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Hanford Waste Vitrification Plant Reference Conceptual Design Report

HWVP Staff
Westinghouse Hanford Company

Date Published
July 1987

Prepared for the U.S. Department of Energy
Assistant Secretary for Defense Programs

Westinghouse Hanford Company P.O. Box 1970 Richland, Washington 99352
Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

HANFORD WASTE VITRIFICATION PLANT

REFERENCE CONCEPTUAL DESIGN REPORT

The original document, SD-HWV-RCD-001, has been voided. This report has been reissued by the current Operations and Engineering Contractor as WHC-EP-0044.

B

EXECUTIVE SUMMARY

This document describes the Reference Conceptual Design (RCD) of the Hanford Waste Vitrification Plant (HWVP). The HWVP will immobilize pretreated Hanford defense liquid high-level waste prior to shipment to a geologic repository, satisfying an objective in the President's Defense Waste Management Plan.

The HWVP will vitrify the waste in borosilicate glass, cast the glass into stainless steel canisters, and store the canisters at Hanford until they are shipped to a Federal Geologic Repository.

The HWVP will support a glass production rate of 100 pounds per hour. The annual production goal of 610,000 pounds of glass is based on 70% plant availability, excluding downtime for Melter replacement.

The HWVP will be located approximately 2,000 feet southwest of B-Plant in the 200 East Area of the Hanford Site and will occupy an area approximately 1,200 feet by 1,200 feet.

The RCD cost estimate for the HWVP is $920 million. Hot startup of the HWVP is currently scheduled for Fiscal Year 1999.

REFERENCE CONCEPTUAL DESIGN REPORT
HANFORD WASTE VITRIFICATION PLANT
PROJECT B-595

Issued by:

Operations and Engineering Contractor

for the
U. S. Department of Energy
Richland Operations Office
Richland, Washington

Prepared by: Fluor Technology, Inc.

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U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR TECHNOLOGY, INC.
Advanced Technology Division
Fluor Contract 8457

SD-HWV-RCD-001 Rev. 0

HANFORD WASTE VITRIFICATION PLANT

REFERENCE CONCEPTUAL DESIGN REPORT

Prepared By:

FLUOR TECHNOLOGY, INC.
Advanced Technology Division
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Contract DE-AC06-86RL10838
Fluor Contract 845704

July, 1987

for the

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HANFORD WASTE VITRIFICATION PLANT
REFERENCE CONCEPTUAL DESIGN REPORT

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LIST OF ACRONYMS

ACFM	Actual Cubic Feet per Minute
ADPE	Automated Data Processing Equipment
ADP	Automated Data Processing
ALARA	As Low As Reasonably Achievable
AMS	Alarm Monitoring System
ANSI	American National Standards Institute
BA/BO	Budget Authority/Budget Outlay
CADD	Computer Aided Design and Drafting
CCR	Central Control Room
CCTV	Closed Circuit Television
CDC	Canister Decontamination Cell
CDMC	Contact Decontamination Maintenance Cell
CMA	Crane Maintenance Area
CMM	Canister Manipulating Mechanism
CPC	Chemical Processing Cell
CR	Computer Room
CRT	Cathode Ray Tube
CS	Carbon Steel
DBA	Design Base Accident
DBE	Design Basis Earthquake
DCS	Distributed Control System
DLPU	Distributed Local Processor Units
DOE	U.S. Department of Energy
DOE/RL	DOE Richland Operations Office
DWMP	Defense Waste Management Plan
DWPF	Defense Waste Processing Facility
DWTT	Decontamination Waste Treatment Tank
ECC	Emergency Control Center
EMM	Electromechanical Manipulator
FAVC	Formic Acid Vent Condenser
FCDC	Final Canister Decon Chamber
Fluor	Fluor Technology, Inc.
FOS	Field Operating Station
GSC	Gas Scrubbing Column
GUN	Hanford Site General Usage Network
HDW-EIS	Environmental Impact Statement for Disposal of Hanford Defense Wastes
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
HLW	High-Level Waste
HP	Health Protection
HPS	High Pressure Sodium
HVAC	Heating, Ventilation and Air Conditioning
HWMP	Hanford Waste Management Plan
HWVP	Hanford Waste Vitrification Plant
ICC	Inner Canister Closure
ICCS	Inner Canister Closure System

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LIST OF ACRONYMS (Continued)

IMS	Information Management System
INEL	Idaho National Engineering Laboratory
IVDTS	Integrated Voice Data Telecommunications System
LAN	Local Area Network
MC	Melter Cell
MFT	Melter Feed Tank
MOG	Melter Off-Gas
MSM	Master Slave Manipulator
NCAW	Neutralized Current Acid Waste
NFPA	National Fire Protection Association
O&EC	Operations and Engineering Contractor
OGCT	Off-Gas Condensate Tank
OSHA	Occupational Safety and Health Administration
PCDC	Preliminary Canister Decon Chamber
PCDR	Preliminary Conceptual Design Report
PSWBS	Project Summary Work Breakdown Structure
PVVF	Process Vessel Vent Filter
RCD	Reference Conceptual Design
RCT	Recycle Collection Tank
RCRA	Resource Conservation and Recovery Act
RDCT	Regulated Drains Collection Tank
REDC	Remote Equipment Decontamination Cell
RLST	Receipt and Lag Storage Tank
SAS	Steam Atomizing Scrubber
SCR	Supervisor Control Room
SFHT	Spent Frit Hold Tank
SIF	Systems Integration Facility
SME	Slurry Mix Evaporator
SMECT	Slurry Mix Evaporator Condensate Tank
SRAT	Slurry Receipt and Adjustment Tank
SRP	Savannah River Plant
SS	Stainless Steel
ST	Scrubber Tank
TLV	Threshold Limit Value
TRU	Transuranic
UPS	Uninterruptable Power Supply
VVS	Vessel Vent System
WAC	Washington Administrative Code
WBS	Work Breakdown Structure
W.C.	Water Column
WHT	Waste Hold Tank
WTC	Weld Test Cell

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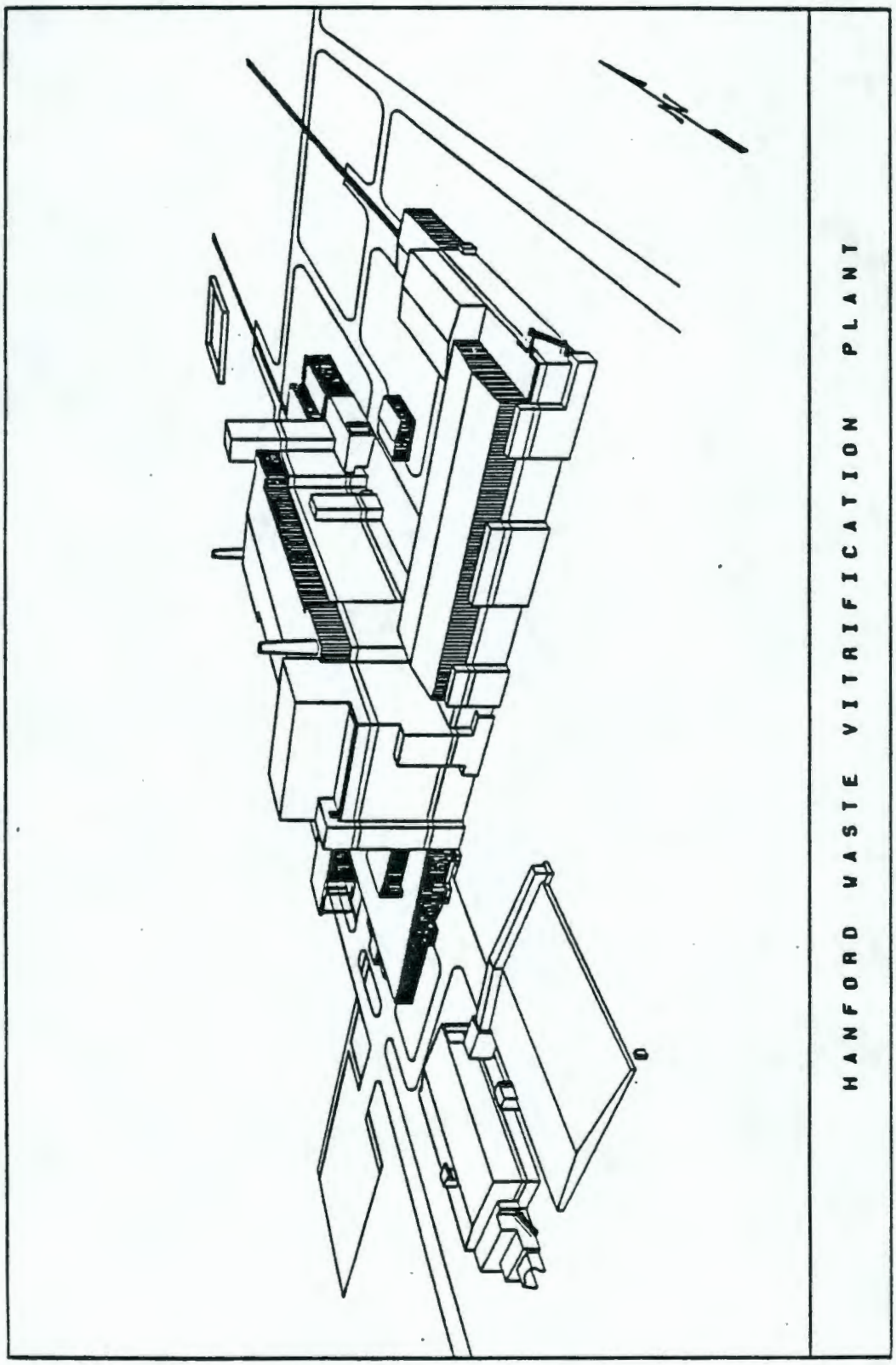

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I. SUMMARY

The Hanford Waste Vitrification Plant (HWVP) will immobilize high-level Hanford Defense Waste by vitrification. This waste includes existing and future waste, stored in the double-shell tanks. Prior to vitrification, these wastes will be retrieved and pretreated at B-Plant, which is an existing facility in the 200-East Area. The pretreatment process will separate the waste into two fractions: 1) a high activity fraction, and 2) a low activity fraction. The high activity fraction will be transferred to double-shell tanks and be available for vitrification. The low activity fraction will be formed into a grout at the Transportable Grout Facility and disposed of in near-surface disposal vaults. The HWVP's function with respect to overall waste treatment and disposal at Hanford is depicted graphically on Figure 1.

The pretreated radioactive feed will be received from the double-shell tank farm, treated with chemicals and concentrated, then mixed with frit and/or glass forming materials. This liquid mixture will be fed to an electrically heated glass melter. The molten glass product will be poured into canisters that are sealed, cleaned, and stored for future shipment to a waste repository. Table I-1 provides a summary of overall design parameters of the HWVP.

The HWVP will be located in the 200 East Area of the Hanford Site, as shown in Figure 2. Within the 200 East Area, HWVP will be located southwest of B Plant, as shown on the HWVP site map, Figure 3. The HWVP site has access to existing railroads, utilities, pipelines connected to the tank farms, and has potential for expansion. The HWVP site is level and does not require extensive clearing or grading.

Nine buildings will make up the facility, and will be utilized to house the vitrification process, glass canister storage, and process/facility supporting systems. Process and storage facilities will be designed for a 40 year life. The facilities will provide for remote operation and maintenance of the process with appropriate biological shielding for operator safety. Heating, ventilation, and air conditioning (HVAC) systems will provide additional confinement barriers to limit any potential spread of radioactive contaminants. Glass canister storage will be sized for approximately a 5 year production. The storage facility layout will allow the storage capacity to be increased to accommodate an additional 5 year production.

The process will be comprised of four major activities, which include: feed preparation, vitrification, canister handling, and Melter Off-Gas (MOG) and vessel vent treatment. Process equipment associated with these activities is remotely operated and maintained, and will be located within cells in the Vitrification Building. Cold chemical and utility systems and personnel support services required to support the vitrification process, will be located within buildings adjacent to the Vitrification Building. Wastes from the process and process support operations will be treated within the HWVP. The vitrification process and support operations will be controlled by a distributed control system. A Systems Integration Facility (SIF) will be used to verify Hanford unique vitrification system equipment performance, integrate vitrification

system equipment with the distributed control system equipment, to allow initial Distributed Control System (DCS) control software routine development prior to HWVP cold startup.

Water and steam utilities required to support the facility will be available at the HWVP site. Two new 13.8 kV power lines will be extended approximately 3.5 miles from the existing 251-W substation to the HWVP site. Standby and uninterruptable power supplies (UPSs) will be provided within the HWVP.

TABLE I-1

HWVP DESIGN PARAMETERS

Glass Production Rate

Design:	100 lb per hour average; 610,000 lb per year*
Expansion Capability:	220 lb per hour average

Canister Data

Overall Height:	9 ft. 10 in.
Diameter:	24 in.
Glass Fill:	22 cubic feet or 3,630 lb
Waste Loading in Glass:	25 weight percent
Total Filled Weight:	4,630 lb
Average Production:	168 canisters per year

Canister Interim Storage Capacity

5 years of average production, with capability to expand for an additional 5 years average production.

*Based on plant operational availability of 70 percent excluding downtime for Melter replacement.

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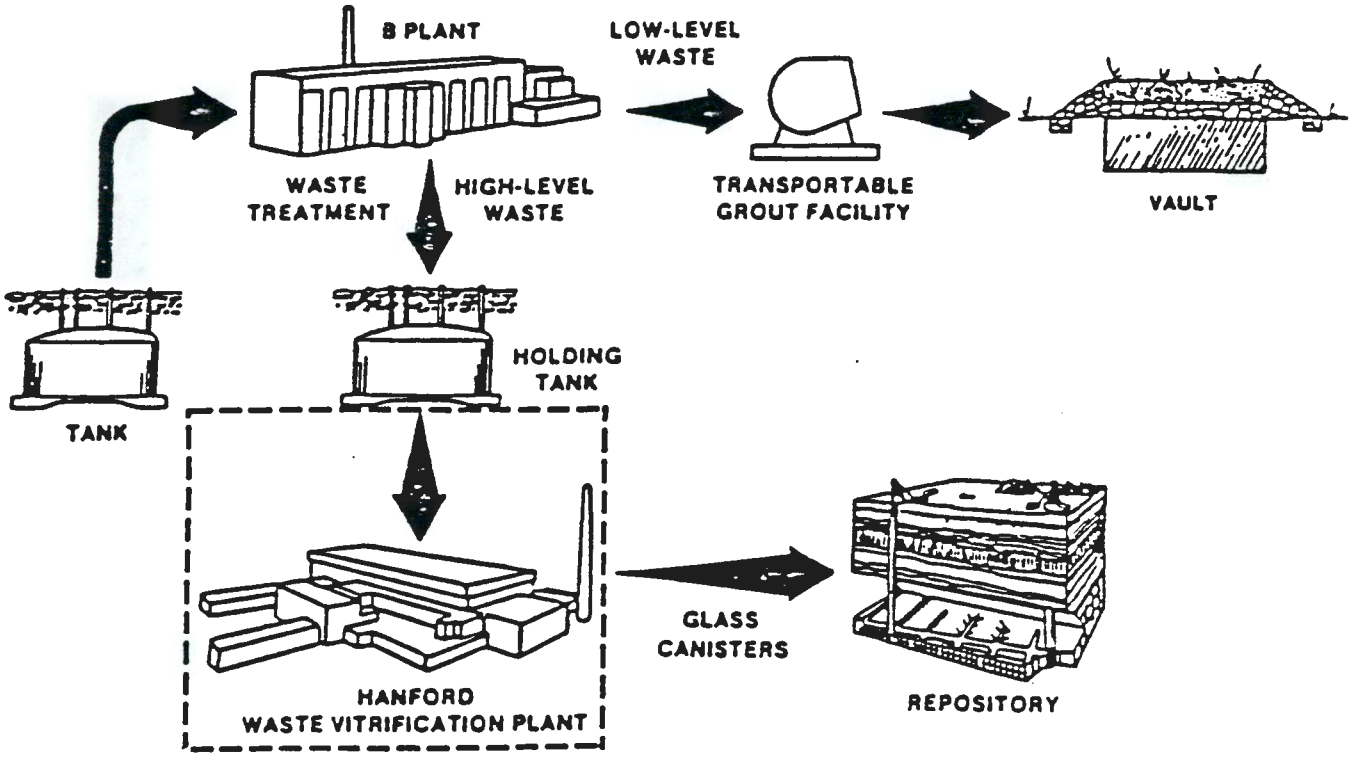

HWVP ROLE AT HANFORD

Figure 1

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HANFORD WASTE VITRIFICATION PLANT (HWVP)

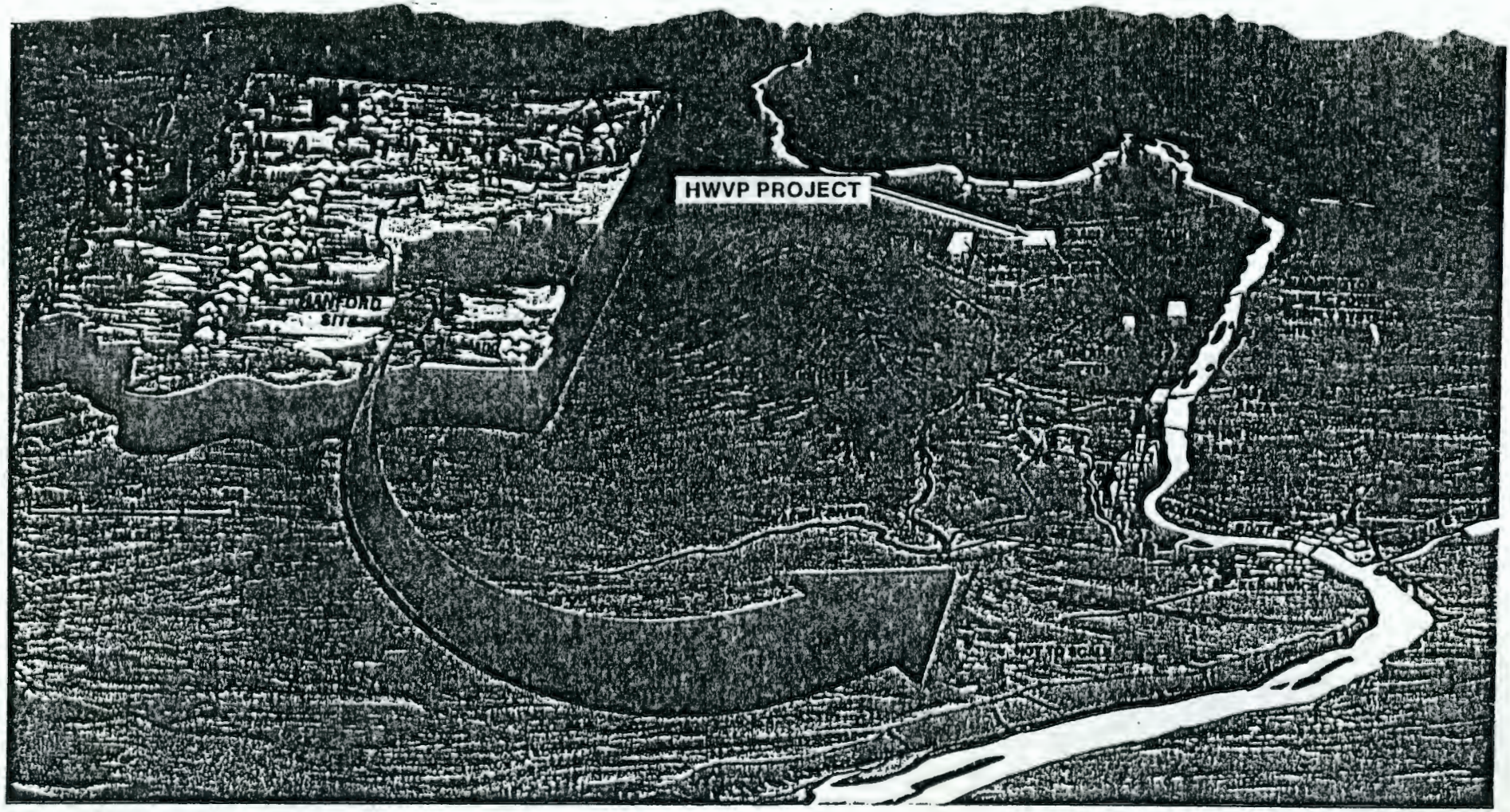

Figure 2

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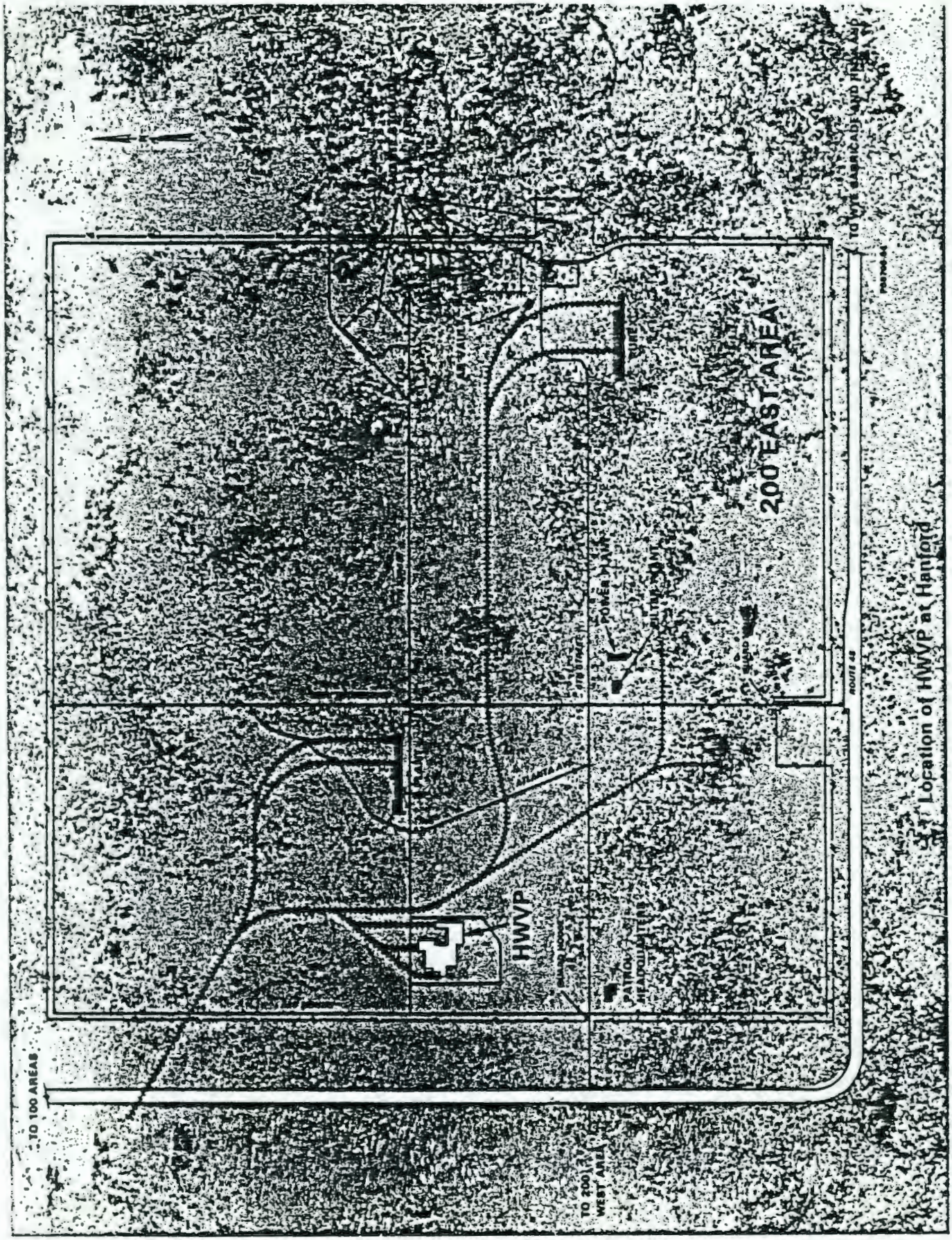

Figure 3 Location of HWVP at Hanford

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II. INTRODUCTION

Fluor Technology, Inc. (Fluor), performed the Reference Conceptual Design (RCD) and prepared this report for the U.S. Department of Energy Richland Operations Office (DOE/RL) under the technical direction of the Operations and Engineering Contractor (O&EC).

The RCD effort was initiated by Fluor and WasteChem Corporation personnel with a review of the design baseline documents, the HWVP Functional Design Criteria (SD-HWV-FDC-001) and the HWVP Technical Data Package (SD-HWV-DP-001), along with the HWVP Preliminary Conceptual Design Report (PCDR, SD-HWV-PCR-001). The purpose of the review was to identify any areas where further definition or modification was required to enhance the schedule and/or reduce the total estimated cost. Additionally the review was to identify areas within the PCDR requiring further study, modification, trade-off evaluation, or optimization. The review concluded that the PCDR configuration provided a valid technical and cost base upon which the RCD should proceed. It was concluded that recommendations for deviating from the PCDR configuration should only be made if the PCDR concept was not safe, did not work, or significant cost/schedule benefits could be achieved. Studies identified through the evaluation review were performed and the approved study recommendations incorporated into the RCD. Additionally, as the RCD progressed, other deviations to the PCDR were identified through modified requirements and design evolution. These deviations were evaluated and, as approved, were incorporated into the RCD.

The results of the RCD work are contained in this report. The RCD Report contains summary descriptions of the required data as outlined in the Conceptual Design Report guidelines DOE/RL Order RL5700.2A, Project Management System.

Documentation contained within this report provides a detailed design basis and a cost and schedule plan upon which the preliminary design can be initiated.

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III. JUSTIFICATION

A major mission of the Hanford Defense Waste Program is to achieve permanent disposal of Hanford Defense Wastes with safe, environmentally acceptable, and cost effective disposal methods which meet applicable regulations. The Atomic Energy Act of 1954 and the U.S. Department of Energy (DOE) Organization Act of 1977 directed the DOE and its predecessors to manage defense related nuclear wastes. Consistent with that responsibility, in June of 1983, and in accordance with Public Law 97-90, the Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1982, the President submitted the Defense Waste Management Plan (DWMP) to Congress. The fundamental goal of this Plan is to end present interim storage practices for defense wastes and to provide for permanent disposal. To achieve this goal, the DWMP establishes, as an objective, that the High-Level Waste (HLW) be immobilized prior to shipment to a geologic repository. The HWVP has been established to accomplish this objective. The HWVP will vitrify pretreated waste in borosilicate glass, cast the glass into stainless steel canisters, and store the canisters at Hanford until they are shipped to a Federal Geologic Repository.

To achieve the most efficient use of available resources, the DWMP called for a sequential approach for the development of liquid HLW immobilization facilities at two of the three DOE sites. First would be the Savannah River Plant (SRP), and then the Hanford Site. Hanford would be followed by development of an immobilization facility for the Calcined Waste of the Idaho National Engineering Laboratory (INEL). This approach permits the experience gained at the first site to be applied to the other sites.

Consistent with the President's Plan, DOE/RL published the Interim Hanford Waste Management Plan (HWMP) and its subsequent annual revisions and the companion Interim Hanford Waste Management Technology Plan. With these plans, an integrated strategy for permanent disposal of Hanford defense wastes was established, involving the consideration of a broad spectrum of alternatives, subject to satisfactory completion of the appropriate National Environmental Policy Act steps. Included as part of this strategy is the processing of high-level defense wastes through a system that will assure safe and acceptable disposal in a geologic repository. The process proposed for the Hanford HLW is the vitrification of waste in borosilicate glass in the HWVP and is based upon the same technology being used at the SRP in South Carolina; West Valley, New York; and at waste processing plants in Germany, France, Japan, and the United Kingdom.

Hanford currently has 62.6 percent of the nation's high-level defense wastes contained in 149 single shell and 28 double shell tanks. Immobilization of the HLW in these tanks will involve pretreatment in B Plant to produce a relatively large waste stream suitable for disposal as low-level waste in cementitious grout and a relatively small waste stream for vitrification in

borosilicate glass for disposal in a geologic repository. For example, pretreatment of the existing and future double shell tank Neutralized Current Acid Waste (NCAW) waste will allow 96.7 percent of the radioactivity (representing only 4.0 percent of the volume) to be vitrified.

The HWVP will be designed with the capacity to vitrify the double shell tank wastes. The HWVP will also be designed so that single shell tank waste could be accommodated in the future with minimal impact on cost, schedule, and plant performance.

Design life of the plant is 40 years which will provide the defense HLW vitrification needs at Hanford over the next few decades. The nominal plant throughput is 45 kg/hour of vitrified waste product. The HWVP will be designed to safely store five years of vitrified and canistered product with an average heat content of 1.4 kW per canister. The design will permit expansion for additional canister storage.

IV. DESCRIPTION OF PROJECT SCOPE

This section provides a summary description of the project scope. The section is organized in accordance with the DOE Construction Cost Codes and generally follows the Construction Cost Code breakdown of the project cost estimate summary contained in Appendix A, Format 1.

In accordance with this breakdown, the discussion of building fire protection/fire detection features and systems is presented under the "Buildings" category, while external fire protection and firewater supply are presented under the "Utilities" category. Communications systems, because they are considered as building communication and alarm systems, are presented under the "Buildings" category. Similarly, electrical, steam and water supply services to the facility are presented under the "Utilities" category, while electrical, steam, and water distribution systems within the facility are presented under the "Special Equipment/Process Systems" category. Although the costs allocated for the Heating, Ventilation and Air Conditioning (HVAC) Systems are included in several DOE cost codes in the cost estimate, the narrative description section of this report describes the HVAC systems under the "Buildings" section for clarity.

IV. DESCRIPTION OF PROJECT SCOPE (Continued)

A. Improvements to Land

1. Site Location

The reference site selected for the HWVP (see HWVP Site Evaluation Report, SD-HWV-SE-001) is located within the 200 East Area on undeveloped land, approximately 2,000 feet southwest of the B-Plant 221-B canyon building. The 200 East Area of the Hanford Site is located approximately 25 miles northwest of the city of Richland, Washington. The reference site has access to existing railroads, utilities, and required waste pipeline tie-ins, and has potential for expansion. The site is level, with about a 1-1/2 percent slope from the southeast to northwest, and will not require extensive clearing and grading. The reference site land area is approximately 1,200 feet by 1,200 feet (35 acres).

The site is located on a terrace, locally referred to as the "200 Area Plateau," near the center of the Hanford Site. From the 200 Area Plateau, the ground surface slopes gently toward the Columbia River. The climate is arid to semiarid as a result of being in the rain shadow of the Cascade range. Because of the arid environment and prevailing winds, the Hanford Site is blanketed by a thin veneer of wind-blown sediments. Water erosion on the plateau is minor because of the minimal precipitation, high soil porosity, and relatively flat topography.

There are several items on the site that cannot be disturbed. An existing encasement to the southeast contains 6 waste-transfer lines, is approximately 7 feet below grade and must not be disturbed. A 24 inch diameter concrete export water-line to the southwest is approximately 3 feet below grade and will not be moved. An existing railroad track to the east of the site will provide rail entrance and exit for HWVP.

The vegetation on the site consists of sagebrush and other common central Washington desert plant species. The soil is classified as sandy gravel with excellent drainage characteristics.

2. Permanent Site Improvements

The HWVP Site Plan and HWVP buildings are shown in Figure 4. Improvements to the site include providing pedestrian, vehicle, and railroad access. In addition, the following civil activities are required.

IV. A. 2. Permanent Site Improvements (Continued)

a. Excavation and Backfill

Excavation is required for the facility. The process cell and canyon area excavations for the Vitrification Building are about 15 feet deep with a small portion being approximately 30 feet deep. An excavation side slope of 1.5:1 is used to eliminate the need for shoring. The bottom of the Vitrification Building excavation is wide enough to provide work space and construction access roads between the toe of the cut slope and the building foundation. Excavated material is stockpiled for use as backfill. Excavations are also required for the Canister Storage Building (28 feet deep), the Sand Filter (24 feet deep), the Receipt and Lag Storage Tank and Waste Holding Tank Vaults (40 feet deep each), and the Switchgear/Generator Building (10 feet deep).

b. Trenching

Trenching is required for the underground utilities and for the feed transfer lines, see Utility Site Plan, Figure 5. All lines are routed to minimize interference with existing utilities. Shoring may be required to install utilities and process transfer lines.

c. Finish Grading

Finish grading blends the facility into the existing topography and provides drainage away from all buildings.

Other areas disturbed during construction have their original contours and grades restored, as much as possible, and are stabilized with gravel.

d. Paved Access

Paved access roads, including a 2,800 foot long perimeter road, are shown on Figure 4. Additional paving is required for access to individual buildings. A paved lot with spaces for automobiles, motorcycles, and handicapped parking is provided for HWVP personnel. Construction access is by a dedicated existing corridor that intersects the 100 Area access highway west of the HWVP site. The existing paved roads provide satisfactory all-weather access.

e. Rail Access

Approximately 4,000 feet of new railroad track are required for the HWVP. From a single tie-in point with

IV. A. 2. e. Rail Access (Continued)

the existing Hanford mainline, three spurs provide access to the Railroad Well in the Vitrification Building, the service area loading dock, and the cask loadout and shipping area.

3. Temporary Site Improvements

The construction schedule will impose constraints on the temporary construction activities. In general, the more accelerated the construction schedule, the more land area is required for construction support. For example, parking for crafts and laydown area for contractors is a direct function of the density of active construction packages. The following temporary construction items are based on the Project Master Schedule.

a. Laydown Areas

Construction laydown areas totalling approximately 74 acres are allocated for the HWVP project. A general laydown of approximately 43 acres, which includes rail access, is available due north of the Vitrification Building and north of 7th street. Utilities are available along the south side of 7th street. Gate access is from the northwest corner and from 7th street.

A laydown area of approximately 7 acres is allocated for and adjacent to the Fan House Building, the Sand Filter, and the Canister Storage Building. Utilities are not provided.

A laydown area of approximately 9 acres is allocated for and adjacent to the Vitrification Building, the Manipulator Repair Building, the Support Building and the Service Building. Utilities are available from lines along the south side of 7th street.

A future additional laydown area of approximately 15 acres is allocated due east of the Canister Storage Building on the east side of the new HWVP perimeter road.

b. Contractors/DOE Temporary Construction Facilities

A contractors/DOE temporary construction area is allocated along the north side of 7th street due north of the HWVP site. Within this area space is available for, but not limited to, the following:

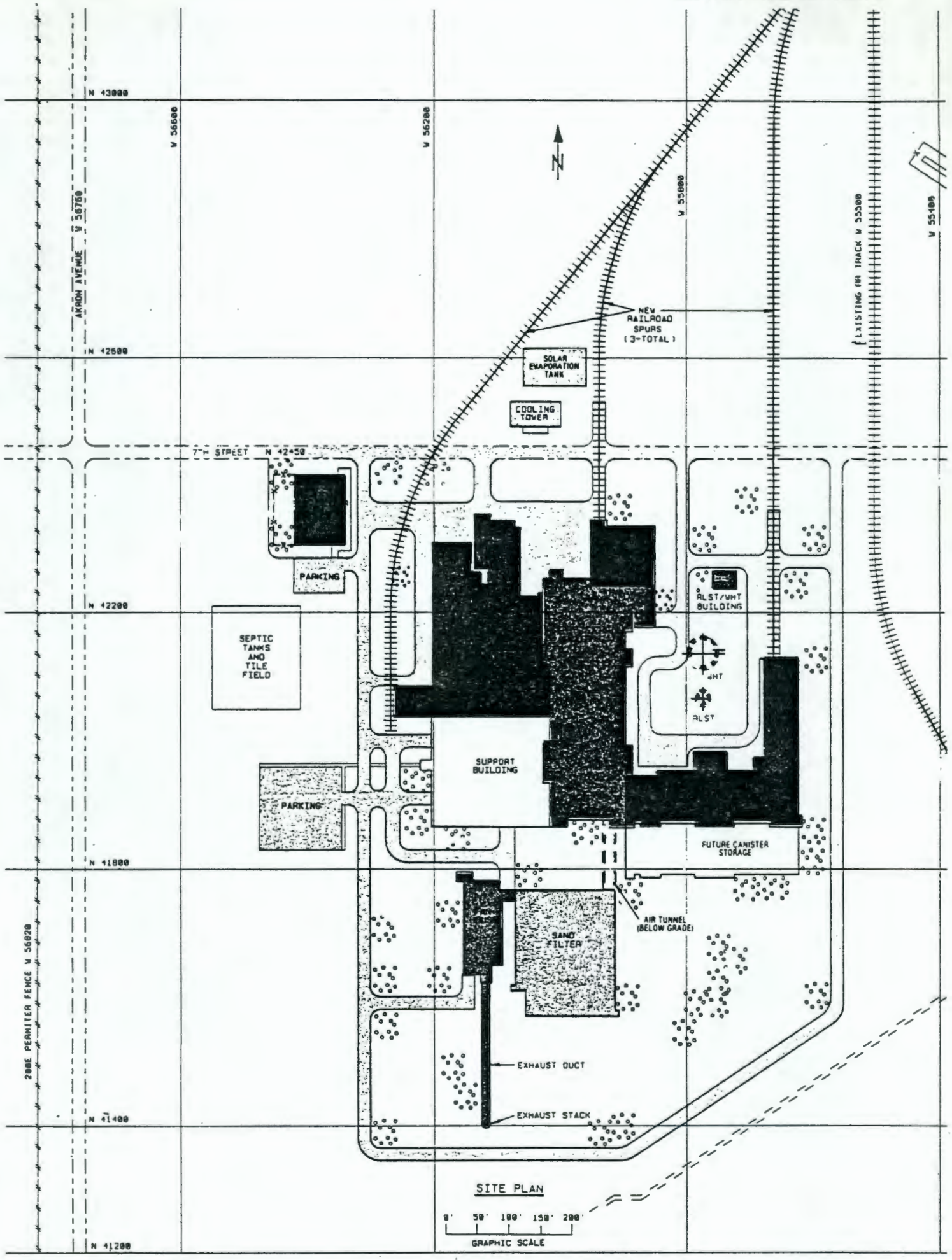

Figure 4

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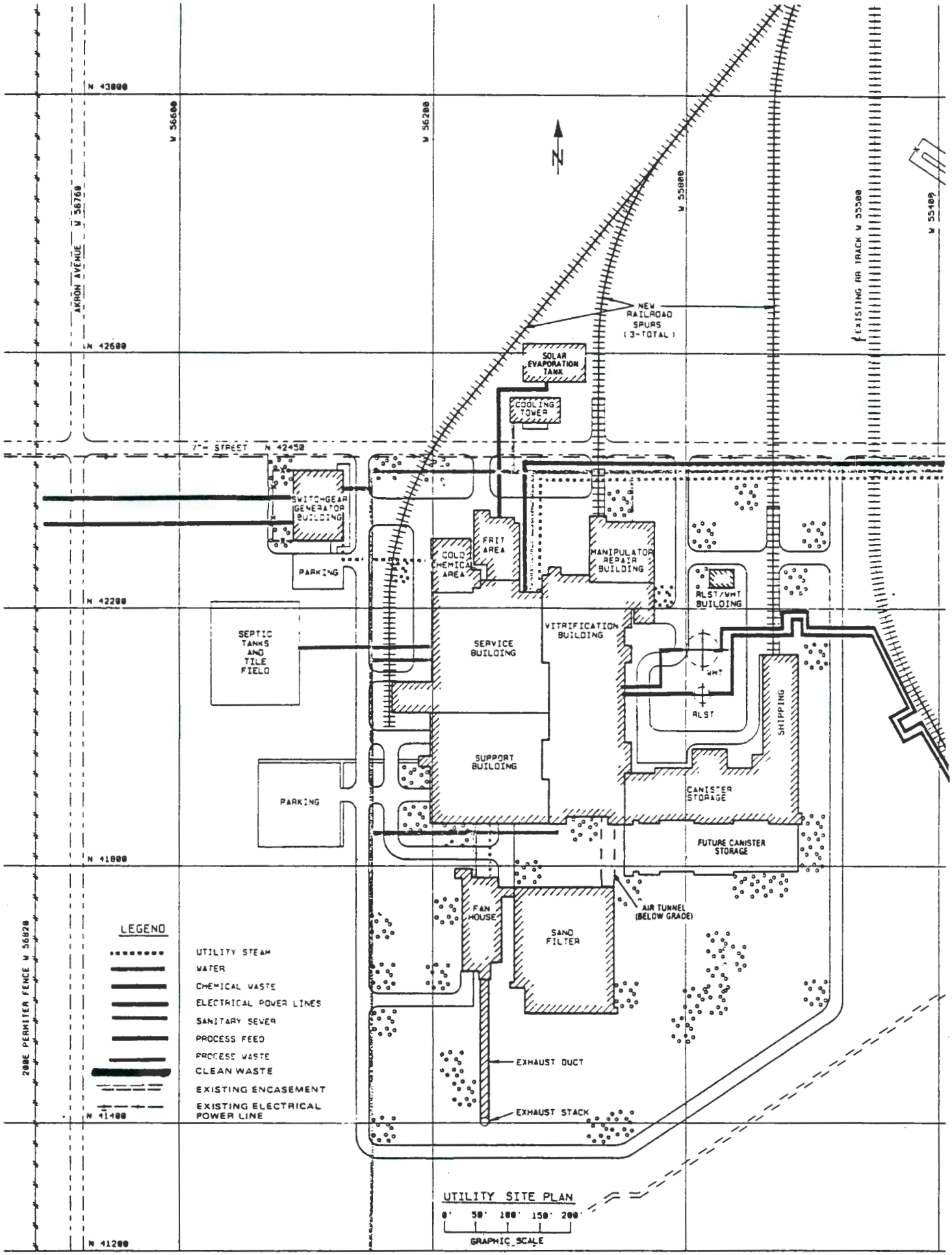
N 43000
N 42600
N 42200
N 41800
N 41400
N 41200
W 56600
W 56200
W 55800
W 55400
W 56760
W 56820
AKRON AVENUE
7TH STREET N 42450
N
NEW RAILROAD SPURS (3-TOTAL)
EXISTING RR TRACK W 55300
SOLAR EVAPORATION TANK
COOLING TOWER
SWITCHGEAR GENERATOR BUILDING
PARKING
COLD CHEMICAL AREA
FRIT AREA
MANIPULATOR REPAIR BUILDING
RLST/WMT BUILDING
SEPTIC TANKS AND TILE FIELD
SERVICE BUILDING
VITRIFICATION BUILDING
WMT
RLST
SHIPPING
SUPPORT BUILDING
PARKING
CANISTER STORAGE
FUTURE CANISTER STORAGE
AIR TUNNEL (BELOW GRADE)
FAN HOUSE
SAND FILTER
EXHAUST DUCT
EXHAUST STACK
200E PERMITER FENCE
LEGEND
UTILITY STEAM
WATER
CHEMICAL WASTE
ELECTRICAL POWER LINES
SANITARY SEWER
PROCESS FEED
PROCESS WASTE
CLEAN WASTE
EXISTING ENCASEMENT
EXISTING ELECTRICAL POWER LINE
UTILITY SITE PLAN
0' 50' 100' 150' 200'
GRAPHIC SCALE

Figure 5

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IV. A. 3. b. Contractors/DOE Temporary Construction Facilities (Continued)

- Temporary office trailer complex for DOE, the Operations and Engineering Contractor, Construction Management and Architect-Engineer field personnel. The trailer complex floor space is approximately 15,000 square feet. Temporary utilities including septic tank and leach field are provided.

- Receiving and storage facilities for equipment and materials procured by Construction Management prior to turnover to construction contractors for installation. The receiving and storage facility is approximately 20,000 square feet and will be equipped with automatic sprinkler protection.

- Temporary facility of approximately 2500 square feet for display and maintenance of the plant model.

- Space for a 10,000 square foot Vitrification Building field fabrication shop for embeds which will be provided by the construction contractor.

c. Parking

A general parking area of approximately 7.5 acres is located outside the construction security fence due west of the Vitrification Building. This area is primarily for construction worker parking with foot traffic to the main entrance gate. Parking for DOE and other Government team personnel is allocated inside the construction security fence adjacent to the contractors/DOE facilities.

d. Security Fence

A security fence of approximately 6,000 feet is provided around the entire construction site to "fence-out" the HWVP project from the remainder of the 200 East Area, and thus eliminate security escort requirements. The fence is 7 feet fabric with a one foot barbed wire top, lighted, and has a security access road on each side. This fence joins the existing security fence along the west boundary of the 200 East Area. Controlled gates are provided for personnel, rail and vehicle access.

IV. A. 3. Temporary Site Improvements (Continued)

e. Spoil Area

A spoil area for excavated material is allocated west of Akron Avenue and north of 7th Street.

IV. DESCRIPTION OF PROJECT SCOPE (Continued)

B. Buildings

The design life of the HWVP buildings is 40 years. The materials of construction are noncombustible, and are provided with protective coatings resistant to corrosion. The overall design considers safety, economy, operability, maintenance, decontamination and decommissioning.

Structures, systems, and components associated with the HWVP are classified into two categories according to their required ability to withstand a Design Base Accident (DBA), namely Category I and non-Category I. For the HWVP, Category I items are those necessary to (1) prevent or mitigate the consequences of accidents which would result in potential release of radioactivity to off-site areas exceeding the dose guidelines set forth in DOE Order 5480.1, Chapter XI; (2) prevent or mitigate the consequences of accidents which would result in potential release of radioactivity to onsite personnel exceeding the dose guidelines set forth in DOE Order 5480.1; (3) shut down operations safely, as necessary, to maintain the plant in a safe shutdown condition, and maintain integrity of the final containment and confinement barriers for radioactive materials. Those portions of structures, systems, and components whose continued function is not required, but whose failure could reduce the functioning of any Category I item to an unacceptable safety level are also Category I. Non-Category I items are all structures, systems and components not included in Category I.

Category I buildings and structures are reinforced cast-in place concrete and are designed for service loads and to withstand the effects of severe and extreme environmental loads, including Safe Shutdown Earthquake, Design Basis Tornado, and Design Basis Ashfall. Non-category I buildings are steel-framed and are designed for normal service.

The Category I buildings are:

- The Vitrification Building except for the heating, ventilation and air conditioning (HVAC) room on the 4th floor
- Canister Storage Building except for the railroad airlock/washdown area, the personnel and equipment facility, and the HVAC room on the 2nd floor
- Fan House Building

IV. B. Buildings (Continued)

- o Switchgear/Generator Building
- o Receipt and Lag Storage Tank/Waste Hold Tank (RLST/WHT) Building (excluding portion housing the annulus ventilation system)

The Non-category I steel-framed buildings are:

- o RLST/WHT Building (portion housing the annulus ventilation system)
- o The Manipulator Repair Building
- o The Support Building
- o The Service Building
- o The Systems Integration Facility

The following section discusses each building separately, including the construction, location, function and the HVAC system.

1. Vitrification Building

a. Construction, Location, Function

The Vitrification Building is a five story structure approximately 360 feet by 120 feet and 90 feet in elevation to the 4th floor or roof of the main process cell. See Figure 4 for location and Figures 6 and 7 for arrangement. The first eight feet are located below grade. The 4th floor supports a two story concrete structure (approximately 30 feet by 120 feet and 40 feet in elevation) located on the extreme south end, and a one story metal structure (approximately 276 feet by 120 feet and 25 feet in elevation) on the remainder.

The process cells are located in the central portion of the building, surrounded by the operating galleries and service corridors. Major HVAC equipment is located on the fourth floor in the one story metal structure.

b. HVAC System

The HVAC system is part of the confinement system for contamination control and functions with confinement barriers to ensure containment. This system is in accordance with DOE Order 6430.1 and DOE/EV/1830-75 "Guide to Reducing Radiation Exposure to ALARA."

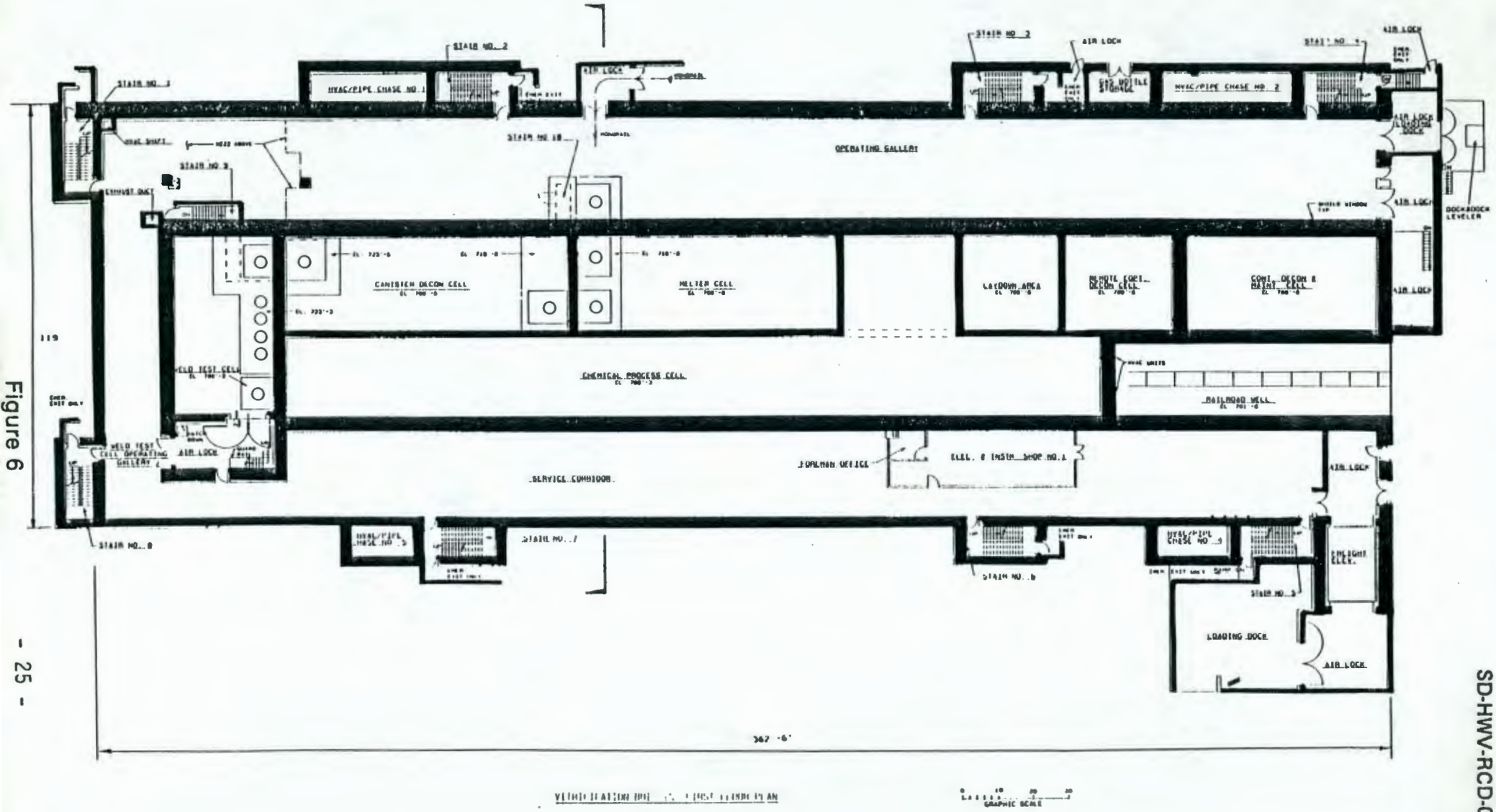
STAIR NO. 2
HVAC/PIPE CHASE NO. 1
AIR LOCK
STAIR NO. 3
STAIR NO. 4
HVAC/PIPE CHASE NO. 2
OPERATING GALLERY
STAIR NO. 9
STAIR NO. 10
CANISTER DECON CELL
HELTER CELL
LAYDOWN AREA
REMOTE EQPT. DECON CELL
CONT. DECON & MAINT. CELL
DOCKBOARD LEVELER
COLD TEST CELL
CHEMICAL PROCESS CELL
RAILROAD WELL
HELD TEST CELL OPERATING GALLERY
SERVICE CORRIDOR
FOREMAN OFFICE
ELEC. & INSTR. SHOP NO. 1
STAIR NO. 8
STAIR NO. 7
STAIR NO. 6
STAIR NO. 5
LOADING DOCK
119
362'-6"
GRAPHIC SCALE

Figure 6

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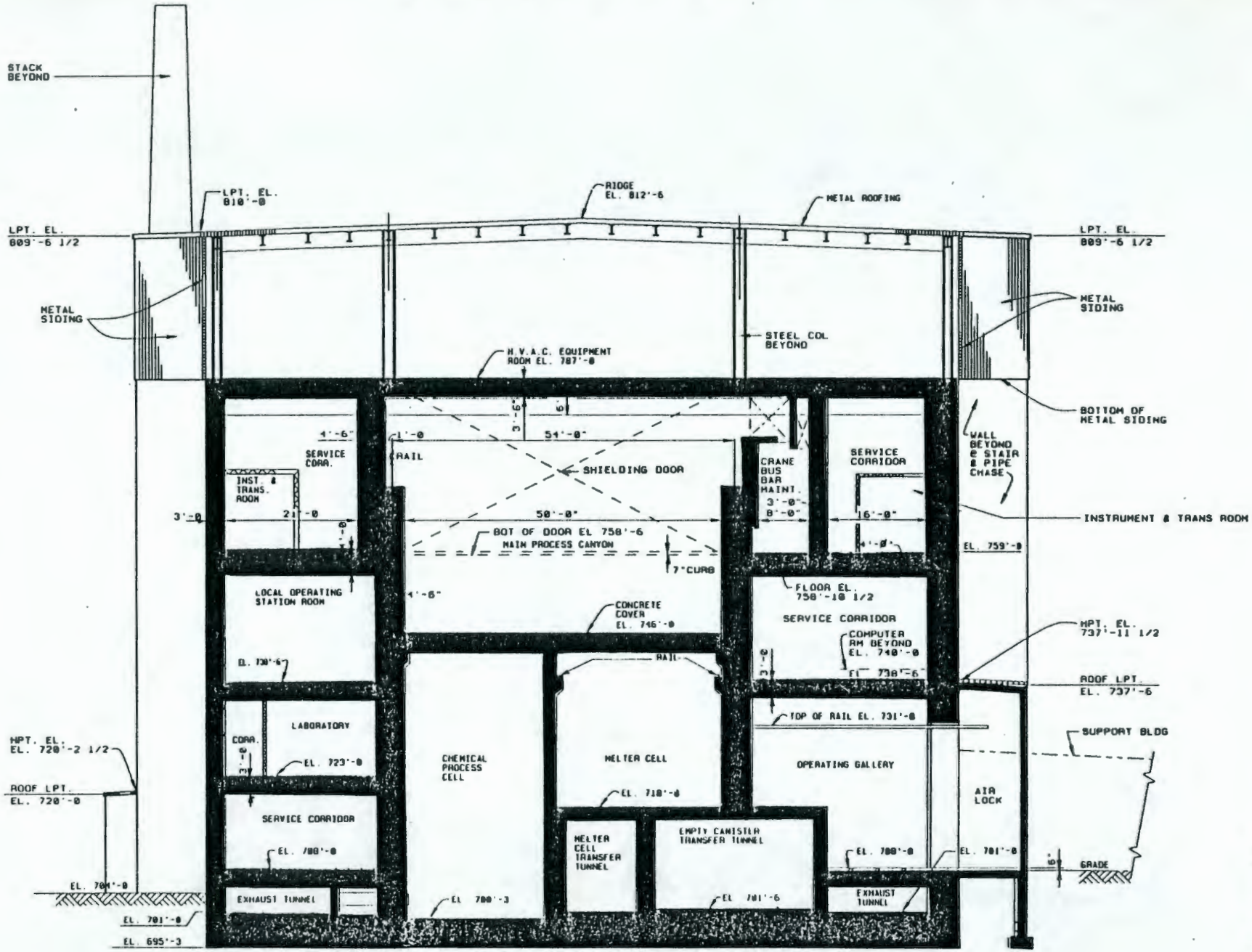

VITRIFICATION BUILDING SECTION

GRAPHIC SCALE

Figure 7

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IV. B. 1. b. HVAC System (Continued)

The total volume of air handled is that required for conditioning or contamination control, and includes the infiltration air from the outside. The infiltration of outside air is limited by providing tight-fitting doors or airlocks, as appropriate, at the entrances to the building.

Sufficient redundancy and/or spare capacity is provided as necessary to ensure adequate ventilation during normal operations and DBA conditions.

The filtration system is designed to assure that airborne radioactive particulate concentrations are as low as reasonably achievable (ALARA) and do not exceed DOE Order 5480.1A requirements during normal, abnormal, accident, and DBA conditions. Exhaust air treatment systems contain a minimum of one stage of high efficiency particulate air (HEPA) or equivalent efficiency filtration. A HEPA filter has an efficiency of 99.97 percent when tested in accordance with Mil-Std-282. The minimum efficiency of a HEPA filter shall be 99.95 percent when tested in place in accordance with American National Standards Institute (ANSI) N510. Radiation monitoring of exhaust filters is provided.

The Vitrification Building is physically separated into four ventilation zones as shown schematically on Figure 8. The HVAC systems establish and maintain different air pressures in each zone of the building. The following minimum zone differential pressures are established with respect to atmosphere:

Zone 1	(process cells and canyon)	-1.00 in. W.C.
Zone 2	(corridors, galleries with higher potential of contamination)	-0.50 in. W.C.
Zone 3	(corridors with low potential of contamination)	-0.25 in. W.C.
Zone 4	(areas with no potential of contamination)	+0.125 in. W.C. or atmospheric

The pressure differential between zones causes air to flow (leak) from zones with lower potential for contamination to zones of greater potential for contamination. Within a zone, air flows from less contaminated areas to more contaminated areas.

IV. B. 1. b. HVAC System (Continued)

The Zone 1 areas, which are essentially the "core" of the building, are served by a once-through HVAC system. The supply air is filtered and conditioned. The exhaust from the Zone 1 areas passes through a final filter prior to discharge to the environment via a stack located approximately 500 feet from the facility. The final filter is a sand filter and a single stage of HEPA filters in series. The sand filter is designed to have minimum 99.95 percent startup efficiency as measured by in-place testing in accordance with ANSI N-510.

The air temperature in the process cells is maintained between 60°F and 104°F under normal operating conditions. The Zone 1 areas which are accessible to personnel are maintained between 60°F to 80°F during normal operating conditions.

The Zone 3 and the Zone 2 areas are served by a separate HVAC system. The filtered and conditioned outside air is supplied into the Zone 3 areas. The air is exhausted from the Zone 3 areas, passed through a single stage of HEPA filters, conditioned as necessary, and supplied to the Zone 2 areas. The exhaust air from Zone 2 areas passes through two stages of HEPA filters prior to discharge to the environment via a stack. The Zone 3 and the Zone 2 areas are designed to be maintained between 68°F and 78°F during normal operation.

Provisions have been made for sampling and continuous monitoring of exhaust air streams in accordance with DOE 5480.1A Chapter XI, and RHO-MA-139. Spare fans and filters are provided to assure continuous operation of the ventilation systems during maintenance or equipment failure. The HVAC system equipment is provided with continuous monitoring and surveillance instrumentation and alarms.

2. Canister Storage Building

a. Construction, Location, Function

The Canister Storage Building consists of four distinct structures separated by seismic joints, and is located adjacent to the southwest corner of the Vitrification Building (see Figure 4). The two story canister storage structure is approximately 80 feet by 274 feet and 28 feet

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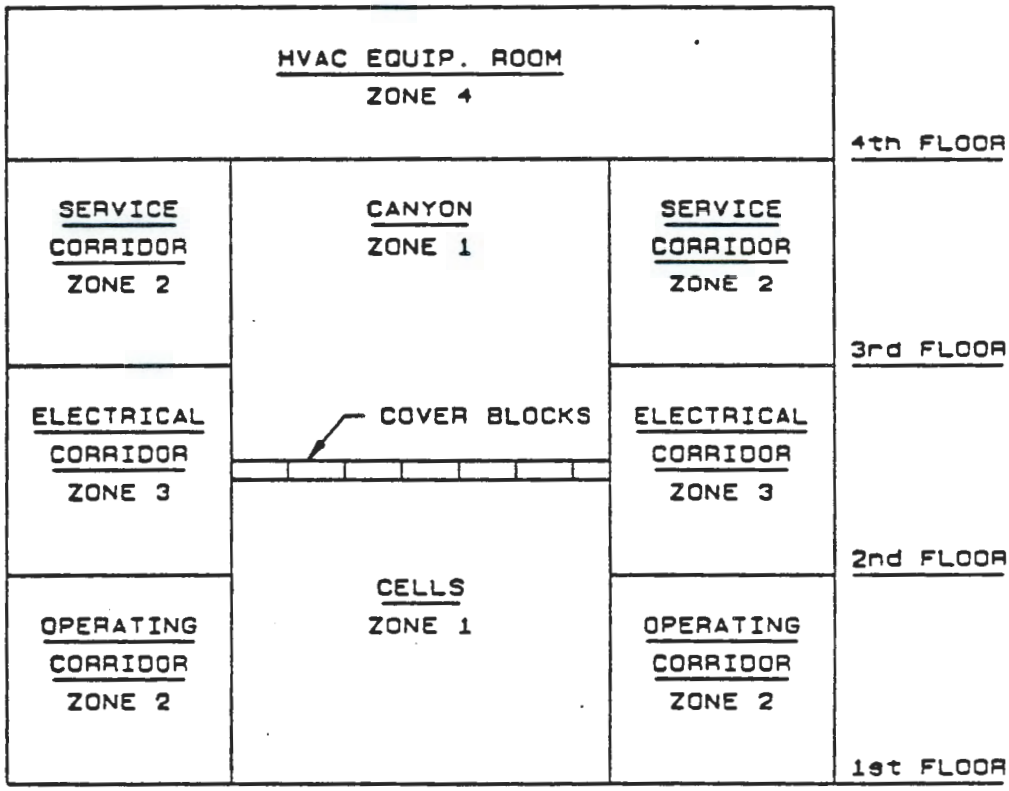

FIGURE 8
VIT.BLDG. VENTILATION ZONES

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IV. B. 2. a. Construction, Location, Function (Continued)

in elevation above grade to the 2nd floor, with an additional 21 feet below grade. The 2nd floor supports a one story metal building (approximately 80 feet by 250 feet and 18 feet in elevation) which houses the major HVAC equipment, see Figures 9 and 10.

The cask loadout/shipping and washdown areas are two structures located adjacent to the canister storage area. The one story cask loadout/shipping area is approximately 100 feet by 56 feet and 46 feet in elevation above grade with a partial basement area (approximately 32 feet by 30 feet and 21 feet below grade) to accommodate a cask pit. This structure abuts a one story metal washdown building that is approximately 80 feet by 56 feet and 24 feet in elevation.

The fourth structure is a metal one-story personnel and equipment facility building located midway along the north side of the canister storage area and is approximately 35 feet by 55 feet and 15 feet in elevation. This structure also contains the regulated entrance to the Canister Storage Operating Area.

The Canister Storage Building serves as a storage location for canisters of vitrified waste. The facilities will receive and store filled canisters, and remove radioactive decay heat by forced ventilation.

The cask loadout/shipping and washdown area of the Canister Storage Building will provide capability for transfer of the canisters from the storage area into a cask and onto a railcar or truck for shipment to a final repository.

The Canister Storage Building has six major functional areas: (1) storage vaults, (2) operating area, (3) HVAC equipment room, (4) personnel and equipment facility, (5) cask loadout/shipping, and (6) railcar, truck, and cask washdown.

IV. B. 2. Canister Storage Building (Continued)

b. HVAC System

This facility has two HVAC systems, one for the canister storage vaults (below) and the other for the operating area (above). The vault HVAC system is a forced, once through HEPA filtered ventilation system and removes the heat generated from the canisters. The operating area has a forced, recirculated ventilation system for environmental conditioning with HEPA filters in standby for use during canister handling or upset conditions. When the HEPA filters are in use, the recirculation path is closed and the air flow configuration is once through. Both systems discharge to the environment via a stack on the facility roof.

3. Fan House Building

a. Construction, Location, Function

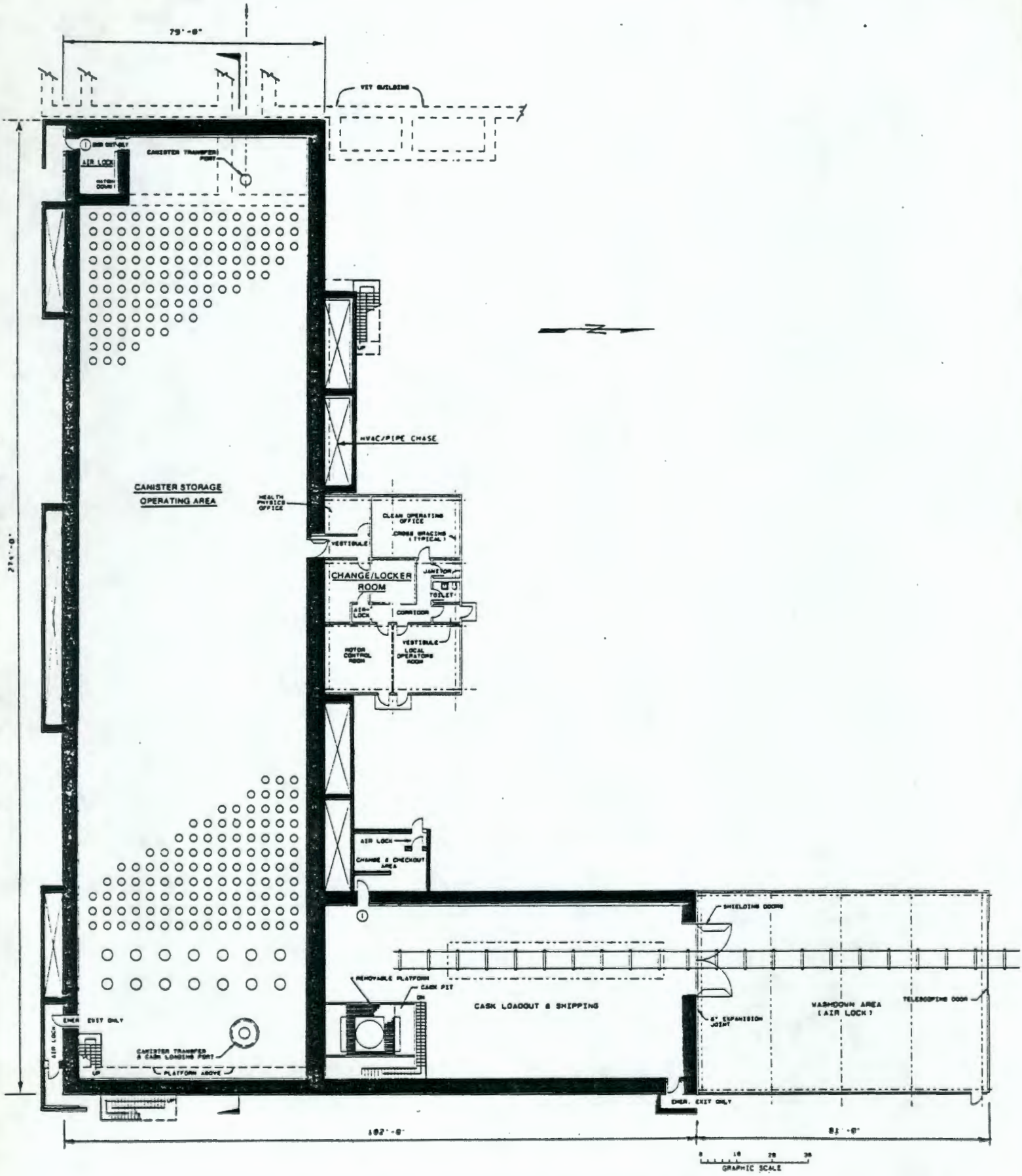
The Fan House Building is a two story structure approximately 170 feet by 90 feet and 30 feet in elevation located south of the Vitrification Building (see Figure 1).

The Fan House contains Zone I exhaust final HEPA filter plenums, fan inlet plenums, fan discharge plenums, exhaust fans and associated electrical equipment, and is unattended during normal operations. Personnel access is necessary only for maintenance. Equipment operations are monitored from the control room in the Support Building.

The Fan House Building has four major functional areas: (1) HVAC tunnels, HEPA filter and fan room, (2) HVAC equipment and storage room, (3) HVAC Zone 1 exhaust air sampling station, and (4) electrical equipment room.

b. HVAC Systems

HVAC systems are provided to maintain proper environment in the Fan House Building.



CANISTER STORAGE BUILDING FIRST FLOOR PLAN

Figure 9

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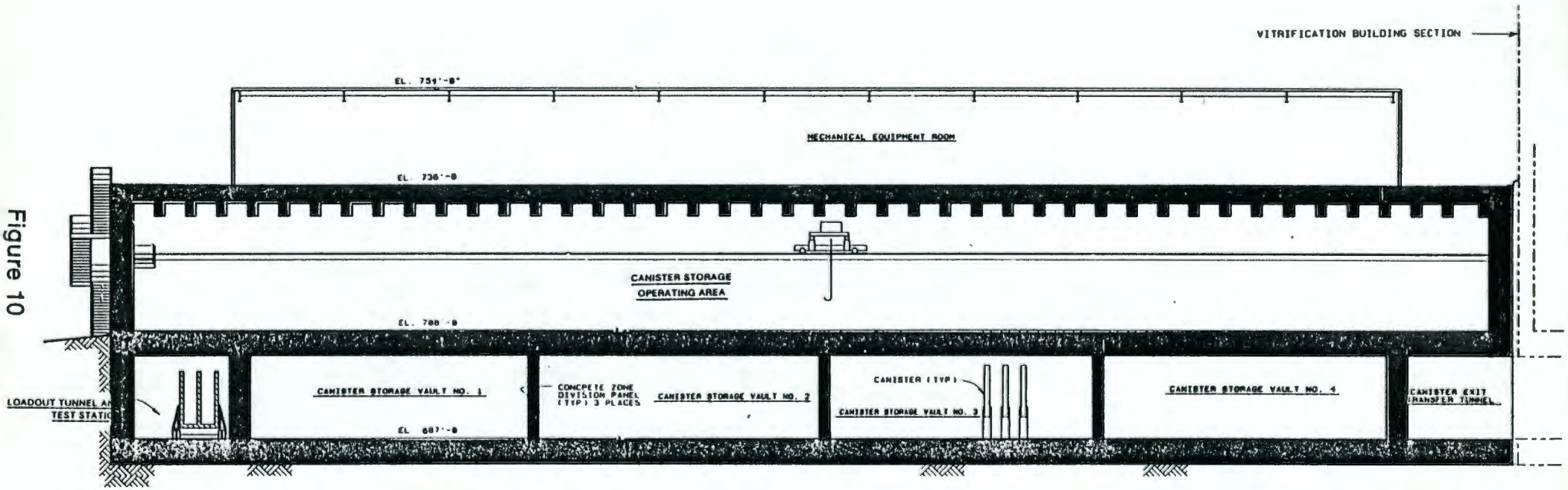

CANISTER STORAGE BUILDING SECTION

0 10 20 30
GRAPHIC SCALE

Figure 10

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IV. B. Buildings (Continued)

4. Switchgear/Generator Building

a. Construction, Location, Function

The Switchgear/Generator Building is a one story structure approximately 100 feet by 80 feet and 22 feet in elevation above grade with a partial basement for a cable spread room (approximately 40 feet by 50 feet and 10 feet below grade) located in the center of the building. This building is located north and west of the Service Building (see Figure 4).

The Switchgear/Generator Building houses the incoming power distribution system switchgear, standby switchgear, and the standby diesel-generators.

b. HVAC System

HVAC systems are provided to maintain proper environmental conditions in the Switchgear/Generator Building. Inlet louvers with automatic dampers are provided to allow entry of cooling air when the generators are operating. Fans are provided to supply filtered generator cooling air during volcanic ashfall conditions.

5. RLST/WHT Building

a. Construction, Location, Function

The RLST/WHT Building is a one story structure approximately 40 feet by 60 feet and 12 feet in height located east of the Vitrification Building (see Figure 4).

This building consists of two structures separated by a seismic joint. The RLST/WHT primary ventilation system is housed in a 40 feet by 30 feet by 12 feet high one story reinforced cast-in-place concrete portion of the building. The RLST/WHT annulus ventilation system is housed in 40 feet by 30 feet by 12 feet high one story metal portion of the building.

b. HVAC Systems

HVAC systems are provided to maintain proper environment in the building.

IV. B. Buildings (Continued)

6. Manipulator Repair Building

a. Construction, Location, Function

The Manipulator Repair Building consists of 2 structures separated by a seismic joint, and is located at the north end of the Vitrification Building (see Figure 4). The manipulator repair area is a 2 story metal building approximately 100 feet by 80 feet and 42 feet in elevation. The 2nd story is a partial floor (approximately 100 feet by 48 feet and 20 feet in elevation) located on the west side of the 2nd floor. The 2nd floor has a concrete slab to support the HVAC equipment.

The 2nd structure is a railroad airlock and washdown area. This is a one story metal building approximately 100 feet by 22 feet and 34 feet in elevation located adjacent to the west wall of the manipulator repair area. The washdown area is an extension of the Railroad Well and provides a transition between the open environment and inside the Vitrification Building.

The manipulator repair area is used for repair of failed Master Slave Manipulators (MSMs) and includes a separate decontamination area. The MSMs are brought from the Vitrification Building for repair and returned along a service corridor on the 1st floor of the Vitrification Building.

The Manipulator Repair Building has five major functional areas: (1) manipulator repair shop; (2) new parts assembly room; (3) decontamination area; (4) HVAC room; and (5) railroad airlock and washdown area.

b. HVAC System

The HVAC systems supply heated, cooled and filtered air into the building. The exhaust air is passed through two stages of HEPA filters prior to discharge to the environment via the Vitrification Building Zone 2 and Zone 3 stack.

IV. B. 6. b. HVAC System (Continued)

There are two glove boxes in the Manipulator Repair Building. Each glove box is provided with an exhaust fan which discharges to the Vitrification Building Zone 2 exhaust plenum. HEPA filters are provided at the inlet and the outlet of each glove box.

The HVAC systems establish and maintain different air pressures in each ventilation zone of the building in order to cause air flow (leakage) from zones with lower potential for contamination to zones of greater potential for contamination.

7. Support Building

a. Construction, Location, Function

The Support Building is a one story metal building located adjacent to the the Vitrification Building, approximately 170 feet by 200 feet and 15 feet in elevation (see Figure 4). There is also a partial 2nd story (approximately 35 feet by 90 feet and 15 feet in elevation) located along the east wall. The 2nd floor has a concrete slab to accommodate major HVAC equipment. Most of the offices and the control rooms for the Vitrification Building plus the Health Protection facilities are housed in this building (see Figure 11). The Support Building is separated from the Service Building by a 4-hr. fire wall and provides access to the Vitrification Building through regulated and clean entrances. Health protection services and change rooms are provided in the regulated sections, which are separated from the clean section by airlocks. The clean section contains showers, toilets, lockers, clothing storage, offices, a lunch room, a supply and reproduction room, a conference room, and space for control functions which provide administrative support and control systems for the Vitrification Building.

The Support Building has six major functional areas: (1) office area: (2) computer rooms; (3) control rooms; (4) clean entrance; (5) regulated entrance; and (6) HVAC room.

b. HVAC System

The HVAC systems are provided to maintain proper environmental conditions.

IV. B. 7. b. HVAC System (Continued)

The exhaust air from the Support Building areas which have potential for contamination is passed through HEPA filters prior to discharge to the environment via the Vitrification Building Zone 2 and Zone 3 stack.

8. Service Building

a. Construction, Location, Function

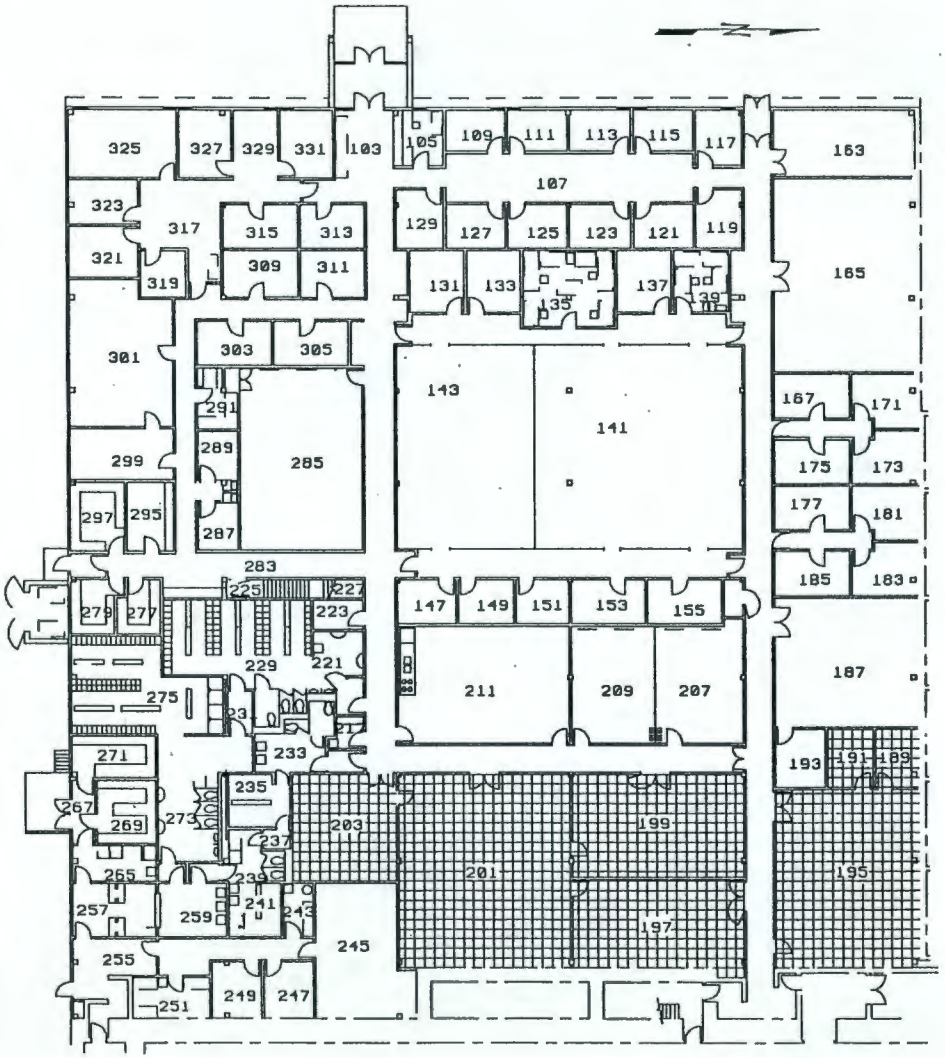
The Service Building consists of 2 structures separated by a seismic joint, located adjacent to the Vitrification Building and adjacent to the north end of the Support Building (see Figure 4). The service area is a 1 story metal building approximately 265 feet by 270 feet and 30 feet in elevation. The frit storage and prep area is a 1 story metal building approximately 105 feet by 70 feet and 30 feet in elevation. A slurry prep room within the frit storage and prep area contains a bucket elevator and has a roof height of 60 feet.

The service area provides operational support functions for the Vitrification Building including empty canister receipt, storage and inspection, maintenance shops, and cold chemical receipt, storage and makeup. The frit storage and prep area is used for storage of the frit tote-bins, preparation of the frit slurry, and neutralization of chemical wastes. The Service Building also has other functional areas, including an electrical and instrumentation shop, an HVAC equipment room, an electrical room, and a mechanical room (see Figure 12).

b. HVAC System

The HVAC systems provide heating, cooling and ventilation in various areas of the Service Building. In areas where chemicals are handled or stored, sufficient ventilation is provided to maintain the airborne concentration below the threshold limit values (TLVs) as specified by the American Conference of Industrial Hygienists.

With the exception of the 90 percent formic acid storage tanks which vent directly to the atmosphere above the building roof, the Cold Feed Service Building Vent System provides tank venting to atmosphere for all of the Service Building cold feed tanks and the non-radioactive liquid waste neutralization tanks.



ROOM NUMBER	ROOM NAMES
103	LOBBY
105	RECEPTIONIST
107	SEC/CLERK
109	BUDGET ADMINISTRATIVE ASSISTANT
111	PROCESS ENG MGR
113	PROCESS OPERATION CONTROL MGR
115	PLANT ENG MGR
117	MAINT MGR
119	SUPPORT STAFF ENG
121	SUPPORT STAFF ENG
123	SUPPORT STAFF ENG
125	CRAFT UNIT MGR
127	CRAFT UNIT MGR
129	CRAFT UNIT MGR
131	MAINT OPER PLANNER
133	MAINT OPER PLANNER/CLERK
135	CAO CENTER
137	MAINT OPER SCHEDULER
139	OPERATIONS SUPPORT MGR
141	OPERATIONS STAGING AREA
143	MAINTENANCE STAGING AREA
147	RADIOLOGICAL ENG
149	RADIOLOGICAL MANAGER
151	SHIFT MANAGER
153	OPERATIONS SUPPORT MGR
155	PROCESS ENGINEER
157	STORAGE
163	COMMUNICATION ROOM
165	MODEL ROOM
167	DRAFTER PLANT ENG
171	DRAFTER PLANT ENG
173	DRAFTER PLANT ENG
175	MECH PLANT ENG
177	PROCESS ENGINEER
181	PROCESS ENGINEER
183	PROCESS ENGINEER
185	PROCESS ENGINEER
187	ELECT & INSTRUMENT SHOP NO 4
189	COMPUTER STORAGE
191	COMPUTER SOFTWARE
193	ELECT & INSTRUMENT OFFICE
195	BCR BACK UP COMPUTER ROOM
197	CRANE CONTROL ROOM
199	SUPERVISORS OFFICE/CONSOLE CONTR RM
201	CENTRAL CONTROL ROOM
203	HEALTH PHYSICS MISC OP STA & COMP'R RM
207	OPERATORS TRAINING ROOM
209	PERSONNEL TRAINING ROOM
211	LUNCHROOM (SEATING CAPACITY=54)
217	JANITOR
221	MEN'S CLEAN WASHROOM
223	STORAGE ROOM

ROOM NUMBER	ROOM NAMES
225	VOID(SPACE UNDER STAIR)
227	STAIR(TO MEZZ)
229	MEN'S CLEAN CHANGE ROOM
231	AIRLOCK
233	WOMEN'S CLEAN WASHROOM
235	WOMEN'S CLEAN CHANGE ROOM
237	AIRLOCK
239	WOMEN'S REGULATED WASHROOM
241	WOMEN'S REGULATED CHANGE/SHOWER ROOM
243	REGULATED JANITOR (W/E.W.H.SERV SINK TO RED WASTE)
245	COUNTING ROOM
247	LABORATORY
249	INSTRUMENT DECON & STORAGE ROOM
251	HEALTH PHYSICS OFFICE
255	AIRLOCK
257	MEN/WOMEN MONITOR ROOM
259	MEN/WOMEN REGULATED HANDWASH
265	MEN/WOMEN DECON ROOM
267	AIRLOCK
269	SOILED "WHITE" LAUNDRY STORAGE
271	SOILED "BLUE" LAUNDRY STORAGE
273	MEN'S REGULATED WASHROOM
275	MEN'S REGULATED CHANGE/ SHOWER ROOM
277	CLEAN "BLUE" LAUNDRY STORAGE
279	CLEAN "SWP" LAUNDRY STORAGE
283	CORRIDOR/MEDICAL WAITING ALCOVE
285	CONFERENCE ROOM
287	MEDICAL ROOM
289	MEDICAL ROOM
291	READY ROOM
295	SUPPLY ROOM
297	MAIL ROOM
299	REPRODUCTION ROOM
301	PLANT RECORDS CENTER
303	ELECTRICAL PLANT ENGINEER
305	INSTRUMENT PLANT ENGINEER
309	ELECTRICAL PLANT ENGINEER/HVAC PLANT ENGINEER
311	MAINTENANCE ENGINEER
313	EXPEDITER COORDINATOR
315	QC OPERATOR/QC INSPECTOR
317	GENERAL FILING/SEC WORK AREA
319	QA ENGINEER
321	ENGINEERING MGR
325	STAFF ENG CLERK/RECEPTIONIST
325	CONFERENCE ROOM
327	PLANT MGR
329	SECRETARY
331	OPERATIONS MGR

FIGURE 11

SUPPORT BUILDING PLAN

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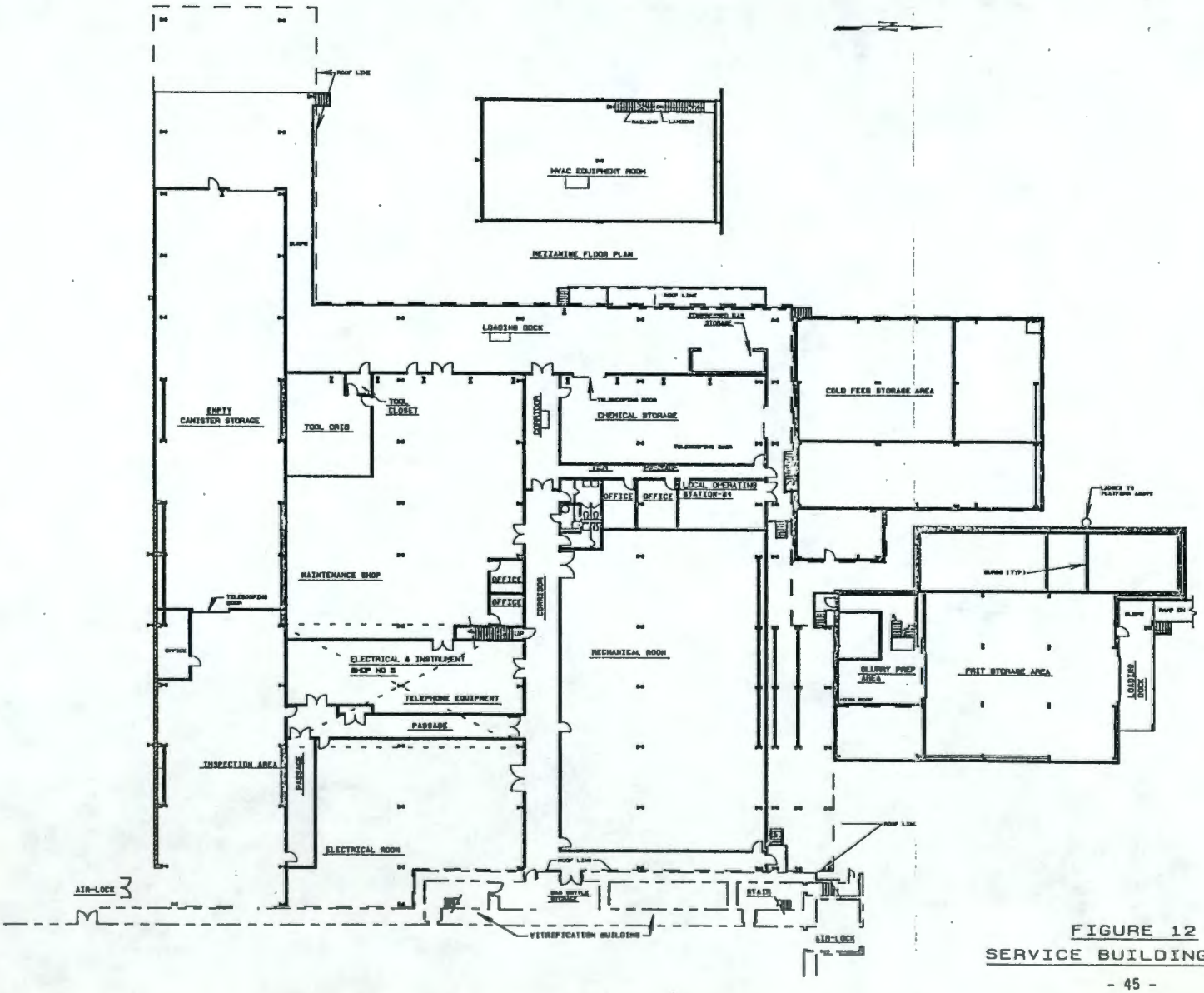

FIGURE 12
SERVICE BUILDING PLAN

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IV. B. Buildings (Continued)

9. Systems Integration Facility

a. Construction, Location, Function

The Systems Integration Facility (SIF) consists of two buildings, a high-bay structure and an adjacent structure. The SIF high-bay structure is a Non-Category I metal building approximately 5,000 square feet by 57 feet in elevation. The adjacent Non-Category I structure is an approximately 7,000 square feet support building. The location of the SIF Building on the Hanford Site has not been determined.

The high-bay building houses the process equipment to be tested. The support building contains computer equipment, shops, warehouse, training rooms, offices and personnel change rooms.

b. HVAC System

The SIF HVAC systems are provided to maintain the proper building environment.

10. Building Fire Protection/Fire Detection Features and Systems

The HWVP has a fire protection system that ensures an improved risk level as defined in DOE Order 5480.1A, Chapter VII. Prescribed standards and guides include DOE Order 5480.1A, Chapter I, Section 7; and DOE Order 6430.1, Chapter X.

a. Structural Features

The Category I structures are designed for confinement of radioactive materials during and after the maximum anticipated fire within the structure. This assumes complete failure of all fire suppression systems.

The exterior of the Vitrification Building has a minimum 2 hour fire resistance rating, with doors rated at 1-1/2 hours. The railroad and personnel airlock interior walls form the fire rated containment barrier. All tornado resistant doors, which are part of this barrier, are rated for 1-1/2 hour fire resistance.

All interior fire separation walls, floors, and ceilings have a minimum 2 hour fire rating with the exception of the north portion of the building, which is separated

IV. B. 10. a. (Continued)

from the south portion by a 4 hour fire rated wall. All fire doors and dampers are rated at 1-1/2 or 3 hours and all penetrations are sealed with fire rated materials.

The design of the building minimizes the combustible loading by using components of fire resistant and noncombustible material wherever possible, particularly containment barriers and structural members. These include: walls, partitions, columns, beams, floors, and roofs. Suspended ceilings, insulation of pipes and ducts, adhesives and other such material are noncombustible. Concealed spaces such as those above suspended ceilings, will have a minimum of combustible materials. Cable enclosures, nonflame propagating electrical insulation, and fire stops in penetrations through walls, floor and ceilings are used to minimize flame-spread potential.

b. Exterior Protection

Exterior fire protection consists of a new 10 inch non-metallic underground water main with fire hydrants, isolation valves, and underground connections to feed the building sprinkler and standpipe systems. Separate 8 inch connections to the underground water main feed wet-pipe sprinkler risers and standpipe systems located in the Manipulator Repair Building and north end of the Vitrification Building, Support Building, the south end of Vitrification Building and the Service Building. In the Service Building, standpipe systems are located in the weld booth, fabrication shop, and clean maintenance shop. One 6 inch connection feeds the wet-pipe sprinkler system in the Fan House Building and one 6 inch connection feeds the wet pipe sprinkler system in the Switchgear/Generator Building. An 8 inch connection feeds the cooling tower dry pipe deluge water spray system.

All underground installations are in accordance with National Fire Protection Association (NFPA) 24.

c. Fire Sprinklers and Wet Standpipes

Dry pipe sprinklers are provided to protect the cold chemical area, exterior bottled gas storage areas, and the Service Building loading dock and canopy area. These areas are provided with dry pipe sprinklers because they are unheated and a potential exists for freezing of water in lines.

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IV. B. 10. c. Fire Sprinklers and Wet Standpipes (Continued)

Automatic wet pipe sprinklers are provided in all other areas of the facility except for the process cell and canyon areas of the Vitrification Building, the Railroad Well and airlock, Vitrification Building HVAC/Pipe Chases, supply and exhaust air tunnels and Vitrification Building void spaces, canister storage vaults and Canister Storage Building loadout area, sample collection areas, and Sand Filter.

All sprinkler systems are designed in accordance with NFPA 13. Fire department connections are arranged so that one connection serves the sprinkler and standpipe systems at each riser location. All sprinkler system piping in Category I areas will be threaded and supported, but will not be required to remain functional following a design basis earthquake (DBE).

Wet standpipes are provided in five of the stairwells in the Vitrification Building with 2-1/2 inch Fire Department Connections at each elevation. Wet standpipes are designed in accordance with NFPA 14, for Class I systems. The use of standpipes allows containment to be maintained in the event fire hoses have to be taken into the building. Standpipes in the Vitrification Building are designed as Category I to allow for fire department connection for supply to hose stations after a DBE.

d. Halon Fire Suppression Systems

Automatic Halon 1301 total flooding fire suppression systems are provided, in addition to wet pipe sprinkler systems, in the local operating stations, control room and computer rooms, including the subfloor and void areas above the suspended ceiling. The system is designed to provide the required Halon 1301 concentration for a soak period of 10 minutes. The system is provided with a connected reserve of extinguishing agents. Each Halon system is provided with its own control panel and smoke detection system.

The Halon 1301 Fire Suppression Systems are designed in accordance with NFPA 12A.

Automatic Halon actuation is provided by photoelectric type smoke detectors with backup manual actuation from manual pull stations. Control panels have battery backup power supplies.

IV. B. 10. Building Fire Protection Fire Detection Features and Systems

e. Fire Alarm System

The fire alarm and detection system includes a Main Fire Alarm Panel, detectors, manual pull stations and red indicating lights. The Main Fire Alarm Panel monitors input from various sources as well as the pull stations and indicates trouble or alarm status. The Main Fire Alarm Panel repeats these indications to Master Radio Boxes for transmission to the site fire station.

Both smoke detectors and heat detectors provide warning of fires. Smoke detectors are photoelectric type detectors. Smoke detectors are located in electrical equipment rooms, switchgear rooms, battery rooms and control rooms, with or without Halon systems. These detectors are placed where an early warning of fire is required. Heat detectors are located in contaminated areas not protected by sprinkler systems and in the Zone I exhaust tunnel.

11. Communication System

The communication system includes all onsite communication means such as telephones, public address system, closed circuit television monitoring system and alarm systems. The telephone system provides an intraplant communication system and an external telephone communication system.

Speaker horns and ceiling-mounted speakers are located throughout the buildings for the public address system. The public address system is coupled to building telephone systems to provide telephone accessed voice paging. Plant wide alarms are annunciated via elements of the public address system.

Telephone and crash alarm systems are linked with the Hanford Site Integrated Voice Data Telecommunications System (IVDTS) which is being installed to serve the Hanford Site.

Data communication within the HWVP and external communication with computer systems outside the facility is accomplished via two data communication systems: the data highway provided by the Distributed Control System, and the general purpose Local Area Network (LAN) which is compatible with the Hanford Site General Usage Network (GUN).

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IV. DESCRIPTION OF PROJECT SCOPE (Continued)

C. Other Structures

The structures are divided into three major types of construction; (1) Category I reinforced cast-in-place concrete; (2) Non-Category I steel framed; (3) Non-Category I reinforced cast-in-place concrete.

The Category I structures are:

- Sand Filter
- RLST/WHT Vaults

The non-Category I steel framed structures are:

- Exhaust stacks (3 total)
- Miscellaneous steel supports

The non-Category I reinforced cast-in-place concrete miscellaneous structures are:

- Cooling Tower Foundation
- Solar Evaporation Tank
- Regulated Drains Collection Tank Vault

The following section discusses each structure separately.

1. Sand Filter

The Sand Filter is a one story below grade structure approximately 200 feet by 160 feet and 27 feet in elevation (2 feet above grade and the remaining 25 feet below grade). It is located approximately 100 feet due south of the Vitrification Building (see Figure 4). A Zone 1 ventilation exhaust tunnel runs from the southeast corner of the Vitrification Building to the northeast corner of the Sand Filter.

The Sand Filter removes particulates from the Zone 1 exhaust air and has three major functional areas: (1) sand filter media, (2) exhaust tunnel, and (3) temporary bypass used during construction.

IV. C. Other Structures (Continued)

2. RLST/WHT Vaults

a. RLST Vault

The RLST Vault is approximately 38 feet in diameter and 20 feet in height to the top of the tank with another 20 foot concrete pump pit extending above the top of the tank. The entire assembly is below grade, and located east of the Vitrification Building (see Figure 4). The primary tank is stainless steel; the secondary tank is carbon steel and is the form for a concrete shell that surrounds the secondary tank and is an integral part of the pump pit.

The RLST vault houses the RLST. The primary purpose of this tank is to receive HWVP feed from the tank farm and provide lag storage before processing. This tank also receives the transuranic (TRU) recycle stream from the Decontamination Waste Treatment Tank located in the Chemical Processing Cell (CPC) in the Vitrification Building.

b. WHT Vault

The WHT Vault is 64 feet in diameter and 20 feet in height to the top of the tank with another 20 foot concrete pump pit extending above the top of the tank. The entire assembly is below grade, and located east of the Vitrification Building (see Figure 4). This vault is constructed similar to the RLST vault described above.

The WHT Vault houses the WHT. The primary purpose of this tank is to provide lag storage of the radioactive process waste to meet tank farm transfer scheduling requirements.

3. Exhaust Stacks

a. Zone 1 Stack

The Zone 1 stack disperses filtered air to the atmosphere from Zone 1 areas of the Vitrification Building. The Zone 1 stack is a free standing metal structure approximately 16 feet in base diameter and 8 feet in diameter at the discharge point, 150 feet in height, and is located 200 feet due south of the Fan House Building

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IV. C. 3. a. Zone 1 Stack (Continued)

(see Figure 4). Provisions for flushing the inside of the stack have been provided. Continuous isokinetic sampling is provided at the stack.

b. Zone 2 and 3 Stack

The Zone 2 and 3 stack disperses filtered air to the atmosphere from Zone 2 and Zone 3 areas of the Vitrification Building, Manipulator Repair Building and regulated areas of the Support Building.

The Zone 2 and 3 stack is a metal structure approximately 8 feet in diameter and 60 feet in height, located at the northwest corner of the Vitrification Building fourth floor. Continuous isokinetic sampling is provided at the stack.

c. Canister Storage Building Stack

The Canister Storage Building stack disperses filtered air from the Canister Storage Building, and is constructed in 2 segments. The first segment is a concrete chase extending above the northwest corner of the Canister Storage Building, and supported from the Vitrification Building. The second segment is an 8 foot diameter metal structure that extends 40 feet above the adjacent roof. Continuous isokinetic sampling is provided at the stack.

4. Miscellaneous Steel Supports

Miscellaneous steel supports include the single bay bents which support a 6 inch overhead steam line, the canister support structure housed in the vaults of the Canister Storage Building, and the pipe supports for the utilities from the Service Building to the Vitrification Building.

5. Miscellaneous Structures

Three additional separate structures are the cooling tower foundation, the solar evaporation tank, and the Regulated Drains Collection Tank (RDCT).

IV. C. 5. Miscellaneous Structures (Continued)

a. Cooling Tower Foundation

The cooling tower foundation is approximately 40 feet by 80 feet and 4 feet in height and is located north of the Vitrification Building (see Figure 4). It will support a 4 cell induced draft cooling tower. The cooling tower will be purchased as a package unit for field erection and provides cooling water to the Vitrification Building and Service Building.

b. Solar Evaporation Tank

The solar evaporation tank is approximately 60 feet by 85 feet and 6 feet in height and is located north of the Vitrification Building (see Figure 4). The tank will consist of a metal tank centered within a concrete basin of sufficient volume to contain the contents of the tank in the event of a tank rupture. The tank services the liquid waste neutralization tanks located in the Service Building.

c. Regulated Drains Collection Tank

The RDCT is approximately 12 feet by 12 feet and 10 feet in height (2 feet above grade and 8 feet below grade) and is contained within a vault located south of the Support Building. It will service the Support Building personnel decontamination area drains.

IV. DESCRIPTION OF PROJECT SCOPE (Continued)

D. Process Special Equipment/Process Systems

1. Process Summary Description

The HWVP is designed as a remote canyon facility due to the radioactive and hazardous nature of the materials handled. Canyon type facilities have been proven effective in containing and confining these process materials. Canyon facilities allow for remote process operation and for maintenance using overhead cranes, impact wrenches, and manipulators.

The overall HWVP vitrification process is presented on the process key diagram (Figure 13). Pretreated feed from the tank farms is transferred to the 50,000 gallon Receipt and Lag Storage Tank (RLST).

The feed slurry is batch transferred from the RLST to the Slurry Receipt and Adjustment Tank (SRAT). The feed is concentrated by evaporation in the SRAT, and chemicals are added to the concentrated slurry to improve its rheology. The condensate is routed to the Slurry Mix Evaporator Condensate Tank (SMECT). The concentrated material in the SRAT is batch transferred to the Slurry Mix Evaporator (SME). The slurry is further concentrated in the SME, glass forming frit is added, and the condensate is also routed to the SMECT. After the solids content of the frit slurry reaches the proper concentration for Melter feed, additional chemicals are added to adjust the redox potential and rheology. The slurry is batch transferred to the Melter Feed Tank (MFT). The feed to the Melter is drawn off as a side stream from each of two recirculating pump loops from the MFT. All four process vessels, the SRAT, SMECT, SME, and MFT, are located in a shielded concrete CPC. These 11,000 gallon tanks are provided with monitoring instrumentation, sampling connections, agitation, steam coil heaters and water coil coolers, as required, and are connected to a Vessel Vent System (VVS). The VVS contains and treats the off-gases from these vessels to assure that release criteria are achieved under expected process conditions.

IV. D. 1. Process Summary Description (Continued)

In the Melter Cell, the Melter converts the concentrated frit slurry feed into a vitreous form by direct Joule heating. The Melter is refractory lined and has water cooling on its walls and bottom. Liquid glass is discharged from the Melter by gravity overflow assisted by an airlift.

Melter off-gases are vented through off-gas nozzles, and are processed through one of two Melter Off-Gas (MOG) systems to remove radioactive and chemically hazardous contaminants prior to release. Each MOG train contains, in sequence, a Film Cooler, a Quencher, Off-Gas Condensate Tank (OGCT), Gas Scrubbing Column (GSC), Scrubber Tank (ST), Steam-Atomizing Scrubber (SAS), Off-Gas Condenser, High Efficiency Mist Eliminator, a heater, a ruthenium adsorber, a second heater, an iodine adsorber, a cooler, a roughing filter and HEPA filter system, and an exhaust blower which discharges the treated off-gas to the Final Filter and Zone 1 stack. The MOG equipment is located in the Melter Cell and the CPC.

A water cooled turntable holds canisters and rotates them through filling and cooling positions. Canisters are loaded and removed by an in-cell bridge crane. The turntable is sealed to the melter discharge nozzles.

Prior to decontamination of a filled canister, an inner canister closure (ICC) plug is inserted into the canister neck at the Inner Canister Closure System (ICCS). The canister is then moved to a Preliminary Canister Decon Chamber (PCDC) where a low pressure water spray removes loose contamination from the canister surface. The canister is then moved out of the Melter Cell into a Final Canister Decon Chamber (FCDC) in the Canister Decontamination Cell, where the canister is frit blasted to meet contamination limits. Decontamination is confirmed by smear tests, and the canister is moved to the Weld Test Cell where a final canister seal is achieved by displacing the ICC plug into the canister, and inserting and resistance welding a plug into the neck of the canister. Canister decontamination is reconfirmed by additional smear tests and the canisters are then moved into interim storage.

Liquid transuranic waste from process condensates and from off-gas treatment and scrubber operation is routed to the Decontamination Waste Treatment Tank (DWTT), where evaporation separates the non-TRU condensates from the TRU containing bottoms. The DWTT condensate and other non-TRU wastes are collected in the Recycle Collection Tank, sampled and analyzed, treated as required, and then routed to the Waste Hold Tank from which they are returned to the underground

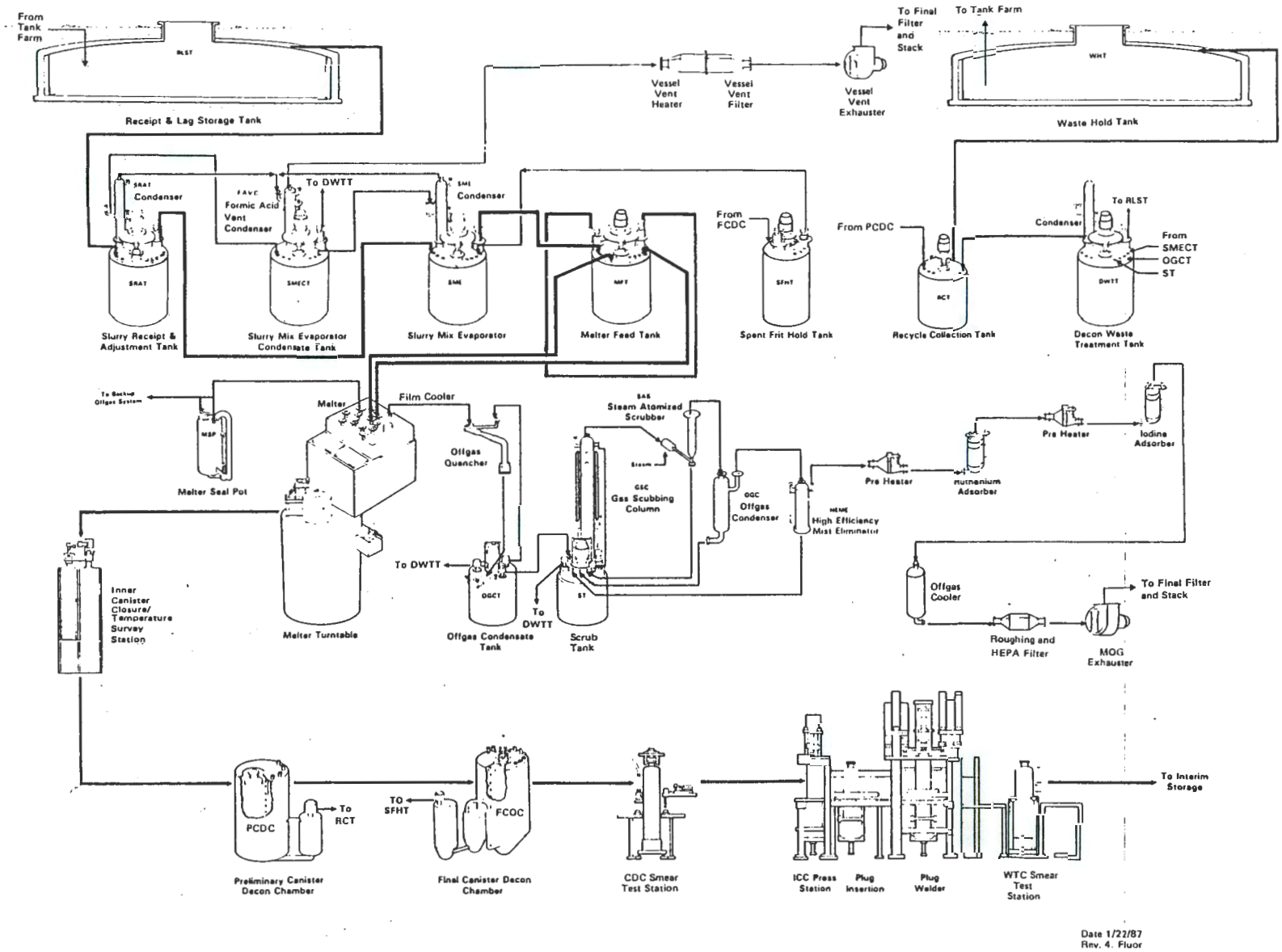

Figure 13

Hanford Waste Vitrification Plant Process Key Diagram

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IV. D. 1. Process Summary Description (Continued)

tank farm for disposal. The DWTT bottoms, which containthe TRU waste, are transferred to the RLST. A more detailed discussion of the primary performance requirements for the process activities and a description of the process equipment and its operation is presented in the following section.

2. Process Activities and Equipment

The HWVP process is comprised of four major activities which include: feed preparation, vitrification, canister handling, and Melter Off-Gas and vessel vent treatment. The location of major process equipment within the Vitrification Building is shown on Figure 14.

a. Feed Preparation

Pretreated Hanford Defense High-level and Transuranic Wastes are transferred from the tank farms via the 241-ER-152 diversion box to the RLST. A 3 inch stainless steel underground line connects the diversion box to the RLST. The 3 inch pipe is encased in a 6 inch carbon steel pipe with cathodic protection and leak detection monitoring.

Receipt and Lag Storage Tank (RLST)

The primary performance requirement for the RLST is to provide lag storage for HWVP feed. Raw feed is transferred to the RLST in up to 50,000 gallon batches approximately once every two weeks. The feed transfer is followed by a water flush. The RLST provides constant agitation and cooling of its contents, as well as sampling for analysis of the feed composition.

The RLST is a 50,000-gallon working volume stainless steel primary tank housed underground in a concrete vault that is lined with a secondary carbon steel tank. The primary tank is provided with a pump agitator to maintain solids in suspension. A cooling coil is provided to maintain slurry temperature. Two pumps are provided to transfer slurry between the RLST and the Vitrification Building. A "sample pump" is provided to recirculate the slurry to the Sample Cell or to transfer feed at a relatively low flow rate to the SRAT. A batch transfer pump is provided for batch transfers to the SRAT. The annular space between the primary and secondary tank walls is provided with leak detection instrumentation and recovery pumps.

IV. D. 2. a. Feed Preparation (Continued)

The RLST is exhausted by the RLST/WHT Primary Ventilation System to maintain a negative pressure in the tank and provide a continuous air sweep to prevent buildup of radiolytic hydrogen in the RLST gas space. The exhaust air is passed through multiple stages of HEPA filters to remove radioactive particulate material, and is delivered to the Vitrification Building Zone 1 exhaust tunnel for discharge to the environment via the Zone 1 exhaust stack.

The RLST annulus is ventilated and maintained at a negative pressure with respect to the outside ambient by the RLST/WHT Annulus Ventilation system. The exhaust from this system is passed through multiple stages of HEPA filters and is discharged to the environment via the Vitrification Building Zone 2 and Zone 3 stack.

The RLST/WHT Primary Ventilation System and the Annulus Ventilation System equipment is located in the RLST/WHT Building.

Table IV.D-1 describes the RLST equipment.

Slurry Receipt and Adjustment Tank (SRAT)

Feed in the RLST is initially transferred to the SRAT for processing in a 7500 gallon batch. Following each batch transfer, the transfer line is flushed.

After heating to boiling, the contents are concentrated from approximately 2.4 weight percent to approximately 11 weight percent (oxide basis) by the continuous addition of feed through a diversion of the RLST sample pump flow as evaporation proceeds. This evaporation takes approximately 50 hours per batch. When the SRAT reaches its final concentration, it is cooled to 195°F. Ninety percent formic acid is added at a controlled rate and allowed to reflux for 4 to 6 hours to assure completion of the formating reactions. The formated feed is then allowed to cool to 125°F, and is sampled and analyzed for chemical composition. Adjustments are made to the chemistry as required. The feed is then transferred to the Slurry Mix Evaporator (SME) in a single 7500 gallon batch.

Table IV.D-2 describes the SRAT equipment.

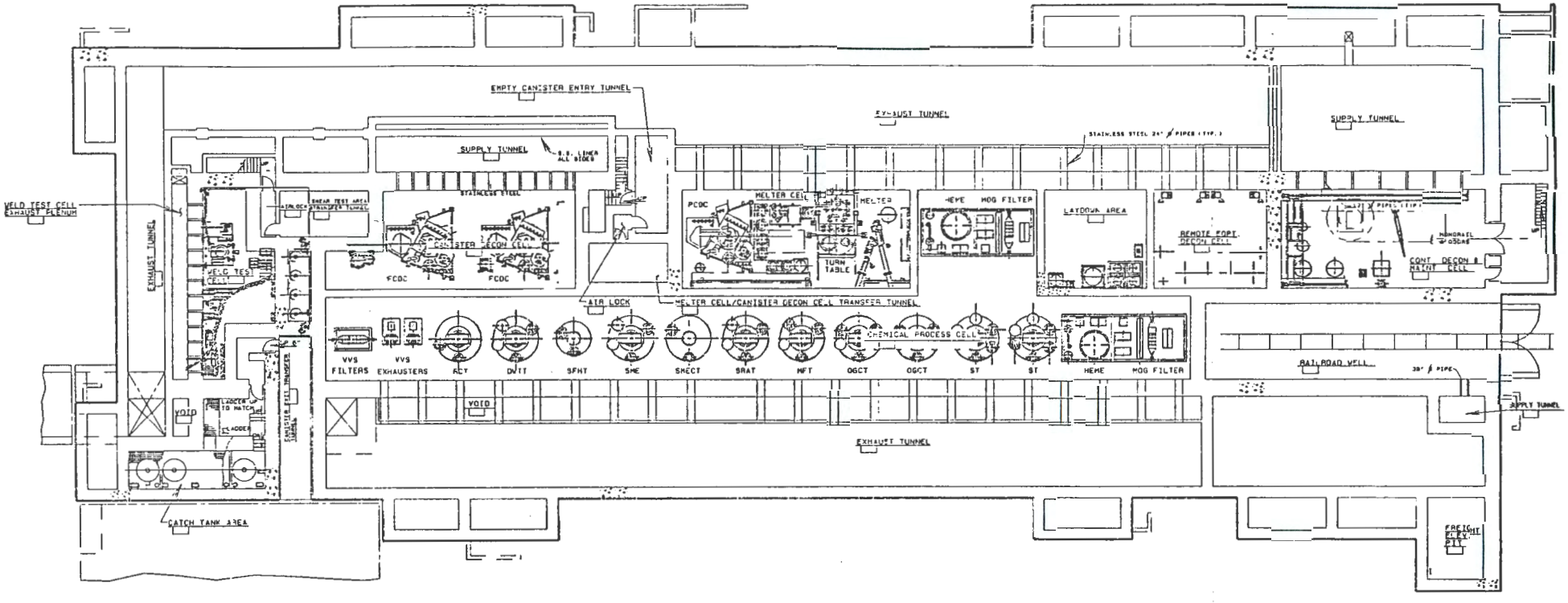

FIGURE 14

VITRIFICATION BUILDING

TUNNEL PLAN

PROCESS EQUIPMENT ARRANGEMENT

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TABLE IV.D-1

RECEIPT AND LAG STORAGE TANK EQUIPMENT, AND AUXILIARY EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Receipt and Lag Storage Tank	11A-90-TK-1000	28'0" ID x 16'4" H 50,000 gal working volume 316L SS primary CS secondary	Receive and store feed
RLST Cooling Coil	11A-90-E-1003	360,000 Btu/hr 316L SS	Cool tank contents
RLST Agitater Pump	11A-90-P-1004	270 gpm ΔP: 80 psi 316L SS	Agitate tank slurry
RLST Sample Pump	11A-90-P-1005	100/10 gpm* ΔP: 80 psi 304L SS	Transfer RLST contents to Sample Cell or SRAT
RLST Transfer Pump	11A-90-P-1006	100 gpm ΔP: 55 psi 304L SS	Transfer feed to SRAT
RLST Annulus Pump	11A-90-P-1008	50 gpm ΔP: 40 psi 304L SS	Transfer tank slurry leakage
RLST Leak Detection Pit Pump	11A-90-P-1009	5 gpm ΔP: 50 psi 304L SS	Transfer tank slurry leakage

*100 gpm is pump capacity including internal recycle
10 gpm is pump discharge flow.

TABLE IV.D-2

SLURRY RECEIPT AND ADJUSTMENT TANK EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Slurry Receipt and Adjustment Tank	12A-1T-TK-1100	12'0" ID x 19'1" H 11,000 gal Alloy 20	Chemically adjust, concentrate and transfer
SRAT Condenser	12A-1T-CD-1101	5,300,000 Btu/hr Alloy 20	Condense SRAT vapor from concentration
SRAT Heating Coil	12A-1T-E-1102	6,000,000 Btu/hr Alloy 20	Heat and boil SRAT contents
SRAT Cooling Coil	12A-1T-E-1103	960,000 Btu/hr Alloy 20	Cool SRAT contents
SRAT Agitator	12A-1T-AG-1104	100 HP Two Speed 65/130 RPM Alloy 20	Agitate SRAT contents
SRAT Sample Pump	12A-1T-P-1105	58/5 gpm* ΔP:55 psi Alloy 20/Stellite 6	Transfer SRAT contents to the Sample Cell
SRAT Transfer Pump	12A-1T-P-1106	100 gpm ΔP: 30 psi Alloy 20/Stellite 6	Transfer SRAT conents to SME

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

IV. D. 2. a. Feed Preparation (Continued)

Slurry Mix Evaporator (SME)

In the SME, the feed is heated to boiling and further concentrated. During the concentration process, batch additions of glass forming frit slurries from canister decontamination and fresh sources are made until the frit slurry reaches a solid concentration of approximately 33 weight percent on an oxide basis (400 g total oxides per liter). The feed is then cooled to 125°F, and is sampled and analyzed for chemical composition. Adjustments (sugar and/or formic acid solution) are made to the chemistry as required. The feed is then transferred to the MFT in a single 7700 gallon batch.

The SRAT and SME are identical, and through jumper reroutes, can be interchanged in function. Each tank is provided with an agitator to maintain solids in suspension. Cooling and heating coils are provided in the tanks. Each tank is also equipped with a pump to recirculate the contents to the Sample Cell. Condensers mounted on the SRAT and SME either reflux the condensate or route it to the SMECT. Vents are routed to the formic acid vent condenser (FAVC).

Table IV.D-3 describes the SME equipment.

Slurry Mix Evaporator Condensate Tank (SMECT)

The SMECT receives condensate from the SRAT and SME. The SMECT also receives condensate from the FAVC mounted on the top of the tank. Agitation is achieved by air sparging. The tank is provided with equipment for sampling the condensate. The FAVC receives vapors from the formic acid vent header, refluxes the liquid to the SMECT, and vents noncondensibles to the Vessel Vent System header. The condensate from the SMECT is transferred to the DWTT using the SMECT transfer pump.

Table IV.D-4 describes the SMECT equipment.

Spent Frit Hold Tank (SFHT)

The SFHT receives spent frit from the Final Canister Decon Chambers and transfers the spent frit slurry to the SME for recycle into the Melter feed. The tank has mechanical agitation and air sparge agitation.

Table IV.D-5 describes the SFHT equipment.

TABLE IV.D-3

SLURRY MIX EVAPORATOR EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Slurry Mix Evaporator	12B-1T-TK-1200	12'0" ID x 19'1" H 11,000 gal Alloy 20	Makeup and concentrate melter feed
SME Condenser	12B-1T-CD-1201	5,300,000 Btu/hr Alloy 20	Condense SME vapor from concentration
SME Heating Coil	12B-1T-E-1202	6,000,000 Btu/hr Alloy 20	Heat and boil SME contents
SME Cooling Coil	12B-1T-E-1203	960,000 Btu/hr Alloy 20	Cool SME contents
SME Agitator	12B-1T-AG-1204	100 HP Two Speed 55/130 RPM Alloy 20	Agitate contents of SME
SME Sample Pump	12B-1T-P-1205	58/5 gpm*/ΔP: 55 psi Alloy 20/Stellite 6	Transfer SME contents to the Sample Cell
SME Transfer Pump	12B-1T-P-1206	100 gpm/ΔP: 30 psi Alloy 20/Stellite 6	Transfer SME contents to MFT

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

TABLE IV.D-4

SLURRY MIX EVAPORATOR CONDENSATE TANK EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Slurry Mix Evaporator Condensate Tank	12D-1T-TK-1400	12'0" ID x 19'1" H 11,000 gal 316L SS	Receive condensate from the SRAT and the SME
Formic Acid Vent Condenser	12D-1T-CD-1401	720,000 Btu/hr 316L SS	Condense formic acid and other vapors Remove mist from off-gas
SMECT Sample Pump	12D-1T-P-1405	58/5 gpm* ΔP:55 psi 304L SS	Transfer SMECT contents to the Sample Cell
SMECT Transfer Pump	12D-1T-P-1406	100 gpm/ΔP: 30 psi 304L SS	Transfer SMECT contents to DWTT

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

TABLE IV.D-5

SPENT FRIT HOLD TANK EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Spent Frit Hold Tank	12C-1T-TK-1500	9'0" ID x 19'1" H 6200 gal 316L SS	Receive spent frit slurry from Final Canister Decon Chambers
SFHT Agitator	12C-1T-AG-1504	10 HP 34/58rpm 316L SS	Agitate SFHT Contents
SFHT Sample Pump	12C-1T-P-1505	58/5 gpm* ΔP:55 psi 304L/Stellite 6	Transfer SFHT contents to the Sample Cell
SFHT Transfer Pump	12C-1T-P-1506	100 gpm/ΔP: 30 psi 304L/Stellite 6	Transfer SFHT contents to SME

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

IV. D. 2. a. Feed Preparation (Continued)

Melter Feed Tank (MFT)

The MFT receives the prepared melter feed slurry from the SME and maintains a homogeneous feed by agitation. The primary performance requirement of the MFT is to provide lag storage and to deliver feed slurry at a controlled rate to the Melter. The slurry is fed continuously to the Melter through two independent circulating feed loops which recirculate through a cross-flow strainer and then through a restricting orifice back to the Melter Feed Tank. The feed to the Melter is drawn off the side of the strainer. Flow in each feed loop is controlled by a variable speed pump. Either loop is independently capable of supplying the nominal 30 gallon per hour feed rate to the Melter. Three way flush valves provide flushing to the feed delivery system components to help prevent plugging. Automatic flushing occurs in both the loops and the side pipes whenever the feed flow drops below preset values.

Feed flows are monitored by flow elements in both the pump loop and side take-off pipe to the Melter. Liquid level in the MFT is monitored to further check flow rates to the Melter.

After each batch addition, the slurry mix is sampled to provide a basis for determining the chemical composition and radionuclide content of the vitrified glass waste. Process frit slurry, sugar solution, formic acid solution and potassium hydroxide/frit modifier can all be added to the MFT if required.

An air sweep is provided through the MFT to prevent the possible build-up of an explosive concentration of radiolytic hydrogen.

The MFT is provided with cooling coils to maintain the contents at the required temperature to prevent cavitation in the sample and feed pumps. An agitator is provided to ensure a uniform Melter feed composition, and a sample pump to recirculate feed to the Sample Cell.

Table IV.D-6 describes the MFT equipment.

TABLE IV.D-6

MELTER FEED TANK EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Melter Feed Tank	22A-1T-TK-1300	12'0" ID x 19'1" H 11,000 gal Alloy 20	Lag store Melter feed
Cooling Coil	22A-1T-E-1303	1,900,000 Btu/hr Alloy 20	Cool MFT contents
MFT Agitator	22A-1T-AG-1304	100 HP 65/130 RPM Alloy 20	Agitate MFT contents
MFT Sample Pump	22A-1T-P-1305	58/5 gpm*/ΔP: 55 psi Alloy 20/Stellite 6	Transfer MFT contents to Sample Cell
Melter Feed Pump No. 1	22A-1T-P-1306	100 gpm/ΔP: 40 psi Alloy 20/Stellite 6	Transfer Melter feed to Melter
Melter Feed Pump No. 2	22A-1T-P-1307	100 gpm/ΔP: 40 psi Alloy 20/Stellite 6	Transfer Melter feed to Melter

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

IV. D. 2. Process Activities and Equipment (Continued)

b. Vitrification

The Melter receives a continuous feed slurry at a rate of about 0.5 gpm through two water-cooled feed tubes mounted on the top flange. The Melter/Turntable (Figure 15) is designed to receive melter feed as a liquid slurry and convert it to a borosilicate glass. Water vapor, volatiles, and semivolatiles are released as off-gas. Molten glass is formed by Joule heating with an alternating current to a temperature of about 2100°F. The design basis glass production rate is 100 pounds per hour, producing 7 canisters in a 250 hour batch cycle operation.

At "steady state" the Melter operates with a crust (cold cap) composed of waste calcine and frit that covers about 90 percent of the melt surface. The feed slurry is introduced onto the top of the cold cap, where water is evaporated and drawn into the off-gas system. The glass melt beneath the cold cap is at a temperature of approximately 2100°F, which enables the cold cap to melt from the bottom and form the waste borosilicate glass.

The Melter consists of a refractory lined Inconel 690 shell. Welded to this shell is a 300 series stainless steel water cooling jacket. The Melter is designed to operate under vacuum up to a maximum of 20 inches W.C. The design life is 3 years.

The Melter incorporates the following three refractory combinations:

1) The Melter lids and discharge sections use a high-density, alumina castable in contact with process vapors, backed by a bubbled aluminum oxide castable and fibreboard.

2) The walls above the glass level are a combination of fused-cast alumina blocks, a high density alumina castable, and fibreboard.

3) Below the glass level are a fused-cast chromia-alumina block, a medium-density alumina-zirconia-silica brick, a high-density alumina castable, and fibreboard.

IV. D. 2. b. Vitrification (Continued)

The refractories in contact with the glass are installed in a conventional rectangular design. The floor refractories are sloped toward a sump located at the center of the Melter floor. The sump serves as a collection site for crystalline materials and electrically conductive sludges to reduce the likelihood of short-circuiting the Melter electrodes.

The Melter is equipped with a two-camera closed circuit television (CCTV) viewing system capable of monitoring the glass surface.

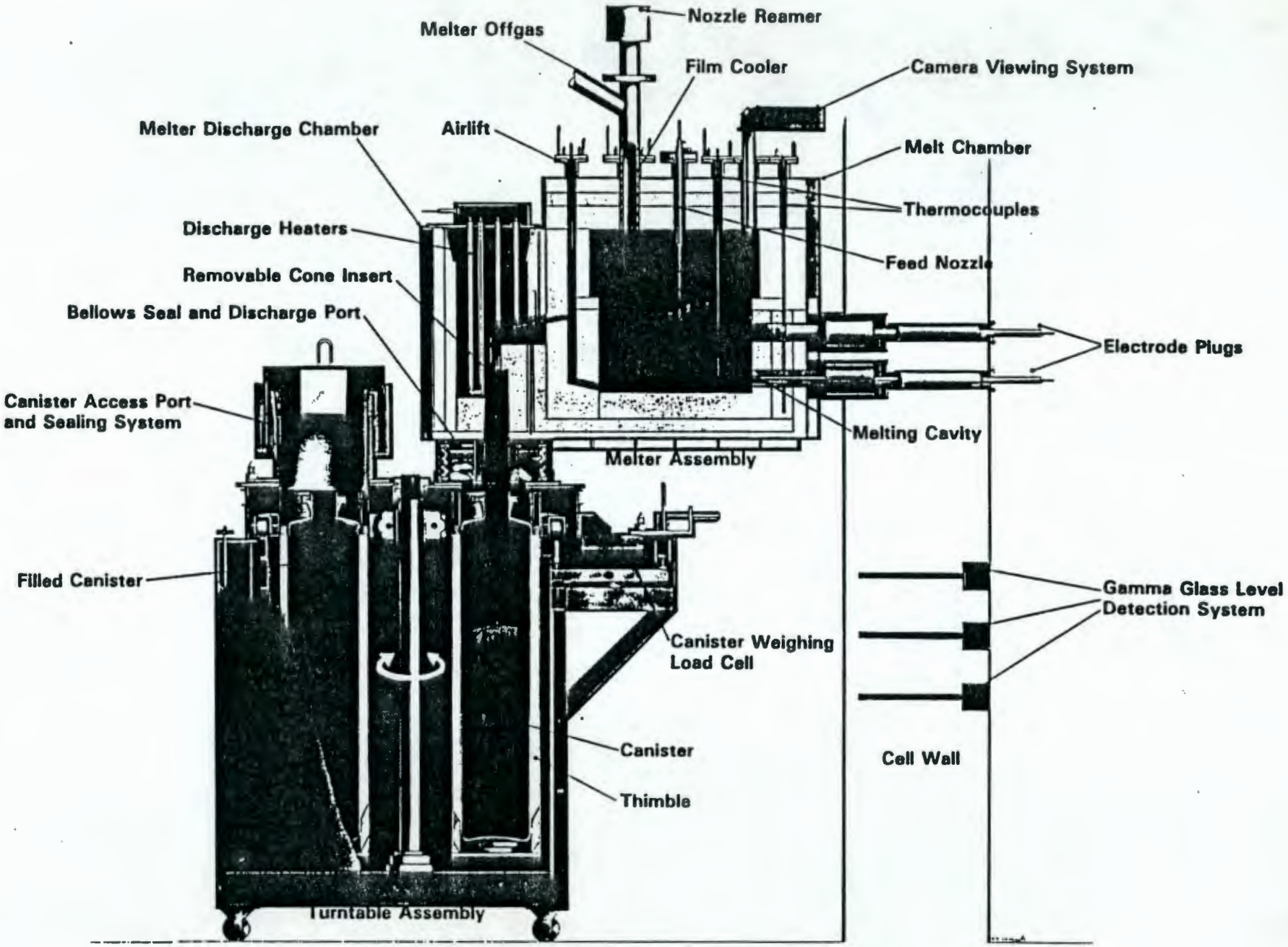
Glass heating is provided by two sets of Inconel 690 electrodes. Power is supplied through air cooled electrode extensions that penetrate the Melter Cell shield wall into the service corridor.

Feed to the Melter cavity is through two remotely replaceable Inconel 690 feed nozzles with double water cooled jackets. All nozzles and other serviceable parts are located to facilitate remote maintenance/replacement using only a crane and impact wrench.

The Melter is mounted on a supporting frame that rests on the cell floor and is positioned above the Turntable.

Normal glass withdrawal from the Melter into the canister is accomplished by displacement of the glass through either of two pour spouts by continuous feeding of slurry to the Melter. Airlifting is used to accelerate pouring, which lowers the molten glass level in the Melter. Stopping the airlift halts the overflow of glass, allowing the canisters to be rotated in the Turntable while Melter feeding continues. The glass level in the canister being filled is monitored by a series of collimated gamma detectors and by canister weight.

Canisters (Figure 16) are positioned under the Melter by a Turntable. An empty canister is loaded into the four position Turntable through the canister port. The port is then closed. During this operation, a vacuum is maintained on the other positions in the Turntable by a secondary lid. The Turntable and the contained canisters are vented up through the Melter overflow section and into the Melter. The empty canister is first rotated to one of two fill positions. These positions



HWVP MELTER/TURNTABLE

Figure 15

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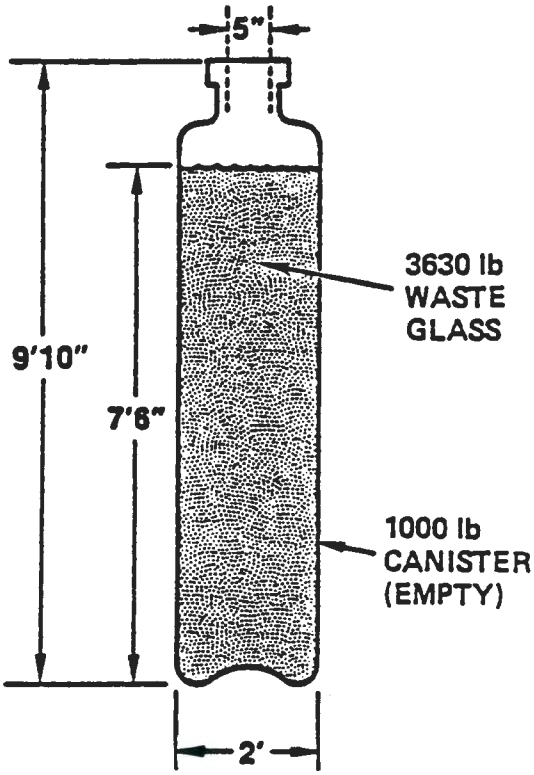
CANISTER

MATERIAL: TYPE 304L SS (SCHEDULE 20 PIPE)

SURFACE AREA: 70 ft^2



HWVP CANISTER

Figure 16

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IV. D. 2. b. Vitrification (Continued)

are sealed to the Melter underside by remotely replaceable bellows seals to limit air inleakage and assure Turntable and canister venting through the Melter to the Melter Off-Gas system. After filling, it is rotated through two cooling positions to allow the glass to solidify at a controlled rate. After the canisters are moved back to the starting position, they can be removed.

c. Off-Gas and Vessel Vent Treatment

Melter off-gas and vessel vent gases are processed by separate treatment systems.

Melter Off-Gas (MOG) System

The Melter off-gas is vented to the MOG System through either of two nozzles. The MOG system removes particulates and adsorbs selected gases from the Melter off-gas, and maintains a negative pressure in the Melter.

The primary performance requirements for the MOG system are as follows:

- Provide a pressure confinement boundary with respect to the process cell to prevent the release of untreated process vapors
- Provide ventilation flow through the melter system to assure that the concentration of potentially explosive gases is maintained at least a factor of two below the lower explosive limit
- Remove radioactive and chemical materials from the Melter off-gas to ensure that discharges to the Zone I exhaust tunnel do not exceed discharge limits

The MOG system consists of two identical subsystems for treating the MOG: the primary system and a backup system (maintained in operating standby mode). The backup MOG system includes a seal pot which automatically controls the flow of off-gas between the systems, and prevents pressurization of the Melter during upset conditions. The off-gas system is designed to remove entrained particulates, condensed semivolatile species, acid gases, ruthenium, and iodine. Treated gas is discharged to the Zone I exhaust tunnel. The MOG equipment is located in the Melter Cell and the CPC.

IV. D. 2. c. Off-Gas and Vessel Vent Treatment (Continued)

Table IV.D-7 describes the MOG equipment.

The MOG is drawn from the Melter through a film cooler/brush assembly which cools the off-gas and dilutes it with air. The film cooler/brush assembly is designed to prevent plugging of the Melter off-gas line. An ejector venturi scrubber (quencher) further cools the off-gas, condenses water vapor, and removes larger particulates. Quenched off-gas and quench solution flow into the Off-Gas Condensate Tank (OGCT) where the liquid is de-entrained and recirculated to the quencher. Periodically, accumulated condensate is withdrawn from the OGCT and transferred to the Decontamination Waste Treatment Tank (DWTT).

The OGCT contents are cooled by cooling coils. A chemical addition line is provided. The OGCT also has provisions for sampling both the process liquid and the process vapor.

Gas is drawn from the OGCT head space into the Gas Scrubbing Column (GSC), via the Scrubber Tank (ST) head space. In the GSC the off-gas is contacted countercurrently with liquid from the ST. Chemicals may be added to the GSC and ST. The GSC removes acid gases and some particulates. The scrubbed gas exits the column through a de-entrainment pad and is drawn into the Steam-Atomizing Scrubber (SAS).

In the SAS, the gas is contacted with a stream of steam-atomized liquid from the ST. The high energy contact allows removal of very small particulates. The gas and liquid streams are separated in a cyclone which is part of the SAS. Liquid is returned to the ST and the gas is routed to the off-gas condenser.

The off-gas condenser cools the off-gas stream for dehumidification and residual formic acid vapor removal. This increases the efficiency and life of the adsorbers, and protects the HEPA filters. Condensate flows to the ST and the off-gas exits the condenser through a de-entrainment pad and is routed to the High Efficiency Mist Eliminator (HEME).

TABLE IV.D-7

MELTER OFF-GAS TREATMENT EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Film Cooler and Brush Assembly	14A-1T-FC-3010	12" ID	Cool Melter off-gas, dilute with air
Seal Pot*	14Y-1T-V-3020	4'0" OD x 5'6" H	Control off-gas flow
Air Ejector Venturi Scrubber (Quencher)	14A-1T-J-3030	120 gpm @ 60 psig	Cool Melter off-gas, condense steam
Off-Gas Condensate Tank	14A-1T-TK-3100	12'0" ID x 19'1" H 11,000 gal	Provide source of scrub solution for quencher
Scrubber Tank	14A-1T-TK-3200	12'0" x 11'6" H 11,000 gal	Provide hold tank for scrub solution
Gas Scrubbing Column	14A-1T-S-3206	2'0" OD x 18'0" H 5.4 psig @ 800°F	Remove acid gases
Steam-Atomizing Scrubber	14A-1T-S-3301	6170 lb/hr Scrub solution	Remove particulates
Off-Gas Condenser	14A-1T-E-3302	67,500 Btu/hr	Dehumidify off-gas
HEME	14A-1T-D-3303	7'0" OD x 9'0" H	Remove submicron particulates
Ruthenium Adsorber	14A-1T-H-3401	4' x 2' x 6' H 5.4 psig @ 300°F	Remove gaseous ruthenium
Ruthenium Preheater	14A-1T-AD-3402	126,000 Btu/hr	Heat gas for ruthenium adsorber
Iodine Preheater	14A-1T-H-3403	72,000 Btu/hr	Heat gas for iodine adsorber
Iodine Adsorber (2)	14A-1T-AD-3404/ 3424	4' x 2' x 6' H 5.4 psig @ 400°F	Remove gaseous iodine
Roughing Filter and HEPA (2)	14A-1T-F-3406	683 ACFM	Remove particulates
MOG Exhauster	14A-1T-B-3501	1190 ACFM $\Delta P = 4.1$ psig	Induce off-gas flow and maintain negative pressure in Melter

* All equipment listed except the Seal Pot (14Y-1T-V-3020) is provided in the backup off-gas system.

IV. D. 2. c. Off-Gas and Vessel Vent Treatment (Continued)

Fine mists and particulates are removed from the cooled off-gas in the HEME. The HEME elements are continuously washed with process water to improve efficiency and control pressure drop. Wash solution drains to the ST and the off-gas flows to the ruthenium adsorbers.

The off-gas is electrically heated to about 120°F before it passes over silica gel to adsorb any residual gaseous ruthenium oxide. The off-gas is further heated to about 300°F before it passes over one of two parallel silver zeolite beds to adsorb any residual gaseous iodine.

The off-gas is then cooled and filtered before being discharged to the Zone I exhaust tunnel through the MOG induction draft exhauster. Filtration is accomplished by a series arrangement of a roughing and two HEPA filters in a remotely replaceable, pretested assembly.

Sampling capability is provided to assess the performance of each major piece of activity removal equipment.

The ST receives liquid drained from the scrubbing column, steam atomizing scrubber, the off-gas condenser, the HEME, the off-gas cooler, and the roughing filter. The ST has chemical addition lines, cooling coils, an agitator, and a sample pump. A pump to recycle liquid to the gas scrubbing column and a pump to recycle liquid to the SAS are mounted on the top of the tank. Transfer of the tank contents to the Decontamination Waste Treatment Tank (DWTT) is done by the scrubber tank transfer pump.

Vessel Vent System (VVS)

A VVS provides ventilation for all in-cell process tanks and equipment except the Melter, which is serviced by the MOG system.

The primary performance requirements of the VVS are as follows:

- Provide a pressure confinement boundary with respect to the process cell to prevent the release of untreated process vapors

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IV. D. 2. c. Off-Gas and Vessel Vent Treatment (Continued)

- Provide sufficient ventilation flow through the process vessel so that gas compositions are maintained below 25 percent of the lower explosive limit for radiolytic hydrogen

- Remove radioactive and chemical materials from vessel off-gases to ensure that discharges to the Zone I exhaust tunnel do not exceed discharge limits

Process vessels are connected to the vessel vent header by jumpers. Prior to entering the vent header, off-gas from the SRAT, SME, SMECT, SFHT, MFT, recycle collection tank (RCT) and DWTT tanks are cooled in the Formic Acid Vent Condenser to remove acid vapors.

Vent gases are heated by an electrical heater to a relative humidity of less than 85 percent before being filtered. Filtration is accomplished by the Process Vessel Vent Filter (PVVF) which consists of a series arrangement of a roughing filter and two HEPA filters in a remotely replaceable, pretested assembly. Following filtration, the vent gas is sampled before discharge to the Zone I exhaust tunnel. The Vessel Vent System header provides about 50 percent spare connections and venting capability.

Table IV.D-8 describes the VVS equipment.

d. Canister Handling

The glass filled canisters are routed through a series of operations referred to as canister handling.

Inner Canister Closure

After the canister is filled with molten glass, it is transferred from the Turntable to either the in-cell storage rack or to the Inner Canister Closure System (ICCS). At the ICCS, the canister neck is heated to 300 to 400°F. An inner canister closure (ICC) plug (Figure 17) is then inserted into the canister opening with a Master-Slave Manipulator.

IV. D. 2. d. Canister Handling (Continued)

Verification that the ICC plug is properly installed is required. This is done visually or with special equipment such as a gauge. The canister neck is allowed to cool to make a water-tight seal by a shrink-fit between the ICC plug and a sleeve installed in the canister neck during canister fabrication. After cooling, the ICC plug is leak tested by pressurizing a container installed around the canister neck to 100 lb/in^2 and monitoring for pressure decay. Canisters passing the leak test (2×10^{-4} STD cm^3/s per atmosphere) are transferred to the Preliminary Canister Decon Chamber or placed in a storage rack in the Melter Cell.

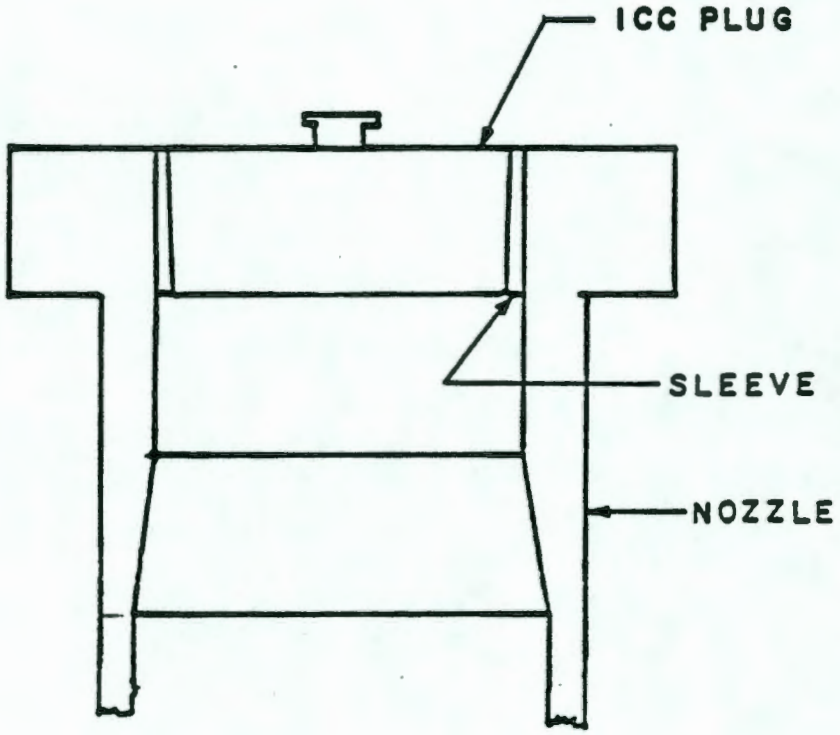
The ICCS is mounted upon a stainless steel structural support frame approximately 5 ft. x 9 ft. x 14 ft. high placed at a shield window/Master-Slave Manipulator work station. Integral with the frame are motor-operated positioner arms that place the resistance heater or leak test jar into position to perform their respective functions. The ICCS is fabricated from corrosion resistant materials for decontamination by sprays.

The ICCS is equipped with the capability to (1) rework ICC plugs which do not pass the leak test by reheating the canister flange, displacing the failed plug and canister sleeve into the canister, and inserting a repair plug in the neck of the canister for shrink fitting, and (2) cleaning canister sealing surfaces prior to ICC operations.

Table IV.D-9 describes the ICC equipment.

Canister Decontamination

After an ICC plug has been installed in the filled canister, and the canister has cooled to below 212°F, it is placed in the Preliminary Canister Decon Chamber (PCDC) by the Melter Cell crane. A Canister Manipulating Mechanism (CMM) is then placed over the canister. The canister is rotated and moved up and down by the CMM grapple while a low pressure water spray is directed at the canister surface through an array of nozzles. After washing, the canister is set down in the spray chamber and the grapple is released. Water used for decontamination is pumped to the RCT.



ICC PLUG

Figure 17

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TABLE IV.D-8

VESSEL VENT EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Vessel Vent Heater	15Y-1T-H-3603	64,000 Btu/hr	Heat vent gas stream to above its dew point
Vessel Vent Roughing Filter and HEPA (PVVF)	15Y-1T-F-3604	1525 ACFM -0.5 psig @ 115°F	Remove particulates from vent gas stream
Vessel Vent Exhauster	15Y-1T-B-3605	1525 ACFM ΔP: 20 in W.C.	Maintain negative pressure in Vessel Vent System with respect to cell pressure
Backup Vessel Vent Exhauster	15Y-1T-B-3615	1525 ACFM ΔP: 20 in W.C.	On line back-up for B-3605

TABLE IV.D-9

INNER CANISTER CLOSURE EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Inner Canister Closure/Temperature Survey System	17-1T-CS-4600	15 kW, 208V Heater 304L SS	o Monitor temperature of canister o Insert ICC plug in canister o Provide recovery capabilities (repair plug) if ICC plug fails leak test
Leak Test Assembly	17-1T-CS-4610	100 psig 304 SS	o Leak test temporary closure (ICC plug)

IV. D. 2. d. Canister Handling (Continued)

Design features of the PCDC are as follows:

- The PCDC is capable of removing loosely adhered material from all external surfaces of the canisters and from the contact surfaces of any canister supports (to minimize the recontamination of the canisters).

- The system contains the contaminated water, vapors, and solid particulates to prevent spread of contamination, and ensures that residual water does not remain on the canister surface.

- The PCDC collects any large pieces of glass that might be removed from canister surfaces during decontamination.

- The PCDC can accommodate canisters in overpacks.

The PCDC spray nozzles are made of boron carbide or materials with equal or better wear resistance. The nozzles are positioned approximately 2 to 18 inches from the surface to be cleaned, and are directed at an angle between 30 and 45 degrees to the surface.

Before removal from the PCDC, the canister is air dried. The Melter Cell Crane then removes the CMM and transports the canister to the transfer car in the Melter Cell-Canister Decontamination Cell (MC-CDC) transfer tunnel. Once the canister is transferred to the canister decontamination cell (CDC) end of the tunnel, the CDC cell crane is used to transfer it to one of two Final Canister Decon Chambers (FCDCs).

The FCDC decontaminates the canister using an air injected frit-slurry blast to remove its surface oxide layer. During final decontamination operations, the canister is raised, lowered and rotated by the CMM grapple. After an initial frit blast cycle, the canister is lowered to a support inside the chamber and the CMM is disengaged, frit blasted, rotated and is then lowered to engage the canister at a different flange location. The frit blast cycle is then repeated.

Residual slurry is water-rinsed from the canister and chamber, and the rinsed canister is then air dried. The frit slurry and rinse water used for final canister decontamination are transferred to the Spent Frit Hold

IV. D. 2. d. Canister Handling (Continued)

Tank in the Chemical Processing Cell (CPC) for use in Melter feed makeup.

The canister decontamination system is designed to reduce surface smearable contamination levels to less than U.S. Department of Transportation Standards, specifically, 220 dpm/100 cm^2 alpha and 2,200 dpm/100 cm^2 beta-gamma.

After final decontamination, the canister is removed by the CDC cell crane, transported to the CDC Smear Test Station, and smear tested. A canister failing the smear test is returned to a FCDC for rework. Canisters passing the smear test are transferred to the Weld Test Cell (WTC) and placed in the Plug Welder.

Design features of the FCDCs are as follows:

- FCDCs are capable of decontaminating canister supports to preclude recontamination of the canister during removal, and are designed to prevent prolonged or repeated slurry blasting of the same location on the canister or chamber.
- To prevent spread of contamination, each FCDC contains contaminated slurry, water, vapors, and frit as well as any large pieces of glass that might be removed from canister surfaces during decontamination.
- FCDCs can accommodate canisters in overpacks.

The FCDC spray nozzles are made of boron carbide or material with equal or better wear resistance. The nozzles are positioned approximately 2 to 18 inches from the surface to be cleaned, and are directed at an angle between 30 and 45 degrees to the surface.

The FCDC, frit slurry supply tank, and Spent Frit Hold Tank are sized to handle the frit and water for at least two canisters.

Off gases from the PCDC and FCDCs are treated by the VVS before release to the Zone 1 Exhaust Tunnel.

Table IV.D-10 describes the canister decontamination equipment.

TABLE IV.D-10

CANISTER DECONTAMINATION EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameter	Function
Preliminary Canister Decon Chamber	16-1T-DC-4000	None	Enclose the equipment used for preliminary canister decontamination.
Final Canister Decon Chamber #1	16-1T-DC-4020	None	Enclose the equipment used for final canister decontamination.
Final Canister Decon Chamber #2	16-1T-DC-4040	None	Same as 16-1T-DC-4020
Preliminary Canister Decontamination Transfer Pump	Note 1	95 gpm ΔP:15 psi 304L SS	Transfer spent preliminary decontamination water to the RCT
Final Canister Decon Chamber #1 Transfer Pump	Note 2	95 gpm ΔP:15 psi 304L SS	Transfer spent frit slurry to SFHT
Final Canister Decon Chamber #2 Transfer Pump	Note 3	95 gpm ΔP:15 psi 304L SS	Transfer spent frit slurry to SFHT
Final Canister Decon Chamber #1 Recirculation Pump	Note 2	400 gpm, ΔP:15 psi 304L SS	Internal frit slurry recirculation
Final Canister Decon Chamber #2	Note 3	400 gpm, ΔP:15 psi 304L SS	Internal frit slurry recirculation

Notes:
(1) Part of 16-1T-DC-4000
(2) Part of 16-1T-DC-4020
(3) Part of 16-1T-DC-4040

IV. D. 2. d. Canister Handling (Continued)

Welding

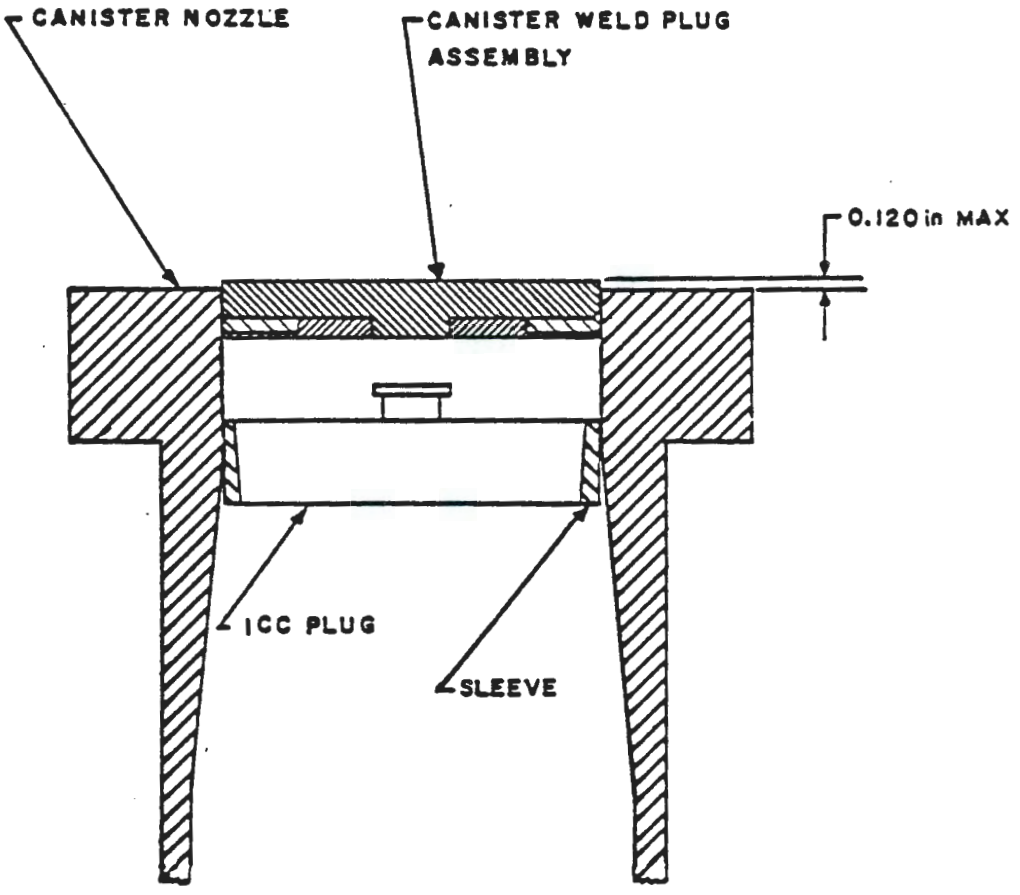
The Plug Welder performs two basic functions in the final closure of the canisters: (1) the ICC plug is pressed down in the neck of the canister a sufficient distance so it will not interfere with the insertion and welding of the weld plug, yet will maintain a seal with the inside diameter of the canister, and (2) the weld plug is installed and is welded into the neck of the canister by a resistance welder.

In the Plug Welder, the canister is first moved to the ICC plug press station. A hydraulic ram exerting a force of 300,000 to 400,000 lb is used to press the ICC plug down into the canister neck. The surface to be welded is visually examined to ensure there are no surface anomalies which could interfere with the insertion of the weld plug and prevent achievement of a satisfactory weld.

A Master-Slave Manipulator is then used to place the weld plug into the canister neck. After insertion, the plug protrudes approximately 1/2 inch above the canister neck. After the weld plug is inserted and just prior to welding, a visual examination is performed to verify that the plug is correctly positioned. The canister is then moved into the welding station where the canister flange is seated and supported on a split-bottom electrode. A pneumatically operated upper electrode is used to press down on the weld plug with 75,000 lb of force. This achieves positive electrical contact and thus completes a circuit through the upper electrode, the plug, the canister flange, and the grounding plates. Circuit resistance is measured to ensure adequate continuity before the actual weld. While the ram force is maintained, a weld current of 240,000 amps at 15 VDC is applied for 1.5 seconds. As the metal at the plug/canister interface heats, plastic deformation occurs and the plug is forced about 1/2 inch into the canister neck, forming a solid-state weld.

The final canister configuration is illustrated in Figure 18.

The Plug Welder is a resistance-type with the capabilities noted in Table IV.D-11 to effect both a primary (5 inch diameter) or repair (7 inch diameter) weld. A primary weld will be judged unacceptable based on a combination of 1) visual examination, and 2) review of weld data.



FINAL CANISTER PLUG CONFIGURATION

Figure 18

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TABLE IV.D-11

WELDING CAPABILITIES

	Primary (5 inch) weld	Repair (7 inch) weld
Weld Current, amperes	240,000	400,000
Weld Duration, seconds	1.5	3.3
Weld Force (lb) acting through a distance of 0.5 inch minimum	75,000	150,000

IV. D. 2. d. Canister Handling (Continued)

The operation is somewhat unique in that it occurs over a very short period of time. Primary weld duration is 1.5 seconds, and most of the data necessary for diagnostic and historical purposes is gathered in this time. A Data Acquisition and Storage System is provided, which records all parameters, derives certain parameters (e.g., ram velocity and acceleration), prints hard-copy reports, and transmits data directly to the computer system for quality assurance and historical purposes.

After the ram is retracted, the canister is moved to the Weld Test Cell smear test station for final inspection and surface contamination checks, prior to transport to the Canister Storage Building.

Table IV.D-12 describes the major Plug Welder equipment.

3. Distributed Control System (DCS)

The DCS is part of an Integrated Plant Management and Control System which is depicted on Figure 19.

The vitrification process and supporting facilities are monitored and controlled by the DCS, which is configured to provide continuous and batch control of all primary building, process, and support system functions. The DCS consists of:

- Signal and Control Termination Cabinets
- Distributed Local Processor Units
- Central Control Rooms (CCRs) and Field Operating Stations (FOSs)
- Host Computer Systems and Information Management System Computer
- Communications Systems (Data Highways and Local Area Networks)
- Training, Program Development and Maintenance Subsystems

Signal and control termination cabinets are distributed throughout the Vitrification Building, as well as in the supporting buildings in areas where primary process and plant functions are located. These cabinets provide hardwired, organized and centralized termination points for local instrumentation connection to the DCS local processors, which perform the control and monitoring programs.

TABLE IV.D-12

PLUG WELDER EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
ICC Press Station	17-1I-HD-4206	3000 psi	o Displace ICC plug into neck of canister
Plug Welder Station	17-1I-HD-4215	400,000 amperes	o Weld closure plug on canister o Visual inspection of weld o Repair weld if necessary
Plug Welder Canister Trolley	17-1I-HD-4201	1 HP	o Move canister to work stations for ICC displacement and plug welding

IV. D. 3. Distributed Control System (DCS) (Continued)

Distributed local processor units (DLPUs) are located throughout the facility and support buildings in the same general locations as the termination cabinets. These processors execute the process control, sequencing, and data acquisition programs, perform data conversions and initiate alarms. Communications from DLPU to DLPU and to field operation stations (FOSs) via the DCS communications network are part of the processor tasks.

DCS primary operating stations are centralized at the Central Control Room (CCR) and Supervisor Control Room (SCR). In addition, various FOSs are provided for backup, surveillance and support. These FOSs are located as follows:

- Two FOSs on the Vitrification Building second floor for process and plant monitoring that are backup and support stations to the CCR/SCR in the Support Building.
- One FOS each in the Service Building and Canister Storage Building for local monitoring of these plant functions.
- Normally unattended FOSs in the RLST/WHT Building, Fan House Building, and on the Vitrification Building roof.

The CCR, SCR and FOS provide a user friendly interface to the plant and process control, monitor, and reporting functions utilizing Cathode Ray Tube (CRT) displays, functional keyboards, and printers.

At a FOS, identical displays to the CCR and SCR are available, and printers allow local printout of plant alarm and other plant reports.

Host computers (in the Computer Room (CR) and backup CR) are networked into a plant Information Management System (IMS) via a local area network (LAN) linking the DCS, laboratory computer system, and the Health Protection (HP) System. The computers provide storage, archiving, and reporting of selected on-line information related to plant operation. The IMS is networked to the Hanford Site (Ethernet) computer network to provide central plant information management and reporting capability.

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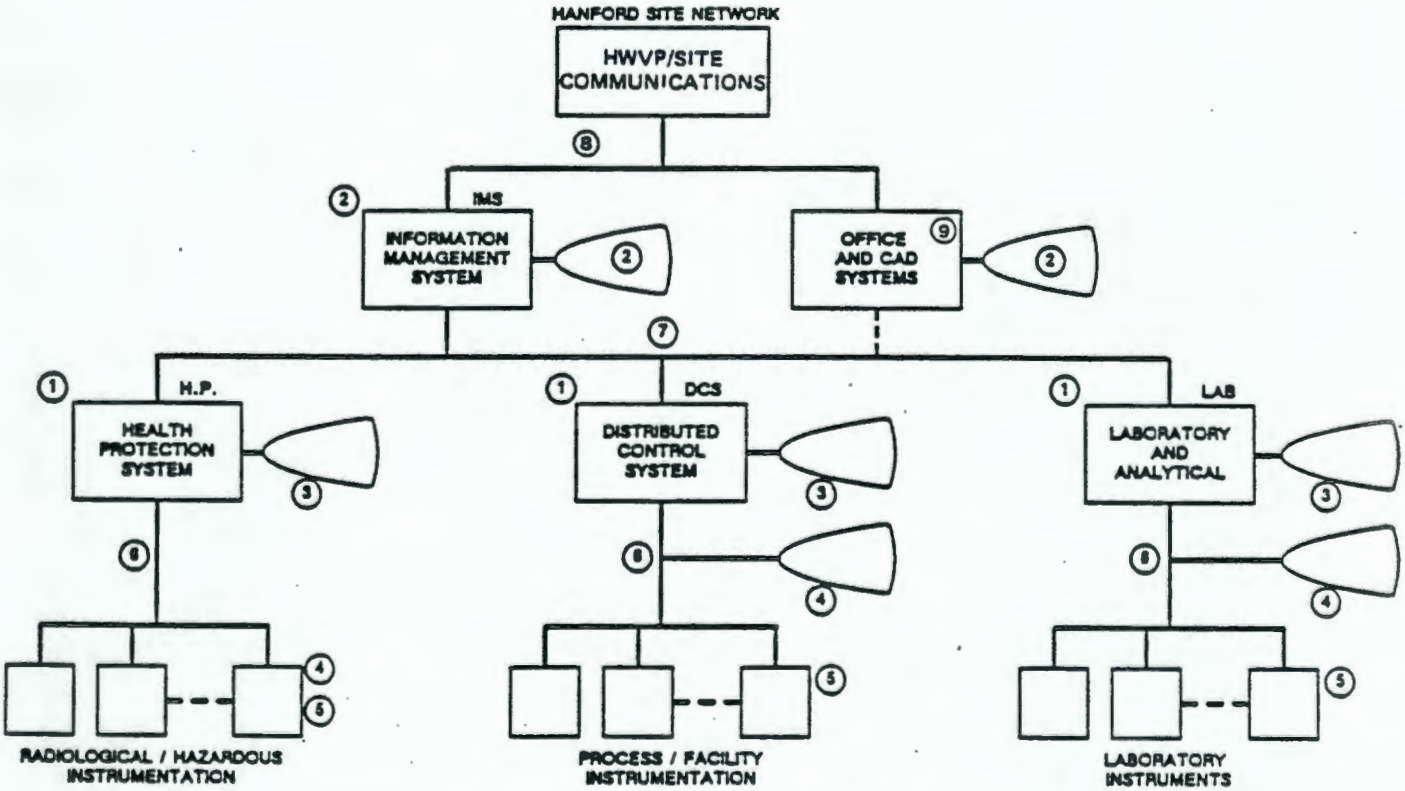

1. Central and Primary Operations Computers
2. HWVP Plant Management Information Computers / Stations
3. Central Plant Operating / Supervisory / Training Stations
4. Local Surveilance and Maintenance Support Operator Stations
5. Local Plant Control and Data Acquisition Processors
6. Manufacturer Specific Local Area Networks
7. Plant Local Area Network (LAN)
8. Office/IMS LAN
9. Not Part of Project Scope

HWVP INTEGRATED MANAGEMENT AND CONTROL SYSTEM

Figure 19

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IV. D. 3. Distributed Control System (DCS) (Continued)

The IMS computer collects and organizes selected data from all plant operations and support computers, and provides terminals for data input and data access at the primary operating, supervisory, and management locations.

The IMS automatic data acquisition programs acquire host computer short-term storage data and selected real-time data required for waste form qualification data, plant summary, and other specialized plant management reports.

The DCS communications system is a multi-tiered network that links the DCS computers involved in plant-wide monitor and control functions, providing data to management through all vertical tiers of the network as follows:

- Communications to/from the processing stations at the local plant material handling stations, laboratory computer system and the HP system
- Communications to/from site computer systems via the IMS and the Hanford Site network for plant information and secondary or higher level data processing or information management

Computer systems are provided at the DCS level of the plant hierarchy to support operator training and software program development.

Operator training is supported by a dual function standalone process simulation computer that interfaces two operator training stations configured to simulate process responses to operator/trainee actions normally available at any plant console. The training stations are also used for program development.

The DCS contains the following features to support plant safety and reliability:

Process/Plant Alarms:	The DCS detects and annunciates alarms for all process and plant control systems to both local and central operating stations. Safety related alarms are annunciated at both DCS and HP stations.
Power:	DCS components are powered from uninterruptable power supplies and internal redundant power supplies.

IV. D. 3. Distributed Control System (DCS) (Continued)

Environmental Considerations:	Critical DCS components are supported with redundant local HVAC units or with redundancy built into area HVAC systems.
Functional Design:	The DCS provides redundant control components for critical plant systems that execute automatic switchover to backup systems when sensing a failure. During normal operations, automatic shutdown of plant systems is provided via DCS control programs. During a DBA, plant shutdown in a safe configuration is accomplished without utilization of the DCS.

4. *Radioactive Process Waste Collection and Treatment Systems and Equipment*

The HWVP commitment is to send only non-transuranic (non-TRU) waste streams to the tank farms. Therefore, the primary performance requirements are to collect and process wastes to accomplish the following:

- Reduce the TRU content of the liquid waste to below 100 nanocuries/gm prior to transfer.
- Recycle the TRU concentrate for incorporation into the Melter feed.
- Chemically treat the non-TRU waste stream to meet tank farm operating requirements, and transfer these wastes to a Waste Hold Tank for discharge from HWVP to the tank farms.

Decontamination Waste Treatment Tank (DWTT)

The DWTT collects potential TRU waste from the process and off-gas treatment operations and is located in the CPC (see Figure 14). Decontamination and maintenance cell sumps are routed to the DWTT, as are in-cell decontamination wastes requiring chemical treatment to stabilize the wastes prior to transfer to the tank farms. The DWTT evaporates the wastes, separating the non-TRU condensates from the TRU containing bottoms. The TRU waste bearing DWTT evaporator bottoms are transferred to the RLST.

IV. D. 4. Radioactive Process Waste Collection and Treatment Systems and Equipment (Continued)

Recycle Collection Tank (RCT)

The RCT, which is located in the CPC, collects the condensates from the DWTT, as well as other radioactive wastes which are below TRU waste levels. These wastes are sampled, then neutralized and chemically adjusted to tank farm requirements after which they are transferred to the WHT.

Waste Hold Tank (WHT)

The WHT provides lag storage for radioactive liquid waste that is to be transferred to the tank forms. After transfer to the tank farms, the waste will be concentrated by evaporation and disposed of by incorporation in grout. These waste concentration and immobilization by grout activities are outside of the scope of HWVP.

The WHT is a double-shelled tank placed in a concrete vault with ventilation provided by equipment located in the RLST/WHT Building. The WHT has a 162,000 gallon working volume. The primary vessel is stainless steel and the secondary vessel is carbon steel. The WHT has leak detection systems and pumps both in the annulus and in an adjacent leak detection well.

The primary tank is provided with a pump agitator to provide homogeneous solutions for sampling. A pump is provided to recirculate the solution to the Sample Cell. A pump is provided to transfer the WHT contents to the tank farms via the 241-ER-152 diversion box.

A 3 inch stainless steel underground line connects the WHT to the diversion box. The 3 inch pipe is encased in 6 inch carbon steel pipe with cathodic protection and leak detection monitoring.

The air in the WHT is exhausted by the RLST/WHT Primary Ventilation System to maintain negative pressure in the tank and provide a continuous air sweep in the WHT gas space. The exhaust air is passed through multiple stages of HEPA filters to remove radioactive particulate material, and is delivered to the Vitrification Building Zone 1 exhaust tunnel for discharge to the environment via the Zone 1 exhaust stack.

The WHT annulus is ventilated and maintained at negative pressure with respect to the outside ambient by the RLST/WHT

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IV. D. 4. Radioactive Process Waste Collection and Treatment Systems and Equipment (Continued)

Annulus Ventilation system. The exhaust from this system is passed through multiple stages of HEPA filters and is discharged to the environment via the Vitrification Building Zone 2 and Zone 3 stack.

The RLST/WHT Primary Ventilation System and the Annulus Ventilation System equipment is located in the RLST/WHT Building.

Table IV.D-13 describes the equipment provided for process liquid waste collection and treatment.

5. Chemical Receipt, Makeup, and Distribution

Facilities are provided in the HWVP to receive liquid and dry chemicals in bulk quantities, to provide safe bulk storage of these chemicals to meet inventory requirements, to prepare these chemicals for use in process, equipment decontamination, and/or waste processing use, and to distribute these prepared chemical solutions to the systems which require them. The facilities include equipment for sampling of raw materials and solutions.

In the cold chemical area of the Service Building, charging chutes, tanks, agitators, and pumps for mixing, storing, and distributing chemical solutions and slurries are provided. Prepared solutions are transferred on a batch basis to feed tanks in the Vitrification Building, which are located outside the process or decontamination areas. The cold chemical feeds are shown on Table IV.D-14.

Concentrated sodium hydroxide and nitric acid are delivered by tank truck and are stored in two storage tanks provided for each of these chemicals. These chemicals are pumped to the appropriate dilution tanks, feed tanks, decontamination makeup and feed tanks, and waste neutralization tanks.

Concentrated formic acid is also delivered by tank truck and stored in two storage tanks. Formic acid is pumped from the storage tank to a formic acid dilution tank and a 90 percent formic acid feed tank. The dilute formic acid is pumped to a feed tank that services the frit slurry makeup tank. The 90 percent feed tank services the in-cell tanks (such as the SRAT).

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TABLE IV.D-13

RADIOACTIVE PROCESS LIQUID WASTE COLLECTION AND TREATMENT EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
Decontamination Waste Treatment Tank (DWTT)	20B-1T-TK-1600	12'0" ID x 19'1" H 11,000 gal Alloy 20	o Accumulate spent decontamination wastes o Destroy oxalic acid in waste o Segregate TRU from non-TRU wastes by concentration
DWTT Condenser	20B-1T-CD-1601	5,300,000 Btu/hr Alloy 20	Condense vapors from DWTT
DWTT Heating Coil	20B-1T-E-1602	6,000,000 Btu/hr Alloy 20	Heat DWTT contents
DWTT Cooling Coil	20B-1T-E-1603	960,000 Btu/hr Alloy 20	Cool DWTT contents
DWTT Agitator	20B-1T-AG-1604	100 Hp 65/130 rpm Alloy 20	Agitate DWTT contents
DWTT Sample Pump	20B-1T-P-1605	58/5 gpm*/ΔP: 55 psi Alloy 20/Stellite 6	Transfer DWTT contents to Sample Cell
DWTT Transfer Pump	20B-1T-P-1606	100 gpm/ΔP: 30 psi Alloy 20/Stellite 6	Transfer TRU process waste to RLST
Recycle Collection Tank (RCT)	20C-1T-TK-1700	12'0" ID x 19'1" H 11,000 gal 316L SS	o Accumulate HWVP process waste o Chemically adjust waste
RCT Cooling Coil	20C-1T-E-1703	960,000 Btu/hr 316L SS (Welded in Tank)	Cool RCT contents
RCT Agitator	20C-1T-AG-1704	20HP 68 rpm 316L SS	Agitate RCT contents

TABLE IV.D-13 (Continued)

PROCESS LIQUID WASTE COLLECTION AND TREATMENT EQUIPMENT

Equipment Name	Equipment Number	Equipment Design Parameters	Function
RCT Sample Pump	20C-1T-P-1705	58/5 gpm*/ΔP: 55 psi 304L SS	Transfer RCT contents to Sample Cell
RCT Transfer Pump	20C-1T-P-1706	100 gpm/ΔP: 25 psi 304L SS	Transfer HWVP waste to WHT
WHT	20E-90-TK-1800	50'0" ID x 17'4" H 162,000 gal working vol. 316L SS Primary CS secondary	Collect processed HWVP wastes prior to transfer to tank farms
WHT Agitator Pump	20E-90-P-1804	540 gpm/ΔP: 80 psi 316L SS	Agitate WHT contents
WHT Sample Pump	20E-90-P-1805	58/5 gpm*/ΔP: 80 psi 304L SS	Transfer WHT contents to Sample Cell
WHT Transfer Pump	20E-90-P-1806	100 gpm/ΔP: 168 psi 304L SS	Transfer processed HWVP wastes to tank farms
WHT Annulus Pump	20E-90-P-1808	50 gpm/ΔP: 40 psi 304L SS	Transfer tank leakage
WHT Leak Detection Pit Pump	20E-90-P-1809	5 gpm/ΔP: 30 psi 304L SS	Transfer tank leakage

*58 gpm is pump capacity including internal recycle
5 gpm is pump discharge flow

TABLE IV.D-14

COLD CHEMICAL FEEDS

Feed Material	Weight %	Usage
Sugar Solution	75	SME redox adjustment
Potassium Permanganate	5	Decontamination
Nitric Acid	50	Decontamination
Decontamination Solution (Detergent)	0.75	Decontamination
Sodium Hydroxide	50	Decontamination, waste neutralization
Glass Frit	60	Feed preparation, canister decontamination
Formic Acid	90	Feed preparation
Dilute Formic Acid	1.5	Frit slurry make-up
Dilute Nitric Acid	12	Decontamination
Surfactant	1	Decontamination and Process Foaming Control
Oxalic Acid	10	Decontamination
Sodium Nitrite	20	Tank farm waste requirement
5% Sodium Hydroxide	5	Waste neutralization
Potassium Hydroxide/ Frit Modifier		SME addition and improve glass formulation
Off-Gas Treatment Chemical		Modify off-gas chemistry

IV. D. 5. Chemical Receipt, Makeup, and Distribution (Continued)

Oxalic acid, potassium permanganate, and other dry chemicals are delivered and stored in bags or drums. Makeup tanks and separate feed tanks are used for oxalic acid, potassium permanganate, and decontamination solutions. Headers distribute the cold chemicals to the cells via embedded piping.

Storage and makeup tanks are located in diked areas with sumps to collect and segregate spillage. Sump contents are sent to waste treatment facilities. Separate waste treatment systems are provided for acid, organic acid, and alkaline waste.

Cold feed vent systems are provided for dust and vapor control. The 90 percent formic acid storage tanks vent directly to the atmosphere through a conservation breather with integral flame arrestor.

The chemical composition of the glass frit will be based on analysis of samples of pretreated HWVP feed stored in million gallon double shell tanks in the 200 East Area tank farms. The glass frit will be ordered for each tank of feed well in advance to support processing schedule. The frit composition will be based on the averge chemical composition of the feed in a particular million gallon double shell tank. The frit and feed will be combined to produce a slurry that will normally satisfy melter feed specifications. Any slurry composition adjustments required due to atypical feed variations will be accomplished by chemical addition to the process vessels. Physical properties of the glass frit, such as size and shape, have been optmized to meet the requirements for melter feed slurry and canister decontamination.

The glass frit used for canister decontamination and process feed is received and stored in portable tote bins. The frit is transferred by forklift from the storage area to the makeup area. The tote bin is inverted and the frit is dumped into a conveyor, which feeds into a bucket elevator, carrying the frit and dropping it through a magnetic particle remover, lump breaker, and scalping screen. The frit is then dropped into a weigh bin from which it is fed by a screw conveyor into the frit slurry makeup tank where the frit is mixed with dilute formic acid.

The Frit Slurry Makeup Tank is used for makeup of canister decontamination frit slurries and process frit slurries. After a slurry is prepared, it is transferred to the appropriate frit slurry feed tank in the Vitrification Building.

IV. D. 6. Potentially Radioactive and Non-Radioactive Liquid Waste Collection and Treatment

a. Potentially Radioactive

Intermediate holding tanks are provided for the collection of potentially contaminated liquid waste from Zones 2 and 3 of the Vitrification Building and regulated areas of the Support Building until it is analyzed.

If non-radioactive, the waste is transferred to non-radioactive liquid waste collection, treatment and disposal facilities. If tank analyses determine the contents to be radioactive, the waste is transferred to radioactive process waste collection tanks for processing. Collection tanks and collection headers are designed to segregate potentially radioactive waste into floor drains (neutral to high pH), acid drains (low pH) and organic acid drains (organic acids and sugar) to facilitate subsequent treatment and disposal of these wastes.

b. Non-Radioactive

Non-radioactive liquid waste collection, treatment, and disposal equipment is provided to ensure that liquid waste released to the environment complies with all federal and Washington State regulations and DOE Orders, including the Resource Conservation and Recovery Act (RCRA) and Washington Administrative Code (WAC 173-303) requirements.

In this facility, only clean waste water which does not contain hazardous chemicals is discharged to the environment via the B-Plant Pond. All treated liquid wastes are evaporated in a solar evaporation tank.

Water soluble chemical waste is collected and neutralized in separate caustic, organic acid, and acid waste collection neutralization tank systems. Tank pH analyses are performed and the contents neutralized by the addition of acid or caustic as appropriate. Neutralized waste and related flush/washdown water is transferred to a solar evaporation tank where excess water is removed by natural evaporation. The following wastes are routinely discharged to the evaporation tank via the waste collection and neutralization tanks:

- Drains from chemical storage, makeup and feed tanks, including tank flush water

IV. D. 6. b. Non-Radioactive (Continued)

- Leaks, spills and flush water from sumps that collect liquids from diked areas around storage, makeup, and feed tanks, (non-radioactive) with the exception of liquid collected in the Floor Drain Catch Tank

The Floor Drain Catch Tank discharges to the solar evaporation tank via the waste collection and neutralization tanks if it receives a large chemical spill; otherwise, that tank discharges to the B-Plant Pond (if non-radioactive).

Cooling tower blowdown, steam condensate, and other waste water not contaminated with hazardous chemicals or radioactivity, and Floor Drain Catch Tank contents as explained above, are combined and discharged to the B-Plant Pond via a single waste water discharge line.

7. Canister Receipt, Handling and Inspection Equipment

The canister receipt, handling, and inspection equipment provide for empty and filled canister handling and inspection, from receipt of empty canisters at the Service Building loading dock, to delivery of the filled canisters to the Canister Storage Building.

Empty canisters and components are delivered to the Service Building by truck or rail. Each canister is fastened in a wooden shipping cradle. Plugs are received in boxes on pallets. On the loading dock, components are removed from the cradles, and protective covers are removed from the nozzles. Each component receives a visual inspection for damage incurred during shipment or handling. Overpacks are handled similarly to the canisters. Depending on final design, overpack covers may be handled similarly to plugs.

A stainless steel inspection stand is provided for holding canisters and overpacks during receipt and audit inspections. All quality examinations for canisters are shown in Table IV.D-15.

A statistically significant sample lot of the components from each shipment is transferred directly to the inspection area for an audit of the vendor's certification. Following the audit inspections, these components are transferred to storage. The remainder are transferred directly from the receiving inspection to storage. When a given lot has been released (based on the results of laboratory examinations and the audit inspection), components are removed from storage.

TABLE IV.D-15

COMPONENT QUALITY EXAMINATIONS

Location	Characteristic	Sample	Method
Vendor	Chemical composition	Melt	Quantitative Analysis
	Metallurgical Characteristics	Plate	Metallography
	Mechanical properties	Plate	Material Testing
	Metal soundness	Billets and/or stock	Ultrasonic
	Weld quality	Canister and overpack	Radiograph
	Cleanliness	All components	Visual
	Surface finish	All components	Gauge
	Dimensions	All components	Gauges
Laboratories	Chemical composition	Melt	Quantitative Analysis
	Metallurgical characteristics	Plate	Metallography
	Mechanical properties	Plate	Material Testing
Receiving inspection	Gross damage	Canister and overpack	Visual
Audit inspection	Weld quality	Canister and overpack	Radiograph
	Surface finish	All components	Gauge
	Dimensions	Canister and overpack	Length gauge
	Length		
	Wall thickness	Canister and overpack	Ultrasonic
In process inspection	Cleanliness	All components	Visual
	Surface mars	All components	Depth gauge
	Throat ID and OD	Canister	Gauge
	Flange OD	Canister	Gauge
	Outer diameter	Canister and overpack	Gauge
	Inner diameter	Overpack	Gauge
	Length	Canister and overpack	Gauge
	Parallelism-flange to bottom	Canister	Gauge
	Leak tightness	Canister and overpack	Helium
	Weight	All components	Scale
	Plug O.D.	Inner and Outer Plug	Gauge
	Concentricity	All components	Gauge

IV. D. 7. Canister Receipt, Handling and Inspection Equipment (Continued)

At the in-process inspection, all canisters and components are inspected for the following items:

- Cleanliness
- Damage incurred in handling or storage
- Dimensions critical to operations in the process cells

At in-process inspection, soiled components are hand-cleaned. Those with minor surface damage are dressed, using hand tools, to meet specifications. Each canister and each overpack will have an identifying number (in addition to the vendor's lot number) to provide a sequential number for processing.

The acceptance/rejection criterion for leak testing as-received canisters and overpacks is a leak rate of 1×10^{-6} STD CM^3/s helium. Rejected canisters and overpacks are returned to the vendor, packaged as they are received. Accepted canisters are transported by monorail hoist from the Service Building into the Vitrification Building and are lowered into the Empty Canister Entry Tunnel.

The in-cell canister handling and inspection equipment provides the capability for moving canisters between cells and to different stations within a cell and for performing visual examinations, temperature surveys, smear tests, and radiation surveys of canisters. Canister transport between cells, including transport of empty canisters to the Melter Cell from the Vitrification Building Empty Canister Entry Tunnel and from the Weld Test Cell to the Canister Storage Building is by motorized transfer cars or trolleys located in transfer tunnels. The transfer cars and trolleys move on tracks mounted on the sides of the tunnel walls. A canister grapple and a crane are used to transport the canister to different stations within a cell or to a transfer tunnel. The grapple has no motors, is positive locking, and has a minimum of moving parts. The grapple is engaged and disengaged by the crane.

The in-cell canister handling equipment is designed to meet the following requirements:

- Keep filled canisters in the vertical position

IV. D. 7. Canister Receipt, Handling and Inspection Equipment (Continued)

- Provide the capability for handling overpacks which enclose damaged canisters
- Minimize contamination and the potential for damage to the canisters

Storage racks in the Melter Cell, Canister Decontamination Cell, and Weld Test Cell are provided as a buffer so that operations in the cells may proceed independently of the operations in adjacent cells.

Two smear test stations are provided to verify that the required canister surface decontamination has been achieved. The first is located in the transfer tunnel between the Canister Decontamination Cell (CDC) and Weld Test Cell (WTC). Smear samples are taken to verify that final decontamination has been successfully completed. Canisters failing this smear test are returned to the CDC for recleaning of only that zone of the canister's surface that failed. This station assures that only clean canisters pass to the WTC, thereby preventing contamination spread and permitting the WTC to be contact maintained.

A second smear test station is provided in the WTC. Following canister closure by the Plug Welder, a final visual inspection of the canister and weld is performed at this station including a video recording. Smear samples collected at this location provide a final verification that contamination levels on canisters to be sent to the Canister Storage Building comply with all anticipated shipping regulations. Canisters failing this check are returned to the Canister Decontamination Cell for zone recleaning.

Smear tests are performed at shield window stations equipped with Master-Slave Manipulators and necessary remote equipment, e.g. rotators, grapples and turntables, to access all canister surfaces. A pneumatic transfer system is provided to pass smear paper into and out of the stations from the operating corridor. Smear samples are sent to one of the facility counting laboratories for analysis.

After final smear testing, the filled canisters are moved to the Canister Exit Transfer Tunnel, and canister radiation levels are measured. Canisters are then transported to the Canister Storage Building for interim storage.

IV. D. Special Equipment/Process Systems (Continued)

8. Process Sampling and Analysis

Sampling and analytical equipment is provided on the mezzanine level of the Vitrification Building to (1) support plant operation and allow monitoring of process control elements, (2) support waste form qualification, (3) support monitoring of all effluents for conformance with applicable regulations, and (4) support health protection and radiation monitoring.

Samples of process liquids, Melter off-gas and vessel vents are taken in the Sample Cell or at sampling locations. Analytical facilities are provided in the Vitrification Building for wet chemical, cold chemical, and radiochemical analyses, in the Analytical (hot) Cells and a Main Analytical Laboratory, as required. Table IV.D-16 provides a summary of specific liquid and gas sample points in the HWVP.

All Chemical Processing Cell (CPC) sample points have an operating supply line, a spare supply line, an operating return line, and a spare return line.

Each sample point is connected to an individual sample module within the Sample Cell. The spare sample points have been provided for future sampling requirements but are not equipped with such a module. Spare sample points can be connected within the Sample Cell to a future liquid sampling module.

Prior to taking a sample, the sample pump is turned on to circulate the stream long enough to ensure uniform and representative samples. Liquid samples are taken via a double-needle device into a 10-15 ml vial.

Gas sampling is similar, except that circulation is accomplished by an air-driven jet, and analyses may be on samples taken via sample bombs or adsorption beds or particulates collected on a filter. The Gas Sampling Module may be purged with air.

Samples are transferred from the Sample Cell to the Analytical Cells by a sample cart resting on rails extending across the full length of the Sample and Analytical Cells. The cart is propelled by pushing it with a manipulator. Two carts are provided.

TABLE IV.D-16

HWVP PROCESS LIQUID AND GAS SAMPLE POINTS

Phase	Sample Point
Liquid	Receipt and Lag Storage Tank (RLST)
Liquid	Slurry Receipt and Adjustment Tank (SRAT)
Liquid	Slurry Mix Evaporator (SME)
Liquid	Slurry Mix Evaporator Condensate Tank (SMECT)
Liquid	Melter Feed Tank (MFT)
Liquid	Recycle Collection Tank (RCT)
Liquid	Spent Frit Hold Tank (SFHT)
Liquid	Decontamination Waste Treatment Tank (DWTT)
Liquid	Off-Gas Condensate Tank (OGCT)
Liquid	Back-up OGCT
Liquid	Scrubber Tank (ST)
Liquid	Back-up ST
Liquid	Waste Hold Tank (WHT)
Liquid	HEME - Iodine Adsorber Area (Spare)
Liquid	Back-up HEME - Back-up Iodine Adsorber Area (Spare)
Liquid	Process Vessel Vent Filter-Blower Area (Spare)
Gas	Formic Acid Vent Condenser (FAVC) Outlet
Gas	Process Vessel Vent Filter (PVVF) Inlet
Gas	PVVF Outlet
Gas	OGCT Vapor Space
Gas	Back-up OGCT
Gas	GSC Inlet
Gas	Back-up GSC Inlet
Gas	Steam-Atomizing Scrubber (SAS) Inlet
Gas	Back-up SAS Inlet
Gas	High Efficiency Mist Eliminator (HEME) Inlet
Gas	Back-up HEME Inlet
Gas	HEME Outlet
Gas	Backup HEME Outlet
Gas	Iodine Adsorber Outlet
Gas	Back-up Iodine Adsorber Outlet
Gas	Roughing Filter Outlet
Gas	Back-up Roughing Filter Outlet
Gas	HEPA Filter Outlet
Gas	Back-up HEPA Filter Outlet

IV. D. 8. Process Sampling and Analysis (Continued)

Routine analyses of highly radioactive samples for process control and waste form qualification are performed in the Analytical Cells (for highly radioactive samples) and in the Analytical Laboratory. In the Analytical Cells, operations such as centrifuging, dilution, drying, dissolution, density measurement and ashing are performed, together with colorimetric and pH analyses, chemical oxygen demand, and cesium precipitation. Analyses performed in the Analytical Laboratory include pH, specific gravity, total solids, chemical oxygen demand, formic acid requirements, elements, anions, total carbon and total organic carbon, radioactivity (alpha, beta, gamma), Fe^{+2}/Fe^{+3}, total formate and particle size.

Specialized and automated equipment is provided for sample analysis, including an inductively coupled plasma emission spectrometer, an atomic absorption spectrometer, an ion chromatograph, a ultraviolet spectrometer, a laser fluorimeter and total organic carbon instrumentation. Counting room equipment includes a scintillation counter and both high and low level alpha, beta, and gamma counters.

9. Remote Handling Equipment

The remote handling equipment in the HWVP includes in-cell, canyon, and canister storage cranes, Electromechanical and Master-Slave Manipulators, monorail/hoists, transfer cars, and miscellaneous bails, yokes and grapples.

a. Canyon Crane with Closed Circuit Televison (CCTV)

A remotely operated canyon crane equipped with a 117 ton main hoist is used to remove cover blocks, and to install and remove jumpers and equipment. The canyon crane can move components between cells for decontamination, maintenance or packaging for disposal, and can access the Railroad Well for bringing in new or repaired components and loading out packaged components.

A 10 ton auxiliary hoist is provided on the canyon crane primarily for moving process equipment subassemblies and the lighter, complete assemblies such as canister storage racks.

Under each canyon crane girder is a 2 ton monorail trolley with dual 1 ton hoists, one provided with a hook

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IV. D. 9. a. Canyon Crane with CCTV (Continued)

and the other with an impact wrench. The hook engages a jumper bail. The impact wrench drives the jumper connector nuts. The monorails are intended mainly to service jumpers, but can access any point in the canyon to service cell lights, cameras, disconnect in-cell crane electrical/control PUREX connectors, etc.

The canyon crane is operated remotely from one of several consoles, and is contact maintained in the Crane Maintenance Area (CMA). Viewing of all canyon crane activities is exclusively by a system of eight CCTV cameras mounted on the crane bridge girders. The crane is equipped with its own lighting system, and is designed to support CCTV viewing of any point in the canyon below the crane, including the cells. The canyon crane CCTV cameras share monitors and recording equipment with the wall and equipment mounted CCTV system.

b. In-Cell and Canister Storage Cranes

In-cell and the Canister Storage Operating Area cranes are remotely operated. Each crane is equipped with a main 7-1/2 ton hoist for handling canisters and jumpers and a 1 ton auxiliary hoist for handling an electric impact wrench. In-cell cranes are controlled from local stations located at each shield window station for a particular cell.

The following in-cell cranes are provided:

Melter Cell	- Used for tunnel plug handling, canister handling, moving the Canister Manipulating Mechanism and jumper handling.
Canister Decontamination Cell	- Used for same activities as Melter Cell hoist
Weld Test Cell (Upper and Lower)	- Used for moving canisters and lifting shield plugs for the tunnel or storage positions.
Contact Decontamination Maintenance Cell (CDMC)	- Used to move components off or on to equipment being repaired or from one work station to another.

IV. D. 9. b. In-Cell and Canister Storage Cranes (Continued)

Canister Storage Area (2) - Used to move sealed canisters into and out of storage and into the shipping cask. Both of these cranes are mounted on the same runway. One serves as a backup.

c. Cask Loadout and Shipping Area Crane

A 117 ton bridge crane with a 10 ton auxiliary hoist tilts and removes the shipping cask from the railcar, and places the cask into the transfer cart. The transfer cart has access to the canister storage tunnel.

d. Electromechanical Manipulators

Electromechanical Manipulators (EMMs) are provided to perform remote decontamination and maintenance on contaminated equipment in the Remote Equipment Decontamination Cell (REDC). This includes holding decontamination spray jets used to decontaminate equipment, and operating tools necessary for disassembly and repair of in-cell equipment such as cranes, pumps, agitators, etc. The EMMs provide full coverage of all sides of equipment to be maintained.

e. Master-Slave Manipulators

Master-Slave Manipulators (MSMs) are installed at cell shield window stations to perform remote handling functions involving limited weight and reach requirements. Examples are (by cell):

Melter Cell	- Plug insertion and temperature checks at ICCS
CDC-WTC Tunnel	- Smear testing canisters
Weld Test Cell	- Plug insertion at plug welder and smear testing canisters
Sample Cell	- Sample collection and handling
Analytical Cells	- Operation of remote analytical equipment
	- Sample preparation

IV. D. 9. e. Master-Slave Manipulators (Continued)

All other shield window stations are equipped with through sleeves sealed with shielding plugs to permit later insertion of additional MSMs if required.

f. Equipment Lifting Yokes, Bails and Grapples

Each piece of equipment installed in the process cell is handled remotely using either a hook on the cell crane or a combination of the crane hook and yoke matched to the equipment piece. To minimize the number of yokes required in the cell, lifting bails and trunnions on similar equipment (weight, size, function) are matched to mate with a single yoke. For example, single yokes are provided for each of the following equipment groups:

- All pumps and agitators
- Large diameter and/or wide equipment
- Small diameter and/or narrow equipment
- In-cell cranes

Additional bracing for bails or trunnions and oversized lifting trunnions is provided to reduce multiplicity of lifting yokes.

Lifting equipment is stored either in the cell or canyon area as near to the corresponding equipment as possible.

10. Equipment Decontamination, Repair and Maintenance

The HWVP is equipped with the necessary facilities for maintenance of equipment according to expected contamination levels and maintenance requirements. Non-contaminated equipment is directly maintained in place or moved to clean repair shops. Contaminated equipment is contact decontaminated prior to contact maintenance whenever feasible, but severely contaminated equipment from operating cells is first remotely decontaminated in the Remote Equipment Decontamination Cell (REDC). In limited cases, maintenance or packaging for disposal is performed remotely.

IV. D. 10. Equipment Decontamination, Repair and Maintenance (Continued)

Canyon crane maintenance is performed in the Crane Maintenance Area (CMA) at the south end of the Vitrification Building. The rails of the canyon bridge crane extend directly into this area, allowing it to pass by a large shield door that isolates the CMA from the process canyon area. The canyon bridge crane can access cell cranes and transport them to the REDC/CDMC for decontamination and repair. Components of cell cranes can be moved to the CMA by the canyon bridge crane as required for critical repairs. The CMA is equipped with decontamination solution tanks and crane washdown facilities suitable for contact decontamination and direct maintenance. Smaller components are removed to adjoining hot repair shops, while large components are repaired in place on the crane.

Process components from the operating cells require remote decontamination. They are moved by the canyon bridge crane to either the REDC or the CDMC, depending on expected feasibility of contact maintenance after cleaning. The REDC is equipped with facilities and equipment to perform all activities remotely. Included are two Electromechanical Manipulators, equipment stands to properly position components, remotely operable utility service racks that supply decontamination solutions, master-slave manipulator/shield window work stations for direct cell viewing and limited light weight repairs, and closed circuit television to supplement direct viewing. The CDMC is equipped similarly to the REDC to support remote decontamination, but also includes a cell bridge crane operable remotely and by pendant from inside the cell. Utility racks supplying decontamination solutions are directly operable inside the cell. Breathing air stations and regulated tool storage are also included.

A Laydown Area equipped with stands for temporary storage of failed cell components is provided within the process canyon to handle any backlog of contaminated equipment requiring maintenance. See also Section VI.E for additional information.

11. Embeds and Jumpers

Transfers of cold chemicals to the process cells, process solutions to and between cells, and transmission of power and instrument signals to, from, and between cells, is done through piping and conduit embedded in the concrete shielding or the dividing walls of the cells. As compared to other design alternatives like pipe trenching, this method protects

IV. D. 11. Embeds and Jumpers (Continued)

piping and conduit from physical damage, eliminates the need for hanger design and fabrication, and consumes less building space. Because embedded piping and conduit displace concrete cell wall shielding material, it is constructed with offsets (i.e., two or more pipe bends) to reduce the possibility of direct radiation streaming through the embed penetrations. This embedded piping and conduit is inaccessible and sufficient spare capacity is provided to support the plant's lifetime needs.

Transfers and transmissions between embedded pipe and conduit wall nozzles, vessels, and equipment in the cells, are made using specially designed piping and conduit sections which have remotely operable connectors at the ends. These sections are commonly known as "jumpers." Jumpers are designed for remote handling by use of a single crane lifting bail. The lifting bail is placed at the jumper's center of gravity such that the jumper hangs in its installed position. They are fabricated of pipe with additional bracing where required for support. They can be multi-headed, have connections for other jumpers to connect to them, and they may contain valves, instruments, and other components.

Several basic types of remote connectors are used to connect jumpers to vessels, equipment, and wall nozzles. For nominal pipe sizes of 4 inches or less, the PUREX pipe connector is used. Remote flange connectors are used for pipe sizes above 4 inches. For electrical jumpers, the modified PUREX I&E connector is used. Where horizontal piping connections are required, a quick-disconnect pipe connector (with taper-hub assembly and seal ring) is used. The quick-disconnect connector and both types of PUREX connectors are normally mounted in alignment with the X-Y-Z axes, and are installed and removed by the operation of a single hexagonal nut which is turned by an electric impact wrench suspended from a crane. Remote flange connectors are installed and removed with captured bolts. PUREX and quick-disconnect connector types basically consist of a fixed portion (male connector) and a removable connector head (female connector). The male connector forms the nozzle at the vessel or at the stub of a pipe or conduit extending from the cell wall. The female connector is mounted to both jumper ends.

To minimize not only hardware cost of jumpers, but even more so the time required for remote jumper removal and installation during plant operation, jumpers are designed to be as

IV. D. 11. Embeds and Jumpers (Continued)

simple and short as possible. Jumper cross overs are avoided to the greatest extent possible. Specifically, in the Chemical Processing Cell (CPC), where a large number of jumpers have to be accommodated in tight space, these jumper design and arrangement requirements are of major importance. Where large distances have to be bridged between process vessels and equipment, hard piped racks have been designed, and jumpers only cross the distance between respective vessels and nozzle points on such racks.

12. Utility Distribution Systems

a. Electrical Distribution

1) Primary Electrical Distribution

The main Switchgear/Generator Building contains 13.8 kV distribution and generation equipment for all HWVP facilities. Normal power is distributed from two 13.8 kV vacuum metal-clad switchgear assemblies, each consisting of a main breaker, feeder circuit breakers, and two tie breakers. One of the tie breakers connects the two normal switchgear buses, and the other tie breaker joins the normal bus to the standby bus. Each of the normal buses is also equipped with one spare feeder breaker. All circuit breakers are rated 1200 amp continuous and 750 MVA short circuit interrupting capacity.

Each normal bus supplies four load centers located in the Vitrification and/or Service Building. Each normal bus also supplies power to one standby bus during normal operation when 13.8 kV offsite power is available.

Each feeder breaker on a 13.8 kV bus feeds a related load center via a fused interrupter switch on the primary of each load center transformer.

These feeders are run in underground duct banks outside buildings, and at suitable points penetrate the building walls or slabs and are routed in conduit to load centers.

IV. D. 12. a. 1) Primary Electrical Distribution (Continued)

Major 480V load centers located in the Vitrification and Service buildings are in a double-ended configuration. An auto transfer scheme provided with each of these load centers affords 100 percent redundancy of supply to the low voltage switchgear.

Each load center consists of one (or two) incoming 15 kV interrupter switch coupled to a 13.8 kV - 480/277V transformer and 480/277V switchgear. Low Voltage Switchgear supplies power to distribution panels, motor control centers and large 480V motors ($\geq$125 HP - 300 $\leq$).

2) Standby Power

Standby power is provided by two diesel generators located inside the seismically qualified Category I Switchgear/Generator Building. Each generator is located in a separate room adjacent to a 13.8 kV switchgear room. The rooms containing redundant diesel generators and switchgear are separated by a fire wall.

Each of the diesel generator sets has a rated capacity of about 3,000 kW at 13.8 kV, 3-phase and 0.8 power factor. Generators are sized to carry HWVP priority standby loads and some of the plant's secondary standby loads under emergency conditions.

Each diesel engine also has a complete starting air system, consisting of a compressor and air receiver unit sized to provide a minimum of five diesel engine starts without recharging.

Each generator diesel fuel day-tank is sized for a minimum of 2 hours (about 450 gallon) at full capacity operation and an underground fuel storage tank is sized for a minimum of 72 hours (about 15,000 gallons) at full capacity operation.

3) Uninterruptable Power Supply (Emergency Power)

Uninterruptable Power Supply (UPS) systems are provided for critical loads and support systems that require power continuously for safe operation and/or shutdown of HWVP equipment and facilities.

IV. D. 12. a. 3) Uninterruptable Power Supply (Emergency Power) (Continued)

Emergency power systems are capable of supplying power for a limited amount of time after loss of normal power and until the standby power supply is started and brought on-line.

Typically, an UPS consists of a battery bank, a battery charger assembly, and a cabinet assembly containing a static voltage regulator, a static inverter, and a static transfer switch with manual bypass switch.

Control power for equipment such as 13.8 kV and 480V switchgear and generator control panels is provided from 125 Vdc battery banks and battery charger units located in close proximity to the load.

The output of the emergency power systems is generally distributed from 120/208 Vac or 125 Vdc panels to loads such as the standby generator control panel, essential lighting, process control and alarm systems.

b. Compressed Air and Gas

Three 50 percent rotary screw air compressors generate compressed air for pneumatically actuated components of the process system (instrument air), plant high pressure air for air spargers and air jets for the transfer of solutions, and general use (e.g., maintenance). Separate compressors are provided for breathing air and for canister decontamination air use. Bottled gases are provided for all required gases other than air, as well as for emergency backup to the breathing air supply system. Bottled gases are used for analytical facilities.

c. Sanitary Water and Fire Water

Sanitary water is supplied to the plant from the 200 East Area. The Fire Protection System is supplied from sanitary water. Sanitary water is supplied to various lavatories, safety showers and eyewashes, sinks, and other sanitary water users throughout the plant.

Process water is also supplied from the sanitary water supply. A backflow preventer is provided in the process water line.

IV. D. 12. Utility Distribution Systems (Continued)

d. Sanitary Sewer

The sanitary sewer system collects waste from clean drains and restrooms and discharges directly to the environment through a septic tank and tile field.

e. Steam and Condensate

Utility steam at 225 psig from the 200 East Area is used as a heating medium on the tubeside of a steam generator which produces 150 psig process closed loop steam on the shellside. Process steam is used for all in-cell vessel heating. Process condensate is returned from the in-cell users, condensed and cooled, and then pumped back to the process steam generator.

The high pressure utility condensate from the steam generator tubeside is flashed to about 40 psig and combined with 40 psig utility steam produced by routing additional 225 psig utility steam through a pressure reducing station. This utility steam is used primarily by the HVAC system and by auxiliary equipment throughout the plant. Utility condensate is discharged to the B-Plant Pond.

f. Cooling and Chilled Water

The cooling water systems provided for HWVP include a cooling tower system, three closed-cycle process cooling water loops (one of which is a chilled water loop) which remove heat from contaminated vessels, and a Central Refrigeration System used by the HVAC systems.

The cooling tower system recirculates cooling water to various out-of-cell equipment, to all three closed-cycle process cooling water loops and to the HVAC Central Refrigeration System. It contains a four cell, cross flow, mechanically induced draft cooling tower and three 50 percent cooling water pumps.

The three closed-cycle process cooling water loops are used to remove heat from contaminated and potentially contaminated equipment. One loop is provided to cool in-cell radioactive streams. A second is used to cool the Melter jacket. A third closed-cycle process chilled cooling water loop is provided to remove heat from

IV. D. 12. f. Cooling and Chilled Water (Continued)

process scrubbers and condensers which require lower temperatures than available from process cooling water. Redundant, packaged unit reciprocating type chillers are provided, with each rated at approximately 108 tons. Provisions are included for radioactivity monitoring, leak detection, and decontamination of these loops during operation if necessary.

The Central Refrigeration System provides chilled water for the air handling units and the packaged air conditioning units serving the Vitrification Building, Manipulator Repair Building, Support Building, and Service Building.

13. Health Protection System

The Health Protection (HP) system is a special purpose, computer based, data acquisition, display and reporting subsystem which is part of the overall Integrated Plant Management and Control System (see Section IV.D.3). The system acquires, archives and reports data and HP system status at central and local plant stations as well as annunciates alarm conditions at these stations. These data and personnel health record data are collected and processed to provide information and reports in the following categories.

- Radiological instrumentation data from liquid effluent monitors, particulate, portal, personnel, stack (isokinetic) gas analyzers and area radiological monitors in all required HWVP areas, and nonradiological instrumentation data from hazardous area monitoring of nonradiological sensors (toxic gas analyzers).

- Manual entry data for personnel/health records, surveys, inspections, and evaluations of hazardous areas, threshold limits and issue of work permits.

- Manual entry of calibration records and check source records.

- HP related data analysis and report generation for short term operational analysis and trending and for long term archiving.

IV. B. 13. Health Protection System (Continued)

The HP system is integrated into the overall Integrated Plant Management and Control System via the Distributed Control System (DCS) Local Area Network (LAN) that networks the HP system, laboratory computer and DCS into one overall integrated plant information system at the host computer level. The majority of the HP personnel and area radiological data is acquired from facility sensors purchased with the HP system. Effluent radiation sensors are part of the DCS and associated control programs.

Data from these sensors are provided in real-time to the HP system via the broad-bandwidth LAN described. The HP system is therefore an integral part of the overall plant monitoring system as an integrated network with data available to the DCS from the HP system and to the HP system from the DCS as if it were a single plant system.

14. Systems Integration Facility (SIF) Equipment

The process equipment and systems critical to HWVP operation which are not fully demonstrated or integrated and have long lead procurement times will undergo SIF testing. The SIF provides for integration testing of these equipment items and systems prior to HWVP cold start-up. The equipment and systems currently identified for SIF testing include the Melter/Turntable, selected feed preparation tanks, Melter Off-Gas System, evacuated canister system, and selected Distributed Control System components.

IV. DESCRIPTION OF PROJECT SCOPE (Continued)

E. Utilities

1. Structures (Sanitary Sewer)

The sanitary sewer system includes two septic tanks and a tile field located approximately 200 feet west of the Service Building and connected to the Service Building by a 6 inch sewer line.

2. Primary Electrical Supply

a. 251-W Substation

The existing distribution lines into the 200 East Area do not have enough spare capacity to supply the HWVP. For this reason, two new independent 13.8 kV feeder lines are brought in from the 251-W substation. The 3-pole breakers, located at the 251-W substation, are rated 15 kV, 1,200 A, 500 MVA.

b. Pole Line

The new parallel 13.8 kV pole lines from the 251-W substation are spaced a minimum of 100 feet from each other and run for a distance of approximately 3.5 miles. Each pole line uses two 336.4 aluminum clad steel reinforced conductors per phase necessary to provide for a maximum load capacity of 20 MW per feeder. The pole lines terminate at a take-off tower where the 13.8 kV lines are fed to the switchyard.

c. Switchyard

The switchyard, a fenced-in area located west of the Switchgear/Generator Building, contains two pole mounted disconnect switches, interconnecting cables and conduit, two pad mounted disconnect switches, lightning arrestors and instrumentation and control equipment. From the switchyard the 13.8 kV feed lines are brought into the Switchgear/Generator Building.

3. Steam Supply

An existing abovegrade 225 psig steam line is located approximately 1,400 feet east of the reference HWVP site. The planned increase in capacity of the 200 East Area steam plant will assure that the steam requirements of the HWVP are met.

IV. E. 3. Steam Supply (Continued)

A new 10-inch carbon steel abovegrade line connected to the existing 225 psig line supplies the HWVP. This line is installed above grade on structural steel supports and routed from the tie-in to the HWVP.

4. Water Supply

a. Raw Water

Raw water for makeup to the cooling tower is supplied via a 4 inch non-metallic underground transfer pipe which runs parallel to 7th Street from the 200 East Area.

b. Fire Water

Sanitary water for fire protection is supplied to the HWVP facility by a new 10 inch non-metallic underground pipeline. The pipeline ties into the existing sanitary water mains at two locations (one at the B-Plant and one near the 2727E Guard Station) This forms a loop around the facility.

Sectionalizing post indicator valves are provided in the fire water loop between each branch tie-in. Four outside fire hydrants are provided in the fire water loop.

Fire protection risers are installed at five locations: in the maintenance shop, Manipulator Repair Shop, Support Building, Switchgear/Generator Building, and in the Fan House Building. All riser locations are served by underground lines from the fire water main. The underground lines are provided with post-indicator valves.

c. Sanitary Water

A branch line from the 10 inch sanitary water line supplies water for sanitary and process use.

5. Liquid Effluents

a. Chemical Effluents

Treated chemical wastes are transferred to a solar evaporation tank where excess water is removed by natural evaporation.

IV. E. 5. Liquid Effluents (Continued)

b. Steam Condensate and Other Nonhazardous Effluents

Cooling tower blowdown, steam condensate, and other waste water not contaminated with hazardous chemicals or radioactivity are combined and discharged to the B-Plant Pond via a 4 inch non-metallic underground line.

V. METHODS OF PERFORMANCE

A. Work Planned for Operating Contractor

The Operations and Engineering Contractor (O&EC) at the Hanford Site is under contract to the Department of Energy Richland Operations Office (DOE/RL). The responsibilities of the O&EC relative to the HWVP Project are described below.

The O&EC has responsibility and authority for providing overall, integrated technical project management services. These services include technical direction of other contractor organizations participating in the HWVP Project. The O&EC will provide project criteria development, definition and control of process and technical interfaces, engineering development activities including Waste Form Qualification, configuration management, technical and programmatic management of the project design and field engineering, procurement support, test documentation, engineering studies and analyses, facility and equipment readiness reviews, operational planning, testing and startup. The O&EC will also provide overall planning, scheduling and performance measurement reporting for the project and assure safety and quality consistent with DOE/RL requirements.

Battelle-Pacific Northwest Laboratory, the Hanford Site Research and Development Contractor, supports the O&EC and is responsible for process development and most of the equipment adaptation of the vitrification systems and waste form qualification technology.

V. METHODS OF PERFORMANCE (Continued)

B. Construction

Construction work for the HWVP Project is planned and estimated to be performed under the sixteen separate fixed price construction packages listed below.

1. Site Preparation and Temporary Construction Facilities
2. Vitrification Building Foundation
3. Vitrification Building Shell and Embeds
4. Vitrification Building Internals and Architectural
5. Distributed Control and Health Protection Systems Installation
6. Receipt and Lag Storage Tank/Waste Hold Tank Facilities and Tie-ins
7. Manipulator Repair Building
8. Vitrification Building Cell Internals
9. Canister Building
10. Service and Support Buildings
11. Sand Filter and Air Inlet Tunnel
12. Fan House and Stack
13. Switchgear/Generator Building and Yard
14. Outside Utilities and Tie-ins
15. 13.8 kV Pole Lines
16. Final Site Work

V. METHODS OF PERFORMANCE (Continued)

C. Offsite Architect-Engineer Work

The Offsite Architect-Engineer has contract options to perform the definitive design and construction engineering/inspection on this project. The definitive design will include the preparation of individual design packages for each construction and procurement package. Construction engineering/inspection will include shop inspection of procurement packages, equipment and materials. Offsite Architect-Engineer services also include the development of a three-dimensional electronic model of the facility and the maintenance of the three dimensional electronic model throughout the construction of the facility. The Offsite Architect-Engineer will participate in day-to-day control surveying during construction.

D. Onsite Engineer-Constructor Work

The Onsite Engineer-Constructor, Kaiser Engineers Hanford Company, will serve as the construction manager for the HWVP Project with prime responsibility for the management of field operations, constructability review, and construction support services. In addition, the Onsite Engineer-Constructor may perform design of site sensitive type items. Design of utility system and feed line interfaces with existing systems represent the type of work anticipated. The Onsite Engineer-Constructor will also participate in field survey activities.

V. METHODS OF PERFORMANCE (Continued)

E. Procurement Strategy

The HWVP is planned and estimated to be constructed under fixed price contract agreements placed and administrated by the Onsite Engineer-Constructor. Responsibility for procurement of materials and equipment is divided into two categories, government furnished and construction contractor furnished. Equipment and material will be furnished by the government when:

- The item cannot be procured by the construction contractor in time to meet construction schedule requirements.
- The item is engineered for a special process or requires special inspection and testing.
- The item must be procured by the Onsite Engineer-Constructor to assure compatibility with existing Hanford installations.

Government furnished equipment will be procured either by the O&EC or the Onsite Engineer-Constructor.

There are 18 separate government furnished equipment/material procurement packages.

1. Embed Material and Nozzle Boxes
2. Shield Windows, Shields, and Cart
3. Manipulators, Plugs, and Cart
4. Canyon Bridge Crane and Controls
5. Process Vessels and Associated Equipment
6. Melter/Turntable and Associated Equipment
7. Gamma Canister Level Detection Equipment
8. Final Canister Decontamination Equipment
9. Plug Welder Station Equipment
10. Inner Canister Closure/Temperature Survey System
11. Jumper Material and Fabrication
12. Standby Generators

V. E. Procurement Strategy (Continued)

13. 13.8 kV Switchgear

14. Distributed Control System Equipment

15. Health Protection Equipment

16. Closed Circuit TV System

17. Laboratory Equipment

18. Shop Maintenance Equipment

The scope of each material and equipment package includes delivery to the project site. The material and equipment will be installed in the facility under the appropriate fixed price construction contract identified in Section V.B. The Onsite Engineer-Constructor's procurement practices will be in accordance with DOE procurement regulations.

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VI. REQUIREMENTS AND ASSESSMENTS

A. Safeguards and Security

The HWVP will be constructed entirely within the existing 200 East Area boundaries. Vehicular and personnel access to the facility will be through existing 200 East Area guardhouses.

During construction, the existing 200 East Area perimeter fence line, patrol roads and security lighting will be modified to isolate the construction area, to reduce or eliminate the security escort requirements for construction personnel, and to prevent unauthorized personnel from entering the 200 East security area.

Upon completion of construction, the temporary construction fence will be modified into a permanent fence surrounding the HWVP, within the 200 East Area. Access gates to the facility from within 200 East Area will be open and unguarded during normal day shift operations. Gates will be secured during off-shift hours with access provided on an as needed basis.

The HWVP will not contain classified information and therefore, the risk assessment is moderate to low. Security system design is concentrated on protection of expensive material and equipment.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

B. Health and Safety

Health and safety requirements are vital criteria for both the design and operation of the facility and for the protection of personnel during construction.

During the construction period, contractors will be required to take all reasonable precautions in the performance of their work to protect the health and safety of their employees, subcontractors, Operating Contractor and DOE personnel. At all times, the construction area will be accessible to emergency vehicles, and emergency evacuation of personnel will not be obstructed.

The HWVP will also be designed and operated in accordance with applicable federal, state and local regulations. Chemicals will be stored in accordance with manufacturers recommendations, NFPA 30, and Occupational Safety and Health Administration (OSHA) 1910. Specific facility design safety features include shielding, contamination control, control of toxic/hazardous materials, process safety, and the design of the facility to withstand design base accidents without undue risk to the health and safety of the general public or operating personnel.

Each of these facility safety design features are described below:

1. Radiation Exposure Criteria and Shielding

The overall goal is to limit radiation exposure levels to as low as reasonably achievable (ALARA). The specific criteria for HWVP are described below. The HWVP will be designed so that individual occupational exposure will be less than or equal to 1 rem/year from all sources. This criteria will be accomplished primarily by using a combination of features in the design and operation of the plant to minimize exposure, including shielding, distance, and where necessary, restricting time of occupancy. In the application of time limitations, working areas of the plant are classified into four zones, depending on their function and the expected occupancy rates. Design maximum exposure limits are established for each zone as follows:

VI. B. 1. Radiation Exposure Criteria and Shielding (Continued)

Shielding Design Criteria

Zone	Design Maximum Exposure Limit (mR/h)
Unrestricted Access Zone	0.1
Normally Occupied Zone	0.2
Limited Access Zone	2.0
Controlled Access Zone	30.0

The Unrestricted Access Zone includes areas that can be occupied on a full-time basis and which have negligible radiation background. These areas may or may not require dosimetry to monitor exposure, and time of occupancy is not limited in any way. Ensuring that radiation levels are at negligible values is accomplished by the location of such areas away from any major sources of radiation, as well as the application of shielding to make sure that personnel occupying such areas of the plant receive negligible radiation exposure. Some examples of plant design features employed to ensure that Unrestricted Access Zone areas are maintained include:

- Location of offices for support personnel, control rooms and non-radiological operations in buildings remote from the sources of radiation.

- Pipelines between the tank farms and the RLST will be buried to a depth of approximately 56 inches to ensure unrestricted personnel activity above grade.

- The Sand Filter roof will be covered with up to 16 inches of concrete to ensure that radiation levels on the roof permit unrestricted access.

- The buried Receipt and Lag Storage Tank will have a shielded cover of up to 57 inches of concrete to ensure that unrestricted personnel activity can be maintained above the tank.

The Normally Occupied Zones include operating galleries and those areas in which the radiation levels are normally low, but in which some above background levels of radiation might exist. These areas require dosimetry and other radiation detection and monitoring equipment. Exposure in these areas is controlled by shielding. Personnel dosimetry is utilized to ensure that personnel radiation exposure does not exceed established limits.

VI. B. 1. Radiation Exposure Criteria and Shielding (Continued)

Radiation shielding materials, primarily in the form of thick concrete shield walls and cover blocks, are a part of the plant design. Examples of areas of the plant where significant concrete shield walls have been included to protect personnel are the following:

- Chemical Processing Cell east wall - 50 inches
- Vitrification Building roof over Chemical Processing Cell - 38 inches
- Canister Storage Building walls (64 inches) and roof (58 inches)
- Sample Cell wall - 34 inches

Limited Access Zones are those areas where workers must be protected by controlled time access and dosimetry, and include areas where it is not possible to reduce radiation practically or economically to levels acceptable for normal occupancy, yet occasional occupancy for short periods is permitted using restrictions on time as an alternative to designing for unrestricted or normal occupancy. In designating an area as a Limited Access Zone, it is necessary to make sure that there are no activities required to be accomplished in such an area which will require frequent, continuous occupancy. No specific examples of Limited Access Zones were identified during RCD.

Controlled Access Zones require health protection surveillance and control over the time a worker can spend in the area. Activities such as decontamination and equipment maintenance and repair fall within this classification. In Controlled Access Zones, shielding and maintaining a distance from sources are used to control radiation in addition to restricting time of occupancy. An example of a Controlled Access Zone is the Canyon space above the Chemical Processing Cell (CPC) cover blocks. Cover blocks over the CPC will limit radiation levels in the areas above the cover blocks to less than 30 mR/hr. This area is not normally occupied except for occasional periods when inspection or maintenance operations are performed.

VI. B. Health and Safety (Continued)

2. Nonradiological Hazards and Control of Toxic/Hazardous Materials

The HWVP will be designed and operated to meet applicable state and local air and water quality standards. Specific provisions are made in the design for the safe storage and handling of hazardous chemicals so that releases of hazardous or toxic materials to the public or exposure of onsite personnel to such materials will be less than established limits. Design features include:

- Separation of incompatible chemicals
- Location of chemical receipt, storage, and feed systems and equipment to limited areas protected with curbing and sumps to contain spillage
- Use of special ventilation systems in hazardous chemical areas to ensure exhausting of harmful vapors which could result from spills
- Inclusion of toxic gas analyzers to detect the presence of toxic materials released in a spill

3. General Siting Considerations

The HWVP will be located in the 200 East Area of the Hanford Site. The Hanford Site was originally established as a facilities site for the large-scale production of plutonium and handling of radioactive material. This site selection was based on site characteristics that are conducive to safe operation and that will minimize the potential for accidents. Other site considerations are the following:

- The site is located in a region in which local weather conditions are normally moderate. However, a potential exists for damage to the plant resulting from weather phenomena such as tornados, high winds, lightning, and snow and ice.
- The site is located in a high, flat plain. General flooding of the plain caused by local precipitation or as a result of the maximum projected water levels of the Columbia River is not considered credible.

VI. B. 3. General Siting Considerations (Continued)

- Seismic activity at the site has been described as infrequent, with moderate intensity levels. An earthquake giving a horizontal acceleration of 0.25 g has been selected as the Hanford Safe Shutdown Earthquake.

In addition to minimizing the probability of accidents, the site characteristics will also mitigate the consequences of any potential accident, including the following considerations:

- The site is isolated and located in a region of sparse vegetation with a small animal population. The closest metropolitan area is 25 miles away.

- The water table is 250 to 300 feet below the site.

- The site is usually subjected to dispersive atmospheric conditions. Very stable (inversion) conditions that are nondispersive prevail only 6 percent of the time; therefore downwind diffusion and dispersion of airborne radioactive effluents released during a potential accident would be under favorable meteorological conditions 94 percent of the time. This will minimize the exposure of the surrounding population and operating personnel, and also minimize recovery time.

4. Facility Design Safety Features

The design of HWVP will provide stringent confinement of radioactive materials, process safety, and adequate protection of the general public and operating personnel, considering the consequences of design base accidents.

Design features for confinement of radioactive materials include:

- The process vessels and off-gas systems form a primary confinement barrier

- Shielded reinforced concrete cells

- Remote operation of process systems

- Process off-gas treatment for removal of gaseous radionuclides and contaminated particulates

VI. B. 4. Facility Design Safety Features (Continued)

- Final exhaust air treatment through a Sand Filter and HEPA filter
- Remote sampling and analysis capabilities
- Penetrations sealed to prevent the spread of contamination
- Airflow from less contaminated to more contaminated areas and separation of areas into HVAC zones
- Remote decontamination of highly radioactive components in confinement areas prior to performing repair or maintenance
- Collection of potentially radioactive liquids in drain catch tanks and transfer of wastes to nonradioactive systems only after analysis demonstrates acceptability
- Effluent monitors on all gaseous and liquid effluent release paths
- Radiation and contamination monitoring for personnel exposure

Process safety will be assured by the use of protective functions in the design of process systems and the Distributed Control System (DCS). The DCS and process systems are designed to sense potentially hazardous or accident situations, and activate systems and components required to ensure the safety of operating personnel and the public, and give audible and visual alarm so that action can be taken in a timely manner.

These protective functions are designed so that no single failure of an active component results in the loss of the protective function, and removal from service of any active component does not result in the loss of the protective function.

Process systems are designed to fail into a safe state if conditions such as disconnection of the system, loss of electrical power, or adverse environments are experienced.

VI. B. 4. Facility Design Safety Features (Continued)

Examples of protective functions in the HWVP include:

- The Zone I HVAC exhaust system is designed to ensure confinement of highly contaminated areas of the Vitrification Building at all times. Upon loss of normal electrical power, the Zone I supply dampers close, and the Zone I HVAC systems are operated in an exhaust-only mode, with power supplied from the diesel-generators. Redundancy is provided for all active components of the Zone I HVAC exhaust system, control systems, and the diesel generators.

- The Melter Off-Gas (MOG) System is designed to maintain a negative pressure in the Melter vapor space at all times the Melter is operating. A pressure rise in the Melter vapor space causes automatic diversion of the off-gas to a backup MOG System.

The facility is designed to withstand design base accidents including design basis fires, power failures, earthquakes, tornados and ashfall.

The HWVP facility and systems will withstand fire damage and maintain containment and confinement barriers. The facility will be designed to withstand a total loss of power for 60 seconds and a loss of normal power for 48 hours without loss of containment and confinement barriers. The structures of the HWVP, which are necessary to prevent or mitigate consequences of accidents that would result in a risk to onsite personnel, or are necessary to maintain the plant in a safe shutdown condition and maintain the integrity of the final containment and confinement barriers, are designed to survive a Safe Shutdown Earthquake without loss of operability or function.

5. Industrial Safety

In accordance with DOE Order 6430.1, the design of the HWVP will follow safety and health requirements of DOE and applicable local, regional and state codes, standards, and regulations. The facility will be designed to ensure compliance with DOE and Occupational Safety and Health Administration regulations. The design's performance objectives for protection against known hazards will include:

- Protection of employees from injury, exposure to harmful physical agents and toxic material, and exposure to radiation over allowable limits.

VI. B. 5. Industrial Safety (Continued)

- Minimizing accident potential
- Limiting loss or damage to government property.

6. Fire Protection System

See Section IV.B.9 of this report for a complete description of the fire protection system proposed for this project.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

C. Decontamination and Decommissioning

1. Facility Design

The HWVP is designed to facilitate future decontamination and decommissioning in accordance with applicable codes and standards. All process cells either have stainless steel liners or have radiation resistant coatings as appropriate. The REDC and CDMC will have 304L stainless steel liners on the walls and floors. The crane maintenance area has a 304L stainless steel floor extending 18 inches up the wall. Flush rings with spray nozzles are installed in all process and service cells to facilitate decontamination. Equipment or components may be decontaminated before repair or disposal. Repairs, if feasible, will be conducted off-line and will be performed by direct contact or remotely, depending on radiation levels present. All process vessels are equipped for internal decontamination.

Design features incorporated for decommissioning of the sand filter include protective coating at the inlet, dust proofing at the exit, and access by airlock to the top of the filter for sand removal and decontamination. Decommissioning of the sand filter is an issue that shall be addressed in future design phases and will incorporate Hanford decommissioning practices.

2. Equipment Disposal

Failed equipment will be included in the solid radioactive wastes produced during the operation of the HWVP; however, the failure of large radioactive process equipment will not be routine except for the Melter which is expected to be replaced every three years. Rapid replacement of such equipment will be essential to plant efficiency. Some failed equipment items and most solid waste can be packaged directly without decontamination or disassembly. Large pieces of equipment will require decontamination and disassembly prior to disposal. Special packaging will be required for radioactive and hazardous wastes.

The level of contamination and disassembly requirements will dictate the method of packaging. If thorough decontamination and disassembly of failed equipment is performed, packaging can be done directly. Highly contaminated waste will require remote packaging.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

D. Provisions for Fallout Shelters

The construction of fallout shelters will not be required for the HWVP.

E. Operation and Maintenance

The Hanford Waste Vitrification Plant is designed to operate safely at a minimum of 70 percent effective operational availability, excluding Melter replacement. A combination of reliability, redundancy, and maintenance/repair features is used in equipment and system design to achieve this goal. Preventive maintenance and surveillance is performed to further enhance plant availability and minimize random failures. The batch nature of the major portion of the process systems, coupled with in-process surge storage capabilities, minimizes process overall downtime and allows for preventive maintenance.

With respect to reliability, commercially available and proven equipment is used to the greatest extent possible. Operational data from such equipment used in similar applications will be used to forecast reliability expectations of such equipment. New equipment, e.g., Melter/Turntable, canister decontamination chamber, etc., is undergoing testing to establish confidence in operational life and maintainability.

Quality assurance/quality control programs during design, component manufacturing, and plant construction will assure and control high quality performance standards during these phases and thus minimize random failure probability during later plant operation.

Redundancy is applied not only according to safety criteria, but also whenever deemed necessary to support the 70 percent operational availability goal. Typically, redundant trains are provided for crucial systems operated on a continuous basis.

Maintenance activities cover both remote and contact maintenance. Remote maintenance is performed in all areas not accessible to manned entry. All contact maintenance is performed in accordance with ALARA guidelines. Contamination control and decontamination features support this approach. For maintenance, the system design considers the following guidelines:

- Contact maintain in place; applies to noncontaminated and low level contaminated equipment in accordance with ALARA guidelines.

VI. E. Operation and Maintenance (Continued)

- Contact maintain after removal and decontamination; applies where downtime for removal, decontamination and repair has no significant effect on overall operational availability (e.g. when redundancy is available).

- Contact maintain after removal and decontamination, replace component with spare unit, requalify disabled unit after repairs; applies where downtime would effect operational availability.

- Remotely maintain in place; applies where remote tooling is available

- Remotely maintain after removal into remote maintenance cell

- Remotely replace

Clean and regulated maintenance shops, as well as contact and remote maintenance cells, serve these requirements. Highly specialized maintenance facilities are provided with the necessary remote handling capabilities for cranes and manipulators.

Spare parts are maintained for all essential production and safety equipment. Spare parts requirement analyses will be started during definitive design.

Design and layout of process systems enhance physical access for operation and maintenance, provide remote handling capabilities where required for safety of operating and maintenance personnel, and reduce personnel radiation exposure.

Similar process operations are grouped or combined to promote overall efficiency. To the extent practical, drive motors, instruments, and other equipment servicing process operations will be located external to the cells to facilitate replacement and repair. Compartmentalization isolates high risk areas to minimize productivity losses in the event of a leak or spill. Sufficient spacing between units and in passageways is provided to facilitate relocation and maintenance of equipment, to ease operation, and to reduce radiation exposure from adjacent operations.

A central control room is provided, along with appropriately shielded field operating stations located at a distance from the processes they serve.

See also Section IV.D.10 for additional maintenance information.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

F. Automated Data Processing Equipment (ADPE)

ADPE will be used extensively within the HWVP for automation of plant processes and support of plant operation and administration. ADPE will provide the capability to safely control the vitrification process, operate the facility, and establish a data base of process, product and facility data. The HWVP automation environment will be a distributed system of separate integrated components under diverse management and control.

The following systems provide the major components of ADPE within the HWVP: Distributed Control; Health Physics and Radiation Monitoring; Information Management; Analytical Laboratory; Development and Training; Computer Aided Design and Drafting (CADD); and Maintenance, Engineering and Administration.

The computer based Distributed Control System (DCS) provides plant/utilities, process/waste, and operation control and monitoring functions in a single integrated system. The DCS is a network of local instrumentation processing units, plant operating stations and host computers that additionally interface to other local networks both inside and outside the HWVP plant. For additional information concerning the DCS, see Section IV.D.3. A Development and Training system will be used for training operators, supervisors, and engineers and will also permit software development and testing.

In addition to the computer systems located inside the facility, the HWVP will interface with a number of computer and control systems outside the plant. These external systems support security, fire alarms, waste transfer, tank surveillance, electrical power, analytical laboratory analyses, maintenance engineering, plant administration, and large scale computer modeling, analysis, and CADD.

Extensive data communication capabilities will interface plant systems with each other and with computer systems outside the facility. HWVP external communication interfaces can be divided into three types: (1) real-time systems to monitor and control physical processes, (2) computer networks to provide computer to computer communication, and (3) interactive (on-line) systems to provide data access and computation resources on demand. As a minimum, there will be at least two data communication systems: the data highway provided by the DCS vendor, and the general purpose Local Area Network (LAN) which will be compatible with the Hanford Site General Usage Network (GUN).

VI. F. Automated Data Processing Equipment (Continued)

The approach to Automated Data Processing (ADP) management will be documented in the periodically issued ADP Plan. This plan will collect in one document, the objectives, strategies, responsibilities, and schedules related to the application of ADP in support of the HWVP. More specifically, this plan will describe the various types of automation required for the plant, who will define it, who will build it or provide it, who will provide training and operation, and the quality assurance and configuration control criteria required for hardware and software. For each system, the key activity is the documentation of system functions. A structured methodology such as Yourdon will be used for requirements analysis and definition.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

G. Quality Assurance and Impact Levels

The HWVP will follow Quality Assurance requirements stated in DOE Order 5700.6B, and DOE Richland Operations Office (DOE/RL) Order RL5700.1A. These orders established American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME), Quality Assurance Program Requirements for Nuclear Facilities, NQA-1, as the quality standard.

The quality impact level will provide a system of control which reflects the importance of the HWVP facilities, systems and equipment, based on their complexity, operation cost and schedule, safety, consequences of failure and compliance with standards and regulations. The assigned impact level represents the highest level of concern for a design. Areas of the design that do not require the same impact level shall be identified by the design media for the proper level of control. Impact levels, based on consequences of failures are provided for the HWVP, on a system, subsystem and major component basis, in accordance with the following criteria:

Impact Level I - Applied to items whose failure could:

- Result in (or increase the severity of) a release of radioactive, hazardous, or toxic material to the public or environs beyond established release limits.
- Inhibit the detection of such releases.
- Prevent control, including safe shutdown, which would reduce the magnitude or consequence of such releases.

Impact Level II - Applies to items whose failure could:

- Expose onsite personnel to radioactive, hazardous, or toxic material beyond established limits.
- Cause a major impact in achievement of facility or program objectives (tests, operations, production).

Impact Level III - Applies to items whose failure could:

Directly impact normal facility operations or services, but would not expose personnel to radioactive, hazardous, or toxic materials beyond established limits.

VI. G. Quality Assurance Impact Levels (Continued)

Impact Level I has been assigned to the following items of the plant:

- Vitrification Building process cells, Sample Cell, Analytical Cells, Railroad Well and Railroad Well door, exhaust tunnels, Canyon, Crane Busbar Maintenance Corridor, Crane Maintenance Area and Vertical Lift Shield Door Area
- Fan House Building
- Sand Filter
- Switchgear/Generator Building
- RLST/WHT Vaults
- Fire Protection (Halon) and Detection System Protecting Zone 1 HVAC Equipment
- Zone I HVAC System
- Zone IV Fan House Building HVAC System
- Zone IV Switchgear/Generator Building HVAC System
- Zone I RLST/WHT Primary Ventilation System
- Feed Receipt System
- RLST/WHT Transfer Piping
- Standby and UPS Subsystems of the Electrical Distribution System
- Instrument/Plant Air Compression System Required to Support Zone I HVAC system
- Vacuum System Required to Support Zone I HVAC Effluent Radioactivity Monitors
- Health Protection and Radiation Monitoring System Hard Wired Controls and Readouts for Zone I HVAC System

Impact Level II has been assigned to the following items of the plant:

- Vitrification Building (other than Impact Level I areas)

VI. G. Quality Assurance Impact Levels (Continued)

- Manipulator Repair Building Glove Boxes
- Canister Storage Building
- Service Building Cold Chemical Area
- Zone 1 Metal Stack and Foundation
- Fire Protection and Detection (other than Impact Level I equipment)
- Zone II Vitrification Building HVAC
- Zone III Vitrification Building HVAC Tornado Dampers in Supply Air Ducts
- Zone III Canister Storage Building HVAC
- Feed Preparation System
- Melter/Turntable
- Melter Offgas System
- Vessel Vent System
- Canister Decontamination System
- Canister Closure System
- Interim Canister Storage System Racks
- Radioactive Process Waste Collection and Treatment System
- Crane Decontamination Feed Tanks
- Melter Feed System
- Canister Handling and Inspection System
- Primary Electrical Supply System
- Electrical Distribution System Normal Subsystem
- Instrument/Plant Air Compression System Required to Support Process Systems, Health Protection and Radiation Monitoring Systems, and Process Sampling System (other than Impact Level I equipment)

VI. G. Quality Assurance Impact Levels (Continued)

- Breathing Air/Bottled Air Subsystems
- Process Steam and Condensate System Radioactivity Monitors
- Process Cooling Water System
- Melter Cooling Water System
- Process Chilled Water System
- Fire Water System
- Potentially Radioactive Liquid Waste Collection System Sump Pumps and Transfer Pumps
- Nonradioactive Liquid Waste Collection, Treatment, and Disposal System Sump Pumps and Transfer Pumps
- Chemical Receipt, Make-up and Distribution System
- Cold Feed Service Building Vent; Cold Feed Vitrification Building Vent
- Distributed Control System
- Health Protection and Radiation Monitoring System (other than Impact Level I Components)
- Process Sampling System
- Analytical Cell Systems
- Hot Cell Crane and Canyon Crane with Bridge Mounted CCTV
- Electromechanical and Master-Slave Manipulators
- Wall Mounted CCTV System
- Shield Windows

Impact Level III has been assigned to the following items:

- Manipulator Repair Building, Except Glove Boxes and Glove Box Exhaust Fans
- Support Building Control Rooms
- Support Building Health Protection Facilities

VI. G. Quality Assurance Impact Levels (Continued)

- Central Refrigeration System
- Zone III Vitrification Building HVAC System (except Tornado Dampers in Supply Air Ducts)
- Zone IV Service Building HVAC System
- Zone IV Support Building Control Room HVAC System
- Zone II RLST/WHT Annulus Ventilation System
- Canister Load Out System
- Interim Canister Storage System (except Racks)
- General Use Instrument/Plant Air System
- Utility Steam and Condensate System
- Process Steam and Condensate System
- Cooling Tower System
- Process Water System
- Potentially Radioactive Liquid Waste Collection System (except Impact Level II equipment)
- Nonradioactive Liquid Waste Collection, Treatment and Disposal System (except Impact Level II equipment)
- Canister Receipt System
- Frit Receipt and Makeup System
- Communications System
- Remote Lighting
- General Purpose Bails, Yokes, and Grapples
- Elevators

Other items in the facility are designated as No Impact Level. Impact levels will be assigned to all systems on a component and subcomponent level during the definitive design phase.

VI. REQUIREMENTS AND ASSESSMENTS (Continued)

H. Emergency Response

Provisions are made in the Plant to appropriately respond to various emergencies, including the following Alarm Monitoring System (AMS) activated emergency situations: building evacuations, fire and/or explosion, loss of essential services, loss of ventilation, radioactive discharges, and high airborne contamination.

Emergencies such as bomb threats or security breaches are handled administratively by emergency procedures developed as part of the overall plant emergency plan.

Emergency Exits. Nearly all emergencies require partial or complete evacuation of the HWVP facility. Adequate emergency exits are provided to ensure the prompt escape of all plant occupants. Kinds, numbers, locations, and capabilities of exits comply with National Fire Protection Association (NFPA) 101, Life Safety Code. All means of egress are protected with at least 1 hour fire resistance rated walls of substantial construction.

Emergency Response Staging Area. An area adjacent to the HWVP facility within the 200 East Area is designated as an emergency response staging area where escaped occupants gather and are processed in accordance with post-emergency procedures. The area may be combined with B-Plant/WESF areas.

Fire-Fighting and First Aid Provisions. The existing fire brigade and medical facilities serving the 200 East area are used by the HWVP facility and are less than 3 miles away.

Emergency Control Station. The central control rooms in the facility are used as emergency control stations where an emergency response team will monitor plant status and will direct recovery operations. The emergency control stations will communicate by radio with the emergency control center (ECC) in the 2750E building, 200 East Area. The AMS telephone and radio communication links couple to control stations within patrol headquarters.

Standby Power and Uninterruptable Power Supply (UPS). Standby and emergency power requirements are met by generator units and a battery-based UPS system, respectively supplying sufficient power to critical loads necessary for the safe shutdown of the plant and to maintain operation of essential life-saving systems.

Emergency Communication. Essential HWVP communication systems have an UPS and are operational during and after emergency occurrences.

VI. H. Emergency Response (Continued)

Other provisions. Emergency eye washes and safety showers are strategically distributed in the HWVP facility for emergency situations involving hazardous materials. An area is provided in the Support Building for personnel decontamination in emergency situations. A distributed breathing air system is installed in the Vitrification Building. Sufficient face masks and bottled breathing air are available to cover all material handling areas and to provide emergency air supplies in case of high airborne contamination or loss of ventilation.

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VII. IDENTIFICATION AND ANALYSIS OF UNCERTAINTIES

Uncertainties associated with the Hanford Waste Vitrification Plant (HWVP) project can be separated into four categories; namely program decisions, feed composition, technology, and waste acceptance.

Program Decisions. The HWVP design is based upon an expected production of 2000 to 4000 metric tonnes of glass, with reference production being 2900 metric tonnes of glass from double-shell tank waste. The actual HWVP production requirements could change significantly if a decision is made to vitrify single-shell tank waste. The current strategy for permanent disposal of Hanford defense wastes does not include the vitrification of single-shell tank waste. However, this is subject to satisfactory completion of the appropriate National Environmental Policy Act steps. Other program decisions, unforeseeable at this time, may also impact the total production of the facility.

The HWVP is designed to permit the installation of a larger capacity Melter and associated Melter Off-Gas system components in the event that single-shell tank waste is eventually vitrified. Potential options ranging from the retrieval of no single-shell tank waste to the retrieval of waste from 149 single-shell tanks were recently evaluated. The option involving the most single-shell tanks could require the HWVP to operate at a glass production rate of 220 lb/hr for 36 years. A 220 lb/hr Melter, roughly equivalent to the Defense Waste Processing Facility (DWPF) Melter could be placed in the HWVP Melter Cell. This glass production rate increase would also require some modification to the feed system and the Melter Off-Gas system. The size of most of the process cells are not affected by the glass production rate. The cell sizes for canister handling, decontamination, and closure systems are dictated by the size of the canister and associated canister handling equipment. The canister handling, decontamination, and closure systems used by HWVP are based on the DWPF design and can handle the 220 lb/hr production rate with no changes. Therefore, the total additional cost caused by an increase in glass production rate is relatively small.

Feed Composition. Retrieval methods for obtaining a representative sample of the waste to be vitrified by the HWVP have not yet been demonstrated. Until actual sampling has been fully demonstrated, current Process Development efforts are using composition estimates based on flowsheet analysis. The Process Development work within the HWVP program currently is focusing on defining acceptable variability limits for the HWVP process within which the actual feed can be expected to be found. This will ensure that the potential variations in the feed composition from what is expected can be processed in the HWVP.

VII. IDENTIFICATION AND ANALYSIS OF UNCERTAINTIES (Continued)

Technology. The HWVP will use existing vitrification technology to the extent practical. However, some technology development is required and is being performed in parallel with conceptual design and the early stages of definitive design. Development is needed to adapt equipment and the process to HWVP specific feeds, site characteristics, and production rates. The required technology is identified in the Hanford Waste Vitrification Plant Technology Plan (RHO-WM-PL-13 P). The plan divides the development work into specific issues and identifies tasks that must be performed to close each issue. Attention has been given to integrating the technology development schedule with the design schedule to assure that information needed to perform specific design packages is available when needed. For the purposes of the technology plan, eight definitive design packages have been identified which technology issues may be expected to impact. For each package a date has been identified for all needed information to be available and for design work to begin on that package. Each technology issue has been evaluated to determine which package(s) is impacted. A technology development schedule has thus been developed to support the needs of definitive design.

Outside the scope of the Technology Plan, there are some additional technical concerns that are being addressed by engineering studies to be performed by the Operating Contractor or by the Offsite Architect-Engineer. Included in these studies will be an evaluation of HWVP Zone 1 exhaust air filter alternatives.

Waste Acceptance. Acceptance requirements for the waste product of the HWVP will be defined through negotiation with the candidate repositories, under guidance from the U.S. Department of Energy. Although the specific requirements for the vitrified Hanford waste have not yet been defined, they are expected to be very similar to those requirements defined for the waste vitrified at the DWPF located at the Savannah River Plant in South Carolina. A Waste Form Qualification Plan (RHO-RE-PL-34 P) has been prepared which describes the activities that will be followed during the design and operation of the HWVP to ensure that the product will meet the acceptance requirements of the candidate geologic repositories. It is uncertain at this time how much glass sampling will be required of the waste producers. Alternative glass sampling techniques are being considered for incorporation into the Melter and Turntable design. The selected technique will depend, in part, on the sampling frequency required. This issue is addressed in the HWVP Technology Plan. Glass sampling and analysis may cause major system and facility design impacts, depending on the final requirements.

VIII. REFERENCES

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2. Rockwell Hanford Operations, 1986. Technical Data Package - Hanford Waste Vitrification Plant, prepared for Department of Energy, Richland, Washington. Rockwell Hanford Operations, May 1986, SD-HWV-DP-001, Revision 3, July 1986.

3. Rockwell Hanford Operations, 1986. Preliminary Conceptual Design Report - Hanford Waste Vitrification Plant - Project B-595, prepared for Department of Energy, Richland, Washington. Rockwell Hanford Operations, June 1986, SD-HWV-PCR-001, Revision 1, June 1986.

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7. U.S. Department of Energy, 1986. Draft Environmental Impact Statement, Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes, Washington D.C.

8. U.S. Department of Energy, 1987. Implementation of the National Environmental Policy Act at the Richland Operations Office, DOE Order 5440.1A, Richland Operations Office, Richland, Washington

9. Rockwell Hanford Operations, 1985. Environmental Protection Manual, prepared for Department of Energy, Richland, Washington. Rockwell Hanford Operations, RHO-MA-139, January, 1985.

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IX. APPLICABLE CODES AND STANDARDS

Specific National, Federal, State, and local codes and standards required for the design of the HWVP are identified in the Functional Design Criteria, Hanford Waste Vitrification Plant, (SD-HWV-FDC-001), Section 6.0. These codes and standards are incorporated into the Reference Conceptual Design. Additional National, Federal, State and local standards and codes are incorporated into the Reference Conceptual Design. Listed below are the issuing organizations whose standards, specifications, codes, and guides are incorporated into the design.

A. National

Air Conditioning and Refrigeration Institute (ARI)
Air Moving and Conditioning Association (AMCA)
American Concrete Institute (ACI)
American Conference of Industrial Hygienists
American Gear Manufacturers Association (AGMA)
American Institute of Steel Construction (AISC)
American Iron and Steel Institute (AISI)
American National Standards Institute (ANSI)
American Petroleum Institute (API)
American Railway Engineering Association (AREA)
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
American Society for Testing and Materials (ASTM)
American Water Works Association (AWWA)
American Welding Society (AWS)
American Wood-Preservers Association
Cast Iron Soil Pipe Institute (CISPI)
Crane Manufacturers Association of America (CMMA)
Electronics Industries Association
Factory Mutual Engineering Association (FM)
Hoist Manufacturers Institute (HMI)
Illuminating Engineering Society
Insulated Power Cable Engineers Association (IPCEA)
Institute of Electrical and Electronic Engineers (IEEE)
Instrument Society of America (ISA)
International Association of Plumbing and Mechanical Officials
International Conference of Building Officials
Masonry Institute of America
Monorail Manufacturers Association
National Electrical Manufacturers Association (NEMA)
National Fire Protection Association (NFPA)
Scientific Apparatus Manufacturers Association (SAMA)
Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
Society of Automotive Engineers (SAE)
Steel Deck Institute (SDI)
Steel Structures Painting Council (SSPC)

IX. A. National (Continued)

Tile Council of America (TCA)
Underwriters Laboratories (UL)

B. Federal Government

Department of Energy Headquarters (DOE)
Department of Energy Richland Operations Office (DOE/RL)
Department of Transportation (DOT)
Energy Research and Development Administration (ERDA)
Environmental Protection Agency (EPA)
Federal Safety Standards
Federal Specifications
Federal Standards
Military Standards
Nuclear Regulatory Commission (NRC)
Occupational Safety and Health Administration (OSHA)

C. State of Washington

Washington Administrative Code
Washington Industrial Safety and Health Act
Washington Department of Transportation

D. Hanford Plant Standards

E. Operations and Engineering Contractor

APPENDIX A

COST ESTIMATE

INTRODUCTION

The HWVP Total Estimated Cost is presented on the following pages in four summary formats (Formats 1 through 4), and the HWVP Project Cost Estimate is presented in two summary formats (Formats 5 and 6).

- Format 1 - Summary by DOE Cost Code for Construction Projects (primary level) as defined by DOE Order RL5700.3.
- Format 2 - Summary by facility for Budget Authority/Budget Outlay (BA/BO) as shown in Appendix B, HWVP BA/BO Schedule Summary.
- Format 3 - Summary by facility in accordance with the HWVP Project Summary Work Breakdown Structure (PSWBS) as shown in Appendix C, Work Breakdown Structure (WBS).
- Format 4 - Summary by system.
- Format 5 - Total Project Cost Budget Authorization by WBS.
- Format 6 - Total Project Cost Budget Outlay by WBS.

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HANFORD WASTE VITRIFICATION PLANT
TOTAL ESTIMATED COST
FORMAT 1 - SUMMARY BY DOE COST CODE

Cost Code	Description	Escalated Total Cost	-- Contingency -- %	Total	Total Dollars
000	Engineering	139,400,000	24	33,200,000	172,600,000
460	Improvements to Land	10,100,000	20	2,000,000	12,100,000
501	Buildings	174,700,000	17	29,000,000	203,700,000
550	Other Structures	18,200,000	16	2,900,000	21,100,000
600	Utilities	7,200,000	22	1,600,000	8,800,000
700	Special Equipment/Process Systems	404,900,000	23	92,000,000	496,900,000
720	Laboratory Equipment	2,100,000	19	400,000	2,500,000
730	Office Furniture and Equipment	800,000	15	100,000	900,000
755	Shop Equipment	1,200,000	16	200,000	1,400,000
	TOTAL ESTIMATED COST	758,600,000	21	161,400,000	920,000,000

Dollars rounded to the nearest 100,000.

HANFORD WASTE VITRIFICATION PLANT
TOTAL ESTIMATED COST
PROJECT WBS
FORMAT 2 - SUMMARY BY WBS

Description	Escalated Total Cost	-- Contingency -- %	Total	Total Dollars
Engineering				
Title I Design	16,300,000	15	2,500,000	18,800,000
Title II Design	80,000,000	25	20,000,000	100,000,000
Construction Engineering & Inspection	43,100,000	25	10,700,000	53,800,000
Total Engineering	139,400,000	24	33,200,000	172,600,000
Procurement	130,000,000	22	28,200,000	158,200,000
Construction				
Process Facility	213,100,000	21	45,400,000	258,500,000
Support Facilities	169,800,000	20	33,300,000	203,100,000
Total Construction	382,900,000	21	78,700,000	461,600,000
Construction Management	28,800,000	20	5,800,000	34,600,000
Project Management	77,500,000	20	15,500,000	93,000,000
TOTAL ESTIMATED COST	758,600,000	21	161,400,000	920,000,000

Dollars rounded to the nearest 100,000.

HANFORD WASTE VITRIFICATION PLANT
TOTAL ESTIMATED COST
FORMAT 3 - SUMMARY BY WBS

Description	Escalated Total Cost	-- Contingency -- %	Total	Total Dollars
Engineering				
Title I Design	16,300,000	15	2,500,000	18,800,000
Title II Design	80,000,000	25	20,000,000	100,000,000
Construction Engineering & Inspection	43,100,000	25	10,700,000	53,800,000
Total Engineering	139,400,000	24	33,200,000	172,600,000
Procurement and Construction				
Process Facility Vitrification Building	291,900,000	22	64,700,000	356,600,000
Support Facilities Site Work	34,200,000	19	6,500,000	40,700,000
Manipulator Repair Bldg	5,400,000	19	1,000,000	6,400,000
RLST/WHT Facilities	10,400,000	13	1,400,000	11,800,000
Support Building	51,300,000	18	9,000,000	60,300,000
Service Building	23,000,000	17	3,900,000	26,900,000
Canister Storage Bldg	29,000,000	17	4,800,000	33,800,000
Canister Load Out	9,400,000	21	2,000,000	11,400,000
Sand Filter	11,200,000	14	1,600,000	12,800,000
Fan House and Stack	12,500,000	17	2,100,000	14,600,000
Switchgear/Generator Bldg	12,000,000	19	2,300,000	14,300,000
Systems Integration Facility	22,600,000	34	7,600,000	30,200,000
Total Procurement and Construction	512,900,000	21	106,900,000	619,800,000
Construction Management	28,800,000	20	5,800,000	34,600,000
Project Management	77,500,000	20	15,500,000	93,000,000
TOTAL ESTIMATED COST	758,600,000	21	161,400,000	920,000,000

Dollars rounded to the nearest 100,000.

HANFORD WASTE VITRIFICATION PLANT
TOTAL ESTIMATED COST
FORMAT 4 - SUMMARY BY SYSTEM

Description	Escalated Total Cost	Contingency %	Contingency Total	Total Dollars
Title I Design	16,290,000	15	2,450,000	18,740,000
Title II Design	80,010,000	25	20,000,000	100,010,000
Construction Engr. & Insp.	43,060,000	25	10,770,000	53,830,000
Temporary Construction	4,330,000	25	1,080,000	5,410,000
Structures	140,260,000	14	19,610,000	159,870,000
Central Refrigeration	2,500,000	20	500,000	3,000,000
Fire Protect and Detection	2,210,000	55	1,200,000	3,410,000
HVAC	31,160,000	20	6,380,000	37,540,000
Support Equip Repair and Maint	1,720,000	15	250,000	1,970,000
Feed Receipt	7,370,000	13	960,000	8,330,000
Feed Preparation	14,350,000	12	1,780,000	16,130,000
Melter/Turntable	7,240,000	26	1,850,000	9,090,000
Melter Off-Gas	28,060,000	77	21,520,000	49,580,000
Vessel Vent	1,730,000	11	180,000	1,910,000
Canister Decontamination	15,620,000	10	1,560,000	17,180,000
Canister Closure	6,310,000	12	760,000	7,070,000
Interim Canister Storage	2,540,000	30	780,000	3,320,000
Canister Load Out	3,830,000	30	1,140,000	4,970,000
Rad Proc Waste Collect and Treat	18,850,000	10	1,960,000	20,810,000
Equip Decon, Repair and Maint	7,010,000	22	1,540,000	8,550,000
Melter Feed	4,470,000	17	740,000	5,210,000
Canister Handling and Insp	4,940,000	10	500,000	5,440,000
Primary Electrical Supply	1,620,000	43	700,000	2,320,000
Electrical Distribution	42,220,000	20	8,450,000	50,670,000
Compressed Air and Gas	3,300,000	15	490,000	3,790,000
Utility Steam and Condensate	3,820,000	15	570,000	4,390,000
Process Steam and Condensate	1,710,000	40	690,000	2,400,000
Cooling Tower Water	2,290,000	15	340,000	2,630,000
Process Cooling Water	1,570,000	15	240,000	1,810,000
Melter Cooling Water	520,000	15	80,000	600,000
Process Chilled Water	1,110,000	15	170,000	1,280,000
Process Water	770,000	15	110,000	880,000
Sanitary Water and Firewater	2,100,000	15	310,000	2,410,000
Raw Water	260,000	15	40,000	300,000
Sanitary Sewer	480,000	25	120,000	600,000
Potential Rad Liq Waste Collect	2,890,000	21	600,000	3,490,000
Non-Rad Liq Wst Coll, Trt and Disp	2,410,000	15	360,000	2,770,000
Chem Receipt, Make-Up and Distrib	6,700,000	15	1,000,000	7,700,000
Cold Feed Chem Bldg Vent	410,000	15	60,000	470,000
Cold Feed Vit Bldg Vent	880,000	15	130,000	1,010,000
Canister Receipt and Handling	200,000	15	30,000	230,000
Frit Receipt and Make-Up	2,700,000	15	400,000	3,100,000

HANFORD WASTE VITRIFICATION PLANT
TOTAL ESTIMATED COST
FORMAT 4 - SUMMARY BY SYSTEM (Continued)

Description	Escalated Total Cost	-- Contingency -- %	Total	Total Dollars
Distributed Control System	33,030,000	19	6,240,000	39,270,000
HP Rad and Environ Monitoring	16,670,000	14	2,370,000	19,040,000
Process Sampling	10,560,000	21	2,250,000	12,810,000
Analytical Facilities	3,180,000	21	670,000	3,850,000
Communications	760,000	30	230,000	990,000
Remote Handling Equipment	37,190,000	18	6,650,000	43,840,000
Cold Handling Equipment	590,000	20	120,000	710,000
Systems Integration Facility	22,510,000	34	7,730,000	30,240,000
GFE Warehousing	5,900,000	25	1,480,000	7,380,000
Construction Management	28,840,000	20	5,770,000	34,610,000
Project Management	77,530,000	20	15,510,000	93,040,000
TOTAL ESTIMATED COST	758,580,000	21	161,420,000	920,000,000

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR TECHNOLOGY, INC.
Advanced Technology Division
Fluor Contract 8457

SD-HWV-RCD-001 Rev. 0

TOTAL PROJECT COST BUDGET AUTHORIZATION BY WBS
FISCAL YEAR ($000'S, INCLUDES ESCALATION)
FORMAT 5

06/10/87

WBS	TITLE	PRIOR	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	TOTAL
V1	PROGRAM SUPPORT	124,522	113,326	7,500	6,860	16,299	12,647	14,895	19,168	24,674	26,719	30,694	37,895	46,645	37,462	319,306
V11	VITRIFICATION SYS. TECH. DEV.	112,549	3,025	3,096	3,440	7,071	4,638	3,996	3,793	5,359	5,021	4,816	4,410	3,303	0	64,537
V12	CONCEPTUAL DESIGN	6,019	5,920	930	0	0	0	0	0	0	0	0	0	0	0	12,869
V13	WASTE FORM QUALIFICATION	585	199	514	560	2,361	2,621	4,440	6,033	3,430	4,289	4,956	3,065	2,680	242	35,975
V14	TECH. SUP. & STUDIES	2,062	2,071	1,580	1,340	3,789	2,504	2,754	2,484	2,516	2,120	1,742	1,832	1,569	1,051	30,214
V15	HWVP OPERATIONS SUPPORT	0	0	0	0	0	300	1,167	4,138	10,471	12,183	15,624	24,850	35,659	33,496	137,888
V16	BIF TECHNICAL SUPPORT	0	0	100	100	797	193	23	0	0	0	0	0	0	0	1,213
V19	PROGRAM MANAGEMENT	2,487	2,111	1,280	1,420	2,281	2,391	2,515	2,720	2,898	3,106	3,556	3,738	3,634	2,673	34,610
V2	HWVP FACILITY	0	0	7,500	10,000	34,100	71,000	143,100	186,000	300,700	98,300	46,300	23,000	0	0	920,000
V21	ENGINEERING DESIGN & INSPECTION	0	0	4,600	5,900	18,300	42,800	40,100	20,300	13,000	13,000	9,600	5,000	0	0	172,600
V22	PROCUREMENT	0	0	0	0	0	0	78,400	62,400	13,200	1,400	2,800	0	0	0	158,200
V23	CONSTRUCTION	0	0	0	0	5,500	14,100	8,300	84,900	258,900	68,800	18,900	200	0	0	461,600
V24	CONSTRUCTION MANAGEMENT	0	0	200	400	1,800	2,800	4,300	4,700	5,300	5,400	5,300	4,400	0	0	34,600
V25	PROJECT MANAGEMENT	0	0	2,700	3,700	8,500	11,300	12,000	11,700	10,300	9,700	9,700	13,400	0	0	93,000
V4	CEMRTC	0	0	0	0	0	3,305	4,700	6,110	7,665	0	0	0	0	0	21,780
V41	SPARE EQUIPMENT	0	0	0	0	0	500	4,700	6,110	5,600	0	0	0	0	0	16,910
V42	B-CELL EQUIPMENT	0	0	0	0	0	2,805	0	0	2,065	0	0	0	0	0	4,870
V	HWVP (TOTAL PROJECT)	124,522	113,326	115,000	116,860	50,399	86,952	162,695	211,278	333,039	125,019	76,994	60,895	46,645	37,462	1,261,086

TOTAL PROJECT COST BUDGET OUTLAY BY WBS
FISCAL YEAR ($000'S, INCLUDES ESCALATION)
FORMAT 6

06/10/87

WBS	TITLE	PRIOR	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97	FY 98	FY 99	TOTAL
V1	PROGRAM SUPPORT	124,522	113,326	7,500	6,860	16,299	12,647	14,895	19,168	24,674	26,719	30,694	37,895	46,645	37,462	319,306
V11	VITRIFICATION SYS. TECH. DEV.	112,569	3,025	3,096	3,440	7,071	4,638	3,996	3,793	5,359	5,021	4,816	4,410	3,303	0	64,537
V12	CONCEPTUAL DESIGN	6,019	5,920	930	0	0	0	0	0	0	0	0	0	0	0	12,869
V13	WASTE FORM QUALIFICATION	585	199	514	560	2,361	2,621	4,440	6,033	3,630	4,289	4,956	3,065	2,680	242	35,975
V14	TECH. SUP. & STUDIES	2,862	2,071	1,580	1,340	3,789	2,504	2,754	2,484	2,516	2,120	1,742	1,832	1,569	1,051	30,214
V15	HWVP OPERATIONS SUPPORT	0	0	0	0	0	300	1,167	4,138	10,471	12,183	15,624	24,850	35,659	33,496	137,888
V16	RIF TECHNICAL SUPPORT	0	0	100	100	797	193	23	0	0	0	0	0	0	0	1,213
V19	PROGRAM MANAGEMENT	2,487	2,111	1,280	1,420	2,281	2,391	2,515	2,720	2,898	3,106	3,556	3,738	3,434	2,673	36,610
V2	HWVP FACILITY	0	0	6,900	8,400	26,100	53,100	111,100	160,600	149,600	217,900	153,300	25,900	7,100	0	920,000
V21	ENGINEERING DESIGN & INSPECTIO	0	0	4,000	5,300	16,900	34,600	40,900	28,000	12,200	13,000	10,400	6,100	1,200	0	172,600
V22	PROCUREMENT	0	0	0	0	0	0	36,600	81,000	27,100	10,000	3,500	0	0	0	158,200
V23	CONSTRUCTION	0	0	0	0	500	5,400	18,200	35,200	94,500	179,600	124,400	3,800	0	0	461,600
V24	CONSTRUCTION MANAGEMENT	0	0	200	300	1,400	2,500	3,600	4,600	5,200	5,400	5,300	5,000	1,100	0	34,600
V25	PROJECT MANAGEMENT	0	0	2,700	2,800	7,300	10,600	11,800	11,800	10,600	9,900	9,700	11,000	4,800	0	93,000
V4	CENRTC	0	0	0	0	0	1,775	5,055	5,760	6,505	2,685	0	0	0	0	21,780
V41	SPARE EQUIPMENT	0	0	0	0	0	375	3,650	5,760	5,725	1,400	0	0	0	0	16,910
V42	HB-CELL EQUIPMENT	0	0	0	0	0	1,400	1,405	0	780	1,285	0	0	0	0	4,870
V	HWVP (TOTAL PROJECT)	124,522	113,326	114,400	115,260	42,399	67,522	131,050	185,528	180,779	247,304	183,994	63,795	53,745	37,462	1,261,086

APPENDIX B

PROJECT MASTER SCHEDULE

INTRODUCTION

The HWVP Project Master Schedule Summary is contained on Page B-2, the HWVP BA/BO Schedule Summary on Page B-3, and the Total Project Summary Schedule on Page B-4.

Major milestone dates shown on the Project Master Schedule Summary are as follows:

Start Title I Design	January 1988
Start Title II Design	May 1990
Complete Title I Design	July 1990
Start Construction	July 1990
Complete Title II Design	March 1993
Complete Construction	December 1997

The BA/BO Schedule is based on the premise that BA funds for a given fiscal year will not be available until the month of January of that fiscal year. For fixed price construction and procurement contracts the total estimated cost plus escalation plus all but a 10 percent contingency will be required as BA before the contract may be awarded. For cost plus type contracts the BA for the year will be the estimated costs for the year plus escalation plus contingency. The costs shown on the BA/BO schedule are in accordance with the Project Cost Summary, Format 2, shown on page A-3.

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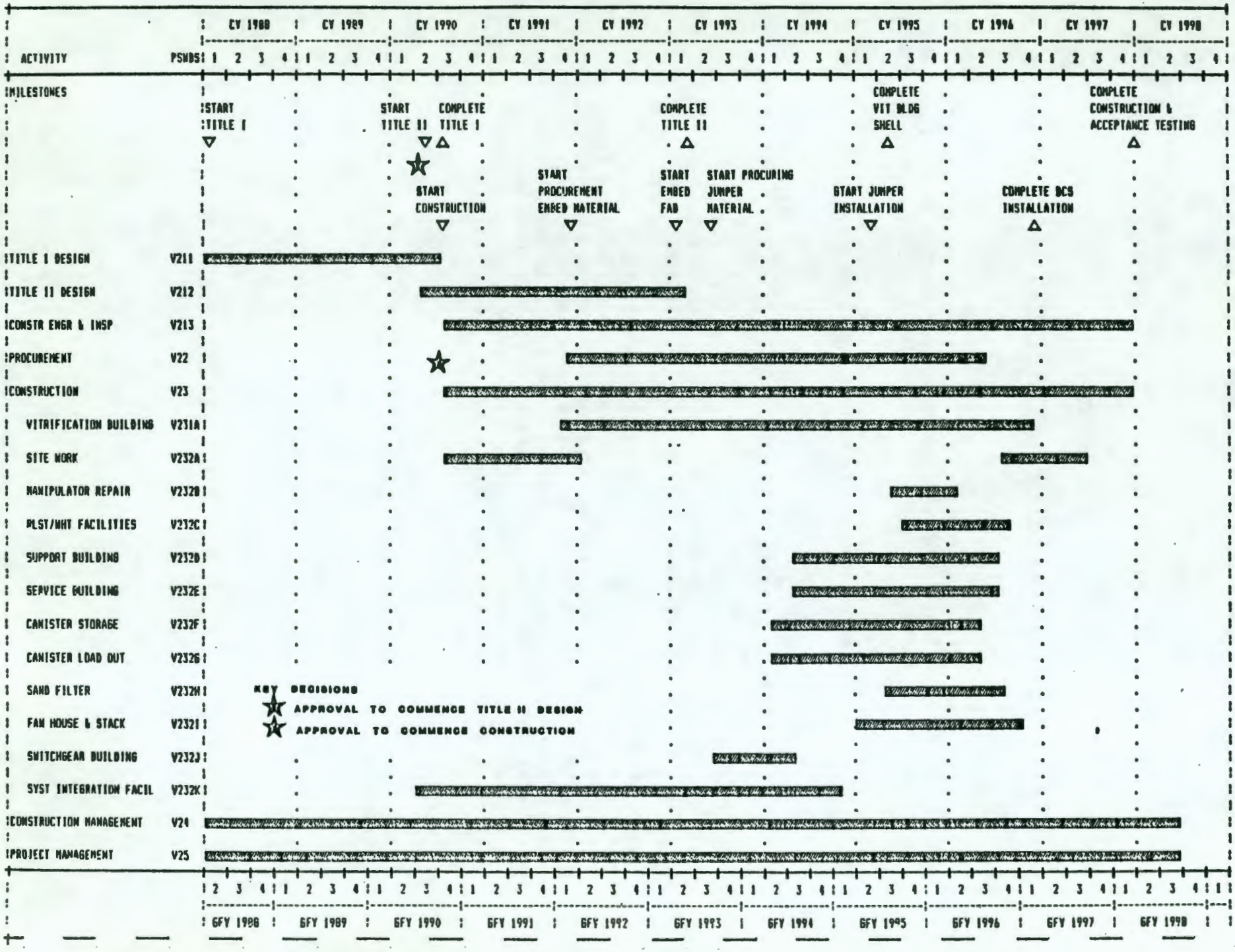
HWVP PROJECT MASTER SCHEDULE SUMMARY

REV 0



HWVP BA/BO SCHEDULE SUMMARY

(BA/BO BASED ON THE RCD PROJECT COST ESTIMATE AND SCHEDULE - REV 0)

ACTIVITY	PSHOS	DOLLARS (BILLIONS)	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
MILESTONES			START TITLE I		START TITLE II; START CONSTRUCTION; COMPLETE TITLE I			COMPLETE TITLE II					COMPLETE CONSTRUCTION
TITLES I & II DESIGN	V211	118.0	0.6 / 0.0	5.9 / 5.3	17.9 / 16.6	32.3 / 30.1	37.6 / 38.7	16.7 / 20.1					
CONSTRUCTION EQUIP/INSP	V212	53.0			0.4 / 0.3	0.5 / 0.5	2.7 / 2.2	9.6 / 7.9	13.0 / 12.2	13.0 / 13.0	9.6 / 10.4	5.0 / 4.1	1.2
PROCUREMENT	V22	130.2					70.4 / 34.6	62.4 / 81.0	13.2 / 27.1	1.4 / 16.0	2.0 / 3.5		
CONSTRUCTION:	V23												
PROCESS FACILITY	V231	250.5				12.3	1.2 / 13.1	45.4 / 18.7	161.6 / 50.1	10.6 / 102.2	7.4 / 45.1	1.3	
SUPPORT FACILITIES	V232	203.1			3.5 / 0.5	1.0 / 5.4	7.1 / 5.1	21.5 / 16.5	97.3 / 34.4	50.2 / 77.4	11.5 / 30.3	0.2 / 2.3	
CONSTRUCTION MANAGEMENT	V24	34.6	0.7 / 0.2	0.4 / 0.3	1.8 / 1.4	2.0 / 2.5	0.3 / 3.4	0.7 / 0.6	5.3 / 5.2	5.4 / 5.4	5.3 / 5.3	4.4 / 5.0	0.1
PROJECT MANAGEMENT	V25	93.0	2.7 / 2.7	3.7 / 2.8	8.5 / 7.3	11.3 / 10.6	12.0 / 11.8	11.7 / 11.8	10.3 / 10.6	9.7 / 9.9	9.7 / 9.7	13.4 / 11.0	4.8
TOTAL BA		920.0	7.5	10.0	34.1	71.0	143.1	185.0	300.7	98.3	44.3	23.0	6
TOTAL BO			4.9	8.4	24.1	53.1	111.1	144.6	149.6	217.9	151.3	25.9	7.1
ACTIVITY			CY 1988	CY 1989	CY 1990	CY 1991	CY 1992	CY 1993	CY 1994	CY 1995	CY 1996	CY 1997	CY 98

LEGEND:

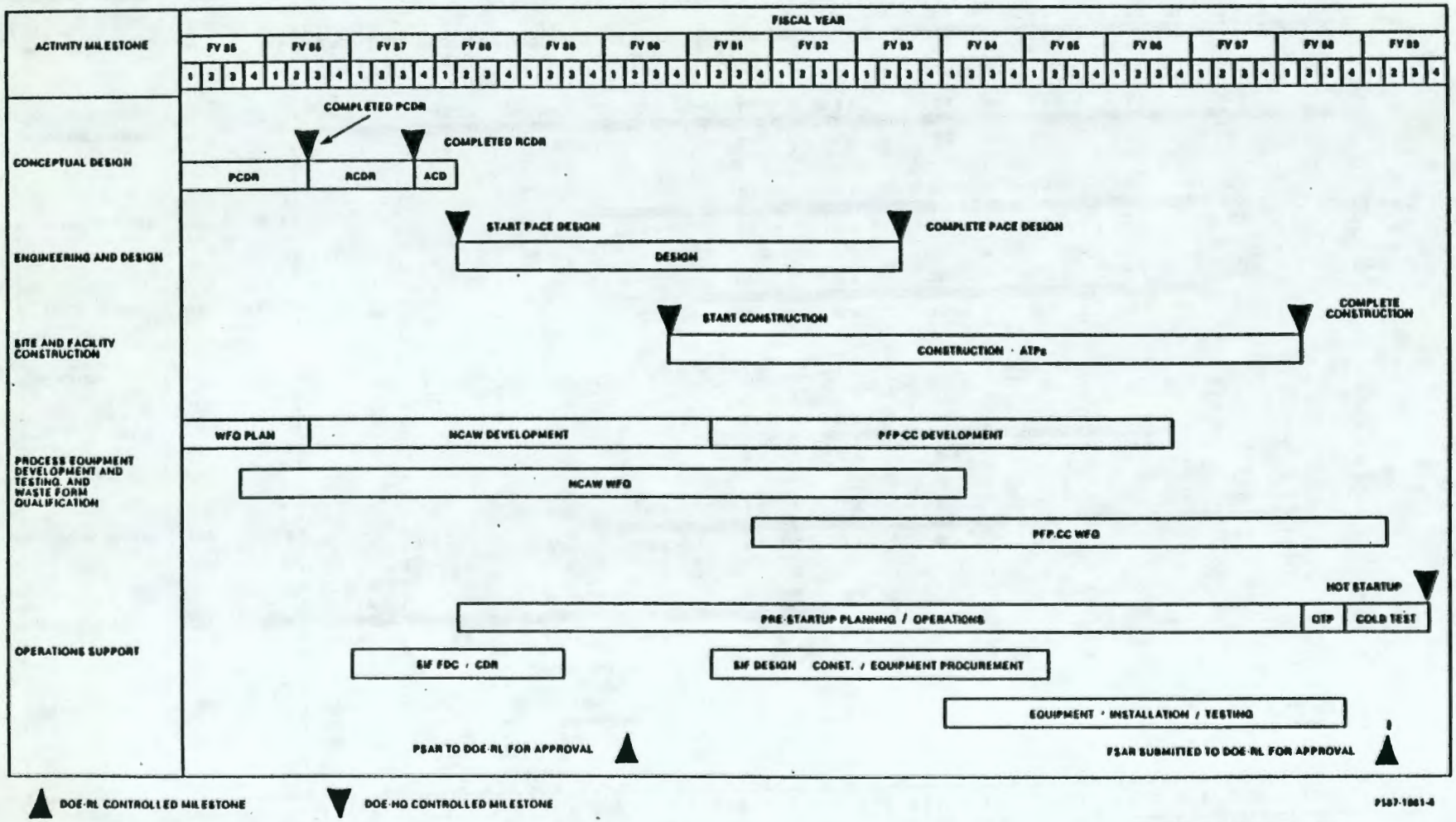
BA ($ IN BILLIONS)

BO ($ IN BILLIONS)

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR TECHNOLOGY, INC.
Advanced Technology Division
Fluor Contract 8457
SD-HWV-RCD-001 Rev. 0

Total Project Summary Schedule



APPENDIX C

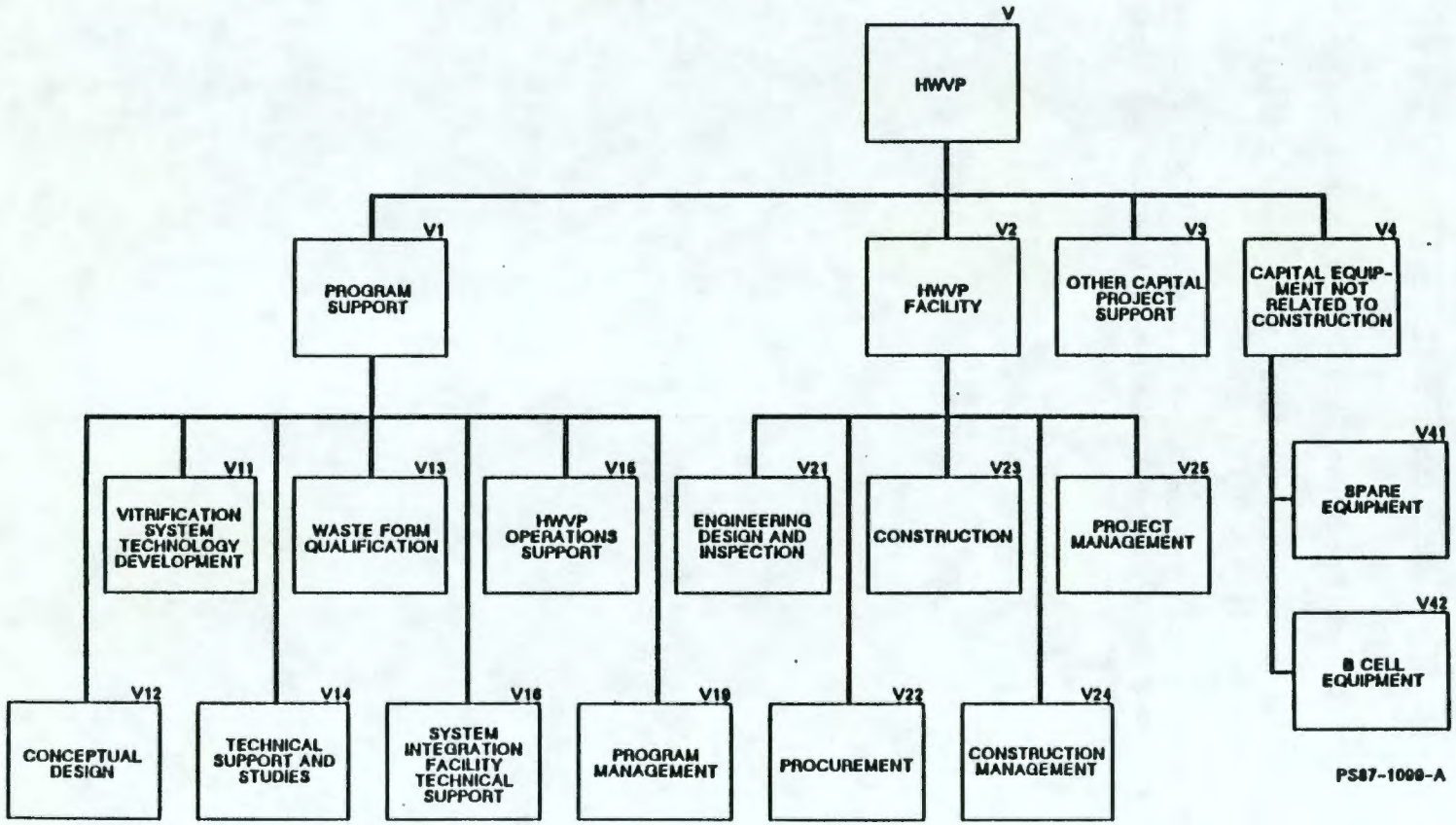
WORK BREAKDOWN STRUCTURE (WBS)

The Total Project Work Breakdown Structure is shown on Page C-2.

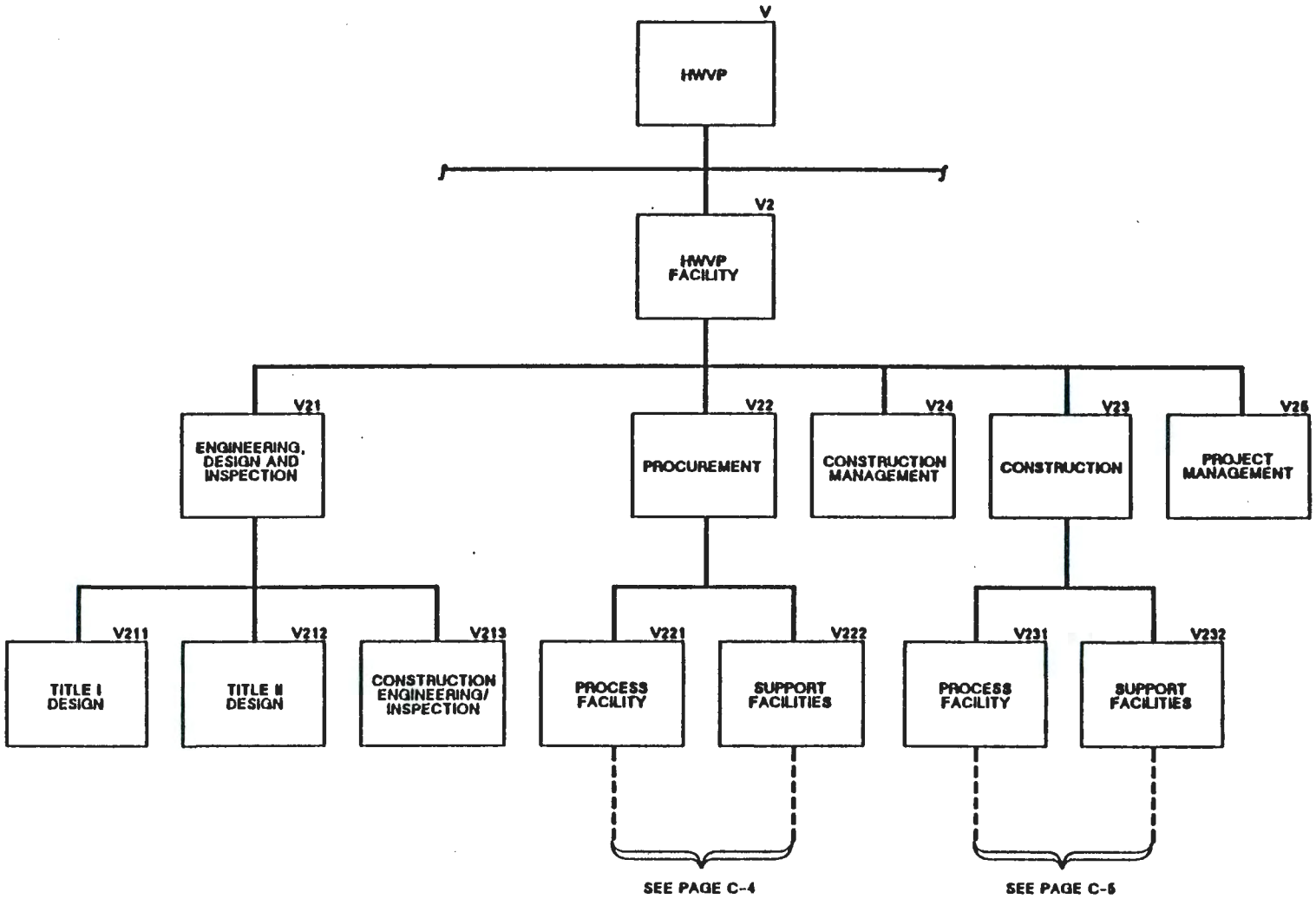
The HWVP Facility portion of the Total Project Work Breakdown Structure (PSWBS) is shown on Pages C-3 through C-5.

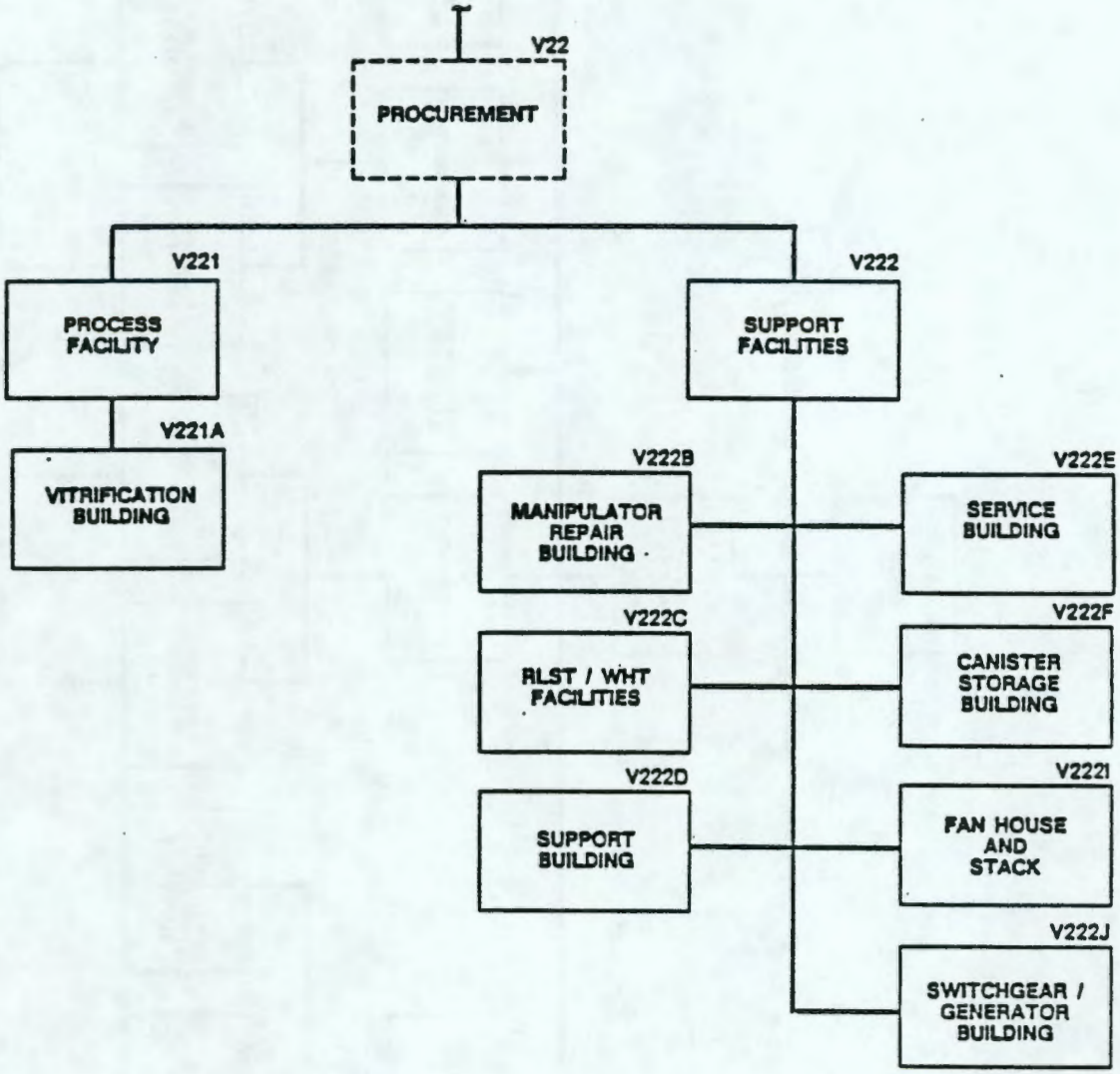
The WBS Dictionary outlined on Pages C-6 through C-8 identifies the procurement and construction packages contained within the procurement and construction WBS elements.

TOTAL PROJECT
WORK BREAKDOWN STRUCTURE



HWVP = HANFORD WASTE VITRIFICATION PLANT


V
HWVP
V2
HWVP FACILITY
V21
ENGINEERING, DESIGN AND INSPECTION
V22
PROCUREMENT
V24
CONSTRUCTION MANAGEMENT
V23
CONSTRUCTION
V26
PROJECT MANAGEMENT
V211
TITLE I DESIGN
V212
TITLE II DESIGN
V213
CONSTRUCTION ENGINEERING/ INSPECTION
V221
PROCESS FACILITY
V222
SUPPORT FACILITIES
V231
PROCESS FACILITY
V232
SUPPORT FACILITIES
SEE PAGE C-4
SEE PAGE C-5


V22
PROCUREMENT
V221
PROCESS FACILITY
V221A
VITRIFICATION BUILDING
V222
SUPPORT FACILITIES
V222B
MANIPULATOR REPAIR BUILDING
V222E
SERVICE BUILDING
V222C
RLST / WHT FACILITIES
V222F
CANISTER STORAGE BUILDING
V222D
SUPPORT BUILDING
V222I
FAN HOUSE AND STACK
V222J
SWITCHGEAR / GENERATOR BUILDING

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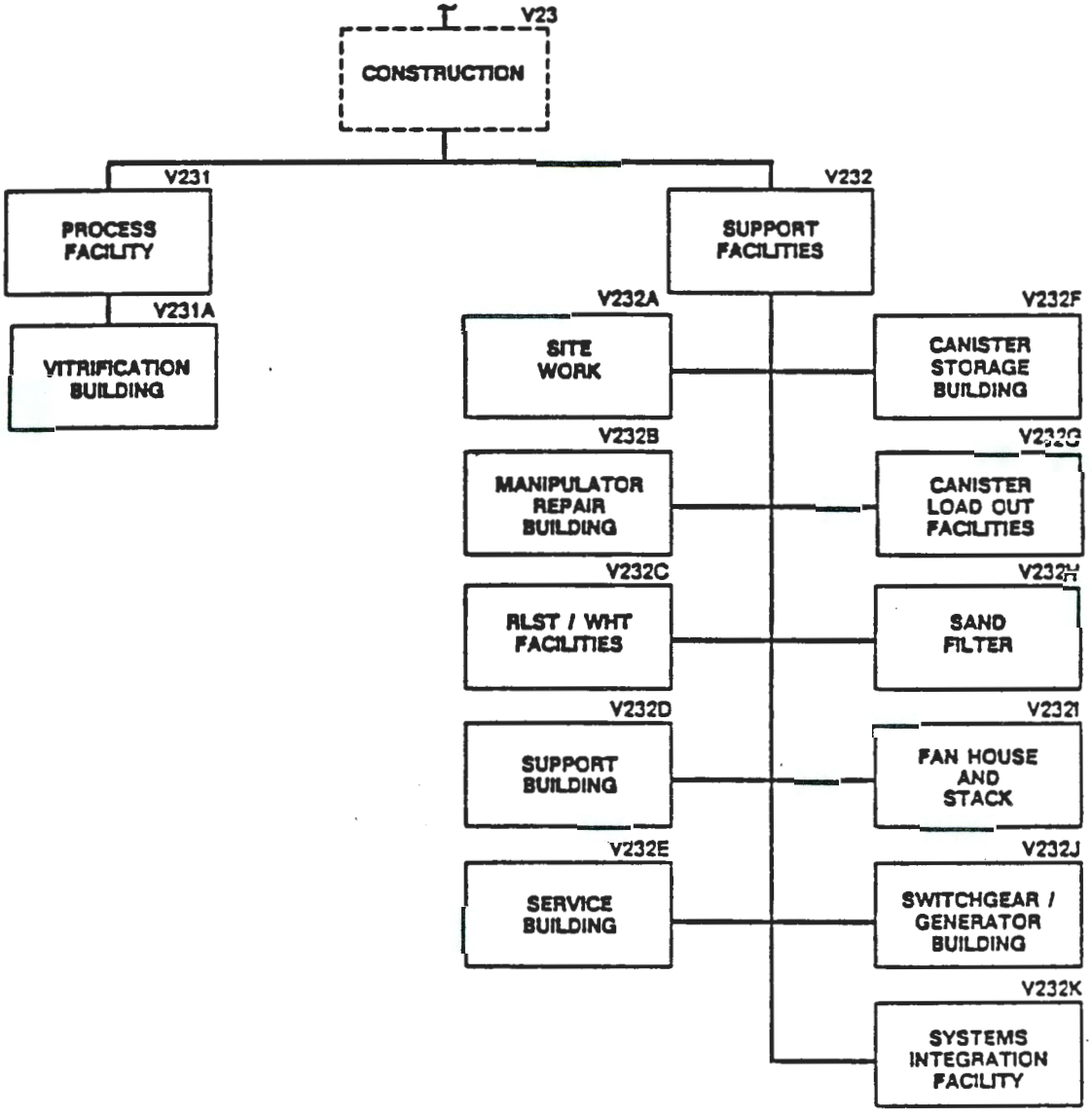
V23
CONSTRUCTION
V231
PROCESS FACILITY
V231A
VITRIFICATION BUILDING
V232
SUPPORT FACILITIES
V232A
SITE WORK
V232B
MANIPULATOR REPAIR BUILDING
V232C
RLST / WHT FACILITIES
V232D
SUPPORT BUILDING
V232E
SERVICE BUILDING
V232F
CANISTER STORAGE BUILDING
V232G
CANISTER LOAD OUT FACILITIES
V232H
SAND FILTER
V232I
FAN HOUSE AND STACK
V232J
SWITCHGEAR / GENERATOR BUILDING
V232K
SYSTEMS INTEGRATION FACILITY

PROJECT COST ESTIMATE & SCHEDULE WORK BREAKDOWN STRUCTURE DICTIONARY

PSWBS LEVEL 1 2 3 4 5	6	DESCRIPTION
V		Hanford Waste Vitrification Plant (HWVP)
V.2		HWVP Facility
V.2.1		Engineering, Design & Inspection
V.2.1.1		Title I Design
V.2.1.2		Title II Design
V.2.1.3		Construction Support & Inspection
V.2.2		Procurement
V.2.2.1		Process Facility
V.2.2.1.A		Vitrification Building:
	P01	Embed Material & Nozzle Boxes
	P02	Shield Windows, Shields & Cart
	P03	Manipulators, Plugs & Cart
	P04	Main Process Crane & Controls
	P05	Process Vessels & Associated Equipment
	P06	Melter/Turntable & Associated Equipment
	P07	Gamma Canister Level Detection System
	P08	Final Canister Decontamination Equipment
	P09	Plug Welder Station Equipment
	P10	Inner Canister Closure/Temperature Survey System
	P11	Jumper Material & Fabrication
	P15	HP Monitoring Equipment
	P16	Closed Circuit TV Equipment
	P17	Laboratory Equipment
	P18	Shop Maintenance Equipment
V.2.2.2		Support Facilities
V.2.2.2.B		Manipulator Repair Building:
	P18	Shop Maintenance Equipment

PSWBS LEVEL 1 2 3 4 5	6	DESCRIPTION
V.2.2.2.C		RLST/WHT Facilities:
	P01	Embed Material & Nozzle Boxes
	P11	Jumper Material & Fabrication
V.2.2.2.D		Support Building:
	P14	DCS Equipment & Software
	P15	HP Monitoring Equipment
V.2.2.2.E		Service Building:
	P15	HP Monitoring Equipment
	P17	Laboratory Equipment
	P18	Shop Maintenance Equipment
V.2.2.2.F		Canister Storage Building:
	P15	HP Monitoring Equipment
V.2.2.2.I		Fan House & Stack:
	P15	HP Monitoring Equipment
V.2.2.2.J		Switchgear/Generator Building and Yard:
	P12	Standby Generators
	P13	13.8kV Switchgear
V.2.3		Construction
V.2.3.1		Process Facility
V.2.3.1.A		Vitrification Building: (1)
	C02	Vitrification Building Foundation & Shell to Elevation 709
	C03	Vitrification Building Shell & Embeds
	C04	Vitrification Building Internals & Architecture
	C08	Vitrification Building Cell Internals

(1) Facility also includes DCS/HP installation package, C05.

PSWBS LEVEL 1 2 3 4 5	6	DESCRIPTION
V.2.3.2		Support Facilities
V.2.3.2.A		Site Work:(1)
	C01	Site Preparation & Temporary Facilities
	C06	RLST/WHT Transfer Line and Tie-Ins
	C15	Outside Utilities & Tie-Ins
	C16	13.8kV Pole Lines
	C17	Final Site Work
V.2.3.2.B	C07	Manipulator Repair Building(1)
V.2.3.2.C	C06	RLST/WHT Facilities(1)
V.2.3.2.D	C11	Support Building(1)
V.2.3.2.E	C11	Service Building(1)
V.2.3.2.F	C10	Canister Storage Building(1)
V.2.3.2.G	C10	Canister Load Out Facilities
V.2.3.2.H	C12	Sand Filter and Air Inlet Tunnel(1)
V.2.3.2.I	C13	Fan House & Stack(1)
V.2.3.2.J	C14	Switchgear/Generator Building and Yard
V.2.3.2.K	C09	Systems Integration Facility
V.2.4		Construction Management
V.2.5		Project Management

(1) Facility also includes DCS/HP installation package, C05.

APPENDIX D

ENERGY CONSERVATION

I. SUMMARY

The HWVP Function Design Criteria identifies specific requirements for energy conservation to be incorporated into the HWVP design. A comprehensive energy conservation report for the HWVP project shall be prepared in a later phase of the design. However, some energy conservation features such as building insulation, heat recovery, evaporative cooling, economizer cycles and automatic controls have been incorporated in the Reference Conceptual Design (RCD). The HWVP is a one-of-a-kind facility and its energy usage cannot be related to a similar facility built to 1975 standards.

II. HWVP ENERGY CONSERVATION FEATURES

A. Heating, Ventilation, and Air Conditioning (HVAC) Heat Recovery

A glycol heat recovery loop is used to recover heat from the Vitrification Building Zone 2 and Zone 3 stack. This heat is used to preheat the Vitrification Building Zone 3 supply air.

Provisions have been incorporated in the design of the Canister Storage Vault HVAC System to accommodate future heat recovery coils. Once the vaults are sufficiently filled with heat generating canisters, this heat would be recovered from the exhaust air stream and used to heat the supply air stream.

The heat recovery systems are also used to precool the supply air stream during the cooling season to reduce refrigeration load.

The economic analysis of the heat recovery systems shall be performed in a later phase of the design.

B. Solar Systems

Solar systems have not been considered for the HWVP in this phase of the design.

C. Building Envelope "U" Factors

The HWVP buildings (except for the Vitrification Building concrete walls and the Sand Filter) are insulated to meet the requirements of DOE General Design Criteria 6430.1 for energy conservation. The walls are insulated to provide an overall heat transfer coefficient of 0.07 Btu/hr. ft.^{2} °F. The roofs are insulated to provide an overall heat transfer coefficient of 0.05 Btu/hr. ft.^{2} °F.

II. C. Building Envelope "U" Factors (Continued)

The Vitrification Building hardened areas have thick concrete walls and heat loss through these walls is minimal. Minimum insulation is provided over these walls to prevent occurrence of freezing temperatures in the walls for protection of embedded piping. The walls are insulated with minimum R = 4 insulation.

The use of fenestration in hardened buildings is not practical. The fenestration in other buildings shall be kept to a minimum. The percent of fenestration of the gross wall area shall be determined in a later phase of the design.

D. Building Systems

1. HVAC Systems

The discussion of building HVAC systems, including fuel type and reason for selection shall be provided in the energy conservation report to be prepared in a later phase of the design. However, the following energy conservation features have been incorporated in the RCD.

a. *Evaporative Cooling*

A study entitled, "Alternative Building Cooling Methods for Vitrification Building and Canister Storage Building," was performed during the RCD phase of the design. The study concluded that use of direct evaporative cooling is the most economical method of cooling the Canister Storage Building. The use of direct evaporative cooling is maximized to conserve energy.

b. *Economy Cycle*

In nonprocess areas the use of an economy cycle is maximized. The outside air is used for cooling as much as possible without mechanical refrigeration or evaporative cooling.

c. Fans

Fans are selected for high operating efficiency. Variable inlet vanes are provided on the fans which require modulation. High efficiency motors are specified for driving the fans.

II. D. 1. HVAC Systems (Continued)

d. Air Duct Design

The supply air ductwork is sized for low velocity/low pressure for energy conservation. The supply ductwork is insulated to minimize heat gain and loss.

2. Interior Lighting

High efficiency fluorescent lighting is provided in all work and operating areas such as control rooms, hallways and offices. In remote locations of high bay areas, low maintenance lighting fixtures with high pressure sodium (HPS) lamps are provided to minimize energy requirements. High power factor ballasts (90 percent or greater) are provided with fluorescent and HPS lighting units.

E. Automatic and Supervisory Control Features

All HVAC systems are provided with automatic controls for temperature control and system operation. The details of HVAC controls shall be included in the energy conservation report to be prepared in a later phase of the design.

F. Total Annual Energy Use Rates

The total annual energy use rate for the facility is approximately 56.8 million KWH of electrical energy and 118 million pounds of 225 psig steam as determined for the HWVP Life Cycle Cost Analysis in the RCD (Appendix F). The HWVP is a unique facility and its energy usage cannot be related to a similar facility built in 1975.

Provisions to meter use of electrical energy are included in the RCD. All significant utilization of energy within the HWVP facility is metered in the primary distribution center within the Switchgear/Generator Building, as required by DOE Order 6430.1. Permanent metering units are installed in the main 15 kV switchgear for the incoming power lines. Permanent metering is also provided with the switchgear branch feeders supplying major load centers in the Vitrification Building, Service Building and the Fan House Building.

The output power for each standby generator is also metered during the standby operation of generator units.

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APPENDIX E

ENVIRONMENTAL PROTECTION EVALUATION

An Environmental Impact Statement for Disposal of Hanford Defense, High-Level, Transuranic, and Tank Wastes (HDW-EIS) is being prepared and encompasses construction and operation of the Hanford Waste Vitrification Plant (HWVP). The Draft Environmental Impact Statement, Disposal of Hanford Defense, High-Level, Transuranic, and Tank Waste (DOE 1986) was released for comment in April 1986 and describes the HWVP facility in general, estimates operational releases, and evaluates the performance of the waste form.

The analyses in the Draft HDW-EIS provide a preliminary indication that the environmental impacts associated with the construction and operation of the facility are minimal. Issuance of the Final HDW-EIS based upon a preliminary HWVP conceptual design will be sufficient to satisfy the documentation requirements of the National Environmental Policy Act (NEPA), 42 USC 4371 et seq. As the definitive design progresses, environmental compliance analyses will be performed to:

- Evaluate the performance of the glass waste form
- Determine that the environmental impacts from the operational releases do not significantly differ from those predicted in the Final HDW-EIS
- Identify any additional NEPA documentation that might be required.

Issuance of the Final HDW-EIS will fulfill the environmental documentation requirements of DOE Order 5440.1A.

A checklist (Table 1) of potential environmental impacts (DOE Order 5440.1A [DOE 1987]) has been completed. Items on the checklist that are marked "yes" and assessed in the Draft HDW-EIS are listed in Table 2. Those that are marked "yes" and not assessed in the Draft HDW-EIS are discussed below:

Air

Item f, Construction and Operations

The construction and operation of the HWVP will be subject to the requirements of 40 CFR 60 - 40 CRF 61. These regulations specify hazardous air pollutant emission limits, including radionuclides, resulting from operations and the permitting requirements for construction and operation.

Water

Item a, Operations

Under normal operating conditions, neither radioactive nor dangerous wastes (Washington Administrative Code (WAC) 173-303) will be in the liquid effluents released to the environment.

An engineering study on the management of liquid effluents from HWVP is scheduled for completion in the first quarter, 1988. The study will establish a plan for segregating, classifying, and handling liquid effluents. It is projected that strategies that are similar to the following will be adopted. Liquids from clean area sanitary drains would be discharged to a sanitary septic system. Utility steam condensate and cooling tower blowdown would be discharged to B Pond. Nonradioactive but potentially dangerous liquid waste streams would be transferred to a solar evaporation tank. Low-level liquid radioactive wastes would be mixed with cementitious solids at the grout facility and disposed by shallow land burial. Transuranic liquid wastes resulting from HWVP operations would be recycled through the plant and thus not released as an effluent.

Item b, Operations

The liquid effluents released to B Pond would likely be thermally warmer than natural streams and impoundments. Since the releases would not be made directly into natural streams or impoundments, the effects of the thermal discharges on the natural environment should be minimal.

Item g, Construction and Operations

Monitoring wells will be installed around HWVP to monitor the groundwater quality in the preconstruction phase (e.g., to establish a baseline) and the operational phase of the facility.

Item k, Construction and Operations

An Oil or Chemical Spill Control and Prevention Plan will be required for HWVP for both the construction and operation of the facility.

Land Use

Item d, Construction

Excavation and construction activities would generate both volumes of excavated soil and solid debris associated with normal construction activities. A spoil area will be established near the 200 Areas for the excavated soil. The spoil pile will be stabilized as soon as practical after emplacement. The location and size of the spoil pile will be determined prior to construction. It is

likely that the excavated soil would be used as "fill" at solid waste disposal sites at Hanford and the debris from construction would be disposed onsite in accordance with established policies. Small volumes of radioactive waste will be generated during the tie-in of transfer lines to existing facilities.

Item d, Operations

Operation of the HWVP would generate various categories of solid wastes. Nonradioactive wastes which are not designated dangerous (WAC 173-303) would be disposed of in a sanitary landfill. Sanitary wastes will be disposed of in a septic system. Nonradioactive, dangerous wastes would be packaged and segregated before shipment to a licensed treatment, storage, and disposal facility. Low-level radioactive and low-level mixed wastes would be packaged and disposed of onsite, in accordance with established procedures and controls. Transuranic wastes would be packaged and placed in retrievable storage onsite before shipment to a geological repository.

General

Item a, Construction and Operations

The construction and operation of the HWVP will be in accordance with the provisions of the Resource Conservation and Recovery Act (i.e., RCRA) as implemented in 40 CFR 260-270 and WAC 173-303.

Item b, Construction

Excavation and construction of the HWVP would increase noise levels in the immediate vicinity of the construction site. However, the remote location of the 200 East Area prevents any detectable increase in offsite noise levels.

Item c, Construction

To support the completion of the Final HDW-EIS, an archaeological survey and assessment has been scheduled for the HWVP construction site. Because the proposed site is within the fenced 200 East Area, it is anticipated that no undiscovered archaeological, historical, or Native American religious sites will be found. If there is a finding and the U.S. Department of Energy (DOE) and the State of Washington determine it to be significant, an acceptable resolution of the issues would be obtained prior to construction.

Item d, Operations

The operation of the HWVP will require the use of carcinogenic, pesticides, and toxic substances. Radioactive materials are carcinogenic, and certain chemicals used in the process are toxic.

TABLE 1

POTENTIAL ENVIRONMENTAL IMPACTS

	CONSTRUCTION Yes	CONSTRUCTION No	OPERATION Yes	OPERATION No
1. Air Will the proposed project/activity:				
a. Result in any gaseous discharges to the environment?	X*		X*	
b. Result in any particulate of droplet releases to the environment?	X*		X*	
c. Result in any thermal discharges to the atmosphere?	X*		X*	
d. Cause any other atmospheric disturbances?		X		X
e. Violate any Federal/State or Local emission standards?		X		X
f. Be subject to Federal or State standards of performance for new stationary sources? (see WAC 173-400-115)	X		X	
g. Violate any applicable ambient air quality standards (e.g., CO, hydrocarbons, particulates, NO_2, etc.)?		X		X
2. Water Will the proposed project/activity:				
a. Result in any liquid discharges to the environment?		X	X	
b. Discharge heat to surface or subsurface water?		X	X	
c. Alter stream flow rates?		X		X
d. Significantly alter natural evaporation rates?		X		X
e. Release soluble solids to natural waters?		X		X

*See Table 2.

TABLE 1

POTENTIAL ENVIRONMENTAL IMPACTS (Continued)

	CONSTRUCTION Yes	CONSTRUCTION No	OPERATION Yes	OPERATION No
f. Interconnect aquifers?		X		X
g. Require installation of wells?	X		X	
h. Require review/permit under the Federal National Pollutant Discharge Elimination System?		X		X
i. Require a Corps of Engineers or other permit?		X		X
j. Violate any State water quality standards (COD, BOD, TOC, DO, TDS, pH, temperature, etc.)?		X		X
k. Require an Oil or Chemical Spill Control and Prevention Plan	X		X	
3. Land Use Will the project:				
a. Conflict with existing zoning or land use?		X		X
b. Be located on the 100-yr or 500-yr flood-plain?		X		X
c. Be located on wetlands?		X		X
d. Generate a volume of solid waste for disposal?	X		X	
(1) Hazardous?		X	X	
(2) Radioactive?	X		X	
(3) Other?	X		X	
e. Cause erosion?		X		X
f. Be located on the Arid Land Ecology Reserve?		X		X
g. Conflict with National Environmental Policy Act activities?		X		X
h. Impact prime or unique farmland?		X		X

TABLE 1

POTENTIAL ENVIRONMENTAL IMPACTS (Continued)

	CONSTRUCTION		OPERATION	
	Yes	No	Yes	No
4. General Will the proposed project/activity?				
a. Be subject to any other Federal, State or Local environmental regulations not otherwise addressed in this checklist?	X		X	
b. Increase noise levels?	X			X
c. Disturb or alter the ground surface potentially impacting known or undiscovered archaeological, historical or Native American religious sites?	X			X
d. Require use of carcinogens, pesticides or toxic substances?		X	X	
e. Impact wildlife or habitat (terrestrial or aquatic)?		X		X
f. Affect endangered species or critical habitat?		X		X
g. Require long-term commitment of nonrenewable resources?	X*		X*	
h. Require new utilities or modifications to existing utilities?	X*		X*	
i. Increase offsite radiation dose?		X	X*	
j. Impair recreation?		X		X
k. Require modifications to the Site-wide Environmental Surveillance Program?		X		X

*See Table 2.

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TABLE 2

ITEMS ADDRESSED IN THE DRAFT ENVIRONMENTAL IMPACT STATEMENT DISPOSAL OF HANFORD DEFENSE, HIGH-LEVEL, TRANSURANIC AND TANK WASTES (DOE 1986)

Issue	Construction	Operation	DOE 1986
1. Air: Will the proposed project/activity			
a. Result in any gaseous discharges to the environment?	Yes	Yes	Tables C.9, C.10, and C.11
b. Result in any particulate or droplet releases to the environment?	Yes	Yes	Tables C.9 and C.10
c. Result in any thermal discharge to the atmosphere?	Yes	Yes	Tables C.10 and C.11
4. General: Will the proposed project/activity			
g. Require long-term commitment of nonrenewable resources?	Yes	Yes	Tables C.3 and C.4
h. Require new utilities or modifications to existing utilities?	Yes	Yes	Page C.4
i. Increase offsite radiation dose?	No	Yes	Tables C.5, C.6, C.7 and C.8

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APPENDIX F

LIFE CYCLE COST ANALYSIS

DOE Order 6430.1 requires that the design of facilities have as an objective minimizing consumption of nonrenewable energy on a life cycle cost effective basis. Subpart A, "Methodologies and Procedures for Life Cycle Cost Analyses," of 10 CFR part 436 establishes a methodology for estimating and comparing the life cycle costs of Federal buildings and for determining life cycle cost-effectiveness. A life cycle cost analysis was performed as part of the Reference Conceptual Design for the HWVP. As specified by the O&EC and in the 1985 Annual Supplement to the NBS Handbook 135 (NBSIR 85-3273), for federal nonenergy conservation projects which require energy price forecasts, a 10 percent discount rate is currently required to be used for determination of the present value of future investment, energy, and operating and maintenance costs. The results are presented in the format of Exhibit 5.1 of NBS Handbook 135, i.e. "New Building Design LCC Worksheets."

NEW BUILDING DESIGN LCC WORKSHEETS

I. PROJECT DESCRIPTION

AGENCY: Department of Energy

ADDRESS: STREET
CITY/COUNTY Hanford
STATE Washington
DoE REGION 10

PROJECT CONTACT PERSON: NAME
POSISTION
TELEPHONE

BUILDING OR FACILITY DESCRIPTION: Nuclear waste processing facility

CLASSIFICATION FOR ENERGY CHARGES: Industrial

PROJECT DESCRIPTION: Vitrified waste processing facility including buildings, installation of all equipment, offsites and engineering

EXPECTED BUILDING OR SYSTEM LIFE: 40 years or greater

ESTIMATED BUILDING OR SYSTEM INVESTMENT COST: 688,300,000 (total installed cost)

ENERGY INFORMATION:

Energy Type: Electricity

Annual Quantity	Price Unit
5.68E+07 kwh	$0.0294 per kwh

Energy Type: Steam

Annual Quantity	Price Unit
1.188E+08 lb	$7.88 per 1000 lb

PERIOD OF STUDY: 1998 (start-up) To 2022 (end year)

NUMBER OF YEARS COVERED: 25 BASE YEAR: 1988

DISCOUNT RATE: 10%

NEW BUILDING DESIGN LCC WORKSHEETS (Continued)

A. Calculating the Present Value of Energy Costs

Type	(1) Annual Units Purchased	(2) Base-Year Energy Price Per Unit	(3) Base-Year Energy Costs	(4) Escal. Adjusted Present Worth Factor	(5) Present Value of Energy Cost
Electricity - kwh	5.68E+07	(per kwh) $0.0294	$1,671,000	4.9150	$8,213,000
		Base Charge			
		Demand			
		Time of Day			
		Capacity			
		Other			
Steam - lbs	1.188E+08	(per 1000 lb) $7.88	$936,000	4.2688	$3,996,000
TOTAL	xxxx	xxxx	xxxx	xxxx	$12,209,000

B. Calculating Investment Costs for the New Building Design

(1) PV Estimated Actual Investment Costs for the New Building Design		$426,063,000
(2) Investment Cost Adjustment Factor	X	1
(3) Adjusted Investment Costs		$426,063,000

NEW BUILDING DESIGN LCC WORKSHEETS (Continued)

C. Calculating the Annually Recurring (Nonfuel) Operation and Maintenance (O&M) Costs

Item	(1) Amount of Annually Recurring Costs in Base Year Dollars	(2) Modified UPW Factor	(3) Present Value of Annually Recurring Costs
Normal Maintenance Materials	6,354,000	3.8496	$24,460,000
Unplanned Maintenance	5,504,000	3.8496	$21,188,000
Operating & Maintenance Labor	24,024,000	3.8496	$92,482,000
Consumable Chemical Usage	1,787,000	3.8496	$6,879,000
Radwaste Disposal Costs	1,892,000	3.8496	$7,283,000
Fixed Operational Cost Assessments	1,440,000	3.8496	$5,543,000
TOTAL	xxxx	xxxx	$157,835,000

NEW BUILDING DESIGN LCC WORKSHEETS (Continued)

D. Calculating Nonannually Recurring (Nonfuel) O&M Costs, Repalcement Costs, and Salvage Value

(1) Year in Which Expenditure to Occur	(2) Amount of Non Annually Recurring O&M (Base Year $)	(3) Amount of Replacement Cost (Base Year $)	(4) Amount of Salvage Value (Base Year $)	(5) SPW Factors	(6) PV of Non-Annually Recurring O&M	(7) PV of Replacement	(8) PV of Salvage Value
2023	Decontamination & Decommissioning		(71,569,400)	0.0356			(2,546,733)
TOTAL	xxxx	xxxx	xxxx	xxxx			(2,547,000)

E. Calculating the TLCC

(1) Present Value Energy Costs		$12,209,000
(2) Present Value Adjusted Investment Costs	+	$426,063,000
(3) Present Value of Annually Recurring (Nonfuel) O&M Costs	+	$157,835,000
(4) Present Value of Nonannually Recurring (Nonfuel) O&M Costs	+	$0
(5) Present Value of Replacement Costs	+	$0
(6) Present Value of Salvage	-	($2,547,000)
(7) TLCC of the New Building or System Design	=	$598,654,000

BASE YEAR = 1988

COMPONENTS OF LIFE CYCLE COSTS

Component	Estimate Year	Cost Frequency	Estimated Nominal $	Constant Dollar Escalation Rate	Base Year Estimate Constant Dollars
Equiv. Total Installed Cost	1987	Lump Sum	688,300,000	Per Schedule A & F (to '88)	715,694,000
Salvage Value(Decommissioning)	1987	Lump Sum	(68,830,000)	Per Schedule A & F (to '88)	(71,569,400)
Normal Maintenance Materials	1988	Annual	6,354,000	0	6,354,000
Unplanned Maintenance(*)	1987	Annual	5,293,000	Per Schedule A (to '88)	5,504,000
Operating & Maint. Labor(*)	1988	Annual	24,024,000	0	24,024,000
Elect. Energy Usage Costs(*)	1988	Annual	1,671,000	Per Sched. B	1,671,000
Steam Usage(*)	1988	Annual	936,000	50% Sched. C (coal)	936,000
Consumable Chemical Usage(*)	1988	Annual	1,787,000	0	1,787,000
Radwaste Disposal Costs(*)	1988	Annual	1,892,000	0	1,892,000
Fixed Oper. Cost Assess'ts(*)	1988	Annual	1,440,000	0	1,440,000

Note: The values for asterisked (*) components of Life Cycle Costs include a 20% contingency

SCHEDULE A
CONSTANT DOLLAR ESCALATION FACTORS - CONSTRUCTION
(From 1-87 to Mid Year 1988)

Period	Cum. Rate	Factor
From 1-1-87 to 6-30-88	3.98%	1.0398

SCHEDULE B
ADJUSTED UNIFORM PRESENT WORTH FACTOR
FOR INDUSTRIAL ELECTRICITY
(Ref: RHO & Table Cb-10, Region 10, NBS Publication 709)

Year	Rate	Factor	PV @ 10%	Mod PV	UPW
1986	-0.85%	1.0172	0.0000	0.0000	0.0000
1987	-0.85%	1.0086	0.0000	0.0000	0.0000
1988	-0.85%	1.0000	0.0000	0.0000	0.0000
1989	5.00%	1.0500	0.0000	0.0000	0.0000
1990	-0.85%	1.0411	0.0000	0.0000	0.0000
1991	2.10%	1.0629	0.0000	0.0000	0.0000
1992	2.10%	1.0853	0.0000	0.0000	0.0000
1993	2.10%	1.1080	0.0000	0.0000	0.0000
1994	2.10%	1.1313	0.0000	0.0000	0.0000
1995	2.10%	1.1551	0.0000	0.0000	0.0000
1996	1.60%	1.1736	0.0000	0.0000	0.0000
1997	1.60%	1.1923	0.0000	0.0000	0.0000
1998	1.60%	1.2114	0.3855	0.4671	0.4671
1999	1.60%	1.2308	0.3505	0.4314	0.8984
2000	1.60%	1.2505	0.3186	0.3984	1.2969
2001	0.98%	1.2627	0.2897	0.3658	1.6627
2002	0.98%	1.2751	0.2633	0.3358	1.9984
2003	0.98%	1.2876	0.2394	0.3082	2.3067
2004	0.98%	1.3002	0.2176	0.2830	2.5896
2005	0.98%	1.3130	0.1978	0.2598	2.8494
2006	-0.22%	1.3101	0.1799	0.2356	3.0850
2007	-0.22%	1.3072	0.1635	0.2137	3.2988
2008	-0.22%	1.3043	0.1486	0.1939	3.4927
2009	-0.22%	1.3015	0.1351	0.1759	3.6685
2010	-0.22%	1.2986	0.1228	0.1595	3.8281
2011	0.00%	1.2986	0.1117	0.1450	3.9731
2012	0.00%	1.2986	0.1015	0.1318	4.1049
2013	0.00%	1.2986	0.0923	0.1199	4.2248
2014	0.00%	1.2986	0.0839	0.1090	4.3337
2015	0.00%	1.2986	0.0763	0.0991	4.4328
2016	0.00%	1.2986	0.0693	0.0900	4.5228
2017	0.00%	1.2986	0.0630	0.0819	4.6047
2018	0.00%	1.2986	0.0573	0.0744	4.6791
2019	0.00%	1.2986	0.0521	0.0677	4.7468
2020	0.00%	1.2986	0.0474	0.0615	4.8083
2021	0.00%	1.2986	0.0431	0.0559	4.8642
2022	0.00%	1.2986	0.0391	0.0508	4.9150

SCHEDULE C
ESCALATION ADJUSTED UNIFORM PRESENT WORTH FACTOR
FOR COAL FUELED INDUSTRIAL ENERGY
(Ref: Table Cb-10, Region 10, NBS Publication 709)

Year	Rate	Factor	PV @ 10%	Mod PV	UPW
1986	1.16%	0.9772	0.0000	0.0000	0.0000
1987	1.16%	0.9885	0.0000	0.0000	0.0000
1988	1.16%	1.0000	0.0000	0.0000	0.0000
1989	1.16%	1.0116	0.0000	0.0000	0.0000
1990	1.16%	1.0233	0.0000	0.0000	0.0000
1991	1.43%	1.0380	0.0000	0.0000	0.0000
1992	1.43%	1.0528	0.0000	0.0000	0.0000
1993	1.43%	1.0679	0.0000	0.0000	0.0000
1994	1.43%	1.0831	0.0000	0.0000	0.0000
1995	1.43%	1.0986	0.0000	0.0000	0.0000
1996	1.27%	1.1126	0.0000	0.0000	0.0000
1997	1.27%	1.1267	0.0000	0.0000	0.0000
1998	1.27%	1.1410	0.3855	0.4399	0.4399
1999	1.27%	1.1555	0.3505	0.4050	0.8449
2000	1.27%	1.1702	0.3186	0.3729	1.2178
2001	0.78%	1.1793	0.2897	0.3416	1.5594
2002	0.78%	1.1885	0.2633	0.3130	1.8723
2003	0.78%	1.1978	0.2394	0.2867	2.1591
2004	0.78%	1.2071	0.2176	0.2627	2.4218
2005	0.78%	1.2165	0.1978	0.2407	2.6625
2006	0.70%	1.2251	0.1799	0.2203	2.8828
2007	0.70%	1.2336	0.1635	0.2017	3.0845
2008	0.70%	1.2423	0.1486	0.1847	3.2692
2009	0.70%	1.2510	0.1351	0.1690	3.4382
2010	0.70%	1.2597	0.1228	0.1548	3.5930
2011	0.70%	1.2685	0.1117	0.1417	3.7346
2012	0.70%	1.2774	0.1015	0.1297	3.8643
2013	0.70%	1.2864	0.0923	0.1187	3.9830
2014	0.70%	1.2954	0.0839	0.1087	4.0917
2015	0.70%	1.3044	0.0763	0.0995	4.1912
2016	0.70%	1.3136	0.0693	0.0911	4.2823
2017	0.70%	1.3228	0.0630	0.0834	4.3657
2018	0.70%	1.3320	0.0573	0.0763	4.4420
2019	0.70%	1.3413	0.0521	0.0699	4.5119
2020	0.70%	1.3507	0.0474	0.0640	4.5759
2021	0.70%	1.3602	0.0431	0.0586	4.6345
2022	0.70%	1.3697	0.0391	0.0536	4.6881

SCHEDULE D
ESCALATION ADJUSTED UNIFORM PRESENT WORTH FACTOR
FOR 50% SCHEDULE C & 50% ZERO ESCALATION
(End of Year Payments)

Year	Rate	Factor	PV @ 10%	Mod PV	UPW
1986	0.58%	0.9886	0.0000	0.0000	0.0000
1987	0.58%	0.9943	0.0000	0.0000	0.0000
1988	0.58%	1.0000	0.0000	0.0000	0.0000
1989	0.58%	1.0058	0.0000	0.0000	0.0000
1990	0.58%	1.0117	0.0000	0.0000	0.0000
1991	0.72%	1.0190	0.0000	0.0000	0.0000
1992	0.72%	1.0264	0.0000	0.0000	0.0000
1993	0.72%	1.0339	0.0000	0.0000	0.0000
1994	0.72%	1.0416	0.0000	0.0000	0.0000
1995	0.72%	1.0493	0.0000	0.0000	0.0000
1996	0.64%	1.0563	0.0000	0.0000	0.0000
1997	0.64%	1.0634	0.0000	0.0000	0.0000
1998	0.64%	1.0705	0.3855	0.4127	0.4127
1999	0.64%	1.0778	0.3505	0.3777	0.7905
2000	0.64%	1.0851	0.3186	0.3457	1.1362
2001	0.39%	1.0897	0.2897	0.3156	1.4519
2002	0.39%	1.0943	0.2633	0.2882	1.7400
2003	0.39%	1.0989	0.2394	0.2631	2.0031
2004	0.39%	1.1036	0.2176	0.2402	2.2432
2005	0.39%	1.1083	0.1978	0.2193	2.4625
2006	0.35%	1.1125	0.1799	0.2001	2.6626
2007	0.35%	1.1168	0.1635	0.1826	2.8452
2008	0.35%	1.1211	0.1486	0.1666	3.0119
2009	0.35%	1.1255	0.1351	0.1521	3.1639
2010	0.35%	1.1299	0.1228	0.1388	3.3027
2011	0.35%	1.1343	0.1117	0.1267	3.4294
2012	0.35%	1.1387	0.1015	0.1156	3.5450
2013	0.35%	1.1432	0.0923	0.1055	3.6505
2014	0.35%	1.1477	0.0839	0.0963	3.7468
2015	0.35%	1.1522	0.0763	0.0879	3.8347
2016	0.35%	1.1568	0.0693	0.0802	3.9149
2017	0.35%	1.1614	0.0630	0.0732	3.9881
2018	0.35%	1.1660	0.0573	0.0668	4.0550
2019	0.35%	1.1707	0.0521	0.0610	4.1160
2020	0.35%	1.1754	0.0474	0.0557	4.1716
2021	0.35%	1.1801	0.0431	0.0508	4.2224
2022	0.35%	1.1849	0.0391	0.0464	4.2688

SCHEDULE E
ADJUSTED UNIFORM PRESENT WORTH FACTOR
FOR NO ESCALATION
(End of Year Payments)

Year	Rate	Factor	PV @ 10%	Mod PV	UPW
1986	0.00%	1.0000	0.0000	0.0000	0.0000
1987	0.00%	1.0000	0.0000	0.0000	0.0000
1988	0.00%	1.0000	0.0000	0.0000	0.0000
1989	0.00%	1.0000	0.0000	0.0000	0.0000
1990	0.00%	1.0000	0.0000	0.0000	0.0000
1991	0.00%	1.0000	0.0000	0.0000	0.0000
1992	0.00%	1.0000	0.0000	0.0000	0.0000
1993	0.00%	1.0000	0.0000	0.0000	0.0000
1994	0.00%	1.0000	0.0000	0.0000	0.0000
1995	0.00%	1.0000	0.0000	0.0000	0.0000
1996	0.00%	1.0000	0.0000	0.0000	0.0000
1997	0.00%	1.0000	0.0000	0.0000	0.0000
1998	0.00%	1.0000	0.3855	0.3855	0.3855
1999	0.00%	1.0000	0.3505	0.3505	0.7360
2000	0.00%	1.0000	0.3186	0.3186	1.0547
2001	0.00%	1.0000	0.2897	0.2897	1.3443
2002	0.00%	1.0000	0.2633	0.2633	1.6077
2003	0.00%	1.0000	0.2394	0.2394	1.8471
2004	0.00%	1.0000	0.2176	0.2176	2.0647
2005	0.00%	1.0000	0.1978	0.1978	2.2625
2006	0.00%	1.0000	0.1799	0.1799	2.4424
2007	0.00%	1.0000	0.1635	0.1635	2.6059
2008	0.00%	1.0000	0.1486	0.1486	2.7545
2009	0.00%	1.0000	0.1351	0.1351	2.8897
2010	0.00%	1.0000	0.1228	0.1228	3.0125
2011	0.00%	1.0000	0.1117	0.1117	3.1242
2012	0.00%	1.0000	0.1015	0.1015	3.2257
2013	0.00%	1.0000	0.0923	0.0923	3.3180
2014	0.00%	1.0000	0.0839	0.0839	3.4019
2015	0.00%	1.0000	0.0763	0.0763	3.4782
2016	0.00%	1.0000	0.0693	0.0693	3.5475
2017	0.00%	1.0000	0.0630	0.0630	3.6106
2018	0.00%	1.0000	0.0573	0.0573	3.6679
2019	0.00%	1.0000	0.0521	0.0521	3.7200
2020	0.00%	1.0000	0.0474	0.0474	3.7674
2021	0.00%	1.0000	0.0431	0.0431	3.8104
2022	0.00%	1.0000	0.0391	0.0391	3.8496
2023	0.00%	1.0000	0.0356	0.0356	3.8851

SCHEDULE F
CONSTRUCTION ESCALATION TABLE
USING SCHEDULE A ESCALATION
(millions of dollars)

Year	Percent Expended	Estimate 1987 $	Estimat 1988 $	Escal-ator	Est. in Const $	PV Expend.
1988	1%	7.2	7.5	1.00	7.5	7.5
1989	1%	9.3	9.7	1.00	9.7	8.8
1990	4%	27.2	28.3	1.00	28.3	23.4
1991	7%	48.9	50.8	1.00	50.8	38.2
1992	14%	95.3	99.1	1.00	99.1	67.7
1993	18%	125.1	130.1	1.00	130.1	80.8
1994	16%	110.2	114.6	1.00	114.6	64.7
1995	22%	150.7	156.7	1.00	156.7	80.4
1996	14%	95.7	99.5	1.00	99.5	46.4
1997	3%	18.7	19.4	1.00	19.4	8.2
Total	100%	688.3	715.7	xxx	715.7	426.1

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APPENDIX G

PLANT FORCES WORK REVIEW

Construction, alteration, and/or repair of public buildings or public works of the United States currently costing in excess of $2,000 are subject to the requirements of the Davis-Bacon Act. Work that may be performed by plant (or other nonconstruction) forces is referred to as "non-covered." "Covered" work indicates that the task must be performed by construction personnel, or under special conditions nonconstruction personnel receiving construction level compensation.

The Hanford Waste Vitrification Plant is a major system acquisition and involves the construction of new facilities. Therefore, all activities necessary to achieve a functional plant ready for operational testing are considered as "covered" work. It is currently expected that the vast majority of this covered work will be performed by construction forces under their own supervision and control. Kaiser Engineers Hanford Company construction forces will directly perform those activities requiring cleared personnel and may also perform selected installation activities.

Presently conceived "non-covered" work would be associated with connections to existing services and utilities and software verification. These areas will be clarified by the Davis-Bacon Review Process.

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APPENDIX H

PHYSICALLY HANDICAPPED ASSESSMENT

To the extent practical, the Hanford Waste Vitrification Plant (HWVP) can accommodate handicapped personnel. Special parking places are designated in the parking area. Handicapped access to the Vitrification Building and other hazardous areas is precluded. Audible and visual alarms are used for continuous air monitoring and effluent monitoring systems. Fire and emergency evacuation alarms are audible only.

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GSA 2076A (RL/1-79)

APPENDIX H

RECORD KEEPING/DOCUMENTATION ON ACCOMMODATIONS OF PHYSICALLY HANDICAPPED IN THE DESIGN, CONSTRUCTION OR ALTERATION OF BUILDINGS AND FACILITIES

PROJECT: NO. B-595 TITLE Hanford Waste Vitrification Project (HWVP)

LOCATION: AREA 200 East BUILDING NO. & NAME 214B/Hanford Waste Vitrification Plant

TYPE OF PROJECT

- [X] NEW BUILDING (OR BUILDING ADDITION)
- [ ] BUILDING ALTERATION
- [ ] LEASED BUILDING
- [ ] BUILDING FINANCED IN WHOLE OR IN PART BY FEDERAL GRANT OR LOAN
- [ ] SITE DEVELOPMENT (GRADING, WALKS, PARKING LOTS)

APPLICATION OF STANDARDS

- [ ] ANSI A117.1(R 1971) STANDARDS ARE APPLICABLE TO AND HAVE BEEN OR WILL BE INCORPORATED IN THE DESIGN, CONSTRUCTION, OR ALTERATION.
  - [ ] ALL STANDARDS
  - [X] LIMITED APPLICATION (REMARKS ON STANDARDS TO BE INCORPORATED):

    Occupancy by the handicapped will only be provided in the designated office support area. Access to the process building by handicapped personnel will be restricted.

EXCEPTIONS

- [ ] THE PROJECT IS WITHIN ONE (OR MORE) OF THE EXCEPTIONS SET OUT IN FPMR SUBPART 101-19.604 AS SHOWN BELOW:
  - [X] EXCEPTION (a) NOT INTENDED FOR OCCUPANCY OR USED BY THE HANDICAPPED
  - [ ] EXCEPTION (b) ALTERATION NOT INVOLVING EXISTING STAIRS, DOORS, ELEVATORS, TOILETS, ETC.
  - [ ] EXCEPTION (c) NOT STRUCTURALLY POSSIBLE

GENERAL COMMENTS The main process building because of its intended use will not be accessible to or usable by the public or physically handicapped persons.

PREPARED BY G. D. Wright 01-28-87 DATE

APPROVED BY K. R. Shah [signature] 03-16-87 DATE

REFERENCES:

FPMR SUBPART 101-19.6, (AMENDMENT 5-47, JUNE 1974) "ACCOMMODATIONS FOR THE PHYSICALLY HANDICAPPED."

ANSI 117.1(R1971), "AMERICAN STANDARD SPECIFICATIONS FOR MAKING BUILDINGS AND FACILITIES ACCESSIBLE TO AND USABLE BY THE PHYSICALLY HANDICAPPED."

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APPENDIX I

DRAWING LIST

This section contains a listing of the drawings prepared for the Reference Conceptual Design.

The drawings provide the basis upon which the material and equipment take-offs were developed for the cost estimate.

Drawing List

Number	Title
	General
SK-2-90900	General Title, Area Map and Perspective
	Civil
SK-2-90904	Civil Facility Plot Plan Railroad, Paved Access, Roads, Utilities and Feed Lines
SK-2-90906	Civil Cooling Tower Fdn and Zone 1 Stack and Fdn
	Construction Facility
SK-2-90911	Civil Utilities, Power, Laydown Areas, Roads and Fences
SK-2-90913	Civil Composite Plan and Foundation Location Plan
	Architectural
SK-2-90914	Architectural Vit Bldg Tunnel Plan
SK-2-90915	Architectural Vit Bldg 1st Floor Plan
SK-2-90916	Architectural Vit Bldg Mezzanine Level Plan
SK-2-90917	Architectural Vit Bldg 2nd Floor Plan
SK-2-90918	Architectural Vit Bldg 3rd Floor Plan
SK-2-90919	Architectural Vit Bldg 4th Floor Plan
SK-2-90920	Architectural Vit Bldg 3rd Floor Plan, Mezz & 5th Floor Plan
SK-2-90921	Architectural Vit Bldg Roof Plan
SK-2-90922	Architectural Vit Bldg Longitudinal Sections
SK-2-90923	Architectural Vit Bldg Transverse Sections
SK-2-90924	Architectural Vit Bldg Miscellaneous Bldg Sections
SK-2-90925	Architectural Vit Bldg East & West Elevations
SK-2-90926	Architectural Vit Bldg North & South Elevations
SK-2-90927	Architectural Manipulator Repair Bldg 1st & 2nd Floor & Roof Plans
SK-2-90928	Architectural Manipulator Repair Bldg Elevations and Sections
SK-2-90929	Architectural Canister Storage Bldg Basement Plan and Sections
SK-2-90930	Architectural Canister Storage Bldg 1st Floor Plan
SK-2-90931	Architectural Canister Storage Bldg 2nd Floor and Roof Plans
SK-2-90932	Architectural Canister Storage Bldg Elevations
SK-2-90933	Architectural Fan House 1st Floor, 2nd Floor & Roof Plan
SK-2-90934	Architectural Fan House Bldg Elevations & Section
SK-2-90935	Architectural Sand Filter Basement, Tunnel, and Roof Plan
SK-2-90936	Architectural Sand Filter Sections
SK-2-90937	Architectural Support Bldg 1st Floor & Mezzanine Plans
SK-2-90938	Architectural Support Bldg Elevations & Section
SK-2-90941	Architectural Service Bldg 1st Floor & Mezzanine Plans
SK-2-90942	Architectural Service Bldg Roof Plan
SK-2-90943	Architectural Service Bldg Sections & Elevations

Number	Title
SK-2-90945	Architectural Switchgear/Generator Bldg Floor, Roof & Basement Plans
SK-2-90946	Architectural Switchgear/Generator Bldg Elevations & Sections
	Equipment Arrangements
SK-2-90950	Equip Arrangement Vit Bldg Tunnel Plan
SK-2-90951	Equip Arrangement Vit Bldg 1st Floor Plan
SK-2-90952	Equip Arrangement Vit Bldg Mezzanine Level Plan
SK-2-90953	Equip Arrangement Vit Bldg 2nd Floor Plan
SK-2-90954	Equip Arrangement Vit Bldg 3rd Floor Plan
SK-2-90955	Equip Arrangement Vit Bldg 4th Floor Plan
SK-2-90957	Equip Arrangement Vit Bldg Roof Plan
SK-2-90963	Equip Arrangement Manipulator Repair Bldg 1st & 2nd Floor & Roof Plans
SK-2-90965	Equip Arrangement Canister Storage Bldg Basement Plan and Sections
SK-2-90966	Equip Arrangement Canister Storage Building 1st Floor Plan
SK-2-90967	Equip Arrangement Canister Storage Bldg 2nd Floor and Roof Plans
SK-2-90969	Equip Arrangement Fan House Bldg 1st Floor, 2nd Floor & Roof Plan
SK-2-90973	Equip Arrangement Support Bldg 1st Floor & Mezzanine Plans
SK-2-90975	Equip Arrangement Service Bldg 1st Floor & Mezzanine Plans
SK-2-90976	Equip Arrangement Service Bldg Roof Plan
SK-2-90978	Equip Arrangement Switchgear/Generator Bldg Floor, Roof & Basement Plans
SK-2-91192	Equip Arrangement CPC Cell Plan
SK-2-91193	Equip Arrangement CPC Cell Elevation
SK-2-91194	Equip Arrangement CPC Cell Section
SK-2-91195	Equip Arrangement CPC Cell Section Penetration Locations
SK-2-91196	Equip Arrangement Waste Hold Tank
SK-2-91197	Equip Arrangement Receipt & Lag Storage Tank
SK-2-91200	Equip Arrangement Canister Decontamination Cell Plan
SK-2-91201	Equip Arrangement Canister Decontamination Cell Elevation
SK-2-91202	Equip Arrangement Canister Decontamination Cell Sections
SK-2-91203	Equip Arrangement Canister Decontamination Cell Section
SK-2-91204	Equip Arrangement CDC Crane Envelopes & Viewing Plan
SK-2-91205	Equip Arrangement WTC Plan
SK-2-91206	Equip Arrangement WTC Elevation
SK-2-91207	Equip Arrangement WTC Section
SK-2-91208	Equip Arrangement WTC Smear Test Station Plan
SK-2-91209	Equip Arrangement WTC Smear Test Station Section
SK-2-91210	Equip Arrangement WTC Smear Test Station Section
SK-2-91211	Equip Arrangement WTC Crane Envelopes & Viewing Plan
SK-2-91213	Equip Arrangement Melter Cell Plan
SK-2-91214	Equip Arrangement Melter Cell Section "A-A"
SK-2-91215	Equip Arrangement Melter Cell Section B
SK-2-91216	Equip Arrangement Melter/Turntable Assembly
SK-2-91218	Equip Arrangement MC Crane Envelope & Viewing Plan

Number	Title
SK-2-91219	Equip Arrangement REDC Plan
SK-2-91220	Equip Arrangement REDC Front Sectional View
SK-2-91221	Equip Arrangement REDC Sectional View and Manipulator Reach
SK-2-91222	Equip Arrangement REDC EMM Envelope & Viewing Plan
SK-2-91224	Equip Arrangement CDMC Plan
SK-2-91225	Equip Arrangement CDMC Section
SK-2-91226	Equip Arrangement CDMC Section B
SK-2-91227	Equip Arrangement CDMC Crane/EMM Envelope & Viewing Plan
SK-2-91229	Equip Arrangement Equipment Laydown Area
SK-2-91230	Equip Arrangement Equipment Laydown Area
SK-2-91231	Equip Arrangement Empty Canister Entry Tunnel Plan
SK-2-91232	Equip Arrangement Empty Canister Entry Tunnel Elevation
SK-2-91233	Equip Arrangement MC/CDC Tunnel Plan
SK-2-91234	Equip Arrangement MC/CDC Tunnel Section A&B
SK-2-91235	Equip Arrangement CDC Smear Test Station Plan
SK-2-91236	Equip Arrangement CDC Smear Test Station Sections
SK-2-91237	Equip Arrangement CDC Smear Test Station Section
SK-2-91238	Equip Arrangement CDC Smear Test Station Section
SK-2-91239	Equip Arrangement CDC Smear Test Station Elevation
SK-2-91240	Equip Arrangement Canister Exit Tunnel Plan
SK-2-91241	Equip Arrangement Canister Exit Tunnel Section
SK-2-91242	Equip Arrangement Crane Maintenance Area Plan
SK-2-91243	Equip Arrangement Crane Maintenance Area Section
SK-2-91246	Equip Arrangement Loadout Tunnel Plan
SK-2-91247	Equip Arrangement Loadout Tunnel Elevations
SK-2-91248	Space Allocation Service Rms., Analy. Lab., Analy. Cells, Sample Cell Plan, Elev. & Sections
SK-2-91249	Equip Arrangement Service Rooms Plan and Section
	Process Flow Diagrams
SK-2-90716	Legend of Symbology for Process Flow and Piping and Instrument Diagrams
SK-2-90717	Legend of Symbology for Process Flow and Piping and Instrument Diagrams
SK-2-90720	Process Flow Diagram Dry Frit Receipt and Slurry, Preparation
SK-2-90721	Process Flow Diagram Canister Handling
SK-2-90722	Motion Diagram Canister System
SK-2-90723	Material Balance Summary Dry Fits, Canister, Melter/Turntable System
SK-2-90724	Process Flow Diagram Melter/Turntable System
SK-2-90725	Process Flow Diagram Melter Off-Gas System
SK-2-90726	Process Flow Diagram Vessel Vent System
SK-2-91280	Time/Motion Diagram-Feed Prep. System 100 lbs/hr Glass Production
SK-2-91281	Time/Motion Diagram-Feed Prep. System 220 lbs/hr Glass Production

Number	Title
SK-2-91282	Process Flow Diagram-Feed Receipt, Storage, Preparation and Waste Systems
SK-2-91283	Process Flow Diagram-Feed Receipt, Storage, Preparation and Waste Systems
SK-2-91284	Process Flow Diagram-Feed Receipt, Storage, Preparation and Waste Systems
SK-2-91285	Material and Energy Balance Summary Melter Off-Gas System
SK-2-91286	Material and Energy Balance Summary Melter Off-Gas System
SK-2-91287	Material and Energy Balance Summary Feed Receipt, Storage and Preparation, and Waste Systems
SK-2-91288	Material and Energy Balance Summary Feed Receipt, Storage and Preparation, and Waste Systems
SK-2-91289	Material and Energy Balance Summary Feed Receipt, Storage and Preparation, and Waste Systems
	Piping and Instrument Diagrams
	Feed Preparation
SK-2-90755	Piping & Instrument Diagram Receipt and Lag Storage Tank (RLST)
SK-2-90756	Piping & Instrument Diagram Receipt and Lag Storage Tank (RLST)
SK-2-90758	Piping & Instrument Diagram Slurry Receipt & Adjustment Tank (SRAT)
SK-2-90759	Piping & Instrument Diagram Slurry Receipt & Adjustment Tank (SRAT)
SK-2-90760	Piping & Instrument Diagram Slurry Receipt & Adjustment Tank (SRAT)
SK-2-90761	Piping & Instrument Diagram Slurry Mix Evaporator Condensate Tank (SMECT)
SK-2-90762	Piping & Instrument Diagram Slurry Mix Evaporator Condensate Tank (SMECT)
SK-2-90764	Piping & Instrument Diagram Slurry Mix Evaporator (SME)
SK-2-90765	Piping & Instrument Diagram Slurry Mix Evaporator (SME)
SK-2-90766	Piping & Instrument Diagram Slurry Mix Evaporator (SME)
SK-2-90767	Piping & Instrument Diagram Spent Frit Hold Tank (SFHT)
SK-2-90768	Piping & Instrument Diagram Spent Frit Hold Tank (SFHT)
SK-2-90769	Piping & Instrument Diagram Melter Feed Tank (MFT)
SK-2-90770	Piping & Instrument Diagram Melter Feed Tank (MFT)
SK-2-90771	Piping & Instrument Diagram Recycle Collection Tank (RCT)
SK-2-90772	Piping & Instrument Diagram Recycle Collection Tank (RCT)
SK-2-90773	Piping & Instrument Diagram Decon Waste Treatment Tank (DWTT)
SK-2-90774	Piping & Instrument Diagram Decon Waste Treatment Tank (DWTT)
SK-2-90775	Piping & Instrument Diagram Decon Waste Treatment Tank (DWTT)
SK-2-90776	Piping & Instrument Diagram Waste Hold Tank (WHT)

Number	Title
SK-2-90777	Piping & Instrument Diagram Waste Hold Tank (WHT)
SK-2-90779	Piping & Instrument Diagram Sump System and DWTT Collection System
	Melter, Sampling, Analytical
SK-2-90790	Piping & Instrument Diagram Melter
SK-2-90791	Piping & Instrument Diagram Melter
SK-2-90792	Piping & Instrument Diagram Turntable
SK-2-90793	Piping & Instrument Diagram Liquid Sampling System
SK-2-90794	Piping & Instrument Diagram Gas Sampling System
SK-2-90795	Piping & instrument Diagram Water Services to Sampling Lab
SK-2-90796	Piping & Instrument Diagram Analytical Laboratory, Propane & Nitrous Oxide Gas System
	Canister Handling
SK-2-90810	Piping & Instrument Diagram Preliminary Canister Decontamination Chamber
SK-2-90811	Piping & Instrument Diagram CDC Smear Test Station
SK-2-90812	Piping & Instrument Diagram WTC ICC Press and Canister Trolley
SK-2-90813	Piping & Instrument Diagram WTC Plug Welder
SK-2-90814	Piping & Instrument Diagram WTC Smear Inspection Station
SK-2-90815	Piping & Instrument Diagram CDC Smear Test Station Trolley
SK-2-90816	Piping & Instrument Diagram Crane Decon Feed Tanks
SK-2-90817	Piping & Instrument Diagram Canister Entry Transfer Car
SK-2-90818	Piping & Instrument Diagram MC/CDC Canister Transfer Car and Canister Exit Transfer Car
SK-2-90819	Piping & Instrument Diagram REDC Utility Supplies
SK-2-90820	Piping & Instrument Diagram CDMC Utility Supplies
SK-2-90821	Piping & Instrument Diagram Inner Canister Closure & Temperature Survey Station
SK-2-90745	Piping & Instrument Diagram Dry Frit Handling
SK-2-90746	Piping & Instrument Diagram Frit Slurry Makeup Tank
SK-2-90747	Piping & Instrument Diagram Process Frit Handling
SK-2-90748	Piping & Instrument Diagram Decon Frit Handling
SK-2-90749	Piping & Instrument Diagram FCDC Service Headers
SK-2-90750	Piping & Instrument Diagram FCDC Nozzle Feed Pump
SK-2-90751	Piping & Instrument Diagram FCDC Spray Nozzles
SK-2-90752	Piping & Instrument Diagram FCDC Grapple & Rinse Cycle
SK-2-90753	Piping & Instrument Diagram FCDC Spent Frit Handling and CCTV
SK-2-90800	Piping & Instrument Diagram Film Coolers, Seal Pot & Quenchers
SK-2-90801	Piping & Instrument Diagram Off-Gas Condensate Tank
SK-2-90802	Piping & Instrument Diagram Scrub Column and Scrub Tank
SK-2-90803	Piping & Instrument Diagram Scrub Column and Scrub Tank

Number	Title
	Off-Gas
SK-2-90804	Piping & Instrument Diagram Scrubber, Condenser & HEME
SK-2-90806	Piping & Instrument Diagram Ruthenium & Iodine Adsorbers
SK-2-90807	Piping & Instrument Diagram Off-Gas Filtration
SK-2-90808	Piping & Instrument Diagram Vessel Vent System
	Cold Chemical and Utility Systems
SK-2-90826	Piping & Instrument Diagram Decon Solution Makeup Tank
SK-2-90827	Piping & Instrument Diagram Potassium Permanganate Feed System
SK-2-90828	Piping & Instrument Diagram Sodium Nitrite Feed System
SK-2-90829	Piping & Instrument Diagram Oxalic Acid Decon Feed System
SK-2-90830	Piping & Instrument Diagram Sugar Solution Feed System
SK-2-90831	Piping & Instrument Diagram Off-Gas Treatment Chemical Feed System
SK-2-90832	Piping & Instrument Diagram KOH/Frit Modifier Feed System
SK-2-90833	Piping & instrument Diagram Flush Water Feed System
SK-2-90834	Piping & Instrument Diagram Caustic Storage Tanks
SK-2-90835	Piping & Instrument Diagram Caustic Feed Tank
SK-2-90836	Piping & Instrument Diagram Instrument/Plant Air Compressors and Dryers
SK-2-90837	Piping & Instrument Diagram Plant Instrument Air Receivers
SK-2-90838	Piping & Instrument Diagram Breathing Air System
SK-2-90839	Piping & Instrument Diagram Plant, Instrument and Breathing Air Distribution
SK-2-90840	Piping & Instrument Diagram Bottled Gases System
SK-2-90841	Piping & Instrument Diagram 90% Formic Acid Storage Tanks
SK-2-90842	Piping & Instrument Diagram 90% Formic Acid Feed Tank
SK-2-90843	Piping & Instrument Diagram Formic Acid Dilution & Dilute Formic Acid Feed Tank
SK-2-90844	Piping & Instrument Diagram Cooling Tower
SK-2-90845	Piping & Instrument Diagram Tower Water Distribution
SK-2-90846	Piping & Instrument Diagram Process Cooling Water System
SK-2-90847	Piping & Instrument Diagram Melter Cooling Water System
SK-2-90848	Piping & instrument Diagram Process Chilled Water System
SK-2-90849	Piping & Instrument Diagram Nitric Acid Storage Tanks
SK-2-90850	Piping & Instrument Diagram Steam Desuperheater
SK-2-90851	Piping & Instrument Diagram Steam Distribution
SK-2-90852	Piping & Instrument Diagram Process Condensate System
SK-2-90853	Piping & Instrument Diagram Utility Condensate System
SK-2-90855	Piping & Instrument Diagram Sanitary Water and Firewater Systems
SK-2-90856	Piping & Instrument Diagram Process Water System
SK-2-90857	Piping & Instrument Diagram Nitric Acid Decon Feed System
SK-2-90858	Piping & Instrument Diagram Regulated Liquid Waste Collection

Number	Title
SK-2-90859	Piping & Instrument Diagram Floor Drain Catch Tank
SK-2-90860	Piping & Instrument Diagram Caustic Waste Neutralization
SK-2-90861	Piping & Instrument Diagram Acid Drain Catch Tank
SK-2-90862	Piping & Instrument Diagram Acid Waste Hold Tank
SK-2-90863	Piping & Instrument Diagram Organic Acid Drain Catch Tank
SK-2-90864	Piping & Instrument Diagram Organic Acid Waste Neutralization
SK-2-90865	Piping & Instrument Diagram Solar Evaporation Unit
SK-2-90866	Piping & Instrument Diagram 5% NAOH Feed System
SK-2-90867	Piping & Instrument Diagram Decon Air System
SK-2-90868	Piping & Instrument Diagram Cold Feed Vent System Service Building Vent System
SK-2-90869	Piping & Instrument Diagram Cold Feed Vitrification Building Vent System
SK-2-91270	Piping & Instrument Diagram Nitric Acid Feed Tank
SK-2-91271	Piping & Instrument Diagram Process Steam Generator & Flash Tank
SK-2-91272	Piping & Instrument Diagram Regulated Drains Collection Tank
	Heating, Ventilation and Air Conditioning Zone Diagrams
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