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340 FACILITY EMERGENCY PREPAREDNESS HAZARDS ASSESSMENT

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Abstract: This document establishes the technical basis in support of Emergency Planning activities for the 340 Facility on the Hanford Site. Through this document, the technical basis for the development of facility specific Emergency Action Levels and Emergency Planning Zone, is demonstrated.

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**340 FACILITY
EMERGENCY PREPAREDNESS HAZARDS ASSESSMENT**

L. R. Campbell
T. L. Johnson

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1.0 INTRODUCTION

This report documents the emergency planning hazards assessment for the 340 Facility located on the U.S. Department of Energy (DOE) Hanford Site. A hazards assessment is required by DOE Orders to provide the emergency planning technical basis for the facility. Operation of the 340 Waste Handling Facility is the responsibility of Waste Management Hanford (WMH).

2.0 FACILITY AND SITE DESCRIPTION

Detailed descriptions of the 340 Facility and the Hanford Site are found in various technical reports, the Safety Assessment Document (WHC, 1989), the Interim Safety Basis document (WHC, 1995) and the Hanford Site Environmental Policy Act (NEPA) Characterization Document (Cushing, 1992). The following summary is derived from these descriptions.

2.1 Facility Mission

The 340 Facility has completed its mission of receiving, storing and shipping mixed liquid waste generated by DOE facilities in the 300 Area. The plan for the facility is to embark on a phased deactivation mission. The phased approach is necessary to support the continued operation of the adjacent 307 Basins which share utilities and some infrastructure with the 340 Facility. As soon as funding is approved, the decontamination of the RLWS will begin. The deactivation project activities are specified in the 340 Facility Deactivation Project Management Plan (HNF 1998).

2.2 Location

The 340 Facility is located in the central portion of the 300 Area on the south side of the east end of Apple Street.

The nearest site boundary (the 300 Area fence) is 345 m to the east. The nearest possible resident is about 1500 m east, across the Columbia River. The 300 Area is located in the southeastern corner of the DOE Hanford Reservation, along the west bank of the Columbia River (see Figure 2.1). The 300 Area contains over 100 buildings most of which are offices or laboratories. Several Hanford contractors and private enterprises have facilities within the 300 Area.

2.3 Hanford Site Description

2.3.1 Physical Description

The DOE Hanford Site lies within the semiarid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 2.2). The Hanford Site occupies an area of about 1450 km² (560 mi²) north of the confluence of the Snake and Yakima Rivers with the Columbia River. The Hanford Site is about 50 km (30 mi) north to south and 40 km (24 mi) east to west. This land, with restricted public access, provides a buffer for the smaller areas currently used for research, waste storage, and waste disposal; only about 6% of the land area have been disturbed and is actively used. The Columbia River flows through the northern part of the Hanford Site, and turning south, it forms part of the eastern boundary of the Site. The Yakima River runs along part of the southern boundary and joins the Columbia River south of the city of Richland, which bounds the Hanford Site on the southeast. Rattlesnake Mountain, the Yakima Ridge, and the Umtanum Ridge form the southwestern and western boundary. The Saddle Mountains form the northern boundary of the Hanford Site.

Major metropolitan areas within the broad vicinity of Hanford include Spokane, Washington, about 120 air miles to the northeast; Seattle, Washington, about 130 air miles to the northwest; and Portland, Oregon, about 150 air miles to the southwest. Two other areas of significant population density in Washington State, include Moses Lake, about 30 miles north of the 100 K-Area, and the Yakima Valley, extending from Yakima, about 45 miles west of Hanford, to the Tri-Cities, (Richland, Pasco and Kennewick). The nearest of the Tri-Cities, Richland, is immediately south of the site.

The Hanford Reservation contains the following major facilities or activities: six reactor areas designated 100-B/C, 100-N, 100-KE/KW, 100-D/DR, 100-H, and 100-F, which contain eight shutdown production reactors and one shutdown dual purpose reactor (N Reactor); the KE and KW Fuel Storage Facilities within the 100-KE/KW Area; two areas for waste processing and waste storage designated 200-E and 200-W Areas; the 300 Area which contains a shutdown fuel fabrication facility and laboratory facilities supporting all of DOE's Hanford Programs; the 400 Area which contains the shutdown Fast Flux Test Facility (FFTF); a commercial nuclear waste burial operation on land leased to the State of Washington; and an operating Washington Public Power Supply System, nuclear power plant.

2.3.2 Floods

Large Columbia River floods have occurred in the past (DOE 1987), but the likelihood of a recurrence of large-scale flooding has been reduced by the construction of several flood control/water storage dams upstream of the Site.

There are no Federal Emergency Management Agency (FEMA) flood plain maps for the Hanford Reach of the Columbia River. FEMA only maps developing areas, and the Hanford Reach is specifically excluded.

Evaluation of flood potential is conducted in part through the concept of the probable maximum flood (PMF), which is determined from the upper limit of precipitation falling on a drainage area and other hydrologic factors, such as antecedent moisture conditions, snowmelt,

and tributary conditions, that could result in maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 40,000 cms (1.4 million cfs) and is greater than the 500-year flood. The PMF is not expected to inundate the buildings in the 300 Area but will flood the 100 F, 100 H, and part of the 100 B/C Areas. The river pumps that supply water to the K Fuel Storage Basins will also be submerged and likely destroyed. The PMF may also flood access roads and temporarily cut off electrical power to the 100 and 300 Areas (see Figure 4.2-10 in Cushing, 1992).

Potential dam failures on the Columbia River have been evaluated. Upstream failures could arise from a number of causes, with the magnitude of the resulting flood depending on the degree of breaching at the dam. The U.S. Army Corps of Engineers evaluated a number of scenarios on the effects of failures of Grand Coulee Dam, assuming flow conditions of the order of 11,000 cms (400,000 cfs). For purposes of emergency planning, they hypothesized that 25% and 50% breaches, the "instantaneous" disappearance of 25% or 50% of the center section of the dam, would result from the detonation of nuclear explosives in sabotage or war. The discharge or floodwave resulting from such an instantaneous 50% breach at the outfall of the Grand Coulee Dam was determined to be 600,000 cms (21 million cfs). In addition to the areas inundated by the probable maximum flood (see Figure 4.2-10 in Cushing, 1992), the remainder of the 100 Areas, the 300 Area, and nearly all of Richland, Washington, would be flooded (DOE 1986; see also ERDA 1976). Flooding of this magnitude would be a regional emergency along the entire downstream length of the Columbia River. Planning and assessment for flooding of this magnitude is beyond the scope of this document.

There have been fewer than 20 major floods on the Yakima River since 1862 (DOE 1986). The most severe occurred in November 1906, December 1933, and May 1948; discharge magnitudes at Kiona, Washington, were 1,870, 1,900, and 1,050 cms (66,000, 67,000, and 37,000 cfs), respectively. The recurrence intervals for the 1933 and 1948 floods are estimated at 170 and 33 years, respectively. The development of irrigation reservoirs within the Yakima River Basin has considerably reduced the flood potential of the river. The 300 Area is not within lands susceptible to a 100-year flood on the Yakima River.

2.3.3 Seismology

The Hanford Reservation is in a region of low to moderate seismicity. The historic record of earthquakes in the Pacific Northwest dates from about 1840. The early part of this record is based on newspaper reports of structural damage and human perception of the shaking, as classified by the Modified Mercalli Intensity (MMI) scale, and is probably incomplete because the region was sparsely populated. Seismograph networks did not start providing earthquake locations and magnitudes of earthquakes in the Pacific Northwest until about 1960.

Large earthquakes (magnitude greater than Richter 7) in the Pacific Northwest have occurred in the vicinity of Puget Sound, Washington, and near the Rocky Mountains in eastern Idaho and western Montana. A large earthquake of uncertain location occurred in north central Washington in 1872. This event had an estimated maximum MMI ranging from VII to IX and an estimated Richter magnitude of approximately seven. The distribution of intensities suggests a location within a broad region between Lake Chelan, Washington, and the British Columbia border. Seismicity of the Columbia Plateau, as determined by the rate of earthquakes and the historical magnitude of these events is low when compared to other regions of the Pacific

Northwest. In the central portion of the Columbia Plateau, the largest earthquakes near the Hanford Site are two earthquakes that occurred in 1918 and 1973. These two events had magnitudes of 4.4 and intensity V and were located north of the Hanford Site. For more information concerning the seismology and geology of this area, see Section 4.2.3 of the Hanford Site National Environmental Policy Act (NEPA) Characterization (Cushing, 1992).

2.3.4 Local Meteorology

Continuous observation and recording of meteorological data has been carried out at the Hanford Meteorological Station (HMS), located near the 200 West Area, since 1945. Climatological conditions on the 200 Area plateau are significantly different from those on the south end of the site, especially during the winter months when the incidence of low clouds and fog is much greater at the HMS.

The average daily maximum temperature in July, the hottest month of the year, is 33.2 EC (91.8 EF); the average minimum is 16.1 EC (61.0 EF). During January, the coldest month, the average maximum temperature is 2.6 EC (36.6 EF), and the average minimum temperature is -5.6 EC (21.9 EF). The daily temperature range is about 8.2 EC (14.7 EF) in January and 17.1 EC (30.8 EF) in July.

The average annual precipitation for the Hanford Site is about 16 cm (6.25 inches). Most of the precipitation occurs during the winter season with nearly half of the annual amount occurring in the months of November through February. Snowfall accounts for about 38% of all precipitation, during the months of December through February.

The predominant wind direction over most of the region is southwesterly. However, because of local topographic influences, the predominant wind direction at the HMS and over much of the Hanford Site including the 200 Area Plateau is northwesterly. Monthly average wind speeds are lowest during the winter months, averaging 10 to 11 km/h (6.2 to 6.8 mph), and highest during the summer, averaging 14 to 16 km/h (8.7 to 9.9 mph).

The Hanford Site is located in a semiarid region of southeastern Washington State. The Cascade Mountains, beyond Yakima to the west, greatly influence the climate of the Hanford area, by means of their rain shadow effect. This range also serves as a source of cold air drainage which has a considerable effect on the wind regime on the Hanford Site.

2.3.5 Wind and Tornado

The Site is subject to frequent strong westerly winds. The all-time peak wind recorded at the HMS tower in the 200 West Area at the 15-m level was a gust of 81 mph recorded January 11, 1972. The 80-mph gust is expected to occur once every 30 years. A peak of 85 mph would be expected to occur once every 100 years (Cushing, 1992).

The Site is well outside of established tornado alleys. The probability of a tornado in any year, at any point within the 100-mile radius of the HMS, is $6.8 \times 10^{-6}/\text{yr}$ (Stone 1972).

Figure 2.1 Location of the 340 Waste Handling Facility in the 300 Area

Figure 2.2 Location of the Hanford Site in Washington State

Figure 2.3 340 Facility

2.3.6 Ashfall

The Hanford Reservation is in a region subject to ashfall from volcanic eruptions. The three major volcanic peaks closest to the project are Mt. Adams about 160 km (100 mi) away, Mt. Rainier at about 180 km (110 mi) away, and Mt. St. Helens approximately 210 km (130 mi) away.

Important historical ashfalls affecting this location were from eruptions of Glacier Peak about 12,000 BP, Mt. Mazama about 6,000 BP, and Mt. St. Helens about 3,600 BP. The most recent ashfall resulted from the May 18, 1980 eruption of Mt. St. Helens. The table below indicates the estimated ash depth deposited at the Hanford Site from past volcanic eruptions in the region.

Table 2.1 Estimated Ash Depth at Hanford from Major Eruptions

<u>Volcano</u>	<u>Time</u>	<u>Depth of Ash</u>	<u>Equivalent Roof Loading</u>	
			<u>Dry (psf)</u>	<u>Wet (psf)</u>
Glacier Peak	12,000 B.P.	1 in	6	8.4
Mt. Mazama	6,000 B.P.	6 in	36	50
Mt. St. Helens	3,600 B.P.	1 in	6	8.4
Mt. St. Helens	1980	0.5 in	3	4.2

B.P. - Before Present

2.4 Facility Description

The 340 Facility (Figure 2.3) has completed its mission of receiving, storing and shipping radioactive and mixed liquid wastes generated during laboratory operations. The facility is slated for deactivation in a phased approach, to account for the continued operation of the adjacent 307 Basins. Solid Waste stored in the 340-B Storage Area generally comes from 340 Facility Operations and Maintenance activities. Other DOE, 300 Area, solid waste generators, occasionally use the 340 Facility as a staging area for solid waste transfers.

The 340 Facility consists of six buildings: 340 (control room, decontamination area, mechanical equipment room, change rooms, truck lock area and operators office), 340-A (above ground radioactive liquid waste system tank storage), 340-B East (railroad car loading station) and 340-B West (radioactive solid waste storage area), MO-036 (office trailer), and MO-741 (health physics technician office and 340 Facility survey station). 340-B East and 340-B West is one building.

2.4.1 340 Building

The 340 Building is a corrugated steel structure that contains a concrete vault, 11.3 x 7.6 x 6.4 meter deep (37 x 25 x 21 ft) for two 56.8 kL (15,000 gallon) tanks. The tanks store radioactive liquid and potential solid heel from past operation. The pit is covered by 30-cm (12 inch) thick removable concrete blocks. A hatch is provided in the roof, allowing entry for inspection and maintenance. All access holes and hatches to the vault and valve pit are blocked.

The storage vault contains two 57-kL (15,000 gal) waste tanks. The vault can contain up to 360 kL (94,000 gal) of liquid in the event of a tank or piping leak. The vault is equipped with a leak detector located at the sump and a sump pump discharging into the tanks. Each tank is equipped with an agitator for mixing during sampling and pump out activities.

The exhaust system for the 340 Building consists of two-stage HEPA filters, an exhaust fan, and a stack, which is located above the rest rooms. The stack is continuously sampled, and the sample is changed and analyzed on a bi-weekly basis.

The 340 Vault and vault tanks have a separate ventilation system. The system exhausts through a dust stop filter, two-stage HEPA filters, a charcoal absorber stage, and two exhaust fans located just east of the vault. During normal operation, the fans are alternated with one in standby. A control damper on the vault line is used to maintain a higher vacuum in the vault tanks than in the vault. The off-gas line from the vault tanks contains a demister and heater ahead of the tie-in to the filter system. The vault stack is continuously monitored with three types of alarms, high radioactivity, low sample flow, and failure alarms.

The truck lock, control room, and decontamination room are monitored with smoke and temperature detectors and automatic sprinklers.

A radiation detector with an associated alarm, is provided in Valve Box 9 to monitor the radiation level of incoming liquid. There are radiation air monitors at several locations in the 340 Facility.

2.4.2 340-A Building

The 340-A Building is a steel frame rectangular structure with a concrete floor, 3 feet below grade and concrete walls, to grade. The above grade walls and roof are steel. The building contains six 30 kL (8000 gallon) cross-connected stainless steel waste storage tanks. The tanks have been flushed and await final cleaning and disposition.

The 340-A Building does not have an air supply or exhaust system. A process radiation detector is located inside the west door.

2.4.3 340-B Building

The walls and roof of the 340-B Building are corrugated steel. The east side of the building serves as the railcar load-out station. The railcar sits over a drain system, which returns spills to the 340 vault tanks. The east side of the building is separated from the west side by a 30 cm (1 foot) thick concrete wall.

Water flushing equipment is provided to clean the exterior of the railroad cars; however, the equipment is rarely used.

The east side of the 340-B Building is serviced by a ventilation system consisting of a HEPA filter, vent fan, and stack located in the west side of the building. The ventilation equipment is operated only when a railroad car is in the loading station.

The 340-B Building has an automatic fire suppression system, that alarms locally and at the central dispatch. A process radiation detector is located inside the railroad car loading station. It has both local and remote alarms at the 340 Building Control Room and the 384 Powerhouse Building. Continuous air samplers are located in the west room and in the railroad car loading station. The samplers are operated, when deemed necessary.

3.0 IDENTIFICATION AND SCREENING OF HAZARDS

The hazardous materials at the 340 Facility, are liquid and solid radioactive wastes. The buildings that used the RLWS were research facilities with many and varied programs. The programs change over time as one is finished and another started and therefore, the waste also changes. It is possible that during one time period, a single isotope would account for most of the activity in the waste, while at other times, a variety of isotopes could be present. Bounding concentrations have been determined (WHC, 1995) for the liquid waste, based on a review of shipping records from 1989 to 1993. Until additional analysis confirms the potential for inventory changes from deactivation, the maximum assumed concentration for each isotope is shown in Table 3.1. It is very unlikely that all isotopes would be at their maximum concentration at the same time. Table 3.1 compares the total potential inventory with screening quantities specified in 10 CFR 30.72. The upper bound inventory was based on the combined capacity of the two vault tanks. During deactivation activities, the two tanks would not be full at the same time and the volume in each tank would be limited to less than the tanks capacity.

Several isotopes exceed the screening quantity, therefore emergency planning is required for the facility based on historical records.

Table 3.1 340 Vault Tank Bounding Inventory

Isotope	Ci/L	Total Ci	Screening value (Ci)
Mn-54	7.66E-07	0.086979	1000
Co-60	0.000002	0.210068	5000
Sr-90	0.00107	121.4985	90
Zr-95	0.000002	0.255488	5000
Nb-95	0.000004	0.455336	1000
Tc-99	4.73E-08	0.005371	10000
Ru-106	0.00005	5.63208	200
Sb-125	0.00004	4.49658	1000
Cs-134	0.000069	7.800885	2000
Cs-137	0.0237	2691.135	3000
Ce-144	0.000315	35.76825	300
Eu-152	0.00449	509.8395	500
Eu-154	0.0079	897.045	400
Eu-155	0.0019	215.745	3000
Ta-182	0.000011	1.29447	1000
U-234	1.50E-07	0.017033	2
U-235	1.88E-09	0.000213	2
U-236	1.23E-08	0.001397	2
U-238	5.98E-08	0.00679	2
Pu-238	0.000272	30.8856	2
Pu-239/240	0.000058	6.597255	2
Pu-240	0.000079	8.913675	2
Pu-241	0.00748	849.354	2
Pu-242	2.35E-07	0.026684	2
Am-241	0.000626	71.0823	2
Cm-243/244	0.000002	0.189629	3

The majority of the liquid waste, over 93%, is water. The chemicals appearing most frequently in the waste are:

Nitric Acid
 Sodium Hydroxide
 Sodium Nitrate
 Ultimagold (solvent Di-isopropylnathalene)
 Optifluor (solvent alkylbenzene)
 Sodium Phosphate
 Potassium Persulfate
 Sodium Carbonate
 Potassium Nitrate
 Potassium Hydroxide
 Hydrochloric Acid
 Sulfuric Acid
 Ammonium Hydroxide
 Oxalic Acid
 Dimethylsulfoxide

Because of the low concentration, these chemicals do not pose a significant hazard to on-site or off-site personnel (WHC, 1995).

Solid waste from facility operations is temporarily stored in the 340-B Building. Shipping records during the years 1989 through 1993 (WHC, 1995) show that the maximum 208 L (55 gallon) drum contained 3.08E-03 Ci and the maximum plywood box contained 7.2E-04 Ci. However, a total facility limit of 10 Ci beta/gamma and 1.5 Ci alpha has been established, to provide a margin for future operations.

4.0 HAZARDS CHARACTERIZATION

Table 3.1 lists the bounding concentration for each isotope based on historical records for the period 1989 to 1993. The facility has established an administrative limit on the activity in one vault tank of 39,300 Ci of beta/gamma activity and 66 Ci of alpha activity. This limit is based on the accident analysis for a spray release during transfer to the railcar. The beta gamma activity is assumed to be ^{154}Eu and the alpha activity is assumed to be ^{239}Pu . The corresponding concentrations are 0.69 Ci/L beta/gamma (^{154}Eu) and 1.16E-03 Ci/L alpha (^{239}Pu).

The facility limit for solid waste is 10 curies of beta/gamma and 1.5 curies of alpha activity. The consequence calculations in the Interim Safety Basis (WHC, 1995) assumed that the beta/gamma activity is ^{154}Eu and the alpha activity is ^{239}Pu . These isotopes have high inhalation dose conversion factors (rem per curie inhaled).

4.1 Conditions of Storage and Use

Handling of liquid wastes at the facility are limited to pumping liquid waste between tanks, sampling, and pumping the waste to a container for transfer to the 200 East Area.

Radioactive and mixed solid wastes are generated in the 340 Facility during the routine operations, maintenance, and decontamination activities. In accordance with facility procedures, wastes are generated and packaged by 340 Facility personnel. Waste generated at the facility is typically low-dose rate waste, and classified as low-level waste.

5.0 CONSEQUENCE MODELS AND CLASSIFICATION DESCRIPTIONS

5.1 Assessment Model

Radiological consequences are estimated using the Hanford Unified Dose Utility (HUDU) computer code (Scherpelz, 1991). This code is the primary emergency response tool for evaluating radiological releases on the Hanford Site and in the Unified Dose Assessment Center (UDAC).

HUDU 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. Release of radionuclides into the environment are either elevated (effective release height is >2.5 times the building height) or ground level. By convention, release heights less than 10 meters, default to ground level releases. In these analyses, plume rise is not considered, producing conservative dose estimates.

5.2 Receptor Locations

Facility Boundary Receptor:

For the purpose of calculations, the nearest receptors outside of the facility are considered to be 100 meters (328 feet), down wind.

Site Boundary Receptor

The nearest receptors outside of the site boundary (the bank of the Columbia River) are 345 meters (1,130 feet) from the 340 Facility.

5.3 Emergency Classification Criteria

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. Emergency classification is based, in part, on projected total effective dose equivalent (TEDE), hazardous material concentrations at the facility, and Hanford site boundaries for pre analyzed accident scenarios. The emergency classification criteria are shown below.

Table 5.1 Radiological Release Criteria

<u>Emerg. Class</u>	<u>Criteria</u>
Alert	<ul style="list-style-type: none"> > 0.001 Sv (100 mrem) TEDE at facility boundary > 0.005 Sv (500 mrem) thyroid dose at facility boundary > 0.05 Sv (5 rem) skin dose at facility boundary
Site Area	<ul style="list-style-type: none"> > 0.01 Sv (1 rem) TEDE at facility boundary > 0.05 Sv (5 rem) thyroid dose at facility boundary > 0.5 Sv (50 rem) skin dose at facility boundary
General	<ul style="list-style-type: none"> > 0.01 Sv (1 rem) committed dose equivalent at site boundary > 0.05 Sv (5 rem) thyroid (infant) dose at site boundary > 0.5 Sv (50 rem) skin dose at site boundary

Table 5.2 Non-Radiological Release Criteria

<u>Emerg. Class</u>	<u>Criteria*</u>
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 Emergency Response Planning Guideline (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 dose commitment and airborne release concentration values specified in the tables above.

ALERT

An ALERT 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 Emergency Action Levels. 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 emergency classification criteria.

6.0 EVENT SCENARIOS, CONSEQUENCES AND CLASSIFICATIONS

Several accident scenarios are described below, to establish the emergency planning basis for the 340 Facility. The spray release and solid waste fire scenarios are from the Interim Safety Basis document (WHC, 1995). The others were included to assure that a broad spectrum of events is considered.

6.1 Spray Release from 340 Vault Tanks

A spray release from the 340 Vault Tanks is the most likely significant accident. Because the vault tanks are not under pressure and are underground, a spray release from the piping can occur only while the transfer pumps are operating. One tank must be valved to receive waste and automatic transfers from one tank to another do not occur while transferring waste. Therefore, when one tank has been emptied, it is necessary to shut down the transfer pump and switch the valving to the other tank, making the maximum duration of a spray leak the time it takes to pump out one full tank.

Each of the vault tanks have a 57 kL (15,000 gal) maximum capacity, and the pump has a capacity of 380 L/min (100 gal/min) with a head of 16 m (53 ft). The maximum time a spray release can occur is 150 min (15,000 gal) 100 gal/min = 150 minutes). This time will be used, for the spill ignoring the periodic leak inspections.

The pump head of 16 m (23 psi) and friction losses for the pipeline crack were used to calculate (WHC, 1994) a total liquid release of 1.07 m^3 (280 gal), with a respirable liquid release of $5.11 \times 10^{-4} \text{ m}^3$. The respirable release amount was multiplied, by the 0.69 Ci/L beta/gamma (^{154}Eu) and 1.16E-03 Ci/L alpha (^{239}Pu) bounding concentrations to give the source term shown below:

Table 6.1 Spray Release Source Term

¹⁵⁴ Eu	3.53E-01 Ci
²³⁹ Pu	5.93E-04 Ci

The facility boundary and site boundary dose estimates are 0.028 Sv (2.8 rem) CEDE and 3.4 mSv (0.34 rem) CEDE, respectively. These values were calculated, with the HUDU program using "F" atmospheric stability, a 1 m/s wind speed, a mixing height of 60 m and a ground level release. This event would be a SITE AREA Emergency.

6.2 Solid Waste Fire

The west side of the 340-B Building is a 90-day solid mixed waste accumulation area separated from the loadout facility by a 30 cm concrete shield wall. Waste from the 340 Facility, is collected and packaged where it occurs, then moved to 340-B West Building for shipment. Examples of the solid waste stored on the 340 Building 90-day hazardous waste accumulation area and the 340-B West Building 90-day solid mixed waste accumulation area, are cleaning materials, personal protective equipment and clothing, worn out equipment, and tools that cannot be completely decontaminated.

Because the waste is solid and stored in boxes or drums, the worst-case accident would be a fire, as a result of the combustible contents. Possible facility boundary and site boundary releases were estimated, using an airborne-release fraction (ARF) of 5×10^{-4} from *Increment of Analysis: An Estimate Of Airborne Release Of Plutonium From Babcock and Wilcox Plant As A Result Of Severe Wind* (Mishima et al. 1978). The administrative limits of 10 Ci of beta/gamma and 1.5 Ci of alpha activity in the waste were used to derive the following source term:

Table 6.2 Waste Fire Source Term

¹⁵⁴ Eu	5.00E-03 Ci
²³⁹ Pu	7.50E-04 Ci

The estimated total dose at the facility boundary is 0.023 Sv (2.3 rem) CEDE and the estimated total dose at the site boundary is 2.8 mSv (0.28 rem) CEDE. These values were calculated, with the HUDU program using "F" atmospheric stability, a 1 m/s wind speed, a mixing height of 60 m, and a ground level release. This event would be a SITE AREA Emergency.

6.3 Malevolent Event

This scenario demonstrates the potential consequences of a malevolent event at the 340 Facility. The scenario postulates a bomb placed inside a solid waste container in the 340-B Building. One tenth of the allowed solid waste inventory is assumed, to be in the container. The bomb explodes with sufficient force to aerosolize all of the activity. However, 90% of the activity is assumed to be retained, within the building. The remaining 10% escapes through a hole created by the explosion or other openings. The source term is:

Table 6.3 Malevolent Event Source Term

0.1 Ci of Eu¹⁵⁴
1.5E-02 Ci of Pu²³⁹

For typical worst-case emergency preparedness conditions ("F" class stability, 1 m/s wind speed, a 60 m mixing layer depth), the dose is 0.47 Sv (47 rem) at 100 m and 0.056 Sv (5.6 rem) at the site boundary (345 meters). This event would be a GENERAL Emergency.

6.4 Stack Release

The 340 Vault and Vault Tanks are serviced by a common exhaust system discharging through a stage of dust stop filters, two stages of HEPA filters, a charcoal absorber stage, and two exhaust fans. The exhaust exits a 20-foot tall stack. The stack is too short to be considered, an elevated release in calculations.

The liquid in the vault tanks is mostly water which, has a slow evaporation rate at ambient temperatures. A recent radiation measurement for the HEPA filter housing of 80 mrem/hr after more than 3 years of continuous operation, indicates that the release rate from the liquid is small. A simultaneous filter failure and above normal liquid activity and evaporation rate would be required to give a significant release. The paragraphs below estimate the sample filter and monitor readings that correspond to an ALERT reading.

The dose from inhalation is the product of the breathing rate, release amount, dilution factor, inhalation dose factor and exposure time.

$$H = B'Q\left\{\frac{X}{Q'}\right\}CT$$

H is the inhalation dose (rem)

B is the breathing rate ($3.33 \times 10^{-4} \text{ m}^3/\text{s}$) for light activity

Q' is the release rate (Ci/s)

χ/Q' is the dilution factor ($3.01 \times 10^{-2} \text{ s/m}^3$) from HUDU

C is the inhalation dose conversion factor (rem/Ci)

T is the exposure time (seconds)

The dose conversion factors were obtained, from the HUDU program library.

ISOTOPE	Sv/Bq	Rem/Ci
Sr-90	5.5E-08	
Y-90	2.4E-09	
Total	5.7E-08	2.12E05
Pu-239	8.2E-05	3.03E08

The total release to yield a 1.0 mSv (100 mrem or 0.1 rem) dose, is calculated as follows for Sr/Y-90, which is taken to be representative of beta/gamma isotopes and Pu-239, which is representative of an isotope that decays by alpha emission.

Sr-Y-90

$$Q(Ci) = Q'T = \frac{0.1rem}{(3.33E-04 m^3/s)(3.01E-02S/m^3)(2.12E05)} = 4.71 \times 10$$

Pu-239

$$Q(Ci) = Q'T = \frac{0.1rem}{(3.33E-04 m^3/s)(3.01E-02S/m^3)(3.03E08)} = 3.29 \times 10$$

The activity captured on the sample filter is related to the activity released from the stack, using the ratio of the sample to stack flow rate.

$$Sample\ filter\ Activity = \left(\frac{Sample\ Flow\ Rate}{Release\ Flow\ Rate} \right) (Released\ activity)$$

The count rate when the sample filter is monitored by portable instruments, is calculated using an instrument efficiency factor of 10% for Sr/Y-90 and 20% for Pu-239. The results are summarized, in Table 6.4.

Table 6.4 Sample Filter Count Rate for an Alert Emergency

Isotope	Release (Ci)	Filter Activity (Ci)	Efficiency	Instrument Reading(cpm)
Sr/Y-90	4.71×10^{-2}	7.68×10^{-3}	0.1	1.7×10^7
PU-239	3.29×10^{-5}	5.37×10^{-8}	0.2	23,800

There is a remote stack monitor in the control room, that indicates stack concentration (beta/gamma) in the units of micro curies per cubic centimeter. The stack monitoring system uses the change in count rate over a thirty minute time period and the measured flow to obtain the concentration. The monitor reading that corresponds to an ALERT Emergency is calculated as follows:

Stack Flow rate 1900 cfm

Total Flow in 30 minutes = (1900 cfm)(28.32 L/ft³)(1000 cc/L) = 1.61×10^9 cc

Beta/gamma Monitor (Sr/Y-90 Assumed in Calculation)

$$\frac{(4.71 \times 10^{-2})(10^6 \mu Ci/Ci)}{1.61 \times 10^9} = 2.93 \times 10^{-5} \mu Ci/$$

The alpha monitor does not indicate in the control room. However, it does have a high level alarm which is far below the level that would suggest an ALERT Emergency.

7.0 EMERGENCY ACTION LEVEL DEVELOPMENT

The facility accidents, trigger events, and recommended emergency classifications are provided in the following sections.

7.1 Operational Upsets

The only operational upset that has the potential to reach an emergency condition is a spray release or very large spill while transferring waste. This event has the potential to reach a SITE AREA Emergency if the leak continues for approximately thirty minutes. Closing a valve to isolate the leak or securing the transfer pump will quickly stop the release. Activation of the emergency centers would only be warranted, if the leak cannot be stopped quickly or a significant volume of liquid (hundreds of gallons) has escaped.

7.2 Fire/Range Fire

Section 6.2 demonstrates that, with conservative assumptions, a solid waste fire has the potential to reach a SITE AREA Emergency. An ALERT Emergency should be declared if a large fire occurs at or near the 340 Facility. This declaration would be based, on the general criteria for an Alert (degradation of the level of safety). A large fire is one that lasts longer than 15 minutes and requires fire department assistance. The emergency level should be upgraded, to a SITE AREA Emergency if the fire involves or threatens radioactive waste.

7.3 Stack Release

The stack monitor alarms and above normal indication on the installed instrumentation warn of an abnormal stack release. The release could be confirmed if necessary by removing the record sample filter and monitoring with portable instruments. Section 6.5 provides estimates of the values that correspond to an Alert level release. These values are many times higher than the normal readings and, in some case, are above the full scale indication on the instrument. Rather than wait for the readings to reach such high levels, an ALERT Emergency should be declared if a stack alarm is judged to be valid after appropriate investigation. A valid alarm would indicate a very unusual condition since routine emissions are very low.

7.4 Earthquakes

A seismic event has not been analyzed for the 340 Facility. As a precaution, an ALERT Emergency should be declared, if a seismic event is felt by personnel and there is some damage, such as breakage of windows.

If a seismic event is felt by personnel, with evidence of falling debris at the 300 Area, it will be classed as a SITE AREA Emergency, because damage may have occurred which involves actual or likely major failures of facility functions needed for protection of workers and the public.

A seismic event causing severe building damage (walls fall, underground pipes broken, ground cracked) at the 300 Area, is classified as a GENERAL Emergency, since damage may have occurred that involves actual or imminent catastrophic failure of facility safety systems with a potential for loss of confinement or containment integrity.

7.5 Ashfall/Snowfall

An automatic emergency classification is unnecessary since a release is not expected if a 340 Facility roof fails due to ash or snow accumulation. The generic classification criteria should be consulted, for substantial facility damage from any cause.

7.6 Explosive Device

The presence of a confirmed (concurrence of security personnel) explosive device is classified as a SITE AREA Emergency. The presence of an explosive device indicates a serious threat to facility security and an extreme hazard to the safety of personnel and the facility. The proximity of the 340 Facility to occupied buildings and the site boundary indicate a need for prompt action if an explosive device is located. A GENERAL Emergency is appropriate (see Section 6.3), if a malevolent explosion involves radioactive material at the 340 Facility.

7.7 Sabotage

Sabotage is another potentially serious threat to the safety of personnel and the facility. As used here, sabotage refers to the intentional disruption/destruction of a system or component to cause a release of hazardous material. Confirmed physical damage is classified, as an ALERT Emergency since the level of safety has been degraded. There could be additional damage that has not been discovered. Any release that occurs due to sabotage is classified, based on the known or potential severity of the release.

7.8 Hostage Situation/Armed Intruder

A confirmed hostage situation or armed intruder within the 340 Facility is considered a serious threat to facility personnel and a situation which could degrade the safety of the facility. An ALERT Emergency shall be declared for these events.

7.9 Aircraft Crash

An ALERT Emergency shall be declared as a minimum, if an aircraft crash has occurred at or near the 340 Facility.

7.9 Aircraft Crash

An ALERT Emergency shall be declared as a minimum, if an aircraft crash has occurred at or near the 340 Facility.

7.10 High Winds/Tornado

Sustained winds greater than 90 mph exceed the design criteria for buildings in the 300 Area. An ALERT emergency shall be declared, for these wind speeds. A tornado that touches ground in the 300 Area warrants declaration of a SITE AREA Emergency because of the potential for extensive damage to a hazardous Facility.

8.0 EMERGENCY PLANNING ZONE DETERMINATION

An Emergency Planning Zone (EPZ) with a three-mile radius has been established for all the radiological facilities in the 300 Area. By DOE guidance, extreme malevolent events are excluded, from the evaluation. The worst event is the spray release while transferring waste.. The one rem TEDE Protective Action Guide is exceeded out to a distance of 0.1 miles. The 300 Area three-mile EPZ is conservative for this facility.

9.0 HAZARDS ASSESSMENT MAINTENANCE REQUIREMENTS

The Director of Emergency Preparedness, is responsible for ensuring that this Hazards Assessment is reviewed once a year and revised if necessary.

10.0 REFERENCES

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