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West Valley Demonstration Project

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DESIGN CRITERIA

SLUDGE MOBILIZATION WASTE REMOVAL SYSTEM

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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.

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	07/24/92

RECORD OF REVISION (CONTINUATION SHEET)

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1.0 SCOPE

The Waste Removal System is the key part of the overall Sludge Mobilization System. This system involves resuspending and transferring the high level nuclear wastes at the West Valley Demonstration Project and delivering them to the Vitrification Facility. The processing of the high level waste from the West Valley Tank Farm Underground Storage Tanks 8D-1, 8D-2, and 8D-4, will occur in stages.

When the processing of the supernatant from Tank 8D-2 is completed through the Supernatant Treatment System, Tank 8D-1 will contain a cesium loaded zeolite by-product. This zeolite will be resuspended with water to form a solids slurry. The zeolite solids will be slurried by mobilization pumps installed in the 8D-1 tank and the slurry will be transferred to Tank 8D-2 after sludge washing. Sludge washing will take place in Tank 8D-2 after supernatant processing. Washing of the sludge consists of adding dilute caustic water solution to 8D-2, mixing the sludge with the solution, and decanting the wash water solutions to the Supernatant Treatment System for processing. This removes both interstitial salts and salt crystals from the PUREX insoluble sludge layer. These salts have an adverse effect on the Vitrification Facility product and must be below certain levels prior to being transferred. Therefore, the interstitial salts must be removed from the insoluble sludge. Once the zeolite is transferred to Tank 8D-2, it will be mixed with the washed PUREX waste sludge that remains in Tank 8D-2 after washing. This mixing will be accomplished using mobilization pumps installed in the tank.

The THOREX waste stored in Tank 8D-4 will be removed and also transferred to Tank 8D-2. All three waste streams will be thoroughly mixed to obtain a relatively homogeneous mixture. The zeolite-THOREX-PUREX sludge mixture will then be transferred to the concentrator feed makeup tank in the Vitrification Facility for concentration and the addition of glass formers.

In order to perform these waste transfers on the tank farm, mobilization pumps, waste diversion pit(s), transfer pumps, a pump pit for each of the respective tanks, transfer piping, instrumentation, a containment system, and necessary utilities will be required. These facilities and equipment shall be designed to these criteria.

These criteria include the structural requirements and the process requirements for transferring high level nuclear waste to and from the tank farm during the vitrification campaign. It includes the transfer piping outside the pits and the connection to the vitrification facility.

Table 1 is a list of the minimum pump and diversion pits required for waste transfer at the tank farm. These identification numbers shall be used on all drawings and documents. Eight is the tank farm area designator; Q identifies pits; and the number locates and/or identifies the pit itself.

Table 1. Pit Identification

Location	Function	Identification Number
Tank 8D-4	THOREX Removal	8Q-4
Tank 8D-1	Zeolite Removal	8Q-1
Tank 8D-2	PUREX Sludge Removal	8Q-2
Tank Farm	Waste Diversion	8Q-5

1.1 Definitions

ACI - American Concrete Institute
AISC - American Institute of Steel Construction
ALARA - As Low As Reasonably Achievable
ANSI - American National Standards Institute
ASME - American Society of Mechanical Engineers
CFMUT - Concentrator Feed Make-up Tank
HLW - High-level Waste
ISA - Instrument Society of America
LWTS - Liquid Waste Treatment System
MFHT - Melter Feed Hold Tank
PVS - Process Ventilation System
SMS - Sludge Mobilization System
SSE - Safe Shutdown Earthquake
STS - Supernatant Treatment System
TID - Total Integrated Dose
UBC - Uniform Building Code

VF - Vitrification Facility

WVDP - West Valley Demonstration Project

2.0 FUNCTIONAL REQUIREMENTS

The waste removal system shall be designed to perform the following general functions:

1. The pits and transfer piping at the restricted access tank farm area must provide adequate radiation shielding to allow for controlled access and shall be designed to the exposure standards of ID 12044 and DOE Order 5480.11.

2. Services must be provided to each pit for line flushing, pit wash down and drainage.

3. The pits must be self-contained and amenable to remote maintenance with the use of an overhead crane, gantry and/or jib crane.

4. The HLW transfer piping required for waste transfer could be housed in a common containment system connecting Tanks 8D-4, 8D-1, 8D-2, and the vitrification facility.

5. Valve diversions within the pits shall maximize the use of common piping from tank to tank and tank to the VF so as to minimize the total number of transfer lines.

6. The system shall facilitate installation and future decontamination and decommissioning of the HLW transfer piping. The confinement system can also provide for the required radiation shielding.

7. The environment of the pits, once operational, will require that all high maintenance and failure prone items and/or equipment be serviced or replaced by remote means.

8. All transfer piping to process equipment (valves, pumps) connections shall be made with remotely coupled jumpers using PUREX type connectors.

These jumpers shall be connected through piping embedded in the pit walls.

9. Process jumpers within the pits shall include all of the instruments required to operate and monitor the transfer system.

10. Electrical connections shall be hardwired to the equipment and extend out of the pits through wall slots or conduit.

11. Each pit shall have transfer line flushing capabilities for the prevention of plugging and the clearing of plugs if they occur.

12. The transfer piping a[illegible]ts support structure shall be designed to asrure the piping will slope back to the tanks.

13. The transfer piping shall connect to the west wall of the VF below the west operating aisle.

14. A utility manifold of water and air shall be permanently piped to the pits. This utility manifold shall be connected to the HLW transfer system to allow for the use of each utility separately or together to flush the transfer lines and jumpers.

15. The utility manifold shall also allow the addition of chemical cleaning fluids to both the transfer lines and the tanks.

16. Pit wash down shall be implemented by external portable spray nozzles that can be inserted through a plug or plugs in the pit cover. These spray nozzles shall provide a spray pattern so that the walls, ceiling, and floor of the pit can be washed down.

17. Pump pits 8Q-1, 8Q-2 and 8Q-4 shall have a recirculation loop back to their respective tank.

18. The discharge pumps will extend into the tanks through their respective tank risers. The pump discharge line will be remotely installed to the pit piping via a process line jumper.

19. The pump discharge jumper shall contain all the waste process transfer instrumentation for the system. The line shall include valving to allow for total recycle back to the tank or transfer out of the pit.

20. All instrumentation shall be placed in the line where waste is transferred in both the recirculation mode and during removal from the pit.

21. The pit floor shall be sloped to a sump or drain to promote pit drainage.

22. The VF in-cell process shall provide, if required, any utility support services for waste header and condensate return lines from in-cell to the tank farm.

23. HLW transfer piping at the VF and outside the tank farm restricted access area must provide radiation shielding to allow for full time occupancy and meet the exposure standards of ID 12044 and DOE Order 5480.11.

24. Provide a chemical feed area for the receipt and makeup of nonradioactive chemical solutions.

25. The waste transfer system shall be capable of intertank transfer and transfer from Tanks 8D-1, 8D-2 and 8D-4 to the VF.

26. Failed equipment will be disposed per approved procedures.

27. Provide access capabilities for operations and maintenance personnel and for equipment installation and removal in all areas where maintenance is required.

28. Provide process system reliability through redundancy (i.e., spares) for hard piped transfer lines. Each transfer route shall have one installed spare line.

29. Use existing STS tank farm utilities and support systems to the extent practicable, e.g. tank farm ventilation, electrical, steam, process water, and compressed air.

30. Provide a central control area that will include but may not be limited to: monitoring, recording, alarming and controlling the transfer process. Use programmable logic controllers and administrative controls to meet operational and safety requirements.

31. Provide the capability to control contamination during routine and emergency operating conditions and during all remote maintenance activities.

32. Maximize the reuse of process water for waste transfer operations to the extent possible by recycling water from tank to tank.

33. Utilize the STS process to the extent possible for recycling water or treating process water, if required, prior to liquid transfer to LWTS.

34. The design of the pump pits as well as the diversion pit shall optimize the wall nozzle arrangement and jumper layout to provide for interchangeability of jumpers between pits.

The HLW process parameters to be used in the design of the pit, piping, valves and instrumentation are summarized in Table 2.

There will be no sampling in the waste transfer system. Any sampling shall be performed at the CFMUT in the VF or from the waste tanks directly.

3.0 OPERATIONAL REQUIREMENTS

The HLW transfer system will be operated as a batch system or on a semicontinuous basis. In the semicontinuous operations, sludge, zeolite, THOREX and/or waste mixtures can be pumped from tank to tank. In a batch operation, a preset volume of waste would be transferred from tank to the VF.

Table 2. HLW Transfer Process Parameters

	THOREX	8D-4 WASTE	PUREX Sludge	Zeolite Slurry
Temperature				
Maximum	200°F	200°F	220°F	212°F
Normal	135°F	140°	150°F	150°F
Minimum	70°F	70°	70°F	70°F
Pressure				
Maximum	150 PSIG	150 PSIG	150 PSIG	150 PSIG
Flow Rates				
Maximum	2 GPM	50 GPM	100 GPM	100 GPM
Normal	1 GPM	35 GPM	60 GPM	60 GPM
Minimum	1 GPM	20 GPM	30 GPM	30 GPM
Specific Gravity				
Maximum	1.7	1.5	1.6	1.8
Normal	1.6	1.2	1.3	1.3
Minimum	1.0	1.0	1.0	1.0
Rheological Properties				
Maximum	12 CP	50 CP	20 CP	1.1 CP
Normal	9 CP	20 CP	12 CP	1.0 CP
Minimum	1 CP	1 CP	6 CP	1.0 CP
General				
pH Range	< 1	< 1	11.7 - 12.5	11.0 - 12.0
Average Particle Size	N/A	80 μm	80 μm	570 μm
Activity				
Cs-137	8.6 Ci/l	3.8 Ci/l	0.1 Ci/l	6.8 Ci/l
Sr-90	8.2 Ci/l	3.9 Ci/l	8.3 Ci/l	< 0.1 Ci/l

3.1 Processing Description

A generalized flow sheet is represented schematically in Figure 1.

After STS wash water processing, the three storage tanks will contain the following: 1) Tank 8D-2 containing washed PUREX sludge; 2) Tank 8D-4 containing THOREX waste in dilute nitric acid solution; and 3) Tank 8D-1 containing cesium loaded (spent) zeolite.

The method of processing the contents of these three tanks is to mix them together in Tank 8D-2 and then deliver the mixture to the Vitrification Facility. The advantage of combining the wastes in Tank 8D-2 is that the vitrification process feed stream will not vary in composition nearly as much as if three separate streams of vastly different compositions are processed. Processing a combined waste stream will significantly simplify vitrification operations.

The THOREX solution will be removed from 8D-4 and transferred to the 8D-2 tank. The THOREX waste in Tank 8D-4 is in the form of an acidic solution. Therefore, the contents of Tank 8D-4 will be easily removed in the form of a solution. Prior to blending the THOREX waste with the washed PUREX sludge, a quantity of sodium hydroxide will be added to the 8D-2 waste to precipitate the THOREX metal ions and neutralize the nitric acid in the THOREX solution. The cesium loaded zeolite in Tank 8D-1 is resuspended using water, pumped through an in-line grinder to reduce the particle size of the zeolite, and transferred to the 8D-2 tank.

With the three waste streams in 8D-2 the waste is thoroughly mixed to the maximum extent possible using the sludge mobilization pumps, to give a homogeneous feed mixture to the Vitrification Facility for solidification into borosilicate glass.

The waste in 8D-2 will be batch transferred to the CFMUT in the Vitrification Facility. In the CFMUT excess water is removed and nitric acid is added to adjust the pH of the waste. Finally, the waste, largely nitrates, is blended with glass formers, mixed and transferred to the melter feed hold (MFHT) tank. The excess water removed in the CFMUT is sent back to Tank 8D-3 through the process condensate return line. This water can be sent from 8D-3 to LWTS or Tank 8D-2 via the STS piping system.

3.2 Process Requirements

The valving of the pits shall allow for a number of alternative routing configurations. These routing configurations, at a minimum, are listed below:

a. From CFMUT V-001 to Tank 8D-2
b. From CFMUT V-001 to Tank 8D-4
c. From Tank 8D-4 to CFMUT V-001
d. From Tank 8D-4 to Tank 8D-2
e. From Tank 8D-1 to CFMUT V-001
f. From Tank 8D-1 to Tank 8D-2
g. From Tank 8D-2 to CFMUT V-001

In addition, the waste streams from the VF (waste header) to Tank 8D-4, and VF (CFMUT condensate) to Tank 8D-3 shall be routed directly through the VF west wall and do not require alternative routing or spares. Waste from various sumps and equipment is transferred to the waste header by steam jet. Evaporated water from the CFMUT is pulled to the in-cell condenser by the VF off-gas system. Once the vapor condenses it drains to the condensate return line which shall connect to the 8D-3 tank. These lines shall be gravity flow transfer back to the tank farm since the 8D-4 and 8D-3 tanks are underground and at a lower elevation than in-cell lines.

The waste transfer process equipment shall be designed to meet the various conditions listed in Section 2.1, Process Parameters. Each of the pump pits will contain transfer pumps sized to the worst case combination of process parameters and capable of delivering waste to the VF. Waste transfer diversions or alternative routing will be accomplished at the centralized diversion pit on the tank farm near the VF. Maintaining the diversion pit, 8Q-5, near the VF will minimize the volume of water added to the facility when waste transfer line flushing from the tank farm to the VF occurs.

Since the acidic THOREX waste will be transferred to the basic washed PUREX sludge a means to measure and control the 8D-2 tank pH must be available. There also needs to be a method to add and control the addition of sodium hydroxide to Tank 8D-2.

Zeolite size reduction equipment, e.g. in-line grinder(s), shall be housed in the pump pit(s) and must be capable of providing discharge pressures to deliver ground waste to its discharge point in the tank. The zeolite shall be ground to the acceptable particle size as a separate operating step during waste preparation and not during transfer to the VF.

3.3 Operating Conditions

There are various conditions under which the waste transfer system shall operate. This section defines the normal operating modes from tank to tank and from tank to the VF, possible upset conditions, and shutdown states.

3.3.1 Tank 8D-1 Zeolite Transfer

The spent zeolite resulting from supernatant treatment and sludge wash solution processing will be stored at the bottom of Tank 8D-1. It is estimated that there will be between 45,000 kg to 75,000 kg of zeolite in Tank 8D-1 after STS processing is completed. This zeolite must be resuspended with water, pumped from Tank 8D-1 and transferred to the 8D-2 tank. Five long shafted centrifugal pumps, called zeolite mobilization pumps, mounted at strategic locations in the tank will be used to resuspend the zeolite.

Starting with approximately three to five feet of water in the tank the mobilization pumps will be operated at 100% speed. Zeolite pump pit valving will be positioned to transfer zeolite slurry to 8D-2. The zeolite removal pump would be energized and the slurry concentration monitored using the pit instrumentation and pump operation.

The zeolite particles must be size reduced prior to transfer to the VF. One method to accomplish this is to size reduce the zeolite before it enters the 8D-2 tank. This will provide optimum mixing with the sludge and assure the mixed zeolite was size reduced. Therefore, the zeolite discharge pump shall transfer the zeolite slurry from Tank 8D-1, through a in-line grinder and into Tank 8D-2. Pump pits 8Q-1 and 8Q-2 valving would be arranged to allow this transfer configuration. Once the valving is arranged, and the zeolite mobilization pumps are fully operational, the zeolite removal pump would be energized to remove the zeolite slurry from Tank 8D-1. The zeolite slurry will continue to be removed until the liquid level in 8D-1 drops to approximately one foot.

After a batch of zeolite slurry is transferred to Tank 8D-2, the five mobilization pumps would be operated to assist in distributing the zeolite within the 8D-2 waste.

Additional water would be added to Tank 8D-1 to bring the level back to a minimum of three to four feet and the zeolite batch transfer process would be repeated. The additional water added to 8D-1 for batch zeolite removal could be decanted from Tank 8D-2. This could be accomplished using the STS supernatant transfer pump.

These batch transfers to Tank 8D-2 will continue until about 90 percent or more of the zeolite is removed from 8D-1. Pumping the zeolite down from four to one foot removes approximately 75 percent of the solids each time. The remaining percent solids will be 100×0.25^n when n is the number of batch transfers. The remaining residual zeolite can be removed using chemical cleaning agents during final tank flushing near the end of the vitrification campaign.

Once the zeolite has been transferred through the process lines, all lines which have contacted the slurry shall be flushed back to the tanks to remove any residue zeolite.

3.3.2 Tank 8D-4 THOREX Transfer

The THOREX waste will be transferred to Tank 8D-2 where an appropriate caustic level, initially added to 8D-2, will effectively neutralize the THOREX and maintain corrosion control of 8D-2. Laboratory-scale studies with actual waste shall be performed to address technical concerns of adding Tank 8D-4 contents to Tank 8D-2. This test will form the basis for developing the appropriate and safe operating parameters.

As the THOREX is added it will be blended with the washed 8D-2 PUREX sludge using the mobilization pumps. Since the THOREX waste is a solution, agitation in Tank 8D-4 is not required during this waste transfer operation.

The THOREX transfer system could be valved for waste recycle back to Tank 8D-4. The THOREX waste removal pump would be energized with the discharge returned back to the tank, and the waste would be mixed to provide a homogenous solution. Instrumentation within the THOREX removal pit will allow monitoring of temperature, pressure and flow. Once mixed, the THOREX removal pump would be shut down to prepare for 8D-2 transfer.

At Tank 8D-2, the five mobilization pumps will be started. Sodium hydroxide solution will be added to 8D-2 in excess to neutralize the total volume of THOREX waste to be transferred. This will be approximately 1,000 gallons of 20% caustic added through the Caustic Addition System. Valving arrangement would be set in Pits 8Q-4, 8Q-1 and 8Q-2 to allow waste transfer from 8Q-4 to 8Q-2. The 8Q-4 recycle line would be closed. With the sludge mobilization pumps operational at 100 percent speed, the THOREX removal pump is energized, and approximately 700 gallons of THOREX will transferred to Tank 8D-2. Additional flushing in

8D-4 and transfer to 8D-2 would be required to maximize the THOREX waste removal.

The volume of THOREX waste transferred to 8D-2 at any one time will be based on acceptable pH operating ranges (11.7 to 12.5) for Tank 8D-2 and any off gassing of NO_x produced during the neutralization of the nitric acid, not to exceed 5 lbs/hr. If for example, the volume of sodium hydroxide that would have to be added to Tank 8D-2 for transfer of all the THOREX raised the pH higher than the allowable limit, the THOREX would be transferred in smaller volumes.

Once the THOREX waste is transferred all process lines shall be flushed to remove residue waste.

3.3.3 Tank 8D-2 Waste Transfer

To transfer a waste batch in Tank 8D-2 to the CFMUT in the VF, first the five sludge mobilization pumps would be started and run for approximately six to twelve hours. The valving in the 8Q-2 and 8Q-5 pits would be arranged for the proper transfer to the CFMUT and the 8Q-2 pump pit discharge line would be opened. A flow controller could be set to transfer a batch volume of waste slurry. This batch volume would be based on either the slurry density or the CFMUT volume during that transfer. Approximately 5,000 gallons of waste would be transferred at approximately 15 weight percent solids concentration. Once the total gallons are set on the controller, and with all the mobilization pumps operating, the discharge pump would be started. The waste slurry will travel through the 8Q-2 pit to the 8Q-5 diversion pit and on to the CFMUT in the VF. The pump shall be controlled to automatically shut down when the preset volume is reached. As a backup, the CFMUT high-level switch shall be interlocked to automatically cut power to the discharge pump if the level was to exceed the CFMUT high-level alarm set point.

Each time a batch of waste is transferred, all transfer lines will require flushing. It is more beneficial to flush to the tank farm since additional water will be required during waste removal. However, unless there is a way to flush from the CFMUT to the tank farm, some line flushing from the 8Q-5 diversion pit to the VF will be necessary. A minimum of two line volumes shall be used during line flushing.

3.4 Transfer System Configuration and Essential Features

The waste transfer system design shall be based on ALARA and optimum safety, as defined in Operational Safety Design Criteria Manual ID-12044, DOE Order 6430.1A, General Design Criteria Manual for Department of Energy Facilities, and OSHA, Part 1910, Occupational Safety and Health Standards. This can be accomplished by providing the equipment, support systems, and features that achieve the basic functions and processing rates listed within this document.

The following paragraphs describe possible design approaches upon which the designer can expand, modify, or improve. Other approaches shall be considered and the final design, provided it meets the functional and operational requirements of the system, shall be prioritized based on the optimum balance between: 1) operational risks, 2) ease of remote maintenance, 3) cost, and 4) safety.

The waste transfer system shall be composed of single pump pits for each of the respective HLW storage tanks from which the system is required to remove waste. Each pit shall be sized to accommodate the physical requirements of the process equipment. Each pit shall also provide required radiation shielding and contamination control features. Equipment access to the pits shall be gained through pit cover hatches and must be removable between the mobilization pump support structure spanning Tanks 8D-1 and 8D-2.

Due to the limited space available at the tank farm for the pump pits and the infrequent batch type operations, all valve operations involving waste transfer will be manual. Valve handles will be extended through plugs in the pit cover hatches. Interlocks using limit switches will be provided on diversion valves to prevent unwanted diversions and monitor valve positions. Valve funnels shall be provided for each of the manual valves for easier handling and installation through the pit covers.

All tank return lines will be contained within the pit's removal pump riser to avoid making new tank penetrations.

3.4.1 Zeolite Removal and Transfer System

Pump Pit 8Q-1 will contain the zeolite discharge pump for Tank 8D-1 and will be used to pump the spent zeolite from the 8D-1 tank through either a recirculation line back to 8D-1 or to Tank 8D-2. The zeolite transfer system shall also be capable of transferring from 8Q-1 directly to the CFMUT in the VF. This shall be accomplished using the 8Q-2 pump pit discharge line to the VF by valving in the 8Q-2 pit. By using the transfer piping from 8Q-2 pit to VF, the total number of transfer lines to the VF can be greatly reduced.

The zeolite removal and transfer system shall be designed to achieve the following basic operational features:

1. Transfer zeolite slurry at flow rates from 70 gal/min to 100 gal/min back to Tank 8D-1, or to Tank 8D-2 or to the VF.

2. Size reduce the zeolite particles to an average size of 80 μm or less[8] prior to transfer into the VF.

3. Maintain a fluid velocity of seven to ten feet/second under normal conditions in the design of the slurry transfer lines to prevent settling of solids in the transfer line. This velocity shall be verified quantitatively during the design of the removal pump.

4. Provide a flow control and process monitoring system.

5. Provide valving arrangements for bypassing the pump recycle line and/or jumper drain lines.

6. Provide line isolation valves and flush lines as required.

7. Monitor the inside of the pump pit for leaks.

8. Provide a drain in the pit to transfer leaked solutions to the waste storage tank.

9. Provide a minimum of two physical contamination control barriers between the process solutions and the environment.

10. Provide remote techniques as required to perform remote equipment maintenance or replacements (valves, pumps, instruments).

11. Provide shielding and other design features to minimize personnel radiation exposure.

12. Use existing tank farm equipment for the measurement of storage tank waste levels, densities, temperatures and vapor space pressures.

13. Provide a minimum negative pressure of 0.5 in. water, relative to atmosphere, inside the pump pit using existing tank farm ventilation. Pit ventilation must be within the flow capabilities of the tank farm ventilation.

14. Provide flushing and decontamination capabilities for piping internal surfaces.

15. Provide a means internally for isolating utility lines from the transfer lines.

16. Provide a pump to remove the zeolite slurry from underground storage Tank 8D-1 with the required discharge pressure at the normal flow condition to transfer the zeolite slurry to either the VF or through the 8Q-2 grinder and into Tank 8D-2.

17. Slope the transfer piping to allow drainage; Low points or stagnant pockets shall be avoided to the maximum extent possible.

18. Provide jumper connections for the pump discharge line to the spare transfer lines out of the pit.

3.4.2 THOREX Removal and Transfer System

Pump Pit 8Q-4 will contain the THOREX discharge pump for Tank 8D-4 and will be used to pump the THOREX waste to either Tank 8D-2 or the CFMUT V-001 in the VF. During the vitrification operation, Tank 8D-4 will be used for transferring both unacceptable acid waste from the CFMUT and Waste Header Material from Process sumps. In most cases these wastes will be transferred to Tank 8D-2 and mixed with the VF waste feed.

The 8Q-1 pump pit transfer piping shall provide a diversion route for the THOREX waste from Tank 8D-4 to Tank 8D-2. The waste removal line from Pit 8Q-1 to 8Q-2 shall be common and transfer both THOREX and zeolite waste streams. Transferring Tank 8D-4 material to the VF shall utilize the 8Q-2 to VF discharge line.

The THOREX removal and waste header transfer system shall be designed to achieve the following basic operational requirements:

1. Transfer Tank 8D-4 waste header material at flow rates from 20 gal/min to 50 gal/min either back to a Tank 8D-4, to Tank 8D-2 or to the VF and THOREX waste at 1 to 2 gal./min. to Tank 8D-2.

2. Provide valving arrangements for bypassing the THOREX recycle line and/or jumper drain lines.

3. Provide line isolation valves and flush lines as required.

4. Monitor the inside of the pump pit for leaks.

5. Provide a drain in the pit to transfer leaked solutions to the waste storage tank.

6. Provide a minimum of two physical contamination control barriers between the process solutions and the environment.

7. Provide a flow control and monitoring system.

8. Provide remote techniques as required to perform remote equipment maintenance or replacements (valves, pumps, instruments).

9. Provide shielding and other design features to minimize personnel radiation exposure.

10. Use existing tank farm equipment for the measurement of storage tank waste levels, densities, temperatures and vapor space pressures.

11. Provide a minimum negative pressure of 0.5 in. water, relative to atmosphere inside the pit.

12. Provide flushing and decontamination capabilities for piping internal surfaces.

13. Provide an internal means for isolating utility lines from the transfer lines.

14. Provide a pump to remove the THOREX waste and waste header solutions from underground storage Tank 8D-4 with the required discharge pressure to transfer the material to the VF.

15. Transfer piping shall be sloped to allow drainage. Stagnant pockets shall be avoided to the maximum extent possible.

16. Provide jumper connections for the pump discharge line to the spare transfer lines out of the pit.

17. Provide a means to allow the Waste Header from the VF to enter the 8D-4 tank.

3.4.3 Sludge Removal and Transfer System

Pump Pit 8Q-2 will contain the sludge discharge pump for Tank 8D-2 and will pump the PUREX sludge and/or mixed waste through a recirculation loop back to Tank 8D-2 or transfer the 8D-2 waste to the VF.

The valve diversions in pump Pit 8Q-2 will extend the waste diversion flexibility by allowing material from Tank 8D-4 or 8D-1 to flow to either Tank 8D-2 or to the CFMUT in the VF. Valving shall also provide for the ability to transfer the 8D-2 waste through the size reduction equipment.

The sludge removal and transfer system shall be designed to achieve the following basic operational features:

1. Transfer sludge and/or mixed waste at flow rates from 50 gal/min to 100 gal/min either back to Tank 8D-2 or the VF.

2. Maintain a fluid velocity of five to ten feet/second under normal conditions in the design of the slurry transfer lines to prevent settling of solids in the transfer line. This velocity shall be verified quantitatively during the design of the removal pump.

3. Provide a flow control and processing monitoring system.

4. Provide valving arrangements for bypassing the pump recycle line and/or jumper drain lines.

5. Provide line isolation valves and flush lines as required.

6. Monitor the inside of the pump pit for leaks.

7. Provide a drain in the pit to transfer leaked solutions to the waste storage tank.

8. Provide a minimum of two physical contamination control barriers between the process solutions and the environment.

9. Provide remote techniques as required to perform remote equipment maintenance or replacements (valves, pumps, instruments).

10. Provide shielding and other design features to minimize personnel radiation exposure.

11. Use existing tank farm equipment for the measurement of storage tank waste levels, densities, temperatures and vapor space pressures.

12. Provide a minimum negative pressure of 0.5 in. water, relative to atmosphere, inside the pump pit using the existing tank farm ventilation system.

13. Provide flushing and decontamination capabilities for piping internal surfaces.

14. Provide a means internally for isolating utility lines from the transfer lines.

15. Provide a pump to remove the sludge or mixed waste from underground storage Tank 8D-2 with the required discharge pressure to transfer the waste to the VF.

16. Slope transfer piping to allow drainage. Stagnant pockets shall be avoided to the maximum extent possible.

17. Provide jumper connections for the pump discharge line to the spare transfer lines out of the pit.

3.4.4 Waste Diversion Pit 8Q-5

The 8Q-5 waste diversion pit will provide the basic route for sending all HLW from the tank farm to the CFMUT in the VF through either of two lines. Waste diversion Pit 8Q-5 will also allow for the return and diversion of waste, either acidic or basic, from the CFMUT to Tank 8D-4 or Tank 8D-2 respectively.

The waste diversion pit shall be designed to achieve the following basic operational features:

1. Provide valving arrangements to divert waste return from the VF to either Tank 8D-2 or Tank 8D-4.

2. Provide line isolation valves to prevent transfers to wrong tanks and flush lines as required.

3. Monitor the inside of the pump pit for leaks.

4. Provide a drain in the pit to transfer leaked solution to waste storage Tank 8D-2.

5. Provide a minimum of two physical contamination control barriers between the process solutions and the environment.

6. Provide remote techniques as required to perform remote equipment replacements (valves).

7. Provide shielding and other design features to minimize personnel radiation exposure.

8. Provide a minimum negative pressure of 0.5 in. water relative to atmosphere, inside the pit.

9. Provide flushing and decontamination capabilities for piping internal surfaces.

10. Provide a means for internally isolating utility lines from the transfer piping.

11. Slope transfer piping within the pit to allow drainage; Stagnant pockets or low points shall be avoided to the maximum extent possible.

12. Provide diversion pit valving to allow transfer line flushing to either the tank farm pump pits or the VF.

13. Provide capability to clear and flush lines with water, air, steam or decontamination solutions.

14. Provide jumper connections for the spare transfer line from the tank farm to the 8Q-5 pit and from the 8Q-5 to the VF.

3.4.5 Vitrification Facility Return Lines

There are three HLW process return lines required for removing waste from the VF during the operation of the VF. Waste header from various sumps and vessel overflows, CFMUT condensed overheads during melter feed concentration, and CFMUT waste return in the event that an unqualified batch of melter feed resulted during feed preparation. The waste transfer system incorporates the waste header line and vessel vent condensate return line once they exit the VF cell. These two lines do not require jumpers since there are no valves required outside the VF cell.

The waste header shall be directed to the 8D-4 tank due to the anticipated acidic nature of the waste. This line has been previously sized and is a nominal three inch gravity flow process line hard piped in the VF cell.[4] The line extends through the VF west pit wall below the 100-foot elevation. Connection to the 8D-4 tank shall be accomplished through the only existing 8P71-3"-C spare line penetrating the 8D-4/8D-3 vault wall.

The CFMUT condensate overheads is also hard piped in the VF west wall. This line has also been previously sized and shall be a nominal three inches, gravity flow, routed to Tank 8D-3. The condensate line shall connect to the only spare line 8P84-3"-C in Tank 8D-3 directly next to the 8D-4/waste header.

The CFMUT waste return in the VF, unlike the waste header and condensate return is remotely jumpered from the CFMUT to the cell west wall nozzle. The waste is transferred via a steam jet, and shall be diverted in the 8Q-5 diversion pit to either Tank 8D-2 or 8D-4. The acid waste, pH less than or equal to 7.0 shall be diverted in 8Q-5 to Tank 8D-4. The acid shall enter Tank 8D-4 through line 8P71-3"-C in which the waste header feeds into 8D-4. A basic waste, pH greater than 7.0 shall be diverted to pump Pit 8Q-2. In pump Pit 8Q-2 the waste shall be connected to a common tank 8D-2 return line which also serves as the sludge removal pump recycle return line. The return line shall be housed in the sludge discharge pump riser M-9.

3.4.6 High Level Waste Line Flushing

A permanent transfer line flush system shall be provided to each pit to permit prompt flushing of the HLW transfer lines to keep the transfer lines clean, thereby reducing the potential for line plugging. In the event of plugging or suspected plugging, utility water shall be available to clear the line. This flush system shall include a means to add chemicals that could be used for dissolution and/or decontamination of the lines and/or jumpers. Each transfer line used shall be flushed with a minimum of two line volumes of utility water.

3.5 Decontamination and Decommissioning

Decontamination requirements are to be considered in the design of the transfer pits. A spray nozzle system shall be provided for internal decontamination of the pits. Removal of high-level radioactive material from any pit sump will require flushing the pit prior to opening a pit cover. This is necessary to reduce personnel exposure and potential contamination releases. The removal pumps shall be decontaminated with a water flush during removal from the tank riser. Supply water for these spray systems shall be supplied from an external header having a hose connection.

3.6 Ventilation

Pit ventilation is required to prevent the escape of radioactive material. Pump pit 8Q-1, 8Q-2, and 8Q-4 will ventilate into their respective tanks when covered. Air flow through the pits is then treated through the existing Tank Farm Ventilation System. Diversion Pit 8Q-5 will ventilate to the 8Q-2 pit where it then will be vented to Tank 8D-2. Air flow to the pit will be provided through cover seals. The air will then enter the waste tank through an opening in the respective removal pump riser. To prevent the escape of radioactive material from the pit in the event a ventilation failure, the pit covers shall be sealed by gasketing.

The air intake to the pits shall be minimized by sealing openings and maintaining a minimum of 0.5 inches of water vacuum in the pit. Provisions shall be made in the pit design to ventilate the pit from an external ventilation system for the purpose of pit cover removal. The existing tank farm ventilation system i.e., tank vent and STS ventilation systems, will provide the necessary ventilation requirements for zeolite and sludge discharge pump installation and removal from Tank 8D-1 M-8 and 8D-2 M-9 risers.

Ventilation to Tank 8D-3 and 8D-4 shall be upgraded to the extent necessary, or an alternative provided, to install the THOREX removal pump and to maintain pit ventilation under normal operations.

3.7 Removal Pumps

The pumps shall be amenable to remote maintenance. Discharge pressures shall be calculated for the worst case transfer. Each pump shall be operated using a variable frequency device for flow control. Packing for shaft seals shall be avoided. Mechanical seals lubricated with process fluids are the preferred choice. All pump components in contact with the process fluid shall be stainless steel. Operating voltage shall be 460V, 60 Hz. Motor heaters and thermal overload instrumentation shall be provided. Detailed specifications for the removal pumps will be incorporated in an WVNS equipment specification.

3.8 Size Reduction Equipment

The size reduction equipment shall be designed for in-line use and continuous operation. Grinding to the required particle size shall be accomplished on a single pass. All wettable parts shall be stainless steel. Grinder cutters on blades shall be of the hardest material practical to provide wear resistance. Grinder shall be direct coupled with its motor. The grinder shall be driven by a standard three-phase motor. Operation voltage shall be 460V, 60Hz.

4.0 DESIGN REQUIREMENTS

The waste transfer system will be housed in a new structure(s) having a design life of ten years. The design life of the equipment within the structure(s) shall be ten years for equipment difficult to repair, such as piping, embeds, and supports. Valves, pumps, motors, seals and other equipment with a design life of less than ten years shall be designed for easy replacement.

The design of the transfer piping, jumpers, jumper containment structure, valves and instrumentation, etc., shall conform to the latest edition of the applicable codes and standards listed in section 7.0 and as defined in this criteria. This section defines specific design requirements from the listed codes and standards the design must satisfy. Detailed design re irements for major components like Removal Pumps and Size Reduction Equipmer nders) will be set within equipment fabrication specifications.

4.1 Structural Design Load Requirements

The structural design shall conform to applicable sections of DOE Order 6430.1A and the Criteria contained in this document, a hall comply with pertinent nationally recognized codes and standards as referenced in 6430.1A.

Designs for the structure of the concrete pit, the covers and the piping containment structure shall be based on the following load requirements:

a. Dead Load (D)
b. Live Load (L)
c. Thermal Load (T_o)
d. Soil Pressure Load (H_{static}, $H_{dynamic}$)
e. Wind Load (W)
f. Tornado Load (W_t)
g. Seismic Load (E_{SSE}, E_{UBC})
h. Differential Settlement (D_y)
i. Internal Pressure (P_o)

The identification of these loads and associated numerical values are enumerated in the following subsections:

4.1.1 <u>Dead Load (D)</u>

Dead load shall include the weight of the structure and its structural components, equipment, piping, cables, and trays. Water, sludge, or other fluid contained in the equipment of piping shall be considered as dead load.

a. Unit weights to be used in establishing dead loads are as follows:

Reinforced Concrete	150	lbs/ft^3
Structural Steel	489	lbs/ft^3
Water	62.4	lbs/ft^3

b. All floor or roof slabs shall be checked locally under equipment supports or other concentrated loads to assure adequacy.

4.1.2 <u>Live Load (L)</u>

Live loads are set to assure a structure, sufficiently strong under normal operation, to provide support for random temporary load conditions for maintenance and to assure structural adequacy for normal construction loads. Live loads shall not be used in establishing inertia forces for seismic loads.

Live loads are listed below. All values listed for estimated equipment loads and laydown loadings shall be increased by 20 percent.

a. In addition to the live loads mentioned above, all floor and roof slabs shall be assessed for a concentrated load of 10,000 pounds located at any positions on a 2 ft x 2 ft area. Areas where this load is controlling shall be identified.

b. Equipment loads shall be included in the design.

- Assumed crane load is 50 tons with a distributed load of 1000 psf. The crane should be a minimum eight feet away from the pit, trench or vault walls.

- Where the inside width of the trench is 6'-0 or less, the assumed truck loading is equivalent to HS 20-44 (16k wheel load). However, the truck loading does not have to be considered at locations where the trench changes direction (corners, elbows, etc.).

c. Equipment laydown loading and locations shall include the following:

- Laydown of the largest pit or trench cover section stacked one high only.

d. The roof of the various underground tanks, pits, and the SMS trench shall be verified or designed to withstand the following minimum loads during construction:

- Equipment to be used in compacting the backfill material is assumed to be a small vibratory roller with a pressure of 3000 lb/ft^2, length of roller is 4'-0" x 1'-0", and an impact factor of 2.0.

- 50 ton crane located 10 feet from the edge of the HLW tank vault roof weighing 40 tons.

4.1.3 <u>Thermal Load (T.)</u>

The structural components shall be designed to withstand the thermal loads due to expansion, contraction, thermal gradients across structural walls, slabs, and beams; and thermal expansion/contraction of structural steel frame members. The coefficient of expansion/contraction to be used are as follows:

Concrete	= 5.5×10^{-6} per °F
Structural Steel	= 6.5×10^{-6} per °F
Stainless Steel	= 9.6×10^{-6} per °F

a. The following ambient air temperature shall be assumed to determine the concrete surface temperature. A linear variation shall be assumed between the faces of the concrete wall or slab.

Outdoor Design Conditions

Summer	78°F
Winter	22°F

Inside Design Conditions (Winter/Summer)

8D-1 Complex

- Concrete Vault 138°F/138°F
- Steel Tank 145°F/145°F
- Pump Pit (8Q-1) 55°F/ 80°F

8D-2 Complex

- Concrete Vault 138°F/138°F
- Steel Tank 145°F/145°F
- Pump Pit (8Q-2) 55°F/ 80°F

8D-3 Complex

- Concrete Vault 110°F/120°F
- Steel Tank 110°F/120°F
- Pump Pit (8Q-3) 55°F/ 80°F

8D-4 Complex

o Concrete Vault	110°F/120°F
o Steel Tank	120°F/130°F
o Pump Pit (8Q-4)	55°F/ 80°F
Diversion Pit 8Q-5	55°F/78°F
SMS Trench	55°F/78°F

b. "As-built" temperature for both steel and concrete shall be assumed as 70°F.

c. Frost depth at West Valley is a minimum of four feet below grade. The temperature of the soil 5 feet below the grade elevations shall be assumed as 55°F. Between grade elevation and 5 feet below the grade elevation a linear temperature gradient from 78°F (summer) to 55°F shall be assumed.

4.1.4 Soil Pressure Load (H_{static},$H_{dynamic}$)

The soil pressures exerted on the substructure walls by the backfill and surcharge shall be computed using the results of the Dames & Moore Field and Laboratory Soil work [5] [6] [7].

This work identified three distinctly different soil conditions throughout the tank farm. Soil conditions in table 4 reflect those at the VF building and in the immediate area. References 6 and 7 report the two other soil conditions.

Table 3: Soil Conditions at the Vitrification Facility

Stratum	Depth (FT)	Density (PCF)	Shear Modulus (PCF)	Vertical Subgrade Modulus (PCI)	Horizontal Subgrade Modulus (PCI)	Poisson's Ratio
1	0-20	125	4.1×10^6	300	200	0.35
2	20-69	110	4.1×10^6	100	67	0.35

Coefficient of Passive Soil Pressure = 3.0

Coefficient of Active Soil Pressure = 0.33

Angle of Internal Friction $\theta = 38°$

a. Static Soil Pressure (H_{static})

	Including Water Pressure	Excluding Water Pressure
Passive Soil Pressure -	240 (PCF)	180 (PCF)
Active Soil Pressure -	80 (PCF)	20 (PCF)

The effects of backfilling and construction loads as specified in 4.1.2 shall also be included in the above pressure.

Design Pressure = 3000 psf x 2 = 6000 psf

Covered area = (1'-0" x 4'-0")

b. Dynamic Soil Pressure ($H_{dynamic}$)

A ground acceleration of 0.1g horizontal SSE is specified. In conjunction with dynamic or seismic pressures, "at rest" (static), conditions shall be assumed. The at rest soil pressure shall be 130 pcf considering earth and water pressure of 70 pcf considering earth pressure only.

4.1.5 Differential Settlement (D_s)

The system is static, and over the long term, settlement may occur due to the differential movement caused by the presence of new structures next to existing structures, the variation in soil properties for long structures, or the variation in soil loading of different portions:

Therefore, differential vertical settlements shall be incorporated to address the potential settlement. The conditions to be considered are as follows:

- o Old structure/New structure: 1/4 inch

- o Two points of long new structure located 100 feet apart: 1/2 inch

Waterstops at structure - structure interfaces shall be designed to accommodate a 1/2 inch vertical, relative displacement.

4.1.6 Internal Pressure (P_a)

A differential pressure range of five inches of water, maintained with reference to atmosphere or adjacent zones, shall be assumed across all surfaces of pits and trenches.

4.1.7 Natural Phenomena

The system, or portions thereof designed to withstand the effects of design basis natural phenomena, shall be shown to meet the requirements by appropriate analyses and calculations.

1. Flood

Data on water flows in Cattaraugus Creek and Buttermilk Creek indicate maximum gauge heights of 14.1 feet on Cattaraugus Creek and 7.9 feet on Buttermilk Creek. These levels would cause only local flooding on the flood plains well below the pit structural elevation that is at a minimum of 85 feet, and these floods would be contained within the creek valleys. In addition, because the flow rate for the maximum probable flood stage could be as much as twice the flow rate for the 100 year flood state, flooding could not occur at the plant site because of its elevation. Snow melt or spring runoff could present a localized flood problem, but it has not been a problem in the past.[2] Adequate drain slopes shall be provided around containment structures and snow removal will be provided for administratively. However, the design is to accommodate a maximum ground water level at grade.

2. Snow Load (S)

The snow load on the pit and pipe trench covers shall be 40 pounds/feet^2 based on the NYSBC.

3. Wind Load (W)

The design of the exposed structures and components shall be designed to withstand 97 mph peak gusts factor at 30 feet above grade. The design wind pressures for the major structure and components shall be established using the procedure in ANSI A58.1-1982 for Exposure C and Importance Factor (I) of 1.07.

4. Seismic Inertia Load (E_{UBC},E_{SSE})

The HLW transfer system shall be designed to prevent uncontrolled release of radioactivity in the event of an earthquake. This can be accomplished by both a safe automatic shutdown of the system and containment of the radioactive material within its piping, pit or pipe transfer trench. The simultaneous occurrence with any other limiting site related event such as a tornado or flood need not be considered for design purposes.

a. Seismic Load (E_{UBC}) - This load shall be established in accordance with the Uniform Building Code (UBC) and shall be used to determine the minimum seismic load during all operating conditions. A vertical component, equal to 2/3 the horizontal components, shall be used with the horizontal component. The horizontal component shall be defined as:

V - ZIKCSW

Where:

V = Total lateral force or shear at base
Z = 0.75
I = 1.50
K = 1.33
CS = 0.14
W = Dead Load + 0.25 Live Load + Snow Load

Inertial loads shall be assumed to act at an eccentricity of 5 percent of the structure dimension.

For elements of structures and nonstructural components, i.e. piping, the lateral forces (F_p) shall be defined as:

$F_p = ZIC_p W_p$

b. Seismic Load (E_{SSE}) - This load is caused by the postulated occurrence of an SSE with ground acceleration of 0.1g horizontal with design spectra and damping according to the Nuclear Regulatory Commission's (NRC) Regulatory Guides 1.60 and 1.61, respectively. Vertical component of 0.067g with the horizontal and vertical combined.

Inertial equivalent static loads and deflections associated with the SSE shall be computed utilizing a dynamic analyses.

5. Seismic Displacements (D_{SSE})

Displacements effects associated with wave propagation aspects during the postulated occurrence of an SSE shall be addressed as described hereunder.

Long, buried structures are primarily subjected to relative displacement-induced strain rather than inertial effects. These strains are induced primarily by seismic wave passage and by differential displacement between structure attachment point (anchor point) and the ground surrounding the buried pipe, etc. For these reasons, the seismic analysis of long, buried structures differs considerably from that of aboveground structures.

SSE induced loadings are of two types:

1. Relative deformations imposed by seismic waves traveling through the surrounding soil or by differential deformations between this soil and anchor points.

2. Lateral earth pressures acting on the cross section of the structural element.

The apparent wave speeds, C, to be used depend on the wave type that results in the maximum wave velocity. Compressional wave, shear waves, and Raleigh waves should be considered.

The apparent wave speed, C depends on the wave type and is associated with the wave travel path from the location of the energy release to the location of the long structure. For the various wave types, the a_ϵ coefficient for determining axial strains and a_k coefficient for curvature determination shall be as given in table 4.

Table 4: Apparent Wave Speed Coefficients

Coefficient	Compressional Waves	Shear Waves	Rayleigh Waves
a_ϵ	1.0	2.0	1.0
a_k	1.6	1.0	1.0

A conservative, minimum wave speed of 500 fps should be used.

6. <u>Tornado Load (W_t)</u>

The confinement barriers pits and trenches, shall be designed for the following site specific tornado conditions:

a. Wind Load

Maximum wind speed of 160 mph.
Tornado radius of 150 feet.
A tornadic rotational wind velocity of 110 mph.
A translational wind velocity of 50 mph.
A peak pressure differential of 0.35 psi from ambient atmospheric pressure (suction).

A non-linear pressure transient of 0.15 psi/sec decrease over a period of 3 seconds, followed by an increase back to ambient in 3 seconds.

b. Missile Load

Penetration and crushing effects of small, high velocity missiles as described below:

Wooden plank 4 inches by 12 inches by 12 feet, 139 pounds weight at an impact velocity of 85 mph. Steel pipe 3-inch diameter by 10 feet, 100 pounds weight at an impact velocity of 50 mph. Missiles will be allowed to damage but not penetrate a confinement structure.

The total tornado load shall be determined using the conservative wind velocity of 160 mph acting on all surfaces at elevations above grade. The velocity pressure shall be determined by the criteria in ANSI A58.1-1982. The gust factors shall be taken as unity.

The total tornado loads shall be established using the most adverse combinations as follows:

$W_t = W_w$

$W_t = W_p$

$W_t = W_w + 0.5W_p$

$W_t = W_w + W_m$

$W_t = W_w + 0.5W_p + W_m$

W_t = Total Tornado Load

W_w = Tornado Wind Load

W_p = Tornado Differential Pressure Load, and

W_m = Tornado Missile Load

7. Lightning

The system shall be equipped with a lightning protecting system to carry lightning discharges safely to ground without injury to personnel or damage to structures or equipment.

4.2 Load Combinations

The following load combinations, using the loads defined in section 4.1, shall be used:

4.2.1 Concrete

a. Normal Operating and Construction Load Conditions

1. $U = 1.4\ D + 1.7\ L + 1.7\ H$ construction
2. $U = 1.4\ D + 1.7\ L + 1.7\ H$ static
3. $U = 1.4\ D + 1.4\ T_o + 1.4\ P_o$
4. $U = 1.05\ D + 1.05\ T_o + 1.3\ L + 1.05\ P_o + 1.05\ D_y$

b. Severe Environmental Load Condition

5. $U = 1.05\ D + 1.3\ L + 1.3\ H$ static $+ 1.3\ W + 1.05\ T_o + 1.05\ P_o$
6. $U = 1.4\ D + 1.7\ L + 1.7\ H$ static $+ 1.7\ W$
7. $U = 0.9\ D + 1.3\ W + 0.9\ T_o + 0.9\ P_o$
8. $U = 1.05\ D + 1.3\ W + 1.3\ H$ static $+ 1.05\ T_o + 1.05\ P_o$

c. Extreme Environmental Load Condition

9. $U = 1.0\ D + 1.0\ L + 1.0\ H$ static $+ 1.0\ E_{SSE} + 1.0\ H$ dynamic $+ 1.0\ T_o + 1.0\ P_o + 1.0\ D_y$*
10. $U = 1.0\ D + 1.0\ L + 1.0\ H$ static $+ 1.0\ T_o + 1.0\ W_t + 1.0\ P_o$

* Either the differential settlement or the displacement effects associated with seismic wave passage.

Where any load reduces the effect of the other loads, the corresponding coefficient for that load shall be taken as

0.9 if this load is always present or occurs simultaneously with the other loads; otherwise, the coefficient for that load shall be taken as zero.

Both cases of live load (L) being 100 percent present and completely absent shall be considered. However, a live load shall not be used when SSE inertial effects are established.

4.2.2 Structural Steel

a. Normal Operating Load Conditions

1. $D + L$
2. $D + L + T_o$

b. Severe Environmental Load Conditions

3. $D + L + W$
4. $D + L + W + T_o$

c. Extreme Environmental Load Conditions

5. $D + L + E_{SSE} + T_o$
6. $D + L + W_t + T_o$

Both cases of live loads (L) being 100 percent present and completely absent shall be considered.

The differential displacement (D_y) shall be considered if applicable.

4.2.3 Piping Systems

The combination of the various loads identified under section 4.0 shall be applied in accordance with requirements in ANSI/ASME B31.3.

4.3 Allowable Stresses

For each of the load combinations in section 4.2, the following allowable stress limits shall constitute the structure acceptance criteria.

4.3.1 Concrete

The containment system, pump pits, and diversion pits shall be of all reinforced concrete. In the design of these concrete structures, U, as defined in section 4.2.1, is the section strength required to resist the design load based on the strength design method described in ACI 318-77 code.

4.3.2 Structural Steel

Design for all structural steel shall conform, as a minimum, to the 1980 edition of AISC, "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings". Steel joists shall conform to the latest edition of the Steel Joist Institute Standard Specifications.

Load	Combination	Limit
4.2.2.a	1	S
4.2.2.a	2	1.5S*
4.2.2.b	3	1.33S*
4.2.2.b	4	1.5S*
4.2.2.c	5 and 6	1.6S*

* Shall not exceed yield strength

S is the required strength based on elastic design methods and allowable stresses defined in Part I of AISC - 1980. Increase in allowable stresses when designing connections including base plates and embedments shall be evaluated based on the characteristics of the particular type of embedment.

4.3.3 Piping Systems

Allowable stresses for piping systems shall be per ANSI/ASME B31.3. Temperature effects, number of cycles, etc. shall be considered. Based on an operating life of 10 years, and system operation two to three times a week, the total number of cycles over the operating life is less than 7000.

4.4 Material Requirements

Pit components including pumps, grinders, embeds, supports and piping shall be of stainless steel, except for special cases. All welded stainless steel, i.e., piping, liners, valve bodies, embeds, etc. shall be type 304L. Out of pit components shall be constructed of materials compatible with the intended service. Materials of construction for the facilities shall be specified as required by function and shall be noncombustible and resistant to corrosion. Concrete and metal panel construction shall be used as required by function (i.e., shielding, support, contamination barrier, etc.)

Building and equipment surfaces exposed to radioactive contamination shall be covered with stainless steel or painted with a protective coating which will resist radiation and decontamination operations.

4.4.1 Pit Liner

Pit internal areas shall be lined with stainless steel to the extent necessary. Typically, this will include the floor, floor sumps and the lower four feet of the pit walls. Any portion of the pit walls not lined with stainless steel shall be coated with an epoxy as described in section 4.4.2.

A minimum thickness of 1/8 inch is required on the pit floors and walls. All inside liner plates are to be 304L stainless steel ASTM A240. This liner shall ensure against leakage to the environment. Special consideration shall be given to the existing carbon steel tank riser liner connection as far as specifying the proper painting and weld requirements.

4.4.2 Pit Covers

The pit covers shall be of reinforced concrete construction. The inside of the pit cover shall be coated with an epoxy for ease of future decontamination. The pit covers exposed to the pit environment shall be sealed with the epoxy AMERON NU-KLAD 110AA and top coated with the epoxy coating AMERCOAT 400. An equivalent coating is acceptable. There is no stainless steel liner on the underside of the pit covers. Pit covers shall seal to the pit walls and to each other to provide minimum air leakage.

4.4.3 Reinforcing Steel

All reinforcing steel shall be new and deformed meeting, as a minimum, the requirements of ASTM A-615 Grade 60. Reinforcing bars shall be size no. 3 through no. 11 having a maximum length of 60 feet. Reinforcing splicing and mechanical connections shall be in accordance with ACI 318-77. The mechanical connectors shall be Lenton Standard Coupler or equal.

4.4.4 Structural Steel

Structural steel rolled shapes, cover plates, steel plates, and embedded sleeves shall generally be of ASTM A-36 steel. Only when absolutely necessary shall a high strength steel conforming to ASTM A-441 be used. Handrails shall conform to ASTM A-53 Grade B or ASTM A-2, Classification 1. All grating shall be of ASTM A-36 steel and shall be hot-dip galvanized after fabrication in accordance with ASTM A-123.

Bolts in bolted connections including suitable nuts and washers, shall be High Strength Steel conforming to ASTM A-325. Bolts for girts, doors, stair framing, and window framing shall be unfinished conforming to ASTM A-307.

Open Web Joist shall be in accordance with the Standard Specification for Open Web, Longspan, and Deep Longspan Joist adopted by the Steel Joist Institute and American Institute of Steel Construction.

Welding shall conform to American Welding Society AWS D1.1-1988 "Structural Welding Code."

4.4.5 Waterstops

All construction joints in the concrete structure and walls below grade shall have waterstops.

4.4.6 Waterproofing

All exterior walls below the grade level and the underside of the pipe trench concrete structure shall be protected with waterproofing.

4.4.7 Anchor Bolts

Anchor bolts, including suitable nuts and washers, shall conform to ASTM A-307 Type B or ASTM A-325 as required.

4.4.8 Embedded Studs

Embedded studs shall be "Nelson" Type H4L or S3L of size required per design or equal.

4.4.9 Expansion Anchors

Expansion anchors shall be HILTI KWIK Bolts and conform to Federal Specification FF-S-325, Group II, Type 4, Class 1. The latest Catalog addressing edge distance, interaction, etc., shall be used.

4.4.10 Concrete

Concrete shall be designed in accordance with the American Concrete Institute Building Code for Reinforced Concrete ACI-318. All concrete shall have a minimum strength of 4000 psi at 28 days.

4.4.11 HLW Transfer Piping

All primary piping in direct contact with the HLW shall be of 304 L stainless steel. This piping shall be welded construction with full penetration butt weld joints where possible. Screwed connections are acceptable for instrumentation. Socket weld joints shall be prohibited on lines carrying HLW. When modifying existing pipelines in contaminated and radiation areas where butt welding is not practical due to ALARA considerations or purging difficulties, socket welds are recommended as the best second choice.

Although not in direct contact with HLW under normal operating conditions, the secondary containment pipe surrounding the primary pipe shall meet the same material requirements.

4.4.12 Utility Piping

Utility piping for water, and/or air shall be of carbon steel construction. Galvanized piping or other piping materials containing anodic coating shall not be used for buried pipelines. This is to avoid undesirable effects associated with galvanic corrosion.

When buried metallic piping is likely to sustain exterior corrosion due to soil conditions, stray currents, electrolysis, etc., they shall be provided with a cathodic protection system unless such protection cannot be justified by life cycle cost. When cathodic systems are not used, a suitable protective coating on jacket shall be applied to the piping to minimize corrosion.

4.5 Piping Design

All piping that makes up the waste transfer system from the removal pump to the inside of the cell wall shall conform to ANSI B31.3, "Chemical Plant and Petroleum Refinery Piping" under the conditions listed in Table 5.

Table 5. Piping Specifications for HLW Piping

	Primary	Encasement
Design Pressure	150 psig	150 psig
Design Temperature	220°F	220°F
Maximum Test Pressure	225 psig	225°F
Minimum Temperature	55°F	55°F
Maximum Differential Pressure	150 psi	150 psig
Installation Temperature	70°F	70°F

Allowance for corrosion and erosion = 0.050 inch.

All HLW piping within the pits (jumpers) shall be single walled, i.e., no double wall pipe. The pit with its liner will maintain the required secondary containment. Once out of the pit, i.e., in the pit wall, the secondary containment will be provided by the outer pipe jacket. Valve installation in the pits shall be installed in pipe jumpers for remote replacement if necessary.

Drain lines for radioactively contaminated waste shall not contain liquid seal traps for preventing backflow of gases; however, provisions shall be made to prevent backflow of contaminated gases by other means such as maintaining a negative pressure on the drain system, use of self closing valves, etc. The drain system must be a separate system, i.e., no permanent connections to any other system with the exception of the pump pits.

The designer shall designate in the specifications and/or on the drawings the applicable welding fabrication code requirements (i.e., ANSI B31.3, AWS D1.1 or ASME Section VIII). The applicable code or standard shall be designated for each welding application.

The designer shall designate in the specification, the applicable welding fabrication code requirements and shall designate submittal requirements (i.e., weld standards, welding procedures, welding procedure qualification records, corrosion samples, and/or welding personnel qualification records) that may be necessary to ensure the required level of quality.

All welding of pipe shall be performed by welders qualified in accordance with the requirements of section IX, ASME Boiler and Pressure Vessel Code as modified by ANSI B31.3.

To provide the operation features described in Section 3.0 the following general requirements shall apply to the transfer piping:

1. Provide methods for monitoring primary lines for leaks.

2. Include provisions for thermal expansion and contraction of the transfer lines based on the conditions given in Section 2.0.

3. Prevent leakage to the soil by locating all connections to underground lines carrying radioactive materials in encasements, valve boxes, pipe tunnels or process cells.

4. Provide shielding of all underground radioactive transfer lines as needed.

5. Slope transfer lines at a minimum of 1/16 inch per foot to drain back to a storage tank minimizing liquid holdup.

6. Provide seismic design for HLW transfer lines and their encasements according to Section 4.1.7, Item 4.

7. Slope the encasement pipe to collection point(s) to provide a drain system for possible leaks from the primary line(s). The encasement shall be monitored to detect leaks in the primary line.

8. The primary line and encasement line shall be fabricated of the same type and grade material. The primary line shall be supported adequately for slope, thermal expansion and seismic design.

9. Ventilation piping must use the same pipe materials as used for the transfer piping.

10. Seismic and thermal analyses of piping shall be done separately with the worst case loads used in order to locate anchors and guides, hold-downs, snubbers, etc.

11. All piping thermal analysis must be based on "maximum" and "minimum" temperatures listed in Table 5.

12. Connections for any temporary instrumentation required for testing (flushing, hydro) must be designed into the piping system and identified.

13. Break points for system testing (hydro and flush) must be designed into the piping and identified.

14. Block valves shall be provided in all branch lines to permit isolating the branch from the header.

15. Sufficient valves must be designed into the utility system to permit isolation of areas.

16. All utility lines entering pits must be equipped with check valves and pit wall block and bleed valves on the outside pit wall. The check valves on the outside of the pit wall shall be located as close to the isolation valve as practical, but after the block and bleed.

17. All pit process piping shall be stainless steel. Utility piping exiting the pits shall not convert to carbon steel, when acceptable, until after the first normally closed out of pit block valve.

18. All elbows shall be long radius to the extent possible.

4.5.1 Waste Transfer Piping

The pipelines carrying highly radioactive liquids or contaminated waste products shall be doubly contained, i.e., the primary pipeline containing the contaminant shall be fully encased and supported inside a corrosion resistant, leak tight pipe duct having the same integrity (except pressure requirements) as the primary line. The outer casing line shall be so designed as to permit detection of any leakage from the primary line (leak detectors, conductivity probes, radiation detectors, etc.) and shall permit sampling and periodic leak testing of the encasement line.

Maintenance shall be a primary consideration in the design of hazardous process piping system. Prevention of plugging and clearing of plugs when they occur shall be considered in the design. The system should be designed so that pockets or traps are minimized if not eliminated and piping can be flushed and drained. Loop seals shall not be used to prevent back flow of contaminated gases. The HLW transfer piping shall be routed inside a concrete trench.

Valves in the jumper pits will require leakproof valve stems of the packless type employing a metal bellows seal. Teflon shall not be used for gasket material in process piping systems, or as a component part of any valve or other piece of equipment subject to radiation.

Since the waste transfer piping is doubly contained, housed in a containment trench, and surrounded with backfill, no freeze protection is required. Trench and pit piping shall drain freely to assure no free standing liquid.

4.5.2 Encasement Piping

Each pit will interface with the HLW Pipe Trench. The four inch stainless steel containment jacket pipe will terminate at the PUREX wall nozzle kick plate. Once in the pit the secondary containment for the high level waste is the pit liner. Any transfer line which has a common spare associated with it can be housed in a common jacket pipe. Containment pipe shall have a means of draining to the pit where it can be removed by the pit drain. Also provide a means to flush the containment pipe.

The encasement pipe shall meet the specified earthquake criteria of this document. The primary line and encasement pipe shall be separated by stainless steel spacers when required.

4.5.3 Utility Piping

Utility piping shall be also designed to ASME/ANSI B31.3. Carbon steel pipelines that carry steam or condensate and are buried or located in inaccessible areas shall be of Schedule 80 wall thickness, and heavy wall fittings shall be used. All joints in buried steam and condensate lines shall be welded. Threaded, flanged or other mechanical type joints will not be permitted. Expansion in buried piping such as steam and condensate lines shall be accommodated by use of loops or offsets only. Utility water piping above ground or buried less than four feet will require freeze protection.

Every utility pipe entering a pit shall be equipped with a suitable block valve(s) and a means to prevent contamination from entering the utility feed lines. This can be accomplished using manual block and bleed valving. Piping contacted by process solutions shall be equipped with a block valve, or equal, immediately outside the pit wall. Piping contacted by process solution in normally pressurized system will require a check valve in addition to the block valve. Piping that is not contacted by process solutions except by failure of a pressure boundary component may be equipped with a standard valve. In every case, the primary block valve and/or check valve shall be of equivalent material as the associated in-pit piping.

A utility system shall be designed to support the requirements described within this criteria. Valves for utilities such as steam, air, and water shall be located outside the pump pit.

4.5.4 Leak Detection System

Encasement of the primary pipe carrying highly radioactive waste shall have leak detection provisions in the encasement or secondary pipe. Drains from a series of encasement pipes at a pit wall shall culminate at a single sample point. The sample point shall allow for a small sample to be taken to determine the extent, if any, of the contamination. Continuous leak detection monitoring of each primary pipe is required. The encasement pipe shall slope to the collection point to provide drainage for leaks from the primary line. The system shall allow for flushing and draining the sample point.

The utility piping inlet lines shall have a radioactive material leak detection system which provides an automated means to prevent the leak from contaminating the utility system.

Leak detection instrumentation shall be equipped with failure warning lights to avoid use or reliance on incorrect indications.

4.6 Pit Liner Requirements

Design of the liner must include sloping floors with a sump or drain line out of the pit into one of the storage tanks. Sump level detection is required in any sump. A utility water line shall be piped, or provide a means of adding flush water, to the sumps to provide agitation within the sump to facilitate solids transfer from the sump. A means of detecting and sampling liquids from within the pits shall be designed into the pit. Each pit shall have a means of detecting leaks and sampling the leaking material.

4.7 Electrical Requirements

Electrical wiring installed in the pits shall have insulation such as cross-link copolymer, polyvinyl chloride, or polyethylene. There will be no electrical remote connectors within the pits. All electrical equipment shall be hard wired to remotely replaceable equipment or jumpers. Cable and conduit shall be run out of the pits through conduit slots in the pit wall. The conduit and wall slots shall be sealed to ensure containment. Sealing shall be accomplished with a pliable and removal sealant. Cable penetration through the pits shall contain sufficient bends or curvature to prevent radiation streaming through the void.

Once the cable exits the pit wall, normal galvanized hard conduit shall be used. Terminal boxes and junction boxes shall be used at the pit walls to connect the remote electrical equipment in the pits. All electrical boxes at the pit shall be NEMA Type 4 watertight. Flexible multistrand cable shall be used for all motors to allow easier manipulation of the equipment during remote installation and removal.

The supply of power for the waste transfer electrical equipment will be supplied from the existing Motor Control Center (MCC-A) in the PVS building. Electrical design must include:

a. Grounding and lightning protection details.

b. Conduit schedules.

c. Elementary wiring diagrams with numbers (CWD's).

d. Terminal box and junction box schedules.

e. Electrical composite diagrams of all building areas dimensioning all electrical penetrations and sleeves.

f. Cable schedules for power and controls.

A motor safety disconnect in sight of the motor shall be required for all installations. Exceptions may be made for in-pit installations. In this case the disconnect can be at the outside of the pit.

4.8 Instrumentation and Control Requirements

Instrumentation shall be selected on the basis of simplicity, reliability and availability. Instrumentation shall be used to monitor process variables and provide automatic or manual control of controlled equipment. An electronic system for process control and monitoring shall be provided as part of the waste transfer system and shall be located in the PVS building.

Instrumentation in the pits shall be designed for remote removal and replacement by placing them in jumpers. The instrumentation in each of the pits is used to monitor the transfer system. Whenever possible, only the instrument sensing device, such as a pressure sensor, shall be in the high radiation field. All such sensing devices shall be environmentally qualified to a total integrated dose (TID) of 1×10^{7} RAD. The transmitter shall be located outside the pit in a nonradioactive area or shielded to the extent required for proper operation. Instrument signals shall be used to shutdown the transfer pumps in the case of high liquid level in the CFMUT, high removal pump motor amperage and/or loss of tank ventilation.

The remote design of the instrumentation shall take into account that each instrument must be recalibrated on a yearly basis. The removal pump shall be operated using a motor speed controller for flow control. Flow control valves shall not be used to regulate flow. Central control of the sludge mobilization system shall be performed in the PVS building. A tie to the vitrification facility control room shall be made to allow monitoring and interface interlocks.

4.8.1 Liquid Detection

Any sump shall have liquid detection built-in. It shall be capable of remote indication and indication shall be instantaneous. The sensor can contact the material. Mechanical moving parts shall be avoided.

4.9 Radiation and Safety Design Requirements

The WVNS Safety Classification System is used to determine the safety classification of the system. The safety classifications were determined by a analysis of the overall vitrification system and its supporting facilities.[1] It has been determined that the waste transfer system safety classification for the transfer lines, pumps, valves and containment system is Safety Class C. The utility support system shall be considered a Safety Class N.

Personnel safety, public safety and property protection during both normal operation and postulated accident conditions shall be provided by facility design features.

An Environmental Check List and Safety Analysis Report (SAR) shall be provided for the transfer system.

4.9.1 Radiation and Contamination Control

The nature of high level radioactive waste requires that the transport be achieved with minimum exposure of operating personnel to radiation and maximum protection of the environment. The pit design shall include provisions to prevent the system from contaminating otherwise nonradioactive areas. Conducting the waste transfer operation in a containment structure is an integral part of this philosophy.

As specified, areas of continuous or full-time occupancy shall be shielded to limit dose equivalent rates to 0.1 mR/hr at contact with the wall or floor. Areas specified for continuous occupancy are be operating areas in the VF where the transfer piping enters the facility cell west wall. Areas of periodic occupancy or full time access shall be designed to limit the annual effective dose equivalent to less than 1 REM. The exposure rate shall be limited to 1 mR/hr/T where "T" is time. In no case shall "T" be less than one hour. Per ID-12044 a full time access area is one on which has no physical or administrative control of entry.

If compliance with the above would be economically unfeasible, impractical or prohibitive, higher dose rates may be allowed. However, access to such fields must be limited and controlled. The tank farm area of the waste transfer system shall be designed to this exposure limit. In the controlled access of the tank farm the pits and trench shielding shall be designed to limit the radiation dose rate to less than 2.5 mRem/hr during a waste transfer operation.

Concrete radiation shielding design shall comply with ANS 6.4 and ACI 349 and shall consider the material specifications of ANS 6.4.2.

In accordance DOE Order 6430.1A, Section 1300-6.5 and with Chapter 1V of ID-12044, area radiation monitoring and alarm systems shall be provided to alert personnel to increases in direct radiation levels and air activity levels.

The confinement of radioactive materials shall be provided by the use of multiple barriers such as piping, liners, building walls, cell walls and pit walls. Pressure differentials shall be maintained between contaminated or potentially contaminated zones and the outside atmosphere. Primary contamination control shall be provided by physical boundaries which are as airtight as possible.

In order to provide airtight controls on the primary boundary and avoid contamination by leaks, the process piping in and out of each pit will be hard piped and welded. The piping itself shall act as the primary boundary to activity release. The secondary pipe in the containment trench is also the secondary containment boundary. The jumpers and pit piping within the pump pits act as the primary boundary to activity release. The pump pits and diversion pit liner shall be considered the secondary containment shell. The pits and secondary containment pipe shall be monitored with continuous leak detection equipment to identify potential leak problems.

Piping and valving arrangement design shall prevent the backflow of radioactive material into nonradioactive lines connecting the utility header and instrument lines. The system must be designed to prevent backflow of material. In addition to arrangement of check valves and isolation valves, air purges shall be installed near the pit walls, as needed, to prevent contamination spread through utility piping. Air purges on steam lines will be required to prevent back suction after the steam line has been turned off. Break tanks shall be used for the water supply.

The waste transfer system contamination control requirement shall be concerned with evaluating the performance of the systems confinement barriers which are described above. Controls deal primarily with instrumentation and administrative controls. Instrumentation may monitor a process parameter (e.g., pit pressure) rather than radioactivity as an indicator of the status of the confinement system.

Provisions shall be made for monitoring the primary containment lines for leaks. This can be accomplished by placing leak detection devices in the secondary containment lines and within the pump pit liners. A method to sample and drain any leaking materials shall be provided.

4.9.2 Industrial and Occupational Safety Requirements

Design requirements in the industrial/occupational area are numerous. The designer must reference the source documentation that defines the requirements. These include ID-12044, "Operational Safety Design Criteria Manual" and DOE Order 6430.1A, "General Design Criteria Manual".

The following list identifies typical design areas and facility features that could have potential occupational safety, or industrial hygiene requirements. If these areas or features are applicable to the waste transfer system, then source documentation defining requirements should be consulted.

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

b. Trenching, excavation, shoring, scaffolding and barricading.

c. Machinery guarding, maintenance and noise control.

d. Ladders, enclosures, gates and weather protection.

e. Overhead pipes and valves.

1. 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.

2. Chemicals - Process reagents and decontamination solutions such as acids, caustics, metal salt solutions and oxidizing solutions will be prepared and used in the system. 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 eyewash fountains shall be provided near the chemical feed area as needed. An exhaust system shall be provided to remove chemical makeup vessel fumes and dust.

3. Grounding - The transfer system shall be connected to the West Valley site grounding grid. All instruments shall be attached to a separate grounding grid that is connected at a single point to the site grounding grid. Ground fault interrupters shall be installed as specified in the National Electrical Code.

4. Fire - Fire protection shall be provided in accordance with DOE Orders 6430.1A and 5480.7, "Fire Protection." Fire protection shall also be in accordance with NFPA codes and site standards. Fire protection requirements will apply to the support equipment and controlled within the PVS Building.

4.9.3 System or Control Malfunction

A fail-safe philosophy shall be used in designing the transfer system. Equipment malfunction shall not initiate a sequence resulting in the uncontrolled release of activity to the environment or radiation exposure to operating personnel in excess of the limits set forth in DOE Order 5480.11, "Radiation Protection for Occupational Workers."

The waste transfer system will not require tie-in to an emergency power system with the exception of the pit ventilation system.

4.10 Maintenance Requirements

The pit covers shall be designed to maintain a minimum ventilation air velocity of 125 linear feet/minute minimum across any access opening required for individual jumper manipulations. The pit access opening or openings shall be sized for this velocity and the maximum airflow that can be handled by each pit. The maximum total design airflow that can be provided by the PVS for each pit is 4500 CFM.

Trunnion guides, remote pins, and/or studs are required to provide precise positioning for remote replacement of equipment within the pits.

4.11 Physical Equipment Location and Configuration

The HLW transfer piping shall begin at the VF west wall below the 100 foot elevation. Here the piping connects to the west wall module. The piping shall turn north under the VF operating aisle area out to the tank farm. Once outside of the VF, the trench shall angle eastward around the equipment shelter through the waste diversion Pit 8Q-5. The trench will continue to Tank 8D-2. From this point, one segment of the trench will branch off to accommodate interconnecting pipe to the 8Q-2 pump pit and Tanks 8D-1 and 8D-4.

Each of the pump pits shall be located directly over the respective tanks from which they will be removing waste. Pump Pit 8Q-1 shall be installed around the new M-8 riser on Tank 8D-1. Pump Pit 8Q-2 shall be installed around the new M-9 riser on Tank 8D-2. The 8D-4 removal pump pit will be placed over the existing S-7 riser access opening on Tank 8D-4.

4.12 Testing

Components and piping will require testing during construction, prior to start-up, and to a limited extent after the transfer system 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. Typical examples may include:

a. Methods for hydrostatic testing piping systems.

b. Instrumentation and control test points, adequate pressure taps, flanges, etc., to measure and monitor system performance.

5.0 INTERFACE REQUIREMENTS

The pits shall be designed to interface with other systems as described in this section.

5.1 Service Utilities

The following service utilities are currently available from the tank farm for use with the Supernatant Treatment System (STS) and other WVDP processes. Utility supply equipment necessary to support the requirements of these criteria shall be housed, to the extent possible, in the West end of the PVS Building.

Utility Air	90 psig
	50 SCFM
Instrument Air	50 psig at the pit wall
	25 SCFM

Utility Water — Shall be supplied by a high pressure pump from a hold tank.

150 PSIG (max)	T_{min} = 40°F
75 GPM (max)	T_{nor} = 70°F
20 GPM (min)	T_{max} = 95°F

Electrical — 480 Volts, 3-phase
120 Volts, 1-phase

5.1.1 Freeze Protection

Utility water piping above ground or buried less than four feet below grade will require freeze protection. This shall be accomplished by electrical heat tracing and insulation.

5.1.2 Chemical Feeds

There is a minimum of two chemical addition feeds required in the HLW transfer system. One is caustic for neutralizing the THOREX waste in Tank 8D-2, and the other is a mild acid for future use as decontamination solution. The decontamination solutions can be used for pit/equipment decon, removal of line plugs if necessary, and final HLW tank clean out.

Up to a 50 weight percent caustic solution can be used for addition to Tank 8D-2. Solid caustic soda could be dissolved in a feed tank to make-up the solution or off load from a tank truck. Since the mixing of solid caustic soda and water has a positive heat of solution, heat will be generated during the dilution step. The quantity of heat, temperature of dilution water, and final solution temperature shall be evaluated to determine the heating/cooling requirements of the caustic feed system.

The decontamination solutions will require heating. Heating the solutions increases the reaction rates. Therefore, a means of heating the solution in the preparation tank shall be provided.

5.2 Removal Pump Pit Risers and Waste Return Lines

In the case of Tanks 8D-1 and 8D-2, the removal pump tank access risers exist. These risers, 8D-1 M8 and 8D-2 M9, were installed using the Remote Riser Installation System. Although the risers exist, some modification will be necessary to incorporate the design requirements of the pump pits. These modifications consist of incorporating the pit drain line(s), attaching the pit liner, and providing a flange adapter for remote removal pump installation and removal. A riser and/or pump mounting plate shall be designed such that the pit removal recycle line(s) and VF waste return lines attach and discharge down the tank riser, into the tanks. The tank riser(s) shall incorporate all waste removal and waste return piping requirements. No new tank penetrations shall be designed to perform the necessary waste transfer operations.

Tank 8D-4 riser modification will be required to support the required THOREX removal operation and equipment.

Waste header acid waste and condensate gravity return lines from VF to Tanks 8D-4 and 8D-3 will connect to existing spare lines on each of the respective tanks. New stainless steel lines have been installed to these existing line during STS installation. These three new lines have been extended to grade level in front of the 8D-4/8D-3 vault. The SMS transfer piping being designed to this criteria shall interface with the existing lines connected to the 8D-4 and 8D-3 tanks. The connector to these lines shall conform to the requirement of this criteria.

5.3 Existing Structures

When new structures or equipment result in "new" loads upon Tanks 8D-1, 8D-2, or 8D-4 and their associated vaults, and existing piping, the loads shall be carried in a manner which does not degrade the original structure's capacity to withstand environmental/service loads. It is not the intent to upgrade the existing facilities.

5.4 Decontaminated Supernatant Removal Pump

Existing STS pump 50-G-007 presently installed in Tank 8D-3 will be used during the VF operation. Condensate from the CFMUT drains to Tank 8D-3 during waste concentration. Once a batch of feed in VF has been concentrated, the pump will either transfer the condensate to LWTS for volume reduction and solidification in cement or will redirect the condensate via the STS valve aisle back to Tank 8D-2 for the waste removal operations.

5.5 Interface to the Vitrification Control Room

Compatible instrumentation or extension of the Vitrification Facility Distributive Control System shall be provided for interface between the Tank Farm Transfer System and the VF. Tanks 8D-3, and 8D-4 conditions, i.e. level, pressure, and density shall be monitored from the Vitrification Facility Control Room.

6.0 QUALITY REQUIREMENTS

The waste transfer system has been established as a Quality Level C system based on its importance to safety and operational reliability.

The designer shall have a quality assurance program manual to control design activities. The designer is responsible for the quality assurance of the work he performs. These requirements shall comply with the ASME/ANSI NQA-1. The quality assurance requirements for the design of this system shall include only those requirements necessary to control design activity, such as organization, design verification, design control, document control of instructions, procedures, and drawings.

7.0 APPLICABLE CODES AND DESIGN DOCUMENT STANDARDS

The following applicable codes, standards, and documents shall be used in the design and fabrication of the pits and their components. The design of pits shall be in accordance with, but not limited to these codes and standards unless otherwise stated. Design documents produced (drawings, specification) must meet minimum requirements and contain specific design information.

7.1 DOE Orders

DOE Order 6430.1A General Design Criteria Manual for Department of Energy Facilities

DOE Order 5480.7 Fire Protection

DOE Order 5480.11 Radiation Protection for Occupational Workers

7.2 U.S. NRC Regulatory Guides

1.60 Design Response Spectrum for Seismic Design of Nuclear Power Plants

7.3 Federal and State Standards

NYSBC New York State Building Code

7.4 General

ACI 318-1977 Building Code Requirements for Reinforced Concrete

ANS A2.4-1979 Symbols for Welding and NDE

ANSI B31.3 Chemical Plant and Petroleum Refinery Piping

ANSI Y14.5 Dimensions and Tolerancing

ASME/ANSI NQA-1-1986 Quality Assurance Program Requirement for Nuclear Facilities.

AWS D1.1-1988 Structural Welding Code for all Weld Acceptance Criteria

ANSI A58.1-1982 Building Code Requirements for Minimum Design Loads in Buildings and Other Structures

UBC-1972 and 1985 Uniform Building Code

NFPA National Fire Protection Association, National Fire Codes

Department of Labor Occupational Safety and Health Administration (OSHA), Part 1910, Occupational Safety and Health Standards, and Part 1926, Safety and Health Regulations for Construction

DOE-ID Architectural Engineering Standards, Revision 6, October 1986

ID-12044, Operational Safety Design Criteria Manual, April 1985

Westinghouse Hanford Operations, "Jumper Design Standard", SD-RE-DS-002, Rev. 3, dated October 4, 1988

Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standards for Seismic Analysis of Safety-Related Nuclear Structure, Reference 582, American Society of Civil Engineers (ASCE), April 1987

7.5 Reference Drawings

900D-557, latest revision, "Tank 8D-1 Roof Framing and Bottom Grid work Arrangement and Riser Locations."

900D-558, latest revision, "Tank 8D-2 Roof Framing and Bottom Grid work Arrangement and Riser Locations."

7.6 Documentation

Guidelines that must be followed in preparing the design documents include:

1. Prepare utility and process flow diagrams (P&IDs) using standard Instrument Society of America (ISA) symbology on all control functions. Show failure positions of essential automated valves (fail/open/closed).

2. State code edition year that applies, any current revisions and identify the applicable sections when referencing codes in specifications or drawings. Clearly state governing documents (drawings or specifications) in case of discrepancies or conflicts.

3. Drawings shall state essential construction tolerances. If some portion of design or engineering is to be done by the construction contractor this information must be clearly conveyed in design document.

4. All drawings shall include continuation interface drawing numbers if applicable.

5. All components depicted on P & IDs shall be identified by appropriate code numbers and/or symbols.

6. Clearly defining trim in valve specifications.

7. State the type of insulation, thickness and cover material in the insulation specification.

8.0 REFERENCES

1) Letter HE:85:0042, C. J. Roberts to C. C. Chapman, "Hazard Classification and Safety Classification of Important Structures, System, and Components for the Vitrification Process," dated March 15, 1985.

2) Design Criteria, WVNS-DC-022, latest revision, "Vitrification of High level Wastes," dated December 1985.

3) Design Criteria, WVNS-DC-013, latest revision, "Supernatant Treatment System," dated December 1985.

4) Letter BW:86:0054, John R. Carol to Dr. James M. Pope, "Transmittal of the CTS Waste Header Hydraulic Study", dated May 9, 1986.

5) Letter Donald J. Murphy, Dames & Moore to Mr. James Patrick, report on Geotechnical Investigation - Proposed Component Test Stand; West Valley Demonstration Project; West Valley, New York; Tab No. 10805-108-23; dated March 18, 1983.

6) Letter ZW:86:0093, William F. Mercurio, Dames & Moore, to Mr. R. Borisch, "STS Building Augered Cast. In-Place Pile Design" West Valley Nuclear Services Co., Inc. Job No. 10805-165-23, July 15, 1985.

7) Letter ZW:86:0092, William F. Mercurio, Dames & Moore, to Mr. R. Borisch, Spread Footing Design Parameters for Pump Foundations for Tanks 8D-2 and 8D-2 West Valley, New York, dated May 27, 1986.

8) Letter WD:84:0769, D. C. Burns to Dr. Bixby, Status Review of Sludge Mobilization System, dated October 13, 1989.

WEST VALLEY HLW PROCESSING FLOW SHEET

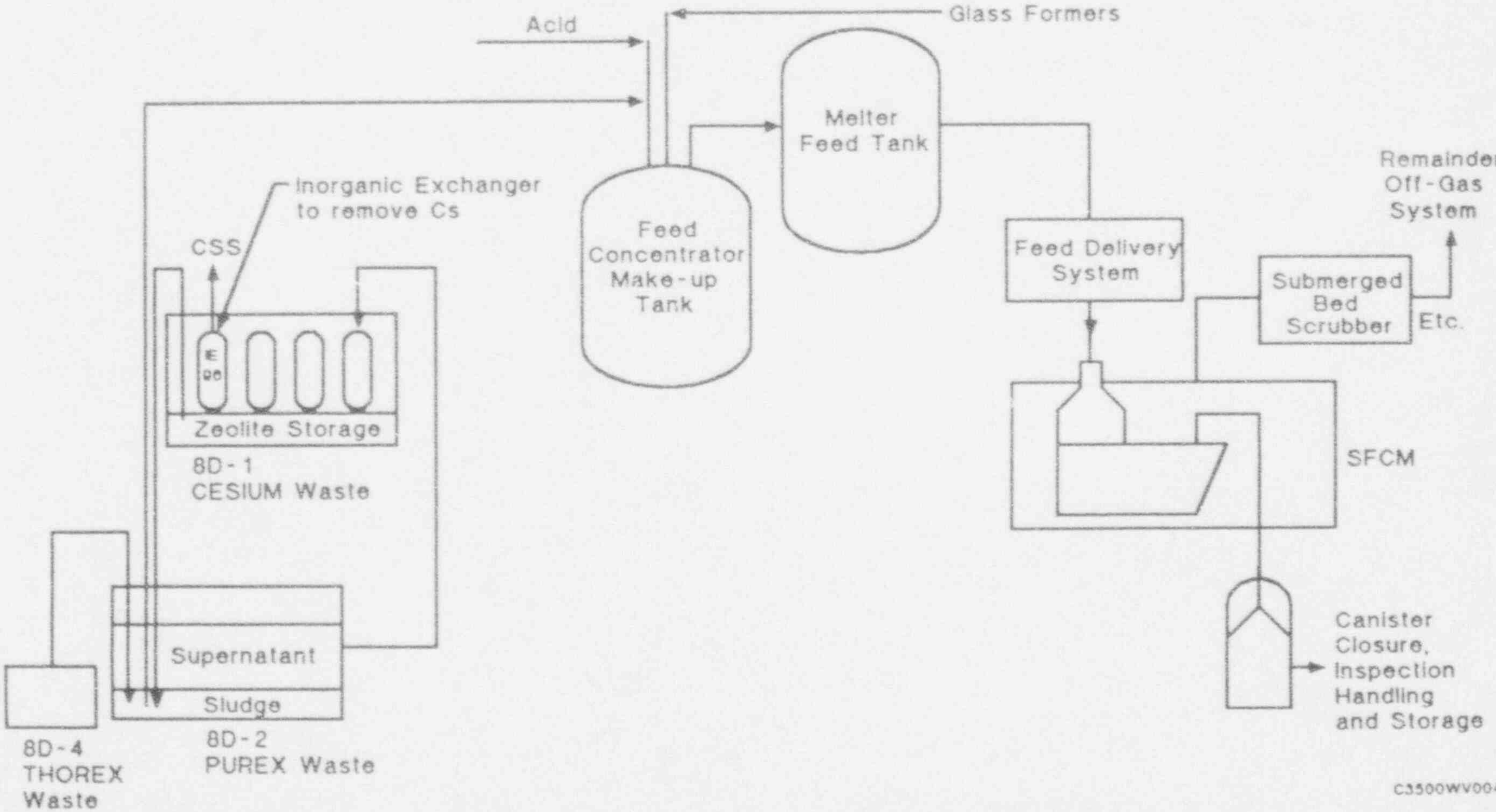

Figure 1