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DESIGN CRITERIA

VITRIFICATION OF HIGH-LEVEL WASTES

PREPARED BY ________ C. G. Skillern
Cognizant Engineer

APPROVED BY ________ R. W. Devlin
Cognizant System Design Manager

APPROVED BY ________ 5/29/90 D. L. Shugars
Quality Assurance Manager

APPROVED BY ________ 5/29/90 R. F. Gessner
Plant Operations Manager

APPROVED BY ________ 5/29/90 R. E. Lawrence
Plant Services Manager

APPROVED BY ________ for D. J. Harward
Radiation and Safety Manager

APPROVED BY ________
Radiation and Safety Committee Chairman

West Valley Nuclear Services Co., Inc.

P.O. Box 191

West Valley, NY 14171-0191

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RECORD OF REVISION

PROCEDURE

If there are changes to the procedure, the revision number increases by one. These changes are indicated in the left margin of the body by an arrow () at the beginning of the paragraph that contains a change.

Example:

The arrow in the margin indicates a change.

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S. M. Barnes
R. W. Devlin
F. W. Damerow
V. A. DesCamp
C. McMahon
J. M. Pope
B. W. Bowan
J. P. Englert

SUMMARY

The West Valley Demonstration Act passed in 1980 required the Department of Energy to solidify over 2 270 m^3 (600,000 gallons) of liquid high-level nuclear wastes currently stored in underground steel tanks at West Valley, New York, the site of a former commercial nuclear fuel reprocessing facility. The plan is to vitrify the high-level wastes into a borosilicate glass form. The vitrification system will be installed and cold functional demonstration tests will be conducted. After the cold tests have been completed, the vitrification facility will be converted for use in processing high-level wastes. This document, in sections 3.0, 4.0, and 5.0, specifies the design criteria to be satisfied in the design of the Vitrification Facility.

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VITRIFICATION OF HIGH-LEVEL WASTES

Rev. 3

1.0 BACKGROUND

The Western New York Nuclear Service Center (WNYNSC) is located in the town of Ashford, Cattaraugus County, New York, about 50 km (30 miles) south of Buffalo. It is the site of the only commercial nuclear fuel reprocessing facility ever to have operated in the United States.

When the plant was built in the early 1960's, the management of high-level radioactive liquid waste at Federal installations employed underground storage in carbon steel tanks. Following this precedent, the WNYNSC was licensed to operate with the expectation that the high-level radioactive liquid wastes generated during fuel reprocessing would be stored underground in steel tanks for an indefinite period.

The plant was in operation from 1966 to 1972 and during that time generated approximately 2 270 m^3 (600,000 gallons) of high-level radioactive liquid waste. This waste is now stored in three underground tanks at the site.

On October 1, 1980, the President signed into law the "West Valley Demonstration Project Act."[1] The Act directs the Secretary of Energy to carry out, a high-level radioactive waste management demonstration project at the Western New York Nuclear Service Center in West Valley, New York, for the purpose of demonstrating solidification techniques which can be used for preparing high-level radioactive waste for disposal.

2.0 INTRODUCTION

Most of the 2 270 m^3 (600,000 gallons) of radioactive waste(s) exist(s) in one storage tank as a liquid, above a sludge layer at the bottom of the tank. As part of the Demonstration Project, the liquid will be removed from the tank and processed to remove most of the radioactivity. The resulting low-level, radioactive liquid waste will be used to form concrete in the Cement Solidification System, which is not covered in this document.

The sludge left at the bottom of the tank, the loaded ion exchange media used to remove the supernatant radioactivity, and the THOREX waste will be transferred to the Vitrification Facility (VF) by the Sludge Mobilization
\> System (SMS)Design Criteria DC-046, which is not covered in this document. This document discusses the criteria to be used for the design, operation, and maintenance of the operational VF processing radioactive high level waste. Once in the VF, the wastes are processed, fed to the melter for vitrification, and poured into canisters for solidification. The canisters are subsequently delivered to an on site interim high-level waste storage area pending shipment to a Federal Repository. The design criteria (DC) for the interim storage and
\> shipout facilities are the subject of a separate document (Design Criteria DC-048).

The overall approach to the Project is to make maximum use of existing technology, facilities, and equipment; while minimizing new development, and avoiding irrelevant development. Minimization of complexity, and new construction is to be stressed. The Project is to produce a system that will vitrify the wastes contained at West Valley in a safe, environmentally sound and cost effective manner.

3.0 FUNCTIONAL REQUIREMENTS:

The VF shall be designed to perform the following general functions:

(1) Receive, from a separate waste mobilization and transfer system, the HLW sludge (PUREX) from Tank 8D-2, product solution (THOREX) from Tank 8D-4, and cesium-137 coated zeolite from Tank 8D-1 which are all located in the high-level waste (HLW) tank farm.

(2) Process the HLW in melter feed preparation equipment by mixing the HLW with other glass formers and chemicals and evaporating the excess water for delivery to the vitrification equipment.

(3) Provide a method for moving the melter feed from the preparation equipment to the vitrification equipment.

(4) Vitrify the melter feed into borosilicate glass, which is the selected final waste form.

(5) Move canisters in and out from underneath the melter pour spout(s) and hold the canister while the glass is being poured into it. Also, move the canisters into position for loading/unloading from the canister positioning equipment.

(6) Detect the glass level in the canister as it is being filled to assure proper level of filling and no overflow. Also weigh the canister.

(7) Decontaminate the canister exterior after covering the opening on the canister.

(8) Remove, to regulated limits, radioactive particulate-matter, toxic gases, and vapors from the process gases for release to environment.

(9) Provide process solution re-use and recycle features to minimize derivative waste disposal demands.

(10) Provide capabilities for the receipt, storage and makeup of process chemicals, and packaging for disposal of nonradioactive chemical solutions.

(11) Provide capability to collect representative process samples for laboratory analysis. Provide remote sampling and sample transfer capabilities.

(12) Provide storage area in the VF cell for both empty and full canisters to support efficient operations.

(13) Heat and cool process liquids and provide flow control as needed throughout the facility. Heating and closed loop cooling systems shall be provided where required.

(14) Provide access capabilities for equipment installation and removal in all areas where maintenance is required.

(15) Provide process system redundancy and/or readily achievable remote removal and replacement capability for planned maintenance.

(16) Provide monitoring and control systems during normal and emergency operating conditions for all potentially radioactive releases to the environment. Maintain the releases below current state and federal regulatory limits to provide protection to the general public and site personnel.

(17) Provide capability for moving remotely replaceable process equipment to and from removal and packaging areas with minimal release of contamination or radiation exposure to personnel.

(18) Provide areas for performing decontamination and repair of manipulators, cranes, etc., as required.

(19) Use existing WVDP utility and support systems as far as practical, e.g., electrical, steam, sewer, alarms, and service waste.

(20) Provide a central control area that will include but may not be limited to: monitoring, recording, alarming, and controlling the process systems (including off-gas systems) the HVAC systems, the radiation monitor systems, and the fire protection systems. This includes both actual and administrative control.

(21) Provide design features to maintain internal and external radiation exposures to operating and maintenance personnel ALARA, and in no case exceed allowable design guidelines. Provide the capability to control contamination during routine and emergency operating conditions and during all hands-on and remote maintenance activities.

(22) Maximize the use of low maintenance process equipment in radioactive areas, and provide remotely-operated decontamination capabilities for cells, cubicles, and internal and external equipment surfaces to the extent necessary to support required maintenance.

(23) Provide maximum criticality safety through the use of geometry and facility design for normal and abnormal operating and maintenance conditions consistent with the existence of fissile materials in the waste.

(24) Provide security measures, alarm systems, and all other plant safety features essential to proper and safe plant operation.

(25) Remote equipment and components used in the VF shall be evaluated for their service life. Service life may be enhanced, if required, by increased quality and reliability for the equipment, redundancy of equipment, and/or remote replaceability.

(26) Provide the capability to monitor and regulate each type of process water service to allow separate treatment when required, and provide recycle capability where applicable.

(27) Provide an alternate power supply and utilities as backup for essential equipment and systems.

(28) Provide necessary HVAC systems to assure temperature control, contamination control, and adequate air flows during normal and off-normal situations, including extreme environmental events.

(29) Avoid inadvertent radioactivity transfer possibility by minimizing multiple manifolded transfer routes, using physical barriers, and/or permissively controlling nonroutine transfer routes.

(30) Provide systems for monitoring radiation levels, airborne radioactivity and personnel contamination in occupied areas. Off normal conditions shall be alarmed.

(31) Provide capabilities for the receipt, storage, and makeup of decontamination chemicals and the packaging for disposal of radioactive chemical solutions.

4.0 FACILITY DESIGN REQUIREMENTS

The Component Test Stand (CTS) facilities and equipment will be used to the maximum extent possible in the design of the VF.

To produce equipment for the CTS testing, the following Design Criterias (DCs) were prepared and may be used as a reference for the VF design and upgrade. If any difference exists between the content of the following DCs and this Design Criteria, this document (WVNS-DC-022) takes precedence.

- Design Criteria, "Concentrator Feed Makeup Tank-100," WVNS-DC-007, Revision 2, dated June 21, 1984.
- Design Criteria, "Slurry Fed Ceramic Melter-200," WVNS-DC-005, revision 2, dated June 21, 1984.
- Design Criteria, "Canister Turntable-410," WVNS-DC-006, revision 2, dated June 21, 1984.
- Design Criteria, "Submerged Bed Scrubber-310," WVNS-DC-010, revision 2, dated June 21, 1984.

- o Design Criteria, "CTS Closed Loop Cooling Water System," WVNS-DC-012, revision 1, dated January 1985.
- o Design Criteria, "General CTS Component Design Criteria," WVNS-DC-011, revision 3, dated November 9, 1984.
- o Design Criteria, "Melter Off-Gas Treatment System and Vessel Ventilation System," WVNS-DC-015, revision 0, dated March 1985.
- o Design Criteria, "Cold Chemical Preparation and Feed System," WVNS-DC-045, revision 0, dated February 1989.

4.1 Operational Requirements and Maintenance Requirements

4.1.1 Operational Requirements

4.1.1.1 General

A. The Vitrification System goal shall be to process the HLW into a borosilicate glass in a maximum period of thirty (30) months after the startup of the VF.

B. The system shall be capable of complete vitrification of a mixture of solids contained in Tank 8D-2, the THOREX waste contained in Tank 8D-4, the Cesium-137 loaded zeolite resulting from the STS operation, and the condensate bottoms produced as a by-product of the Vitrification System.

C. The Vitrification System shall produce a waste product in the form of a borosilicate glass in a container that satisfies the requirements of the federal repositories "Waste Acceptance Preliminary Specifications for the West Valley Demonstration Project High-Level Waste Form" (WAPS), Rev. 1, dated January 1990[2], or later versions as may become applicable during the project life when directed by DOE.

D. The Cold Chemical Addition System provides for the storage and preparation of chemicals in support of the melter feed preparation.

The overall operating principle involves the addition of liquid and solid constituents to an agitated batch preparation tank on the basis of several different recipes. The recipes are dictated by the composition of the high level waste to be processed. Generally, cold chemical batches are heavy solid slurries that require agitation and recirculation to maintain the slurry in a suspended and homogeneous state and to promote batch transfers to hot cell equipment.

E. The canister shall be decontaminated to the extent necessary to meet the requirements of WAPS.

F. The process off-gas system blowers will maintain a negative pressure on the major tankage and melter within the VF and throughout the upstream process train to assure any leaks are into the system. An installed back-up off-gas blower and an alternate power source shall be provided.

G. Lighting standards will be in accordance with the Federal Property Management Regulations. Emergency lighting will be provided for all locations where light is necessary for the safety of personnel and/or equipment. Emergency lighting should be powered from failure-free or alternate power circuits. Where they are not available, emergency lighting should be powered by units meeting NFPA 101, "Life Safety Code."

4.1.1.2 Sampling and Laboratory Analysis

Sampling and laboratory analysis and/or monitoring will be provided to the extent necessary to safely control the process operations and to provide the data to satisfy the WAPS documentation requirements for each canister.

4.1.1.3 Safeguards and Security Requirements

Security administrative and design functions shall be combined to provide an effective safeguards system. Safeguards and security alarm and monitoring systems shall provide input to both the control room and the WVDP security alarm system.

The VF shall be designed with the minimum number of external-access points, as dictated by safe and efficient access and egress. Personnel access shall be limited to authorized personnel.

Locking and alarming appropriate cells and access doors to the process cells shall be considered and used as appropriate to further enhance security.

4.1.1.4 Human Factors Engineering Requirements

The facility shall be designed to be comfortable and natural for humans to operate and maintain. Human factors shall be considered in positioning equipment, switches, valves, and instruments both from an operating and a maintenance viewpoint. The following shall be considered:

A. Instrument readouts located at average eye elevation for ease of reading, and controls for such instruments located to permit visual monitoring without drastic shifts of body position.

B. Equipment accessible for ease of operation and maintenance.

C. Valves properly sized and located for ease of operation without using ladders, platforms, or over extending the body beyond normal reach.

D. Manipulators and viewing equipment properly located for ease of remote operation.

E. Designed for male and female operators.

F. Minimizing or automating operations requiring special skills or special attention.

G. Audible or visual alarms that warn operators in advance of exceeding process limits.

H. Instrument failure warning lights to avoid use of or reliance on incorrect indications.

I. Communications systems to provide rapid reporting of abnormal conditions.

J. System control, display devices, component arrangement, vibration, noise, lighting, emergency lighting, ventilation, temperature, humidity, human dimensions, protective equipment, warming and annunciator systems, and maintainability are all human factors that shall to be considered in the control room design and layout.

4.1.1.5 Cleanliness

Consideration shall be given to facility and process system cleanliness during construction and operation. Typical examples of provisions to allow easy maintenance of facility include:

A. Personnel access around equipment for cleaning.

B. Areas for storing cleaning equipment.

C. Temporary filters on air-cooled equipment that will be operated/testing under construction conditions when there may be abnormal amounts of dust in the air.

D. Connections to support flushing of fluid systems.

4.1.1.6 Testing

Components and systems will require testing during construction, following construction, and after the plant is operational. Test requirements shall be considered during design, and provisions such as electrical and piping connections, valves, plugs, etc., included to accommodate test activities. For clarification, typical examples may include:

A. Sufficient monitoring points for checking pressure, differential pressure, flow rates, and flow path.

B. Calibration points for pneumatic systems.

C. Provisions for power supply load testing, and to confirm compatibility of instrument signals from detector to readout.

D. Methods for hydrostatic testing piping systems.

E. Provisions to permit load testing of cranes and hoists.

F. Special jumper(s) for testing.

4.1.2 Remote Maintenance Requirements

4.1.2.1 Maintenance

The basic plan for maintenance of the Vitrification System shall be remote removal and replacement. Systems and components in contaminated areas shall be designed to be either remotely maintainable in place, or remotely removable and replaceable.

A shielded room shall be provided for parking and decontamination of the crane, and subsequent hands-on maintenance. Hatches shall be provided in the roof of the room so that crane trolleys and components can be removed from the facility.

Components with a high probability of failure shall be located outside the remote areas to the maximum extent possible.

Spares shall be provided for critical components or components that have a high probability of failure during operation. Typical candidates are seals, motors, agitators, pumps, electronics, TV cameras, lights, thermocouples, and crane components.

Electrical systems shall be designed so preventive and corrective maintenance can take place on primary and secondary power without compromising safety or environmental protection.

Considerations of: 1) isolation capability for maintenance, and 2) redundant equipment for maintenance without interrupting services will be evaluated in the design.

4.1.2.2 Remote Requirements

The systems in the VF cell will be designed for remote operations and maintenance. For the VF, remote changeout is used to denote remote replacement, and remote maintenance is used to denote in situ maintenance.

A. Equipment Items. Installation of remotely removable valves, pumps, etc., on jumper assemblies will be used to enhance remote changeout. These items will be located in the VF process cell and the cell is to be provided with remote handling equipment.

Equipment such as tanks, vessels, columns, and airlifts located in the shielded VF process cell will also be designed to permit remote replacement. Thus, space shall be provided for equipment removal with reasonable disassembly and removal of adjacent equipment.

B. Design. To provide adequate remote capabilities, certain design features shall be provided:

1. During remote transfer of radioactive items and materials, personnel radiation exposures shall be maintained ALARA. Viewing of routine remote operations shall use normal window viewing angles. Where viewing through a window is not feasible, closed-circuit TV with movable in-cell support

assemblies shall be provided.

2. Remote process equipment accessibility shall be considered for operational and maintenance requirements.

3. In-cell mechanical and electrical equipment (windows, TV, manipulators, electrical enclosures, etc.) shall be sealed or otherwise protected from corrosive solutions and gases.

4. In-cell lights shall be remotely replaceable.

5. Tool storage areas and work tables shall be provided in the cell to support maintenance requirements.

6. Retrieval systems for remote in-cell cranes and manipulators shall be provided for both normal and off-normal conditions.

7. Dedicated operating or maintenance areas shall be considered and defined on arrangement drawings. Field run or installed equipment such as piping, electrical, instrument, or HVAC shall not violate a dedicated space. Clearances (dedicated space) for master-slave manipulator operation as well as insertion and removal shall be considered. Manipulator counterweights shall be considered.

8. Connectors, bolts, flanges, wrenches, sockets, extensions, etc., shall be standardized to the maximum extent practical to reduce the need for multiple tools and frequent tool changes.

9. Equipment shall be movable, maintainable, and replaceable with minimum disturbance of adjacent equipment.

10. Modular equipment, component, and subsystem designs, shall be used where possible, to facilitate removal and replacement.

11. In-cell equipment "sky-rights" shall be provided to assure accessibility with overhead handling equipment. In addition,

visibility, accessibility, and interferences must be considered during design.

12. Developmental or unproven state-of-the-art items are unacceptable unless the concepts/equipment are able to be proven by remote mockup prior to incorporation into the facility design. In addition, remote tooling and equipment shall be maintained as practical, straightforward, and simple as possible. Standardization (sizes, shapes, arrangement) shall also be maximized.

C. Facility Requirements. To accomplish remote requirements, the VF shall include certain facility features:

1. Adequate embeds for viewing window, master-slave manipulator, and cell door installations.

2. Cell access through ceiling hatches as far as practicable.

3. Bridge crane(s) to provide complete cell coverage.

4. Control stations for in-cell crane(s) should be located adjacent to viewing windows to permit local remote operation.

5. Dedicated areas which can be isolated from the process area, for cranes maintenance.

D. Remote Equipment. In-cell remote handling equipment shall be provided with redundant features and/or retrieval systems to facilitate recovery from failure.

E. Remote Canister Positioning Equipment. The remote canister positioning equipment shall be remotely movable and disassemblable but need not be remotely reassemblable. This is to allow for removal of stuck canister or spill material.

F. Canister Lid Positioning. The lid positioning device shall be comprised of a self-centering system limiting vertical translation movement which would ensure the correct positioning of the lid on the canister neck. Lid placement shall be visually verifiable.

4.1.2.3 Decontamination

The VF systems and structures are to be designed to facilitate post solidification decontamination. This includes decontamination of the structure and equipment, and removal of sources of toxic, hazardous and radioactive materials to acceptable levels or concentrations.

A. In-Cell Decontamination

The VF decontamination system shall permit flooding the inside surfaces of equipment in contact with contaminated process liquids and solids.

Equipment installed in the VF shall include features to reduce the duration and frequency of decontamination efforts:

1. Process piping design shall minimize non draining low points or pockets. Where low points or pockets are unavoidable, provisions shall be required to drain or flush.

2. Vessel design shall enhance the complete removal of process and decontamination solutions. Interior and exterior crevices shall be minimized.

3. Horizontal surfaces are to be avoided. Sloped surfaces are to be utilized to facilitate drainage of decon solutions.

4. Process valves shall be provided with flushing and draining capabilities.

5. Cell floors shall be stainless steel lined. Cell walls shall also be stainless steel lined, to a height the designer deems appropriate for the process. Surfaces not stainless steel lined shall be protected with other appropriate decontaminable coatings, e.g. epoxy coatings.

6. Cell floors shall be adequately sloped for drainage and shall include a means of decontaminating sump areas.

B. Decontamination Support Area

1. A decontamination support area and facilities will be provided for the remote decontamination of the canisters.

2. Cleaning and decontaminating techniques, materials, and equipment should be as simple as possible. All decontaminating and cleaning techniques shall minimize the amount of secondary waste created and provide for disposal of used materials.

3. The decontamination area, access points, and transfer devices shall be sized to accommodate anticipated equipment.

4. A method for the decontamination of the cleanup area shall be provided.

C. Personnel Decontamination

Areas for personnel monitoring and decontamination shall be provided in the facility.

4.2 Structural, Equipment, Piping, and Electrical Requirements

The existing Component Test Stand (CTS) structures and facilities will be used in the design of the VF to the maximum extent possible.

VF systems and components will use the existing plant utilities to the maximum extent possible. New utilities will be provided when existing utilities are not available.

4.2.1 Structural and Components Requirements

Structures that are not required to confine radioactive material shall be designed to the New York State "Code Manual for the State Building Construction Code."

Structures and components, that are required to confine radioactive material that could be hazardous to the public or site personnel, shall be able to withstand the effects of natural hazards (section 4.2.2) without loss of capability to perform safety function(s) or prevent the release of radioactivity and shall be designed to the "Operational Safety Design Criteria Manual" (ID-12044).

4.2.2 Natural Hazards

4.2.2.1 Design Basis Earthquake (DBE)

The Design Basis Earthquake (DBE) was established by the "Seismic Hazard Analysis for the West Valley Demonstration Project"[3] and approved by "Seismic Hazard Analysis" [4]. New confinement structures shall be designed to an acceleration of 0.1 g at ground level (horizontal loads). The design shall include a validated dynamic analysis of the structure(s) or component(s). The component(s) may be validated by testing in lieu of analysis.

4.2.2.2 Design Base Tornado (DBT)

The Design Basis Tornado (DBT) has been specified for the West Valley Project (Nicholas and Egan, 1983).[5] The DBT definition was based on detailed analyses of all tornado occurrences in Western New York State. The characteristics of the DBT were derived by "Natural phenomena studies and recommended design criteria for the West Valley site, West Valley, New York," dated Oct 1981.[6]

A. Maximum wind speed 71.5 m/s (160 mph).

B. Tornado radius of 45.7 m (150 ft).

C. A tornadic rotational wind velocity of 49.2 m/s (110 mph).

D. A translational wind velocity of 22.35 m/s (50 mph).

E. A peak pressure differential of 2 413 Pa (0.35 psi) from ambient atmospheric pressure.

F. A rate of pressure change of 1 034 Pa/s (0.15 psi/sec).

G. Penetration and crushing effects of small, high-velocity missiles:

Wooden plank 0.10 m x 0.30 m x 3.65 m (4" x 12" x 12'), 63 kg (139 pounds) weight at a velocity of 38 m/s (85 mph). Steel pipe 0.076 m (3 inch) diameter by 3.05 m (10 ft), 33.4 kg (76 lb) weight at a velocity of 22.35 m/s (50 mph). Radiological confinement barriers shall be designed to assure confinement under design basis tornado conditions. In general, confinement barriers may be damaged, but not breached due to design basis tornado conditions. In the event that breach prevention is not possible, or cannot be demonstrated additional analysis shall be performed. The radiological consequences of any breach of containment shall be demonstrated to be less than the maximum dose limits for the safety classification of the confinement barrier. These limits are stated in figure 2.2-1 of reference 8.

4.2.2.3 Design Pressure Differential

Concrete building structures shall be designed for negative pressures with respect to the outside atmosphere. The interior design pressure shall be a negative 746 Pa (-3 inches H_2O).

4.2.2.4 Design Wind Forces

Building structures, and equipment on the exterior of the buildings, shall be designed to 100-year wind of 35.8 m/s (80 mph) with peak gusts of 43.4 m/s (97 mph). Wind pressure shall be analyzed using the methods specified in ANSI A58.1, Exposure Condition C.

4.2.2.5 Design Snow Loading

Buildings and outside structures shall be designed for a snow load of 1 915 Pa (40 lb/ft^2).

4.2.2.6 Reference Design Flooding

A flood is not considered to be a hazard to the facility and will not result in releases of radioactivity to the environment. See "Preliminary Safety Analysis for the Vitrification System," Volume III, dated December 1986.[7].

4.2.3 Design Life

The equipment shall be designed for a service life of seven (7) years. This will provide time for cold testing and checkout, as well as, operational time.

The service life for remote equipment may be met by:
1) specifying the quality and reliab'lity into the equipment; 2) specifying redundant backup equipment; or (3) designing the equipment for replacement.

4.2.4 Equipment Environment

Environmental conditions and radiation exposure shall be taken into consideration in the design of the equipment.

Environmental design consideration shall be based on the following conditions: temperature, humidity, pressure, abrasiveness, smoke, acids, caustic vapors, etc. affecting the particular equipment.

Radiological design considerations shall be based on the total radiation (exposure from all radiation sources) affecting the particular equipment. For all organic or elastomeric material exposed to greater than 1.0 * E4 rads total integrated dose (teflon 1.0 * E3 rads) the following shall be evaluated: 1) use of another material, 2) use of local shielding, or 3) design the particular equipment for ease of replacement.

4.2.5 Piping

The piping shall be designed to ANSI B31.3 with the following additions:

A. A second containment shall be provided for all HLW lines that are embedded or exterior to the shielded cell(s).

   1. The containment shall be in the form of a double-wall welded piping.

   2. The inner pipe welds for double wall pipes shall be radiographed.

   3. The volume between the containments shall be monitored for possible leaks.

B. Other High-Level Waste (HLW) piping radiography and leak testing shall be specified line by line by the design engineer.

C. The use of slip-on flanges and lap joint flanges shall be prohibited for all HLW lines.

D. Socket welded and threaded joints should not be used for HLW lines. In the few instances where there is no alternative but to use threaded connections in HLW lines, the joint shall be seal welded.

E. Openings through cell walls such as holes, blockouts, etc., must be sealed to allow HVAC balancing.

F. Where "line slope" and "avoidance of pockets" are essential, this information must be included on the drawings.

G. Bolts, flanges, nuts, externals, etc., used with stainless steel valves and piping must also be stainless steel, unless material is evaluated per section 4.2.4 and found acceptable.

H. Piping systems that penetrate the Zone I boundary, shall be designed to prevent the backflow of solution from contaminated to clean areas. That design shall consider elevation differences, check valves, isolation valves, and air purges to prevent spreading contamination through facility piping.

I. Valves must be shown on the P&ID's. Each valve will require an individual number.

4.2.6 Electrical

A. In-Cell Conduit. In-cell electrical conduit shall be stainless steel pipe with welded connections with the exception of electrical jumpers. The conduit shall be sealed to ensure the integrity of the HVAC pressure zones.

B. Electrical Design. Electrical systems shall be designed to NFPA 70, National Electric Code (NEC), and be in sufficient detail for a safety evaluation and the preparation of installation, operational and maintenance procedures.

4.2.7 Instrumentation and Control

4.2.7.1 Instrumentation

Instrumentation shall be used to monitor process systems, safety and fire protection systems, and radiation monitoring systems and provide automatic or manual control of all controlled equipment and facility parameters. An electronic system for process control, process monitoring, data acquisition, and report generating shall be provided as a part of the facility, and shall be located in a centralized control room. Design shall include provisions to allow easy calibration and testing during operation without process interruption. instrumentation shall be selected on the basis of simplicity, reliability, and availability. To simplify spare parts inventory parts shall be standardized whenever possible.

4.2.7.2 Alarms

Alarms shall be provided for the safety system, and process variables of the VF and shall be alarmed in the control room. The centralized alarm system shall provide a display of the VF alarms.

The alarms shall be set to provide warning when the system or process is off normal, but still provide sufficient response time to respond to or correct the off-normal condition.

The alarms not only will be displayed in the VF central display, but will be tied into plant alarm system and program, where required.

4.2.7.3 Radiation Exposure

All instrumentation located in a radioactive environment shall be subject to the considerations of section 4.2.4 of this procedure. These instruments shall be retrievable from the radiation fields for repair or replacement. Wherever possible, only the instrument sensing device, such as a thermocouple, shall be in the high radiation field, while the transmitter or mechanical device shall be located in a nonradiation area.

4.2.7.4 Accuracy

The accuracy of the monitoring systems or laboratory analysis will be sufficient to provide the information required to operate the process safely and to provide the data for documenting the WAPS requirements. Calibration procedures will be developed to assure the specified accuracies are obtained and maintained.

4.2.7.5 Alternate Power

An uninterruptible power source shall be provided that will provide 30 minutes of full rated load of power to the instrument and controls required to shutdown the process.

4.2.8 Cell Cranes and Doors

Crane bridges(s) shall be provided in the VF cell and shall be used for everyday operations such as canister replacement, sampling operations, jumper removal and high-capacity lifts. Crane(s) will be retrievable back to the CMR in the event of a failure.

Remote and fixed control stations will be provided for each crane(s).

The VF cell crane(s) will be designed and tested in accordance with crane standards CMAA Specification No. 70 Service Class C and ANSI B30.2. The allowable design stress limits shall reflect the appropriate duty cycle in CMAA 70. Operational and rated load tests will be performed in accordance with ANSI B30.2.

Operation of the crane is not required during a seismic event, but the bridge and trolley should be designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event. The crane shall be retrievable back to the crane maintenance room after a seismic event.

The VF doors should be sized to allow removal of the largest component. Permanent air locks will be provided for the entrance and removal of components, such as the canisters that have a high frequency of replacement or removal. Temporary air locks may be used for infrequent operations such as the removal of a turntable. Cell and crane maintenance room removable roof hatches shall be provided as deemed appropriate during design.

4.2.9 Utilities

The VF will provide means for distributing utilities to or from the systems or components requiring them. Existing utilities will be used to the maximum extent practical.

4.3 Safety Design

4.3.1 General Health and Safety-Radiation

New facilities and systems for the VF shall be designed to the requirements stated herein and to the "Operational Safety Design Criteria Manual" (ID 12044). In the event that there are differences between ID 12044 and the Design Criteria, this Design Criteria shall govern.

4.3.2 Safety Classification System

WVNS developed a safety classification system as described in document "Technical and Administrative Approach for the West Valley Demonstration Program" [8] dated August, 1984 using DOE Order 5481.1A, "Safety Analysis and Review System", dated August 13, 1981 and DOE-ID Order 5840.1, "Safety Analysis and Review System for DOE Managed Activities", dated August 21, 1981 as the basis. This WVDP Safety Classification System (or later version) is used to determine the importance of facility components, systems, and structures relative to ensuring the safety of workers and the general public during all phases of the Project.

Each system, subsystem, component, or structure shall be analyzed according to the requirements of the "Technical and Administrative Approach for the West Valley Demonstration Project Safety Program" and a safety classification shall be assigned to each. The minimum codes and standards applicable to each safety classification and Quality Level is shown on Table 4.8.4.

4.3.3 Radiation

A. General

The principle of "As Low As Reasonably Achievable" (ALARA) shall apply to all aspects of radiation exposure. Under this principle, all facilities shall be designed to permit the lowest radiation dose rates possible with due consideration to all operational requirements. On-site personnel exposure levels less than one-fifth of the DOE Order 5480.11 dose equivalent limits should be used as a design objective.

Shielding thicknesses shall be based on the waste containing the greatest radionuclide inventory and emitting the highest energy radiation. Penetrations through shielding walls for windows, manipulators, instrumentation, piping, ventilation ducts, etc., shall be designed to provide shielding equivalent to the walls.

Shielding shall be adequate to protect plant personnel from excessive radiation during normal operations and during decontamination operations. Concrete shielding shall be designed in accordance with ANSI N101.6 to provide primary protection from radiation. Other appropriate materials may be used as needed in specific locations.

Nuclear accident dosimeters shall be provided, and their performance features and placement shall be consistent with the requirements of DOE Order 5480.1, Chapter XI.

B. Radiation Dose Rates for Various Areas

The facility shall be designed to the following:

1. The maximum radiation dose rate for a full-time occupancy area shall be 0.25 mRem/hour. A full-time occupancy area is one in which an individual(s) may be expected to spend all or most of his or her work day.

2. The maximum radiation dose rate for a full-time access area shall be 2.5/t mrem/hr in which "t" is the maximum average time in hours per day that the area is expected to be occupied by any one individual. A full-time access area is one in which no physical or administrative control of entry exists.

   If compliance with full time access area requirements would not be economically feasible, impractical or prohibitive, higher dose rates may be allowed. However, access to such fields shall be strictly controlled.

C. Area Occupancy

The VF process cell shall be designed for remote operation with no planned manned entry of the cell during radioactive operations. The VF control room shall be defined as a full-time occupancy area. All other areas of the VF shall be defined as full-time access areas.

4.3.4 Contamination Confinement

A. General Requirements

Confinement of radioactive materials shall be accomplished using three primary design principles:

1. Using sufficiently air tight physical boundaries to keep contamination as close to the source as practical.

2. Using multiple barriers. Each zone shall be bounded by barriers, such as pipes, and vessels, different pressure zones, and building walls.

3. Maintaining pressure differentials between each confinement zone and between the outermost zone and the outside atmosphere. Air flow travels from zones of lesser contamination potential to zones of greater contamination potential under normal and off-normal conditions. HVAC zones with differential pressures shall be provided. The definition of these zones is as follows:

   Zone I designates areas that may contain radioactive materials during normal operations.

Zone II designates the operating area and other potentially contaminated areas surrounding Zone I.

Zone III designates areas inside of buildings that are expected to be free of contamination.

B. Ventilation Requirements

A ventilation and filtration system shall be provided to maintain release of radioactivity and airborne particulates within limits of DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection", and any applicable state and federal requirements.

HEPA filters shall be provided to ensure that inadvertent backflows are filtered or prevented. Means should be provided to positively seal all Zone I penetrations.

Outdoor air intakes will be located so that they are protected from the weather. The intake design will consider the effects of high winds, rain, snow, and airborne debris so as to prevent blockage or restriction. Supply air will be conditioned and distributed.

Potentially contaminated ventilation air flow shall be filtered by two fire-resistant HEPA filters in series prior to exiting to the atmosphere. HEPA filters will be designed to military specifications MIL-F-51068E and MIL-F-51079C, and satisfy the requirements of UL-586.

Dampers or valves will be located so that a bank of filters can be completely isolated from the operating ventilation systems during filter replacement operations. Each exhaust filter housing will have a rigid mounting frame for the filter. Openings in these housings should permit filter removal and replacement with minimum exposure to personnel and with minimum release of contaminants outside of the housing. Test ports for in-place filter testing with dioctyl phthalate (DOP) using ANSI Standards 509 and 510 will be provided on the filter housings required to protect the environment from radioactive releases. HEPA filter systems will be tested in accordance with MIL-F-51068E after filter installation using a "cold DOP" test.

Filtered air will be discharged to the environs through a stack. A stack monitoring system shall have alarm panels in the VF control room.

The duct work shall be designed to withstand the full shut-off pressure of the fans. HV systems in contaminated or radioactive areas shall be constructed of welded stainless steel; including duct work, in-line components, and filter housings. Weld protrusion shall be minimized and ledges and radioactive contaminate traps shall be minimized. The remaining, duct work in noncontaminated or nonradioactive areas may be constructed of galvanized steel.

Devices shall be provided to control and indicate pressure differentials between confinement zones. Alarms shall be provided in the control room to indicate when pressure differentials are not within a prescribed range.

An air-conditioning unit shall be provided to maintain a control room temperature and humidity suitable for the controls, associated instrumentation and humans.

C. Design Basis

All structures which form the Zone I confinement boundary and the associated Ventilation and Filtration System shall be designed to continue to perform their contamination confinement function during and after the occurrence of a design basis event, accident, or credible fire or explosion.

4.3.5 Criticality

Nuclear criticality safety control provisions shall meet the requirements of DOE Order 5480.1, Chapter V, "Safety of Nuclear Facilities."

A. Process and storage systems shall be designed to be maintained subcritical and to assure that a nuclear criticality accident cannot occur.

B. Criticality safety design features shall ensure criticality safety is maintained during any credible release of mechanical or thermal energy within the process system.

C. Provide criticality safety through the use of geometry, fixed external Neutron-absorbing materials and facility design for normal and abnormal operating and maintenance conditions consistent with the existence of fissile material in the waste.

D. Where favorable geometry and fixed moderator methods of control are judged impractical, administrative control of moderation, fissile material concentration, total fissile material inventory, or use of a soluble neutron-absorbing material may be employed (in shielded areas only) if combined with margins of safety, measurements, appropriate analyses, or engineering monitoring and shutdown capabilities.

E. A criticality alarm system with detectors, local, and remote alarms, and readouts shall be provided, if required. Signals from the system shall be connected to a panel in the main control room and the distributed control system.

4.3.6 Fire

Fire protection systems and components, that are to be installed as part of the VF shall be designed in accordance with the "National Fire Codes," and the "Operational Safety Design Criteria Manual," DOE ID 12044. The fire protection system shall provide the following:

A. Occupied areas shall be protected by an automatic wet-pipe system. Activation of the sprinkler system will trigger the building alarm.

B. The VF Control Room shall be protected by a fire protection system compatible with the electronic equipment.

C. Occupied areas shall be provided with fire detection systems that will monitor and alarm. The system shall alarm at the building fire alarm central control box, which will provide an indication of the zone from which the signal was received. A signal to the control box shall activate a signal to the guard station and the control room.

D. The VF fire protection and alarm system shall be tied into the plant fire protection and alarm system, as required.

4.3.7 Industrial/Occupational Safety

Design requirements in the industrial/occupational safety area are numerous; the designer must reference the source documents that define the requirements. These safety documents include DOE Order 5480.1, Chapter 1, "Environmental Protection, Safety, and Health Protection Standards;" Chapter VIII, "Occupational Medical Program;" Chapter IX, "Construction Safety and Health Programs;"

Chapter X, "Industrial Hygiene Program," and OSHA Document 29-CFR-1910, "General Industrial Standards".

A. Typical Areas for Occupational Safety Review

The following list identifies typical design areas and facility features that could have potential occupational safety, industrial hygiene, or medical requirements. If these areas or features are applicable to the VF, then source document(s) defining requirements should be consulted.

1. Electrical equipment, welding equipment, barriers, and barricades.

2. Aisles, walkways, exits, clearance, floors, stairs, platforms, railing and work surfaces.

3. Material handling equipment, traffic control, cranes and rigging.

4. Machinery guarding, maintenance and safe lubricants.

5. Pressure equipment, steam lines, tanks and relief valves.

6. Dusts, fumes, vapors, and gases.

7. Personnel protective equipment.

B. Noise. Noise levels shall be limited to 70 decibels or less in areas of continuous occupancy and shall not exceed 85 decibels in other personnel access areas. Warning signs and hearing protection devices shall be provided as necessary.

C. Chemicals. Process reagents and decontamination solutions such as acids, caustics, metal salt solutions, and oxidizing solutions will be prepared and used in the facility. Chemical handling will be in accordance with existing site and plant chemical standards. Adequate chemical receipt, storage, and makeup areas shall be provided. Face-shields, protective clothing, safety showers, and eye wash fountains shall be provided near the chemical makeup areas and throughout the facility as needed. An exhaust system shall be provided to remove chemical makeup vessel fumes and dust.

D. Grounding. The VF shall be connected to a grounding grid. All instruments shall be attached to a separate grounding grid that is connected at a single point to the VF grounding grid.

4.3.8 Emergency Planning

The facility design shall include emergency equipment, and shall assure that facility features provide for ease of personnel evacuation. Emergency requirements and procedures will be coordinated with the overall "WVDP Emergency Plan," WVDP-022.[12]

An evacuation alarm system shall be provided for VF evacuation, and shall be incorporated into the existing overall WVDP evacuation system. Methods of manually activating these systems shall be provided.

A public address (PA) system shall be provided as a functional part of the overall emergency warning system and shall be incorporated into the overall WVDP plant PA system.

4.3.9 System or Control Malfunctions

A "fail-safe" philosophy shall be used in designing the VF. A single failure or malfunction of any system or equipment item shall not initiate a failure sequence that results in criticality, uncontrolled release of radiation to the environs, or radiation exposure to operating personnel or the general public in excess of the limits set forth in DOE Order 5480.1, Chapter XI, "Requirements for Radiation Protection."

4.3.10 Loss of Normal Electrical Power

An alternate power system shall be included in the VF. The alternate power system shall supply power to these systems and equipment items necessary to maintain the cell confinement." Alternate power shall be unaffected by natural hazards and by a fire or other failure in normal power switchgear or cables.

4.4 Environmental Features

4.4.1 Waste Release

The waste form produced will be in the form of borosilicate glass contained in a leak tight stainless steel canister and transported through a tunnel to the interim storage cell for storage until shipment to a federal repository.

Equipment and components will either be transferred to a radioactive storage area for later decontamination or decontaminated by an in-cell decontamination system.

The filters will be removed and packaged for disposal per Plant Procedures.

All waste form produced, equipment, and components shall be handled in compliance with all applicable environmental regulations and requirements.

4.4.2 Gaseous Release

The process gases and vapors will be processed through equipment such as scrubbers, demisters, HEPA filters, and NO_x removal equipment suitably arranged to achieve acceptable concentrations prior to release through the main plant stack.

These releases shall be subject to applicable Environmental Protection Agency (EPA), New York State Department of Environmental Conservation (NYSDEC), and Department of Energy (DOE) regulations, Orders, and directives. These regulations shall include, but not be limited to, 40 CFR 61, 6 NYCRR Series 200, and DOE Order 5480.1A.

All permits for the construction and operation of the facility shall be procured in compliance with the above cited regulations and requirements.

4.4.3 Liquid Release

Where possible, radioactive liquid waste will be recycled within the VF.

4.4.4 General

The vitrification design has been based on the environmental agreements defined in the "EPA/DOE Memorandum of Understanding" [13] dated April 12, 1984. In addition, the vitrification design will also comply with all applicable USEPA and NYSDEC rules and regulations.

4.5 Documentation

Design documents (drawings, specifications, etc.) must meet minimum requirements and contain specific design information. Guidelines that must be followed include:

1. Prepare Process and Utility flow diagrams.

2. Stating essential construction tolerances on the drawings.

3. Develop general arrangement drawings as part of the design effort.

4. Preparing exact, definitive, descriptive, and precise specifications. All general, motherhood, and vague description statements must be eliminated.

5. Clearly stating governing documents (drawings or specifications) in case of discrepancies or conflicts.

6. Documenting on the P&IDs and the HVAC diagrams using standard ISA symbology (i.e., ISA-S5.2) all control functions including interlocking control functions.

7. Showing on the P&IDs failure positions of essential/automated valves (fail/open/closed/locked/vented).

8. Including continuations (interface reference drawing numbers) on the design drawings.

9. Including damper failure positions on HVAC, process, and instrumentation diagrams. If failure positions are different as a result of various failure modes (i.e., loss of power, loss of air), this shall also be included.

10. Instrumentation logic and loop diagrams.

4.6 Quality Assurance

The quality level identifies the implementation of the Quality Assurance program which will be based on the eighteen criteria of ASME NQA-1 and all supplements.

The WVNS "Quality Management Manual"[10] provides additional information on defining the quality level for the structures and components that will be used in the VF.

Table 4.6 lists the safety classification, service class, and quality levels for the vitrification system and its major subsystems. This table is for information only and "Hazard Classification and Safety Classification of Important Structures, Systems, and Components for the Vitrification Process"[11] may be revised as appropriate as the VF design is finalized. The assignment of classifications are maintained current in accordance with the methods of 4.3.2 of this document.

Table 4.6. Safety, Service, and Quality Classifications for the Vitrification Systems

COMPONENT OR SYSTEM	LOCATION	SAFETY CLASS	SERVICE CLASS	QUALITY LEVEL
STRUCTURES				
Concrete Hot Cell	CTS	B	IV	B
Connecting Tunnel	CTS+EDR	B	IV	B
Equipment Decontamination Room	EDR	C	(3)	
Chemical Process Cell	CPC	C	(3)	
Crane Maintenance Room	CTS	B	IV	B
Air Lock (Door)	CTS+Tunnel	B	IV	B
Air Lock (Door)	Tunnel-EDR	B	IV	B
Door	EDR+CPC	C	(3)	
Shielded Viewing Windows	CTS	B	IV	B
Shielded Viewing Windows	EDR+CPC	C	(3)	B
Shielded Viewing Windows	Crane Maint. Rm	B	IV	B
Other Major Shield Wall Penetrations (Manipulator, Periscopes, Access Plugs, Utility Plugs)	CTS+Tunnel	B	IV	B
Maintenance Access Hatch	Tunnel	B	IV	B
Maintenance Access Door	EDR	C	(3)	
Sheet Metal Building	CTS	N	(3)	
Safety Protective Structures	CTS	B(1)	IV	B
01-14 Building	01-14 Bldg.	C	(3)	
Shield Walls	01-14 Bldg.	C	IV	C
HLW Tank Vaults	WTF	C	(3)	
Connecting Underground Pipe Trench	WTF-CTS	C	IV	C
Connecting Underground Pipe Trench	CTS+01-14 Bldg.	C	(3)	
WASTE PROCESSING				
Cold Chemical Storage	Near CTS	N	IV	N
Cold Chemical Mixing Tanks	Chem Makeup	N	IV	N
Cold Chemical Transfer System	Chem Makeup	N	III	C
HLW Storage Tanks	WTF	C	(3)	
HLW Transport Lines	WTF+CTS	C	III	C
HLW Transport Pumps	WTF	C	III (2)	C
HLW Transport Valves	WTF+CTS	C	III (2)	C
Concentrator Feed Makeup Tanks (2)	CTS Cell	N	II	B
Melter Feed Tank	CTS Cell	N	ii	B
Airlift/Pump Feed System	CTS Cell	N	III (2)	C

NOTES

(1) Safety Protective Structures are those structures interior to the Sheet Metal Building and exterior to the Concrete Hot Cell necessary to protect safety related equipment.

(2) Assumes spare or spare subcomponents are provided.

(3) Existing structure or component.

COMPONENT OR SYSTEM	LOCATION	SAFETY CLASS	SERVICE CLASS	QUALITY LEVEL
Vessel Vent System	CTS Cell	C	IV	C
Jumpers	CTS Cell	N	III (2)	C
CTS Penetrations, Pipes and Isolation Valves	CTS	C	III (2)	C
GLASS PRODUCTION				
Slurry-Fed Ceramic Melter	CTS Cell	N	II (3)	B
Canister Turntable	CTS Cell	N	II (3)	B
Jumpers	CTS Cell	N	III(2)	C
Glass Level Detection System	CTS Cell	N	III	C
Startup Heaters	CTS Cell	N	III(3)	C
CLOSED LOOP COOLING SYSTEM				
Cooling Tower	Yard	N	IV	N
Heat Exchanger	CTS	N	II	B
Cooling Water Transport Lines	CTS+Yard	N	IV	N
Cooling Water Transport Pump	CTS	N	II	B
Cooling Water Transport Valves	CTS	N	III (2)	C
CTS Penetrations, Pipes and Isolation Valves	CTS	N	III (2)	C
SOLIDIFIED HLW HANDLING SYSTEMS				
Overhead Cranes	CTS+Tunnel+EDR+CPC	N	II	B
Auxiliary Hoists and Cranes	CTS+Tunnel EDR+CPC	N	II	B
Mobile Cranes	As Needed	N	III	C
Remote Manipulators	CTS+Tunnel+EDR+CPC	N	III (2)	C
Transfer Carts	CTS+Tunnel+EDR+CPC	N	III (2)	C
Storage Racks	CTS+Tunnel+EDR+CPC	N	IV	N
CANISTER DECONTAMINATION AND MONITORING SYSTEM				
Canister Welding Station Welder	CTS	N	IV (2)	N
Canister Decontamination Station	CTS - Tunnel	N	IV	N
Water Spray System	EDR	N	III	C
Decontamination Liquids Transport Lines	EDR	N	III	C
Decontamination Liquids Transport Pump	EDR	N	II	B
Transport Valves	EDR	N	III (2)	C
MONITORING SYSTEMS, CONTROLS, AND INSTRUMENTATION (Excepting HV)				
Process Radiation Monitors	CTS	C	III (2)	C
Area Radiation Monitors	Area	C	III (2)	C
Airborne Particulate Monitors	Area	C	III (2)	C

COMPONENT OR SYSTEM	LOCATION	SAFETY CLASS	SERVICE CLASS	QUALITY LEVEL
Exhaust Stack Monitoring System and Alarms	Stack	C	II (2)	B
HV Radiation Monitoring system	CTS	C	III (2)	C
Closed Circuit Television System	CTS+Tunnel+EDR+CPC	N	III (2)	C
In-Cell Lights	CTS+Tunnel+EDR+CPC	N	III (2)	C
Communications Equipment	CTS+Tunnel+EDR+CPC	N	III	C
Electronic Instruments and Controls	CTS+Tunnel+EDR+CPC	N	III (2)	C
Pneumatic Instruments and Controls	CTS+Tunnel+EDR+CPC	N	III (2)	C
Liquid HLW Sampling Systems	CTS	N	III (2)	C
Sample Transfer System	CTS+Plant	C	II	B
UTILITIES AND SUPPORTING SYSTEMS				
Electrical Power Systems				
New Electrical Substation	Near CTS	N	II	B
Uninterruptible Power System	CTS	B	II	B
Panels, Transformers, Motor Control Centers and Switchgears	CTS	N	II	B
Conduits	CTS	N	IV	N
Conduit Supports	CTS	N	IV	N
Natural Gas	CTS+Tunnel+EDR+CPC	N	IV	N
Steam	CTS+Tunnel+EDR+CPC	N	IV	N
Utility Air	CTS+Tunnel+EDR+CPC	N	IV	N
Instrument Air	CTS+Tunnel+EDR+CPC	N	IV	N
CO2	CTS+Tunnel+EDR+CPC	N	IV	N
Cooling Water	CTS+Tunnel+EDR+CPC	N	IV	N
Fire Detection and Protection	CTS+Tunnel+EDR+CPC	N	IV	N
Safety Shower and Eyewash	CTS+Tunnel+EDR+CPC	N	IV	N
PROCESS OFF-GAS SYSTEM				
Submerged Bed Scrubber	CTS	N	II	B
High Efficiency Mist Eliminator	CTS	N	III	C
Demister	CTS	N	IV	N
Heater	CTS	N	III	C
HEPA Filter Bank	CTS Bldg	N	IV (2)	N
Ducting	CTS+Tunnel+01-14	C	IV	C
NO_x Abatement Equipment	01-14 Bldg	N	IV	C
Exhaust Filtration	01-14 Bldg	C	IV (3)	C
Heaters, Electric	01-14 Bldg	N	III	C
Exhaust Blower, Electric	01-14 Bldg	C	III (3)	C
Exhaust Blower, Electric	01-14 Bldg	C	III	C
Backup Blower, Diesel	01-14 Bldg	C	II (3)	B
CTS Penetrations, Pipes, Isolation valves, Valve supports	CTS	B	III	B

COMPONENT OR SYSTEM	LOCATION	SAFETY CLASS	SERVICE CLASS	QUALITY LEVEL
HEATING AND VENTILATION (H&V) SYSTEM				
Ducting - Cell Exhaust System	CTS	B	IV	B
Ducting - CTS Air Distribution and Supply	CTS	N	IV	N
Intake Blowers	CTS	N	II	B
Controls to Intake Blowers (From exhaust system)	CTS	B	III	B
Primary and Backup Blowers	CTS	B	III	B
Primary HEPA Filter Bank	CTS	B	IV	B
Cell Dampers (Shut-off) and Penetrations	CTS	B	IV	B
UPS Power Supply to Controls and Actuators	CTS	B	II	B
Conduit and Supports	CTS	B	IV	B
Electrical Supply-Exhaust (Motor control center, switchgear, panels)	CTS	B	III (2)	B
Emergency Backup Generator	CTS	B	II	B
Electronic Instruments and Controls	CTS	B	III (2)	B
Pneumatic Controls and Actuators	CTS	B	III (2)	B
HV Supply and Exhaust System for CPC and EDR Cells	Plant	C	II (3)	B
Backup Emergency Power Supply	Plant	C	II (3)	B
Electronic Instruments and Control	Plant	C	II (3)	B
Ducting	01-14 Bldg	C	IV	C
Primary and Backup Blowers	01-14 Bldg	C	III	C
Exhaust Filtration	01-14 Bldg	C	IV	C

4.7 Decommissioning

The VF design shall incorporate features that facilitate future decommissioning of the facility. The VF facilities and structures shall be designed in accordance with ANSI-N-300, "Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants."

4.8 Codes and Standards

The following codes and standards are applicable but are not all inclusive. The codes or standards effective date is contract or order placement date.

4.8.1 Commercial Codes and Standards

ACI 318	Building Code Requirements for Reinforced Concrete
ACI 349	Code Requirements for Nuclear Safety Related Concrete Structures
ANSI A58.1	Building Code Requirement for Minimum Design Loads for Buildings and other Structures
ASME-NQA-1	Quality Assurance Program Requirements for Nuclear Facilities
ANSI B16.5	Steel Pipe Flanges and Flanged Fittings
ANSI B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley)
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ANSI N101.6	Concrete Radiation Shields, 1972
ANSI N-300	Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Plants
ANSI 509	Nuclear Power Plant Air Cleaning Units and Components
ANSI 510	Testing of Nuclear Air Treatment Systems
ASME Section VIII	ASME Boiler and Pressure Vessel Code, Pressure Vessels
ASME Section III	Nuclear Power Plant Components
CMAA 70	Crane Manufacturers Association of America Specification No. 70, Specifications for Electric Overhead Traveling Cranes

NFPA 70	National Electric Code (NEC)
IEEE	Standards Clars 1E
ISA-S5-2	Instrument Society of America (Symbology)
NFPA 101	Life Safety Code
NFPA	National Fire Protection Association, National Fire Codes, Standards, Recommended Practices, and Manuals
U.B.C.	Uniform Building Code, International Conference of Building Officials

UL 586 High Efficiency Particulate Air Filter Units

4.8.2 U.S. Department of Energy Documents

The following applicable documents are required, but are not all inclusive.

DOE ORDER 5480.1	Department of Energy
Chapter I	Environmental Protection, Safety and Health Protection Standards
Chapter V	Safety of Nuclear Facilities
Chapter VIII	Occupational Medical Program
Chapter IX	Construction Safety and Health Program
Chapter X	Industrial Hygiene Program
Chapter XI	Requirements for Radiation Protection
DOE 5481.1A	Safety Analysis and Review System
DOE-ID-12044	Operational Safety Design Criteria Manual
DOE-ID-5840.1	Safety Analysis and Review System for DOE Managed Activities
> DOE-ID Architectural	WVDP to use a General Guidelines per WD:84:0190 March 30, 1989
> 6430.1A	General Design Criteria, an defined in letter CA:91:0048, November 1991 in accordance with 6430.1A Section 0101-2

4.8.3 Federal and State Standards

The following applicable standards are required, but are not all inclusive.

29 CFR 1910	OSHA, General Industrial Standards
40 CFR 61	National Emission Standards for Hazardous Air Pollutants

TABLE 6.3.2: MINIMUM CODES AND STANDARDS FOR STRUCTURES, SYSTEMS, AND COMPONENTS

Classification	Structures	Process Equipment					Control and Electrical
		Vessels/Vents	Pumps	Valves	Piping	Heat Exchangers	
Safety Class A	ACI 349; ASME Sec. III Division 1 Subsection NF	ASME Sec. III Division 1	ASME Sec. III Division 1	ASME Sec. III Division 1 TEMA "R"	ASME Sec. III Division 1	ASME Sec. III Division 1;	IEEE Class IE
Safety Class B	ACI 318	ASME Sec VIII Division 1	ASME Sec VIII Division 1	ANSI B16.5; ANSI B31.3	ANSI B31.3	ASME Sec VIII Division 1; TEMA "R"	ISA Standards; NEC (designed to fail on preferred mode)
Safety Class C	NYS Building Code	ASME Sec VIII Division 1 (or API 620 and API 2000 for large, low pressure tanks)	API-610 (or manufacturer's standard)	ANSI B16.5; ANSI B31.3	ANSI B31.3	ASME Sec VIII Division 1; TEMA "C"	ISA Standards; NEC
Class N	NYS Building Codes	Manufacturer's Standard	Manufacturer's Standard	Manufacturer's Standard	Manufacturer's Standard	Manufacturer's Standard	ISA Standards; NEC

MIL-F-51068E	Military Specification, "Filter-Particulate, High-Efficiency, Fire Resistant"
MIL-F-51079C	Military Specification, "Filter Medium, Fire-Resistant High Efficiency"
New York State	"Code Manual for the State Building Construction Code"

5.0 SITING CRITERIA

The new VF shall be located within the existing WVDP. Criteria that must be considered in locating the facility within the selected area include:

- o Providing the interfaces with existing facilities, as needed, while minimizing the distance for conveying radioactive materials.
- o Where possible, process and utility piping systems shall be located to allow building and process expansion.
- o Minimizing interferences with existing and proposed structures, both above and below ground, and including roadways.
- o Providing ready access for receiving and removing materials and equipment.
- o Providing good vehicular and pedestrian traffic patterns.
- o Provide adequate plant protection from the effects of natural phenomena.

6.0 REFERENCES

1. West Valley Demonstration Project Fact Book.

2. Waste Acceptance Preliminary Specifications for the West Valley Demonstration Project High-Level Waste Form," Rev. 1, dated January 1990.

3. Letter WD:83:0391, J. L. Knabenschuh to W. H. Hannum, "Seismic Hazard Analysis for the West Valley Demonstration Project," dated August 31, 1983.

4. Letter DW:83:0555, W. H. Hannum to R. C. Mairson, "Seismic Hazard Analysis," dated October 20, 1983.

5. "Meteorological Program for West Valley Demonstration Project," G. W. Nicholas and R. C. Eagan, Dames and Moore, dated January 1983.

6. "Natural Phenomena Hazard Studies and Recommended Design Criteria for the West Valley Site, West Valley, New York," draft, dated October 1, 1981, Lawrence Livermore National Laboratory.

7. Preliminary Safety Analysis for the Vitrification System, Volume III, dated December 1986.

8. Letter WD:84:0471, S. Marchetti to W. H. Hannum, "Technical and Administrative Approach for the West Valley Demonstration Project Safety Program," dated April 1985.

9. Letter WD:85:0191, C. J. Roberts to W. H. Hannum, "Application for a New York State Department of Environmental Conservation (NYSDEC) Permit to Conduct the Vitrification Off-Gas System," dated March 22, 1985.

10. WVNS "Quality Management Manual", WVDP-002, Rev. 5, dated July 1, 1988.

11. Letter HE:86:0042, C. J. Roberts to C. C. Chapman, "Hazard Classification and Safety Classification of Important Structures, Systems, and Components for the Vitrification Process," dated March 15, 1985.

12. WVDP-022, "WVDP Emergency Plan", Rev. 2, dated April 10, 1988.

13. EPA/DOE Memorandum of Understanding, dated April 12, 1984.

\> 14. Design Criteria, DC-046 "Sludge Mobilization Waste Removal System", (to be engineering released).

\> 15. Design Critera DC-048 "Canister Storage System" Rev. 0, Dated 7/30/87.