DISTRIBUTION SHEET

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DISTRIBUTION	HAZARDS ASSESSMENT	Date 11/1/94
Project Title/Work Order		EDT No. 608147
FAST FLUX TEST FACILITY HAZARDS ASSESSMENT		ECN No. N/A

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7. Abstract

This document establishes the technical basis in support of Emergency Planning Activities for the Fast Flux Test Facility on the Hanford Site. The document represents an acceptable interpretation of the implementing guidance document for DOE Order 5500.3A. Through this document, the technical basis for the development of facility specific Emergency Action Levels and the Emergency Planning Zone is demonstrated.

8. RELEASE STAMP

FAST FLUX TEST FACILITY

HAZARDS ASSESSMENT

L. N. Sutton

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Order 5500.3A, Emergency Planning and Preparedness for Operational Emergencies, requires that a facility specific hazards assessment be performed to support Emergency Planning activities. The Hazard Assessment establishes the technical basis for the Emergency Action Levels (EALs) and the Emergency Planning Zone (EPZ). Emergency Planning activities are provided under contract to DOE through the Westinghouse Hanford Company (WHC). This document represents the facility specific hazards assessment for the Hanford Site Fast Flux Test Facility (FFTF) as interpreted from DOE guidance, Emergency Management Guide, Hazards Assessment (June 26, 1992). [Note: The scope of this effort is limited by DOE Order 5500.3A exclusively.]

2.0 FACILITY DESCRIPTION

2.1 Location

The FFTF is located on the Hanford Site, a 560 square mile DOE Site in southeastern Washington State. The FFTF is located in the center portion of the 400 Area near the center of the Hanford Site.

2.2 Mission

The FFTF is the largest, most modern, liquid metal-cooled test reactor in the world. Originally constructed to support the U.S. Liquid Metal Fast Breeder Reactor Program, the FFTF has demonstrated its ability to perform fuel and materials tests in support of both national and international fast breeder reactor programs, produce medical and industrial isotopes, perform materials tests for the fusion and space programs, perform passive safety tests, and provide customized neutron environments to meet customer needs. In January, 1990, after an evaluation of long term missions for FFTF, the DOE concluded that justification to support the expense of continued operation did not exist. In April, 1992 DOE ordered the FFTF to be placed in a non-operating standby condition. No reactor operation has taken place since that time. On December 15, 1993, the DOE directed the FFTF be placed in a radiologically and industrially safe shutdown condition. This shutdown transition is expected to take approximately five years. The term FFTF includes the reactor as well as the equipment and structures for heat removal, core component handling and examination, instrumentation and control, and for supplying utilities and services, such as emergency power generation and irradiated fuel storage.

Figure 2.1 Location of the Hanford Site

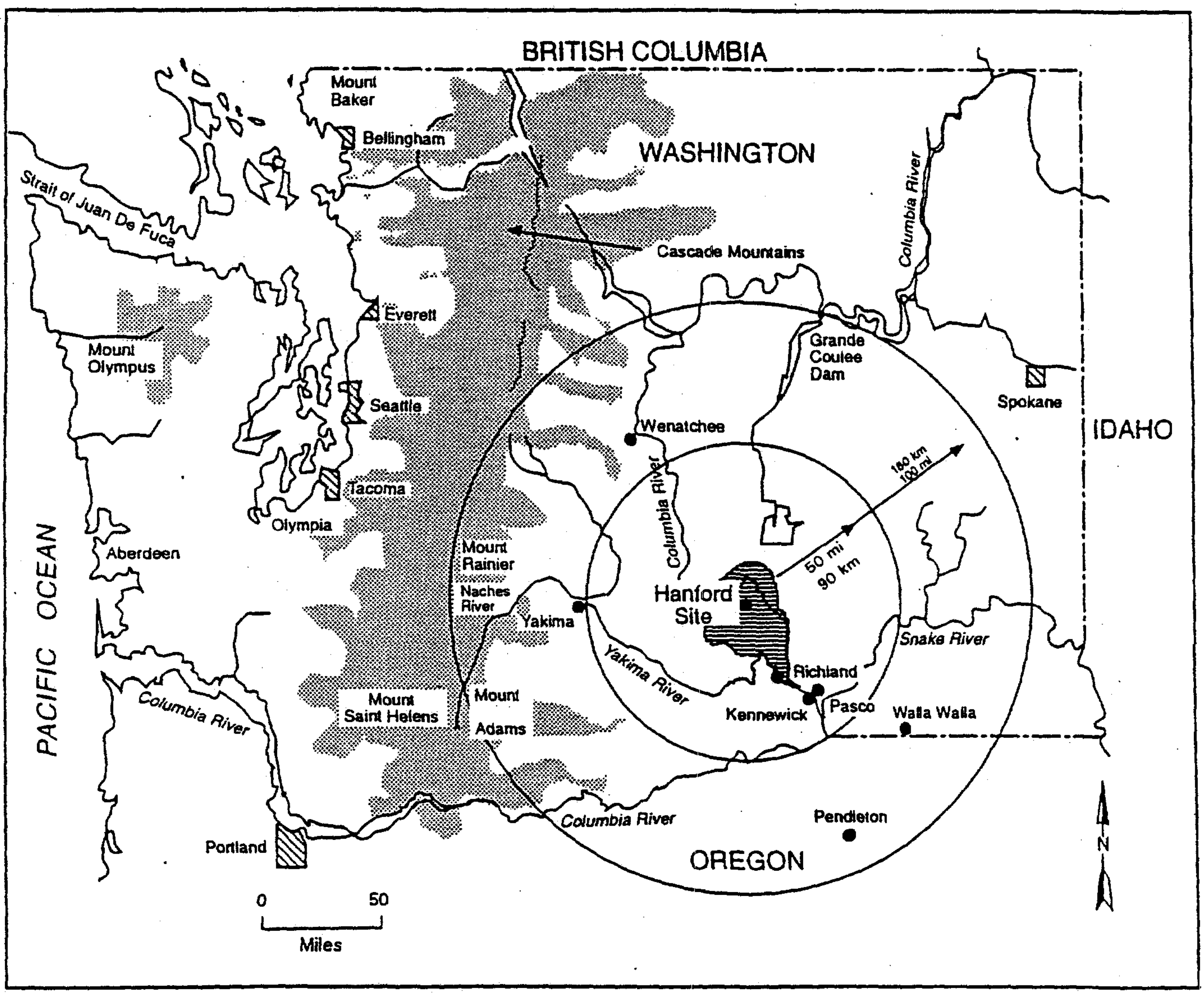

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Figure 2.2 Location of FFTF in the 400 Area

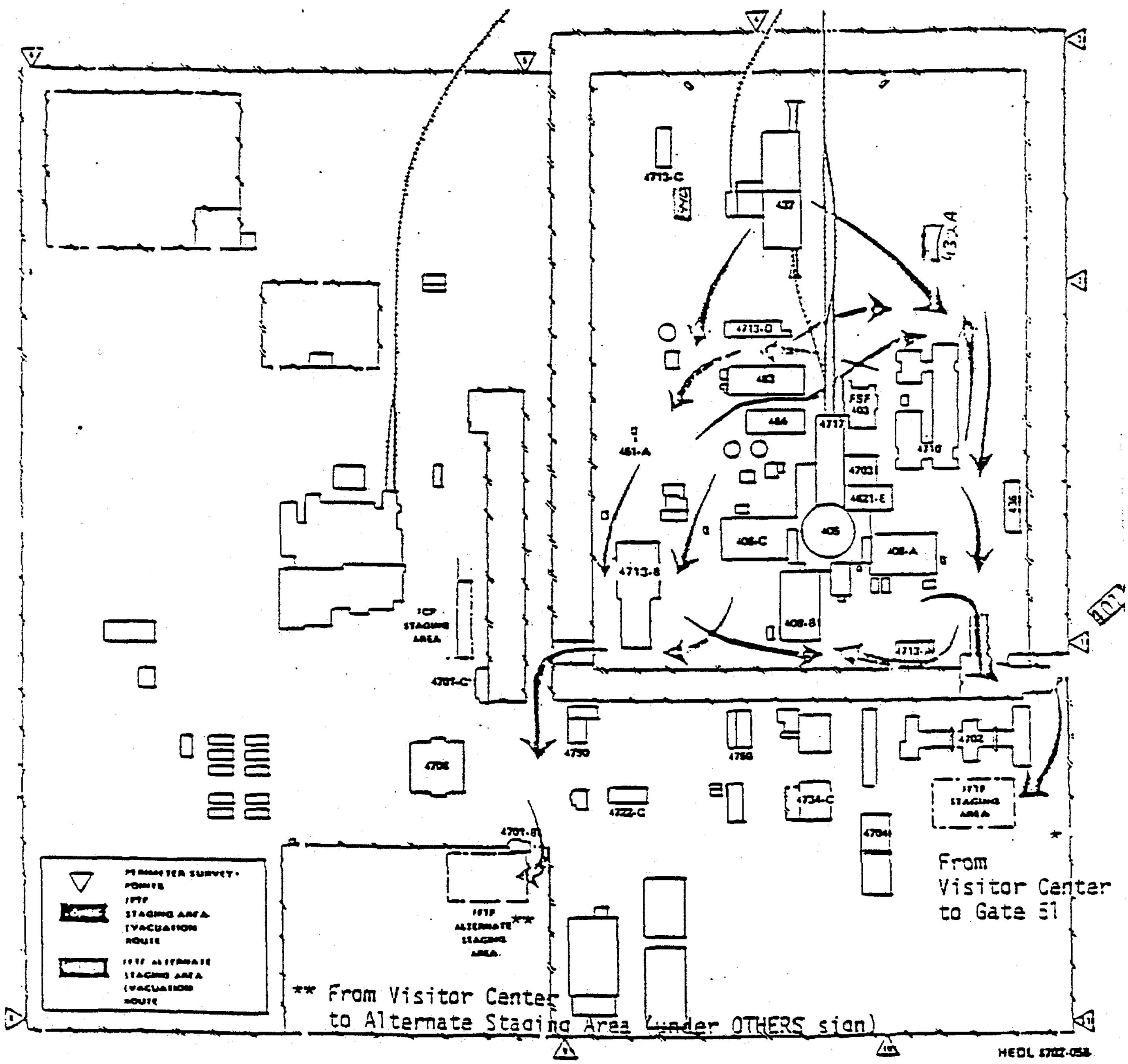
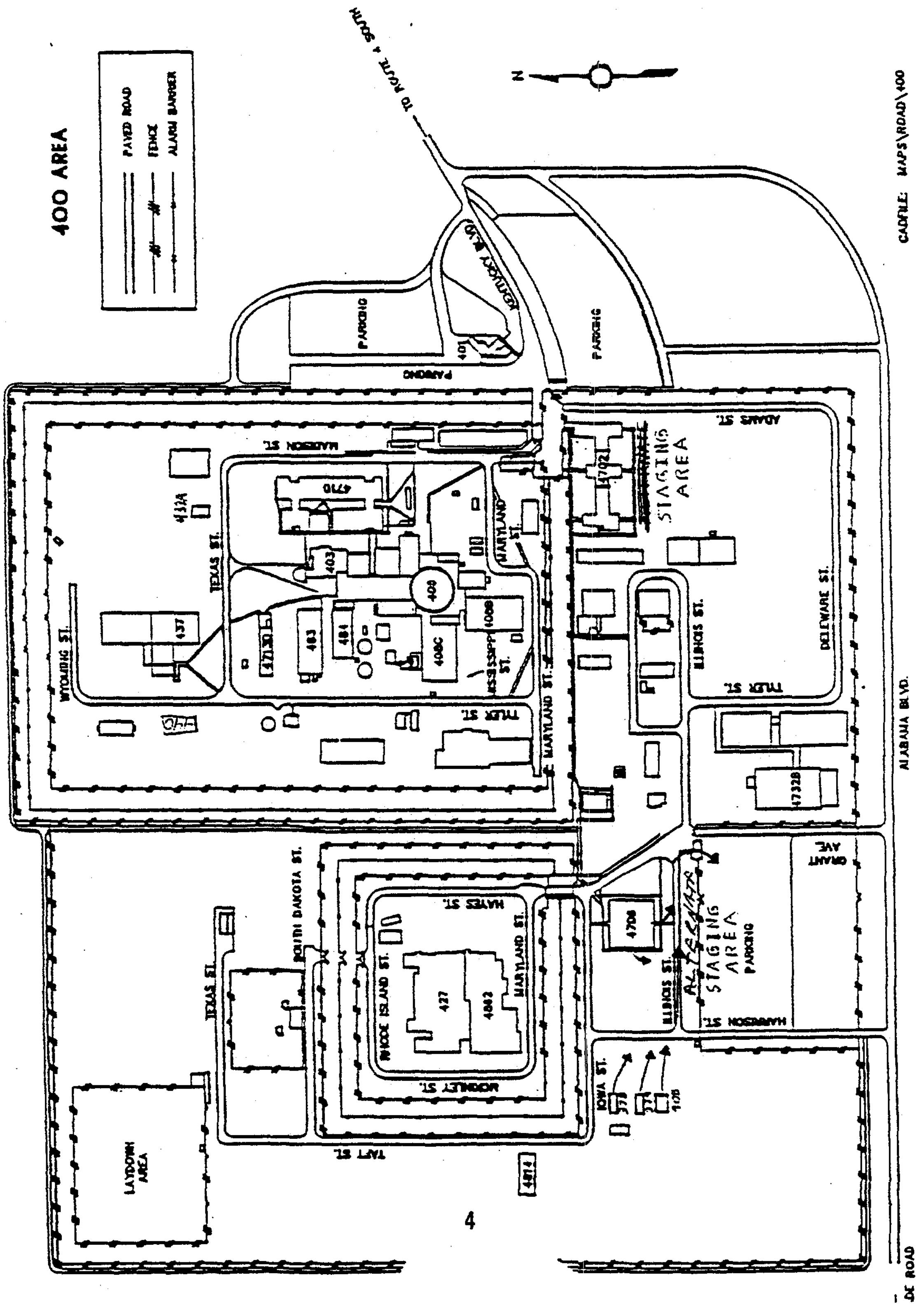


Figure 2.3 400 Area Buildings



2.3 FFTF Facility

The FFTF is a sodium-cooled, three primary and secondary loop, reactor complex utilizing 12 sodium-to-air Dump Heat Exchangers (DHX) that transfer heat from the secondary loops to the ambient air. Nominal conditions at the shutdown state include plant temperature of 193°C (380° F), and a nominal secondary sodium flow of 165,000 liters/min (43,500 gal/min). On loss of normal power, decay heat levels are sufficiently low such that decay heat can be removed via losses to ambient in the environment surrounding the reactor.

The principle hazards associated with the FFTF during its transition to a shutdown state are typical of hazards encountered at other DOE category A reactors, including irradiated fuel handling and the presence of several PCB transformers in the primary electrical distribution system. However, the use of the liquid metal, sodium, as a coolant presents some unique hazards since it is reactive in air and highly reactive with water. Exclusion of water from the facility, use of stainless-steel piping and components, low operating pressure, and gas inerting combine to minimize the potential for leaks and to mitigate the consequences of special sodium hazards.

2.3.1 MASF Facility

This facility is a multipurpose service center that supports the specialized maintenance and storage requirements of the 400 Area facilities and the Hanford Site. These include sodium film removal, decontamination, repair, site waste tank pump testing, and storage of nonfueled components and hardware for the FFTF and other major 400 Area facilities.

2.3.2 432A

This building is used to store compressed gases utilized at FFTF, including Argon, Nitrogen, Helium, Acetylene, Propane, Freon-12, Oxygen and Hydrogen.

2.3.3 440

This building is utilized as the FFTF <90 day hazardous waste accumulation area and is used to perform 400 Area hazardous waste handling operations.

3.0 IDENTIFICATION AND SCREENING OF HAZARDS

The Emergency Management Guide on Hazards Assessment indicates that 40 CFR 355 Appendix A and 10 CFR 30.72 Schedule C provide screening quantities or thresholds that should be used to eliminate the need to analyze insignificant hazards. The screening quantity is called a Threshold Planning Quantity (TPQ). These lists are not entirely inclusive. Other hazardous materials may exist in sufficient quantity which when released to the environment may pose health hazards to Hanford workers and the general public.

3.1 Chemicals Identified

Identification of chemicals stored and used at the FFTF was accomplished through the Hazardous Materials Inventory Database which is updated quarterly for the Hanford Site. The database supplies a list of the chemicals for each facility, provides the quantities and lists storage location and configuration. This list is used for the initial screening of chemicals at the FFTF. Chemicals with inventories in excess of 85 percent of the reporting quantity were compared against the threshold planning quantity if one existed for the chemical. If a threshold planning quantity had not been established for the chemical, it was evaluated independently when inventories appear to be substantial based on "apparent" toxicity; this analysis included evaluation of chemical carcinogens which may not pose an acute exposure hazard.

3.1.1 Non-Radiological Hazardous Materials

The FFTF facility does not store a wide variety of hazardous materials, however, the most significant of the hazardous materials is in the form of liquid sodium contained within the primary and secondary loops of the plant. In addition to the sodium hazard, various transformers supporting FFTF still contain Polychlorinated Biphenyls (PCB's), which during fire situations produce hazardous by-products.

Table 3.1 Comparison of Extremely Hazardous Chemical Inventory with TPQ Values

Substance	Amount	TPQ
Sodium	980,000 liters (259,000 gallons)	Not Listed
Polychlorinated Biphenyls	30,300 liters (8,000 gallons)	Not Listed

This table represents typical quantities of hazardous materials [further information on the physical properties and toxicities of these substances may be found in the Material Safety Data Sheets (MSDS).

3.1.2 Sodium

Sodium within the primary and secondary systems of FFTF is in a liquid metal state and approximately 530,000 liters (140,000 gallons)(Ref. WHC-SD-FF-HC-002 8/30/94) are contained within the primary Heat Transport System (HTS). The secondary HTS presently contains approximately 250,000 liters (66,000 gallons). An additional 200,000 liters (53,000 gallons) are contained in the Interim Decay Storage (IDS) and Fuel Storage Facility (FSF) systems.

3.1.3 Polychlorinated Biphenyls (PCB's)

An estimated 30,300 liters (8,000 gallons) of PCB contaminated oils are currently used as coolant within various FFTF facility transformers.

3.2 Radiological Hazards

FFTF currently contains spent reactor fuel assemblies within the Fuel Storage Facility (FSF), Interim Decay Storage vessel (IDS), IEM Cell, and the reactor vessel. Spent fuel assemblies are being removed from the reactor vessel and are being stored within the IDS and FSF vessels. The planned disposition is to clean sodium from the fuel assemblies in the IEM cell, place them into Core Component Containers (CCC), then load them into Interim Storage Casks (ISC). ISC's will then be stored on a concrete storage pad surrounded by a safety/security fence.

4.0 HAZARD CHARACTERIZATION

4.1 Sodium

4.1.1 Inventory and Properties

Sodium metal within the primary and secondary HTS systems is hot and in liquid form. Sodium is flammable and reacts violently when exposed to moist air or water and generates sodium hydroxide and hydrogen gas. Sodium hydroxide is corrosive and will cause severe eye and skin burns and hydrogen is flammable or explosive depending on the concentration.

Table 4.1 Sodium Physical Properties

Physical Properties (pure)	
Molecular weight	22.9
Specific gravity	0.97
Melting point	98°C
Boiling point	881°C
Vapor pressure	1.5 E-4 mm Hg @ 200°C

Table 4.2 Sodium Hydroxide Exposure Limits

Exposure Limits*	
ERPG-1	2 mg/m^3
ERPG-2	40 mg/m^3
ERPG-3	100 mg/m^3

* ERPG values are draft values in use by various DOE contractors and are not approved AIHA values (4/93).

4.2 Polychlorinated Biphenyls

4.2.1 Inventory and Properties

Polychlorinated Biphenyls are toxic and harmful if absorbed through the skin or inhaled. PCB's cause eye and skin irritation and the liquid is combustible with by-products of polychlorinated dibenzo-para-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs), which are highly toxic and may be a greater risk than PCBs.

Table 4.3 PCB Physical Properties

Physical Properties (pure)	
Molecular weight	257.6-326.4
Specific gravity	1.20-1.56
Boiling point	275-420°C
Vapor pressure	<1 mm Hg @ 38°C

4.2.2 Exposure Limits

There are no ERPG values established for PCBs. Existing guidance directs that the limit should be three times the TWA of 1 mg/m^3 (skin) or 3 mg/m^3.

4.3 FFTF Spent Fuel

4.3.1 Inventory and Properties

The total FFTF inventory of fueled components includes 371 fuel assemblies and pin containers. Thirty-two unirradiated fuel assemblies are also presently in sodium storage. The unirradiated fuel is to be cleaned of sodium and transported via shipping containers to PFP. Current plans call for the remaining spent fuel assemblies to be cleaned of sodium within the IEM Cell and placed within core component containers and then into Interim Storage Casks for longer storage on concrete storage pads.

5.0 EVENT SCENARIOS

This section briefly describes several scenarios from Environmental Impact Statements, Environmental Assessments, SARs, Hazards Identification and Evaluations, Technical Safety Assessments, and Operational Safety Requirements applicable to the status of the facilities. The projected consequences from these events are used to establish the size of the EPZ and to provide guidance for establishing EALs.

DOE Order 5500.3A also specifies that accidents whose consequences and probabilities fall outside the scope of traditional SARs must be considered. These events include accidents of higher probability and less consequence and those that may be classified as incredible in the SAR.

5.1 Facility Emergency Events

5.1.1 Seismic Event During BLTC Transfer of Assembly

5.1.1.1 Failure of Primary Barrier and Range of Possible Releases

The primary barriers for the fuel during Bottom Loading Transfer Cask (BLTC) transfer are the fuel clad and the seal boundary. The FFTF FSAR section 15.2.1.1.3.D reports the potential consequences of a Design Basis Earthquake (DBE) occurring while a fuel assembly is being transferred between the BLTC cask and a storage location. Under these conditions, it was determined that the BLTC might slide on its tracks, placing a side load on the assembly under transfer. Although calculations indicated that the assembly shouldn't experience any failure due to this event, it was conservatively assumed that 5% of the pins would be crushed and breached.

5.1.1.2 Effects of Other Barriers

Administrative controls placed on the defueling activity and design limitations help assure that no more than one assembly would be involved in a accident.

5.1.2 Sodium pool fires in containment HTS cells

5.1.2.1 Failure of Primary Barrier and Range of Possible Releases

The bounding event postulates a spill of 27,200 kgs (60,000 pounds) of primary sodium in a HTS cell open to outer containment. The reactor primary temperature is 204 °C (400 °F) and the HTS cell shielding block is removed to provide access to the cell, and the spill occurs and is assumed to ignite spontaneously in air and burn as a pool fire. The maximum concentration in containment (occurring at the end of the first two hours) is 6.4 g/m^3 (all particle diameters).

Larger spills in an HTS cell would have a lower aerosol generation rate owing to reduction in burning surface caused by submergence of the intermediate heat exchanger (IHX) and pump guard tanks in the lower HTS cell.

5.1.2.2 Effects of Other Barriers

The foregoing estimates assume maximum pool fire burning rate until the sodium reaction stops, and that the containment ventilation fan continues to operate. Limited aerosol fallout was assumed based on tests conducted under similar conditions.

5.1.3 Dump Heat Exchanger Leak

5.1.3.1 Failure of Primary Barrier and Range of Possible Releases

Secondary MHTS system piping is assumed to fail by a rupture near the lowest elevation in the DHX pit area (at the penetration to the Secondary pump tower). Approximately 75% of the loop sodium (45,400 kgs or 100,000 lbs) drains into the DHX pit.

5.1.3.2 Effects of Other Barriers

No other barriers exist since this event occurs exterior to any closed cell.

5.1.4 PCB Transformer Fire

5.1.4.1 Failure of Primary Barrier and Range of Possible Releases

This event postulates that a high energy electrical fault burns electrical transformer PCB coolant oil. The fire produces toxic by-products of polychlorinated dibenzo-para-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs), which are then drawn into the plant ventilation system.

5.1.4.2 Effects of Other Barriers

The plant heating and ventilation system is designed to automatically shutdown supply and exhaust fans on activation of a fire alarm and is assumed to provide only limited filtration of the toxic fire by-products.

5.2 Natural Emergencies

5.2.1 Seismic Event (Earthquake)

5.2.1.1 Failure of Primary Barrier and Range of Possible Releases

Primary barriers for a fuel assembly in the BLTC is the fuel cladding, the BLTC barrel and the seals between the BLTC floor valves and storage vessels. The postulated accidents which release the radioactive material include a failure of the fuel pin cladding during a transfer evolution with the BLTC.

5.2.1.2 Effects of Other Barriers

No release containment is assumed since containment integrity is no longer maintained. The potential radionuclide release from a damaged fuel assembly is reduced as the fuel ages due to radioactive decay.

5.2.2 High Winds/Tornado

The Hanford Site is frequently subject to strong winds. The all-time peak gust of 35.8 m/sec (80 mph) was recorded January 11, 1972. The peak gust is expected to occur once every 30 years. A peak gust of 42.9 m/sec (110 mph) would be expected to occur once every 500 years.

The Site is well outside of established tornado alleys. The probability of a tornado in any year at any point within the 161 km radius of the Hanford Meteorology Station is 6.8 E-6/yr. The Hanford design base tornado is defined as having a 67.1 m/sec (150 mph) rotational velocity and a 11.2 m/sec (25 mph) translational speed.

5.2.3 Flood

The Probable Maximum Flood (PMF), calculated by the Corps of Engineers, is based on the concurrence of the worst of several natural phenomena, including a record snowfall in the Columbia River watershed, no melting of this snow until late spring, then warm, heavy rain. This hypothetical flood would have a flow of 2.4 E9 l/hr (23,500 ft^3/sec) and is estimated to be well below the level of the FFTF facility. No emergency level declaration should be made.

5.2.4 Range Fire

5.2.4.1 Failure of Primary Barrier and Range of Possible Releases

The primary barrier is the fire suppression system in the FFTF facility. The land immediately around the FFTF is cleared of range grasses and plants. Flying embers could ignite the roof of the FFTF support buildings or a neighboring facility, which in turn could ignite buildings or interrupt electrical power within the 400 Area. The fire is not extinguished and the FFTF facility looses some or all of site power.

5.2.4.2 Effects of Other Barriers

Other barriers are the administrative procedure to maintain the cleanliness around and in the facility as well as minimize the quantity of flammable liquids. FFTF is designed with multiple backup power sources for critical equipment and instruments.

5.2.5 Snow and Ashfall

The Hanford Site is in a region subject to snowfall as well as ashfall from volcanic eruptions. The SAR does not hypothesize this event. The three major volcanic peaks closest to the project are: Mt. Adams about 1.6E+2 km away, Mt. Rainier, and Mt. St. Helens approximately 1.9E+2 km away.

Important historical ash falls affecting this location were from eruptions of Glacier Peak about 12,000 years ago, Mt. Mazama about 6,000 years ago, and Mt. St. Helens about 3,600 years ago. The most recent ashfall resulted from the May 18, 1980 eruption of Mt. St. Helens. Table 5.1 contains the estimated ash depth deposited at the Hanford site from past volcanic eruptions in the region. The ash weight from the Mt Mazama event would probably have exceeded the design roof loading of most older Hanford buildings and roof failure is probable. However, the ash loading from the other eruptions would have been well below the roof loading limit. No emergency declaration is suggested for either ash or snow accumulation.

As a result of the 1980 Mt. St. Helens eruption, the site design criteria was modified to include ashfall.

5.2.6 Aircraft Crash

This event is not discussed in the facility SAR but is assumed to be initiated by a plane crash into the FFTF facility, along with a fire. The same inventory and meteorological conditions as the seismic/fire event would be expected with the same consequences.

Table 5.1 Estimated Ash Depth at 400 Area from Major Eruptions

Volcano	Time	Depth of Ash	Equivalent Roof Loading Dry (psf)*	Equivalent Roof Loading Wet (psf)*
Glacier Peak	12,000 B.P.	0.025 m	6	8.4
Mt Mazama	6,000 B.P.	0.15 m	36	50
Mt. St. Helens	3,600 B.P.	0.025 m	6	8.4
Mt. St. Helens	1980	0.013 m	3	4.2

* pounds per square foot
B.P. = Before present

5.3 Security Contingencies

The following events have not been analyzed but are discussed and given a consequence in section 6.

5.3.1 Explosive Device

This event assumes confirmed physical damage as a result of a detonation of an explosive device occurs, in which there is a potential loss of confinement/containment of hazardous or radioactive materials in any of the FFTF facilities.

5.3.2 Sabotage

This event assumes confirmed physical damage as a result of sabotage occurs, resulting in potential loss of confinement/containment of hazardous materials to any of the FFTF facility buildings.

5.3.3 Hostage Situation

This event assumes that a confirmed hostage situation occurs within the FFTF facility.

5.3.4 Armed Intruder

This event assumes that a confirmed armed intruder(s) is located within the FFTF facility.

6.0 EVENT CONSEQUENCES

6.1 Calculational Models

Environmental radiological releases shown in the facility safety document were evaluated by modeling with the Hanford Unified Dose Utility computer code (HUDU). This code is the primary emergency response tool for evaluation of radiological releases on the Hanford Site. It employs a straight line Gaussian plume model, Pasquill-Gifford stability classes, and ICRP 26 and 30 Aerodynamic Mean Activity Diameter (AMAD). Release source terms considered only the respirable fraction, nominally 0.1 percent (DOE-STD-0013-93).

Release of radionuclides into the environment occurs either through a facility stack, or by loss of facility containment integrity. By convention, release heights less than 10 meters default to ground level releases. In these analysis plume rise is not considered, producing conservative dose estimates.

Chemical environmental releases were modelled using the Emergency Prediction Information computer code (EPI). EPI is the primary emergency prediction computer code utilized in the Unified Dose Assessment Center for the Hanford Site. EPI employs a straight-line Guassian plume model, Pasquill-Gifford stability classes, and uses a plume depletion algorithm based on deposition velocity. EPI allows the user to model term and continuous releases from point sources and area sources, as well as an option for modelling spills. Meteorological parameters used in the analysis were one meter per second wind speed, class "F" stability and an air temperature 20 degrees Centigrade (C). These parameters produce the most restrictive concentration estimates for sodium hydroxide.

6.2 Hazardous Material Release

6.2.1 Sodium Leak to HTS

The maximum release rate from the containment building was calculated to be 98 g/s of NaOH (Ref. 6). This release rate was input into the EPI code assuming a ground release, F stability, a 1 m/sec (2.2 mph) wind speed, and city terrain (includes building wake effects).

EPI results were 130 mg/m^3 at 150 meters, and 0.1 mg/m^3 at the 7200 meter site boundary. These results are quite different from those calculated in the reference; however, both calculations indicate that the event should be classified as a Site Area Emergency.

6.2.2 Sodium Leak to DHX

For this event, 45,400 kgs of sodium is assumed to leak into the DHX pit covering an area of 140 m^2. A burn rate of 45.4 kg/hr-m^2 (9.3 lbs/hr-ft^2) is assumed with 25% released as aerosol (Ref. 9); no plate out is assumed. Approximately 34 kg (75 lbs) NaOH is produced for every 21 kg (46 lbs) of sodium. Total release rate of NaOH is 700 g/sec. Other release parameters are as described for the HTS event. Saturation effects were ignored adding an additional layer of conservatism.

EPI results are 4100 mg/m^3 at 150 meters and 0.37 mg/m^3 at 7200 meters, this places the event in the Site Area Emergency classification.

6.2.3 PCB leak and fire

PCBs are a fire retardant but in the event of a high energy fault small amounts may burn. It is not possible to determine combustion product generation rates but since the resulting combustion products are extremely toxic, any indication of a fire in a transformer should be classified as an Alert with immediate precautionary evacuation of the area required (Ref. 10).

6.3 Radiological Releases

6.3.1 Seismic Event During BLTC Transfer of Assembly

This accident assumes that 5% of the fuel pins in an assembly are crushed releasing all remaining noble gasses and 5% of the volatile metals. The source term for a 5.4 MW fuel assembly aged 250 days is contained in reference 5. Three isotopes, Kr^{85}, Cs^{134} and Cs^{137} account for well over 90% of the dose. Release quantities of each isotope are 8.9 E11 Bq Kr^{85}, 3.3 E11 Bq Cs^{134} and 7.4 E11 Bq Cs^{137}. These quantities were input to HUDU and cumulative effective dose equivalents estimates were calculated for a ground level release, F stability and 1 m/sec (2.2) wind speed at distances of 100, 150 and 7200 meters.

Following are the results:

100 meters 0.10 Sv (10 rem)
150 meters 0.049 Sv (4.9 rem)
7200 meters 0.00012 Sv (12 mrem)

The dose at 7200 meters is higher than the value reported in the revision to the FFTF safety analysis report documented in reference 7 since the SAR value was based on a 30-day exposure period. It does compare favorably with a 0.00010 Sv (10 mrem) commitment calculated in reference 8.

6.4 Natural Emergencies

6.4.1 Earthquake

The consequences associated with a seismic event were calculated in section 6.3.1.

6.4.2 High Winds/Tornado

A graded precautionary approach is recommended for high winds at the FFTF facility. An Alert emergency should be declared if sustained winds exceed 40 m/sec (90 mph) and damage from high winds is observed. The 40 m/sec (90 mph) wind speed is suggested for consistency with the EAL at other Hanford facilities.

A Site Area Emergency should be declared if a tornado strikes a portion of the FFTF facility which houses radioactive or non-radioactive hazardous materials, and causes extensive damage. Significant off site consequences are not expected with the current plant condition and hazardous material inventory. The sodium leak to the DHX was postulated based on a tornado striking one of the non-tornado hardened DHXs. Consequences were calculated in 6.2.2.

6.4.3 Range Fire

The FFTF facility would probably not be affected by a range fire since the ground near the buildings is devoid of vegetation. As a precaution, it is suggested that an Alert be declared if a range fire or intra 400 area fire threatens the FFTF facility or buildings which store significant quantities of radioactive or hazardous material. The Alert emergency is based on the potential for degradation of safety at the facility.

6.4.4 Aircraft Crash

The range of possible releases from an aircraft crash is quite large. A light aircraft crash near the facility may not release any material whereas a direct hit from a commercial jet liner could cause extensive damage to the facility and a large release. The suggested approach is to classify any aircraft crash within the FFTF Property Protected fence line as an Alert Emergency. Any upgrade of the emergency class would be based on hazardous material release quantities.

6.5 Security Contingencies

The following events have not been analyzed but are discussed and given a consequence.

6.5.1 Explosive Device

An Alert Level Emergency shall be declared if a credible threat is received or a confirmed device is located. Physical damage as a result of a detonation of an explosive device, in which potential loss of confinement/containment of hazardous materials, occurs in the FFTF facility should be classified as a Site Area Emergency.

6.5.2 Sabotage

An Alert Level Emergency shall be declared if confirmed physical damage as a result of sabotage, results in potential loss of confinement/containment of hazardous materials to the FFTF facility.

6.5.3 Hostage Situation

An Alert Level Emergency shall be declared if a confirmed hostage situation is occurring within the FFTF facility.

6.5.4 Armed Intruder

An Alert Level Emergency shall be declared if confirmed armed intruder(s) are located within the FFTF facility.

6.6 Receptor Locations

The facility boundary receptor location is chosen to be the FFTF Property Protected Area fence, which is 150 meters from FFTF release points. The 150 meters (property protected area fence line) is less than the default value of 200 m suggested in the guidance document for hazards assessments but consistent with the distance used at some other Hanford facilities. The nearest Hanford Site boundary to FFTF is 7200 meters.

7.0 THE EMERGENCY PLANNING ZONE

The EPZ is an area within which special planning and preparedness efforts are warranted since the consequences of a severe accident could result in Early Severe Health Effects (ESHE). DOE Order 5500.3A endorses the EPZ concept and requires that the choice of an EPZ for each facility be based on an objective analyses of the hazards associated with the facility. The Emergency Management Guide on Hazards Assessment provides guidance on establishing the size of the EPZ. The suggested approach is to determine the emergency classification of the events analyzed in the Hazards Assessment and then base the EPZ size on the larger of a default size for each emergency class or the maximum distance that an ESHE Threshold is exceeded. A final step is to make adjustments to the area, if necessary, based on reasonableness tests in the guidance document. For example, the selected EPZ should conform to natural and jurisdictional boundaries where reasonable. The selection of the EPZ for the FFTF facility is based on this review and is described below.

7.1 The Minimum EPZ Radius

This hazards assessment identifies the sodium leak to the DHX as the worst case accident which meets Site Area emergency criteria. The EPZ size is the larger of 2 km (the default size for a Site Area emergency) or the maximum radius for ESHE. The Emergency Management Guide on Hazards Assessments provides the following criteria for ESHEs.

Radiological

External or uniformly distributed internal emitters	1 Sv
Thyroid	30 Sv
Skin	12 Sv
Ovary	1.7 Sv
Bone Marrow	1.65 Sv
Testes	4.4 Sv
Other Organs	55 Sv

Non-Radiological

A peak concentration of the substance in air that equals or exceeds the ERPG-3 value, or equivalent.

Conclusion

None of the evaluated accidents exceed the EHSE criteria at the default distance of 2 kilometers. An existing EPZ of 7.24 km (4.5 miles) was established for FFTF based on the consequences of a very severe reactor accident. Extreme malevolent acts can be postulated but have not yet been evaluated in a Vulnerability Assessment (VA) for the FFTF. The VA is scheduled for next year. For FFTF, it is suggested that the EPZ remain as is since, even though not evaluated, an extreme malevolent act would be expected to have consequences similar to the worst case reactor accident.

7.2 Test of Reasonableness

1. Are the maximum distances to PAG/ERPG-level impacts (Hanford PAG is 1 rem) for <u>most</u> of the analyzed accident scenarios equal to or less than the EPZ radius selected?

   All of the analyzed accident scenarios give consequences less than the ESHE criteria at the selected EPZ radius of 7.24 km.

2. Is the selected EPZ radius large enough to provide for extending response activities outside the EPZ if conditions warrant?

   The FFTF facility EPZ will remain at the original 7.24 km (4.5 mile) EPZ established for reactor operations. Therefore, emergency plans are already in place.

3. Is the EPZ radius large enough to support an effective response at and near the scene of the emergency?

   The EPZ radius encompasses the entire FFTF facility, the nearest other occupied Hanford facilities, and the Hanford Site roads leading past the facility. Access control can readily be established on these roads.

4. Does the proposed EPZ conform to natural and jurisdictional boundaries where reasonable, and are other expectations and needs of the offsite agencies likely to be met by the selected EPZ?

   There are no natural boundaries with which it makes sense to align any of the EPZ boundary lines. Therefore, all the jurisdictional boundary questions and offsite agency needs are included in the emergency planning zone.

5. What enhancement of the facility and site preparedness stature would be achieved by increasing the selected EPZ radius?

   None.

8.0 EMERGENCY CLASSES, PROTECTIVE ACTIONS, AND EMERGENCY ACTION LEVELS

8.1 Emergency Classes

A goal of the DOE emergency preparedness system is to quickly classify the severity of an accident. Preplanned actions are then implemented for each emergency class. The emergency classification is based, in part, on projected dose and concentration values at the facility and Hanford site boundaries for pre-analyzed accident scenarios. The emergency classification criteria are shown in Tables 8.1 and 8.2.

Table 8.1 Radiological Release Criteria

Emerg. Category	Criteria*
Alert	> 0.001 Sv committed dose equivalent at facility boundary > 0.005 Sv thyroid (worker) dose at facility boundary > 0.05 Sv skin dose at facility boundary
Site Area	≥0.01 Sv committed dose equivalent at facility boundary > 0.05 Sv thyroid (worker) dose at facility boundary > 0.5 Sv skin dose at facility boundary
General	≥0.01 Sv committed dose equivalent at site boundary > 0.05 Sv thyroid (infant) dose at site boundary > 0.5 Sv skin dose at site boundary

Table 8.2 Non-Radiological Release Criteria

Emerg. Category	Criteria*
Alert	> ERPG 1 at facility boundary
Site Area	≥ERPG 2 at facility boundary
General	≥ERPG 2 at site boundary

*The criteria apply to a peak concentration of the substance in air. If ERPG values have not been established for a substance, alternative criteria specified in the Emergency Management Guide for Hazards Assessments shall be used.

There are also general criteria for emergency classification in addition to the numerical values in the tables above. The threshold between reportable occurrences and the Alert classification is difficult to establish based solely on a numerical value. The following general criteria apply in addition to the airborne release concentration values specified in the tables above.

ALERT

An ALERT LEVEL Emergency shall be declared when events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the facility with an increased potential for a release.

In general, the ALERT classification is appropriate when the severity and/or complexity of an event may exceed the capabilities of the normal operating organization to adequately manage the event and its consequences.

SITE AREA

A SITE AREA emergency shall be declared when events are in progress or have occurred which involve actual or likely major failures of facility functions needed for protection of workers and the public.

GENERAL

A GENERAL EMERGENCY shall be declared when events are in progress or have occurred that involve actual or imminent catastrophic failure of facility safety systems with a potential for loss of confinement or containment integrity.

There is additional emergency classification guidance in the Emergency Management Guide on Event Classification and EALs. The Hazards Assessment in the following sections is based primarily on a comparison of calculated consequences with the numerical criteria in the tables above. However, some recommendations are provided based on the more general emergency classification criteria.

8.2 Emergency Action Levels

The facility accidents, trigger events, and recommended EALs are provided in Appendix A.

9.0 MAINTENANCE AND REVIEW OF THIS HAZARDS ASSESSMENT

The Operating Contractor, Manager of Emergency Preparedness, is responsible for ensuring that this Hazards Assessment is regularly reviewed and maintained current.

10.0 REFERENCES

1. Department of Energy, June 26, 1992, Emergency Management Guide, Guidance for Hazards Assessment, U.S. Department of Energy, Washington, D.C.

2. Department of Energy, April 30, 1991, Planning and Preparedness for Operational Emergencies, DOE Order 5500.3A, U.S. Department of Energy, Washington, D.C.

3. Emergency Prediction Information Code, Homann Associates, Inc., Fremont, Ca.

4. Scherpelz, R. I., February 1991, HUDU - The Hanford Unified Dose Utility Computer Code, PNL-7636, Pacific Northwest Laboratory, Richland, Wa.

5. Gantt, D. A., April 13, 1994, Ex Reactor Safety Analysis for Shutdown Conditions, WHC-SD-FF-ER-098, Westinghouse Hanford Company.

6. Internal Memo from Radiological and Toxicological Analysis to D. D. Stepnewski, March 10, 1993, Radiological and Toxicological Consequences of a Postulated Sodium Fire in the FFTF Containment.

7. D. A. Gantt, February 1, 1994, Engineering Change Notice 606897

8. Internal Memo from Safety Analysis to D. A. Smith and D. M. Art, August 11, 1983, Radiological Dose Assessment of BLTC Fuel Transfer Seismic Event.

9. *Internal Memo from D. D. Stepnewski to J. B. Waldo, March 30, 1993,* Report on Containment Integrity Requirements During Plant Standby-Revision 1.

10. NIOSH Current Intelligence Bulletin 45, February 24, 1986, Polychlorinated Biphenyls (PCB's): Potential Health Hazards from Electrical Equipment Fires or Failures.

APPENDIX A FACILITY AND/OR AREA INDEX OF EMERGENCY CONDITIONS

No. 1A
FACILITIES EMERGENCY EVENTS
(sheet 1 of 1)

FIRE

Initiating Condition	Emergency Action Level	Event Classification
A fire in the FFTF facility.	Building or range fire which potentially impacts required plant safety systems and requires Hanford Fire Department assistance for suppression.	**ALERT LEVEL EMERGENCY**
A PCB fire in the FFTF facility.	A fire occurs in association with any PCB oil filled transformer.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified.

No. 1B
FACILITIES EMERGENCY EVENTS
(sheet 1 of 1)

HAZARDOUS MATERIAL RELEASE

Initiating Condition	Emergency Action Level	Event Classification
Catastrophic release of sodium to environment from HTS or DHX failure.	Airborne concentration of 2mg/m^3 (visible white smoke) at the facility boundary.	**ALERT LEVEL EMERGENCY**
Catastrophic release of sodium to environment from HTS or DHX failure.	Measured airborne concentration of 40mg/m^3 at the facility boundary. ---------------OR---------------- Failure of MHTS system resulting in loss of 75% of loop volume. ---------------OR----------------- Confirmed significant leak according to FFTF Procedure PR-3, and reactor sodium level below minimum safe level (-12ft)	**SITE AREA EMERGENCY**

Note: No General Emergency class identified.

No. 1C
FACILITIES EMERGENCY EVENTS
(sheet 1 of 1)

RADIOACTIVE MATERIAL RELEASE

Initiating Condition	Emergency Action Level	Event Classification
BLTC failure during fuel transfer	BLTC fails during fuel transfer exposing fuel with no damage to fuel.	**ALERT LEVEL EMERGENCY**
BLTC failure during fuel transfer	BLTC fails during fuel transfer exposing and damaging the fuel.	**SITE AREA EMERGENCY**

Note: No General Emergency class identified.

No. 2A
NATURAL EMERGENCIES
(sheet 1 of 1)

SEISMIC EVENT

Initiating Condition	Emergency Action Level	Event Classification
A seismic event occurs in the 400 Area.	Earthquake felt onsite and producing a maximum ground acceleration of 0.02g to 0.05g. Ground acceleration determined by using the indications described in FFTF Procedure PR-12.	**ALERT LEVEL EMERGENCY**
A seismic event occurs in the 400 Area.	Earthquake producing a maximum ground acceleration between 0.05g and 0.12g. Ground acceleration determined by using the indications described in FFTF Procedure PR-12.	**SITE AREA EMERGENCY**

Note: No General Emergency classes identified.

No. 2B
NATURAL EMERGENCIES
(sheet 1 of 1)

TORNADO/HIGH WINDS

Initiating Condition	Emergency Action Level	Event Classification
High winds or tornado observed within 400 Area.	Tornado strikes within the 400 Area causing damage or interruption of plant operations. Confirmed report of sustained wind speeds within the 400 Area of 40 m/sec (90 mph) or greater.	**ALERT LEVEL EMERGENCY**
A tornado strikes a FFTF facility	Tornado visually seen striking a FFTF facility which contains radioactive or hazardous materials causing extensive damage.	**SITE AREA EMERGENCY**

Note: No General Emergency classes identified.

No. 2C
SECURITY CONTINGENCIES
(sheet 1 of 1)

AIRCRAFT CRASH

Initiating Condition	Emergency Action Level	Event Classification
An aircraft crash has occurred at the FFTF facility.	An aircraft crash has occurred AND has or is likely to have an adverse affect on the facility's safety or has or is likely to release radioactive/hazardous material to the environment.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified.

No. 3A
SECURITY CONTINGENCIES
(sheet 1 of 1)

EXPLOSIVE DEVICE

Initiating Condition	Emergency Action Level	Event Classification
Explosive device within FFTF.	Credible threat or a confirmed explosive device located within the FFTF plant.	**ALERT LEVEL EMERGENCY**
Explosive device within FFTF.	Confirmed detonation of an explosive device within the FFTF plant.	**SITE AREA EMERGENCY**

Note: No General Emergency classes identified.

No. 3B
SECURITY CONTINGENCIES
(sheet 1 of 1)

SABOTAGE

Initiating Condition	Emergency Action Level	Event Classification
Confirmed sabotage to FFTF facility.	Credible threat or confirmed physical damage as a result of sabotage against FFTF safety systems or equipment.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency class identified.

No. 3C
SECURITY CONTINGENCIES
(sheet 1 of 1)

HOSTAGE SITUATION

Initiating Condition	Emergency Action Level	Event Classification
Hostage situation.	A confirmed hostage situation is occurring personnel within the 400 Area Property Protected Area.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified.

No. 3D
SECURITY CONTINGENCIES
(sheet 1 of 1)

ARMED INTRUDER

Initiating Condition	Emergency Action Level	Event Classification
Armed intruder(s) within the FFTF facility.	Penetration of the 400 Area Property Protected Area by hostile forces.	**ALERT LEVEL EMERGENCY**

Note: No Site Area or General Emergency classes identified.