps, and control panels for the five cells. All of the equipment was removed prior to the building's storage missions. Observational windows with movable shielded covers allowed viewing into the cells. These windows too were sealed with concrete prior to the beginning of the storage missions. An elevator on the gallery side of the building serves all three floors. The 4-ton elevator has a 7-ft-wide by 8-ft-high opening and provides access to the building from a concrete loading platform.

Process Cell (Canyon) Side

The process cell portion of the building consists of six cells (A through F). Cells A through E are three stories, or 12.2 m (40 ft), high and are separated from each other by 4.5 m (15 ft) high, 20 cm (8 in.) thick concrete walls. Each cell is approximately 7.6 m (25 ft) by 8.5 m (28 ft). Cells A, B, D, and E are similar in equipment and configuration, except that the Cell B contains an additional tank. There are ground level personnel access doors into each of the five cells on the southeast side of the building. In addition, there is a 3.7 m (12 ft) by 3.7 m (12 ft) high equipment access door located at the second floor level outside of E Cell.

A manually operated 8 ton bridge crane is installed over the cells. The rails run the length of Cells A through E, allowing access to each of the cells. The internal rails of the bridge crane are aligned with external rails that pass through the equipment access door, allowing the crane to move equipment into and out of the building. The crane was operated from a walkway that extends around the outside of the cells at the second-floor level. The crane is without power and is now deactivated. A 1.8 m (6 ft) high wall shields the walkway from the cells, and access doors to the walkway are located at both ends of the A through E pipe gallery.

Cell F is 7.5 m (24.5 ft) by 7.6 m (25 ft) by 7.6 m (25 ft) high and is separated from the other cells by a concrete wall. Modifications completed in the 1970s reduced the size of Cell F to approximately 50% of its original size with the installation of steel barrier walls. Access to the Cell F mezzanine is gained via an external staircase and door in the TRUSAF area. There are two additional points of access to Cell F: one is an exterior door on the southwest side of the building and the other is through a door in the TRUSAF receiving area.

Cell A

Cell A contains three tanks on the ground floor (Figure 1-2, Cell A). Process tanks A-1 and A-3 are 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high, each having a capacity of 16,202 L (4,280 gal). Process tank A-4 is 1.4 m (4.5 ft) in diameter by 2.1 m (7 ft) high with a capacity of 3,153 L (833 gal). Centrifuge A-2 is located on the 3 m (10 ft) by 4.3 m (14 ft) operating deck at the second floor level. The general area radiation levels are less than 0.5 mr/hour.

Cell B

Cell B contains four tanks on the ground floor (Figure 1-3, Cell B). Process tanks B-1 and B-3 are 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high, each having a capacity of 16,202 L (4,280 gal). Process tanks B-4 and B-6 are 1.4 m (4.5 ft) in diameter by 2.1 m (7 ft) high, each having a capacity of 3,153 L (833 gal). The general area radiation levels are less than 0.5 mr/hour.

Cell C

Cell C contains four tanks (Figure 1-4, Cell C). The Cell C differs in structure and arrangement from the other cells. Approximately one-half of the cell is a deep pit, where the floor of the pit is 5.8 m (19 ft) below the first floor level. Tanks C-4, C-9, and C-7 are located in the pit section. Process tanks C-4 and C-9 are 1.4 m (4.5 ft) in diameter by 2.1 m (7 ft) high, each having a capacity of 3,153 L (833 gal). Tank C-7, the overflow tank, is 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high with a capacity of 16,202 L (4,280 gal). The first floor level Cell C contains the tank C-8, a process waste tank, which is 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high with a capacity of 16,202 L (4,280 gal). A 1.7 m (5.5 ft) by 3.4 m (11 ft) high pipe tunnel extends 10.4 m (34 ft) from the deep cell beneath the first floor to a pipe encasement. The piping in this tunnel and the encasement were used for transferring solutions between the 221-T Building and the 224-T Building, and connects with the 221-T main Building exhaust tunnel. The general area radiation levels are less than 0.5 mr/hour.

Cell D

Cell D contains three tanks on the ground floor (Figure 1-5, Cell D). Process tanks D-1 and D-3 are 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high, each having a capacity of 16,202 L (4,280 gal). Process tank D-4 is 1.4 m (4.5 ft) in diameter by 2.1 m (7 ft) high with a capacity of 3,153 L (833 gal). Centrifuge D-2 is located on the 3.1 m (10 ft) by 4.3 m (14 ft) operating deck at the second floor level. The general area radiation levels are less than 0.5 mr/hour.

Cell E

Cell E contains three tanks on the ground floor (Figure 1-6, Cell E). Process tanks E-1 and E-3 are 2.7 m (9 ft) in diameter by 2.7 m (9 ft) high, each having a capacity of 16,202 L (4,280 gal). Process tank E-4 is 1.4 m (4.5 ft) in diameter by 2.1 m (7 ft) high with a capacity of 3,153 L (833 gal). Centrifuge E-2 is located on the 3.1 m (10 ft) by 4.3 m (14 ft) operating deck at the second floor level. The general area radiation levels are less than 0.5 mr/hour.

Cell F

The first floor level of Cell F contains the F-1, F-7, F-8, and F-9 process tanks and the F-WT tank (Figure 1-7, Cell F). Each tank has dimensions of 1.2 m (4 ft) diameter by 1.5 m (5 ft) high and a capacity of 1,779 L (470 gal). The F-WT tank (also listed as "special tank" in building drawings) has a capacity of approximately 284 L (75 gal). The F-2 and F-22 centrifuges are located on a 3.9 m (12.7 ft) by 7.6 m (25 ft) mezzanine deck that is elevated 2.1 m (7 ft) above the cell floor. The general area radiation levels are less than 0.5 mr/hour.

F-10 Loadout Hood

The F-10 Loadout Hood is located on the ground floor in the southwest end of the building in the TRUSAF area (Figure 1-8, F-10 Loadout Hood). It contains a slab tank with a capacity of approximately 133 L (35 gal).

Feed and Waste Lines

Feed lines from 221-T cells 17 and 19 run through an underground encasement into the Cell C pit to tank C-4.

A process waste line exits Cell C from tank C-8 to a settling tank. This line has been isolated and blanked outside of Cell C. Two chemical sewer lines were also provided for 224-T operations. A chemical sewer for higher activity waste led to the 221-T chemical sewer, and a low risk cooling water waste line connected to the 221-T cooling water discharge. A schematic of these waste lines is shown in Figure 1-9.

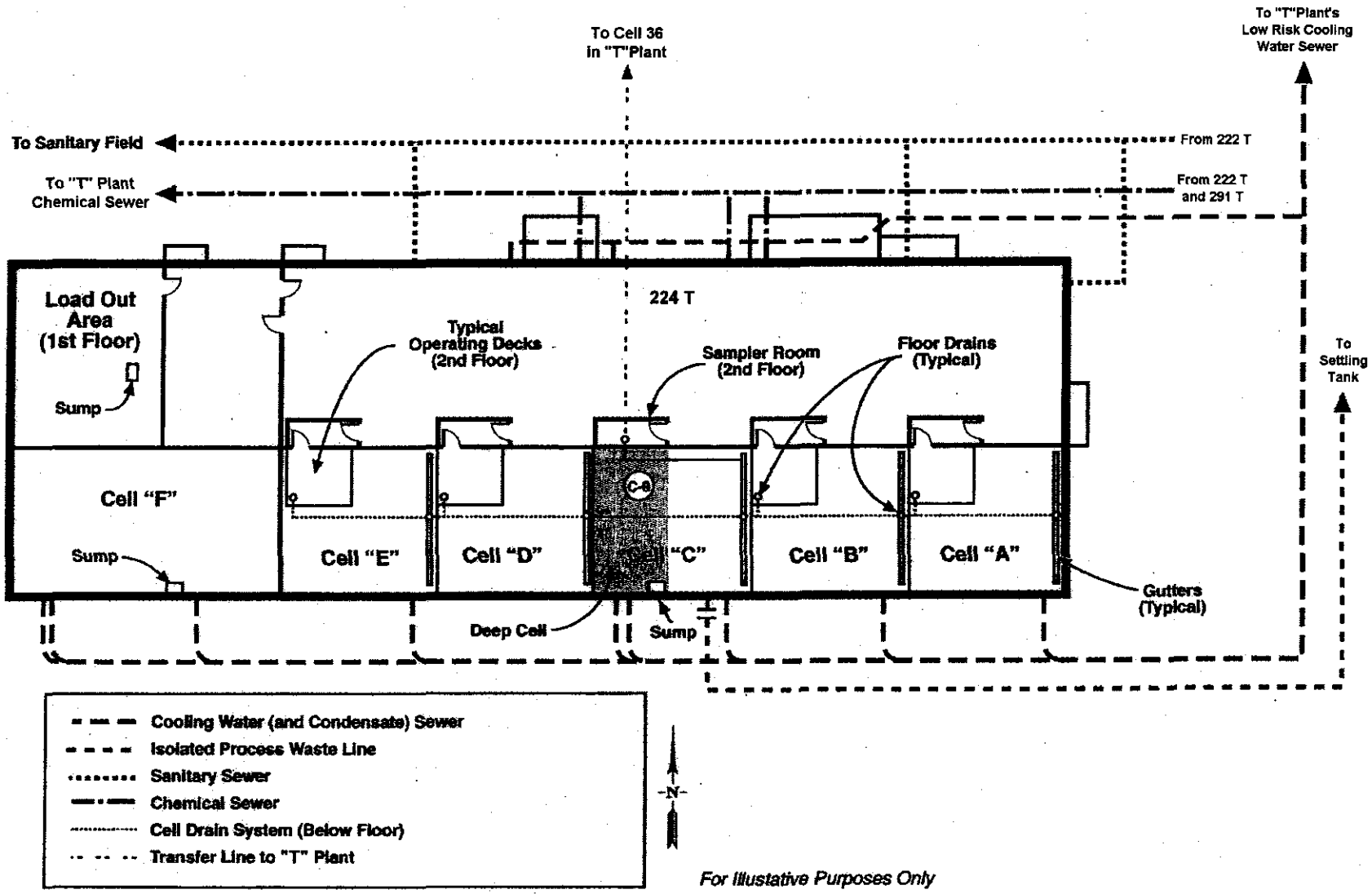

Figure 1-9. Waste Lines.

Ventilation

The 224-T building exhaust ventilation system is not in service, but has not been deactivated. Vessel ventilation (approximately 250 scfm) of the 224-T tanks and centrifuges is provided by the T Plant main exhaust system (the vacuum created by the 291-T fans). Air in-leakage provides the supply air to the process cells. Stainless steel sub-headers, connected to the tanks and centrifuges inside the cells, exit the southwest side of the building above grade. The stainless steel headers are directed down and transition to 15 cm (6 in.) clay pipe below ground level. The clay pipes connect to a 61 cm (24 in.) diameter clay main header below grade. The 61 cm (24 in.) line connects to the T Plant main exhaust tunnel at the west end of the 221-T Building. In areas where the original soil cover was less than 1.2 m (4 ft) or greater than 2.1 m (7 ft) deep, the clay pipe is protected by a reinforced concrete encasement.

Fire Alarm and Suppression System

The gallery areas of the 224-T building are protected by an automatic dry-pipe sprinkler system and an early-warning fire alarm system that use ionization-type detectors (smoke detectors). A 15 cm (6 in.) sanitary water line supplies water to the fire sprinkler system. The sealed process cells are not protected by the systems listed above, but they are free from combustibles and are isolated. Sprinklers are located in the room containing the F-10 Loadout Hood, but they do not enter the plywood enclosure surrounding the hood. Activation of the fire alarm system or the sprinkler system results in the following:

- A single-stroke gong system installed within the building will actuate.
- A panel board outside the building near the entrance by the master fire alarm box will indicate the location of the alarm by floor levels.
- A signal will be sent to the fire station.

Electrical Utilities

Normal electrical power is supplied by a 13.8 kV three-phase line from the 251-W substation that is reduced from 13.8 kV to a 480 V, three-phase system, and a 240/120 V, single-phase system. The fire alarm system is backed up with a battery pack.

Sanitary Water

Sanitary water to the 224-T building has been isolated with the exception of the fire suppression system.

Process Knowledge

The purpose of the 224-T building was to receive plutonium solution from the 221-T Separations Facility and further purify and concentrate it. The goal was to produce a concentrated plutonium nitrate solution that could be transferred to the 231-Z Isolation Facility for final concentration to a product that could be shipped offsite.

Concentration Process

Feed was received from 221-T in approximately 330 gallon batches to C cell in the 224-T. The chemical processing in the 224-T Building consisted of an oxidation step, bismuth phosphate precipitation of impurities, a lanthanum fluoride crossover step, two lanthanum fluoride precipitations, followed by a final metathesis from a fluoride to hydroxide carrier so that the plutonium could be dissolved in nitric acid.

The overall process is illustrated in Figure 1-10, with an indication of the cells and equipment where the steps were carried out in Figures 1-11 through 1-14.

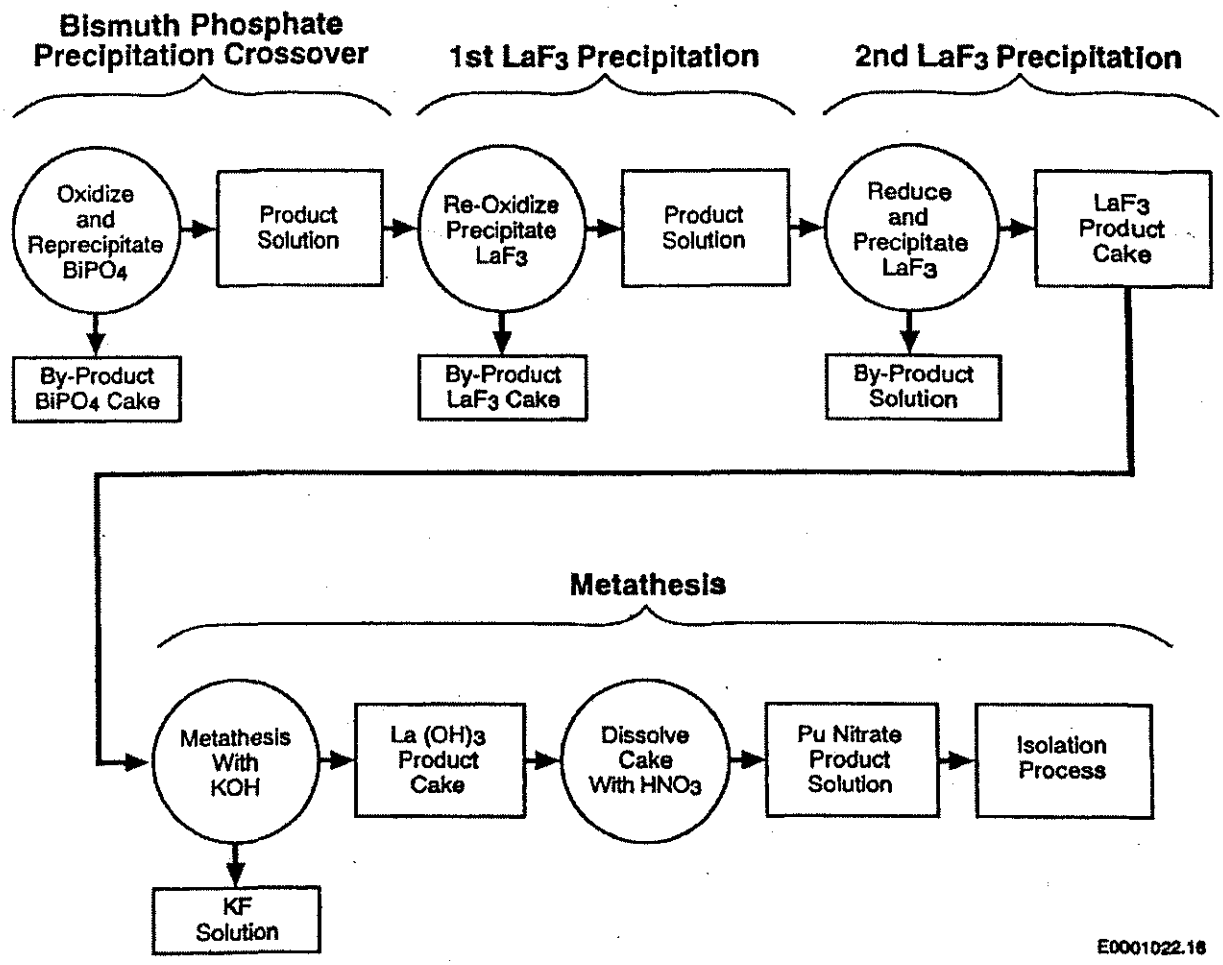

Figure 1-10. 224-T Process Flowsheet Block Diagram.

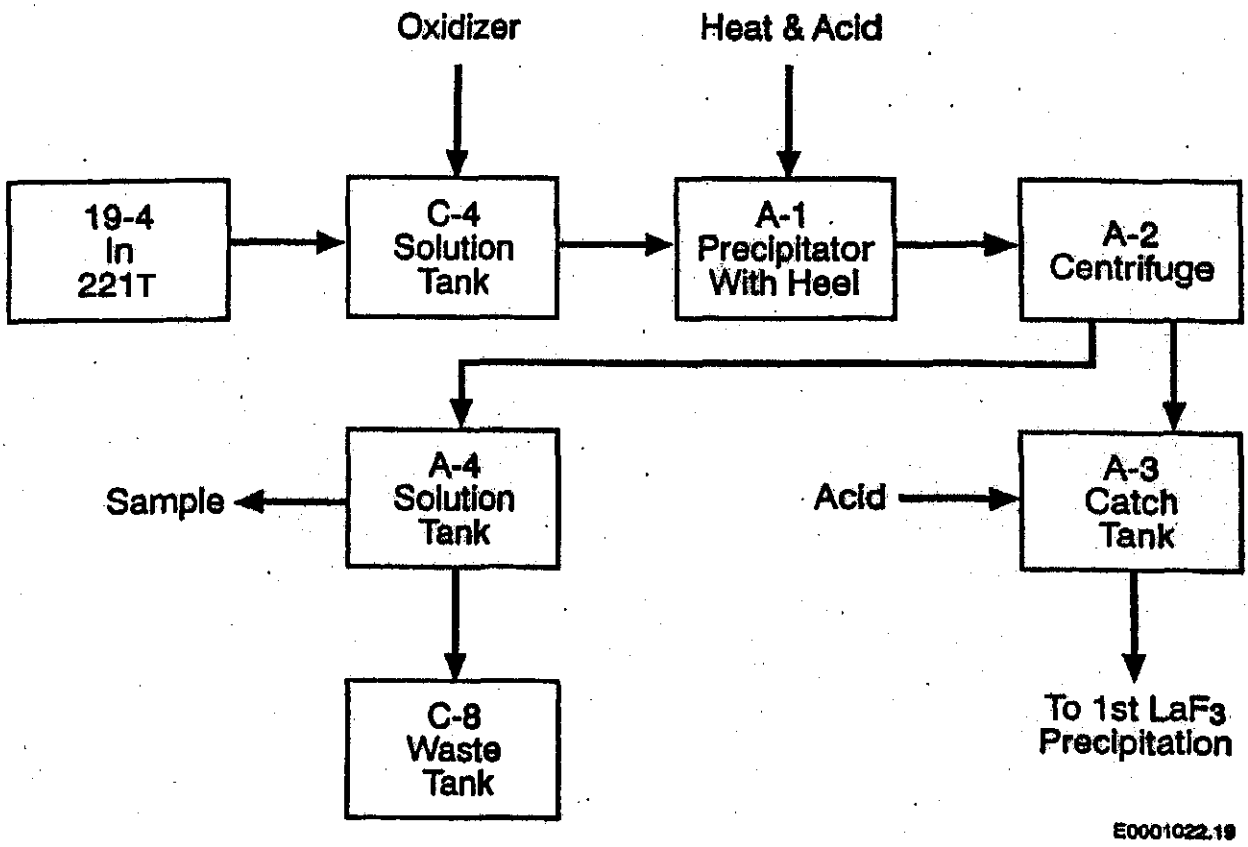

Figure 1-11. 224-T Bismuth Phosphate Precipitation and Crossover Steps Block Diagram.

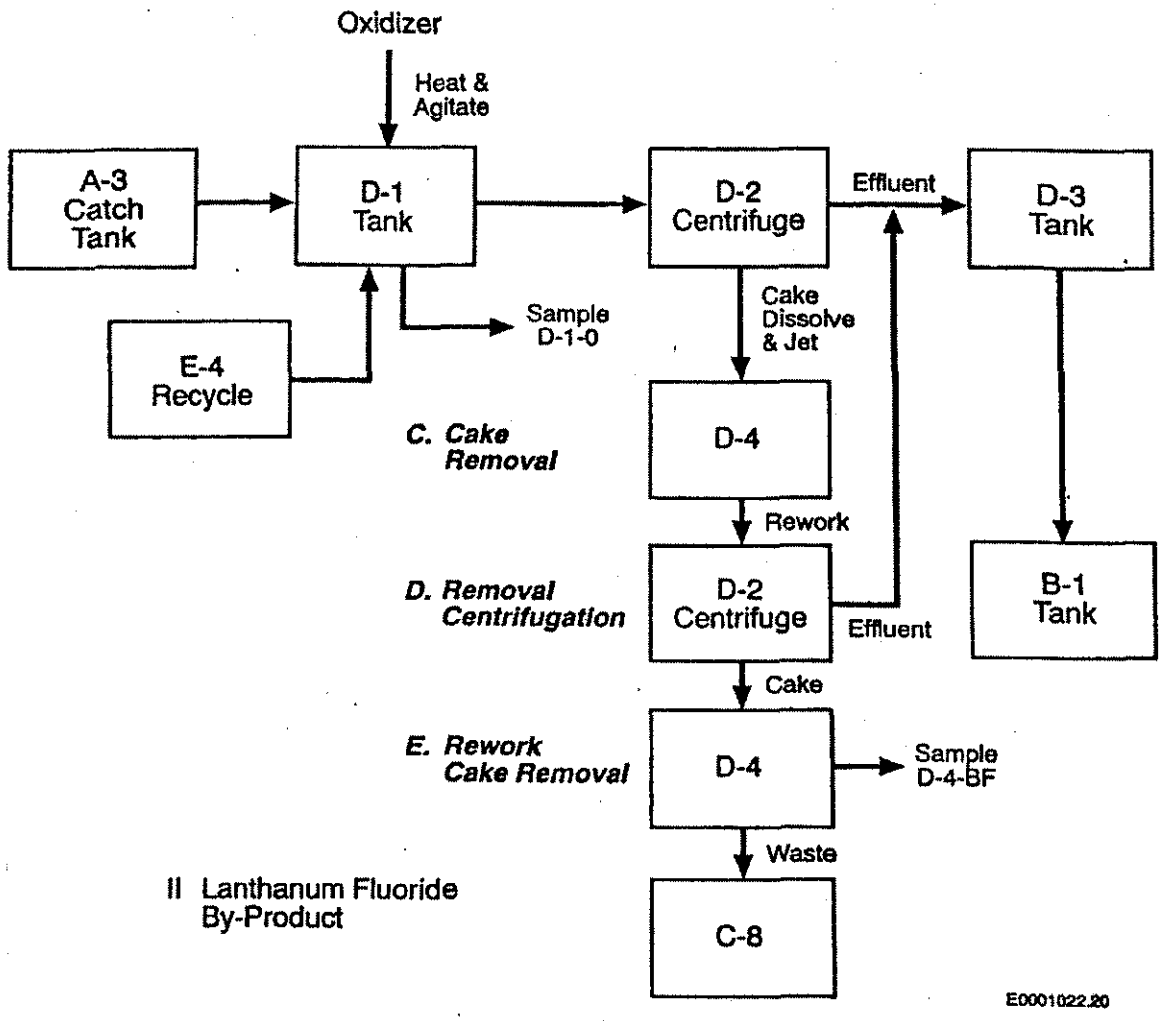

Figure 1-12. 224-T First lanthanum Fluoride Precipitation Step Block Diagram.

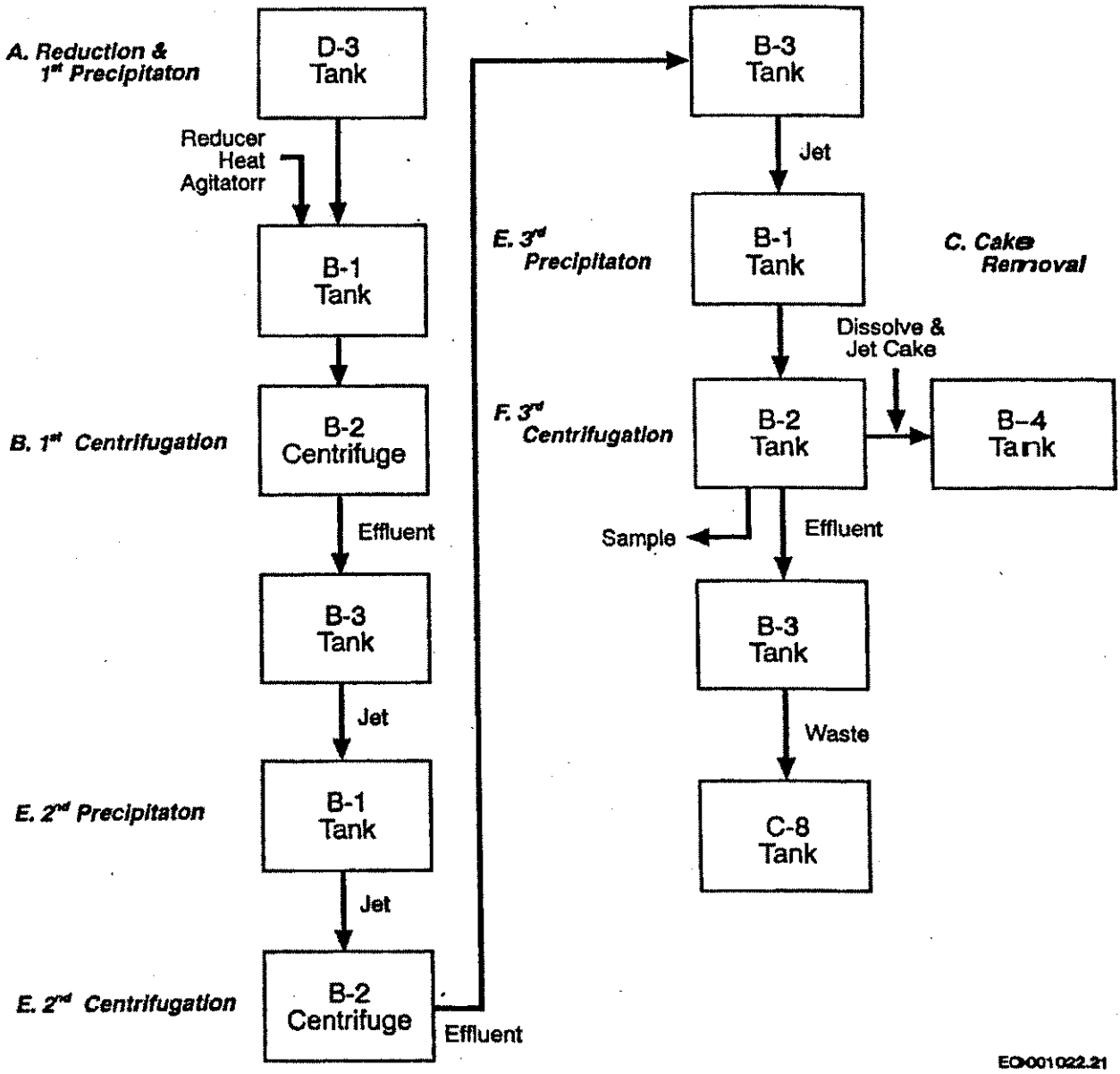

Figure 1-13. 224-T Second and Third Lanthanum Fluoride Precipitation Step Block Diagram.

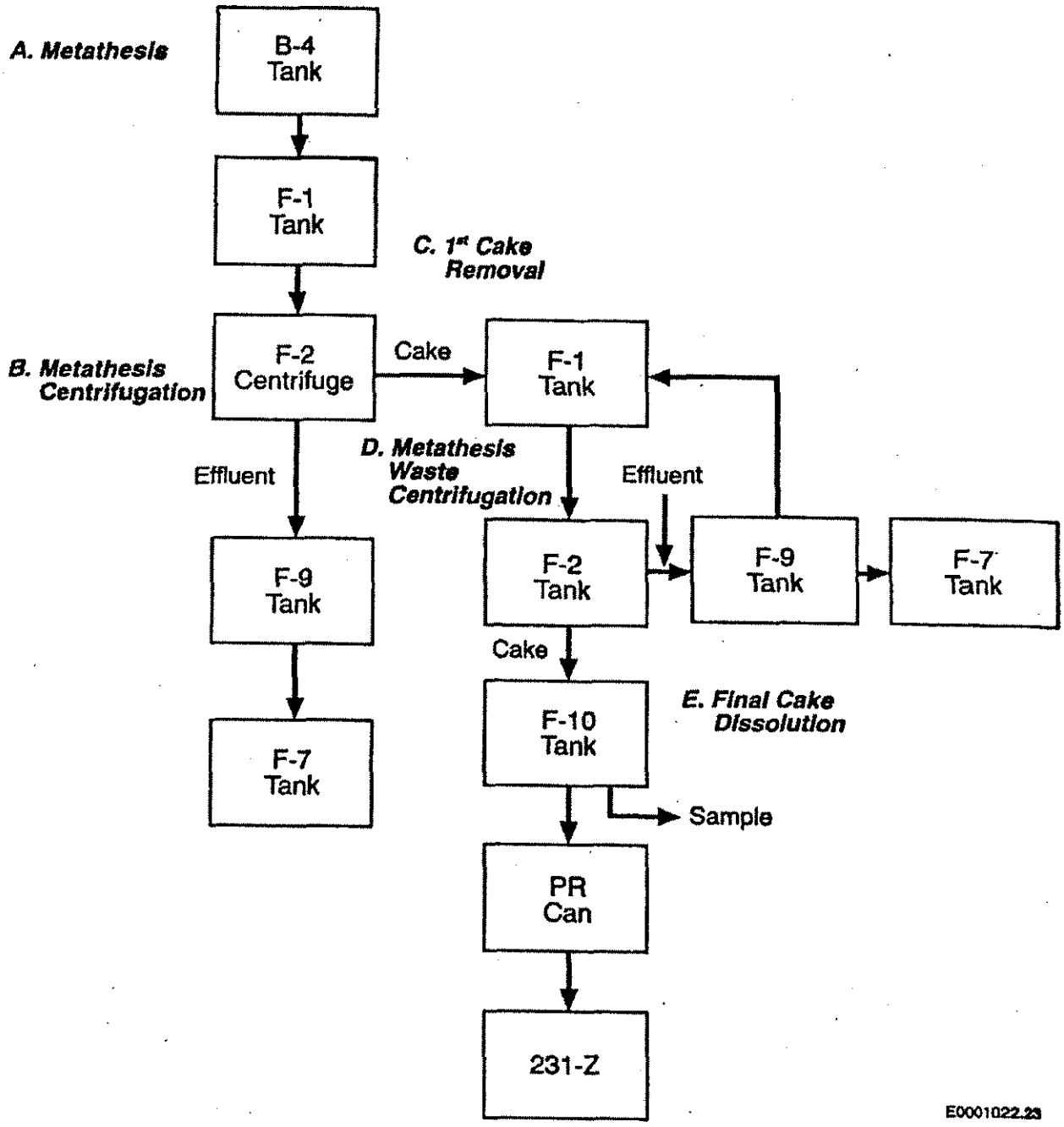

Figure 1-14. 224-T Metathesis and Product Loadout Step Block Diagram.

Feed Material

Product solution from the 221-T Separations Facility process was provided via underground lines to the 224-T as the feed material for the concentration process. Table 1-4 shows the composition of this material.

Table 1-4. Feed from 221-T.

Bismuth Phosphate	BiPO4
Nitric Acid	HNO_3
Sodium Metabismuthate	$NaBiO_3$
Sodium Dichromate	$Na_2Cr_2O_7$
Plutonium	n/a
Trace Americium	n/a
Trace Fission Products	n/a

During the early process development of the entire cycle through the separations, concentration and isolation facility, it was found that plutonium losses could be further minimized by bringing a recycle solution stream back from the 231-Z Isolation Facility to the 224-T Bulk Reduction Building and combining it with the feed from the 221-T Separations Facility. The chemical constituents of the recycle stream from 231-Z are given in Table 1-5.

Table 1-5. Recycle Solutions from 231-Z.

Sulfuric Acid	H_2SO_4
Ammonium Sulfate	$(NH_4)_2SO_4$
Plutonium	n/a

Process Chemicals

The chemicals used in the 224-T Concentration Facility Process are given in Table 1-6.

Table 1-6. Chemicals Used In 224-T Concentration Process.

Sodium Bismuthate	$NaBiO_3$
Phosphoric Acid	H_3PO_4
Nitric Acid	HNO_3
Potassium Permanganate	$KMnO_4$
Hydrofluoric Acid	HF
Lanthanum Salts	$La(NO_3)_3$-$2NH_4NO_3$-$4H_2O$
Sodium Hydroxide	NaOH
Oxalic Acid	$H_2C_2O_4$
Potassium Hydroxide	KOH
Sodium Dichromate	$Na_2Cr_2O_7$

Waste solutions from the process steps were routed to Tank C-8 and the combined solution disposed to a settling tank after neutralization with NaOH. Chemical species of the combined waste streams are shown in Table 1-7.

Table 1-7. Waste Solutions from 224-T Processing.

Bismuth Phosphate	$BiPO_4$
Nitric Acid	HNO_3
Lanthanum Fluoride	LaF_3
Potassium Hydroxide	KOH
Phosphoric Acid	H_3PO_4
Sodium Nitrate	$NaNO_3$
Chromium Nitrate	$Cr(NO_3)_3$
Hydrofluoric Acid	HF
Oxalic Acid	$H_2C_2O_4$
Manganese Nitrate	$Mn(NO_3)_2$
Ammonium Nitrate	NH_4NO_3
Potassium Fluoride	KF
Fission Products	n/a

The routing of these process solutions through the tanks and equipment is described in detail in the early process flowsheets (GE 1951). A description of the tanks and the process chemistry applicable to each is given in Table 1.8, along with the functional steps performed in the process.

Table 1-8. Process Vessel Table.

Vessel Identifier	Design Capacity (gal)	Chemicals Used	Comments
A-1	4280	HNO_3, H_3PO_4, $BiPO_4$, Na_2CrO_7	Initial bismuth phosphate precipitation.
A-2	N/A	Same as contents of A-1	Centrifuge used to separate liquid from solids from initial bismuth phosphate precipitation.
A-3	4280	HNO_3, H_3PO_4, Na_2CrO_7	Received product solution from centrifuge.
A-4	833	$BiPO_4$, HNO_3	Received effluent solution from centrifuge.
B-1	4280	HNO_3, H_3PO_4, $NaNO_3$, KNO_3, $Cr(NO_3)_3$, HF, LaF_3, $H_2C_2O_4$, $Mn(NO_3)_2$, NH_4. NO_3, H_2SO_4, $(NH_4)_2SO_4$	Second and third lanthanum precipitation steps.
B-2	N/A	Same as contents of B-1	Centrifuge used to separate liquid from solids for second and third lanthanum precipitation steps
B-3	4280	HNO_3, H_3PO_4, $NaNO_3$, KNO_3, $Cr(NO_3)_3$, HF, $H_2C_2O_4$, $Mn(NO_3)_2$, NH_4. NO_3, H_2SO_4, $(NH_4)_2SO_4$	Received effluent solution from centrifuge.
B-4	833	$La(OH)_3$, KOH, KF	Received product solution from centrifuge.
B-6	833	Same as B-4	Received product solution from centrifuge.
C-4	833	$BiPO_4$, HNO_3, $NaBiO_3$, Na_2CrO_7	Received feed from 221-B and performed oxidation step.
C-7	4280	Contents of F-7, A-4, D-4, and E-3	Overflow tank for C-8
C-8	4280	Contents of F-7, A-4, D-4, and E-3	Tank that received waste from other cell, neutralized and shipped waste to disposal.

Table 1-8. Process Vessel Table.

Vessel Identifier	Design Capacity (gal)	Chemicals Used	Comments
D-1	4280	HNO_3, H_3PO_4, Na_2CrO_7, $KMnO_4$, HF, LaF_3, NH_4NO_3, KNO_3, H_2SO_4, $(NH_4)_2SO_4$	First lanthanum precipitation and crossover step. Recycle from E-4 added here.
D-2	N/A	Same as contents of D-1	Centrifuge used to separate liquid from solids from first lanthanum precipitation step.
D-3	4280	HNO_3, H_3PO_4, Na_2CrO_7, $KMnO_4$, HF, NH_4NO_3, KNO_3, H_2SO_4, $(NH_4)_2SO_4$	Received product solution from centrifuge.
D-4	833	LaF_3, HNO_3, HF, MnO_2	Received effluent solution from centrifuge.
E-1	4280	HNO_3, H_3PO_4, $NaNO_3$, KNO_3, $Cr(NO_3)_3$, HF, LaF_3, $H_2C_2O_4$, $Mn(NO_3)_2$, NH_4NO_3, H_2SO_4, $(NH_4)_2SO_4$	Second and third lanthanum precipitation steps.
E-2	N/A	Same as contents of E-1	Centrifuge used to separate liquid from solids for second and third lanthanum precipitation steps
E-3	4280	HNO_3, H_3PO_4, $NaNO_3$, KNO_3, $Cr(NO_3)_3$, HF, $H_2C_2O_4$, $Mn(NO_3)_2$, NH_4NO_3, H_2SO_4, $(NH_4)_2SO_4$	Received effluent solution from centrifuge.
E-4	833	KNO_3, H_2SO_4, $(NH_4)_2SO_4$	Received recycle solution from 231-Z
F-1	470	$La(OH)_3$, KOH, KF	Metathesis step to concentrate product.
F-2	N/A	Same as contents of F-1	Centrifuge used to separate liquid from solids for Metathesis step.
F-22	N/A	Same as contents of F-1	Centrifuge used to separate liquid from solids for Metathesis step.
Misc Tank	N/A	Unknown	Appears to be a process tank removed from the process and left of the mezzanine.
F-7	470	$La(OH)_3$, KOH, KF, NH_4NO_3	Received effluent from metathesis step, also used for rework solutions.
F-8	470	KOH, KF, NH_4NO_3	Received effluent from metathesis step
F-9	470	KOH, KF, NH_4NO_3	Received effluent from metathesis step.
Special Tank	75	$La(NO_3)_3$, HNO_3, KNO_3, $Pu(NO_3)_4$	Believed to have received product from metathesis step.
F-10	20	$La(NO_3)_3$, HNO_3, KNO_3, $Pu(NO_3)_4$	Received product from metathesis step. Load-out tank for final product concentrated Pu solution.

Shutdown

As production rates were increased at Redox and PUREX, the operation of the T Plant complex became unnecessary in 1956. The 224-T Building ceased its concentration process mission in early 1956.

Documentation on the shutdown of the building is not available, but monthly reports indicate that the 221-T Facility was placed into a lay away status with steam and water disconnected, chemical and process lines drained, flushed and blanked (See Table 1-3). Similar actions were taken at the 224-T Building.

As part of preparation for RCRA closure and D&D planned in the late 1990's, an assessment of the status of the tanks and lines in the building was performed. The assessment concluded that although documentation of tank and line draining and flushing did not exist, personnel accounts stated that these activities took place, and all external visual indications were that there were no liquids present in the equipment.

Post Processing Facility Operations

Since the building was shutdown in 1956, there have been no process operations in the canyon. The 224-T Building was idle for several years before being modified in 1975 to meet the requirements for storing plutonium-bearing wastes. The cells in the process areas were sealed and isolated from the operating gallery and services areas of the building, and the service areas were stripped of all unnecessary control equipment. Panel boards and partitions were removed to provide 1,068 m^2 (11,500 ft^2) of storage space on three floors. These modifications are detailed in Section 1.6.2.

In 1985 the building became the 224-T TRUSAF and operated in that capacity until the late 1990s. The TRUSAF began storing TRU and TRU-mixed wastes from DOE offsite and onsite generators in 1985. The TRUSAF provided a central location for interim storage of newly generated and retrieved TRU waste. Administrative waste processing in TRUSAF included inspection of containers and associated documentation, examination with a real-time radiography system to confirm the absence of prohibited items, and neutron assay of the waste containers to confirm fissile isotope content. The TRUSAF operations ended prior to receipt of the building by the responsible S&M organization in 2000.

Plan for Project Action

An EE/CA (DOE, 2003) is in progress that proposes the demolition of the 224-T facility to slab on grade. An Action Memorandum approving this removal action is expected in 2004.

Existing Sources of Data

The EE/CA contains general background information on the building and alternatives evaluated for remediation. References cited in that document are a general starting point for information to support the DQO. A significant effort to identify radionuclide distributions in the process cells was made in 2001/2002. Both Non Destructive Assay (NDA) of equipment and surveys by Radiological Control Technicians (RCTs) of surfaces and equipment contamination were completed. The NDA results have been used in safety analysis documents, and the contamination levels provide an extensive survey of the building condition. Since the building is in an inactive configuration with little ventilation or other motive forces that could transport the contaminants, this distribution is unlikely to have changed significantly.

The general dose levels of penetrating radiation in the building are minimal, and the hazard to workers is associated with airborne and surface contamination, as well as potential for exposure when performing D&D on equipment containing residual radionuclide inventory.

The inventory of transuranic radionuclides was measured via non-destructive assay to establish an inventory for use in the characterization of the facility in support of D&D activities. That measured inventory is shown in Table 1-9 below which presents summary information regarding the amounts of radionuclides associated with each cell and tank or centrifuge. The data indicate that most of the inventory of transuranics can be found in equipment where primary processing activities were conducted and some residual holdup could be expected.

Errors are reported at the 1 sigma level and are based on counting statistics alone. A High Purity Germanium (HPGe) detector system, used for this NDA activity, generally has a 2 to 5% total error. A 95% confidence interval is represented by 1.96 sigma. Table 1-9 lists the measured value for Pu-239 and Am-241, along with 1 sigma and 1.96 sigma values.

Table 1-9. 224-T Nondestructive Assay Results – Centrifuges and Mezzanine Tanks.

	Measured	**1 sigma**	**1.96 sigma**	**Measured**	**1 sigma**	**1.96 sigma**
Equipment #	**gPu**	**gPu**	**gPu**	**Ci Am-241**	**Ci Am-241**	**Ci Am-241**
A-1	6.32E-01	7.56E-01	8.75E-01	4.16E-03	4.76E-03	5.34E-03
A-3	4.10E+00	4.31E+00	4.51E+00	1.10E-03	1.46E-03	1.80E-03
A-4	8.65E-02	8.65E-02	8.65E-02	1.82E-03	2.09E-03	2.35E-03
B-1	7.02E-01	8.33E-01	9.59E-01	1.67E-02	1.85E-02	2.02E-02
B-3	2.64E-01	3.17E-01	3.68E-01	3.46E-02	3.82E-02	4.17E-02
B-4	5.47E-01	6.18E-01	6.86E-01	2.09E-02	2.29E-02	2.48E-02
B-6	1.74E-01	1.97E-01	2.20E-01	5.09E-02	5.57E-02	6.03E-02
C-8	2.32E+00	2.47E+00	2.62E+00	1.29E-02	1.43E-02	1.56E-02
D-1	3.41E-01	4.63E-01	5.80E-01	5.59E-02	6.13E-02	6.65E-02
D-3	1.80E-03	1.80E-03	1.80E-03	2.00E-02	2.20E-02	2.39E-02
D-4	2.11E-01	2.31E-01	2.50E-01	7.76E-02	8.48E-02	9.18E-02
E-1	1.70E-02	1.70E-02	1.70E-02	3.50E-02	3.82E-02	4.13E-02
E-3	1.70E-02	1.70E-02	1.70E-02	1.60E-02	1.30E-01	2.39E-01
E-4	7.20E-01	8.20E-02	9.16E-01	2.20E-02	2.45E-02	2.69E-02
F-1	6.40E-01	7.21E-01	7.99E-01	5.35E-02	5.87E-02	6.37E-02
F-10	9.02E+00	9.65E+00	1.03E+01	5.56E-02	6.09E-01	1.14E+00
F-7	4.90E-01	5.71E-01	6.49E-01	2.17E-01	2.39E-01	2.60E-01
F-8	4.00E-01	4.58E-01	5.14E-01	4.89E-02	5.37E-02	5.83E-02
F-9	3.80E-02	4.36E-01	8.18E-01	6.59E-03	7.30E-03	7.98E-03
F-BOX	6.90E-01	7.55E-01	8.17E-01	2.00E-04	2.20E-04	2.39E-04
F-WT	4.00E-04	4.00E-04	4.00E-04	8.18E-03	8.98E-03	9.75E-03
	2.14E+01	**2.37E+01**	**2.60E+01**	**7.59E-01**	**1.50E+00**	**2.20E+00**

Radionuclide contamination levels from radiological survey reports developed during the 2001/2002 cell entries are summarized in Table 1-10. Figures 1-15 through 1-23 show the cell layout and survey data points that correspond to contamination levels listed in the Table 1-10.

Table 1-10. Summary of Radionuclide Contamination Levels in 224-T Cells.

Location of Survey	Survey Data Points	Contamination Level (dpm α)
A Cell		
Figure 1-15 (1 of 2)	1	2450
	2	3500
	3	4900
	4	25200
	5	3500
	6	4200
	7	7000
	8	25200
	9	5600
	10	5600
	11	7400
	12	25200
	13	8400
	14	35000
	15	11200
Figure 1-15 (2 of 2)	16	980
	17	7000
	19	14000
	20	11200
	21	5600
	22	3080
	23	18200
	24	11200
	25	840
	26	840
	27	1260
	28	25200
	29	21000
	30	16800
B Cell		
Figure 1-16 (1 of 2)	1	1400
	2	1400
	3	1400
	4	2100
	5	8400
	6	700
	7	1400
	8	4900
	9	4200
	10	1400
	11	4200
	12	42000
	13	4000
	14	9400
	15	8000
	16	8500

Table 1-10. Summary of Radionuclide Contamination Levels in 224-T Cells.

Location of Survey	Survey Data Points	Contamination Level (dpm α)
Figure 1-16 (2 of 2)	17	4000
	18	7000
	19	9500
	20	3800
	21	4500
	22	1500
	23	7000
	24	2000
	25	1500
	26	4000
	27	2000
	28	2000
	29	4000
C Cell		
Figure 1-17 (1 of 2)	1	1400
	2	1400
	3	1820
	4	1050
	5	1400
	6	360
	7	1050
	8	700
	9	1050
	10	840
	11	1750
	12	1050
	13	1820
	14	1750
	15	1400
Figure 1-17 (2 of 2)	16	700
	17	1050
	18	700
	19	420
	20	700
	21	1050
	22	350
	23	840
	24	560
	25	560
	26	4550
	27	1400
	28	1050
	29	840
	30	3500
	31	2450
	32	3500
	33	2450
	34	4550

Table 1-10. Summary of Radionuclide Contamination Levels in 224-T Cells.

Location of Survey	Survey Data Points	Contamination Level (dpm α)
Figure 1-17 (1 of 2)	35	3150
	36	1750
Figure 1-17 (2 of 2)	37	1050
	38	560
Cell D		
Figure 1-18	1	700
	2	2100
	3	2100
	4	700
	5	700
	6	2100
	7	1400
	8	4200
	9	700
	10	350
	11	2800
	12	350
	13	700
	14	350
	15	700
	16	350
	17	350
	18	700
	19	350
Cell E		
Figure 1-19	1	140
	2	840
	3	700
	4	700
	5	1750
	6	840
	7	19600
	8	1400
	9	840
	10	280
	11	140
	12	<70
	13	140
	14	140
	15	280
	16	140
	17	140
	18	140
	19	280

Table 1-10. Summary of Radionuclide Contamination Levels in 224-T Cells.

Location of Survey	Survey Data Points	Contamination Level (dpm α)
Cell F		
Figure 1-20	1	2100
	2	7700
	3	3500
	4	4200
	5	3500
	6	4200
	7	2450
	8	1400
	9	700
	10	700
F-10 Hood Enclosure		
Figure 1-21	1	<20
	2	1050
	3	140
	4	280
	5	140
	6	350
	7	350
	8	1750
	9	2100
	10	<20
	11	<20
	12	<20

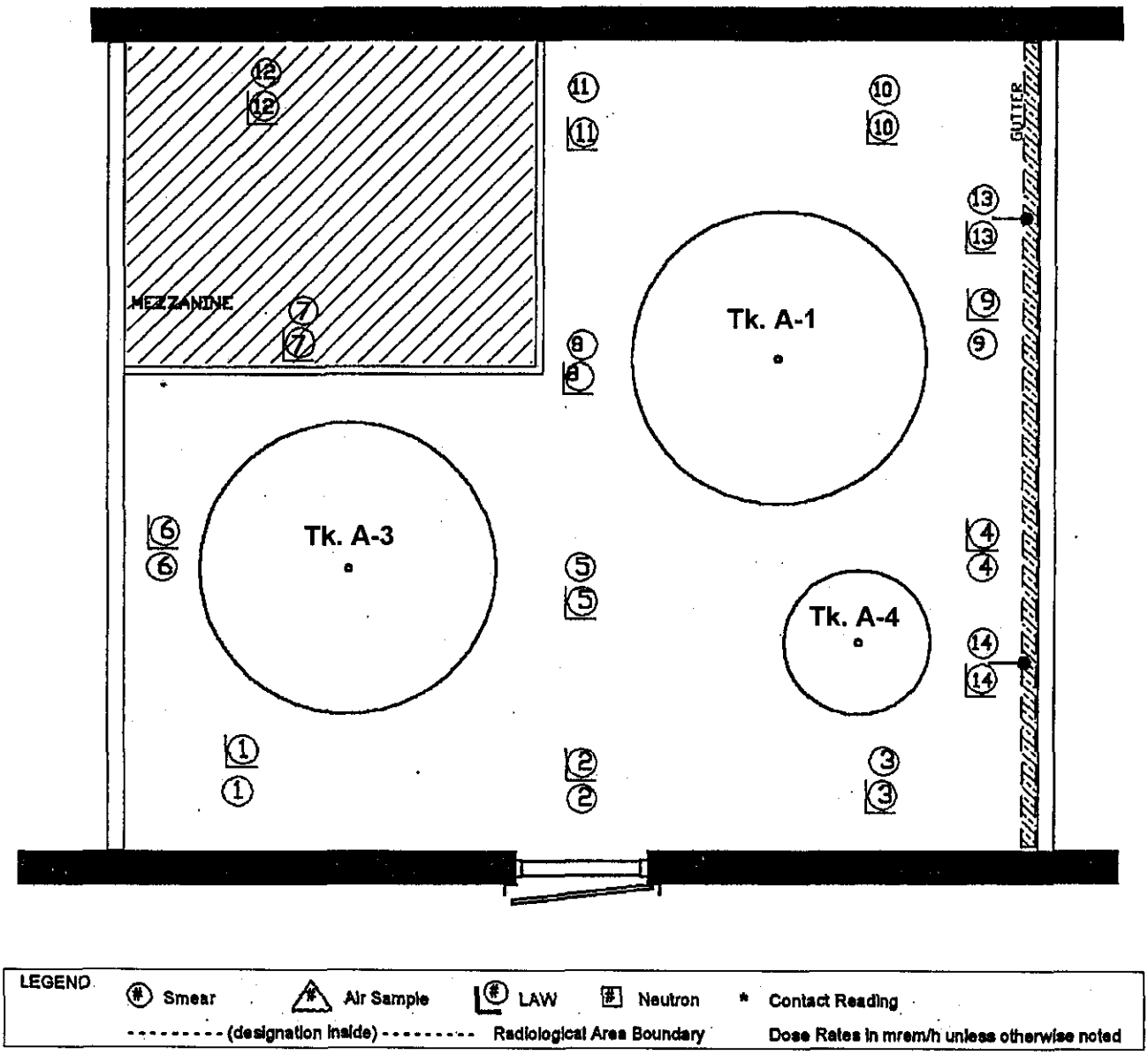

Figure 1-15. 224-T A Cell (1 of 2).

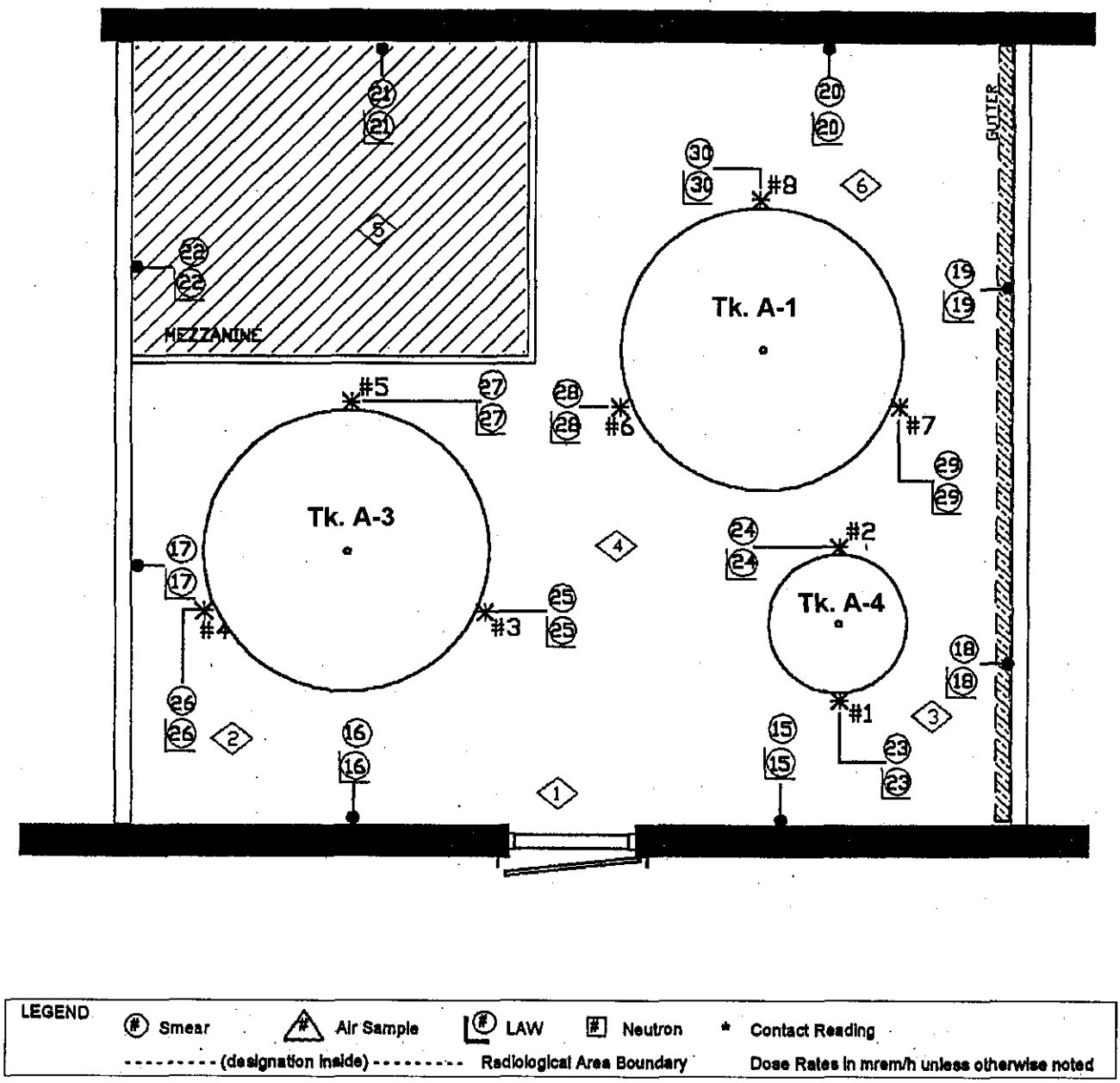

Figure 1-15. 224-T A Cell (2 of 2).

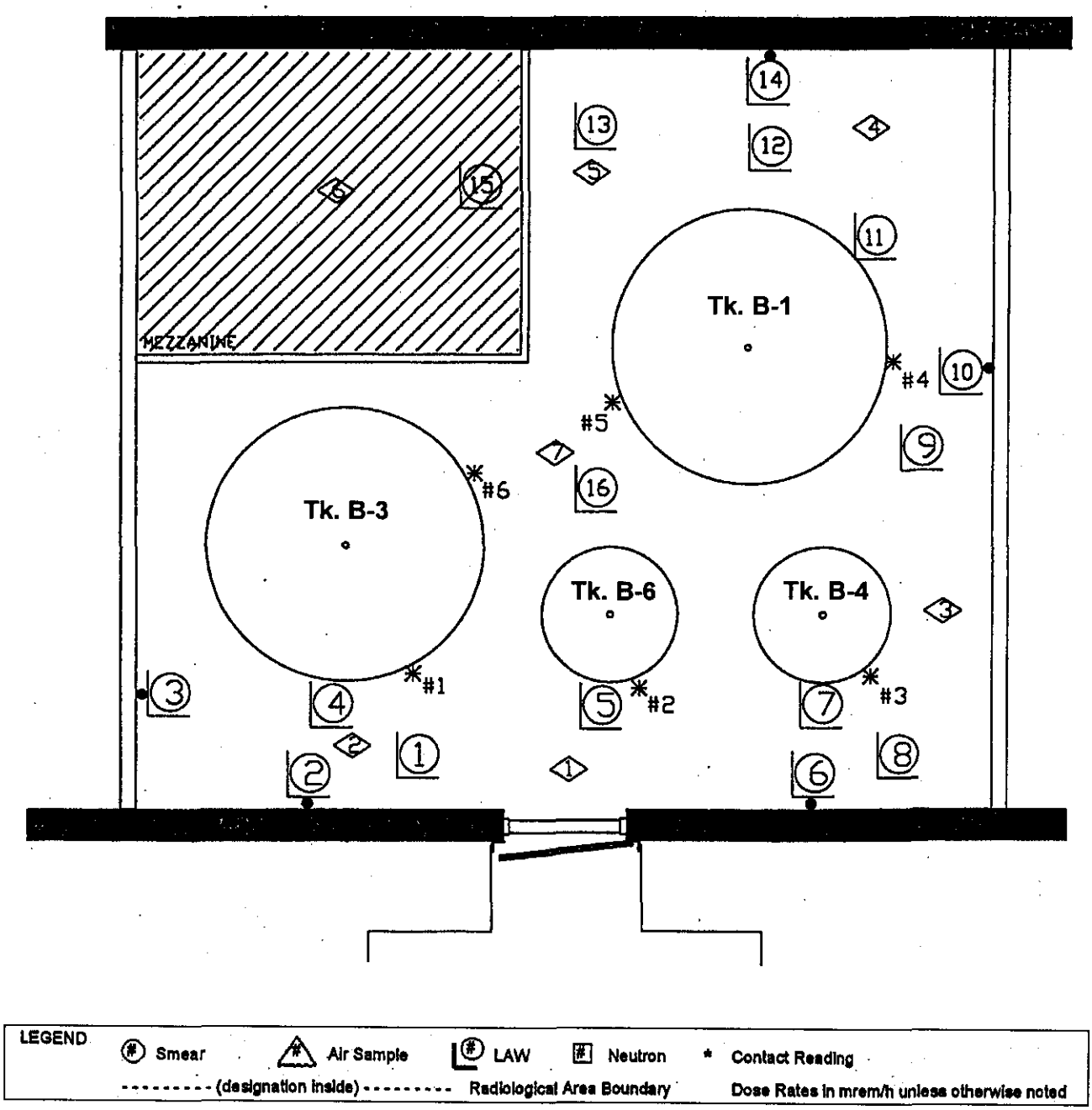

Figure 1-16. 224-T B Cell (1 of 2).

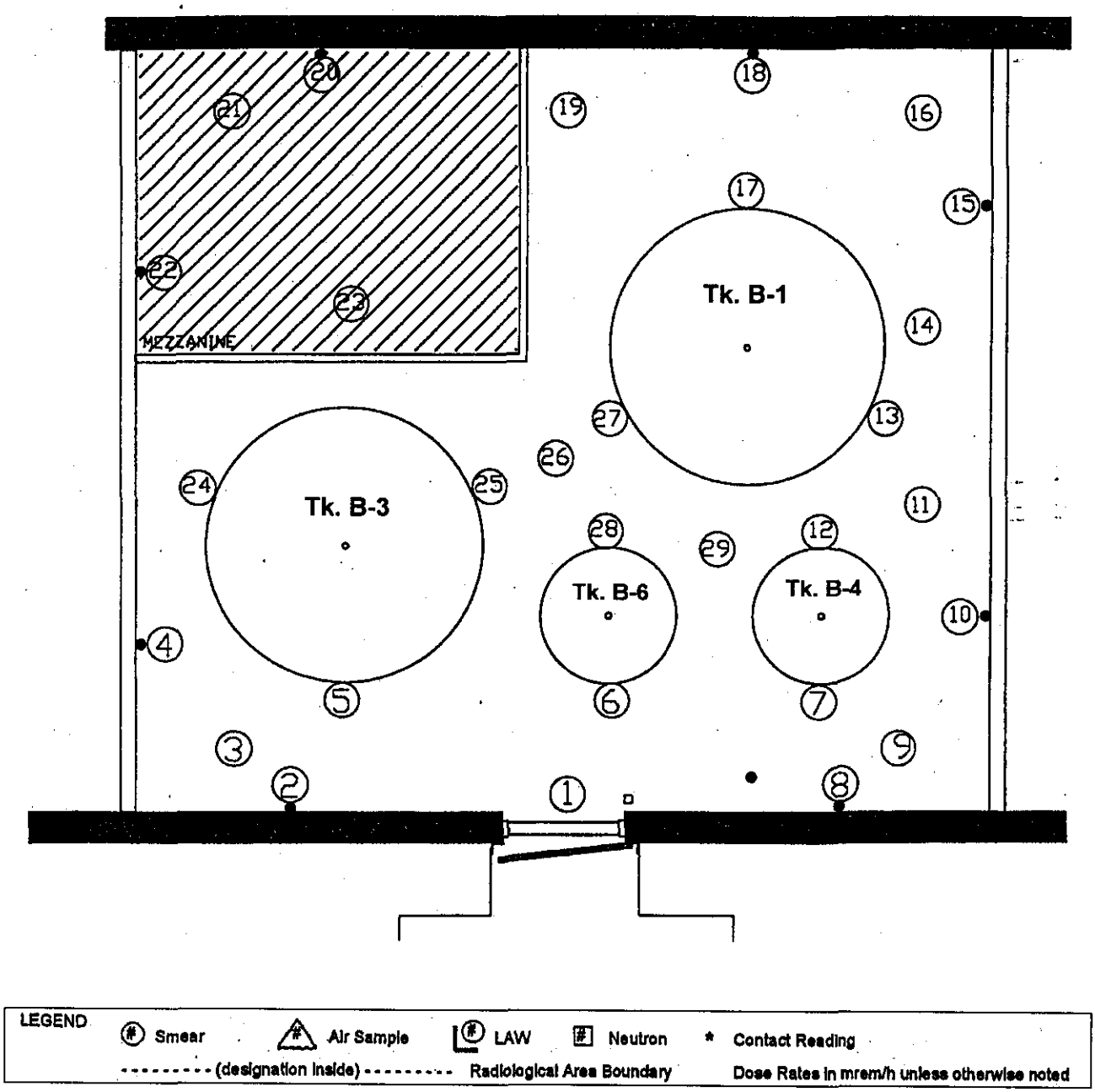

Figure 1-16. 224-T B Cell (2 of 2).

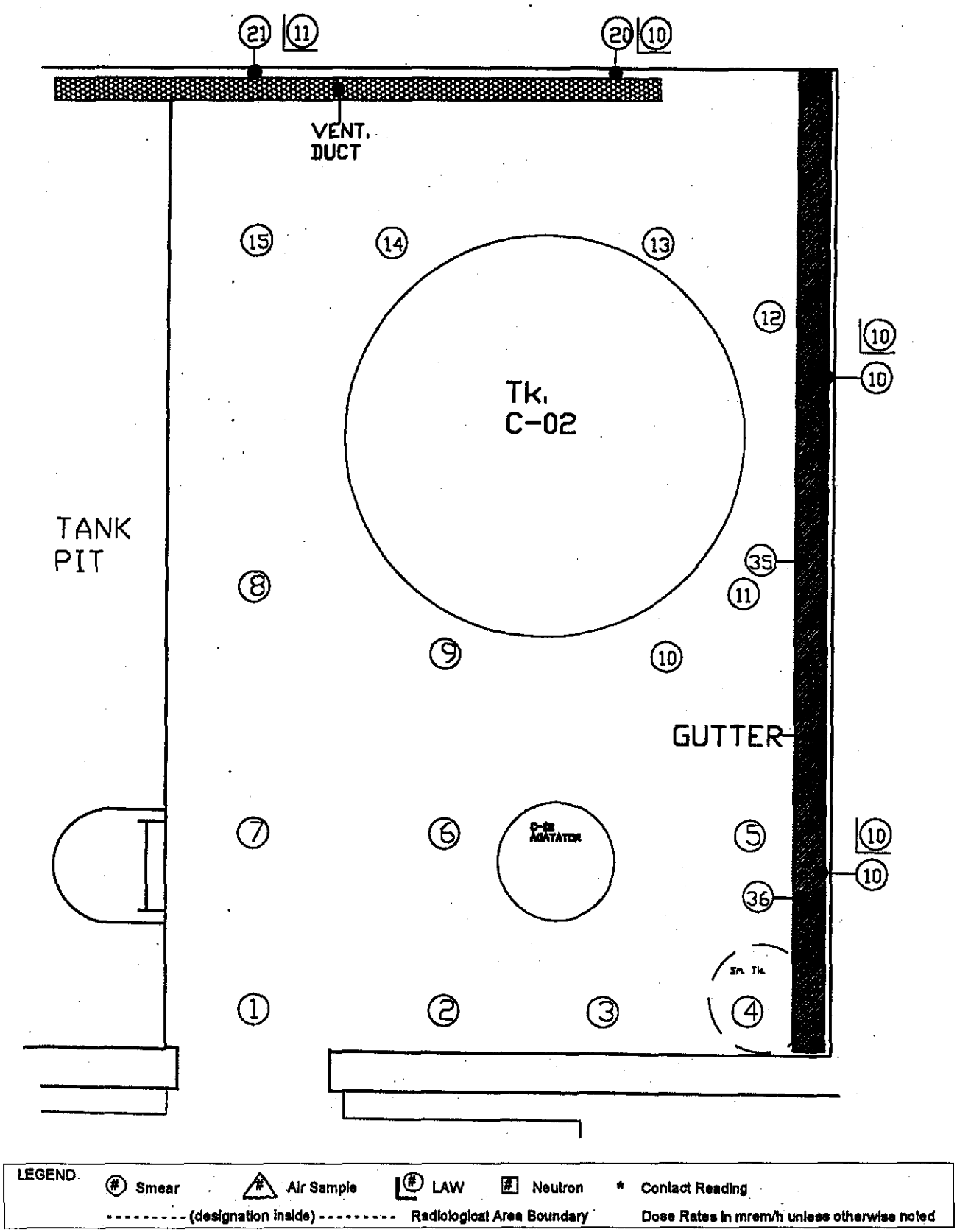

Figure 1-17. 224-T C Cell (1 of 2).

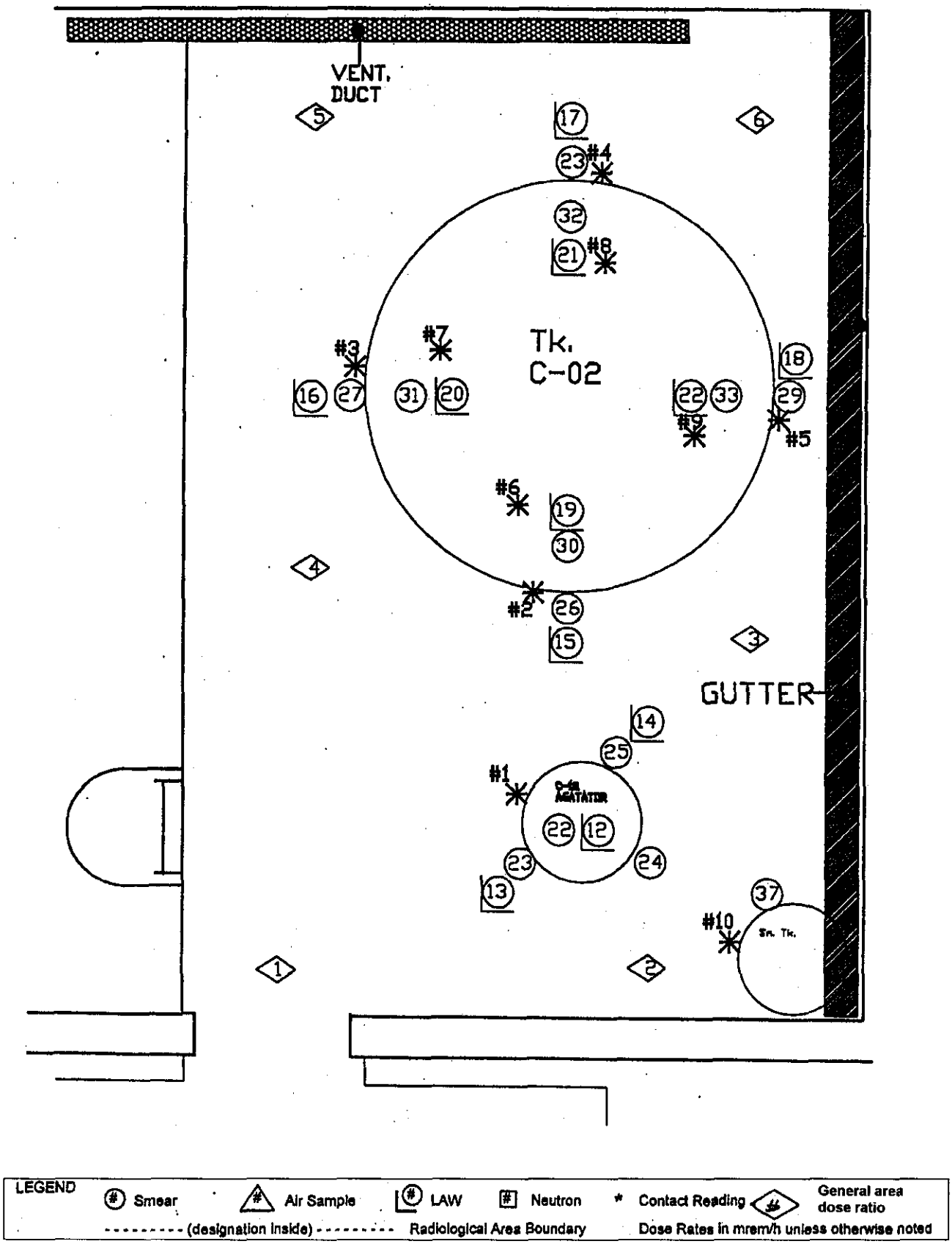

Figure 1-17. 224-T C Cell (2 of 2).

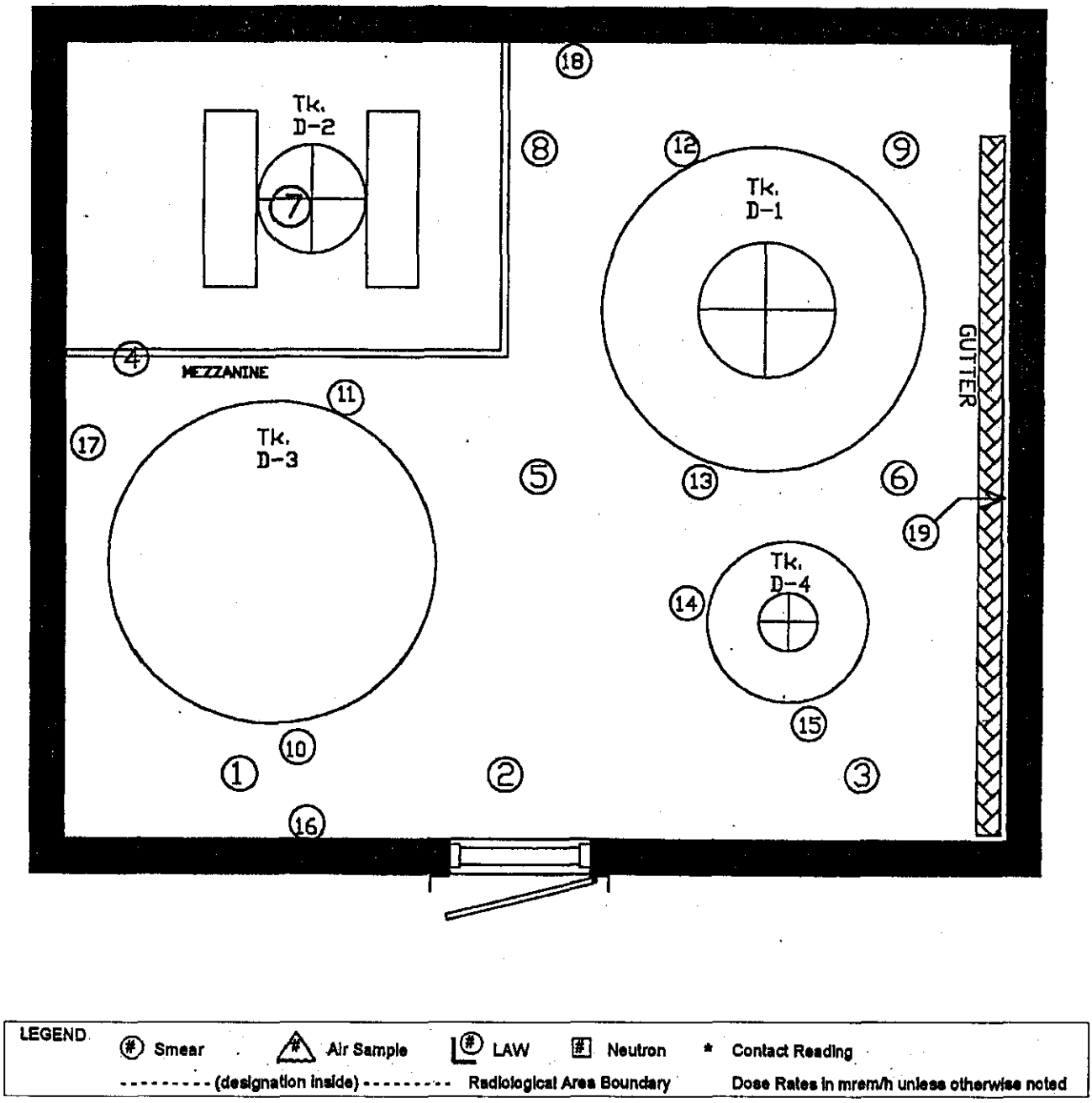

Figure 1-18. 224-T D Cell.

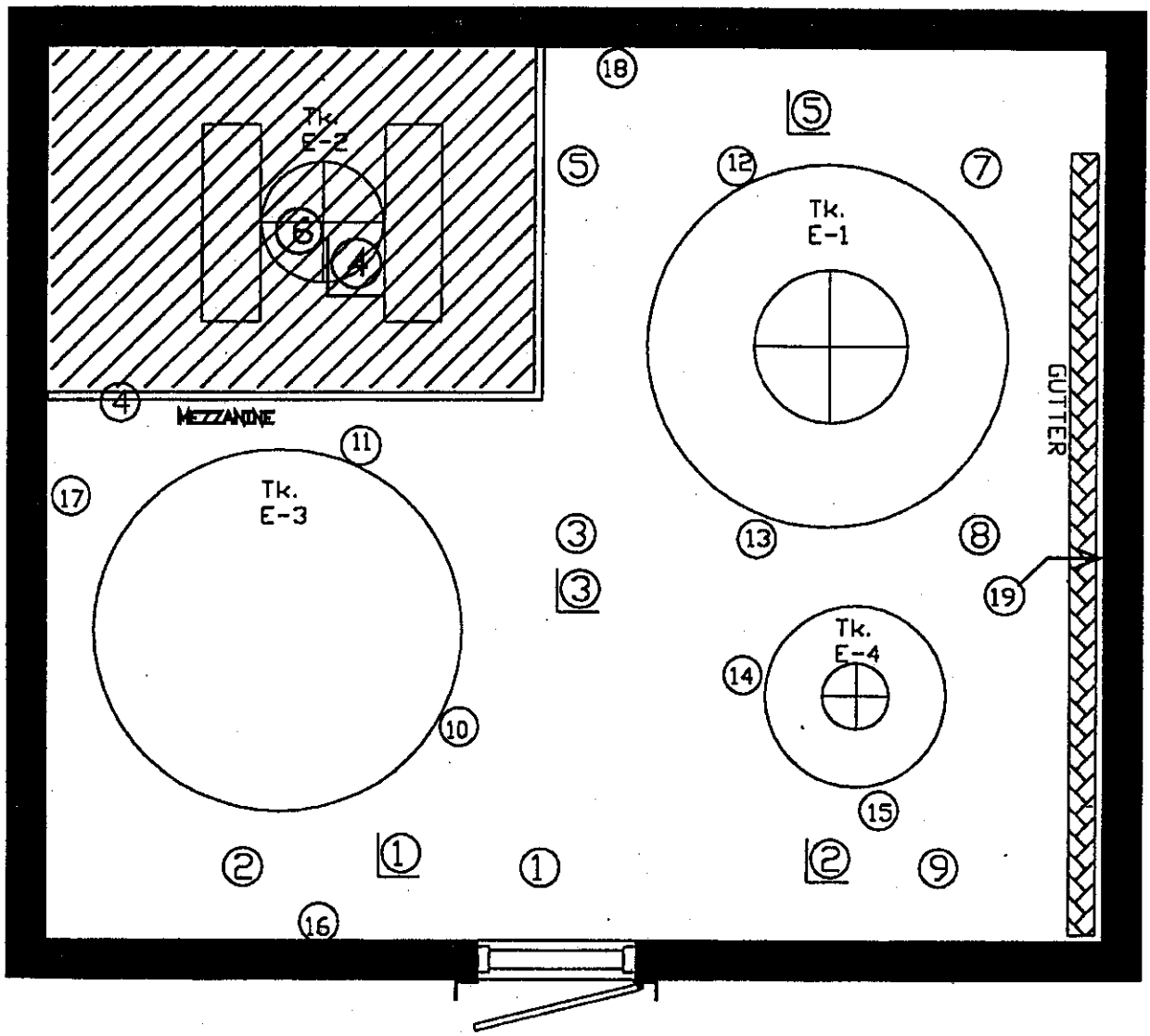

Figure 1-19. 224-T E Cell.

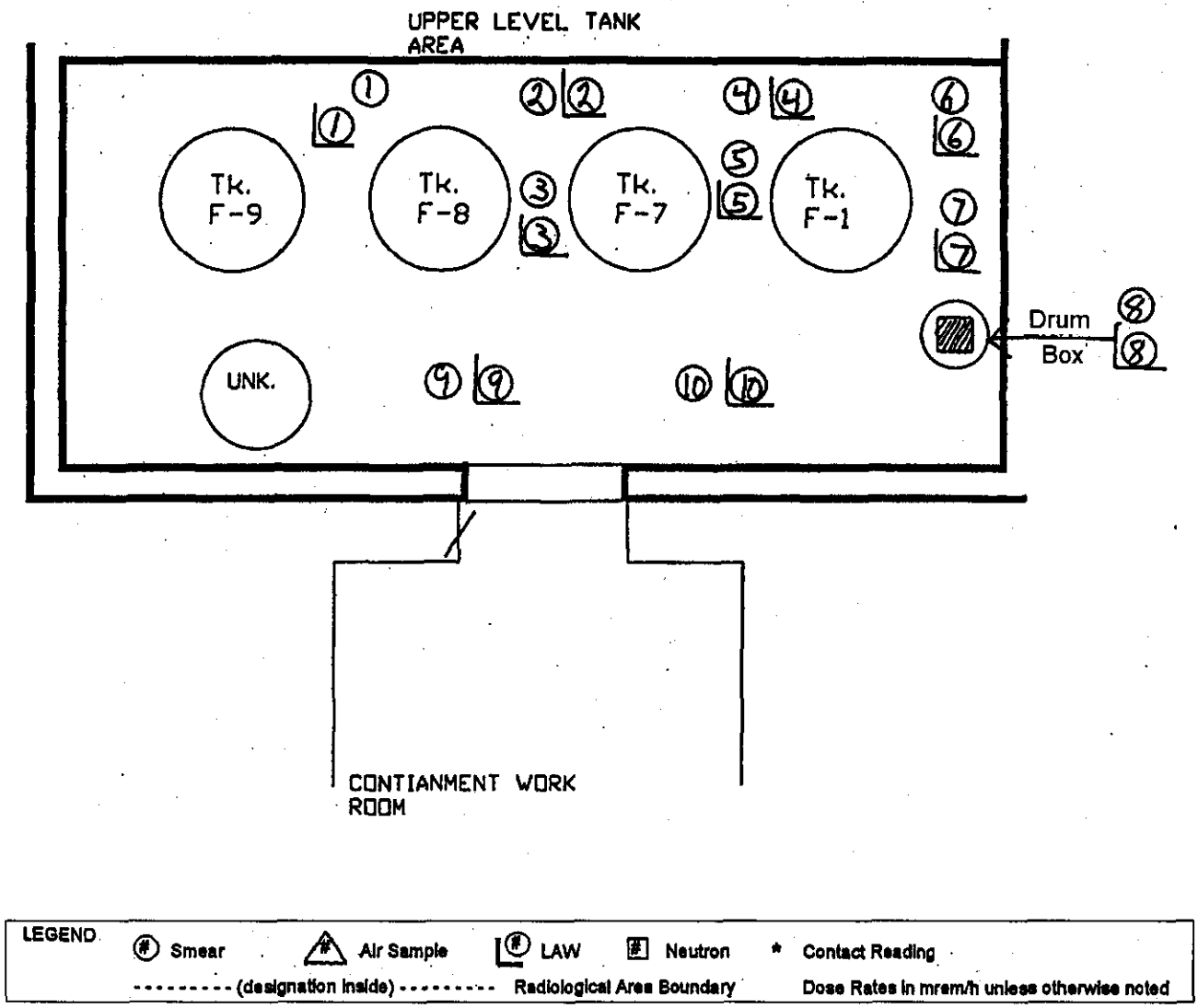

Figure 1-20. 224-T F Cell.

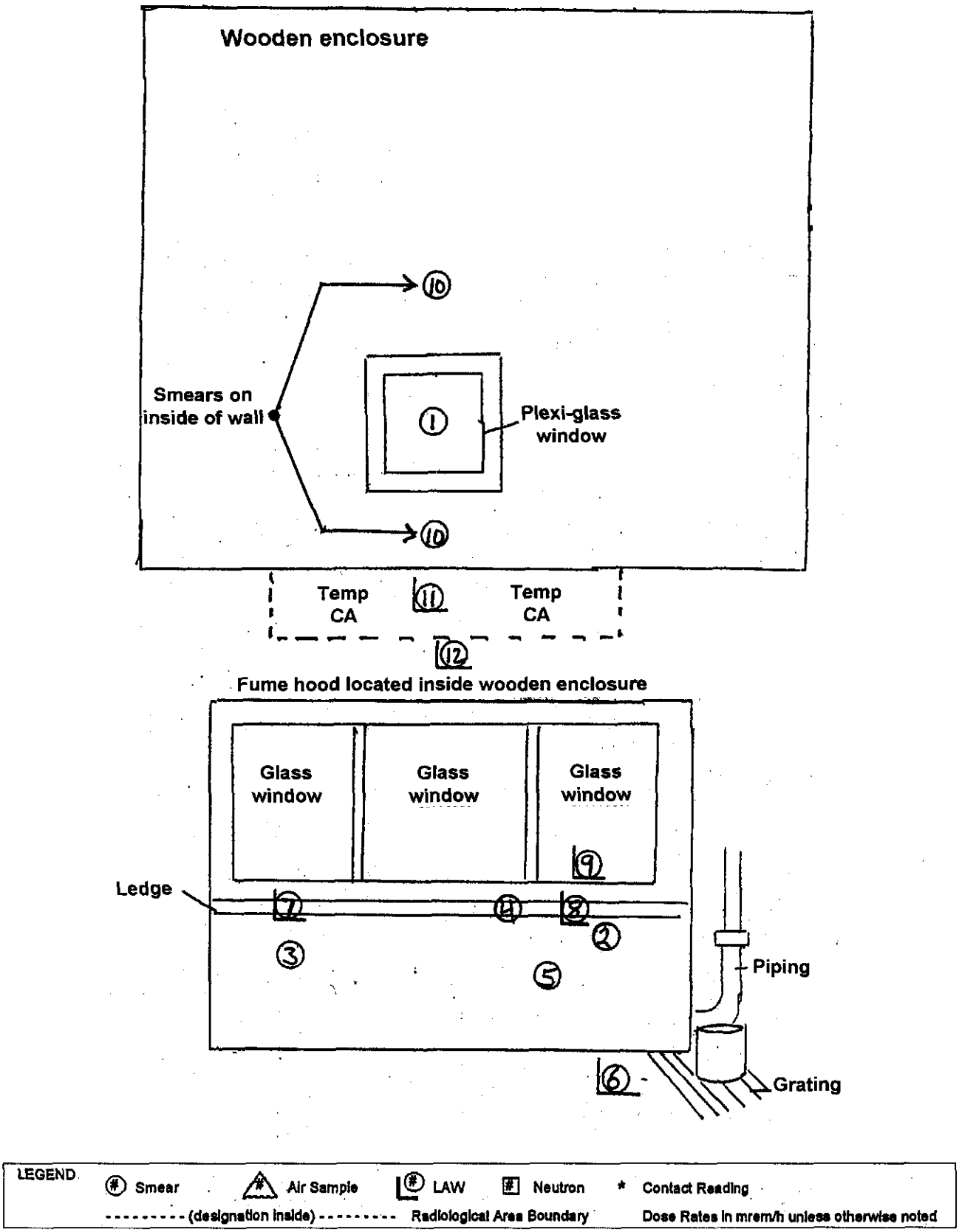

Figure 1-21. F-10 Hood Wooden Enclosure.

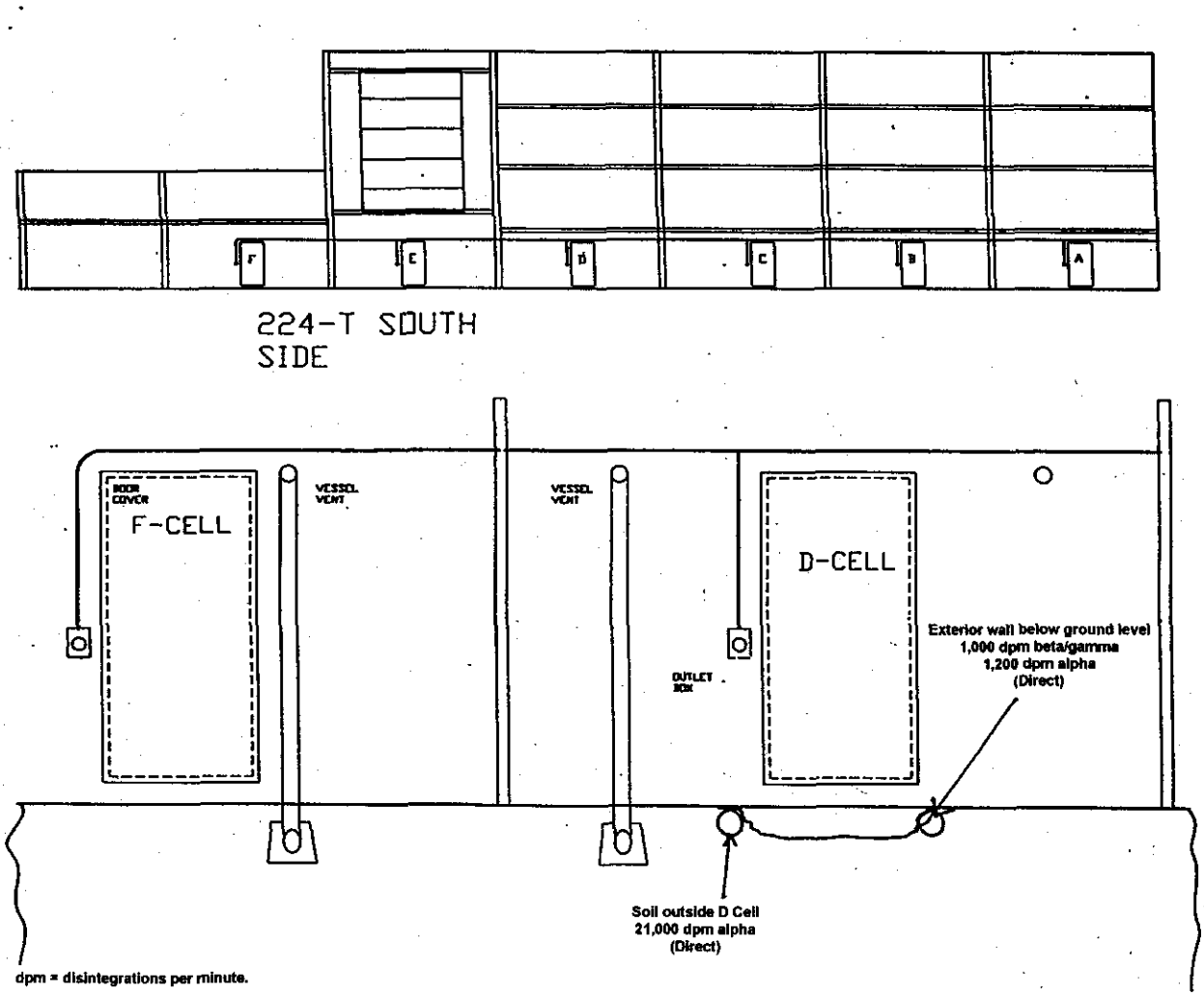

Figure 1-22. 224-T, Outside D Cell.

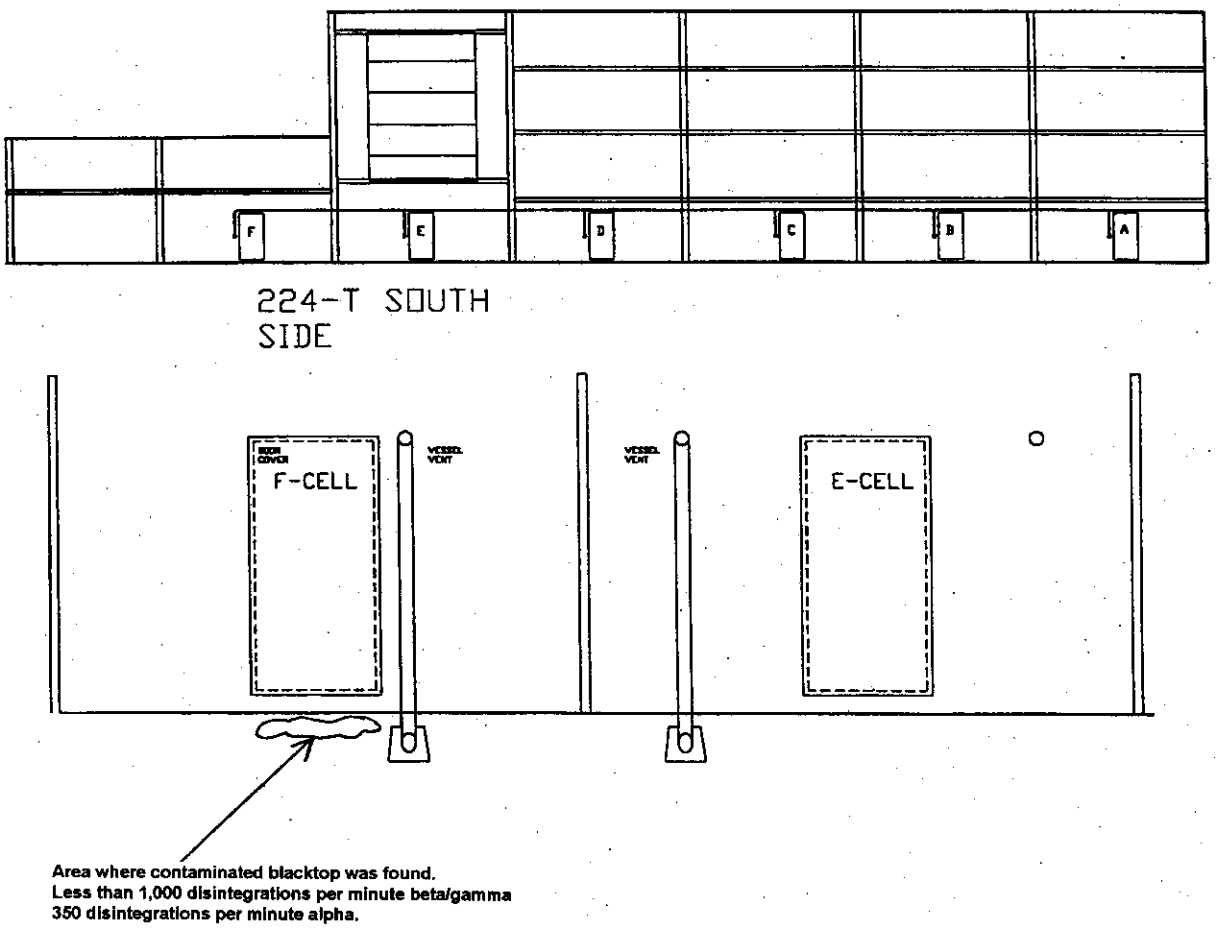

Figure 1-23. 224-T, Outside F Cell.

1.7 CONTAMINANTS OF POTENTIAL CONCERN

Table 1-11. Waste Streams and Contaminants of Potential Concern.

WS #	Waste Stream	Known or Suspected Source of Contamination	COPCs
1	Process vessels, equipment and piping in Cells A-F	Radiological contamination present in feed solution and first decontamination step.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from structural corrosion of processing equipment and residues from chemicals involved in the process and flushing activities.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
2	Miscellaneous aqueous liquid residuals identified in system pumps, sumps, tanks, piping, floor drains, and processing equipment	Radiological contamination from the process solutions and sediments.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from structural corrosion of processing equipment and residues from process and decontamination chemicals that may have contaminated the liquid effluent and sediments.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
3	Miscellaneous solids, sediments and residuals identified in system pumps, sumps, tanks, floor drains, piping, and processing equipment	Radiological contamination from the process solutions and sediments.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from structural corrosion of processing equipment and residues from process and decontamination chemicals.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
4	Bulk demolition debris includes but is	Potential radiological contamination from airborne and/or waterborne contamination.	Transuranics, fission and activation products (see Table 1-12).

Table 1-11. Waste Streams and Contaminants of Potential Concern.

WS #	Waste Stream	Known or Suspected Source of Contamination	COPCs
	not limited to: • poured concrete • concrete block • sheetrock • wooden doors • non-asbestos containing roofing materials • pumps and miscellaneous equipment • steel siding • ventilation system • dried paints	Potential chemicals from waterborne contamination.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
		Paint/coatings.	Cadmium, chromium, barium, lead, mercury, and PCBs.
5	Asbestos-containing material	Potential radiological contamination from airborne contamination, or cross contamination with process solutions or equipment.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from cross contamination with process solutions or equipment.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
		Asbestos in pipe insulation, cement wall board, floor tiles, valve gaskets, and roofing material.	Asbestos fibers.
6	Incandescent light bulbs	Potential radiological contamination from airborne contamination.	Transuranics, fission and activation products (see Table 1-12).
		Light bulbs (lead-base).	Lead.
7	Fluorescent light fixtures and tubes	Potential radiological contamination from airborne contamination.	Transuranics, fission and activation products (see Table 1-12).
		Internals of light ballasts.	PCBs.

Table 1-11. Waste Streams and Contaminants of Potential Concern.

WS #	Waste Stream	Known or Suspected Source of Contamination	COPCs
		Internals of fluorescent tubes.	Mercury.
8	Lead packing in bell and spigot piping in galleries	Potential radiological contaminants on exposed surfaces.	Transuranics, fission and activation products (see Table 1-12).
		Packing in pipe base.	Lead.
9	Lead shielding	Potential radiological contaminants on exposed surfaces.	Transuranics, fission and activation products (see Table 1-12).
		Lead bricks and blankets used for shielding.	Lead
10	Mercury switches	Potential radiological contamination from airborne contamination.	Transuranics, fission and activation products (see Table 1-12).
		Switchgear/instrumentation.	Mercury.
11	Emergency light batteries	Potential radiological contamination from airborne contamination.	Transuranics, fission and activation products (see Table 1-12).
		Battery constituents.	Cadmium, nickel, lead, sulfuric acid, mercury.
12	Exit signs and smoke detectors	Potential radiological contamination from airborne contamination.	Transuranics, fission and activation products (see Table 1-12).
		Internal radioactive sources.	Tritium and americium-241.
13	Lubrication grease, oil, hydraulic oils (includes door actuators and transformer oil)	Potential radiological contamination from past operations.	Transuranics, fission and activation products (see Table 1-12).
		Residue from metallic parts and chemicals used as additives.	PCBs, arsenic, barium, cadmium, chromium, lead, mercury, sulfides, chlorides.
14	HEPA Filters	Potential radiological contamination from past operations	Transuranics, fission and activation products (see Table 1-12).
15	Step Off Pad Soft Waste	Potential radiological contamination from handling process equipment and other facility components.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from handling process equipment and other facility components	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
16	Subsurface soil below	Potential contamination from process solution leaks	Transuranics, fission and activation products (see Table 1-12).

Table 1-11. Waste Streams and Contaminants of Potential Concern.

WS #	Waste Stream	Known or Suspected Source of Contamination	COPCs
	building slab and adjacent to building	or mishandling. Limited data to be obtained to support path forward planning for final site remediation, not part of this CERCLA action.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, iron, molybdenum, tin.
17	RCRA closure samples from concrete	Potential radiological contamination from airborne contamination, or cross contamination with process solutions or equipment.	Transuranics, fission and activation products (see Table 1-12).
		Potential chemical contamination from cross contamination with process solutions or equipment.	Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid, aluminum, chlorides, iron, molybdenum, tin.
18	Water sample from Cell C pit	Potential radiological contaminants from contact with contaminated exposed surfaces in pit.	Transuranics, fission and activation products (see Table 1-12).
		No chemical contaminants expected based on sampling in 2002. Confirmatory total metals sample will be taken to facilitate disposal at 200 ETF.	RCRA metals.

Table 1-12. Radiological Contaminants of Potential Concern.

Americium-241	Europium-152	Plutonium-238	Rhodium-106	Technetium-99
Cesium-137	Europium-154	Plutonium-239/240	Ruthenium-106	Tritium
Cobalt-60	Europium-155	Plutonium-241	Yttrium-90	Uranium-238
Europium-150	Neptunium-237	Plutonium-242	Strontium-90	

Table 1-13. Chemical Contaminants of Potential Concern.

Process Chemicals	Feed Solutions	Flush Solutions	Miscellaneous
Ammonium sulfate	Bismuth phosphate	Nitric acid	Asbestos
Ammonium nitrate	Nitric acid	Sodium hydroxide	Arsenic
Chromium nitrate	Sodium bismuthate		Barium
Hydrofluoric acid	Sodium dichromate	Corrosion Products	Cadmium
Lanthanum fluoride		Tin	Lead
Lanthanum hydroxide	Recycle Solution	Aluminum	Mercury
Magnesium oxide	Sulfuric acid	Iron	PCBs
Magnesium nitrate	Ammonium sulfate	Carbon	Silver
Manganese nitrate		Nickel	Sulfides
Nitric acid		Chromium	Chlorides
Oxalic acid		Molybdenum	
Phosphoric acid		Niobium	
Potassium fluoride			
Potassium hydroxide			
Potassium nitrate			
Potassium permanganate			
Sodium bismuthate			
Sodium dichromate			
Sodium hydroxide			
Sodium nitrate			

1.8 COPC'S EXCLUSIONS

1.8.1 Contaminant of Potential Concern Exclusions

Table 1-14 presents a list of the COPCs to be excluded from the investigation. These exclusions are based on physical laws, process knowledge, existing analytical data, and/or other mitigating factors. Table 1-14 also provides rationale for the exclusion of the identified COPCs.

The COPCs identified in Tables 1-12 and 1-13 are excluded from further consideration for this DQO summary report because they meet at least one of the following criteria for exclusion:

- Short-lived radionuclides with half-lives less than 2 years in accordance with ERDF waste acceptance criteria (BHI 2002)
- Naturally occurring isotopes that were not created as a result of Hanford Site operations and expected to be at background levels
- Chemicals that exist in a gaseous state under ambient conditions and cannot accumulate
- Chemicals that are not federally regulated (40 *Code of Federal Regulations* [CFR] 261, 40 CFR 268, or 40 CFR 761) or Washington State (WAC 173-303) constituent
- Concentration of the progeny can be determined from the parent nuclide when in secular equilibrium with a parent nuclide (i.e., the progeny is decaying as fast as it is formed from the parent)

Table 1-14. Contaminant of Potential Concern Exclusions.

COPC	Rationale for Exclusion
Radionuclides	
Rhodium-106	Less than 2-year half-life.
Ruthenium-106	Less than 2-year half-life.
Chemical COPCs	
Aluminum	Excluded as a solid material; not a Washington State toxic or persistent waste and not a UHC as defined in 40 CFR 268.2.
Chloride	Excluded as a solid material; not a Washington State toxic or persistent waste and not a UHC as defined in 40 CFR 268.2.
Iron	Excluded as a solid material; not a Washington State toxic or persistent waste and not a UHC as defined in 40 CFR 268.2.
Molybdenum	Excluded as a solid material; not a Washington State toxic or persistent waste and not a UHC as defined in 40 CFR 268.2.
Tin	Excluded as a solid material; not a Washington State toxic or persistent waste and not a UHC as defined in 40 CFR 268.2.

UHC = underlying hazardous constituent

1.8.2 Contaminants of Concern to be Determined by Calculation

Table 1-15 identifies the COCs that will not necessarily require laboratory analysis for quantification but can be estimated based on calculations from other COC concentrations by one of the following methods:

- The concentration of the progeny can be determined from the parent nuclide when in secular equilibrium with a parent nuclide (i.e., the progeny is decaying as fast as it is formed from the parent)
- Can be calculated using reactor physics principles/relationships from known concentrations of isotopes being analyzed during the characterization activities
- Can be calculated based on previous analysis of PNNL 2002a, *224-T Nondestructive Assay of Tanks in Cells A Thru F* and verification NDA data associated with isotopic ratios determined from material samples or swipes.

Table 1-15. Contaminants of Concern to be Determined by Calculation.

COC	Rationale for Determination by Calculation
Plutonium isotopes	The concentration of plutonium isotopes can be calculated using NDA data for americium-241 or micro-R instrument readings, and isotopic ratios for associated plutonium, based on smears/samples from material and equipment.
Yttrium-90	Calculated based on secular equilibrium equations from strontium-90 results.

1.8.3 Final List of Contaminants of Concern

This section identifies the final list of COCs and the rationale of inclusion. Table 1-16 identifies COCs for which laboratory analysis may be conducted, as appropriate.

Table 1-16. Final Contaminant of Concern List.

Final COCs	Rationale for Inclusion
Radionuclide COCs	
Americium-241	Known fission product.
Cesium-137	Known fission product.
Cobalt-60	Known activation product.
Europium-150	Known fission product.
Europium-152	Known fission product.
Europium-154	Known fission product.
Europium-155	Known fission product.
Neptunium-237	Known product from fission reaction, special production runs.
Plutonium-238	Known product from fission reaction.
Plutonium-239/240	Known product from fission reaction.
Plutonium-241	Known product from fission reaction.
Plutonium-242	Known product from fission reaction.
Strontium-90	Known fission product. Analyzed as total radioactive strontium.
Technetium-99	Reactor fuel/target component.
Tritium	Known product from fission reaction.
Uranium-238	Reactor fuel component.
Yttrium-90	Daughter product of Sr-90 in secular equilibrium.
Chemical COCs	
Ammonium nitrate	No rationale for exclusion.
Ammonium sulfate	No rationale for exclusion.
Asbestos fibers	No rationale for exclusion.

Table 1-16. Final Contaminant of Concern List.

Final COCs	Rationale for Inclusion
Arsenic	No rationale for exclusion.
Barium	No rationale for exclusion.
Bismuth phosphate	No rationale for exclusion.
Cadmium	No rationale for exclusion.
Chromium nitrate	No rationale for exclusion.
Chromium	No rationale for exclusion.
Carbon	No rationale for exclusion.
Hydrofluoric acid	No rationale for exclusion.
Lanthanum fluoride	No rationale for exclusion.
Lanthanum hydroxide	No rationale for exclusion.
Lead	No rationale for exclusion.
Magnesium oxide	No rationale for exclusion.
Magnesium nitrate	No rationale for exclusion.
Manganese nitrate	No rationale for exclusion.
Mercury	No rationale for exclusion.
Niobium	No rationale for exclusion.
Nitric acid	No rationale for exclusion.
Nickel	No rationale for exclusion.
Oxalic acid	No rationale for exclusion.
PCBs (or list the aroclors)	No rationale for exclusion.
Phosphoric acid	No rationale for exclusion.
Potassium hydroxide	No rationale for exclusion.
Potassium fluoride	No rationale for exclusion.
Potassium nitrate	No rationale for exclusion.
Potassium permanganate	No rationale for exclusion.
Silver	No rationale for exclusion.
Sodium dichromate	No rationale for exclusion.
Sodium hydroxide	No rationale for exclusion.
Sodium bismuthate	No rationale for exclusion.
Sodium nitrate	No rationale for exclusion.
Sulfuric acid	No rationale for exclusion.

1.8.4 Final Waste Stream and Contaminant of Concern List

Table 1-17 shows the waste streams and specific COCs identified for each waste stream in the facility.

Table 1-17. Final Waste Streams and Contaminants of Concern.

WS #	Waste Stream	Final COCs
1	Process vessels, equipment and piping in Cells A-F	See radiological COCs (Table 1-16).
		Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, sulfuric acid.

Table 1-17. Final Waste Streams and Contaminants of Concern.

WS #	Waste Stream	Final COCs
2	Miscellaneous aqueous liquid residuals identified in system pumps, sumps, tanks, piping, floor drains, and processing equipment	See radiological COCs (Table 1-16).
		Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, and sulfuric acid.
3	Miscellaneous solids, sediments and residuals identified in system pumps, sumps, tanks, floor drains, piping, and processing equipment	See radiological COCs (Table 1-16).
		Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, and sulfuric acid.
4	Bulk demolition debris includes but is not limited to: • poured concrete • concrete block • sheetrock • wooden doors • non-asbestos containing roofing materials • pumps and miscellaneous equipment • steel siding • ventilation system • dried paints	See radiological COCs (Table 1-16).
		Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, and sulfuric acid, silver.
		Cadmium, chromium, barium, lead, mercury, and PCBs.
5	Asbestos-containing material	Transuranics, fission and activation products (Table 1-16).
		Ammonium nitrate, ammonium sulfate, bismuth phosphate, chromium nitrate, chromium, carbon, hydrofluoric acid, lanthanum fluoride, lanthanum hydroxide, magnesium oxide, magnesium nitrate, manganese nitrate, niobium, nitric acid, nickel, oxalic acid, phosphoric acid, potassium hydroxide, potassium fluoride, potassium nitrate, potassium permanganate, sodium dichromate, sodium hydroxide, sodium bismuthate, sodium nitrate, and sulfuric acid.
		Asbestos fibers.
6	Incandescent light bulbs	See radiological COCs (Table 1-16).
		Lead.
7	Fluorescent light tubes and fixtures	See radiological COCs (Table 1-16).
		PCBs.
		Mercury.
8	Lead packing in bell and spigot piping in galleries	See radiological COCs (Table 1-16).
		Lead.
9	Lead shielding	See radiological COCs (Table 1-16).
		Lead.
10	Mercury switches	See radiological COCs (Table 1-16).
		Mercury.
11	Emergency light batteries	See radiological COCs (Table 1-16).

Table 1-17. Final Waste Streams and Contaminants of Concern.

WS #	Waste Stream	Final COCs
		Cadmium, nickel, lead, mercury, and sulfuric acid.
12	Exit signs and smoke detectors	See radiological COCs (Table 1-16).
		Tritium and americium-241.
13	Lubrication grease, oil, hydraulic oils (includes door actuators and transformer oil)	See radiological COCs (Table 1-16).
		PCBs, arsenic, barium, cadmium, chromium, lead, and mercury.
14	HEPA Filters	See radiological COCs (Table 1-16).
15	Step off pad soft waste	See radiological COCs (Table 1-16).
		Chemical constituents seen in process streams 1-15.
16	Subsurface soil below building slab and adjacent to building	Transuranics, fission and activation products (Table 1-16). Chemical constituents seen in process streams, see WS #1.
17	RCRA closure samples	See radiological COCs (Table 1-16).
		See chemical COCs (Table 1-16).
18	Water in Cell C pit	See radiological COCs (Table 1-16).
		Total Metals[1]

[1] Total metals analysis for water in Cell C pit only, based on sampling performed in 2002. This sample analysis will be used as a confirmatory analysis for the data collected in 2002.

1.8.5 Anomalous Waste Materials

This waste category includes any unplanned or unexpected material discovered during D&D operations that will require sampling and analysis to support disposition. The anomalous waste category is provided to allow field decision making based on "as-found" conditions discovered during demolition (described in further detail in Sections 3.0, and 7.0). Project Waste Specialists will support the final determination of the sample analyses that is required on a case-by-case basis, based on the appropriate acceptance criteria for treatment, storage or disposal.

1.8.6 Waste Disposition Options

The primary disposal option for the waste streams described in this DQO summary report is ERDF. The ERDF waste acceptance criteria addresses the radiological, chemical, and physical forms of waste. The ERDF cannot accept TRU waste, TRU-mixed waste, or nonradioactive hazardous waste. If these waste streams are encountered, regulatory approval will be sought to store the waste in the CWC, or ship the waste off the Hanford Site. Nonradioactive hazardous waste will be shipped to an offsite treatment, storage, and/or disposal (TSD) unit for disposal. Waste shipped to the CWC or to an offsite TSD must meet the acceptance and packaging criteria outlined in HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria* (FH 2003).

Liquid waste will either be sent to the ETF (with regulatory approval) or will be treated to meet the acceptance criteria of the receiving facility. Waste acceptance criteria for the ETF is established after submittal of waste stream characterization data.

The project will evaluate salvageable materials that may have the potential for reuse. At this time, the only items that will be considered for release for reuse will be those items that are not volumetrically contaminated (e.g., light fixtures and chairs). It is recognized that lubricants (i.e., grease and oils) have the potential for volumetric contamination; however, these items will be evaluated for recycling using established criteria.

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2.0 STEP 2 – IDENTIFY THE DECISION

The purpose of DQO Step 2 is to define the principal study questions (PSQs) that need to be resolved to address the problem identified in DQO Step 1 and to define the alternative actions (AAs) that would result from the resolution of the PSQs. The PSQs and AAs are then combined into decision statements (DSs) that identify AAs that may be used.

2.1 PRINCIPAL STUDY QUESTIONS, ALTERNATIVE ACTIONS, AND DECISION STATEMENTS

Table 2-1 presents the task-specific PSQs, AAs, and resulting DSs. This table also provides a qualitative assessment of the severity of the consequences of taking an AA if it is incorrect. This assessment takes into consideration human health and the environment (i.e., flora/fauna) and political, economic, and legal ramifications. The severity of the consequences is expressed as low, moderate, or severe.

Table 2-1. Summary of DQO Step 2 Information.

PSQ-AA#	Alternative Action	Description of Consequences of Implementing the Wrong Alternative Action	Severity of Consequences (Low/Moderate / Severe)
PSQ #1 – Does the waste material exceed the radiological criteria for the disposal facility?			
1-1	The affected media exceeds the waste acceptance criteria for radionuclides.	Waste is improperly managed and disposed at an inappropriate facility.	Severe
1-2	The affected media does not exceed the waste acceptance criteria for radionuclides.	Additional project cost incurred as a result of using alternative disposal facilities.	Moderate
DS #1 – Determine if the radionuclides present in the waste material exceed the disposal facility's waste acceptance criteria.			
PSQ #2 – Do the chemical and/or physical properties of the waste material exceed the disposal facility's waste acceptance criteria limits?			
2-1	The chemical and/or physical properties of the waste material exceed the disposal facility's waste acceptance criteria limits.	Waste is managed as a nonhazardous waste and improperly disposed.	Severe
2-2	The chemical and/or physical properties do not exceed the disposal facility's waste acceptance criteria limits.	Waste is unnecessarily managed as a hazardous waste. Additional project cost is incurred.	Low
DS #2 – Determine if the chemical and/or physical properties of the waste material exceed the disposal facility's waste acceptance criteria limits.			
PSQ #3 – Is the waste material a listed dangerous waste?			
3-1	The waste material is a listed dangerous waste and receives a listed waste code.	Waste is managed as a non-listed dangerous waste and improperly disposed.	Severe

Table 2-1. Summary of DQO Step 2 Information.

PSQ-AA#	Alternative Action	Description of Consequences of Implementing the Wrong Alternative Action	Severity of Consequences (Low/Moderate / Severe)
3-2	The waste material is not a listed dangerous waste and is not regulated as such.	Waste is managed as a listed dangerous waste and improperly disposed. Additional project costs incurred.	Low
DS #3 – Determine if the waste material is regulated as listed dangerous waste.			
PSQ #4 – Is the waste material a characteristic dangerous waste (e.g., ignitable, corrosive, reactive, or toxic)?			
4-1	The waste material is a characteristic dangerous waste (e.g., corrosive, ignitable, reactive, and/or toxic) and receives a characteristic waste code.	Waste is managed as a noncharacteristic dangerous waste and improperly disposed.	Severe
4-2	The waste material is not a characteristic dangerous waste (e.g., corrosive, ignitable, reactive, and/or toxic) and is not regulated as such.	Waste is managed as a characteristic dangerous waste and improperly disposed. Additional project costs incurred.	Low
DS #4 – Determine if the characteristic dangerous waste codes (e.g., corrosivity, ignitability, reactivity, and toxicity) apply to the waste material.			
PSQ #5 – Is the waste material a toxic dangerous waste per Washington State criteria?			
5-1	The waste material is a toxic dangerous waste per Washington State criteria and receives a toxic dangerous waste code.	Waste is managed as a non-toxic dangerous waste and improperly disposed.	Severe
5-2	The waste material is not a toxic dangerous waste per Washington State criteria and is not regulated as such.	Waste is managed as a toxic dangerous waste and improperly disposed. Additional project costs incurred.	Low
DS #5 – Determine if the waste material meets the definition of a toxic dangerous waste in accordance with Washington State criteria.			
PSQ #6 – Is the waste material a persistent dangerous waste in accordance with Washington State criteria?			
6-1	The waste material meets the definition of a persistent dangerous waste in accordance with Washington State criteria.	Waste is managed as a non-persistent dangerous waste and improperly disposed.	Severe
6-2	The waste material does not meet the definition of a persistent dangerous waste in accordance with Washington State criteria.	Waste is managed as a persistent dangerous waste and improperly disposed. Additional project cost incurred.	Low
DS #6 – Determine if the waste material meets the definition of a persistent dangerous waste in accordance with Washington State criteria			
PSQ #7 – Is the waste material a PCB waste?			
7-1	The waste material is regulated due to PCB concentrations.	Waste is managed as a non-PCB regulated waste and improperly disposed.	Severe

Table 2-1. Summary of DQO Step 2 Information.

PSQ-AA#	Alternative Action	Description of Consequences of Implementing the Wrong Alternative Action	Severity of Consequences (Low/Moderate / Severe)
7-2	The waste material is not regulated due to PCB concentrations	Waste is managed as a PCB regulated waste and improperly disposed.	Low
DS #7 – Determine if the waste material is regulated due to PCB concentrations.			
PSQ #8– Is the waste material ACM?			
8-1	The waste material is regulated due to asbestos content.	Waste is managed as non-ACM and improperly disposed.	Severe
8-2	The waste material is not regulated due to asbestos content.	Waste is managed, as an ACM and improperly disposed. Additional project cost incurred.	Low
DS #8 – Determine if the waste material is regulated due to asbestos content.			
PSQ #9 – Is the waste material LDR?			
9-1	The waste material is LDR. Treatment is imposed on the debris prior to disposal.	Waste is managed and disposed as non-LDR waste when it should have been treated.	Severe
9-2	The waste material is not land disposal restricted. Treatment is not required for the debris prior to disposal. The debris will be disposed in an onsite facility without treatment.	Waste is managed and disposed as LDR waste. Additional project costs incurred.	Low
DS #9 – Determine if LDRs impose treatment for waste material.			
PSQ #10 – Does the material meet the requirements for recycling?			
10-1	The affected media meets the requirements for recycling.	Waste is disposed when it should have been recycled. Additional project costs incurred.	Low
10-2	The affected media does not meet the requirements for recycling and must be managed as a waste material.	Waste is improperly recycled when it should have been disposed.	Severe
DS #10 – Determine if the affected media meets the recycling requirements.			

[a] The definition of dangerous waste also includes hazardous waste.
LDR = land disposal restriction

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3.0 STEP 3 – IDENTIFY INPUTS TO THE DECISION

The purpose of DQO Step 3 is to identify the type of information needed to resolve each of the DSs identified in DQO Step 2. The information may already exist or may be derived from computational or surveying/sampling and analysis methods. Analytical performance requirements (e.g., practical quantitation limit [PQL], precision, and accuracy) are also provided in this step for any new data that need to be collected.

3.1 INFORMATION REQUIRED TO RESOLVE DECISION STATEMENTS

Tables 3-1 includes the information needed to resolve the DSs, and existing data are evaluated for use. Table 3-1 identifies the DSs where existing data are available, do not exist, and are of sufficient or insufficient quality to resolve the DSs. For those cases where data do not exist or are insufficient to resolve the DS, the table identifies computational and/or surveying/sampling information that could be used to obtain the required data.

As noted in Table 3-1, sufficient information may be based on process knowledge (provided such knowledge can be demonstrated to be sufficient for proper designation) and environmental measurements. If a waste is designated as dangerous, compliance with land disposal restrictions (LDRs) must be demonstrated based on testing, as process knowledge is not sufficient to demonstrate compliance with LDR standards prior to disposal (40 CFR 268). However, sampling the wastes after treatment is beyond the scope of the sampling design presented in this DQO summary report, as the final waste forms (and volume) of treated wastes (if any) are unknown at this time. This is also noted in DQO Step 5.

Table 3-1. Required Information and Reference Sources.

DS #	Informational Need	WS #	Required Data	Do Data Exist? (Y/N)	Available Information	Sufficient Data? (Y/N)	Additional Computational Methods Needed	Additional Survey/Sampling Information Needed
1	Radionuclides	1, 4, and 17	Radiological activity in the waste material	Y	Existing laboratory data, waste disposition documentation	N	Engineering evaluation/ calculation	NDA, radiological surveys and smears
		2, 18		Y	Existing laboratory data, waste disposition documentation	N	Engineering evaluation/ calculation	NDA, radiological surveys, media sampling and analysis
		3		Y	Existing laboratory data, waste disposition documentation, process knowledge, MSDS	N	Engineering calculation	NDA, radiological surveys, media sampling and analysis
		5 through 16		N	Process knowledge	N	N/A to these waste streams	Radiological surveys, media sampling and analysis
2	Chemical contaminants	1, 4, and 17	Chemical concentration and/or physical properties	N	Process knowledge, MSDS	N	N/A to these waste streams	Media sampling and analysis
		2		Y	Existing laboratory data, waste disposition documentation	N	Engineering calculations	Process knowledge, and/or media sampling/analysis
		3		Y	Process knowledge, MSDS, existing laboratory data, waste disposition documentation	N	Engineering calculations	Process knowledge, MSDS, and/or media sampling/analysis
		5 through 16		N	Process knowledge, MSDS.	N	None	Process knowledge, MSDS, and/or media sampling/analysis
3	Listed dangerous waste status	All	Chemical constituents of materials	Y	Process knowledge	Y	None	Additional research of process knowledge, and/or media sampling/analysis
4	Characteristic dangerous waste code status	1, 4, and 17	Chemical and/or physical properties	Y	Process knowledge, existing laboratory data, waste disposition documentation	N	Engineering calculations	Additional research of process knowledge, and/or media sampling/analysis
		2		Y	Existing laboratory data, waste disposition documentation	N	Engineering calculations	Additional research of process knowledge, and/or media sampling/analysis
		3		Y	Process knowledge	N	Engineering calculations	Chemical information collected for DS #2

Table 3-1. Required Information and Reference Sources.

DS #	Informational Need	WS #	Required Data	Do Data Exist? (Y/N)	Available Information	Sufficient Data? (Y/N)	Additional Computational Methods Needed	Additional Survey/Sampling Information Needed
		5 through 13		Y	Existing designation of routine waste streams	Y	None	None
5	Toxic dangerous waste code status	1, 4, and 17	Chemical and/or physical properties	Y	Existing laboratory data, waste disposition documentation	Y	None	None
		2		Y	Existing laboratory data, waste disposition documentation	N	Engineering calculations	Additional research of process knowledge, and/or media sampling/analysis
		3		N	Process knowledge	N	Engineering calculations	Chemical information collected for DS #2
		5 through 16		Y	Existing lab data, process knowledge, MSDS.	Y	None	None
6	Persistent dangerous waste code status	13	Chemical and/or physical properties	N	Process knowledge	N	None	Media sampling and analysis and Chemical information collected for DS #2
7	PCB concentrations	7 and 13	Chemical concentration and/or physical properties	N	Process knowledge	N	None	Media sampling and analysis and Chemical information collected for DS #2
8	Asbestos contamination	3	Percent of asbestos in the waste material	N	Process knowledge	N	None	Media sampling and analysis and Chemical information collected for DS #2
9	LDRs	All		Y	Process knowledge, MSDS	N	None	Additional research or process knowledge, and/or media sampling/analysis and Chemical information collected for DS #2-7, or 9.
10	Radionuclides Recycle	Only applies to 5 through 16	Radiological activity of waste materials	Y	Data collection for general waste designation to answer DS #1	N	N/A	Radiological information collected for DS #1 and / or radiological instrument surveys

Table 3-1. Required Information and Reference Sources.

DS #	Informational Need	WS #	Required Data	Do Data Exist? (Y/N)	Available Information	Sufficient Data? (Y/N)	Additional Computational Methods Needed	Additional Survey/Sampling Information Needed
	Chemical contaminants Recycle		Chemical and/or physical properties of the waste materials	Y	Data collection for general waste designation to answer DS #2	N	N/A	Chemical information collected for DS #2

MSDS = material safety data sheet
N/A = not applicable
NDA = nondestructive assay

3.2 ENGINEERING CALCULATIONS

Engineering calculations will need to be prepared or existing calculations will need to be revised to support radiological waste inventories and scaling factors and to develop chemical waste inventories prior to removal and final disposition of many waste streams, as determined in Table 3-1. The engineering calculations will use existing data or additional data that is required to be collected prior to final waste disposition. These waste calculations will assist in the determination of final designation and packaging and will be used by Waste Management and Transportation in association with the appropriate waste profiles.

3.3 DANGEROUS WASTE EVALUATION

The waste streams that are being evaluated for regulation under the Land Disposal Restrictions (LDRs) include those waste streams with paint coatings, used oils, and grease and the residues associated with the tanks, centrifuges and piping. The paint is only a small percentage of the total debris (e.g., concrete, tanks, pumps, equipment, and sheetrock) being disposed but is of concern because of potential target compound metals. The paint will not be separated from the substrate before disposal; therefore, the likelihood of failing LDRs for these waste streams is low. The use of process knowledge, material safety data sheet (MSDS) information, and/or the collection of paint samples will be needed to evaluate this material. The average thickness of paint will be estimated and process knowledge, MSDS information, and/or laboratory data will be used to calculate the total volume of paint based on the appropriate volume of the waste stream to which the paint is applied.

The oils, greases, and small amounts of other liquid may be segregated in containers. Each container will become a sample boundary and evaluated separately. The COCs for the oils and grease are not complex. If the laboratory detection limits are higher than the target compound regulatory levels, then the waste will be appropriately designated. No engineering calculations will be required in support of final disposition. The laboratory data will be used to confirm contamination levels in the waste stream materials and to determine appropriate disposition of the waste materials. Containerized aqueous liquids and petroleum products may be evaluated for reuse or recycling.

The accumulation of target compound metals in the tanks and equipment needs to be determined. Samples will need to be collected from the tanks, centrifuges and piping as available and sent to the laboratory for analysis to determine the concentration of *Resource Conservation and Recovery Act of 1976* (RCRA) chemical contaminants in the material. The laboratory data will need to be evaluated to support final disposition of these waste streams. The evaluation and supporting calculations will use the tank or equipment mass and appropriate fixatives/stabilization materials to determine concentrations for chemical contaminants.

3.4 ISOTOPIC EVALUATION

Process history and existing analytical data show that the residues in several tanks and centrifuges may exceed the radiological ERDF criteria and require additional evaluation prior to final disposition and packaging. The existing data needs to be verified by selective sampling, to confirm the isotopic mixture of these waste streams. The existing engineering calculations will need to be revised to adequately calculate the final isotopic concentrations in the waste to assist with the final removal design for appropriate waste disposition and packaging.

Nondestructive assay (NDA) using high-resolution germanium gamma spectroscopy will be used to detect gamma radiation emitted from selected tanks and centrifuges as identified in Table 3-1. Not all of

the radionuclides of interest that are present in these waste streams can be directly measured through gamma spectroscopy, therefore, isotopic ratios or scaling factors must be provided for the non-detectable nuclides. The isotopic ratios and scaling factors can be obtained with engineering calculations. The information used in the engineering calculations will be based on existing data. The NDA information will be used in correlation with existing laboratory data and engineering calculations to support optimum removal and the final disposal approach.

3.5 ANOMOLOUS WASTE

As described in Section 1.0, the anomalous waste category includes unplanned or unexpected material discovered during D&D that will require sampling and analysis to support disposition. The anomalous waste category is provided to allow field decision making based on "as-found" conditions discovered during demolition. Waste Management will support the final determination by using process knowledge, historical information, and required sample analysis on a case-by-case basis.

3.6 FIELD MEASUREMENT METHODS AND ANALYTICAL PERFORMANCE REQUIREMENTS

Table 3-2 defines the analytical performance requirements for the data that need to be collected to resolve each of the DSs for the solids and oils that require additional analytical data. Table 3-3 defines the analytical performance requirements for the data that need to be collected to resolve each of the DSs for aqueous liquids. These tables also reflect additional analyses that are associated with anomalous media (i.e., liquids and solids) that may be found during D&D activities and must meet ETF and/or ERDF analytical criteria, as well as the analysis requirements to determine if waste can be recycled. The specific methods (e.g., EPA Method 6010B), based on contracts with the standard fixed laboratory, will be identified in the SAP. The action level and performance requirements include the required detection limit (RDL) and precision and accuracy requirements.

Table 3-2. Analytical Performance Requirements for Solid/Other Materials.

Analyte	Analytical Method	Action Level[e,f]	RDL Requirement	Accuracy (% Recovery)	Precision (% RPD)
Radiological Constituents					
Americium-241	AmAEA	2 pCi/g	1 pCi/g	70-130[a]	±30[a]
Cesium-137	GEA	10 pCi/g	0.1 pCi/g	70-130[a]	±30[a]
Cobalt-60	GEA	10 pCi/g	0.05 pCi/g	70-130[a]	±30[a]
Europium-150	GEA	10 pCi/g	0.1 pCi/g	70-130[a]	±30[a]
Europium-152	GEA	10 pCi/g	0.1 pCi/g	70-130[a]	±30[a]
Europium-154	GEA	10 pCi/g	0.1 pCi/g	70-130[a]	±30[a]
Europium-155	GEA	2 pCi/g	0.1 pCi/g	70-130[a]	±30[a]
Neptunium-237	NpAEA	2 pCi/g	1 pCi/g	70-130[a]	±30[a]
Plutonium-238	PuAEA	2 pCi/g	1 pCi/g	70-130[a]	±30[a]
Plutonium-239/240	PuAEA	2 pCi/g	1 pCi/g	70-130[a]	±30[a]
Total Strontium	Rad-Sr	10 pCi/g	1 pCi/g	70-130[a]	±30[a]
Technetium-99	Liquid scintillation	30 pCi/g	15 pCi/g	70-130[a]	±30[a]
Uranium-238	UAEA	2 pCi/g	1 pCi/g	70-130[a]	±30[a]
Nonradiological Constituents – Metals					
Arsenic	EPA Method 6010	100 mg/kg	10 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	5.0 mg/L[d]	0.5 mg/L	70-130[b]	±30[b]
Barium	EPA Method 6010	2,000 mg/kg	2 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	100 mg/L[d]	10 mg/L	70-130[b]	±30[b]
Cadmium	EPA Method 6010	20 mg/kg	0.5 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	1.0 mg/L[d]	0.1 mg/L	70-130[b]	±30[b]
Chromium	EPA Method 6010	100 mg/kg	10 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	5.0 mg/L[d]	0.5 mg/L	70-130[b]	±30[b]
Lead	EPA Method 6010	100 mg/kg	5 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	5.0 mg/L[d]	0.5 mg/L	70-130[b]	±30[b]
Mercury	EPA Method 200.8	4.0 mg/kg	0.2 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/200.8	0.2 mg/L[d]	0.02 mg/L	70-130[b]	±30[b]
Silver	EPA Method 6010	100 mg/kg	1 mg/kg	70-130[b]	±30[b]
	EPA Method 1311/6010	5.0 mg/L[d]	0.5 mg/L	70-130[b]	±30[b]
Nonradiological Constituents – General Inorganics					
Asbestos	PLM	1 wt%[g]	<1 wt%[g]	N/A	N/A
Sulfide	EPA 9030	None	5 mg/kg	70-130[b]	±30[b]
Organic Compounds					
PCBs	EPA Method 8082	2 mg/kg	0.017 mg/kg	70-130[c]	±30[c]
Waste Characteristics					

Table 3-2. Analytical Performance Requirements for Solid/Other Materials.

Analyte	Analytical Method	Action Level[e,f]	RDL Requirement	Accuracy (% Recovery)	Precision (% RPD)
Corrosivity	EPA Method 9045 (pH)	2.0 <pH <12.5	0.1 pH unit	70-130[b]	±30[b]
Gross alpha	Proportional counting	5 pCi/g	10 pCi/g	70-130[a]	±30[a]
Gross beta	Proportional counting	10 pCi/g	15 pCi/g	70-130[a]	±30[a]
Ignitability (flash point)	EPA Method 1010	<140°F	N/A	N/A	N/A
TOX	EPA Method 9020	1,000 mg/kg	0.5 mg/kg	70-130[c]	±30[c]

[a] Accuracy criteria for associated batch laboratory control sample percent recoveries. With the exception of GEA, additional analysis-specific evaluations also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria for batch laboratory replicate sample analyses.

[b] The accuracy criteria specified is for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples is also performed. The precision criteria specified is for calculated relative percent differences (RPDs) for batch laboratory replicate matrix spike analyses or replicate sample analyses.

[c] Accuracy criteria are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control if more stringent. Additional analyte-specific evaluations also performed for matrix spikes and surrogates as appropriate to the method. Precision criteria for batch laboratory replicate matrix sample analyses.

[d] Lower action level may be needed to determine land disposal treatment requirements.

[e] The 222-S Laboratory may be used for sample analyses due to high sample Pu content or dose rates. Laboratory procedures based on EPA SW-846 methods will be used. This approach has been accepted by Washington State Department of Ecology due to the ALARA concerns with the samples and how they must be handled in the 222-S Lab.

[f] MDLs for the 222-S laboratory are orders of magnitude higher than these values and will be acceptable since only the very high content samples will be sent to 222-S for radionuclide quantification. The 222-S lab will not be used for any kind of clearance sampling that could require these low MDLs.

[g] Asbestos concentrations in soil samples will be reported by one of the following phrases, rather than weight percent:

1.) None: No asbestos fibers found.

2.) Trace detectable: with extensive searching, a few asbestos fibers were found; concentration very low, well below 1%.

3.) Obvious presence: Asbestos fibers easily found but overall concentration still low.

4.) Significant presence: Asbestos fibers readily found; overall concentration may approach or exceed 1% level.

AEA = alpha energy analysis

EPA = EPA's *Test Methods for Evaluating Solid Waste: Physical and Chemical Methods* (SW-846 [EPA 1997]), except for Methods 300.0 and 418.1 (from EPA's *Methods for Chemical Analysis of Water and Wastes* [EPA 1983]).

GEA = gamma energy analysis

N/A = not applicable

PLM = polarized light microscopy

RPD = relative percent difference

TOX = total organic halides

Table 3-3. Analytical Performance Requirements for Liquid Materials.

Analyte	Analytical Method	Action Level[d,e]	RDL Requirement[d,e]	Accuracy (% Recovery)	Precision (% RPD)
Radiological Constituents					
Americium-241	AmAEA	None	1 ρCi/L	80-120[a]	±20[a]
Cesium-137	GEA	None	15 ρCi/L	80-120[a]	±20[a]
Cobalt-60	GEA	None	25 ρCi/L	80-120[a]	±20[a]
Europium-150	GEA	None	50 ρCi/L	80-120[a]	±20[a]
Europium-152	GEA	None	50 ρCi/L	80-120[a]	±20[a]
Europium-154	GEA	None	50 ρCi/L	80-120[a]	±20[a]
Europium-155	GEA	None	50 ρCi/L	80-120[a]	±20[a]
Neptunium-237	NpAEA	None	1 ρCi/L	80-120[a]	±20[a]
Plutonium-238	PuAEA	None	1 ρCi/L	80-120[a]	±20[a]
Plutonium-239/240	PuAEA	None	1 ρCi/L	80-120[a]	±20[a]
Total strontium	Rad-Sr	None	2 ρCi/L	80-120[a]	±20[a]
Technetium-99	Liquid scintillation	None	15 ρCi/L	80-120[a]	±20[a]
Tritium	Liquid scintillation	None	400 ρCi/L	80-120[a]	±20[a]
Nonradiological Constituents – Metals					
Arsenic	EPA Method 6010	None[c]	100 μg/L	80-120[b]	±20[b]
Barium	EPA Method 6010	None[c]	20 μg/L	80-120[b]	±20[b]
Cadmium	EPA Method 6010	None[c]	5 μg/L	80-120[b]	±20[b]
Chromium	EPA Method 6010	None[c]	10 μg/L	80-120[b]	±20[b]
Lead	EPA Method 6010	None[c]	50 μg/L	80-120[b]	±20[b]
Magnesium	EPA Method 6010	None	750 μg/L	80-120[b]	±20[b]
Manganese	EPA Method 6010	None	5 μg/L	80-120[b]	±20[b]
Mercury	EPA Method 200.8	None[c]	0.5 μg/L	80-120[b]	±20[b]
Nickel	EPA Method 6010	None[c]	40 μg/L	80-120[b]	±20[b]
Potassium	EPA Method 6010	None	4,000 μg/L	80-120[b]	±20[b]
Silver	EPA Method 6010	None	10 μg/L	80-120[b]	±20[b]
Sodium	EPA Method 6010	None[c]	500 μg/L	80-120[b]	±20[b]
Nonradiological Constituents – General Inorganics					
Ammonium	EPA Methods 300.7	100,000 mg/L	50 μg/L	80-120[b]	±20[b]
Chloride	EPA Method 300.0	None	200 μg/L	80-120[b]	±20[b]
Fluoride	EPA Method 300.0	None	500 μg/L	80-120[b]	±20[b]
Nitrate	EPA Method 300.0	None	250 μg/L	80-120[b]	±20[b]
Nitrite	EPA Method 300.0	None	250 μg/L	80-120[b]	±20[b]
Phosphate	EPA Method 300.0	None	500 μg/L	80-120[b]	±20[b]
Sulfide	EPA Method 9030	None	500 μg/L	80-120[b]	±20[b]
Sulfate	EPA Method 300.0	None	500 μg/L	80-120[b]	±20[b]
Waste Characteristics					
Conductivity	EPA Method 120.1	None	1 μmho/cm^3	80-120[b]	±20[b]
Corrosivity	EPA Method 150.1 (pH)	0.5 <pH <13.0	0.1 pH unit	80-120[b]	±20[b]
Gross alpha	Proportional counting	None	3 ρCi/L	80-120[a]	±20[a]
Gross beta	Proportional counting	None	4 ρCi/L	80-120[a]	±20[a]

Table 3-3. Analytical Performance Requirements for Liquid Materials.

Analyte	Analytical Method	Action Level[d,e]	RDL Requirement[d,e]	Accuracy (% Recovery)	Precision (% RPD)
TDS	EPA Method 160.1	None	10 mg/L	80-120[b]	±20[b]
TOC	EPA Method 415 or 9060	None	1 mg/L	80-120[b]	±20[b]
TSS	EPA Method 160.2	None	5 mg/L	80-120[b]	±20[b]

[a] Accuracy criteria for associated batch laboratory control sample percent recoveries. With the exception of GEA, additional analysis-specific evaluations also performed for matrix spikes, tracers, and carriers, as appropriate to the method. Precision criteria for batch laboratory replicate sample analyses.
[b] Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples also performed. Precision criteria for batch laboratory replicate matrix sample analyses or replicate sample analyses.
[c] Lower action level may be needed to determine land disposal treatment requirements.
[d] The 222-S Laboratory may be used for sample analyses due to high sample Pu content or dose rates. Laboratory procedures based on EPA 600/4-79-020 methods will be used. This approach has been accepted by Washington State Department of Ecology due to the ALARA concerns with the samples and how they must be handled in the 222-S Lab.
[e] MDLs for the 222-S laboratory are orders of magnitude higher than these values and will be acceptable since only the very high content samples will be sent to 222-S for radionuclide quantification. The 222-S lab will not be used for any kind of clearance sampling that could require these low MDLs.

EPA = EPA's *Test Methods for Evaluating Solid Waste: Physical and Chemical Methods* (SW-846 [EPA 1997]), except for Methods 300.0 and 418.1 (from EPA's *Methods for Chemical Analysis of Water and Wastes* [EPA 1983]).
TOC = total organic carbons
TDS = total dissolved solids
TSS = total suspended solids

3.7 RADIOLOGICAL SURVEY PERFORMANCE REQUIREMENTS

Table 3-4 defines the radiological survey instrument performance requirements for the data that need to be collected to resolve each of the DSs. Table 3-5 provides the methods for obtaining the concentration of each radionuclide using NDA equipment and the action levels which would be unacceptable for disposal at ERDF.

Table 3-4. Radiological Survey Instrument Performance Requirements.

Analyte	Analytical Method	Action Level/ Detection Limit	Accuracy Requirement	Precision Requirement
Standard Survey Instruments				
Dose rate	Portable NaI detector or Bicron µrem meter or ion chamber	0.1 mR/h	a	a
Removable alpha	Bench-top scaler for removable alpha Portable radiation detection instruments (such as PAM alpha survey instrument, Pancake G-M survey instrument)	20 dpm/100 cm^2	a	a
Total (fixed + removable) alpha		100 dpm/100 cm^2 0.2 mrem/hr direct		
Removable beta-gamma		1,000 dpm/ 100 cm^2		
Total (fixed + removable) beta-gamma		5,000 dpm/ 100 cm^2		

[a]In accordance with manufacturer's specifications.
dpm = disintegrations per minute
NaI = sodium iodide

3.8 NDA REQUIREMENTS

3.8.1 Measurement Uncertainty

Measurement uncertainty is inherent in all nondestructive assay systems, due to both random and systematic elements. Total measurement uncertainty is typically stated at the 95 percent confidence level. Efforts should be made in all planning and assay collection to minimize influences that compound data collection uncertainty. Measurement uncertainty contributions include but are not limited to:

- Item/container count duration.
- Use of multiple detectors or larger intrinsically efficient single detectors to increase detector efficiency.
- Reduce the item/container to detector distance.
- Install lead shielding around NDA system to reduce contributions from background radiation.
- Remove sources of background radiation that are in or near the vicinity of the NDA system.
- Orient NDA counting system away from areas of increased radiation activity.
- Do not cross contaminate NDA counting area/system.

3.8.2 MDA

The minimum detectable activity (MDA) is a function of the size and density of the item, the distance of the detector from the item, the detector counts, etc. The MDA can be directly calculated by the assay

software for each measurement. If measured values are not reported, the NDA analyst will use the calculated MDA result in lieu of the measured value to determine the upper bound for the item activity.

To obtain a reasonable quantification of the radionuclide concentrations, an efficiency calibration must be developed to account for the item geometry and the attenuators and matrix elements within the item that will attenuate or absorb the gamma radiation. This is accomplished through a commercial modeling program. The analyst uses the information concerning the item weight and dimensions, material of construction, and source distributions to model the item to be assayed. The program generates an efficiency calibration curve for the item. The efficiency curve is applied to the spectrum generated by the germanium detector to provide a quantitative value for the detected radionuclides or an MDA for radionuclides that are not detected. The efficiency calibration curve produced from the modeling accounts for the effects from the attenuation, geometric correction factors, and source distributions.

Not all of the radionuclides of interest that are present in the waste generated from D&D activities can be directly measured through gamma spectroscopy; therefore isotopic ratios or scaling factors must be provided for the non-detectable nuclides. These nuclides can be obtained through process knowledge, through destructive laboratory sample analysis, or through specialized plutonium isotopic analysis software for plutonium isotopes. The plutonium isotopic analysis can only be obtained for items with significant gram quantities of plutonium. The normal calculation for the plutonium content is based on a measured plutonium-239 quantity multiplied by the isotopic rations for the other plutonium isotopes. Applicable isotopic ratios will be used to determine the concentration of non-measurable isotopes for all the waste items generated at the corresponding D&D project.

For very low activity measurements (typically in the LLW range), the plutonium-239 gamma energy lines may be below detection levels. Therefore, the only detectable peak that can be used to calculate the content of the actinides in the item may be the 59.5 KeV americium-241 line. Although this line has a high abundance, the low-energy gamma peak is significantly affected by the assumptions of internal versus external contamination. The use of the low-energy americium-241 line to calculate the TRU activity will be used only for light-weight items (typically less than 10 lbs.). The NDA subcontractor needs to be aware of these limitations and apply an appropriate level of conservatism to the analysis.

Table 3-5. Analytical Performance Requirements for NDA.

Measurable Radionuclides[a]	Analytical Method	Action Level	MDA (Expected)
Am-241	NDA	TRU/GTCC	≈20 nCi/g
Pu-239		TRU/GTCC	≈30 nCi/g
Np-237		TRU/GTCC	$\approx 10^{-2}$ nCi/g
Cs-137		2.7E+7 pCi/g	$\approx 10^{-1}$ nCi/g
Co-60		3.81E+6 pCi/g	$\approx 10^{-1}$ nCi/g

[a] Not all of the radionuclides of interest can be directly measured through gamma spectroscopy, therefore, isotopic ratios or scaling factors must be provided for the non-detectable nuclides (Section 3.4).

Note: In cases where both TRU and GTCC are listed as action levels, the isotope is subject to both limits and the more limiting of the two will be considered to be the action level.

TRU = The action level of "TRU" indicates the transuranic waste definition is the limiting factor. The activities of all transuranic alpha-emitting isotopes with a half-life of greater than 20 years must be less than 100 nCi/g in total.

GTCC = The action level of "GTCC" indicates that the "greater than Class C" waste definition is the limiting factor (defined in 10 CFR 61.55).

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4.0 STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The primary objective of DQO Step 4 is to identify the population of interest, define the spatial and temporal boundaries that apply to each DS, define the scale of decision making, and identify any practical constraints (i.e., hindrances or obstacles) that must be taken into consideration for the sampling design. Implementing this step ensures that the sampling design will result in the collection of data that accurately reflect the true condition of the facility under investigation.

4.1 POPULATION OF INTEREST

Prior to defining the spatial and temporal boundaries of the area under investigation, it is first necessary to clearly define the populations of interest that apply for each DS (Table 4-1). The intent of Table 4-1 is to clearly define the attributes that make up each population of interest by stating them in a way that makes the focus of the study unambiguous.

Table 4-1. Characteristics that Define the Population of Interest.

DS #	Population of Interest
1	Radiological contamination in the waste material
2	Chemical contamination levels and/or physical properties of the waste material
3, 4, 5, and 6	Waste designation codes for the building waste materials
7	PCB contamination in the waste materials
8	Asbestos contamination levels of building waste materials
9	LDR evaluation of waste materials
10	Materials intended for recycling or reuse

4.2 ZONES WITH HOMOGENOUS CHARACTERISTICS

The elements of the population are segregated into zones or subsets that exhibit relatively homogenous characteristics in DQO Step 4. This distinction has already been made by the identification of waste streams in Table 1-12.

4.3 SPATIAL SCALE OF DECISION MAKING

The spatial scale of decision making for this DQO process are the individual waste streams identified in the 224-T facility.

4.4 TEMPORAL BOUNDARIES

Table 4-2 identifies temporal boundaries that may apply to each DS. The temporal boundary refers to both the timeframe over which each DS applies (e.g., number of years) and when (e.g., season, time of day, and weather conditions) the data should optimally be collected.

Table 4-2. Temporal Boundaries of the Investigation.

DS #	WS #	Timeframe	When to Collect Data
All	All	1,000 years	No temporal boundaries have been identified for collection of data for D&D activities.

4.5 PRACTICAL CONSTRAINTS

Table 4-3 identifies the practical constraints that may impact the data collection effort. These constraints include physical barriers, difficult sample matrices, or any other condition that will need to be taken into consideration in the design and scheduling of the sampling program.

Table 4-3. Practical Constraints on Data Collection.

- Soils under the slab are more easily accessible after the slab-on-grade condition is achieved and the soil samples less vulnerable to gross cross contamination when the great majority of the source term has been removed with the building rubble.
- The paints are not considered uniformly distributed. There are several types of paint and primers throughout the facility, each type or color needs to be addressed separately.
- Residues in the tanks, centrifuges and piping are not easily accessible. There is limited physical ability to collect a representative sample in its current configuration.
- Roofing materials may be found containing more than one layer, with old and new roofing materials existing in the same area.

5.0 STEP 5 – DEVELOP DECISION RULES

The preceding sections present the basis for making decisions for characterization and final disposition of the waste streams identified in Table 1-12. Step 5 of the DQO process develops the decision rules, which establish specific criteria for these determinations.

5.1 PARAMETER OF INTEREST

A sampling design (based on professional judgment) and worst-case (authoritative) sampling will be used to determine the maximum levels of radiological and chemical contamination. The parameter of interest will be a single maximum analytical value for every constituent in each waste stream that will be compared with the waste acceptance criteria decision levels.

5.2 FINAL ACTION LEVELS

The concentration or action levels for disposal/recycling/reuse options are described in Tables 5-1 through 5-5. The most restrictive concentration limits or action levels for the disposal/recycling/reuse options are used for the materials included in this DQO summary report. By meeting the analytical requirements for the most restrictive disposal/recycling/reuse options, the data will be adequate for other less restrictive options. These tables also reflect analysis that may be associated with the anomalous media (i.e., liquids and solids) that may be found during D&D activities and must meet ETF and/or ERDF analytical criteria.

Table 5-1. Concentration Limits – Environmental Restoration Disposal Facility.

COCs	Concentration Limits
PCBs[a]	
PCBs	500 mg/kg
Metals[a]	
Arsenic	3,000 mg/kg
Barium	940,000 mg/kg
Cadmium	39,000 mg/kg
Chromium (total)	59,000 mg/kg
Manganese	440,000 mg/kg
Silver	350,000 mg/kg
Radionuclides[b]	
Americium-241	0.050 Ci/m^3 [(c,f)]
Cesium-137	32 Ci/m^3 [(c)]
Cobalt-60	Unlimited
Europium-152	21,000,000 Ci/m^3 [(c)]
Europium-154	Unlimited

Table 5-1. Concentration Limits – Environmental Restoration Disposal Facility.

COCs	Concentration Limits
Neptunium-237	0.0015 Ci/m^3 [c,f]
Plutonium-238	1.5 Ci/m^3 [c,f]
Plutonium-239	0.029 Ci/m^3 [c,f]
Plutonium-240	0.029 Ci/m^3 [c,f]
Plutonium-241	6.2 Ci/m^3 [d,f]
Plutonium-242	0.11 Ci/m^3 [d,f]
Strontium-90	7,000 Ci/m^3 [g]
Technetium-99	1.3 Ci/m^3 [d]
Tritium	Unlimited
Uranium-238 + daughters	0.012 Ci/m^3 [c]
Waste Characteristics	
Ignitability (flash point)	140°F[h]
pH	2 < pH <12.5
Moisture content	Fail

[a] Public exposure is limiting (DOE-RL 1994).
[b] Radioactive waste Class C limits also apply (10 CFR 61).
[c] *Remedial Investigation and Feasibility Study Report for the Environmental Restoration Disposal Facility* (DOE-RL 1994).
[d] *Environmental Restoration Disposal Facility Performance Assessment* (Delorenzo et al. 1995).
[e] Limit if nuclide contained in activated metal.
[f] EDRF limit is lower of indicated value and TRU limit of 100 nCi/g.
[g] Class C limit in accordance with 10 CFR 61.
[h] Ignitable non-liquids in accordance with WAC 173-303-090(5)(a)(ii). Capable under standard temperature and pressure of causing fire through friction, absorption of moisture, or spontaneous chemical changes, and when ignited, burns so vigorously and persistently that it creates a hazard.

Table 5-2. Action Levels – Dangerous Waste Limits – WAC 173-303.

COCs	Action Levels[a]	
	Totals	TCLP
Ag	100 mg/kg	5 mg/L
As	100 mg/kg	5 mg/L
Ba	2,000 mg/kg	100 mg/L
Cd	20 mg/kg	1 mg/L
Cr	100 mg/kg	5 mg/L
Hg	4.0 mg/kg	0.2 mg/L
Pb	100 mg/kg	5 mg/L
PCBs – specific source	2 mg/kg	
Ignitability	<140°F	
pH	2.0 < pH <12.5	

[a] UHCs may require lower limits in accordance with 40 CFR 268.48.
TCLP = toxicity characteristic leaching procedure

Table 5-3. Analytical Requirements – Effluent Treatment Facility.

COCs	Concentration Limits
Metals	
Arsenic	No specific limits. Information needed for development of ETF waste profile.
Barium	
Cadmium	
Chromium	
Lead	
Magnesium	
Manganese	
Mercury	
Nickel	
Potassium	
Silver	
Sodium	
Uranium	
Nonmetals	
Ammonia	100,000 mg/L
Chloride	No specific limits. Information needed for development of ETF waste profile.
Fluoride	
Nitrate	
Nitrite	
Phosphate	
Sulfate	
Radionuclides	
Americium-241	No specific limits. Information needed for development of ETF waste profile.
Cesium-137	
Cobalt-60	
Europium-154	
Europium-155	
Neptunium-237	
Plutonium-238	
Plutonium-239/240	
Strontium-90	
Technetium-99	
Tritium	
Waste Characteristics	
pH	$0.5 < pH < 13.0$
Gross alpha	No specific limits. Information needed for development of ETF waste profile.
Gross beta	
TSS	
TDS	
TOC	
Conductivity	

Table 5-4. Action Limits – Recycling Requirements for Used Oil.

COCs	Preliminary Action Levels
PCBs	2 mg/kg
TOX	1,000 mg/kg
Chemical constituents and characteristics	See Table 5-5
Radiological constituents	See Table 5-6

Table 5-5. Action Levels – PHMC Radiological Control Manual Radiological Release Limits.[a]

WS #	COCs	Action Levels for Water	Action Levels for Soil, Other
All	Total uranium	0.2 µg/L	2 µg/g
	Gross alpha	3 pCi/L	5 pCi/g
	Gross beta	4 pCi/L	10 pCi/g
	Americium-241	2 pCi/L	2 pCi/g
	Cesium-137	50 pCi/L	10 pCi/g
	Cobalt-60	50 pCi/L	10 pCi/g
	Europium-152	50 pCi/L	10 pCi/g
	Europium-154	50 pCi/L	10 pCi/g
	Europium-155	50 pCi/L	10 pCi/g
	Neptunium-237	2 pCi/L	2 pCi/g
	Plutonium-238	2 pCi/L	2 pCi/g
	Plutonium-239/240	2 pCi/L	2 pCi/g
	Strontium-90	2 pCi/L	10 pCi/g
	Technetium-99	30 pCi/L	30 pCi/g
	Tritium	400 pCi/L	400 pCi/g
	Uranium-238	2 pCi/L	2 pCi/g
	Removable alpha	N/A	20 (dpm/100 cm^2)
	Total (fixed + removable) alpha	N/A	100 (dpm/100 cm^2)
	Removable beta-gamma	N/A	1,000 (dpm/100 cm^2)
	Total (fixed + removable) beta-gamma	N/A	5,000 (dpm/100 cm^2)

[a] HNF-5173, PHMC Radiological Control Manual.
N/A = not applicable

Table 5-6 provides the methods for obtaining the concentration of each radionuclide using NDA equipment and the action levels that would be unacceptable for disposal at ERDF.

Table 5-6. Analytical Methods and Action Levels for NDA.[a]

COCs	Action Levels	Basis	Analytical Method
Americium-241	TRU/GTCC	ERDF waste acceptance criteria (BHI-2002)	GEA by portable NDA or ratio compared to detected isotopes
Cesium-137	2.7E+7 ρCi/g	ERDF safety analysis (BHI 2001)	GEA by portable NDA or ratio compared to detected isotopes
Cobalt-60	3.81E+6 ρCi/g	ERDF safety analysis (BHI 2001)	GEA by portable NDA or ratio compared to detected isotopes
Neptunium-237	TRU/GTCC	ERDF waste acceptance criteria (BHI-2002)	GEA by portable NDA or ratio compared to detected isotopes
Plutonium-239	TRU/GTCC	ERDF waste acceptance criteria (BHI-2002)	GEA by portable NDA or ratio compared to detected isotopes

[a] Not all of the radionuclides of interest can be directly measured through gamma spectroscopy, therefore, isotopic ratios or scaling factors must be provided for the non-detectable nuclides. The isotopic ratios and scaling factors can be obtained with engineering calculations.

Note: In cases where both TRU and GTCC are listed as action levels, the isotope is subject to both limits and the more limiting of the two will be considered to be the action level.

TRU = The action level of "TRU" indicates the transuranic waste definition is the limiting factor. The activities of all transuranic alpha-emitting isotopes with a half-life of greater than 20 years must be less than 100 nCi/g in total.

GTCC = The action level of "GTCC" indicates that the "greater than Class C" waste definition is the limiting factor (defined in 10 CFR 61.55).

6.0 STEP 6 – SPECIFY TOLERABLE LIMITS ON DECISION ERRORS

One of the primary objectives normally accomplished in DQO Step 6 is the selection of a statistical or judgmental sample design. Characterization of the waste streams identified in this DQO process does not require statistically based sampling, as it deals with individual waste components.

The evaluation of the need for statistical and/or judgmental sampling also considers the potential consequences of erroneous decisions. The potential consequences for waste disposed at ERDF are generally acknowledged to have a low degree of severity (Table 2-1) because the matrix will reside in an engineered facility remote from human population centers; in addition, the waste is retrievable if necessary. Therefore, a focused sampling design is suited for obtaining waste characterization information for all of the waste streams identified as needing additional data for final disposition. Discrete samples will be collected from selected areas to determine the upper-bounding level of each contaminant of interest.

6.1 DECISION ERRORS

In general, two types of decision errors are associated with this project. The first is treating (i.e., managing and disposing) clean waste material as if it was contaminated. The second decision error is treating contaminated waste material as if it were clean. The second decision error, treating contaminated waste material as if it were clean, has the more severe consequence as the error could result in human health and/or ecological impacts.

6.2 NULL HYPOTHESIS

Table 6-1 identifies the null hypothesis that applies to the waste materials under investigation. The term "null hypothesis" refers to the baseline condition of the site, which has been defined based on historical data process knowledge, and existing analytical data.

Table 6-1. Defining the Null Hypothesis.

WS #	Null Hypothesis Statement	Indicate Selection
All	Waste materials are assumed to be radioactively and chemically contaminated until shown clean.	X
	Waste materials are assumed to be clean until shown to be radioactively and chemically contaminated.	

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7.0 STEP 7 – OPTIMIZE THE DESIGN

The objective of DQO Step 7 is to present data collection designs that meet the minimum data quality requirements specified in DQO Steps 1 through 6.

7.1 FOCUSED SAMPLE DESIGN

A focused sampling design is suited to provide waste characterization information that will meet the DSs for all of the waste streams identified in this project. The sample design will incorporate historical information, process knowledge, and facility inspections, together with radiation surveys and discrete samples of selected waste materials, to determine the upper bounding level of each COC in each waste stream. The following sections provide information on each part of the proposed sample design.

7.2 SPECIFIC MEDIA SAMPLING

As needed, discrete samples of specific media will be collected from biased locations from those waste streams that have been identified as needing additional sampling/analytical data (Table 3-1) for final disposition. The laboratory data will be used to confirm contamination levels in each of the materials and to establish the engineering calculation and waste profile. This sampling and analysis process will occur prior to and during facility demolition.

Table 7-1 identifies the specific media sample design for all of the waste streams identified in this DQO process to resolve the DS for each waste stream. In some cases, existing data and process knowledge will be used to resolve the DS and provide adequate characterization information.

Table 7-1. Specific Media Sampling.

WS #	Waste Stream	Media	Sampling Methods	Analytical Requirements
1	Process vessels, equipment and piping in Cells A-F	Residual solids and surface contamination, potential for residual liquids	1. Visual observation of material consistency and geometry in tanks 2. Check piping for liquid via non intrusive methods or hot taps 3. If found, sample residual liquids 4. NDA and flange smear or sample residual solid material in process vessels listed in Section 7.3	See Table 1-17

Table 7-1. Specific Media Sampling.

WS #	Waste Stream	Media	Sampling Methods	Analytical Requirements
2	Miscellaneous aqueous liquids	Aqueous liquid residuals identified in piping system pumps, sumps, tanks, floor drains, piping, and processing equipment	Non-intrusive liquid sampling using ultrasonic instruments, or hot taps into low spots or likely collection locations.	See Table 1-17
3	Miscellaneous solids	Sediments and residuals identified in piping system pumps, sumps, tanks, floor drains, piping, and processing equipment	Sample as indicated in Section 7.3.	See Table 1-17
4	Bulk demolition debris	Paint/coatings on exterior of materials if observed	Scraping paint; minimum of one representative sample from each type paint/coating	Cadmium, chromium, barium, lead, silver, mercury, PCBs
5	Asbestos-containing material	AHERA asbestos inspector will perform inspection	Samples will be obtained in accordance with simplified sampling scheme for friable surface materials (EPA, 1985)	Asbestos fibers
6	Incandescent light bulbs	Lead-base bulbs	No sampling required; see Table 3-1	N/A
7	Florescent lights and fixtures	Internal light ballasts and fluorescent tubes	No sampling required; see Table 3-1	N/A
8	Lead packing in bell and spigot piping in galleries	Lead packing material	No sampling required; see Table 3-1	N/A
9	Lead shielding	Lead bricks, blankets used for shielding	No sampling required; see Table 3-1	N/A
10	Mercury Switches	Switchgears	No sampling required; see Table 3-1	N/A
11	Emergency light batteries	Battery constituents	No sampling required; see Table 3-1	N/A
12	Exit signs and smoke detectors	Internal radioactive sources	No sampling required; see Table 3-1	N/A

Table 7-1. Specific Media Sampling.

WS #	Waste Stream	Media	Sampling Methods	Analytical Requirements
13	Lubrication grease, oil, hydraulic oils (includes door actuators and transformer oil)	Nonaqueous liquids	One representative sample per container or batch of the same material from the same source	See Table 1-17 for isotopic requirements. PCBs, arsenic, barium, cadmium, chromium, lead, mercury.
14	HEPA Filters	Filter media	1. The isotopic breakdown developed for WS#1 will be assumed for the filters. 2. Sampling per Table 3-1. NDA may be performed on a case-by-case basis to verify non-TRU prior to disposal.	See Table 1-17 for isotopic requirements.
15	Step Off Pad Soft Waste	PPE garments, rags, tape, plastic, gloves	No sampling required, analysis performed for other waste streams bounds this waste.	N/A
16	Contaminated Soil below slab and adjacent to building	Soil	Standard sampling/ compositing methods. One sample from under Cell C pit and 1 from UPR-200-W-102.	See Table 1-17
17	RCRA closure samples	Concrete	Sample concrete in 2 specific locations requested by the State of Washington Department of Ecology. See Section 7.6.	See Table 1-17
18	Water in Cell C Pit	Water	One water sample to confirm process knowledge and past analytical results.	See Table 1-17 for isotopic requirements. Total RCRA Metals.

AHERA = *Asbestos Hazard Emergency Response Act of 1986*

7.3 NONDESTRUCTIVE ASSAY

The NDA equipment and techniques shall be quantitative and capable of addressing DS #1. The assay equipment shall be commercial systems, use proven technologies, and have verified and validated data analysis software for this application. Proposed techniques shall be previously demonstrated for similar in situ actinide measurements.

The data requirements and the accuracy and precision information will be documented in a specific SAP prior to using this equipment. The subcontractor's quality control procedures must be compatible with specifications in the *Hanford Analytical Services Quality Assurance Requirements Document* (DOE-RL 1998) and must be followed in the field to ensure that reliable data are obtained.

Since existing NDA data is available from the 2001/2002 cell entries, additional NDA will be limited only to those groups of tanks that could not be measured due to inaccessibility. The list of tanks/vessels that were not assayed in 2001/2002 includes:

- Tanks C-4, C-7, and C-9, all located in the Cell C pit.

The tanks/vessels will be visually inspected if possible, to supplement the NDA and provide information on the distribution and homogeneity of any residual materials. Smears and/or samples will be taken where possible to allow determination of isotopic distribution and material form. As described in Section 3, the use of the NDA, isotopic information, and sample data will be used to correlate with dose readings through engineering calculations in a conservative manner to perform waste designation and determine equipment/piping inventory values.

7.4 RADIOLOGICAL SURVEYS

7.4.1 Routine Radiological Surveys

Routine radiological surveys will be conducted prior to any major equipment removal activities. The routine radiological surveys will consist of routine surveys of accessible surfaces of the waste media and will be conducted by project radiological control technicians (RCTs). Additional uniformly distributed and/or biased measurements may be collected at the discretion of the project radiological engineer or project characterization lead. Information obtained from the routine radiological surveys will be used to determine the extent of contamination in the facility and to support worker health and safety during D&D activities. These surveys will be conducted in accordance with the appropriate requirements, as specified in the SAP.

7.4.2 Percent Profile Verification Surveys

Prior to waste disposition, radiological surveys will be completed for all of the waste materials in the scope of this project. These surveys will involve environmental radiological surveys of the shipping containers and will be conducted by project RCTs under direction of the waste transportation specialist in accordance with the appropriate requirements, as specified in the SAP. The profile verification surveys will be used to determine and document the activity per volume (ρCi/g) of waste profile for the waste materials.

7.4.3 Material Release Surveys for Reuse

Salvageable materials that have no potential for volumetric contamination may be surveyed for release. The material release surveys will involve routine radiation surveys of accessible surfaces of the waste materials and will be conducted by project RCTs in accordance with appropriate procedures, as specified in the SAP.

Additional surveys for offsite release will be conducted as needed in accordance with appropriate property release requirements.

7.5 ANOMALOUS WASTE MATERIALS

Anomalous waste materials include any unplanned or unexpected material discovered during D&D operations that will require sampling and analysis to support disposition. The anomalous waste category is provided to allow field decision making based on "as-found" conditions discovered during demolition. Waste Management will support the final determination of the sample analysis that is required on a case-by-case basis. The project will evaluate appropriate historical information, process knowledge, and existing analytical data to determine if additional analytical information is needed to facilitate the appropriate disposal pathway. The project will work with Ecology and EPA to determine the best path forward for these materials.

7.6 RCRA CLOSURE SAMPLES

Closure of the 224-T TRUSAF storage unit will occur as part of an integrated RCRA/CERCLA approach. Demolition of 224-T Building as part of the CERCLA removal action will facilitate RCRA closure of the 224-T TRUSAF storage unit. The State of Washington Department of Ecology requested that a minimum of two samples be gathered from the RCRA permitted storage area. These specific locations are as follows:

- First floor, near the stairs, in an area where the concrete is discolored
- First floor, crack in the foundation near the F Cell Hood enclosure

7.7 CONTAMINATED SOIL SAMPLES

The intent of the samples of contaminated soil from around and below the building foundation is to provide information for planning activities leading to site remediation at a future date. Since the area of concern is associated with the potential for significant contamination in soils external to the building related to process activities in the facility, a soil sample will be obtained from the area near the sump in Cell C. All liquids in the other process cells that leaked or otherwise found their way to the cell floors were routed to the Cell C collection tank C-8, so there is a low probability that these solutions would have affected soil external to the building at other locations. The Cell C floor drained to a sump in the southeast corner of the deep pit, and that area is the most likely location for any standing liquid to have been incurred, and therefore the most likely for any long term leakage path leading to external soil contamination.

Therefore an access core hole will be bored through the concrete floor in or adjacent to the Cell C sump and a soil sample obtained external to the building foundation. The approximate depth of the soil column sample will be 3' below the concrete.

An additional soil sample will be taken on the southeast side of the building, in the area identified as waste site UPR-200-W-102. Contamination was observed in the soil in this location in 1972 during an excavation of the area. This soil sample will provide an indication of the depth and levels of chemical and radionuclide contamination associated with the site. This sample depth will represent a 3' deep column of soil.

7.8 INSPECTION OF PIPING ENTERING/EXITING FACILITY

As the facility is demolished, points where process and service piping entered and exited the facility will be identified. Since the desired end point for this remedial action is a slab on grade condition, pipelines

entering and exiting from below grade through the slab will be cut off and isolated or plugged. As this activity is performed, normal radiological surveys will be performed, and visual inspection of the pipelines will be done. If significant quantities of anomalous solids/liquids are seen in the pipelines near the cutoff points, and samples can be readily obtained, sampling will be performed to provide an indication of the properties of the residues in the pipes.

7.9 COORDINATION WITH INITIAL CELL ENTRIES

Several initial entries to the process cells are planned to provide early information on the radiological condition of the ventilation space and general area, and to vacuum and remove extensive dust and loose contamination known to exist in these areas. The data obtained from these entries is not intended to directly support the DQO / SAP requirements but may provide indications of specific areas that the focused samples should be taken in. The intent is to take samples to support waste designation under the DQO / SAP requirements after initial cleanup is performed, and before significant fixatives are applied that could prevent representative smears or NDA assays from being obtained.

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8.0 REFERENCES

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