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Project Title/Work Order: SPARE MITIGATION/RETRIEVAL MIXER PUMP FDC		EDT No. 608251
		ECN No.

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7. Abstract

This document presents the functional design criteria for design, analysis, fabrication, testing and installation of a waste tank mixer pump. The mixer pump will be operated to eliminate the periodic release of flammable gas (e.g.. hydrogen) from Hanford Site waste tanks and also to accommodate retrieval of the waste.

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SPARE MITIGATION/RETRIEVAL MIXER PUMP

Functional Design Criteria
January 1995

Westinghouse Hanford Company

SPARE MITIGATION/RETRIEVAL MIXER PUMP

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ABSTRACT

This document presents the functional design criteria for design, analysis, fabrication, testing, and installation of a waste tank mixer pump. The mixer pump will be operated to eliminate the periodic releases of large quantities of flammable gas (e.g., hydrogen) from Hanford Site waste tanks and also to accommodate retrieval of tank waste.

ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
B&PV	boiler and pressure vessel
DACS	data acquisition and control system
DBA	design basis accident
DBE	design basis earthquake
DOE	U.S. Department of Energy
ECN	engineering change notice
EDE	estimated dose equivalent
ERPG	emergency response planning guideline
FDC	functional design criteria
gpm	gallons per minute
HEPA	high efficiency particulate air
hp	horsepower
HPS	Hanford plant standards
HVAC	heating, ventilation, and air conditioning
I/O	input/output
ISA	Instrument Society of America
LFL	lower flammability limit
MAB	maximum allowable burp
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
psi	pounds per square inch
RCRA	Resource Conservation and Recovery Act
W	watt
WHC	Westinghouse Hanford Company
WISHA	Washington Industrial Safety and Health Act

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1.0 INTRODUCTION

1.1 BACKGROUND

Several Hanford Site waste tanks are known to experience periodic tank level increases and decreases during which hydrogen gas is hypothesized to be released. It is hypothesized that the generated gases are accumulated in the thicker, lower layer near the bottom of the tank (i.e., the nonconvective layer). The accumulation of gases creates a buoyancy that eventually overcomes the density and cohesive strength of the nonconvective layer. When this happens, the gas is released upward through the convective layer and carries some of the nonconvective layer upward also.

On July 3, 1993, a test mixer pump was installed in tank 241-SY-101 to test the mitigation by mixing concept. As a result of this testing, it was determined that the mixing concept will mitigate the tank therefore allowing the hydrogen to be vented in a safe manner. A mixer pump with different design features that integrate mitigation and retrieval functions will be used as a spare for 241-SY-101 or to mitigate any other flammable gas double shell tank on the Hanford Site. The different design features are the results of lessons learned from the design, fabrication, installation, and operation of the test pump. A major change in design is lowering the pump suction to utilize the mixer pump during retrieval of the tank at a later date.

The primary objective of the mitigation project is to cause the release of hydrogen in a manner that eliminates the potential for accumulation of flammable gases in the vapor space at levels above 25% of the LFL of hydrogen in a hydrogen/nitrous oxide atmosphere.

A secondary objective is to accommodate retrieval as much as practical without designing a full retrieval pump.

The scope of this document is to provide the functional and/or design requirements necessary to design, build, test and install a Hanford Site waste tank mixer pump. Because site location items are beyond the scope of this FDC any site specific items found necessary for design or installation will be addressed in a revision of this document or in a later FDC. Pump removal hardware, disposal hardware, and development of the DACS is also outside the scope of this FDC; therefore, the design criteria for these systems is not included in this document.

1.2 DEFINITIONS

SHALL CONSIDER: Requires a referable assessment with discussion of rationale when an alternative is selected.

SHALL: Denotes a requirement.

SHOULD: Denotes a recommendation.

1.3 WASTE CHARACTERISTICS

The waste characteristics that shall be considered for design of the pump are as follows:

Note: Because a large amount of waste characteristic data is accumulated on waste in Tank 241-SY-101 and very little data on waste in the other tanks, the data from 241-SY-101 shall be used for design.

- A maximum value of 1.0 psi shall be used for the design yield strength in shear for the sludge. This value applies when there is zero shear rate.
- Temperature information is found in WHC-SD-WM-DTR-024, *Laboratory Characterization of Samples Taken in May 1991 from Hanford Waste Tank 241-SY-101*. Based on this report, the design basis waste temperature for hardware design shall be 79 °C (175 °F).
- The design particle size range is 2.5-100 μm.
- Abrasiveness is assumed to be the same as $NaNO_3$, $NaNO_2$, and $NaCO_3$ crystals of the size given above.
- Chemical composition is found in WHC-SD-WM-DTR-024, *Laboratory Characterization of Samples Taken in May 1991 from Waste Tank 241-SY-101*.
- Equipment placed in the waste is to be subjected to an equivalent solution of 2.5 wt% NaOH (Sodium Hydroxide).
- The design radiation level is 850 rad/hr in the waste.
- For design purposes, the density is 1.6 g/ml (100 lb/ft^3).
- The mixer pump design viscosity is 40 cP for the pump hydraulic performance calculations.
- The waste consists of 45 wt% solids.
- The cooling capabilities of the waste are assumed to be 25% that of water. This is the figure to be used to calculate submerged motor cooling requirements.

1.4 EQUIPMENT INTERFACES

The pump systems shall use existing facilities to the greatest extent possible. Following installation, the pump systems shall minimize impact to normal tank farm operations. Items to be considered include:

- Fit through the existing nominal 42 inch clearance of the riser.
- Accessibility to the pump pit area or risers located within the pump pit.
- Connection to existing Data Acquisition and Control systems.
- Impact on and connection to existing HVAC systems.

Interface control documentation/drawings will be included as a deliverable part of the design effort. Requirements for interface control documentation/drawings are established in WHC-CM-6-1, EP-1.5. The interface control documentation shall be defined when the destination tank is determined.

2.0 MIXER PUMP SYSTEM FUNCTIONAL DESIGN CRITERIA

2.1 GENERAL GUIDELINES

Based on the primary objective of the overall mitigation project the following general functional requirements have been developed:

- Design shall note that the mixer pump may need to be used as a mitigation/retrieval pump in any flammable gas double shell tank on the Hanford Site.
- The potential for releases of all materials to the environment from the tank (e.g., liquid, slurry foam-over, etc.) shall be minimized.
- The application of stresses or loads in or on the tank and ancillary support structures (e.g., tank dome, riser, and pump pit) that exceed allowable values shall be prevented.
- Conditions in the tank to avoid foreclosing any realistic mitigation, retrieval, and/or disposal options shall be maintained.
- The design shall provide for ease of maintenance and operation.
- All materials or equipment exposed to the tank vapor space and pump pit shall be suitable for use in an NEC Class 1, Div 1 & 2, Group B, explosive hydrogen environment.
- The addition of corrosion-inducing materials or conditions in the tank shall be minimized.

- The design shall provide for ease of removal and disposal.
- All equipment shall be grounded or bonded to control static electricity.
- The pump system shall have a minimum tank insertion life of 10 years.
- Electrical, mechanical, and thermal spark sources shall be eliminated, if not intrinsically safe, to prevent the ignition of combustible gases.
- Mitigation pump shall be rigid enough after assembly to be brought from the horizontal position to the vertical position without using a strongback or brace.

2.1.1 Component Design Life

The component installed design life is defined as a 10 year hydrogen mitigation system operating period that requires all active, non-active, and replaceable components to maintain their design functions to the system for the periods of required availability. The design function of each component shall withstand gamma radiation, thermal exposure, corrosion, fatigue, abrasion, wear, abnormalities requiring uninterrupted or resumption of operation, or other adverse conditions which includes storage prior to use. Total radiation dose design life shall be 7.5 x 10^7 rad. Replaceable components may be exchanged during system operation, normal periods of shutdown that do not limit required availability, or during acceptable periods that the hydrogen mitigation system is allowed to be out of service.

2.1.2 Materials

- Materials shall be compatible with the exposed environment. Where possible, radiation-resistant materials shall be specified for equipment to be located in radiation fields. Materials such as plastics, organic compounds, lubricants, and insulation that degrade in radiation environments shall be shielded when not in use, or otherwise protected from excessive radiation exposure, or selected so that the design life exceeds the required design life of the pump.
- Materials that react to the waste shall not be used on mitigation pump where waste may come in contact with it. (i.e. aluminum, brass, etc.)
- Design shall consider using stainless steel on any component in direct contact with waste.
- Materials chosen shall be selected such that installation can be performed under adverse weather conditions without damage to the pump or tank, e.g., installation during the winter months. If required, steps shall be taken to prevent damage to the pump and tank, i.e, heating.

- Elastomers shall be chosen for both the chemical and radiation environments. Elastomers shall meet their intended design purposes for the design life of the pump.

- Permanently installed materials shall be resistant to: radiation, process solutions, caustic vapors and solutions, and known decontamination agents. Permanently installed materials shall be nonabsorbent, and/or oversized to permit partial destruction without affecting structural integrity.

2.1.3 Required Availability

The required availability of the hydrogen mitigation system shall provide unrestricted daily operation over the system design life that maintains hydrogen inventory in the non-convective layer at acceptable levels. The daily system operation shall be up to 4 hours per day.

2.2 MIXING PUMP

A submerged jet shall be used to induce flow of the waste tank fluid and mix the tank contents. The intent is to impart energy to disrupt the nonconvecting slurry region sufficiently to allow release of most of the trapped gas bubbles.

The pump shall include a suction strategically located as close to the tank floor as possible, without going below 24 inches above the tank floor. The pump shall discharge through 180° opposing nozzles located in the nonconvective layer of waste sludge. It is assumed the suction of the pump will initially be in a location of nonconvective material and water may have to be injected to get the mixing started. Pumping power shall be provided for moving the solids off the tank floor to allow for a somewhat continuous release of hydrogen. The discharge of the pump, or the nozzle centerlines, shall be located 26 to 30 inches above the tank floor.

To the extent possible, equipment and controls shall be located outside radiation areas and be readily accessible by authorized personnel. Commercially available equipment and parts shall be used to the greatest extent practical.

2.2.1 Installation Method

The pump and nozzle assembly will be lowered by a crane through the central riser into the tank.

2.2.2 Pump Mechanical/Physical Requirements

- A Hazleton type SSB Submersible Slurry Pump shall be utilized to design and fabricate the mixer pump. It must move 2800 gpm of water through two nozzles each being 2.6 inch diameter at full speed.

- The pump assembly shall have provision for decontamination such as:
  - Drain holes to prevent trapped waste
  - Provision for internal flushing of pump and pump lines

- The installed life of the pump shall meet the requirements of component design life. (Reference 2.1.1)

- The operating life of the pump shall meet the conditions of required availability. (Reference 2.1.3)

- The pump and support assembly shall fit inside the nominal 42 inch clearance of the riser. To meet this requirement the pump outer envelope shall not exceed a 40 inch diameter cylinder. Any dimensions that fall outside this envelope must be approved by WHC Waste Tank Safety Programs.

- Location of pump access ports, maintenance ports, and operational apparatus that require employee manipulation shall consider ergonomics as well as exposure.

- Required availability of pump operation can be considered as a means to prevent plugging.

- All pump openings used to facilitate connections of tubing and conduits shall be closed with liquid tight "hatch covers". Cut-out and rewelded windows shall be avoided.

- The pump shall be mounted on a rotating mechanism such that the nozzles sweep back and forth through a maximum 360° arc.

- The speed of the nozzles through the arc they travel shall be 0.0 to 0.2 rpm. The pause point of the nozzles shall be ± 1° through the arc they travel.

- One of the nozzles shall discharge up 30° from the position parallel with the tank bottom.

- If pressurization of internal voids by an inert gas is required, then the pressure of the gas shall be maintained at the maximum submergence depth head pressure to be experienced by the pump plus 5 psi.

- The pump shall be retrievable (out of the tank) at the end of its life.

- Surfaces should minimize crevices, ledges, and/or protrusions which could collect radioactive material.

- The pump system shall be designed such that plugging will be minimized, e.g., remote water injection system for clearing nozzles or water injection for clearing suction.

- The pump systems shall be designed to confine contaminants within the combination of boundaries defined by the existing tank, the confinement surfaces of the pump systems, and any other barriers that may be required.

- The rotation and mixer pump motors should be capable of operating simultaneously.

- Feature to obtain a gas grab sample shall be provided in the tank vapor space.

- The pump design should consider accommodating an auxiliary motor cooling system that may be installed at a later date.

- The final pump assembly shall have a centerline and all pump subassemblies shall be centered on this line within a 1/4 inch (6mm) tolerance. (i.e. The pump must be straight!)

- The pump shall be perpendicular to the mounting flange to allow it to hang vertical when installed in the tank riser.

- The pump rotation system shall be designed and fabricated to rotate freely.

- All piping should be arranged for gravity flow wherever possible, sloped to drain completely, and shall include provisions for flushing. Piping sizes shall be specified to prevent solids from accumulating, and a means of removing solids shall be provided. All piping shall be designed to preclude radioactive wastes from being syphoned or backflowed into nonradioactive lines.

2.2.3 Pump Power and Mixing Requirements

- Pump horsepower shall be in the range of 150 to 200.

- The pump shall have a $U_o d = 18.3\ ft^2/s$ where U_o = fluid discharge velocity in ft/s and d = discharge nozzle diameter in ft.

2.2.4 Pump Structural Requirements

- Pump drop accidents shall not damage the tank.

- Normal operational loads, loads from a plugged discharge nozzle, loads from waste rollover (including wasteberg impact), seismic loads, burn event, transportation and normal installation shall be described in a structural design specification.

- If necessary, the pump loads can be spread to the pump pit walls or to the area above the cover blocks to prevent overstressing the riser.

2.2.5 Pump and Associated Systems Decontamination Requirements

The design of the pump and its associated systems shall facilitate decontamination so that the pump can be decommissioned at a future date.

- The pump shall include an internal and external decontamination system for use during decommissioning. Disposal of wash water and decontamination chemicals shall be to tank. Water use shall be minimized.
- The pump internal and associated systems shall use filtered water for decontamination purposes.
- The pump external decontamination system shall consist of strategically located spray nozzles to remove the waste from the pump and its associated system.

The following principles shall be employed to the extent practicable.

- Areas subject to contamination shall be designed to facilitate decontamination.
- Penetrations shall be gas and liquid tight.
- The use of lifting lugs to move the pump.
- The project design shall minimize hazardous waste generation and use of hazardous materials during construction, operation, decontamination/decommissioning and RCRA closure.

2.2.6 Hazardous Classification Areas (NFPA)

WHC Fire Protection Group is responsible for establishing the NFPA Hazardous Classification Areas around the installed pump.

Installation shall meet NFPA 70, National Electrical Code, 1993 Articles 500, 501, 502, and 504 as appropriate. Where equipment is not listed for the appropriate hazardous classification, then engineering calculation shall be provided to WHC Fire Protection with supporting engineering documentation and experimental data as defined in UL 913.

2.3 INSTRUMENT SYSTEMS: WIRING AND INSTALLATION

The design of instrumentation and control systems wiring shall provide for reliable electrical transmission of measurement, status and control signals.

2.3.1 General Requirements

Provisions shall be made for both radioactive and nonradioactive equipment maintenance to support operations and to minimize equipment downtime. The pump instrumentation and control systems shall be designed to preclude the need for routine, hands-on maintenance in contaminated, or high dose rate areas. However, the design of the system shall not prohibit repair activities which may become necessary as the result of a faulted condition.

Provisions shall be made for remote replacement of system components that operate in a high radiation zone. If remote replacement is not feasible, ALARA principles shall be employed to minimize total integrated radiation dose to personnel making repairs or replacements. The capability shall be provided for preliminary decontamination of equipment, where practical, prior to repair or removal. Services and utilities required to repair/replace/test instruments shall be considered as part of the project.

All instrument enclosures in areas of potential radioactivity shall be sealed or otherwise protected from penetration by contamination and decontamination solutions.

2.3.2 Specific Instrument System Requirements

- If used, strain gage(s) shall be specifically reviewed for attachment, location, and proposed use.
- Field designations and DACS designations for instruments/ instrument loops shall be similar.
- The I/O cabinet shall be fabricated in such a way as to allow for removal/adjustment of each component without interfering with unrelated instruments within the cabinet.
- Local instrument readout in the I/O cabinet is not required.
- Instruments which require local access during pump operation for interpretation or diagnostics shall be avoided or located outside the exclusion area.
- To the extent possible, connections between the I/O cabinet and the pump shall utilize quick disconnects.

The use of limit switches or position sensors to control mechanical movement should be minimized. Where it is necessary to use limit switches for positive stop or position indication, the following guidelines should be observed.

- The limit switch should be mounted in a stationary position, and the actuator should be mounted to the movable member. The limit switch shall be protected to preclude damage from inadvertent bumping.
- The positioning and configuration of the limit actuator should prevent damage to the limit switch and actuator in the event of overtravel, misalignment, or malfunction.

- Failure of limit switches should be addressed by the design. Failure detection circuitry can be included to disable the moving component or mechanical stops can be designed to protect equipment from overtravel due to limit switch failures.

- These switches should be suitable for the classification area they are located in.

- Fine adjustment should be accomplished by an actuator with a positive means for securing the final position.

As a minimum, instruments shall be provided for the following functions:

- To provide indication of nozzle or pump suction blockage (e.g., flow, pressure, temperature).

- To monitor motor performance (e.g., stator oil moisture sensor, motor oil temperature).

- To monitor adjustable frequency drive performance (e.g., voltage, current).

- To provide indication of nozzle position.

2.4 ELECTRICAL

A hazardous classification document, Hazardous Classification Tank 241SY101, WHC-SD-WM-HC-010, rev. 1, has been developed and will be utilized for procurement, design, and fabrication of the pump. All electrical components and their installation shall adhere to the requirements of the "Hazardous Classification document".

All electrical equipment or components shall be selected or protected to resist adverse affects of the environment in which they are installed. This includes the use of electrical enclosures and junction boxes of the proper NEMA rating and material to resist, and to protect internal component from the corrosive effects of moisture and chemicals.

Sensitive (calibration, corrosion, etc.) electronic devices shall be located outside the high radiation areas, where possible. When required to be inside high radiation areas, the equipment shall be designed to withstand the demands of the environment and meet the design life requirements identified above.

Passive devices are preferred over any other type. Other specific requirements for the pump system are as follows:

- Electrical equipment located outside the tank shall meet the hazardous classification requirements of that area.

- All enclosures shall be rated for the location in which they will be located.

- Electrical cables and other connections transitioning from the rotating pump platform to the stationary zone shall be designed for long term trouble free service. The electrical cables transition in particular should be examined. Replacement of cables is considered routine maintenance; per the conditions allowed for component design life and required availability.

- The pump and jib boom will be grounded; specific additional lightning protection features are not provided due to the low incidence of lightning in the area.

- The pump electrical system will be grounded in accordance with the NFPA for grounded conductors for motors and equipment grounding. NFPA 70 articles 250, 430 and 501 cover these installations.

- Flexible conduit which is built to WHC standards shall consider a non-conductive inner liner similar to commercial explosive flexible conduit.

- The electrical system shall be bonded and grounded to minimize static electricity buildup. Static electricity shall have resistive discharge circuits of 1,000,000 ohms or less.

- If flexible conduit is used, twisting shall be avoided. Thus assembly of the pump unit shall consider final assembly and minimize wire and conduit movement or twisting.

- Filler/sealer, compounds shall be suitable for the application. Specifically, certain compounds need air to cure and cannot be thicker than allowed or sealed in an enclosure.

- Sealing spaces against explosive mixtures shall be considered through out the design. Sealing gases (inert) under pressure are likely to leak around objects exiting a sealed space, around groups of wires in a conduit or even around the strands of wire under the conductor insulation.

- Continuous carbon steel or stainless steel pipe shall be considered for use as electrical conduit to make continuous raceways to eliminate the intrusion of explosive gases and liquid and to eliminate the generation of hazardous gases when welding galvanized conduit.

- An Adjustable Frequency Drive shall be used for rotational and pump speed control.

2.5. GENERAL MECHANICAL PROCESS

Equipment shall be designed such that no single failure of mechanical or electrical equipment will cause a loss of control that will result in an unsafe condition. Functions shall be provided which will facilitate placement of the equipment in the appropriate position to establish a safe configuration during a faulted condition.

Design of the equipment should provide fail-safe operation in the event of a loss of control system supply power. Control circuits shall prevent the following failure modes:

- The pump starts if stopped.
- The pump increases in speed if operated at partial speed.
- Unexpected rotation.
- Rotation to an undesired location.
- Inadvertent start ups.
- Pump fails to stop after stop command.

3.0 GENERAL REQUIREMENTS

3.1 SAFETY

3.1.1 Safety Assessment

A preliminary assignment of minimum safety classes for the various systems is identified in Table 3-1.

3.1.1.1 **Safety Classification**. The safety classification of the mixer pump and associated instrumentation and control systems shall be based on the potential consequences of their failure. The safety classification of items provides a graded approach to applicable design and quality assurance requirements as established in WHC-CM-1-3, MRP 5.46, "Safety Classification of Systems, Components, and Structures". Significant safety functions related to the pump installation and operation are as follows:

The primary tank has been designated as a Safety Class 1 structure to prevent a significant environmental impact as a result of loss of tank integrity.

- Drop of the pump during installation or removal could compromise the tank integrity. The pump impact limiter limits the impact loading on the tank and is designated as Safety Class 1.

Continuous pump operation that meets the conditions of required availability is required to prevent a gas release with hydrogen concentrations exceeding the LFL or ammonia releases which could result in onsite concentrations in excess of the ERPG-3 limit. A gas release with hydrogen concentrations between the LFL and the MAB could result in onsite exposures greater than 5 rem EDE. Therefore, the time necessary to recover from a loss of pump operation shall be classified as a Safety Class 2.

The failure of the mixer pump and associated instrumentation and control components which could impact the safety function of a separate Safety Class 1 item will be classified Safety Class 1.

3.1.1.2 Safety Class Design Criteria. The design criteria for safety class items shall be in accordance with MRP 5.46. The WHC safety class 1 designation is equivalent to "safety class items" as defined in DOE Order 6430.1A. The application of some of the design criteria to the tank mixer pump and associated instrumentation and control systems is discussed below.

- Natural Phenomena Hazards. The design and analysis for natural phenomena hazards shall be in accordance with SDC 4.1, "Design Loads for Facilities". The seismic loading will consider the requirements established in DOE Order 5480.28.

- Environmental Qualification. The safety class equipment shall be capable of performing its intended safety function during normal, abnormal, or design basis accident conditions.

- Single Failure. The design shall ensure that a single failure does not result in the loss of capability of a safety class system to perform its required safety function in accordance with DOE Order 6430.1A.

Table 3-1. Preliminary Safety Class Designations
Waste Tank Mitigation System.

SYSTEMS, COMPONENTS, STRUCTURES	MINIMUM SAFETY CLASS
Tank Modifications	3
Cover Block Modifications	3
Pump Supporting Structure	3
Pump System	3
Control Systems	3
Pump	3
Pump Electrical System	3
Instrumentation System	3

3.1.1.3 Design Basis Accidents. The mitigation systems shall be designed to withstand the effects of DBA, as delineated in DOE Order 6430.1A, without loss of containment and with confinement of radioactive and toxic materials within allowable limits. Releases postulated to occur as a result of design basis accidents shall be limited according to Section 0200-1, Facility Siting, of DOE Order 6430.1A. Simultaneous occurrences of more than one DBA shall be considered when a joint occurrence, causally related to a common-mode failure, is possible.

3.2 NATURAL FORCES

The requirements of DOE 5480.28 shall be complied with in the design of the mixer pump and associated fixtures, whenever possible. Because the design of the mixer pump and associated fixtures will require being compatible with the existing tank structure and will rely upon the existing structures for support, it may not always be possible to meet all of the requirements of DOE 5480.28.

Note: The mixer pump is not required to operate after an event; however, the mixer pump must be removable and not damage the tank or its structural components. An "event" will be described in depth in a Structural Design Specification.

3.2.1 Design Basis Earthquake

Safety Class 1 and 3 items shall be designed to survive a DBE, as defined in HPS-SDC-4.1. Safety Class 4 items shall be designed in accordance with the Uniform Building Code as stated in HPS-SDC-4.1. Features necessary to maintain the mitigation systems and waste tank in a safe condition without undue risk to the health and safety of the public shall be Safety Class 1 items. The spectra given in HPS-SDC-4.1 shall be utilized in designing the facility for a DBE.

3.2.2 Design Basis Wind

All equipment and features necessary to protect onsite personnel and the public shall be designed to withstand the 100-year recurrence interval windloading according to HPS-SDC-4.1.

3.2.3 Design Basis Flood

The elevation of the 200 Area site has been judged to be outside the maximum extent of the Hanford Site design basis flood.

3.2.4 Volcanic Eruptions

The mitigation systems location suggests that volcanic action could result in ashfall that might affect operation. Therefore, mitigation systems Safety Class 1 item designs shall include protection from ash resulting from volcanic eruption according to HPS-SDC-4.1.

4.0 CODES AND STANDARDS

Use of codes and standards identified in Table 4-1 shall be considered.

Table 4-1. Codes and Standards

American Society for Testing and Materials (ASTM)	
ASTM A 276 or ASTM A 193	Bar Stock
ASTM A 240	Plate, Sheet, and Strip
ASTM A 312	Pipe
ASTM A 269	Tubing
ASTM A 182 or ASTM A 336	Forgings
ASTM A 351 or ASTM A 744	Castings
ASTM A 380	Cleaning & Descaling Stainless Steel Parts, Equipment, and Systems
ASTM A 564	Bar & Shapes (17-4 PH Shaft)
American National Standards Institute (ANSI)	
B2.1	Pipe Threads
B16.5	Steel Pipe Flanges & Fittings
B30.20a	Below the Hook Lifting Devices
B16.11	Forgings, Steel Fittings
B31.1	Piping (Power Plant and Steam)
B31.3	Piping (Process)
B31.9	Piping (Utility and Nonsafety Class)
N690	Steel Support Structures
Y14.5	Dimensions & Tolerancing
American Concrete Institute	
349	For Concrete Support Structures
American Society of Mechanical Engineers	
B&PV Code	Section VIII, Division 1 or 2
American Welding Society	
D1.1	Structural Welding
American Society of Nondestructive Testing	
ASNT-TC-1A	
AISC Manual of Steel Construction	
Hydraulic Institute	

Hydraulic Institute Standards	14th Edition 1983
National Electrical Manufactures Association (NEMA)	
ANSI/NEMA	MG1 Motors & Generators
National Fire Protection Association	
ANSI/NFPA 70, NFPA 497A	1993 Edition, National Electrical Code 1992 Edition, Class I Hazardous Locations

5.0 REFERENCES

5.1 U.S. DEPARTMENT OF ENERGY HEADQUARTERS

DOE 6430.1A, *General Design Criteria*, Washington, D.C.

DOE/EV/1830-T5, *A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)*, Department of Energy, Washington, D.C.

DOE 5480.28, *Natural Phenomena Hazards Mitigation*, Washington D.C.

5.2 U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE

HPS-SDC-4.1, "Standard Architectural-Civil Design Criteria," Rev 12, September 3, 1993, Department of Energy, Richland, WA.

5.3 WESTINGHOUSE HANFORD COMPANY

WHC-CM-1-3, *Management Requirements and Procedures*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-11, *ALARA Program Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-6-1, *Standard Engineering Practices*, Westinghouse Hanford Company, Richland, Washington.

WHC-SD-WM-DTR-024, *Laboratory Characterization of Samples Taken in May 1991 from Waste Tank 241-SY-101.*

WHC-SD-WM-HC-010, rev. 1, *Hazardous Classification Tank 241SY101*, Westinghouse Hanford Company, Richland, Washington.

5.4 CODES AND STANDARDS

NFPA, *National Electrical Code*, NFPA-70, National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts.