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Fluor Hanford Safety Management Programs

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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P.O. Box 1000
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Contractor for the U.S. Department of Energy
Richland Operations Office under Contract DE-AC06-96RL13200

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Fluor Hanford Safety Management Programs

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March 2004

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EXECUTIVE SUMMARY

This document summarizes safety management programs used within the scope of the *Project Hanford Management Contract*.[1] The document has been developed to meet the format and content requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*.[2]

This document provides summary descriptions of Fluor Hanford safety management programs, which Fluor Hanford nuclear facilities may reference and incorporate into their safety basis when producing facility- or activity-specific documented safety analyses (DSA). Facility- or activity-specific DSAs will identify any variances to the safety management programs described in this document and any specific attributes of these safety management programs that are important for controlling potentially hazardous conditions. In addition, facility- or activity-specific DSAs may identify unique additions to the safety management programs that are needed to control potentially hazardous conditions.

This document was prepared using the 17-chapter format of DOE-STD-3009-94. Chapters 2.0 through 5.0 of this format require information that is uniquely facility and activity dependent. Accordingly, this document does not provide information for these chapters. To ensure comparability and ease of use, this document uses the chapter designations provided by DOE-STD-3009-94.

The information presented in this document will be updated as necessary in annual reviews. Facility- or activity-specific DSAs may be reviewed or updated at different times than this document. Changes affecting this document will be reviewed using the unreviewed safety question process.

This document may identify features of a program or a facility. These features are not considered commitments required to ensure compliance to requirements or control of hazardous conditions evaluated in the DSA within individual facilities or activities. These additional safety

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[1]DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

[2]DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

management program elements, or other descriptive information, may be desirable as good management practices or defense-in-depth for workers, the public, and the environment, or may only describe existing or as-built conditions. Where facility- or activity-specific program requirements or credited design features are needed for the control of evaluated hazardous conditions, they will be identified in the facility- or activity-specific DSAs.

CONTENTS

FIGURES

TABLES

TERMS

ACGIH	American Conference of Governmental Industrial Hygienists
AJHA	Automated Job Hazard Analysis
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
BED	building emergency director
BEP	building emergency plan
CAS	criticality alarm system
CSB	Canister Storage Building
CERCLA	*Comprehensive Environmental Response, Compensation and Liability Act of 1980*
COO	chief operating officer
CPS	criticality prevention specification
CRD	Contractor Requirements Document
CSER	criticality safety evaluation report
CSR	criticality safety representative
CVDF	Cold Vacuum Drying Facility
D&D	decontamination and decommissioning
DAC	derived air concentration
DOE	U.S. Department of Energy
DSA	documented safety analysis
EAL	Emergency Action Level
EAS	Emergency Alert System
EDO	Emergency Duty Officer
EJTA	Employee Job Task Analysis
EOC	Emergency Operations Center
EPHA	emergency preparedness hazard assessment
EPZ	Emergency Planning Zone
ERO	Emergency Response Organization
ERP	emergency response procedure
FERO	Facility Emergency Response Organization
FGE	fissile gram equivalence
FH	Fluor Hanford
FHA	fire hazards analysis
FRP	facility response plan
HMS	Hanford Meteorological Station
IC	incident commander
ISMS	Integrated Environment, Safety, and Health Management System
M&TE	measuring and test equipment
MCM	minimum critical mass
MSDS	Material Safety Data Sheets
N&CS	Nuclear and Criticality Safety
NA	not applicable
NEPA	*National Environmental Policy Act of 1969*
NFPA	National Fire Protection Association

ONC	Occurrence Notification Center
OSHA	Occupational Safety and Health Administration
PFP	Plutonium Finishing Plant
PHMC	*Project Hanford Management Contract*
PHMS	Project Hanford Management System
QA	quality assurance
QAPP	quality assurance program plan
RCM	Radiological Control Manager
RCRA	*Resource Conservation and Recovery Act of 1976*
RL	U.S. Department of Energy, Richland Operations Office
RWP	radiological work permit
S&H	Safety and Health
TEDE	total effective dose equivalent
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSR	technical safety requirement
UDAC	Unified Dose Assessment Center
USQ	unreviewed safety question
VP	Vice President

1.0 SITE CHARACTERISTICS

1.1 INTRODUCTION

The objective of this section is to provide the summary of U.S. Department of Energy (DOE) Hanford Site characteristics specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. Fluor Hanford (FH) operates facilities throughout the Hanford Site, and, therefore, this section provides summary descriptions of the entire Hanford Site. The scope of FH operations and associated nuclear facilities is provided in the *Project Hanford Management Contract* (PHMC) (DE-AC06-96RL13200). Although the information in this section is general for the Hanford Site, it has been tailored to reflect information relevant to nuclear facilities within the scope of the PHMC. Individual facilities or activities will define specific features of the Site characteristics, including receptor distances important for evaluating consequences for the facility or activity.

The U.S. Army Corps of Engineers selected the Hanford Site in 1943 for the production of nuclear weapons material. Current activities on the Hanford Site focus on environmental restoration, waste management, and technology research. The Hanford Site uses access control points at the entrance roads for reasons of national security as well as health and safety considerations.

The characteristics of the Hanford Site have been researched continually and documented since the early 1940s. Information about local winds and diffusion estimates are based on measurements at the Hanford Meteorological Station (HMS). Data specific to the FH nuclear facilities include nearby industrial, transportation, and military facilities; subsurface hydrology; potential impacts of river flooding; and seismic hazards.

1.2 REQUIREMENTS

The Hanford Site historically has been designed and built using a range of different requirements since 1943. Current requirements for design, construction, and operation of Project Hanford Team nuclear facilities are specified in HNF-8663, *Standards/Requirements Identification Document*. Compliance with the agreed-upon set of safety and health (S&H) standards is required by the PHMC, Clause I 99.b.5.

1.3 SITE DESCRIPTION

This section describes the overall Hanford Site and area boundaries, and presents demographic information for the area based on 1990 and 2000 census data. Specific distances used in hazard classification and accident analyses for FH facilities vary depending on the location of the facility on the Hanford Site and are provided in the documented safety analysis (DSA) for each FH nuclear facility. Much of the current information is obtained from PNNL-6415, *Hanford Site National Environmental Policy Act (NEPA) Characterization*.

1.3.1 Geography

The Hanford Site is a 1517 km^2 (586 mi^2) tract of semiarid land located within the Pasco Basin of the Columbia Plateau in southeastern Washington State. Facilities and activities at the

Hanford Site are consolidated in dispersed operating areas that occupy approximately 6 percent of the total Site area. The Site is bounded on the north by the Saddle Mountains, on the east by the Columbia River, on the south by the Yakima River, and on the west by the Rattlesnake Hills. The Site extends into Benton, Franklin, Grant, and Adams Counties. State Highways 24, 240, and 243 pass through the Hanford Site. FH nuclear facilities are located in various locations of the Hanford Site. Figures 1-1 through 1-4 show the location of the Hanford Site within the state of Washington, a Hanford Site map, and more detailed maps of the 200 Area. Evaluation guidelines are applied at the Site boundary.

The Hanford Patrol controls access to the Hanford Site for the DOE, and only DOE-authorized people are allowed to enter. Although the public may travel on the Columbia River and State Route 240, both of which allow passage close to the FH facilities within the Site boundary, such travel may be placed under the control of the Benton County Sheriff's Office in cooperation with the Hanford Patrol; thus, these routes are not considered public.

Individual FH facilities may have exclusion fences to prevent unauthorized entrance into the area. Distances from the FH facilities to the Site boundaries vary due to the diverse location of facilities within the Site. The hazard and accident analysis for each facility will document the boundaries and distances used for establishing values for accidental releases of radioactive and other hazardous materials, in conjunction with HNF-8739, *Hanford Safety Analysis and Risk Assessment Handbook (SARAH)*.

1.3.2 Demography

This section summarizes data on the current regional and transient population. Within the Site boundary, only DOE-authorized workers, contractors, and visitors are permitted. There are no residents within the Hanford Site boundary. The population distribution in the area surrounding the Site is not uniform.

The distribution of the population within an 80 km (50-mi) radius of the HMS (according to 1990 census data) is shown in Figure 1-5. There are no major metropolitan areas within the immediate vicinity of the Hanford Site. Communities nearest the Site include Richland, Kennewick, Pasco, West Richland, Benton City, Prosser, Sunnyside, Grandview, and Mesa. Table 1-1 provides the 1990 census data for these communities. Information regarding the schools, hospitals, and other such institutions is provided in PNNL-6415 and is not provided here. Hanford High School and Washington State University and residential areas are located near the southern boundary of the site, and are of potential interest when evaluating potential accident scenarios for some facilities.

Comparison of the 1990 census data to the 2000 census data demonstrates the recent changes in local populations adjacent to the Hanford Site. According to Census 2000, population totals for Benton and Franklin counties were 142,475 and 49,347, respectively. Both Benton and Franklin counties grew at a faster pace than Washington as a whole in the 1990s. The population of Benton County grew 8.8 percent, up from 130,999 in 1990. The population of Franklin County grew 12.2 percent, up from 44,000 in 1990.

Within each county, Census 2000 figures indicate the distribution of the Tri-Cities population by city as follows: Richland – 38,708; Pasco – 32,066; and Kennewick – 54,693. The combined populations of Benton City, Prosser, and West Richland totaled 15,847 in 2000. The unincorporated population of Benton County was 33,227. In Franklin County, incorporated areas other than Pasco had a total population of 3,595. The unincorporated population of Franklin County was 13,886.

Census 2000 data indicate that a total population of approximately 511,500 people resided within an 80 km (50-mi) radius of the Hanford Site.

The key transient or seasonal populations considered in radiological dose and nonradiological hazard assessments can be divided into three groups: onsite personnel, agricultural workers, and recreational visitors.

Onsite personnel are industrial employees working in areas predominantly under DOE access control. They are employed by such organizations as the DOE, FH, and other DOE contractors, and Energy Northwest. The current employee population located within the Hanford Site boundaries is approximately 9,000 people.

The most recent estimates of agricultural worker and recreational populations were developed by Energy Northwest (*Nuclear Project Numbers 1 and 4, Emergency Preparedness Plan, Rev. 7*) and are shown in Figure 1-6. The data show the distribution of these transient populations with respect to the Energy Northwest 16 km (10-mi) Emergency Planning Zone (EPZ), centered among the Washington Nuclear Plant 1, 4 and Columbia Generating Station reactor sites. Although this zone does not extend to the 80 km (50-mi) radius around the Hanford Site, the data are the best currently available and are representative of the Hanford Site EPZ. Energy Northwest is required to describe this zone in accordance with U.S. Nuclear Regulatory Commission regulations.

Energy Northwest estimated that as many as 2,800 agricultural farm workers might be employed in the agricultural region just east of the Columbia River. The peak season for agricultural employment is in May and June, with the next highest employment during the fall harvest months of September and October. The agricultural workforce consists of permanent and temporary residents in the bi-county area. The data reflect work locations, not residences, in Franklin County. The Energy Northwest survey found that the number of agricultural workers living in its EPZ is very low. Most agricultural workers who work in locations within the Energy Northwest zone reside in Pasco, Washington.

Recreational enthusiasts (e.g., hunters, anglers, boaters, off-road sports enthusiasts) enjoy recreational activities throughout the Hanford Site vicinity. The primary fishing season is June through November; the main hunting season is October through January.

The heaviest recreational use of the Columbia River area is on weekends and holidays, usually in the early morning hours. On average, 50 anglers, and 10 hunters are reported east of the Columbia River during the weekdays. The numbers increase to about 100 anglers, and 50 hunters on weekends and holidays. Recreational visitors also use the Yakima River, with an estimated maximum of 50 people in this area at one time. Additionally, there could be as many as 1,500 people at the Horn Rapids Off-Road Vehicle Park attending competitive events in the 8 to 16 km (5- to 10-mi) south-southwest EPZ sector. During peak fishing, hunting, and sporting events, 2,550 people could be within the area.

About 400 people engaged in recreation are assumed to be within the 3 to 8 km (2- to 5-mi) northeast EPZ sector, which includes the Ringold Fish Hatchery and the Wahluke Wildlife Recreation Area. Of the 2,550 total people engaged in recreation, 1,000 are assumed to be in Franklin County and 1,550 in Benton County (primarily at the Horn Rapids Off-Road Vehicle

Park). Annually, on the last weekend in July, 30,000 to 40,000 visitors attend the Tri-Cities Water Follies at Columbia Park in Kennewick, Washington.

1.4 ENVIRONMENTAL DESCRIPTION

This section summarizes the meteorological, hydrological, and geological information pertaining to the FH facilities located on the Hanford Site.

1.4.1 Meteorology

Data for the Hanford Site are compiled at the HMS. The HMS is located on the Hanford Site's Central Plateau, just outside the northeast corner of the 200 West Area and about 4 km (3 mi) west of the 200 East Area. Meteorological measurements have been made at the HMS since late 1944. Before the establishment of the HMS, local meteorological observations were made at the Old Hanford Townsite (1912 through late 1943) and in Richland (1943-1944). A climatological summary for the Hanford Site is documented in PNNL-13469, *Hanford Site Climatological Data Summary 2000 with Historical Data.*

Data from the HMS capture the general climatic conditions for the region and describe the specific climate of the Central Plateau. The large size of the Hanford Site and its complex topography can give rise to substantial spatial variations in wind, precipitation, temperature, and other meteorological parameters. For example, this is seen in the marked differences in the annual distribution of wind directions and speeds measured at the HMS on the Central Plateau and at the 300 Area near the southeastern corner of the Hanford Site. To accurately characterize meteorological differences across the Hanford Site, the HMS operates a network of automated monitoring stations. These stations, which currently number 30, are located throughout the Site and in neighboring areas. A 124 m (408-ft) instrumented meteorological tower operates at the HMS. Sixty-one meter (200-ft) instrumented towers operate at each of the 100-N, 300, and 400 Area meteorology-monitoring sites. Most of the other network stations use short-instrumented towers with heights of about 9 m (30 ft). Data are collected and processed at each monitoring site, and key information is transmitted to the HMS every 15 minutes. This monitoring network has been in full operation since the early 1980s.

The Hanford Site is located in a semiarid region of southeastern Washington State. The region's climate is greatly influenced by the Pacific Ocean, the Cascade Mountain Range to the west, and other mountain ranges located to the north and east. The Pacific Ocean moderates temperatures throughout the Pacific Northwest and the Cascade Range generates a rain shadow that limits rain and snowfall in the eastern half of Washington State. The Cascade Range also serves as a source of cold air drainage, which has a considerable effect on the wind regime on the Hanford Site. Mountain ranges to the north and east of the region shield the area from the severe winter storms and frigid air masses that move southward across Canada.

Information concerning local winds and diffusion estimates are based on measurements at the HMS. Meteorological parameters measured in the area of the Hanford Site are documented in PNNL-11107, *Climatological Data Summary 1995 with Historical Data*, and in PNNL-13469. In December 1944, the HMS and its 124 m (408-ft) instrumented tower became operational. In 1982, the instruments on the tower were replaced with equipment that met applicable U.S. Nuclear Regulatory Commission requirements. Temperature, relative humidity, precipitation, atmospheric pressure, solar radiation, cloud cover, and visibility are measured or observed at regular intervals at the HMS.

Wind data at the HMS are collected at 2.1 m (7 ft) above the ground and at the 15.2-, 61.0-, and 121.9 m (50-, 200-, and 400-ft) levels on the 124 m (408-ft) tower. Each of the three 61 m (200-ft) towers has wind-measuring instrumentation at the 10, 25, and 60 m (33, 82, and 197 ft) levels. The short towers measure winds at 9.1 m (30 ft) above ground level.

Prevailing wind directions near the surface on the Central Plateau are from the northwest in all months of the year (Figure 1-7). Winds from the northwest occur most frequently during the winter and summer. Winds from the southwest also have a high frequency of occurrence on the Central Plateau. During the spring and fall, there is an increase in the frequency of winds from the southwest and a corresponding decrease in winds from the northwest.

In the southeastern portion of the Hanford Site (including the 300 and 400 Areas), the prevailing wind direction near the surface is from the southwest during most months; winds from the northwest are much less common (Figure 1-7). In the 100 Area and along the Columbia River, local winds strongly are influenced by the topography near the river. At the 100-K and 100-N facilities, the prevailing wind direction is from the west. At the 100-F Facility and near the Old Hanford Townsite, winds often have a northwesterly or southeasterly component.

Stations that are relatively close together can exhibit significant differences in wind patterns. For example, the stations at Rattlesnake Springs and the 200 West Area are separated by about 5 km (3 mi), yet the wind patterns at the two stations are very different (see Figure 1-7). Care should be taken when assessing the appropriateness of the wind data used in estimating environmental impacts. When possible, wind data from the closest representative station should be used for assessing local dispersion conditions.

Monthly and annual joint frequency distributions of wind direction versus wind speed for the HMS are reported in PNNL-13469. Monthly average wind speeds at 15.2 m (50 ft) above the ground are lower during the winter months, averaging 2.7 to 3.1 m/s (6 to 7 mi/h), and faster during the summer, averaging 3.6 to 4.0 m/s (8 to 9 mi/h). The fastest wind speeds at the HMS usually are associated with flow from the southwest. However, the summertime drainage winds from the northwest frequently exceed speeds of 13 m/s (30 mi/h). The maximum speed of the drainage winds (and their frequency of occurrence) tends to decrease as one moves toward the southeast across the Hanford Site.

Table 1-2 presents information on number of days, by month and annually, with wind gusts greater than or equal to 11 m/s (25 mi/h) and 16 m/s (35 mi/h) for the HMS. The table also includes record high and low values.

Surface features have less influence on winds aloft than winds near the surface. However, there still are substantial spatial variations in the wind distributions across the Hanford Site at 61 m (200 ft) above ground level (Figure 1-8). For elevated releases, the most representative data may come from the closest representative 61 m (200-ft) tower rather than from the nearest 9.1 m (30-ft) tower.

Monthly averages and extremes of temperature, dew point, and humidity are presented in PNNL-13469. Based on data collected from 1946 through 2000, the average monthly temperatures at the HMS range from a low of -0.7 °C (31 °F) in January to a high of 24.7 °C (76 °F) in July. The highest winter monthly average temperatures were 6.9 °C (44 °F) in February 1958 and February 1991, and the lowest average monthly temperature was -11.1 °C

(12 °F) in January 1950. The highest monthly average temperature was 27.9 °C (82 °F) in July 1985, and the lowest summer monthly average temperature was 17.2 °C (63 °F) in June 1953.

Daily maximum temperatures at the HMS vary from an average of 2 °C (35 °F) in late December and early January to 36 °C (96 °F) in late July. There are, on average, 52 days during the summer months with maximum temperatures greater than or equal to 32 °C (90 °F) and 12 days with maximums greater than or equal to 38 °C (100 °F). The greatest number of consecutive days with maximum daily temperatures of greater than or equal to 32 °C (90 °F) is 32 days. The 45 °C (113 °F) record maximum temperature occurred at the HMS on August 4, 1961.

From mid-November through early March, the average daily minimum temperature is below freezing; the daily minimum in late December and early January is -6 °C (21 °F). On average, a daily minimum temperature of less than or equal to -18 °C (~0 °F) occurs only 3 days per year; however, only about one winter in two experiences such low temperatures. The greatest number of consecutive days with minimum daily temperatures of less than or equal to -18 °C (~0 °F) is 11 days. The -31 °C (-23 °F) record minimum temperature occurred on February 1 and 3, 1950.

Average annual precipitation at the HMS is 17 cm (6.8 in.). In 1995, the wettest year on record, 31.3 cm (12.3 in.) of precipitation were measured; in 1976, the driest year, only 7.6 cm (3 in.) were measured. The wettest season on record was the winter of 1996-1997 with 14.1 cm (5.4 in.) of precipitation; the driest season was the summer of 1973 when only 0.1 cm (0.03 in.) of precipitation was measured. Most precipitation occurs during the late autumn and winter, with more than half of the annual amount occurring from November through February. Days with greater than 1.3 cm (0.50 in.) precipitation occur on average less than one time each year.

Average snowfall ranges from 0.25 cm (0.1 in.) in October to a maximum of 13.2 cm (5.2 in.) in December and decreases to 0.8 cm (0.3 in.) in March. The record monthly snowfall of 59.4 cm (23.4 in.) occurred in January 1950. The seasonal record snowfall of 142.5 cm (56.1 in.) occurred during the winter of 1992-1993. Snowfall accounts for about 38 percent of all precipitation from December through February.

Atmospheric dispersion (the transport and diffusion of gases and particles within the atmosphere) is a function of wind speed, duration and direction of wind, intensity of atmospheric turbulence, and mixing depth. Atmospheric turbulence is not directly measured at the Hanford Site; instead, the impact of turbulence on atmospheric dispersion is characterized using atmospheric stability. Atmospheric stability describes the thermal stratification or vertical temperature structure of the atmosphere. Generally, six or seven different classes of atmospheric stability are used to describe the atmosphere. These classes range from extremely unstable (when atmospheric turbulence is greatest) to extremely stable (when atmospheric mixing is at a minimum and wind speeds are low). When the atmosphere is unstable, pollutants rapidly can diffuse through a wide volume of the atmosphere. When the atmosphere is stable, pollutants will diffuse much more slowly in a vertical direction. Horizontal dispersion may be limited during stable conditions; however, plumes also may fan out horizontally during stable conditions, particularly when the wind speed is low. Most major pollutant incidents are associated with stable conditions when inversions can trap pollutants near the ground.

Favorable dispersion conditions are most common in the summer when neutral and unstable stratification exists, about 56 percent of the time (PNL-4622, *Climatological Summary for the Hanford Area*). Less favorable dispersion conditions are most common during the winter when moderately to extremely stable stratification exists, about 66 percent of the time (PNL-4622). Less favorable conditions also occur periodically for surface and low-level releases in all seasons from about sunset to about an hour after sunrise because of ground-based temperature inversions and shallow mixing layers. Occasionally, there are extended periods of poor dispersion conditions associated with stagnant air in stationary high-pressure systems. These instances tend to occur during the winter months (PNL-4622).

BNWL-1605, *Climatography of the Hanford Area*, estimated the probability of extended periods of poor dispersion conditions. The probability of an inversion once established persisting more than 12 hours varies from a low of about 10 percent in May and June to a high of about 64 percent in September and October. These probabilities decrease rapidly for durations of greater than 12 hours. Table 1-3 summarizes the probabilities associated with extended surface-based inversions.

Many simple dispersion models use the joint frequency distribution of atmospheric stability, wind speed, and wind direction to compute diffusion factors for chronic and acute releases. Tables 1-4 through 1-11 present joint frequency distributions of atmospheric stability, wind speed, and transport direction for the 100-N, 200 East, 300, and 400 Areas at two heights (10 m and 60 m [33 ft and 197 ft]). The values in the joint frequency distributions represent the percentage of the time that pollutants initially would be transported toward the direction listed (e.g., south, south-southwest, southwest). For each station, the joint frequency distributions were determined using local wind data measured at the 9.1 m (30 ft) aboveground level and atmospheric stability measurements at the HMS. For the 60 m (197 ft) joint frequency distributions, wind speed was estimated assuming a power law represented the wind speed profile. A more detailed description of the procedures used to develop the joint frequency distributions is found in PNL-3777, *Recommended Environmental Dose Calculation Methods and Hanford-Specific Parameters*, Appendix H.1.

The annual sector-average atmospheric dispersion coefficient ($\overline{\chi}/Q'$), where χ is the air concentration and Q is the emission rate, is calculated using the Generation II Model for Environmental Dose Calculations code (PNL-6584, *Hanford Environmental Dosimetry Upgrade Project: GENII – The Hanford Environmental Radiation Dosimetry Software System, Volume I – Conceptual Representation*).

1.4.2 Hydrology

The Hanford Site is situated within the Columbia River drainage basin. Two major rivers within the drainage basin, the Columbia and the Yakima, border the Hanford Site. Columbia River flow near the Hanford Site has been measured since 1917. These data show an average discharge of 3,400 m^3/s (120,067 ft^3/s). Data gathered from the mouth of the Yakima River show an average discharge of 99 m^3/s (3496 ft^3/s).

The flow of the Columbia River adjacent to the Hanford Site is regulated by operation of the Priest Rapids Dam. The maximum historical flood recorded on the unregulated Columbia River occurred in 1894, causing a peak discharge at what is now the Hanford Site estimated at 21,000 m^3/s (741,594 ft^3/s). Under regulated conditions, the peak discharge below the Priest Rapids Dam for the 100-year flood is calculated to be 12,500 m^3/s (441,425 ft^3/s).

Dam failures provide the most severe Columbia River flooding potential in terms of downstream damage. The worst-case hypothetical flood of the Columbia River results from an assumed

50 percent breach of the Grand Coulee Dam. Calculations indicate that such a breach would create a maximum flow of 230,000 m^3/s (8,122,220 ft^3/s) on the Hanford Site (RLO-76-4, *Evaluation of Impact of Potential Flooding Criteria on the Hanford Project*). The 230,000 m^3/s maximum flow corresponds to a flood elevation of 148 m (486 ft) above mean sea level.

The most severe flood of the Yakima River was recorded in 1933 and had a peak discharge of 1,900 m^3/s (67,097 ft^3/s). Floods of this size are expected about once every 170 years. The 100-year flood plain for the Yakima River indicates that floodwaters reach only the very southern portions of the Hanford Site and would not affect any existing FH facilities.

The subsurface hydrology system at the Hanford Site consists of unconfined and confined aquifers that flow down gradient to discharge areas along the Columbia River. The unconfined aquifer consists of saturated sands and gravels lying between the water table and the first impermeable bed below the water table. The confined aquifer consists of sedimentary interbred or underflow zones that occur between dense basalt flows.

The water table (representing the upper limit of the unconfined aquifer) in the vicinity of the FH facilities is at least 61 m (200 ft) below surface level. Lying between the surface and the water table is the unsaturated, or vadose, zone. PNL-6152, *Long-Term Performance Assessment of Grouted Phosphate/Sulfate Waste from N Reactor Operations*, contains the results of the modeling of moisture movement and containment transport within the unsaturated zone in support of the Grout Treatment Facility located in the 200 East Area of the Hanford Site. WHC-EP-0645, *Performance Assessment for the Disposal of Low-Level Waste in the 200 West Area Burial Grounds*, contains a model for moisture movement and contaminant flow for the 200 West Area burial grounds. These models indicate that the travel time for contaminants to the groundwater from a depth of about 15 m (49 ft), (i.e., the approximate depth of the bottom of the vaults) ranges from 784 to 1,166 years, assuming a recharge rate of 0.5 cm/yr (0.2 in/yr). Given the proximity of the 200 East and West Areas, these results are judged applicable to the FH facilities in those areas (note that more rapid transport of contaminants has been observed under special conditions such as a large underground tank leak, but this phenomenology is not applicable to the FH-managed facilities). Although transport times can be calculated, the potential for contaminants from the FH facilities to reach the groundwater is minimal because no routine liquid effluent releases (with the exception of sanitary sewage) occur. Liquid spills, should they occur, would be limited in volume, and cleanup would be required in accordance with state and federal regulations. Facilities that may be covered by this description that differ from the above description would need to evaluate the potential impact of the facility operations or accidents on the groundwater in the facility-specific DSA.

1.4.3 Geology

The Hanford Site lies within the Pasco Basin, which is part of the Columbia Basin subprovince of the Columbia Intermontane Province. The Columbia Intermontane Province is bordered on the north and east by the Rocky Mountains, on the west by the Cascade Range, and on the south by the Basin and Range Province (Figure 1-9). The dominant geological characteristics of the Columbia Intermontane Province result from flood, basalt volcanism, and deformation processes. The Pasco Basin comprises thick layers of basalt interspersed with layers of sedimentary material. Principal geologic units beneath the Hanford Site include, in ascending order, the Columbia River Basalt Group, the Ringold Formation, and the deposits informally referred to as the Hanford formation. Major topographic relief forms include several east-to-southeast trending ridges, which are the surface manifestations of anticlinal folding of the underlying basalt.

The Columbia River Basalt Group is composed of numerous basaltic lava flows. The rate of eruption of these lava flows slowed with time, allowing sediment to be deposited before the next basalt flow covered the landscape. These sediments now form water-bearing interbeds between many of the most recent basalt flows. Deposition of these sediments continued after eruption of the basalt flows ceased, creating the Ringold Formation. This formation generally consists of an alternating sequence of sand and gravel main-channel river deposits and muddy overbank and lake deposits. In places, these layers are unconsolidated, while in others they are weakly to moderately cemented. The Ringold Formation was deposited some 3.9 to 8.5 million years ago. Deposition of the Ringold Formation was followed by a period of nondeposition and erosion, which removed varying amounts of the sediment throughout the Pasco Basin. At the same time, the Plio-Pleistocene unit caliche and gravel, and the wind-blown sand and silt of the early "Palouse" soil, were deposited in the western portion of the basin.

The sediments of the overlying Hanford formation were deposited by floods approximately 12,700 to 15,300 years ago on top of the Ringold Formation, the Plio-Pleistocene unit, or the early "Palouse" soil. In areas near the basalt folds, the Ringold Formation has been eroded away, and the Hanford formation lies directly on the basalt. These sediments can be divided into the coarser sands, gravel, and boulders referred to as the Pasco gravel, and the fine-grained sand and silt referred to as the Touchet Beds.

Low-angle reverse faults generally occur at the base of the anticlinal folds discussed previously. A few faults, such as the Cold Creek and May Junction faults, also cut across the folds.

Most of the current seismicity around the Hanford Site seems to be concentrated between the Saddle Mountains and Frenchman Hills, and between the Saddle Mountains and Gable Mountain-Gable Butte areas. The Hanford Site is within a Zone 2 seismic designation area. This implies that there is a credible probability for moderate earthquake damage. Generally, the sands and gravels beneath the Hanford Site attenuate the energy of an earthquake. This offers significant protection against severe damage.

Loess and sand dunes cover the surface of the Pasco Basin. These wind-blown sediments vary in thickness, with some sand dunes reaching 15 m (50 ft). The Pasco Basin is a semiarid steppe with a sparse covering of vegetation, mostly consisting of sagebrush and cheat grass, intermingled to a lesser degree with spiny hop sage and rabbit brush.

1.5 NATURAL PHENOMENA THREATS

This section identifies the natural phenomena with potential for adverse impacts on the safe operation of FH facilities. For each natural phenomenon, information is presented on frequency of occurrence, magnitude, and the design considerations that reduce impacts. The natural phenomena presented in this section are severe weather, floods, earthquakes, snow, rain, volcanic activity, and range fires.

Severe weather includes dust storms, high winds, thunderstorms, lightning strikes, and tornadoes. The most frequent severe weather phenomenon at the Hanford Site and the one with the greatest impact on normal operations is the dust storm. Dust storms occur when winds greater than 29 km/h (18 mi/h) re-suspend dust from various sources into the air. The HMS reports that dust storms occur at the Hanford Site with an average frequency of eight times a year. During these times, visibility is reduced to 9.7 km (6 mi) or less. Restricted visibility, blowing dust, and the *potential to clog high-efficiency particulate air and other filters are the main hazards associated* with these storms.

Extreme winds and the associated wind pressures on the FH facilities and structures constitute the major severe weather hazard to safe operation of the FH facilities. The maximum-recorded peak wind gust (exclusive of Rattlesnake Mountain) at 15 m (49 ft) above ground level is 129 km/h (80 mi/h) at the HMS, which occurred in January 1972. Uniform design and evaluation guidelines based on these wind data have been developed for protection against extreme wind hazards at Hanford Site facilities and are used to determine the design criteria for structures, systems, and components (SSC). HNF-PRO-097, *Engineering Design and Evaluation (Natural Phenomena Hazard)*, establishes the wind load design requirements. Nonreactor safety SSCs are to be designed for wind loads using the following criteria:

- Fastest-mile speed of 90 mi/h at a height of 33 ft
- Importance Factor 1
- Exposure Class C
- Missile (horizontal) 2- x 4-in. timber plank, 15 lb, at 50 mi/h, maximum trajectory height of 50 ft.

The average year has 10 thunderstorm days. Thunderstorms are considered severe weather when accompanied by wind gusts greater than 90 km/h (56 mi/h) and/or hail with a diameter equal to or greater than 1.9 cm (0.75 in). Although very rare, severe weather thunderstorms have occurred at the Hanford Site. Other than the impact of rain, high wind speeds have the potential to adversely affect the FH facilities. The principal hazard associated with the thunderstorms is wild fire due to lightning strikes.

FH structure lightning-protection systems are designed and installed in accordance with recommendations and requirements of National Fire Protection Association (NFPA) 780, *Standard for the Installation of Lightning Protection Systems*. The module trim, structure, and siding of the conducting materials are continuous and are bonded to the facility ground grid. Lightning can affect the FH facilities by starting range fires during the summer months. Range fires are discussed later in this section.

Tornadoes are very rare in the vicinity of the Hanford Site. The DOE no longer requires design criteria to be established for tornadoes for nonreactor facilities on the Hanford Site.

Three scenarios for possible flooding on the Hanford Site are breach of the Grand Coulee Dam, blockage of the Columbia River, and intense precipitation.

The maximum postulated flood scenario results from a hypothetical 50 percent breach of Grand Coulee Dam on the Columbia River, upstream from the Hanford Site. This scenario is calculated to result in an inundation of the Hanford Site with floodwaters to an elevation of about 148 m (486 ft) above mean sea level in the vicinity of the B and C Reactors. The FH facilities are dispersed throughout the Hanford Site and each facility is evaluated for flood hazard in the facility-specific DSA.

The potential for massive landslides resulting in blockage along the Columbia River is judged to be bounded by the 50 percent breach of the Grand Coulee Dam case.

The location of most FH facilities near the top of the Central Plateau, in addition to the grading and drainage features that are provided, ensures that precipitation, even from a downpour as severe as 30 cm (12 in.) in 24 hours, would infiltrate the ground or drain off toward the Columbia River without significant flooding. Controls preclude adverse impacts from less severe local precipitation run-on and runoff. FH facilities are not sited in a wetlands or coastal high-hazard areas.

The Columbia Plateau experiences seismic activities that are relatively shallow in nature and of low to moderate intensities. A seismic network installed on the Hanford Site in 1969 shows that the majority of seismic events have magnitudes of less than 3.5 and occur at depths of less than 4 km (2.5 mi). These are considered to be shallow micro earthquakes and may consist of as many as 100 events lasting from a few days to several months.

The largest known earthquake in the region occurred in 1936 near Milton-Freewater, Oregon. WHC-MR-0023, *Evaluation of Seismic Hazard for Non-Reactor Facilities, Hanford Reservation, Hanford, Washington*, suggests that the epicenter was closer to Waitsburg, Washington, which is 136 km (84.5 mi) east of the FH facilities. The estimated surface-wave magnitude of this earthquake was 5.7 to 5.8. Other events occurred near Umatilla, Oregon, in 1893; near the Saddle Mountains in 1918; near Corfu, Washington, in 1973; and near College Place, Washington, in 1979. All of these events measured less than 4.5 in intensity.

A seismic event is the most significant natural phenomenon affecting safety, because it has the greatest potential for resulting in common-cause failures. For most facilities, the primary seismic hazard is earthquake ground motion. Because earthquake ground motion is unavoidable, ground motion is a potential hazard to the FH facilities. Other potentially adverse affects of earthquakes stem from fault displacement, liquefaction, seismically induced slope instability, and ground settlement; however, the geologic conditions favorable to these hazards are not present at FH facility locations.

Formal Hanford Site design standards provided in HNF-PRO-097 govern seismic design of FH facilities. The seismic hazard evaluation process in UCRL-15910, *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*, contributed to the development of policies and procedures for these standards and supplements the requirements. UCRL-15910 presents guidelines to control the level of conservatism introduced in the seismic design process appropriate for each DOE facility. The guidelines specify that probabilistic methods be applied to establish performance goals. The performance goals are expressed as the annual probability of exceedence of some level of facility damage from an earthquake.

The seismic hazard curves for nonreactor facilities on the Hanford Site are based on a probabilistic seismic hazard assessment completed for the 100-N, 200 East, 200 West, 300, and 400 Areas (WHC-MR-0023). The methodology and database used generally are the same as those used in the *Energy Northwest Final Safety Analysis Report, Columbia Generating Station, Amendment 18*. A revised earthquake recurrence rate was used, and the ground motions included contributions from magnitude 5.0 and greater earthquakes. Earthquakes of magnitude less than 5.0 contain a narrow, generally high-frequency band and are of short duration. Because of the short duration, these earthquakes are not damaging to engineered structures and are not included in the hazard assessment.

The data show seismic hazards for the various locations on the Hanford Site. For the high-hazard facility-use category, the design-basis earthquake is specified in the seismic guidelines as the maximum horizontal ground surface acceleration, with an annual probability of exceedence of 2×10^{-4} (return period of 5,000 years). This corresponds to a peak horizontal acceleration of 0.20 g. For the moderate and low-hazard facility-use categories, the seismic guidelines specify the design-basis earthquake loading as the maximum horizontal ground surface acceleration with an annual probability of exceedence of 1×10^{-3} (return period of 1,000 years). This corresponds to a peak horizontal acceleration of 0.12 g for the 200 West Area.

The seismic exposure assessment that determines the probability of exceeding specified earthquake ground acceleration at an FH facility area considers known potential earthquake generators within the proper zone of influence. The result of the assessment is a seismic hazard curve for the FH facilities that correlates the peak-free fixed-ground acceleration at the FH facilities with the annual probability of exceedence. The corresponding seismic design criteria then are applied to the facilities based on the safety classifications of SSCs.

The above information has been summarized from WHC-SD-W112-RPT-001, *Solid Waste Operations Complex Site Characteristics Description*, which provides a more complete assessment of geological seismology.

Aboveground structures and components of the FH area are designed to withstand snow loading. The following criteria are used:

- Ground snow load—73 kg/m^2 (15 lb/sq-ft)
- Minimum roof load—98 kg/m^2 (20 lb/sq-ft).

Because FH facilities are located in a semiarid region, the rain loading is bounded by the snow loading.

The Hanford Site is in a region subject to ashfall from volcanic eruptions. The three major volcanic peaks closest to the Site are Mt. Adams, about 100 mi away; Mt. Rainier, about 110 mi away; and Mt. St. Helens, about 130 mi away. Important historical ashfalls 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 8,000 years ago. The most recent ashfall resulted from the May 18, 1980, eruption of Mt. St. Helens. The volcanic ash loading design criterion of 117.2 kg/m^2 (24 lb/sq-ft) is applicable only to the design of safety-class SSCs in accordance with HNF-PRO-097.

When the vegetation becomes extremely dry in the summer, range or grass fires are possible events at the Hanford Site.

Engineering responsibilities include configuration management and maintaining the safety basis for the facility, including the unreviewed safety question (USQ) process.

The radiological control organization implements the requirements of HNF-5173, *PHMC Radiological Control Manual.* Project-specific documents provide the detailed requirements for work performed in the facility. Additional information is provided in Chapter 7.0.

Environmental Compliance has a support responsibility for operations to provide procedures, permits, analysis, and reporting to ensure compliance with environmental regulations and requirements. Facility management is directly responsible for compliance with the applicable environmental regulations and facility-specific permits.

Vegetation is removed from facility sites, and firebreaks are established along roadways as a precaution. Nevertheless, range fires can burn out of control if the fires are driven by strong winds.

The major factors that protect FH facilities from hazards associated with range fires are (1) grading, maintenance, and housekeeping on the Site to minimize combustible material; (2) fire breaks by the roadways in the vicinity of the facilities; and (3) facility locations close to the 200 Area Fire Station. (The fire station can respond to 200 East and 200 West Area calls within 10 minutes.) The Hanford Fire Department has fire-fighting equipment on hand to deal with range fires and has experience protecting Hanford Site facilities from fire damage. For these reasons, potential range fires are considered to be possible, but adverse impacts on FH facilities in excess of the bounding accident scenarios are not anticipated.

The most severe range fire documented on the Hanford Site occurred in 1984. The fire burned approximately two-thirds of the total land area and threatened some Hanford Site facilities; however, because of the efforts of the Hanford Fire Department, facilities were protected and there was no significant damage, project economic loss, or programmatic impact. Only three small mobile office trailers outside of the exclusion areas and adjacent to well-drilling equipment were destroyed by the fire. The biggest problem for operations personnel was smoke entering the occupied facilities through the building intake ventilation systems and setting off the building fire alarm systems.

The most recent large range fire occurred between June 27 and July 2, 2000, when a large wildfire swept through the Hanford Site. Designated the "24 Command Fire," it burned approximately 655 km^2 (250 mi^2). As a result, approximately 178.1 km^2 (68.8 mi^2) of shrub-steppe community and 196.3 km^2 (75.8 mi^2) of communities containing sparse shrub overstories were lost. The fire extended across the southwestern half of the Hanford Site, bordered the 200 Area, and followed major roads to the 300 Area. The fire crossed State Route 240, Army Loop Road, and the State Route 240 Access Road and burned east to Route 10 and northeast to Route 4. With the exception of minor structures in the vicinity of the Fitzner/Eberhardt Arid Lands Ecology Reserve, no facilities were burned onsite. In addition to the fire spreading across the Hanford Site, the fire burned south into Benton City. The fire destroyed 11 residences in Benton City, as well as other structures and outbuildings. The fire had no impact on the waste storage areas or underground tanks on the Hanford Site.

Hazards from other natural phenomena (e.g., surge and seiche flooding, tsunami flooding, and ice flooding) were considered not credible or were determined to have no potential for impact on the FH facilities.

1.6 EXTERNAL HUMAN-GENERATED THREATS

The regional highway network traversing the Hanford Site (State Highways 24 and 240) has restricted access roadways. Commercial trucks that deliver gas, diesel fuel, and chemicals use these highways and Hanford Site roads. Because of the distance from these roads to FH facilities, the impact of a highway accident involving toxic and hazardous chemicals would be less severe than the bounding chemical or toxic material accident occurring in the 200 Areas from events involving high-level radioactive waste storage tanks.

There are no private or commercial airports within 40 km (25 mi) of FH facilities. The nearest such facility is the Richland Airport, a small general-utility airport. Commercial air carriers use the Tri-Cities Airport in Pasco, Washington, located 54 km southeast of FH facilities. The probability of a commercial aircraft adversely impacting the FH facilities is remote, given the low traffic volume at the airport and distance of the airport from the facility.

1.7 NEARBY FACILITIES

No industrial refineries, oil storage facilities, or other major commercial facilities are located within 32 km (20 mi) of the FH facilities. A vehicle refueling station is located adjacent to the 200 East Area approximately 5 km (3 mi) from the 200 West Area. The nearest natural gas transmission pipeline is about 48 km (30 mi) away. The distance of these facilities from the FH facilities makes the hazard from explosions or fire at these installations almost nonexistent.

The Plutonium Finishing Plant (PFP) is a nonreactor nuclear facility that poses a significant potential hazard to other FH facilities from radioactive and toxicological material releases. The PFP is located approximately 800 m (2,625 ft) southeast of the Central Waste Complex and about 100 m (328 ft) east of the nearest low-level burial ground trenches. Previously, the mission of PFP was to produce weapons-grade plutonium metal. Currently, the mission is to place the remaining plutonium in a stabilized form (e.g., plutonium oxide) in preparation for the eventual decontamination and decommissioning (D&D) of the facility. Portions of other FH facilities (i.e., Central Waste Complex, portions of the low-level burial ground, and related office buildings) are within the EPZ of the PFP and are connected to the Patrol Operations Center, which would communicate emergencies to other potentially affected FH facilities through the Site emergency notification system. Data show that in a maximum credible accident these FH facilities could be exposed to as much as 15 rem effective dose equivalent. Other facilities in the 200 East and 200 West Areas with ongoing operations that have a potential for affecting FH operations include the high-level radioactive waste storage tanks, Environmental Restoration Disposal Facility, Liquid Effluent Treatment Facility, Liquid Effluent Retention Facility, and Waste Encapsulation Storage Facility.

Interactions between the FH facilities and future facilities will be addressed in the DSAs for those facilities. The emergency plans for the FH facilities consider events at facilities within the complex and their effects on one another.

Building emergency plans (BEP) provide emergency planning and response guidance for FH facilities. The Sitewide "crash-phone" system or the Hanford Site emergency alerting system notifies neighboring facilities of an FH event, and the occupants respond in accordance with the respective organization emergency plans. The emergency preparedness program is discussed in Chapter 15.0.

The only operating commercial nuclear power reactor in the Pacific Northwest is on the Hanford Site. The Energy Northwest Columbia Generating Station, a boiling water reactor with a design power level of 3,323 MW, is located north of the 300 Area, east of the 400 Area, and southeast of the 200 Areas. Analyses of hypothetical worst-case accidents at this reactor show no significant risk to FH operations.

The southeastern boundary of the U.S. Army Yakima Training Range, used for military maneuvers and weapons training, is located 13 km (8 mi) from the 200 West Area FH facilities. Live firing of weapons with explosive warheads is directed into an impact area within the center boundary; therefore, the U.S. Army states that no safety threat exists for people living adjacent to the Yakima Firing Center or for those living on the east bank of the Columbia River (DOA 1989, *Yakima Firing Center Proposed Land Acquisition*). Accordingly, the firing center is assumed to pose no threat to FH operations or personnel.

1.8 VALIDITY OF EXISTING ENVIRONMENTAL ANALYSES

No significant discrepancies have been identified between the Site characteristic assumptions made in this chapter and those made in the facility-specific environmental impact statements.

1.9 REFERENCES

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TABLES

Table 1-1. 1990 Census Data for Communities Nearest the Hanford Site.

Municipality	Population
Benton City	1,806
Burbank	1,745
Connell	2,005
Finley	4,897
George	253
Grandview	7,169
Granger	2,053
Highland	3,656
Irrigon	737
Kennewick	42,155
Mabton	1,482
Mattawa	941
Mesa	252
Moses Lake	11,235
Moxee City	814
Othello	4,638
Pasco	20,377
Prosser	4,476
Quincy	3,738
Richland	32,315
Royal City	1,104
Selah	5,113
Sunnyside	11,238
Terrace Heights	4,223
Toppenish	7,419
Umatilla	3,046
Union Gap	3,120
Wapato	3,795
Warden	1,639
West Pasco	7,312
West Richland	3,962
West Valley	6,594
Yakima	54,827
Zillah	1,911

Table 1-2. Number of Days with Peak Gusts Above Specific Thresholds at 15 Meter (50-Foot) Level, 1945 through 2000.

	Days with Peak Gusts ≥11 m/s (25 mi/h)					Days with Peak Gusts ≥16 m/s (35 mi/h)				
Month	**Avg**	**Max**	**Year**	**Min**	**Year**	**Avg**	**Max**	**Year**	**Min**	**Year**
January	7.6	21	1953	0	1985*	4.0	14	1953	0	1985*
February	8.7	17	1976*	2	1952*	3.8	14	1976	0	2000*
March	12.9	21	1977	4	1992	5.4	14	1997	0	1992
April	16.9	26	1954	8	1946	6.3	12	1972	1	1967
May	18.7	26	1978	9	1945	6.1	10	2000*	0	1957
June	19.6	26	1963	11	1950*	6.2	12	1973	1	1982
July	19.4	26	1995	11	1955	5.5	11	1994*	1	1982*
August	15.8	24	2000	7	1945	4.1	12	1996	0	1978*
September	11.2	17	1971	7	1975*	3.3	7	1992*	0	1975
October	8.8	17	1985*	3	1987*	3.1	11	1997	0	1993*
November	8.3	16	1990	0	1979	3.8	10	1998	0	1997*
December	7.5	15	1968	0	1985	4.2	11	1957	0	1985*
Annual	155.7	192	1999	123	1952	55.9	83	1999*	31	1978

*Most recent of multiple occurrences.

Table 1-3. Percent Probabilities for Extended Periods of Surface-Based Inversions.

Months	Inversion duration (h)		
	12	24	48
January-February	54.0	2.5	0.28
March-April	50.0	<0.1	<0.1
May-June	10.0	<0.1	<0.1
July-August	18.0	<0.1	<0.1
September-October	64.0	0.11	<0.1
November-December	50.0	1.2	0.13

NOTE: Based on data from BNWL-1605, 1972, *Climatography of the Hanford Area*, Pacific Northwest Laboratories, Richland, Washington.

Table 1-4. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 100 Area at 9 Meters Above Ground Level.
Based on 1983-1996 Data from the 100-N Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 100N Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.28	0.19	0.17	0.16	0.22	0.2	0.17	0.12	0.12	0.12	0.15	0.19	0.26	0.31	0.37	0.33
	B	0.11	0.08	0.1	0.08	0.11	0.14	0.11	0.07	0.06	0.06	0.08	0.1	0.12	0.13	0.17	0.14
	C	0.11	0.09	0.09	0.1	0.1	0.13	0.11	0.08	0.08	0.07	0.08	0.1	0.11	0.13	0.13	0.13
	D	0.51	0.42	0.45	0.54	0.82	1	0.82	0.65	0.59	0.55	0.6	0.66	0.75	0.73	0.69	0.59
	E	0.48	0.43	0.51	0.61	0.84	0.86	0.71	0.54	0.5	0.47	0.58	0.68	0.75	0.77	0.67	0.55
	F	0.45	0.4	0.54	0.61	0.77	0.66	0.51	0.34	0.31	0.33	0.48	0.69	0.79	0.83	0.7	0.57
	G	0.21	0.19	0.23	0.28	0.31	0.23	0.18	0.13	0.12	0.13	0.24	0.37	0.51	0.47	0.4	0.29
2.65	A	0.45	0.48	0.36	0.15	0.23	0.31	0.27	0.17	0.13	0.14	0.32	0.47	0.51	0.47	0.45	0.45
	B	0.14	0.16	0.11	0.06	0.11	0.13	0.13	0.09	0.05	0.04	0.12	0.18	0.2	0.14	0.15	0.12
	C	0.1	0.12	0.1	0.06	0.09	0.12	0.11	0.07	0.04	0.04	0.1	0.15	0.17	0.12	0.11	0.12
	D	0.4	0.46	0.4	0.38	0.53	0.7	0.75	0.41	0.3	0.33	0.56	1.01	0.98	0.76	0.52	0.42
	E	0.22	0.23	0.31	0.51	0.7	0.72	0.64	0.36	0.26	0.28	0.64	1.39	1.54	0.9	0.48	0.25
	F	0.13	0.14	0.2	0.51	0.71	0.49	0.3	0.16	0.11	0.15	0.34	0.8	0.92	0.56	0.31	0.15
	G	0.03	0.05	0.09	0.23	0.27	0.16	0.09	0.04	0.04	0.05	0.15	0.36	0.46	0.23	0.08	0.04
4.7	A	0.09	0.27	0.18	0.04	0.06	0.08	0.11	0.05	0.05	0.08	0.28	0.3	0.35	0.36	0.17	0.08
	B	0.02	0.07	0.06	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.07	0.08	0.11	0.1	0.04	0.03
	C	0.03	0.05	0.04	0.02	0.02	0.03	0.05	0.03	0.01	0.03	0.07	0.05	0.09	0.08	0.04	0.02
	D	0.14	0.21	0.16	0.07	0.07	0.14	0.3	0.15	0.09	0.17	0.34	0.53	0.83	0.64	0.22	0.14
	E	0.09	0.12	0.08	0.06	0.06	0.07	0.25	0.14	0.1	0.13	0.29	0.82	1.47	0.95	0.2	0.08
	F	0.06	0.07	0.04	0.05	0.04	0.04	0.08	0.04	0.02	0.02	0.07	0.27	0.24	0.14	0.05	0.04
	G	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0	0	0.02	0.06	0.03	0.02	0.01	0.01
7.15	A	0.04	0.1	0.08	0.01	0	0.01	0.03	0.02	0.01	0.04	0.21	0.15	0.23	0.36	0.18	0.03
	B	0.02	0.04	0.02	0	0	0	0.01	0.01	0.01	0.01	0.07	0.03	0.06	0.1	0.05	0
	C	0.01	0.02	0.02	0	0	0	0.01	0.01	0.01	0.01	0.05	0.03	0.05	0.07	0.03	0.01
	D	0.05	0.1	0.06	0.02	0.01	0.01	0.05	0.05	0.05	0.1	0.28	0.19	0.38	0.7	0.26	0.05
	E	0.04	0.09	0.05	0.02	0	0.01	0.02	0.02	0.02	0.06	0.13	0.15	0.47	0.67	0.15	0.03
	F	0.01	0.04	0.01	0	0	0	0	0	0	0	0.01	0.03	0.04	0.03	0.01	0.02
	G	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
9.8	A	0	0.02	0.03	0.01	0	0	0	0	0	0.01	0.07	0.05	0.07	0.17	0.11	0
	B	0	0.01	0.01	0	0	0	0	0	0	0.01	0.03	0.02	0.02	0.05	0.03	0
	C	0	0.01	0.01	0	0	0	0	0	0	0.01	0.02	0.01	0.01	0.05	0.03	0
	D	0.02	0.04	0.03	0.01	0	0	0	0.01	0.01	0.06	0.11	0.06	0.08	0.25	0.15	0.01
	E	0.02	0.02	0.03	0.01	0	0	0	0	0.01	0.03	0.05	0.02	0.04	0.15	0.07	0.01
	F	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.7	A	0	0	0	0	0	0	0	0	0	0	0.02	0.01	0.01	0.05	0.04	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0.02	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0.01	0	0
	D	0	0.02	0.01	0	0	0	0	0	0	0.03	0.03	0.02	0.02	0.06	0.02	0.01
	E	0	0.01	0.03	0	0	0	0	0	0	0.02	0.02	0	0	0.02	0.02	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-5. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 100 Area at 60 Meters Above Ground Level. Based on 1983-1996 Data from the 100-N Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 100N Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.23	0.22	0.17	0.16	0.2	0.21	0.18	0.14	0.11	0.1	0.12	0.12	0.17	0.22	0.24	0.26
	B	0.13	0.1	0.09	0.08	0.1	0.14	0.09	0.06	0.06	0.06	0.06	0.08	0.1	0.09	0.12	0.11
	C	0.11	0.1	0.07	0.07	0.11	0.11	0.11	0.07	0.06	0.06	0.07	0.08	0.1	0.1	0.09	0.11
	D	0.51	0.43	0.41	0.45	0.66	0.76	0.65	0.5	0.43	0.37	0.36	0.47	0.52	0.54	0.5	0.48
	E	0.4	0.36	0.43	0.52	0.67	0.62	0.56	0.42	0.33	0.29	0.33	0.36	0.48	0.43	0.37	0.34
	F	0.32	0.34	0.47	0.61	0.82	0.69	0.55	0.36	0.25	0.23	0.24	0.24	0.29	0.35	0.35	0.3
	G	0.17	0.16	0.24	0.35	0.49	0.38	0.21	0.15	0.12	0.1	0.1	0.11	0.15	0.18	0.2	0.17
2.65	A	0.44	0.5	0.3	0.13	0.19	0.29	0.25	0.19	0.12	0.11	0.21	0.37	0.39	0.28	0.27	0.29
	B	0.15	0.19	0.1	0.06	0.12	0.12	0.15	0.09	0.05	0.05	0.1	0.14	0.17	0.13	0.11	0.09
	C	0.11	0.15	0.11	0.05	0.11	0.13	0.11	0.08	0.05	0.05	0.08	0.13	0.15	0.12	0.09	0.09
	D	0.5	0.51	0.42	0.34	0.53	0.65	0.79	0.43	0.31	0.23	0.37	0.54	0.75	0.65	0.46	0.35
	E	0.29	0.33	0.3	0.42	0.68	0.73	0.63	0.38	0.25	0.19	0.26	0.43	0.76	0.9	0.59	0.29
	F	0.26	0.24	0.22	0.46	0.89	0.77	0.49	0.24	0.14	0.1	0.14	0.22	0.49	0.7	0.45	0.23
	G	0.11	0.09	0.13	0.23	0.43	0.35	0.18	0.07	0.05	0.04	0.06	0.06	0.16	0.28	0.23	0.14
4.7	A	0.12	0.29	0.18	0.05	0.06	0.1	0.11	0.06	0.05	0.06	0.19	0.22	0.31	0.24	0.13	0.08
	B	0.05	0.1	0.05	0.02	0.02	0.03	0.05	0.04	0.03	0.03	0.08	0.08	0.12	0.1	0.04	0.03
	C	0.03	0.08	0.05	0.03	0.02	0.04	0.05	0.03	0.01	0.02	0.06	0.06	0.1	0.07	0.03	0.04
	D	0.22	0.29	0.19	0.1	0.1	0.18	0.37	0.17	0.12	0.12	0.23	0.29	0.51	0.41	0.2	0.18
	E	0.18	0.2	0.17	0.14	0.17	0.21	0.4	0.2	0.15	0.15	0.24	0.37	1.04	1.03	0.32	0.17
	F	0.13	0.12	0.08	0.11	0.14	0.16	0.22	0.12	0.05	0.05	0.05	0.14	0.42	0.57	0.19	0.1
	G	0.03	0.04	0.03	0.03	0.05	0.06	0.06	0.02	0.02	0.02	0.02	0.04	0.08	0.14	0.09	0.04
7.15	A	0.06	0.17	0.09	0.03	0.02	0.03	0.05	0.03	0.02	0.04	0.2	0.17	0.26	0.31	0.1	0.03
	B'	0.03	0.05	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.05	0.05	0.06	0.08	0.04	0.02
	C	0.03	0.02	0.01	0.01	0	0.02	0.03	0.02	0.01	0.02	0.05	0.03	0.06	0.08	0.02	0.01
	D	0.12	0.15	0.09	0.05	0.05	0.05	0.14	0.11	0.08	0.12	0.23	0.2	0.5	0.7	0.24	0.07
	E	0.1	0.14	0.1	0.07	0.04	0.06	0.16	0.13	0.08	0.1	0.2	0.26	1.26	1.67	0.24	0.06
	F	0.08	0.1	0.05	0.05	0.04	0.04	0.09	0.05	0.03	0.02	0.03	0.07	0.31	0.28	0.06	0.03
	G	0.02	0.02	0	0.01	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.02	0.01
9.8	A	0.06	0.08	0.05	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.11	0.09	0.15	0.29	0.12	0.02
	B	0.03	0.02	0.01	0	0	0.01	0.01	0	0.01	0.01	0.05	0.02	0.04	0.08	0.05	0.01
	C	0.01	0.02	0.01	0	0.01	0.01	0	0	0.01	0.01	0.03	0.04	0.02	0.06	0.03	0.01
	D	0.09	0.1	0.07	0.03	0.03	0.03	0.06	0.05	0.04	0.07	0.16	0.14	0.31	0.68	0.25	0.03
	E	0.05	0.08	0.07	0.03	0.03	0.03	0.04	0.04	0.03	0.06	0.1	0.1	0.47	0.97	0.17	0.03
	F	0.04	0.05	0.03	0.02	0.03	0.02	0.02	0.01	0.01	0	0.01	0.01	0.09	0.08	0.02	0.01
	G	0	0	0	0	0.01	0.01	0	0	0	0	0	0	0.01	0.02	0	0
12.7	A	0.01	0.03	0.03	0	0	0	0	0	0	0.01	0.04	0.04	0.05	0.12	0.1	0
	B	0.01	0.01	0.01	0	0	0	0	0	0	0	0.02	0.01	0.02	0.04	0.02	0
	C	0.01	0.01	0.01	0	0	0	0	0	0	0.01	0.02	0.01	0.01	0.03	0.02	0
	D	0.04	0.06	0.04	0.02	0.01	0.01	0.02	0.02	0.01	0.06	0.1	0.07	0.11	0.32	0.14	0.02
	E	0.03	0.06	0.06	0.01	0.01	0.01	0.01	0.02	0.01	0.03	0.05	0.04	0.12	0.29	0.09	0.02
	F	0.01	0.02	0	0	0.01	0.01	0	0	0	0	0	0	0.02	0.02	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0.04	0.01	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0.01	0	0
	D	0.01	0.01	0.01	0	0	0	0	0	0	0.03	0.05	0.03	0.03	0.06	0.02	0
	E	0.01	0.02	0.02	0	0	0	0	0	0	0.02	0.02	0.01	0.01	0.05	0.03	0.01
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.03	0.01	0	0.01	0.01	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0.02	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-6. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 200 Areas at 9 Meters Above Ground Level.

Based on 1983-1996 Data from the Hanford Meteorological Station Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.28	0.31	0.34	0.25	0.23	0.22	0.18	0.13	0.11	0.1	0.08	0.07	0.1	0.1	0.16	0.21
	B	0.14	0.15	0.16	0.11	0.11	0.09	0.08	0.05	0.05	0.04	0.04	0.04	0.05	0.07	0.09	0.12
	C	0.15	0.15	0.14	0.1	0.09	0.09	0.09	0.06	0.04	0.04	0.05	0.05	0.06	0.07	0.1	0.13
	D	0.87	0.76	0.72	0.55	0.6	0.65	0.64	0.42	0.36	0.31	0.35	0.38	0.49	0.59	0.77	0.83
	E	0.4	0.29	0.27	0.26	0.3	0.35	0.46	0.41	0.36	0.35	0.44	0.49	0.55	0.66	0.65	0.57
	F	0.25	0.16	0.15	0.15	0.15	0.2	0.25	0.24	0.26	0.29	0.35	0.36	0.43	0.45	0.42	0.33
	G	0.1	0.09	0.1	0.07	0.08	0.08	0.1	0.1	0.1	0.1	0.14	0.11	0.14	0.15	0.17	0.15
2.65	A	0.64	0.45	0.35	0.32	0.35	0.37	0.34	0.23	0.17	0.2	0.27	0.2	0.17	0.26	0.6	0.7
	B	0.26	0.17	0.11	0.1	0.1	0.12	0.1	0.07	0.06	0.06	0.09	0.07	0.07	0.14	0.29	0.31
	C	0.22	0.13	0.1	0.08	0.08	0.09	0.1	0.05	0.05	0.05	0.06	0.06	0.06	0.1	0.25	0.28
	D	0.64	0.46	0.3	0.27	0.31	0.36	0.43	0.29	0.23	0.24	0.3	0.39	0.55	1.05	1.72	1.12
	E	0.29	0.16	0.11	0.1	0.21	0.28	0.35	0.41	0.31	0.29	0.53	0.98	1.68	2.09	1.71	0.77
	F	0.15	0.07	0.05	0.06	0.09	0.11	0.3	0.33	0.31	0.37	0.65	1.23	1.74	1.89	1.57	0.59
	G	0.04	0.03	0.02	0.02	0.04	0.04	0.13	0.18	0.19	0.2	0.32	0.65	0.68	0.78	0.69	0.19
4.7	A	0.19	0.22	0.11	0.04	0.04	0.03	0.04	0.04	0.05	0.13	0.31	0.36	0.21	0.23	0.61	0.3
	B	0.04	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.06	0.1	0.08	0.09	0.22	0.09
	C	0.04	0.03	0.02	0.01	0	0	0.01	0.01	0.02	0.04	0.05	0.08	0.07	0.08	0.2	0.09
	D	0.14	0.13	0.06	0.04	0.05	0.04	0.07	0.09	0.11	0.19	0.34	0.52	0.57	1.11	1.45	0.37
	E	0.07	0.06	0.04	0.02	0.02	0.02	0.06	0.1	0.11	0.15	0.37	0.66	1.09	1.95	1.78	0.25
	F	0.02	0.01	0.01	0.01	0.01	0.01	0.04	0.09	0.04	0.03	0.08	0.3	0.33	0.53	0.72	0.11
	G	0	0	0	0	0	0	0.02	0.04	0.01	0.02	0.04	0.18	0.1	0.16	0.32	0.03
7.15	A	0.03	0.06	0.04	0.01	0	0	0.01	0.01	0.02	0.06	0.23	0.33	0.15	0.17	0.44	0.11
	B	0.01	0.01	0.01	0	0	0	0	0	0.01	0.03	0.06	0.08	0.03	0.05	0.12	0.02
	C	0.01	0.01	0.01	0	0	0	0	0	0.01	0.02	0.04	0.07	0.03	0.03	0.08	0.02
	D	0.03	0.05	0.03	0.01	0	0	0.01	0.03	0.06	0.16	0.38	0.35	0.24	0.6	0.85	0.11
	E	0.01	0.05	0.02	0	0	0	0	0.02	0.05	0.11	0.25	0.23	0.15	0.47	0.93	0.06
	F	0	0	0	0	0	0	0	0.01	0	0	0.01	0.02	0.01	0.01	0.02	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.8	A	0	0.01	0.01	0	0	0	0	0	0	0.02	0.08	0.11	0.04	0.02	0.15	0.02
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.03	0.03	0.01	0.01	0.04	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0.01	0.01	0.03	0
	D	0.01	0.02	0	0.01	0	0	0	0	0.01	0.08	0.16	0.09	0.03	0.11	0.26	0.02
	E	0	0.02	0.01	0	0	0	0	0	0.01	0.05	0.07	0.04	0.01	0.05	0.18	0.01
	F	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.7	A	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0.01	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.03	0.04	0.02	0.01	0.01	0.01	0
	E	0	0	0	0	0	0	0	0	0	0.02	0.01	0.01	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-7. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 200 Areas at 61 Meters Above Ground Level.
Based on 1983-1996 Data from the Hanford Meteorological Station Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 200 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.11	0.13	0.15	0.11	0.11	0.12	0.07	0.05	0.03	0.02	0.04	0.03	0.05	0.03	0.05	0.07
	B	0.09	0.09	0.08	0.07	0.07	0.06	0.06	0.03	0.02	0.03	0.02	0.02	0.02	0.03	0.05	0.07
	C	0.09	0.08	0.1	0.08	0.07	0.06	0.06	0.04	0.02	0.02	0.02	0.02	0.03	0.04	0.04	0.08
	D	0.58	0.53	0.51	0.43	0.45	0.49	0.52	0.35	0.24	0.22	0.22	0.2	0.27	0.35	0.44	0.54
	E	0.29	0.22	0.2	0.18	0.22	0.28	0.32	0.25	0.18	0.17	0.17	0.17	0.23	0.25	0.31	0.32
	F	0.2	0.13	0.12	0.11	0.14	0.14	0.19	0.14	0.13	0.12	0.13	0.12	0.17	0.19	0.23	0.21
	G	0.07	0.05	0.05	0.05	0.06	0.07	0.1	0.07	0.07	0.06	0.08	0.09	0.09	0.11	0.12	0.1
2.65	A	0.61	0.5	0.46	0.41	0.43	0.41	0.43	0.3	0.2	0.18	0.18	0.17	0.12	0.16	0.43	0.58
	B	0.25	0.2	0.16	0.12	0.14	0.13	0.12	0.1	0.07	0.06	0.07	0.05	0.06	0.09	0.22	0.27
	C	0.23	0.16	0.13	0.09	0.1	0.1	0.12	0.07	0.05	0.06	0.06	0.05	0.04	0.08	0.21	0.28
	D	0.79	0.56	0.39	0.32	0.39	0.37	0.5	0.34	0.22	0.23	0.24	0.25	0.35	0.63	1.29	1.1
	E	0.37	0.23	0.18	0.16	0.22	0.23	0.34	0.34	0.18	0.18	0.25	0.34	0.5	0.8	0.95	0.66
	F	0.28	0.13	0.11	0.08	0.1	0.12	0.22	0.23	0.18	0.17	0.23	0.3	0.53	0.79	0.81	0.6
	G	0.09	0.05	0.04	0.03	0.04	0.03	0.08	0.11	0.1	0.1	0.13	0.19	0.33	0.41	0.32	0.23
4.7	A	0.32	0.29	0.18	0.08	0.08	0.06	0.09	0.09	0.09	0.15	0.28	0.27	0.14	0.19	0.64	0.41
	B	0.09	0.08	0.04	0.03	0.03	0.02	0.02	0.03	0.03	0.04	0.08	0.09	0.05	0.09	0.28	0.15
	C	0.06	0.05	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.04	0.05	0.07	0.05	0.07	0.21	0.13
	D	0.2	0.16	0.09	0.06	0.08	0.08	0.13	0.14	0.12	0.16	0.26	0.31	0.31	0.83	1.55	0.48
	E	0.21	0.1	0.09	0.06	0.09	0.08	0.15	0.21	0.13	0.15	0.27	0.54	0.95	1.72	1.52	0.45
	F	0.14	0.06	0.04	0.02	0.04	0.03	0.09	0.2	0.08	0.06	0.15	0.35	0.78	1.34	1.41	0.49
	G	0.04	0.01	0	0	0	0	0.03	0.05	0.03	0.03	0.06	0.15	0.33	0.47	0.64	0.27
7.15	A	0.05	0.11	0.07	0.02	0.01	0	0.01	0.02	0.02	0.09	0.29	0.37	0.15	0.16	0.48	0.11
	B	0.02	0.02	0.02	0.01	0	0	0	0.01	0.01	0.03	0.05	0.09	0.04	0.06	0.14	0.03
	C	0.01	0.01	0.01	0	0	0	0	0.01	0.01	0.03	0.05	0.07	0.04	0.05	0.12	0.02
	D	0.06	0.08	0.04	0.02	0.01	0.01	0.04	0.08	0.08	0.17	0.34	0.46	0.39	0.85	1.18	0.15
	E	0.07	0.05	0.04	0.02	0.02	0.01	0.05	0.1	0.09	0.14	0.31	0.64	0.9	2.11	1.71	0.15
	F	0.04	0.03	0.03	0.01	0.01	0	0.03	0.08	0.03	0.03	0.06	0.23	0.39	0.88	1.3	0.15
	G	0	0	0	0	0	0	0.02	0.04	0.01	0	0.01	0.05	0.08	0.2	0.61	0.1
9.8	A	0.01	0.03	0.04	0.01	0	0	0	0	0.01	0.03	0.16	0.21	0.06	0.1	0.31	0.03
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.05	0.05	0.01	0.03	0.08	0.01
	C	0	0	0	0	0	0	0	0	0	0.01	0.04	0.04	0.02	0.03	0.05	0.01
	D	0.02	0.03	0.02	0.01	0	0	0	0.02	0.04	0.11	0.29	0.28	0.15	0.51	0.68	0.04
	E	0.02	0.04	0.02	0	0	0	0.01	0.02	0.04	0.09	0.24	0.28	0.2	0.78	1.04	0.03
	F	0	0	0	0	0	0	0	0.01	0.01	0	0.02	0.03	0.04	0.08	0.19	0.01
	G	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.03	0.08	0
12.7	A	0	0	0.01	0	0	0	0	0	0	0.02	0.09	0.1	0.02	0.02	0.16	0.01
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.04	0.03	0.01	0.01	0.05	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0.01	0.04	0
	D	0.01	0.02	0.01	0.01	0	0	0	0.01	0.01	0.1	0.23	0.12	0.04	0.24	0.48	0.01
	E	0	0.02	0.01	0	0	0	0	0	0.02	0.07	0.13	0.08	0.04	0.19	0.39	0
	F	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0.02	0.02	0	0	0.02	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	D	0	0	0	0	0	0	0	0	0	0.04	0.08	0.03	0.01	0.03	0.06	0
	E	0	0	0	0	0	0	0	0	0	0.03	0.04	0.01	0.01	0.03	0.05	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0.03	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-8. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 300 Area at 9 Meters Above Ground Level.
Based on 1983-1996 Data from the 300 Area Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 300 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.08	0.06	0.08	0.1	0.11	0.11	0.12	0.11	0.08	0.06	0.05	0.04	0.03	0.03	0.06	0.07
	B	0.06	0.05	0.03	0.04	0.06	0.05	0.07	0.05	0.04	0.03	0.04	0.04	0.03	0.03	0.04	0.06
	C	0.05	0.03	0.04	0.04	0.05	0.06	0.07	0.06	0.04	0.03	0.02	0.03	0.03	0.02	0.04	0.05
	D	0.35	0.21	0.17	0.17	0.22	0.37	0.4	0.43	0.38	0.36	0.37	0.3	0.3	0.28	0.42	0.49
	E	0.34	0.18	0.13	0.13	0.19	0.34	0.51	0.56	0.57	0.46	0.46	0.4	0.44	0.47	0.54	0.49
	F	0.26	0.16	0.12	0.08	0.15	0.26	0.48	0.51	0.51	0.37	0.37	0.32	0.32	0.4	0.48	0.45
	G	0.17	0.08	0.04	0.04	0.08	0.11	0.2	0.22	0.21	0.16	0.17	0.14	0.15	0.18	0.25	0.23
2.65	A	0.23	0.3	0.39	0.41	0.55	0.56	0.53	0.27	0.21	0.26	0.26	0.16	0.08	0.05	0.08	0.19
	B	0.13	0.15	0.13	0.15	0.19	0.21	0.26	0.15	0.11	0.13	0.11	0.06	0.03	0.03	0.04	0.11
	C	0.13	0.13	0.11	0.12	0.15	0.19	0.24	0.13	0.11	0.12	0.11	0.05	0.02	0.03	0.06	0.12
	D	0.99	0.53	0.32	0.34	0.57	1	1.34	0.73	0.66	0.67	0.56	0.37	0.23	0.24	0.61	1.2
	E	1.07	0.34	0.09	0.1	0.25	1.07	1.77	1.06	1.06	0.76	0.61	0.45	0.35	0.42	0.69	1.22
	F	0.65	0.15	0.03	0.02	0.1	0.92	1.82	0.97	0.66	0.42	0.25	0.14	0.14	0.18	0.42	0.81
	G	0.29	0.05	0.01	0	0.03	0.33	0.8	0.4	0.22	0.12	0.07	0.04	0.04	0.06	0.19	0.37
4.7	A	0.27	0.52	0.35	0.09	0.11	0.21	0.27	0.13	0.19	0.47	0.58	0.29	0.08	0.06	0.09	0.14
	B	0.11	0.16	0.08	0.03	0.03	0.08	0.09	0.05	0.09	0.22	0.23	0.11	0.04	0.02	0.04	0.08
	C	0.11	0.14	0.08	0.03	0.02	0.06	0.1	0.05	0.07	0.16	0.2	0.09	0.02	0.01	0.05	0.09
	D	0.75	0.46	0.24	0.09	0.1	0.21	0.4	0.25	0.4	0.87	0.92	0.5	0.2	0.14	0.45	0.9
	E	1.03	0.34	0.06	0.04	0.05	0.25	0.34	0.22	0.49	0.8	0.92	0.52	0.21	0.17	0.44	0.79
	F	0.77	0.22	0.02	0.02	0.03	0.24	0.26	0.1	0.23	0.36	0.33	0.13	0.04	0.03	0.08	0.39
	G	0.42	0.12	0	0	0.01	0.12	0.15	0.04	0.07	0.11	0.09	0.03	0.01	0	0.02	0.16
7.15	A	0.12	0.16	0.04	0	0	0	0.02	0.01	0.05	0.28	0.56	0.41	0.11	0.04	0.09	0.09
	B	0.04	0.04	0.01	0	0	0	0.01	0	0.02	0.12	0.16	0.1	0.03	0.02	0.03	0.04
	C	0.03	0.03	0.01	0	0	0	0.01	0.01	0.01	0.1	0.16	0.09	0.03	0.01	0.03	0.04
	D	0.15	0.11	0.03	0.01	0.01	0.02	0.03	0.03	0.14	0.49	0.7	0.39	0.15	0.07	0.38	0.4
	E	0.14	0.07	0.04	0.02	0.01	0.01	0.03	0.02	0.09	0.32	0.56	0.25	0.09	0.05	0.26	0.28
	F	0.05	0.03	0.02	0.02	0	0	0	0	0.02	0.08	0.15	0.05	0.01	0	0.02	0.05
	G	0.03	0.02	0	0	0	0	0	0	0.02	0.04	0.06	0.01	0	0	0	0.01
9.8	A	0.01	0.03	0	0	0	0	0	0	0.01	0.09	0.17	0.15	0.07	0.01	0.03	0.02
	B	0.01	0.01	0	0	0	0	0	0	0.01	0.03	0.05	0.04	0.02	0	0.02	0.01
	C	0.01	0	0	0	0	0	0	0	0.01	0.02	0.04	0.04	0.01	0	0.01	0.01
	D	0.02	0.01	0.01	0	0	0	0	0	0.02	0.15	0.28	0.14	0.07	0.01	0.16	0.09
	E	0.02	0.03	0.02	0.01	0	0	0	0	0.01	0.09	0.24	0.05	0.02	0.01	0.08	0.04
	F	0	0	0	0	0	0	0	0	0	0.01	0.04	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
12.7	A	0	0	0	0	0	0	0	0	0	0.01	0.04	0.03	0.02	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0.02	0.01	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
	D	0.01	0.01	0	0	0	0	0	0	0.01	0.05	0.15	0.04	0.02	0.01	0.03	0.02
	E	0	0.01	0	0	0	0	0	0	0	0.04	0.12	0.01	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.02	0.05	0.01	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.03	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-9. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 300 Area at 60 Meters Above Ground Level. Based on 1983-1996 Data from the 300 Area Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 300 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.08	0.07	0.07	0.09	0.1	0.11	0.13	0.11	0.09	0.05	0.05	0.04	0.04	0.03	0.05	0.06
	B	0.06	0.05	0.03	0.04	0.04	0.06	0.07	0.05	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.04
	C	0.04	0.04	0.04	0.03	0.05	0.05	0.05	0.06	0.04	0.03	0.02	0.02	0.02	0.03	0.03	0.04
	D	0.3	0.23	0.18	0.17	0.24	0.31	0.3	0.34	0.28	0.18	0.2	0.17	0.18	0.17	0.27	0.31
	E	0.3	0.22	0.17	0.15	0.2	0.25	0.3	0.34	0.35	0.27	0.23	0.19	0.2	0.22	0.25	0.31
	F	0.25	0.19	0.18	0.14	0.16	0.23	0.33	0.3	0.28	0.26	0.21	0.16	0.17	0.2	0.21	0.24
	G	0.1	0.08	0.06	0.04	0.07	0.1	0.15	0.13	0.14	0.11	0.1	0.08	0.1	0.1	0.12	0.14
2.65	A	0.25	0.27	0.36	0.39	0.52	0.54	0.49	0.29	0.19	0.23	0.22	0.13	0.06	0.04	0.06	0.15
	B	0.15	0.13	0.13	0.14	0.18	0.19	0.24	0.16	0.12	0.11	0.1	0.07	0.03	0.03	0.03	0.09
	C	0.14	0.12	0.1	0.11	0.16	0.19	0.22	0.14	0.1	0.11	0.09	0.06	0.02	0.02	0.03	0.09
	D	0.89	0.57	0.36	0.36	0.51	0.71	1.06	0.7	0.52	0.53	0.46	0.29	0.19	0.17	0.34	0.75
	E	0.83	0.44	0.15	0.1	0.22	0.45	0.86	0.81	0.78	0.7	0.62	0.43	0.34	0.36	0.4	0.64
	F	0.56	0.3	0.08	0.04	0.13	0.46	0.87	0.82	0.74	0.52	0.34	0.26	0.2	0.11	0.23	0.43
	G	0.28	0.11	0.03	0.01	0.03	0.23	0.46	0.34	0.27	0.16	0.1	0.07	0.06	0.06	0.1	0.23
4.7	A	0.25	0.56	0.37	0.12	0.11	0.21	0.34	0.17	0.2	0.44	0.57	0.25	0.08	0.04	0.07	0.11
	B	0.12	0.19	0.1	0.04	0.04	0.08	0.12	0.06	0.07	0.21	0.21	0.12	0.03	0.02	0.03	0.07
	C	0.12	0.17	0.11	0.04	0.02	0.07	0.11	0.06	0.07	0.16	0.19	0.08	0.02	0.01	0.04	0.07
	D	0.83	0.55	0.25	0.13	0.13	0.27	0.55	0.3	0.34	0.76	0.79	0.45	0.2	0.15	0.3	0.71
	E	1.01	0.35	0.08	0.07	0.08	0.27	0.59	0.42	0.6	0.93	0.87	0.6	0.35	0.27	0.43	0.85
	F	0.8	0.27	0.02	0.02	0.04	0.25	0.66	0.32	0.4	0.53	0.47	0.25	0.09	0.04	0.08	0.39
	G	0.41	0.13	0	0	0.01	0.12	0.34	0.12	0.14	0.16	0.12	0.05	0.02	0.01	0.02	0.17
7.15	A	0.16	0.27	0.07	0.01	0	0.01	0.03	0.02	0.04	0.32	0.61	0.45	0.11	0.05	0.07	0.08
	B	0.06	0.07	0.01	0	0	0.01	0.01	0.01	0.02	0.14	0.19	0.1	0.04	0.02	0.03	0.05
	C	0.04	0.05	0.01	0	0	0	0.02	0.01	0.02	0.11	0.17	0.1	0.02	0.01	0.02	0.04
	D	0.36	0.19	0.04	0.01	0.01	0.03	0.08	0.07	0.18	0.58	0.79	0.47	0.18	0.12	0.36	0.51
	E	0.6	0.17	0.05	0.02	0.02	0.08	0.18	0.11	0.18	0.5	0.97	0.65	0.25	0.16	0.44	0.63
	F	0.48	0.15	0.03	0.02	0.01	0.05	0.11	0.04	0.06	0.22	0.37	0.2	0.04	0.01	0.06	0.3
	G	0.31	0.07	0	0	0	0.01	0.03	0.01	0.02	0.06	0.1	0.04	0.01	0	0.02	0.14
9.8	A	0.04	0.05	0.01	0	0	0	0	0	0.01	0.11	0.22	0.25	0.1	0.02	0.05	0.03
	B	0.02	0.01	0	0	0	0	0	0	0.01	0.03	0.06	0.05	0.02	0.01	0.02	0.01
	C	0.01	0.01	0	0	0	0	0	0	0	0.03	0.06	0.05	0.02	0.01	0.02	0.01
	D	0.07	0.04	0.02	0.01	0	0.01	0.02	0.01	0.03	0.22	0.37	0.28	0.12	0.05	0.29	0.19
	E	0.08	0.05	0.04	0.01	0.01	0.01	0.01	0.02	0.03	0.17	0.5	0.25	0.09	0.04	0.29	0.19
	F	0.05	0.01	0.02	0.02	0	0	0	0	0.01	0.05	0.14	0.06	0.01	0	0.01	0.04
	G	0.02	0.01	0	0	0	0	0	0	0	0.02	0.05	0.02	0	0	0	0.01
12.7	A	0	0.02	0.01	0	0	0	0	0	0	0.03	0.09	0.07	0.06	0	0.01	0.01
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.04	0.03	0.02	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.04	0.03	0.01	0	0.01	0.01
	D	0.01	0.02	0.01	0	0	0	0	0	0.01	0.1	0.26	0.11	0.06	0.01	0.13	0.04
	E	0.01	0.02	0.02	0.01	0	0	0	0	0.01	0.07	0.24	0.06	0.02	0.02	0.09	0.02
	F	0	0	0.01	0.01	0	0	0	0	0	0.01	0.05	0.01	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0.02	0.01	0.01	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.02	0.01	0	0	0	0
	D	0	0.01	0	0	0	0	0	0	0	0.02	0.13	0.02	0.01	0	0.01	0.01
	E	0	0.01	0.01	0	0	0	0	0	0	0.03	0.1	0.01	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0.01	0	0	0	0	0	0	0	0	0.01	0.09	0.01	0.01	0	0	0
	E	0	0.01	0.01	0	0	0	0	0	0	0.01	0.06	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0

Table 1-10. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 400 Area at 9 Meters Above Ground Level.
Based on 1983-1996 Data from the 400 Area Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 400 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.1	0.12	0.1	0.12	0.12	0.15	0.12	0.09	0.11	0.09	0.08	0.06	0.05	0.06	0.07	0.1
	B	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.05	0.05
	C	0.04	0.05	0.06	0.05	0.05	0.06	0.07	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.06
	D	0.35	0.33	0.3	0.25	0.26	0.33	0.37	0.36	0.34	0.32	0.31	0.23	0.24	0.31	0.4	0.39
	E	0.29	0.25	0.22	0.17	0.22	0.24	0.26	0.27	0.35	0.38	0.38	0.32	0.32	0.34	0.39	0.38
	F	0.28	0.24	0.18	0.14	0.15	0.15	0.18	0.2	0.3	0.29	0.29	0.24	0.23	0.27	0.28	0.27
	G	0.15	0.11	0.07	0.06	0.06	0.07	0.08	0.09	0.12	0.13	0.11	0.09	0.11	0.11	0.14	0.12
2.65	A	0.35	0.41	0.4	0.3	0.3	0.39	0.46	0.42	0.5	0.39	0.2	0.13	0.15	0.16	0.19	0.23
	B	0.16	0.15	0.13	0.09	0.11	0.11	0.16	0.18	0.18	0.16	0.08	0.05	0.05	0.05	0.09	0.13
	C	0.14	0.13	0.12	0.07	0.08	0.09	0.14	0.16	0.17	0.12	0.06	0.04	0.05	0.06	0.1	0.13
	D	0.67	0.59	0.54	0.33	0.32	0.37	0.73	0.99	0.87	0.74	0.4	0.26	0.33	0.54	0.97	0.91
	E	0.6	0.49	0.36	0.2	0.17	0.25	0.62	1	1.12	1.11	0.68	0.46	0.54	0.72	1.1	0.84
	F	0.57	0.56	0.32	0.12	0.1	0.15	0.42	0.76	0.91	0.79	0.46	0.25	0.22	0.35	0.7	0.64
	G	0.31	0.29	0.14	0.05	0.04	0.05	0.14	0.31	0.34	0.26	0.16	0.08	0.08	0.16	0.33	0.31
4.7	A	0.35	0.39	0.21	0.07	0.07	0.07	0.13	0.18	0.53	0.68	0.29	0.18	0.17	0.17	0.24	0.23
	B	0.12	0.11	0.06	0.02	0.02	0.03	0.05	0.08	0.2	0.28	0.1	0.05	0.04	0.03	0.09	0.1
	C	0.09	0.11	0.06	0.01	0.02	0.02	0.05	0.07	0.16	0.22	0.08	0.04	0.04	0.04	0.09	0.1
	D	0.35	0.31	0.22	0.08	0.05	0.08	0.28	0.54	0.86	1.14	0.44	0.21	0.25	0.56	1.08	0.7
	E	0.22	0.2	0.1	0.03	0.02	0.03	0.29	0.9	0.98	1.13	0.55	0.25	0.31	0.8	1.54	0.68
	F	0.17	0.17	0.07	0.02	0	0.01	0.22	0.91	0.75	0.63	0.21	0.06	0.06	0.18	0.73	0.51
	G	0.08	0.08	0.02	0	0	0.01	0.1	0.46	0.29	0.2	0.06	0.01	0.01	0.05	0.32	0.22
7.15	A	0.08	0.1	0.07	0.01	0	0.01	0.01	0.02	0.13	0.59	0.41	0.21	0.16	0.12	0.19	0.11
	B	0.03	0.03	0.01	0	0	0	0.01	0.01	0.04	0.22	0.1	0.07	0.04	0.04	0.06	0.03
	C	0.02	0.02	0.01	0	0	0	0.01	0.01	0.04	0.19	0.1	0.05	0.03	0.04	0.05	0.03
	D	0.09	0.09	0.04	0.01	0	0.01	0.05	0.06	0.27	0.89	0.51	0.22	0.16	0.32	0.67	0.18
	E	0.03	0.06	0.03	0	0	0.01	0.02	0.08	0.2	0.67	0.45	0.16	0.09	0.3	0.6	0.13
	F	0.01	0.01	0.01	0	0	0	0.01	0.06	0.11	0.28	0.11	0.02	0.01	0.01	0.05	0.03
	G	0	0	0	0	0	0	0.01	0.05	0.06	0.11	0.04	0.01	0	0	0.02	0.01
9.8	A	0.01	0.03	0.02	0	0	0	0	0	0.01	0.11	0.18	0.13	0.07	0.04	0.06	0.01
	B	0	0.01	0	0	0	0	0	0	0.01	0.03	0.05	0.03	0.02	0.01	0.03	0
	C	0	0	0	0	0	0	0	0	0	0.02	0.04	0.02	0.01	0.01	0.03	0.01
	D	0.01	0.03	0.01	0.01	0	0	0	0	0.02	0.19	0.27	0.12	0.05	0.1	0.26	0.02
	E	0	0.04	0.01	0	0	0	0	0	0.01	0.16	0.21	0.05	0.02	0.05	0.11	0.01
	F	0	0	0	0	0	0	0	0	0	0.02	0.03	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0	0	0	0
12.7	A	0	0	0	0	0	0	0	0	0	0.01	0.05	0.03	0.01	0.01	0.01	0
	B	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.02	0.01	0	0	0.01	0
	D	0	0.01	0	0	0	0	0	0	0	0.05	0.17	0.04	0.01	0.01	0.04	0
	E	0	0.01	0.01	0	0	0	0	0	0	0.05	0.07	0.01	0	0.01	0.02	0
	F	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0.04	0.01	0.01	0	0	0
	E	0	0	0.01	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 1-11. Joint Frequency Distributions of Atmospheric Stability, Wind Speed, and Transport Direction for the 400 Area at 60 Meters Above Ground Level. Based on 1983-1996 Data from the 400 Area Instrumented Tower.

Average Wind Speed m/s	Atmospheric Stability Class	Percentage of Time Wind Blows from the 400 Area Toward the Direction Indicated															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.08	0.09	0.1	0.09	0.1	0.12	0.1	0.09	0.09	0.07	0.06	0.05	0.06	0.04	0.07	0.07
	B	0.05	0.04	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.03	0.04	0.03	0.03	0.04	0.05	0.04
	C	0.04	0.03	0.05	0.04	0.05	0.06	0.05	0.04	0.03	0.04	0.03	0.02	0.02	0.03	0.04	0.05
	D	0.22	0.21	0.19	0.19	0.23	0.23	0.31	0.3	0.25	0.21	0.22	0.17	0.18	0.19	0.22	0.23
	E	0.18	0.17	0.14	0.13	0.15	0.16	0.22	0.22	0.25	0.21	0.22	0.21	0.19	0.17	0.18	0.2
	F	0.15	0.14	0.13	0.13	0.13	0.15	0.19	0.2	0.22	0.19	0.18	0.15	0.15	0.15	0.13	0.16
	G	0.07	0.06	0.06	0.06	0.06	0.06	0.07	0.09	0.09	0.06	0.06	0.05	0.07	0.05	0.06	0.06
2.65	A	0.27	0.31	0.32	0.23	0.24	0.29	0.36	0.33	0.35	0.28	0.17	0.11	0.11	0.13	0.15	0.2
	B	0.12	0.13	0.11	0.08	0.09	0.1	0.15	0.16	0.16	0.15	0.07	0.05	0.05	0.05	0.1	0.12
	C	0.11	0.11	0.12	0.07	0.07	0.09	0.12	0.14	0.16	0.11	0.06	0.05	0.05	0.06	0.08	0.11
	D	0.5	0.51	0.48	0.34	0.31	0.37	0.57	0.74	0.7	0.54	0.3	0.24	0.24	0.36	0.65	0.61
	E	0.41	0.35	0.29	0.2	0.21	0.2	0.36	0.54	0.65	0.54	0.48	0.4	0.43	0.47	0.57	0.52
	F	0.4	0.39	0.26	0.13	0.1	0.16	0.28	0.57	0.62	0.47	0.36	0.26	0.28	0.27	0.37	0.41
	G	0.2	0.18	0.11	0.05	0.03	0.05	0.13	0.28	0.29	0.19	0.12	0.08	0.09	0.09	0.15	0.18
4.7	A	0.34	0.4	0.25	0.09	0.06	0.06	0.14	0.2	0.47	0.61	0.23	0.14	0.12	0.17	0.2	0.21
	B	0.13	0.14	0.09	0.03	0.02	0.02	0.07	0.09	0.2	0.23	0.11	0.05	0.03	0.04	0.08	0.1
	C	0.09	0.12	0.09	0.02	0.02	0.03	0.06	0.09	0.17	0.21	0.07	0.03	0.03	0.04	0.08	0.1
	D	0.42	0.44	0.36	0.13	0.1	0.1	0.33	0.46	0.73	0.87	0.43	0.16	0.21	0.33	0.85	0.65
	E	0.34	0.3	0.21	0.09	0.06	0.07	0.35	0.61	0.79	0.8	0.68	0.33	0.35	0.61	1.04	0.63
	F	0.3	0.25	0.14	0.05	0.03	0.03	0.22	0.54	0.64	0.6	0.44	0.13	0.11	0.19	0.54	0.55
	G	0.18	0.15	0.07	0.01	0	0.01	0.1	0.29	0.27	0.22	0.13	0.03	0.03	0.06	0.24	0.31
7.15	A	0.14	0.16	0.09	0.01	0	0.01	0.03	0.03	0.13	0.59	0.39	0.17	0.13	0.11	0.19	0.13
	B	0.04	0.04	0.02	0.01	0	0	0.01	0.01	0.06	0.23	0.11	0.05	0.03	0.04	0.08	0.07
	C	0.04	0.04	0.02	0	0	0	0.02	0.02	0.06	0.19	0.09	0.04	0.03	0.04	0.06	0.04
	D	0.14	0.15	0.06	0.02	0.01	0.01	0.12	0.17	0.39	0.95	0.52	0.21	0.15	0.34	0.88	0.37
	E	0.14	0.11	0.07	0.01	0.01	0.01	0.17	0.28	0.44	1	0.79	0.23	0.19	0.74	1.52	0.48
	F	0.13	0.1	0.06	0.02	0.01	0	0.11	0.21	0.33	0.56	0.39	0.05	0.03	0.15	0.67	0.43
	G	0.05	0.03	0.01	0	0	0	0.03	0.07	0.15	0.2	0.11	0.02	0.01	0.05	0.27	0.21
9.8	A	0.02	0.06	0.04	0.01	0	0	0	0	0.02	0.16	0.25	0.16	0.08	0.06	0.1	0.04
	B	0.01	0.02	0.01	0	0	0	0.01	0.01	0.01	0.06	0.06	0.05	0.02	0.01	0.04	0.02
	C	0.01	0.01	0.01	0.01	0	0	0	0	0.01	0.06	0.05	0.03	0.02	0.02	0.04	0.02
	D	0.03	0.05	0.03	0.01	0.01	0.01	0.03	0.03	0.1	0.36	0.39	0.17	0.1	0.22	0.65	0.1
	E	0.04	0.06	0.05	0.01	0.01	0.01	0.02	0.04	0.11	0.44	0.46	0.15	0.08	0.5	1.06	0.11
	F	0.02	0.02	0.03	0.01	0.01	0.01	0.01	0.02	0.04	0.19	0.16	0.02	0.01	0.06	0.25	0.08
	G	0	0	0	0	0	0	0	0.01	0.02	0.1	0.06	0.01	0	0.03	0.11	0.03
12.7	A	0	0.02	0.02	0	0	0	0	0	0	0.04	0.08	0.09	0.04	0.01	0.04	0
	B	0	0.02	0	0	0	0	0	0	0	0.02	0.04	0.02	0.01	0.01	0.02	0
	C	0	0	0	0	0	0	0	0	0	0.02	0.03	0.02	0.01	0	0.02	0
	D	0.01	0.02	0.01	0.01	0	0	0.01	0.01	0.01	0.12	0.26	0.09	0.04	0.09	0.32	0.05
	E	0.01	0.03	0.01	0.01	0	0	0.01	0.02	0.02	0.16	0.27	0.08	0.02	0.08	0.28	0.03
	F	0	0.01	0	0	0	0	0	0.01	0.01	0.03	0.06	0.01	0.01	0	0.01	0.01
	G	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0	0	0	0
15.6	A	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0	0.01	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0	0
	D	0	0	0.01	0	0	0	0	0	0	0.06	0.14	0.04	0.01	0.01	0.04	0.01
	E	0	0.01	0.01	0	0	0	0	0	0.01	0.06	0.1	0.03	0	0.01	0.05	0.02
	F	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
19	A	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.02	0.09	0.01	0.01	0	0	0
	E	0	0	0.01	0	0	0	0	0	0	0.04	0.05	0.01	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

FIGURES

Figure 1-1. The Hanford Site in Washington State.

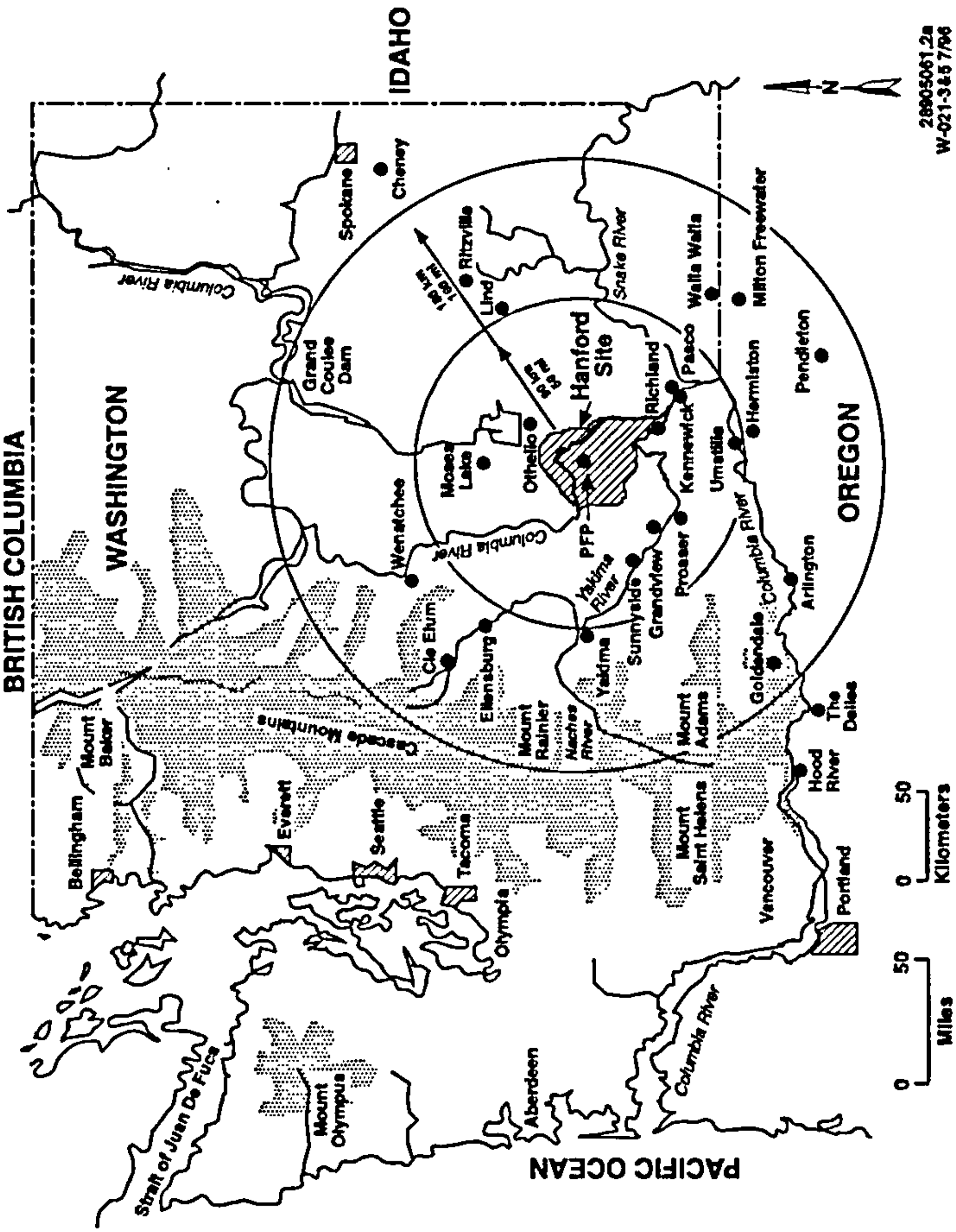
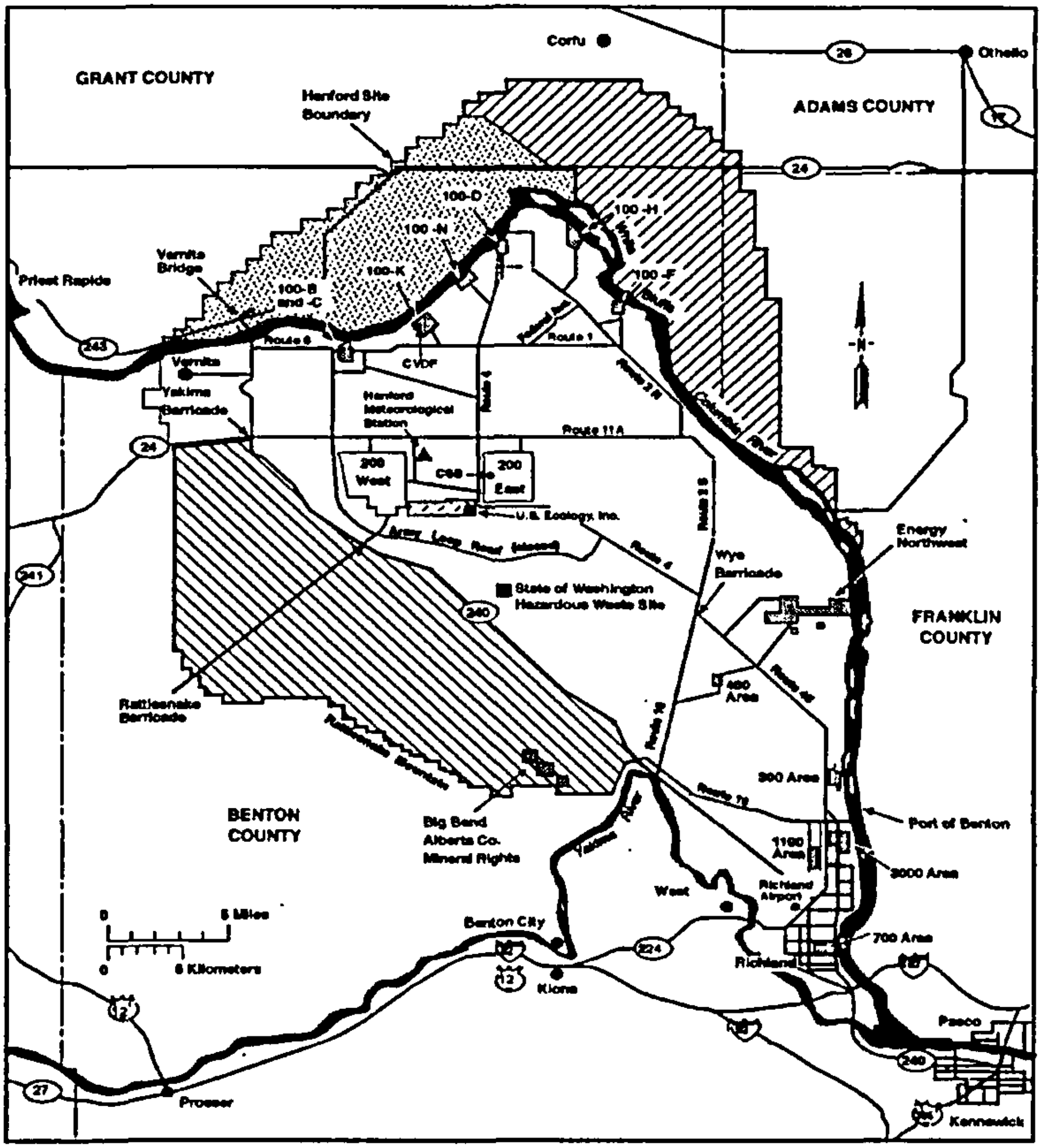


Figure 1-2. Hanford Site Map.



Wahluke Wildlife Recreation Area, State of Washington Department of Game

Saddle Mountain National Wildlife Refuge, U.S. Fish and Wildlife Service

Fitzner-Eberhardt Arid Lands Ecology Reserve

State of Washington Leased Land

Figure 1-3. 200 West Area.

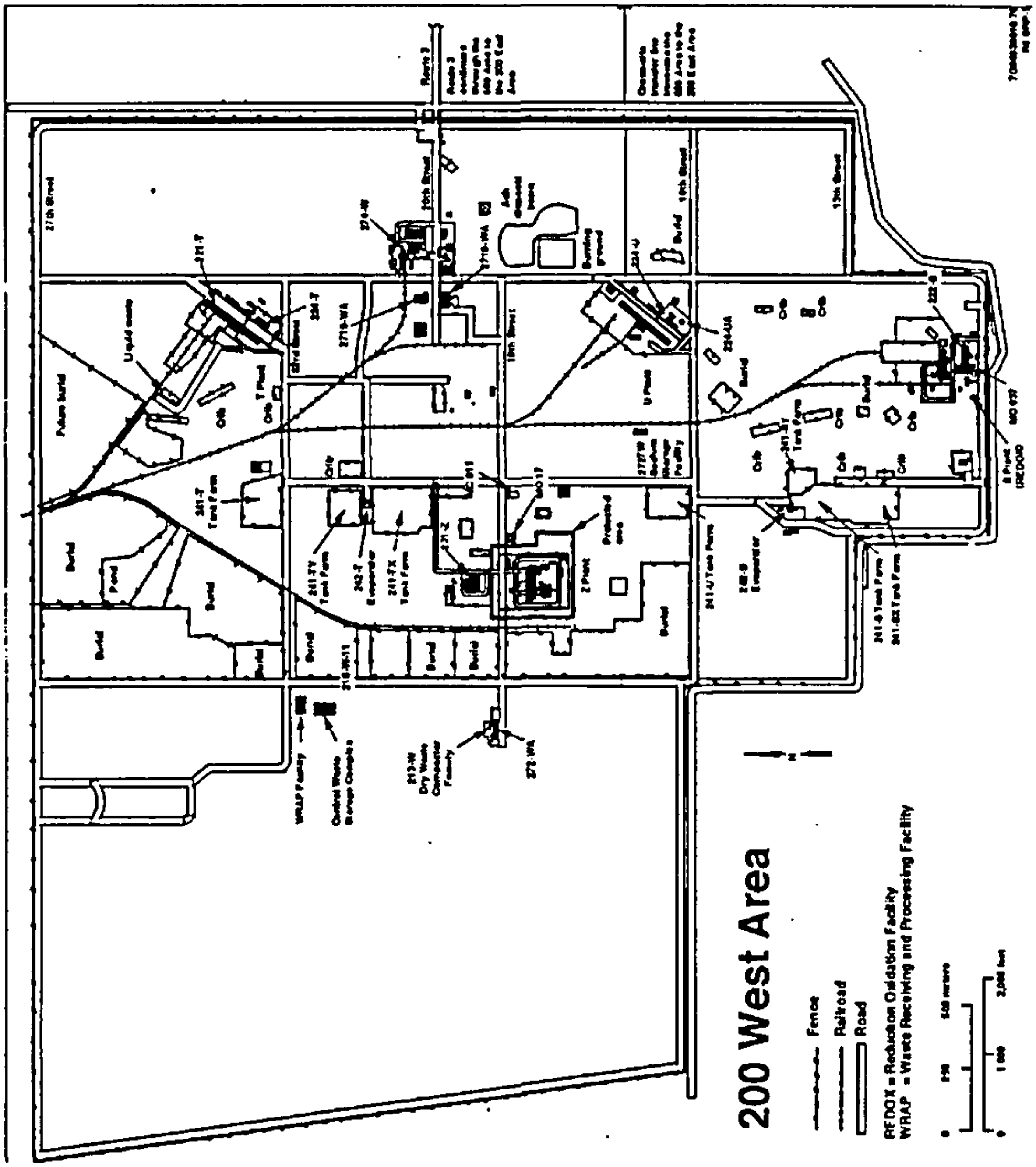


Figure 1-4. 200 East Area.

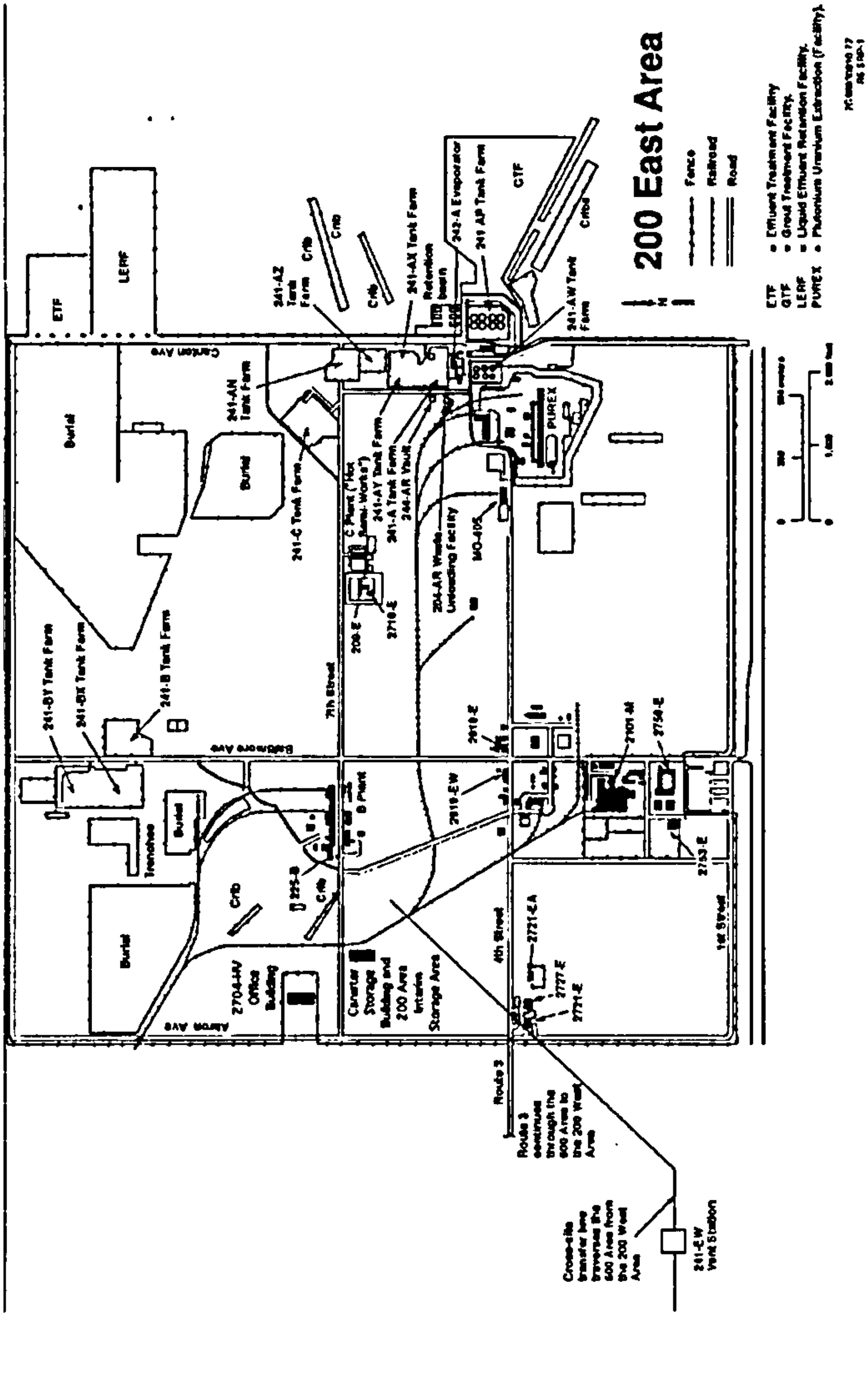


Figure 1-5. 1990 Population Distribution within an 80 Kilometer Radius of the Hanford Meteorological Station.

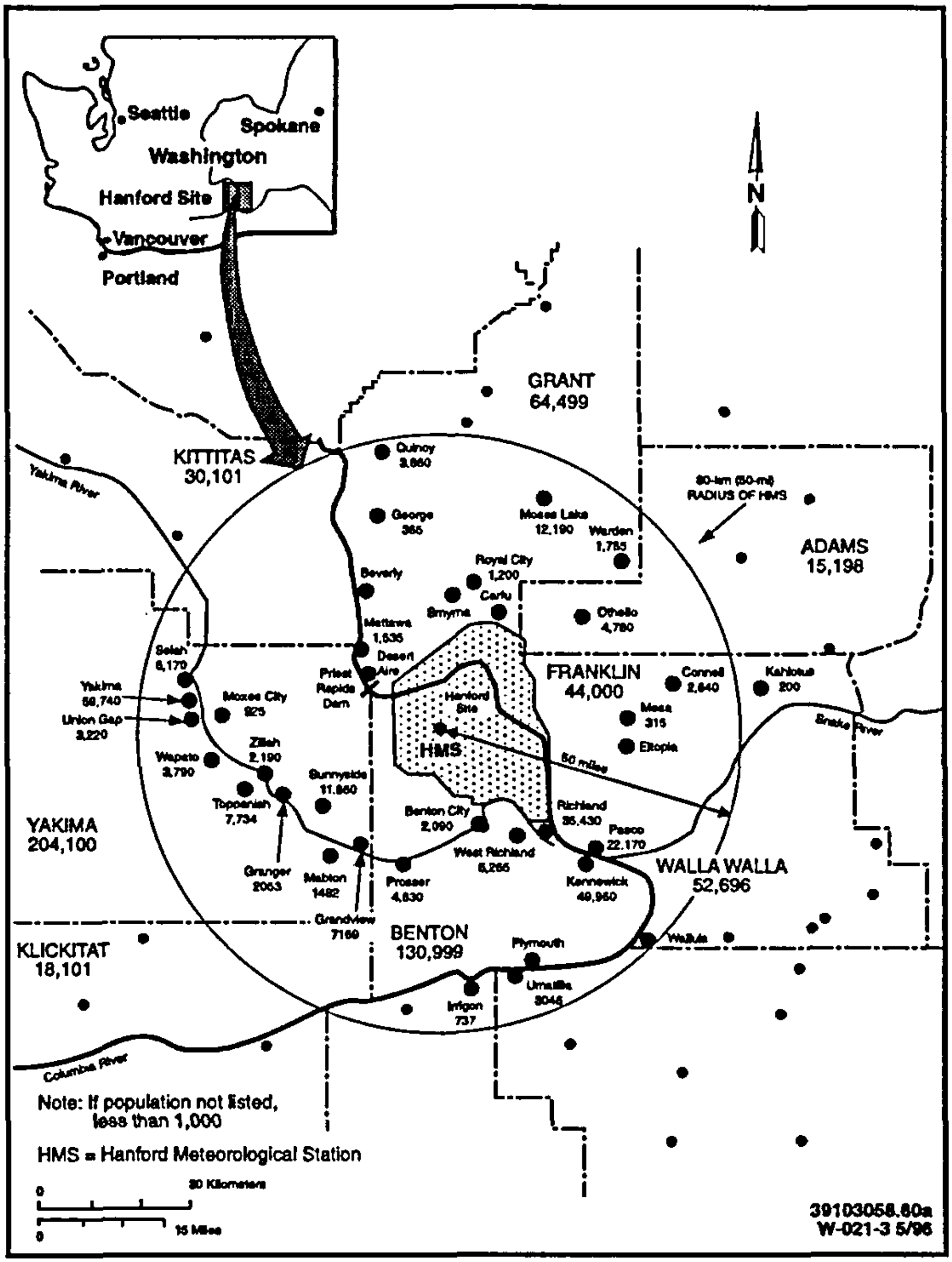


Figure 1-6. Distribution of Transient Population.

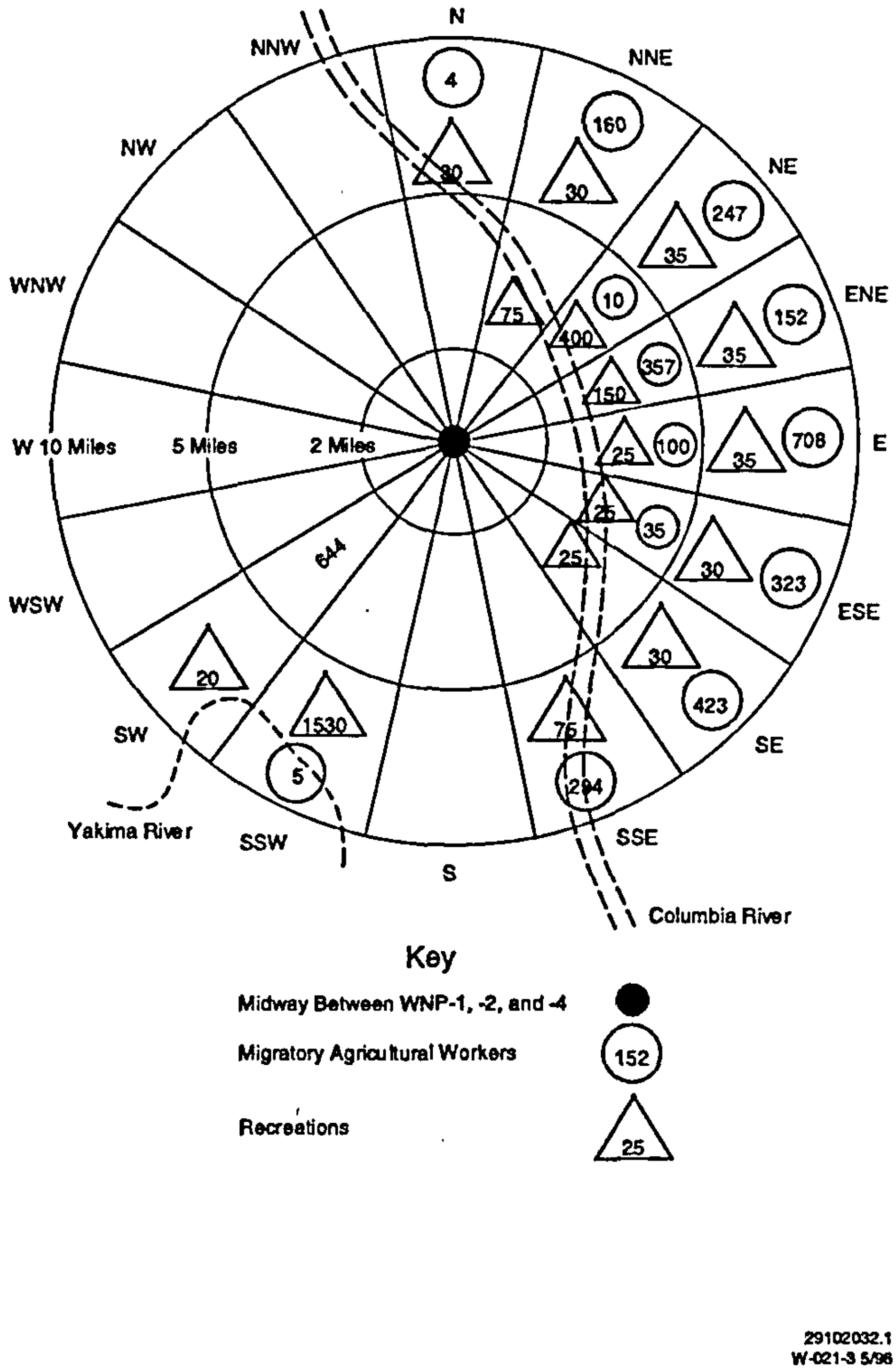


Figure 1-7. Wind Roses at the 9.1 Meter (30-Foot) Level of the Hanford Meteorological Monitoring Network, 1982 to 2000.

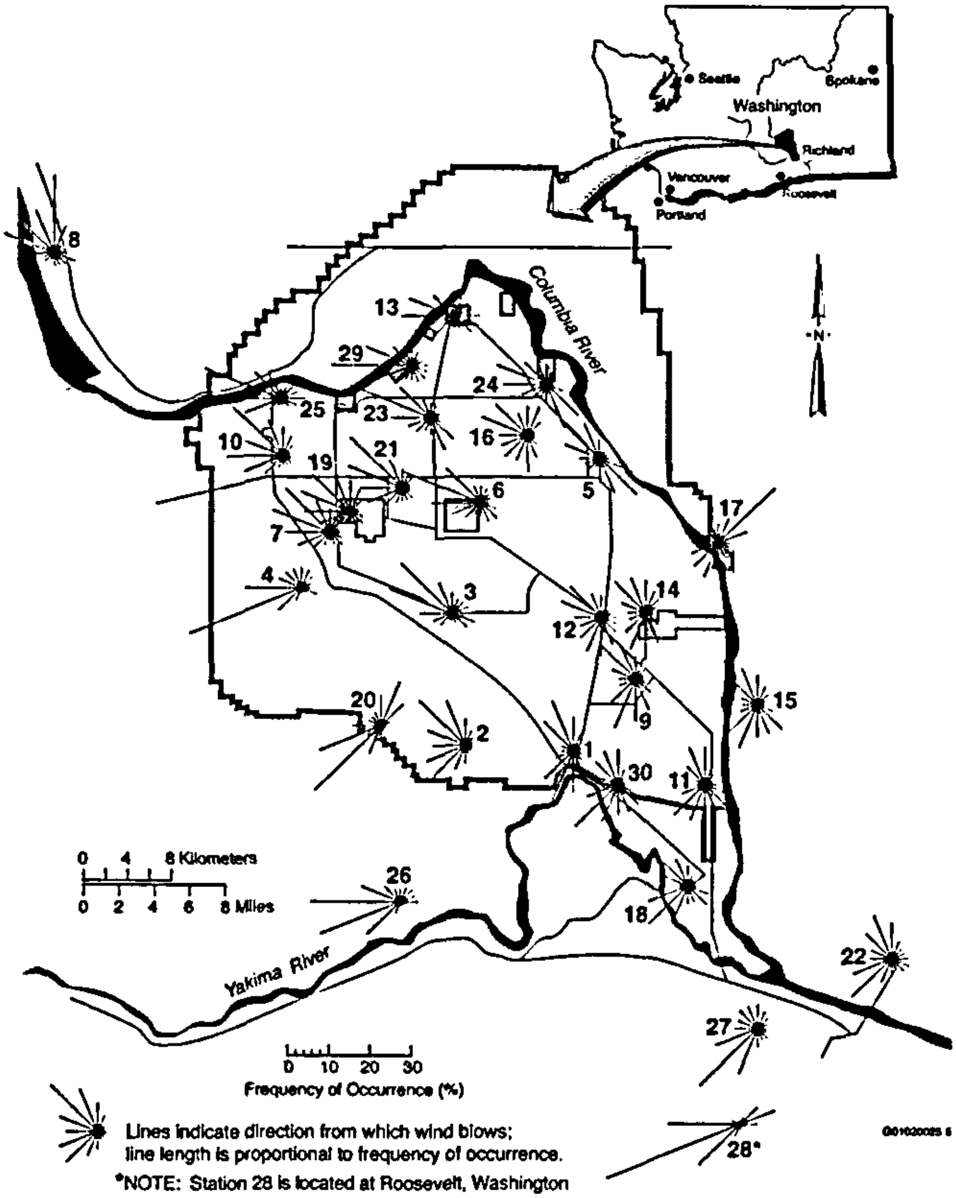


Figure 1-8. Wind Roses at the 60 Meter (197-Foot) Level of the Hanford Meteorological Monitoring Network, 1986 to 2000.

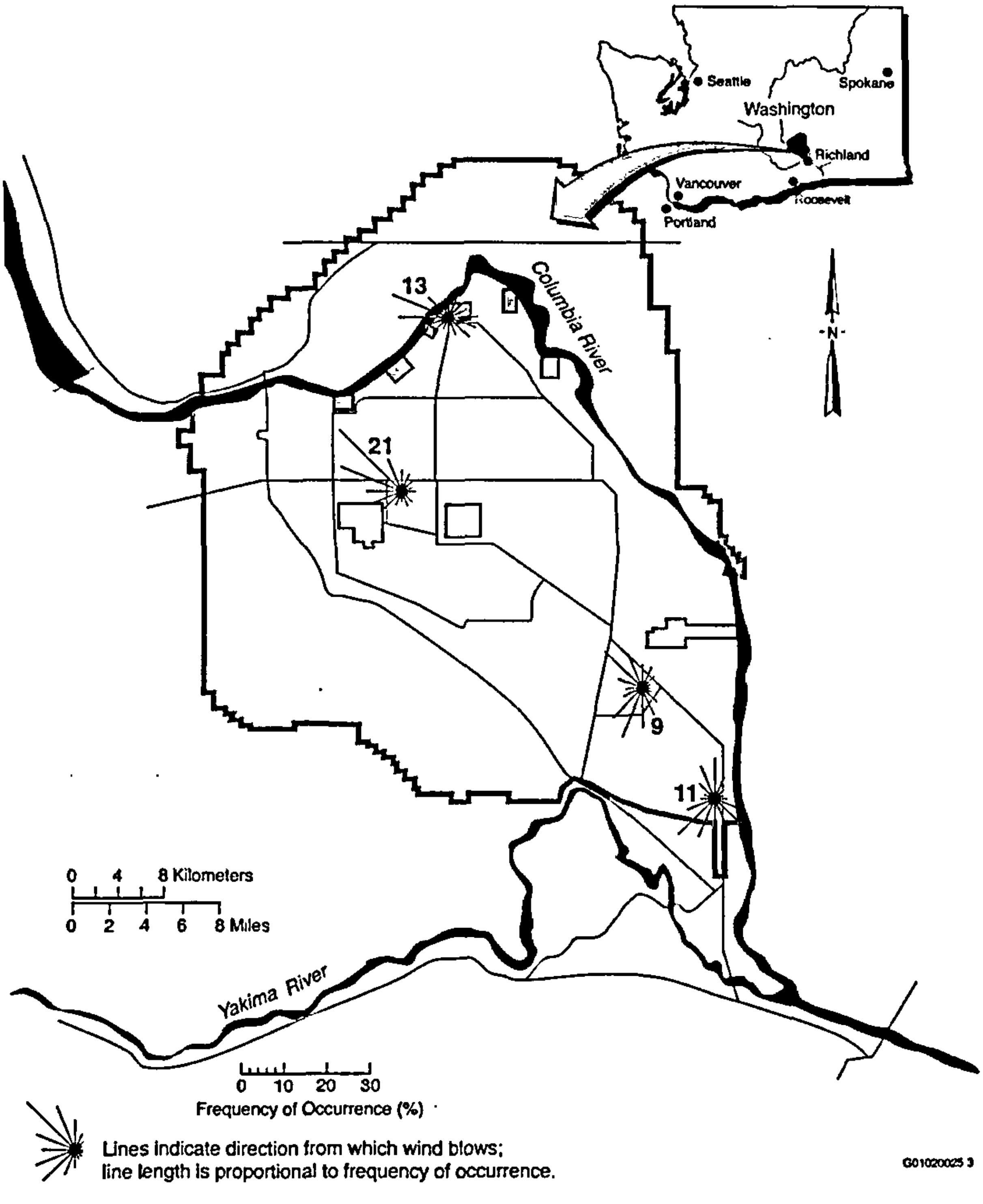
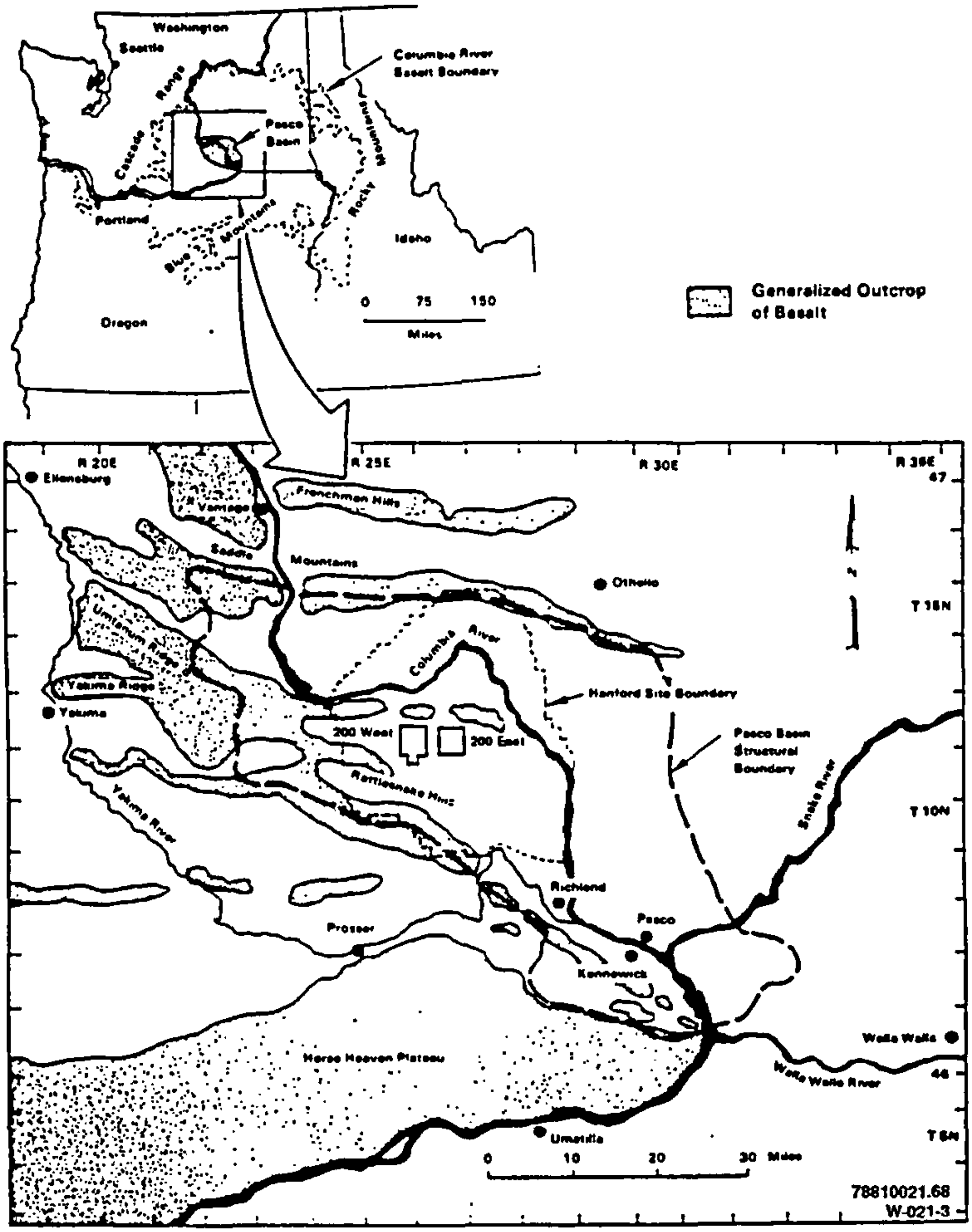


Figure 1-9. Pasco Basin Geologic Setting.



2.0 FACILITY DESCRIPTION

Facility- or activity-specific DSAs provide the information required to fulfill the requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Chapter 2.0.

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3.0 HAZARD AND ACCIDENT ANALYSES

Facility- or activity-specific DSAs provide the information required to fulfill the requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Chapter 3.0.

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4.0 SAFETY STRUCTURES, SYSTEMS, AND COMPONENTS

Facility- or activity-specific DSAs provide the information required to fulfill the requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Chapter 4.0.

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5.0 DERIVATION OF TECHNICAL SAFETY REQUIREMENTS

Facility- or activity-specific DSAs provide the information required to fulfill the requirements of DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Chapter 5.0.

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6.0 PREVENTION OF INADVERTENT CRITICALITY

6.1 INTRODUCTION

This section provides a summary of the criticality safety program specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The criticality safety program described in this section is applicable within the scope of the PHMC (DE-AC06-96RL13200). Facility- or activity-specific DSAs will describe the unique criticality safety program features that are important for preventing criticality accidents.

This program is designed to implement the policy based on Contractor Requirements Document (CRD) O 420.1A, *Facility Safety*, which states the following:

> "Fissionable materials shall be produced, processed, stored, transferred, disposed, or otherwise handled in such a manner that the probability of a criticality accident is acceptably low, and, to the extent practical, all persons, all government, public, and private property, and the environment are protected from damaging effects and undue hazards that may arise from a criticality accident."

Various FH facilities (Hazard Category 2 and 3) contain fissile radionuclide inventories, and the relevant portions of the criticality safety program cover each facility. Operations in these facilities with fissionable materials (which pose a criticality accident hazard) are required to be evaluated and documented to demonstrate that the operation will be subcritical under normal and credible abnormal conditions. Controls are established so that no single credible event or failure can result in a criticality accident having unmitigated consequences. Work must be conducted in accordance with applicable regulations by following the controls to minimize the possibility and consequences of an inadvertent criticality accident and to ensure the safety of the public, workers, and the environment.

In summary, the key attributes of the FH criticality safety program are as follows.

- Operations are conducted such that at least two unlikely, independent, and concurrent changes (contingencies) in processing and/or operating conditions must occur before a criticality accident is possible.
- Handling of fissionable material under normal and credible abnormal conditions is evaluated in criticality safety evaluation reports (CSER). These evaluations also determine the limits, controls, and engineered features necessary to ensure that an acceptable margin of subcriticality is maintained.
- A criticality prevention specification (CPS) is developed based on the results and conclusions from the CSER(s) or other safety basis documents. A CPS provides rules for the safe handling of fissionable material and appropriate criticality safety postings.
- A criticality safety program is maintained and implemented that addresses the requirements of CRD O 420.1A and the referenced American National Standards Institute (ANSI) standards.
- Formal training is required for persons who may be assigned to handle, process, store, or transport more than exempt quantities of fissionable material.

- Criticality safety programs will comply with requirements for criticality accident alarm systems as described in CRD O 420.1A and ANSI/American Nuclear Society (ANS)-8.3-1986, *Criticality Accident Alarm Systems*.

6.2 REQUIREMENTS

The primary requirements for the Project Hanford Team criticality safety program are specified in the following:

- CRD O 420.1A, *Facility Safety*
- 10 CFR 830, "Nuclear Safety Management," Section 204(b)(6).

CRD O 420.1A specifies the application of several standards, which have been implemented within the Project Hanford Team criticality safety program. The standards used to develop the Project Hanford Team criticality safety management program include the following:

- ANSI/ANS-8.1-1983, R88, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*
- ANSI/ANS-8.3-1986
- ANSI/ANS-8.5-1986, *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material*
- ANSI/ANS-8.7-1975, R87, *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials*
- ANSI/ANS-8.15-1981, R87, *Nuclear Criticality Control of Special Actinide Elements*
- ANSI/ANS-8.19-1984, R89, *Administrative Practices for Nuclear Criticality Safety*
- ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*.

Compliance with 10 CFR 830.204(b)(6) is a statutory requirement, and compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

The Hanford Site criticality safety program is defined and fully documented by HNF-7098, *Criticality Safety Program*, and is implemented directly and through facility programs and procedures.

6.3 CRITICALITY CONCERNS

FH facilities are classified into one of five types, depending on the amount and form or distribution of fissionable material present. This allows for a graded approach to the implementation of criticality safety requirements.

- Fissionable Material Facility—A facility in which more than one-half of a minimum critical mass (MCM) of fissionable material is permitted outside the confines of a reactor core.
- Limited Control Facility—A facility that could contain more than one-half of an MCM of fissionable material, but the form or distribution of the material precludes a criticality accident. Or, the probability of occurrence of a criticality accident at this facility is determined to be less than 10^{-6} per year.

- Isolated Facility—A facility that may contain more than 3 percent but less than one-half of an MCM and physically is isolated from other facilities containing fissionable material.
- Exempt D&D Facility—May contain greater than 3 percent but less than or equal to one-half of an MCM and only D&D operations are authorized.
- Exempt Facility—A facility that contains less than 3 percent of an MCM.

The facility classification is documented in the facility DSA and/or CSER. A summary of the criteria used for classifying facilities is provided in Table 6-1.

The specific information pertaining to the amount, form, and location of fissile material is provided in the DSA for each facility.

6.4 CRITICALITY CONTROLS

Criticality controls invoked by FH facilities consist of administrative controls and engineering controls. Inventory controls, container spacing, array spacing, container content characterization using nondestructive examination/nondestructive analysis techniques, and waste acceptance criteria are examples of administrative controls. Physical constraints on form or distribution of material or provision of nuclear poisons constitute engineering controls. These controls are applied, with a preference for engineering controls, to ensure the double contingency principle is satisfied in preventing a criticality accident.

The technical bases for criticality controls are established by CSERs. The purpose of a CSER is to analyze the handling of fissile material and to determine the limits, controls, and engineered safety features necessary to ensure that an acceptable margin of subcriticality is maintained for "normal and credible abnormal conditions" (CRD O 420.1A). An appropriate evaluation is required for any new or modified activity involving fissionable materials that is not in the scope of existing CSERs. This includes activities in which fissionable material is to be handled in a new or modified location, a change in physical form of material to be handled, or a change in storage method. The technical analyses performed in a CSER include requirements for fissionable material form and quantities, neutron moderation, neutron reflection, neutron absorption (poisons), and neutron interactions. Computer codes and cross-section libraries are used to assist in criticality safety analysis.

A CPS is developed based on technical analyses in the CSER. The CPS states the limits and applicable controls that must be observed for criticality safety in a specified area or operation, and rules are provided for the safe handling of fissionable material. Requirements regarding the applicable responsibilities, procedure review, requirements, and content for CPSs are implemented as required by the Project Hanford Team and facility criticality safety programs and procedures. A single CPS may be used to implement limits and controls associated with more than one CSER.

6.4.1 Engineering Controls

Engineering controls are based on physical design limitations placed on equipment size, shape, and location, or on physical limitations of chemical processes. Facility- or activity-specific DSAs and associated criticality safety analyses define engineering controls to be implemented.

Configuration control of engineering controls is maintained as part of the quality assurance (QA) program described in Chapter 14.0 and the Project Hanford Team criticality safety program (HNF-7098, Chapter 9.0). Review by the criticality safety representative (CSR) is required for operational changes, technical procedure changes that could affect criticality safety, drawings, and changes to drawings that could affect criticality safety. Engineering controls relied upon for criticality safety in the CSER may be required to be included in the technical safety requirement (TSR) to ensure their functionality and availability. The need to identify TSRs will be determined in the facility-specific DSA.

6.4.2 Administrative Controls

Administrative controls for criticality safety at FH facilities rely on approved written procedures and the action, judgment, responsibility, and training of personnel. Facility- or activity-specific DSAs and associated criticality safety analyses define administrative controls to be implemented, usually as part of the CPSs.

Inventory limits of fissionable materials are the primary administrative controls used to ensure criticality safety, especially at fissionable material facilities. Sampling, surveying, testing, labeling, and documentation are used to track the mass of fissionable material. Processes and containers are inspected to ensure that they are within the safety envelope (assay, physical inspections, content inventory, etc.).

The possibility of an inadvertent criticality in limited control facilities is minimized by restricting inventory in any process or any single container or array where the form or distribution is subject to change. For isolated facilities, the inventory is at most one-half of an MCM. Containers are identified by record and assay before selection for processing in the areas designated as isolated facilities. Labeling and documentation track the level of fissionable material in containers and process enclosures.

Containers are inspected (nondestructive examination/nondestructive analysis, physical inspections, content inventory, etc.) to ensure the containers are within the analyzed safety envelope and meet waste acceptance criteria (HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*). Project Hanford Team solid waste facilities will not accept any container for storage, processing, or disposal without the proper review and approval to ensure criteria, including criticality limits, are met.

A current inventory is maintained of fissionable material in each isolated facility.

Implementation of the Sitewide criticality safety program usually is identified as an Administrative Control in the TSR for facilities that manage fissile materials. Additional facility-specific Administrative Controls or key programmatic features may be identified in the TSR based on the hazards at the facility and the criticality safety evaluations.

6.4.3 Application of Double Contingency Principle

The double contingency principle maintains that at least two unlikely, independent, and concurrent changes (contingencies) in processing and/or operating conditions must occur before a criticality accident is possible. Even under the circumstance that two contingencies have occurred, a criticality usually would not occur due to the conservative assumptions in the analysis. Having a contingency occur is equivalent to the loss of a barrier to criticality. Double contingency is implemented at FH facilities through the control of process parameters such as fissionable mass limits on containers, distribution of the mass, and control of fissionable mass.

For limited control facilities, double contingency means that the form or distribution of fissile material is such that a criticality clearly is not credible even when two contingencies occur. Or, the probability of occurrence of a criticality accident at this facility is determined to be less than 10^{-6} per year. Specific analyses are required to demonstrate that a criticality is not credible for such a facility, consistent with CRD O 420.1A, Section 4.3.2.e (3).

Double contingency is maintained for fissionable materials at an isolated facility by limiting the total allowable fissionable material to one-half or less of the MCM. More than two concurrent violations are required before a criticality can occur, without taking credit for form or distribution.

A method for determining fissile gram equivalence has been developed to take credit for the distribution of various fissionable isotopes to compare with limits in the CSERs, waste acceptance criteria, and other criticality safety documents for the Project Hanford Team solid waste nuclear facilities.

Project Hanford Team waste container criticality limits and controls usually are based on 100 percent ^{239}Pu. To evaluate different isotopic compositions against a ^{239}Pu criticality mass limit, isotopic masses are converted to an equivalently reactive mass of ^{239}Pu. Conversion factors are the ratio of the ANSI/ANS ^{239}Pu subcritical single-parameter mass to other fissionable isotope subcritical single-parameter masses. This methodology and specific factors are documented in HNF-5134, *CSER 00-005: Determination of Fissile Gram Equivalence for Hanford Solid Waste Operations*. This same methodology and fissile gram equivalence (FGE) factors are used by the Waste Isolation Pilot Plant to accept waste from generators throughout the DOE Complex. At the Hanford Site, additional conversion factors have been determined based on ^{235}U enrichment, taking credit for the poisoning (i.e., neutron absorption) properties of ^{238}U, which remain together absent any isotopic separation process. Other absorbers such as fission products typically are not credited. The Waste Isolation Pilot Plant currently counts ^{235}U as ^{239}Pu on a 1-FGE-for-1-g basis irrespective of enrichment, which is ultra-conservative for depleted or natural uranium.

6.5 CRITICALITY PROTECTION PROGRAM

The Hanford Site criticality safety program is defined and fully documented by HNF-7098 and is implemented through facility programs and procedures. The criticality safety program applicable to FH facilities is applied on a graded basis, and implementation of this program is the responsibility of facility management. This section presents an overview of the FH criticality safety program, including organizational structure, criticality safety plans and procedures, criticality safety training, determination of operational nuclear criticality limits, criticality safety inspections and audits, criticality infraction reporting, and follow-up.

6.5.1 Criticality Safety Organization

The Nuclear and Criticality Safety organization is responsible for the overall coordination, maintenance, and management of the Sitewide nuclear criticality safety program. This organization has the following responsibilities.

- Formulate a nuclear criticality safety policy and make it known to employees involved in operations with fissile material.
- Document the nuclear criticality safety program.
- Verify that facilities use qualified criticality safety engineers to furnish technical guidance appropriate to the scope of operations.
- Review new DOE Orders, technical standards, and industry consensus standards and changes for incorporation into the FH criticality safety program to ensure the Nuclear and Criticality Safety organization maintains current nuclear criticality information.
- Ensure that operations are reviewed at least annually to ascertain that procedures are being followed and that process conditions have not been altered so as to affect the nuclear criticality safety evaluation.
- Verify that validated computation methods for evaluating compliance with FH criticality prevention technical criteria are maintained.
- Verify that emergency procedures are established, maintained, and approved. Verify that local and offsite organizations that are expected to respond to emergencies are made aware of conditions that might be encountered, and that they are receiving assistance in preparing suitable procedures governing their responses.
- Verify that FH provides an adequate criticality safety-training program for fissionable material handlers, supervisors, professionals, and any other workers that require criticality-related training. Verify that the level of knowledge necessary to ensure employees can do their jobs without undue risk is communicated.

Sitewide and facility procedures detail specific responsibilities for facility management, operations, engineering and other support personnel, criticality safety specialists, the CSR, and the facility nuclear safety representative. Primary responsibilities for the facility manager and CSR are described in Chapter 17.0.

6.5.2 Criticality Safety Plans and Procedures

Company and Sitewide criticality safety program plans and procedures have been implemented to control operations involving fissionable materials.

The CSER is used to evaluate the handling of fissionable material under normal and credible abnormal conditions. These evaluations also determine the limits, controls, and engineered features necessary to ensure that an acceptable margin of subcriticality is maintained (see Section 6.5.4). The CSER is prepared and peer reviewed by criticality safety engineers. CSERs are issued as controlled documents containing information such as the introduction and summary of limits and controls, description of the facility or operation, list of requirements uniquely applicable to the evaluation, description of the method of analysis and results, and contingency analysis.

A CPS is developed based on the results and conclusions from the CSER or other safety basis documents. A CPS provides rules for the safe handling of fissionable material and appropriate criticality safety postings. CPSs contain information such as a description of type and form of the fissionable material(s) that can be handled; a description of operations and equipment; specification of additional controls to support the technical limits; and supporting information, including references to the appropriate CSER. CPSs may consolidate requirements from multiple CSERs.

The CPS is used to produce operating procedures and job-specific training at the facility, and often is used directly by operators. Extracting key limits from the CPS and summarizing these limits as an operator aid generate criticality safety limit postings. These postings are placed in conspicuous locations near fissionable material workstations and storage locations in fissionable material facilities and limited control facilities. Isolated facilities have criticality safety limit postings located at all entrances to the facility.

Facility managers at fissionable material facilities, and some limited control facilities, are responsible for having approved CSERs and CPSs and having necessary controls implemented before fissionable material is handled. The facility CSR prepares new or modified CPSs and coordinates the review, approval, and issue of CSERs and CPSs. New or modified CSERs and CPSs are reviewed and approved by several organizations, including criticality safety specialists.

Four fire-fighting categories have been developed as they pertain to criticality safety (HNF-7098, Chapter 12.0). The category depends on the risk for a criticality accident caused by adding water to a fire in a specified area. The fire-fighting category may limit the use of water for fire fighting in facilities containing fissionable material. Facilities (or areas within facilities) are categorized and posted to denote the fire-fighting agents that can be used safely, ranging from no restrictions to prohibiting use of moderators. Standard symbols for each category are defined and requirements for posting and reviewing the fire-fighting categories at each facility have been established. The pre-fire plans incorporate the restrictions identified for each area.

6.5.3 Criticality Safety Training

This section summarizes the criticality safety-training program and training requirements for FH facilities. Chapter 12.0 discusses implementation of the overall Project Hanford Team training program, which includes criticality safety training. Training matrices have been prepared and approved detailing the training required for personnel in various positions.

The purpose of the criticality safety-training program is to provide personnel with an appropriate understanding of the following:

- The importance of criticality safety
- The rules for preventing a criticality when handling, processing, transporting, or storing fissionable material
- Emergency procedures.

Employees and other persons taking the Hanford General Employee Training receive minimum criticality safety training as part of initial orientation training and refresher training programs.

Formal training is required for persons who may be assigned to handle, process, store, or transport more than exempt quantities of fissionable material. FH nuclear operators complete an approved fissionable materials handler course and job-specific orientation for their facility.

Nuclear operators are required to receive formal, specialized training before receiving a work assignment and to possess pertinent experience commensurate with the degree of responsibility and complexity of the work. HNF-7098 provides options to full qualification for facilities in which a criticality has been determined to be not credible.

More detailed knowledge of nuclear criticality is expected of managers, supervisors, and engineers who directly supervise the handling of fissionable material or perform engineering functions that require expertise and understanding of criticality safety requirements. This may include safety or QA managers or engineers who perform oversight or audits of criticality safety programs and professionals who perform a screening role in the acceptance or verification of fissile materials. Each position is evaluated by management and appropriate requirements are established in the training matrix for the individual. This may include job-specific orientation for the facility being supported.

To function properly as the facility subject matter expert for criticality safety and the programmatic requirements, the CSR and any alternates require training beyond that required for managers and engineers. The CSR must have detailed understanding of the CPSs and supporting CSERs. This may require outside formal courses or self-study. Additional criticality safety training primarily is through independent study, which may include facility-specific information, specialized seminars, technical analysis, or review of various subject-specific materials provided by criticality safety specialists. CSR certification requires a formal qualification board and periodic re-certification. CSRs attend training meetings to stay current on criticality issues.

6.5.4 Determination of Operational Nuclear Criticality Limits

Facility-specific CSERs establish the technical bases for criticality limits for the operation. Analytical methods used to determine criticality safety limits are validated by comparison with known critical or subcritical systems.

Many calculational methods, including various computer codes, are available and suitable for determining the effective neutron multiplication factor of a system or for deriving subcritical limits. The available computer codes range from one-dimensional codes, which can describe single units, to three-dimensional codes, which can describe complex geometries. Computer codes used for criticality safety evaluations are required to comply with Sitewide software control standards.

Other methods and sources, including hand calculations, standard tables, and national standards subcritical values, also may be used in determining criticality safety limits. Normally, these are used for backup or scoping studies, but they can be used to determine if criticality limits are properly validated and applied under appropriate conditions. Method and data validation requirements are based on ANSI/ANS-8.1-1983.

The CSER describes the calculational methods used in the criticality safety analysis. In general, this documentation in the CSER is required to provide the technical reviewer with sufficient information to judge the applicability and accuracy of the results. Specific requirements for CSERs are contained in HNF-7098, Chapter 4.0.

The limits from the CSER are incorporated into the facility or process CPS, which collects and provides for implementation the limits established in one or more CSERs (HNF-7098, Chapter 5.0). The CPS is a Hanford Site mechanism used to ensure that criticality safety controls are contained in operating procedures (ANSI/ANS-8.1-1983). The CPS contains the limits for the process or facility in terms understandable to the operator, is used for training, and is available in the operating area.

6.5.5 Criticality Safety Inspections and Audits

The criticality safety inspection and assessments program is composed of operational reviews, programmatic reviews, and annual independent assessments.

Facility personnel perform operational reviews on a monthly schedule for fissionable material facilities and on a quarterly schedule for limited control and isolated facilities. Each applicable facility uses a written inspection plan and detailed inspection checklist for documenting the inspection process and results. The completed inspection report is distributed to the facility manager, the facility CSR, and the criticality safety program manager. Inspection records are retained in accordance with the facility records retention plan.

FH Nuclear and Criticality Safety personnel perform programmatic reviews on an annual schedule for fissionable material and limited control facilities, and on a biennial schedule for isolated facilities. The inspection is performed based on criteria checklists developed from the criticality safety requirements specified in DOE Orders and ANSI/ANS standards. In particular, the programmatic review inspection functions to ensure that the facility is being operated within the proper category of criticality safety control, facility internal inspection programs are functioning effectively, and that any identified corrective actions have been completed. The programmatic review inspection is concluded with a formal, written report provided to the facility manager.

A group of criticality safety professionals, including CSRs and criticality safety engineers, performs Annual Independent Assessments. The FH Nuclear Criticality Safety organization is responsible for organizing and conducting the Annual Independent Assessments. These assessments are performed at all facilities containing more than an exempt quantity of fissionable material. The annual independent assessment functions as a top-level, double check to ensure that the facility is following the requirements of the Hanford Site criticality safety program. The assessment concludes with an exit meeting and a formal, written report is provided to the facility managers.

6.5.6 Criticality Infraction Reporting and Follow-Up

Operating organizations that are custodians for fissionable material are responsible for appropriate notifications of nonconformance with a CPS, CSER, or facility limits and for obtaining technical assistance, as specified in Sitewide programs and procedures (HNF-7098, and HNF-PRO-060, *Reporting Occurrences and Processing Operations Information*). The responsible manager makes the notification of nonconformance as required by the severity of the nonconformance as determined in accordance with HNF-7098, Chapter 14.0. The occurrence notification process is further described in Section 17.4.3 of this document. The facility CSR assists facility management in determining potential nonconformance and coordinating the planned recovery actions. The CSR also is responsible for documenting the technical basis for the evaluation of the nonconformance and may develop a "lessons learned" report of the nonconformance for distribution to other facilities and other sites, as appropriate.

6.6 CRITICALITY INSTRUMENTATION

Criticality instrumentation may consist of a criticality detection system and/or a criticality alarm system (CAS). A CAS consists of a criticality detection system and a personnel evacuation alarm. The justification for installation of criticality instrumentation is based on a DOE-approved DSA for applicable facilities. ANSI/ANS-8.3-1986 defines the minimum fissionable material inventory limits for determining the need of a criticality detection system or CAS. If a facility or operational area contains fissionable material inventory exceeding these limits, but a criticality accident is determined to be impossible due to the physical form of the material, or the probability of occurrence is determined to be less than 1×10^{-6} per year, neither a CAS nor a criticality detection system is required.

Criticality detection systems are required in facilities or operational areas where the mass of fissionable materials exceeds the limits of ANSI/ANS-8.3-1986, and the probability of criticality occurrence has been determined to be greater than 1×10^{-6} per year.

CAS requirements apply to any operation or facility in which the mass of fissionable materials exceeds the limits of ANSI/ANS-8.3-1986, the probability of criticality occurrence has been determined to be greater than 1×10^{-6} per year, and there are occupied areas in which the expected dose exceeds 12 rad in free air. Exceptions to the requirement for a CAS are provided in CRD O 420.1A. The purpose of the CAS is to alert personnel within the coverage area if a criticality event occurs, permitting timely evacuation to limit radiation exposure. Criticality alarm drills shall be conducted at least annually to maintain personnel familiarity with emergency evacuation procedures.

Facility-specific criticality instrumentation system details, detector types, coverage areas, and testing requirements are provided in the DSA for each facility.

6.7 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

ANSI/ANS-8.1-1983, R88, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.3-1986, *Criticality Accident Alarm Systems*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.5-1986, *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.7-1975, R87, *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.15-1981, R87, *Nuclear Criticality Control of Special Actinide Elements*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.19-1984, R89, *Administrative Practices for Nuclear Criticality Safety*, American National Standards Institute/American Nuclear Society, Washington, D.C.

ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*, American National Standards Institute/American Nuclear Society, Washington, D.C.

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DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-5134, 2000, *CSER 00-005: Determination of Fissile Gram Equivalence for Hanford Solid Waste Operations*, Rev. 0, Fluor Hanford, Inc., Richland, Washington.

HNF-7098, 2003, *Criticality Safety Program*, Rev. 3, Fluor Hanford Inc., Richland, Washington.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-EP-0063, 2003, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 9, Fluor Hanford Inc., Richland, Washington.

HNF-PRO-060, *Reporting Occurrences and Processing Operations Information*, Richland, Washington.

TABLES

Table 6-1. Criticality Safety Program, Summary of Facility Classification Criteria.

Classification Characteristic	Fissile Material Facility	Limited Control Facility	Isolated Facility	Exempt Facility	Exempt D&D
Facility inventory	>1/2 MCM	>1/2 MCM	>3% but <1/2 MCM	<3% MCM	<1/2 MCM
Form and distribution preclude criticality	NA	Yes	NA	NA	NA
Criticality alarm system	Yes[a]	No	No	No	No
Documentation	DSA	CSER or DSA	CSER, DSA, or letter	None	Director, N&CS
Six foot of isolation from other sources of fissionable material	No	No	Yes	No	No
Criticality prevention specifications	Yes	Maybe[b]	No	No	No
Criticality safety postings	Yes	Yes	Yes	No	Yes
Labeling	Yes	Yes	Yes	Yes[c]	Yes
Criticality safety for fire fighting	Yes	Yes	No	No	No

Adapted from HNF-7098, 2003, *Criticality Safety Program*, Chapter 1.0, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

[a]Exceptions to the requirement for a criticality alarm system are provided in DOE O 420.1, *Facility Safety*, U.S. Department of Energy, Washington, D.C.

[b]The need for criticality prevention specifications at limited control facilities is determined on a case-by-case basis.

[c]Exempt facilities are exempt from the requirements of HNF-7098, 2003, *Criticality Safety Program*, Rev. 3, Fluor Hanford Inc., Richland, Washington.

CSER = criticality safety evaluation report.
D&D = decontamination and decommissioning.
DSA = documented safety analysis.
MCM = minimum critical mass.
N&CS = Nuclear and Criticality Safety.
NA = not applicable.

7.0 RADIATION PROTECTION

7.1 INTRODUCTION

This section provides a summary of the radiation protection program specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* The radiation protection program described in this section is applicable within the scope of the PHMC (DE-AC06-96RL13200). Facility- or activity-specific DSAs will describe the unique features that are important for preventing or mitigating radiation exposure.

In summary, the key attributes of the FH radiation protection program for safety analysis purposes are as follows.

- Administrative control levels and dose limits, including processes for planned special exposures, are established that meet the requirements of 10 CFR 835, "Occupational Radiation Protection."
- Environmental release of radiological materials is prevented, monitored, and controlled as required by DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*
- The as-low-as-reasonably-achievable (ALARA) process is used for personnel exposures to ionizing radiation.
- The primary methods used to maintain exposure in controlled areas ALARA are physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls are employed only as supplemental methods to control radiation exposure.
- Potential personnel exposure to ionizing radiation is monitored and measured as required by 10 CFR 835.
- Training requirements are specified for general employees, radiation workers, radiation control technicians, supervisors, and managers involved in operations or maintenance activities where radiological protection is required.
- Radioactivity is contained at the source using engineering controls and work practices to limit the need for respiratory protection use. Where respiratory protection is used, ANSI Z88.2, *Respiratory Protection,* and 29 CFR 1910.134, "Respiratory Protection," are applied, including the associated training of personnel.
- A program of preventive and corrective maintenance for radiological instrumentation is established and documented. Radiological instruments undergo calibration before use following any preventive or corrective maintenance or any adjustment that voids the previous calibration. Calibration facility staff perform inspections, calibrations, performance tests, calibration equipment selection, and QA in accordance with the recommendations of ANSI N323, *Radiation Protection Instrumentation Test and Calibration.* Functional tests are performed to periodically test components involved in alarm or trip functions. Calibrations use National Institute of Standards and Technology traceable sources. Calibration frequencies are determined in accordance with National Conference of Standards Laboratories Recommended Practice RP-1, *Establishment and Adjustment of Calibration Intervals.*

- Radiological control records are maintained as necessary to document compliance with 10 CFR 835 and with radiation protection programs required by 10 CFR 835.101.

7.2 REQUIREMENTS

The radiation protection requirements for FH facilities are provided in the following:

- 10 CFR 835
- HNF-SP-1145, *FH Radiation Protection Program*
- DOE/RL-2002-12, *Hanford Radiological Health and Safety Document*
- Radiation protection functional area of HNF-8663, *Standards/Requirements Identification Document*, including the requirements of DOE Order 5400.5.

Radiological requirements are statutory requirements derived from 10 CFR 835. Compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

7.3 RADIATION PROTECTION PROGRAM AND ORGANIZATION

HNF-5173, *PHMC Radiological Control Manual*, describes implementation within the scope of the PHMC for the requirements of 10 CFR 835 and DOE/RL-2002-12, the commitments of HNF-SP-1145, and the requirements of the radiation protection functional areas. HNF-5173 describes the organization and functional responsibilities for radiological control, documents the radiological control program structure, and defines the radiological control management systems necessary to implement the program. FH develops additional implementing procedures for application by FH facilities, or in some cases, individual facilities develop radiological control procedures to implement some aspects of the radiological control program.

The fundamental principle underlying the radiological control program is derived from 52 FR 1716, "Radiation Protection Guidance to the Federal Agencies for Occupational Exposure," which states:

> "There should not be any occupational exposure of workers to ionizing radiation without the expectation of an overall benefit from the activity causing the exposure."

The radiological control policy has the following elements.

- The ALARA process will be used for personnel exposures to ionizing radiation.
- The anticipated occupational exposure to general employees will not exceed the limits established in the radiological control program.
- Activities should be ALARA and each person involved in radiological work is expected to participate in the identification, evaluation, control, and communication of potential hazards and radiological impacts relative to the risk and complexity of work operations or tasks. Feedback and continuing improvement are essential to maintaining excellence in radiological control.
- Excellent performance is evident when radiation exposures and radioactive contamination are maintained ALARA.

The organizational structure for the radiation protection program is described in HNF-5173. The organization summary is provided in Chapter 17.0. Further discussion of the organization also is provided in HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description.*

7.4 ALARA POLICY AND PROGRAM

The Project Hanford Team radiological control program establishes the ALARA policy and program requirements. The radiological control policy is provided in Section 7.3, and ALARA requirements are integrated within the Project Hanford Team radiological control program. The Project Hanford Team radiological control program specifies that the ALARA process is a fundamental requirement of the radiological control program. Projects or activities establish administrative control levels below the regulatory limits to help reduce individual and collective radiation dose. Administrative control levels are assigned in a graded approach as shown in Table 7-1. Optimization methods are used to ensure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls. Measures are taken to maintain radiation exposure ALARA through physical design features and administrative control. The primary methods to maintain exposure in controlled areas ALARA are physical design features. Administrative controls only are employed as supplemental methods to control radiation exposure.

7.5 RADIOLOGICAL PROTECTION TRAINING

The Project Hanford Team radiological protection program specifies requirements for training general employees, radiation workers, radiation control technicians, supervisors, and managers involved in operations or maintenance activities where radiological protection is required. The Project Hanford Team radiological control program requires that individuals responsible for developing and implementing measures necessary for ensuring compliance with the requirements of the Project Hanford Team radiological control program have the appropriate education, training, and skills to discharge these responsibilities.

Radiation safety training includes the following topics, to the extent appropriate to each individual's prior training, work assignments, and degree of exposure to potential radiological hazards: risks of exposure to radiation and radioactive materials, including prenatal radiation exposure; basic radiological fundamentals and radiation protection concepts; physical design features, administrative controls, limits, policies, procedures, alarms, and other measures implemented at the facility to manage doses and maintain doses ALARA, including routine and emergency actions; individual rights and responsibilities as related to implementation of the facility radiation protection program; individual responsibilities for implementing ALARA measures; and individual exposure reports that may be requested.

Specific training and qualifications (as appropriate) are based on the work performed by the individual. Each individual completes General Employee Radiological Training before being permitted unescorted access to controlled areas and before receiving occupation dose during access to controlled areas. Before being permitted unescorted access to radiological areas and before performing unescorted assignments as a radiological worker, each individual completes Radiological Worker I, Radiological Worker II, or specialized radiological worker training (as needed) augmented by project- and activity-specific training. Radiological control technicians are trained and qualified and receive continuing training. Radiological control technician supervisors are trained and qualified. Subcontracted radiological control technicians are required to have the same knowledge and qualifications required of facility technicians performing the same duties. Line managers who manage, supervise, or provide oversight of radiological control programs are trained and receive continuing training in the requirements of 10 CFR 835 and the Project Hanford Team radiological control program. Radiological technical staff and management who are responsible for implementing measures necessary for ensuring compliance with 10 CFR 835 have appropriate training. Work planners who develop detailed work plans involving or associated with radioactivity or radioactive materials have the same level of training as that required for the workers using the work plans. Radiation-generating device operators have training appropriate for the radiation source involved and similar to that described in 10 CFR 34.43 (g), "Training." Emergency response personnel receive special radiological worker training commensurate with the situations they are likely to encounter. Individuals authorized to perform emergency actions likely to result in occupational doses exceeding radiological control program limits are trained and briefed beforehand on the known or anticipated hazards to which the individual will be subjected.

7.6 RADIATION EXPOSURE CONTROL

This section summarizes the plans and procedures for controlling external occupational exposure to radiation, spread of contamination, and inhalation or ingestion of radioactive materials.

7.6.1 Administrative Limits

The Project Hanford Team radiological control program establishes administrative control limits and dose limits, including processes for planned special exposures.

Table 7-1 provides the total effective dose equivalent (TEDE) administrative control levels that have been established in the Project Hanford Team radiological control program. Table 7-2 provides the TEDE dose limits have been established in the Project Hanford Team radiological control program.

A planned special exposure may be authorized for a radiological worker to receive doses in addition to and accounted for separately from the doses received under the limits for general employees. The Project Hanford Team radiological control program requirements for planned special exposures specify that such exposure may be considered only in exceptional circumstances when alternatives that might prevent a radiological worker from exceeding the dose limits are unavailable or impractical; project or activity management requests the planned special exposure in writing; the proposed activity has been reviewed by the FH Radiation Protection Director; and joint written approval is received from the DOE-Headquarters program office and the Secretarial Officer responsible for S&H matters.

7.6.2 Radiological Practices

The Project Hanford Team radiological control program establishes requirements for exposure controls including generic precautions for conducting radiological tasks, special personnel protective equipment, engineered controls, and the use of radiological work permits (RWP). The Project Hanford Team radiological control program also specifies posting and labeling requirements. The objective of this combination of radiological practices is to ensure that the anticipated occupational dose to general employees does not exceed the dose limits of the Project

Hanford Team radiological control program (see Table 7-1), and that the ALARA process is used for personnel exposures to ionizing radiation.

Measures are taken to maintain radiation exposure in controlled areas ALARA through physical design features and administrative control. The primary methods used to maintain exposure in controlled areas ALARA are physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls are employed only as supplemental methods to control radiation exposure.

Radiological requirements may be implemented as part of the RWP process for routine radiological tasks such as tours and minor nonradiological maintenance. Minimum trigger levels are established that will cause formal, documented radiological review of non-routine or complex activities. Radiological requirements identified as part of the radiological review are documented in job plans, procedures, or work packages. Radiological work that is anticipated to exceed individual or collective dose criteria are reviewed and approved by a Project/Activity ALARA Committee.

RWPs are used to control entry into high and very high radiation areas; entry into high contamination areas; entry into areas with airborne radioactivity levels exceeding or potentially exceeding 0.1 derived air concentration (DAC); entry into radiation areas; entry into contamination areas; and handling materials with removable contamination exceeding the values specified in the Project Hanford Team radiological control program.

The RWP content is specified by the Project Hanford Team radiological control program and includes a description of the work; work area radiological conditions; dosimetry requirements; pre-job briefing requirements; training requirements for entry; protective clothing and respiratory protection requirements; radiological control coverage requirements and stay-time controls; limiting radiological conditions that may void the RWP; and special dose or contamination reduction considerations.

Radiation areas, high radiation areas, very high radiation areas, and hot spots are posted to alert personnel to the presence of external radiation using criteria specified in the Project Hanford Team radiological control program. The requirement for personnel dosimetry is included on the posting, and the requirement for an RWP is included on or in conjunction with the posting. Similar types of requirements and criteria are established in the Project Hanford Team radiological control program for posting contamination, high contamination, airborne radioactivity, radioactive material areas, and underground radioactive material areas.

7.6.3 Dosimetry

The Project Hanford Team radiological control program establishes external and internal dosimetry requirements. The Project Hanford Team radiological control program specifies external dose criteria when personnel dosimeters for measuring external radiation are provided and required to be used by individuals. Personnel dosimetry requirements have been established for radiological workers, declared pregnant workers, occupationally exposed minors, and the public. Area-monitoring dosimeters are used to record and document radiation levels in routinely occupied areas adjacent to areas where radiation or operations with radiation exist. Nuclear accident dosimetry is provided in installations that possess sufficient quantities of fissile material to potentially constitute a critical mass.

The Project Hanford Team radiological control program also specifies intake doses when internal dosimetry programs (including bioassay programs) are conducted. Internal dosimetry requirements have been established for radiological workers, declared pregnant workers, occupationally exposed minors, and the public. The estimation of internal dose is based on bioassay data rather than air concentration data unless bioassay data are unavailable, inadequate, or internal dose estimates based on air concentration values are demonstrated to be as or more accurate. Bioassay analyses also are performed when any of the following occurs: facial or nasal contamination is detected that indicates a potential for internal contamination; airborne monitoring indicates the potential for intakes exceeding 100 mrem committed effective dose equivalent; or when directed by the Radiological Control organization. Records of the dosimetry program and dosimetry records are maintained as described in Section 7.9.

7.6.4 Respiratory Protection

The Project Hanford Team radiation protection program establishes respiratory protection requirements, which are implemented in FH procedures. The Project Hanford Team radiological control program requires that radioactivity be contained at the source using engineering controls and work practices to limit the need for respiratory protection use. Where respiratory protection is used, ANSI Z88.2 and 29 CFR 1910.134 are applied, including the associated training of personnel. Respirators only are issued to personnel who are trained, fitted, and medically qualified to wear the specific type of respirator. Additional respiratory protection program requirements are described in Section 8.6.4. The respiratory protection program prescribes the types of respiratory protection equipment and their usage in normal, abnormal, and accident conditions. Respiratory protection program records are maintained as required by the respiratory protection program.

7.7 RADIOLOGICAL MONITORING

The Project Hanford Team radiological control program establishes radiological monitoring requirements, including airborne radiological monitoring requirements. The Project Hanford Team radiological control program requires that radiological monitoring be performed to demonstrate compliance with radiological program requirements, document radiological conditions, detect changes in radiological conditions, detect gradual buildup of radioactive material, verify the effectiveness of controls, and identify and control potential sources of radiation. Instruments to perform radiological monitoring are available and calibrated on an established frequency. Survey frequencies are established based on potential radiological conditions, probability of change in conditions, and area occupancy factors. The monitoring results are made available to line management and used in support of pre- and post-job evaluations, ALARA preplanning, contamination control, and management of radiological control operations. Monitoring data in each building or area are compiled and reviewed at least quarterly. Changes or trends are noted and corrective actions assigned. Recordkeeping requirements are discussed in Section 7.9. Environmental monitoring also is performed to address environmental permit conditions such as those specified by the *Clean Air Act*. Collection of meteorological data is discussed in Chapter 1.0.

7.8 RADIOLOGICAL PROTECTION INSTRUMENTATION

The Project Hanford Team radiological control program establishes requirements for radiological protection instrumentation selection and placement criteria, calibration, and QA for calibration and maintenance. The instruments used for radiological monitoring are required to be periodically maintained and calibrated at an established frequency; appropriate for the type(s), levels, and energies of the radiation encountered; appropriate for the environmental conditions; and routinely tested for operability on a specified frequency commensurate with their application.

Area radiation monitors are installed in frequently occupied locations with the potential for unexpected increases in dose rates and in remote locations where there is a need for local indication of dose rate before personnel enter remote locations.

Monitoring of airborne radioactivity is performed where an individual likely is to receive an exposure of 40 or more DAC-hours in a year, and as necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed. Real-time air-monitoring equipment is installed where unexpected increases in airborne radioactivity levels, should they occur, likely are to result in an exposure exceeding 40 DAC-hours in 1 week. Air-sampling equipment is positioned to measure air concentrations to which persons are exposed. Continuous air-monitoring equipment required for use by the radiological control program has an alarm capability and sufficient sensitivity to alert personnel that immediate action is required. The proper operation of continuous air-monitoring equipment is verified daily by performing an operational check.

FH facilities that possess sufficient quantities of fissile material to potentially constitute a critical mass provide nuclear accident dosimetry. Nuclear accident dosimetry provides a method to conduct initial screening of individuals to determine whether significant exposure to radiation occurred; methods and equipment for analysis of biological materials; a system of fixed nuclear accident dosimeter units; and personal nuclear accident dosimeters.

Staff at calibration facilities perform inspections, calibrations, performance tests, calibration equipment selection, and QA in accordance with the recommendations of ANSI N323. Functional tests are performed to periodically test components involved in alarm or trip functions. Calibrations use National Institute of Standards and Technology traceable sources. Calibration frequencies are determined in accordance with National Conference of Standards Laboratories Recommended Practice RP-1.

A program of preventive and corrective maintenance for radiological instrumentation is established and documented. Radiological instruments undergo calibration before use following any preventive or corrective maintenance or any adjustment that voids the previous calibration.

7.9 RADIOLOGICAL PROTECTION RECORDKEEPING

The Project Hanford Team radiological control program specifies radiological control recordkeeping requirements. Radiological control records are maintained as necessary to document compliance with 10 CFR 835 and with radiation protection programs required by 10 CFR 835.101. In summary, the radiological records management program includes radiological policy statements; radiological control procedures; individual radiological doses;

internal and external dosimetry policies and procedures; personnel training; ALARA records; radiological instrumentation test, repair, and calibration records; radiological surveys; air-monitoring dosimetry results; RWPs; and radiological performance indicators and assessments.

The radiological control records are required to be accurate and legible, and they are maintained in accordance with the Project Hanford Team QA program (see Chapter 14.0). The FH document control program provides provisions to ensure that records are reviewed for accuracy, approved for release by authorized personnel, and distributed to and used at the locations where required and needed. The radiological records are required to include identification of the facility, specific location, function, and process; signature of the preparer and date; and supervisory signature.

7.10 OCCUPATIONAL RADIATION EXPOSURES

The onsite collective occupational dose is provided in Table 7-3, and the environmental exposure to the hypothetical radiological dose to the maximum exposed individual from all pathways is provided in Table 7-4. This table shows that offsite radiological dose from FH activities has been small in comparison to DOE and federal requirements.

7.11 REFERENCES

10 CFR 34.43 (g), "Training," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910.134, "Respiratory Protection," *Code of Federal Regulations*, as amended.

52 FR 1716, 1987, "Radiation Protection Guidance to the Federal Agencies for Occupational Exposure," signed by President Reagan, January 20.

ANSI N323, *Radiation Protection Instrumentation Test and Calibration*, American National Standards Institute, Washington, D.C.

ANSI Z88.2, *Respiratory Protection*, American National Standards Institute/American Nuclear Society, Washington, D.C.

Clean Air Act, 1955, 42 USC 7401, et seq.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

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HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-SP-1145, 2003, *FH Radiation Protection Program*, Fluor Hanford, Inc., Richland, Washington.

RP-1, *Establishment and Adjustment of Calibration Intervals*, National Conference of Standards Laboratories, Boulder, Colorado.

TABLES

Table 7-1. Summary of Radiation Exposure Administrative Control Levels.

Administrative Control Levels				
Maximum Dose Equivalent (Annual), mrem				
TEDE	**Skin and Extremity[a]**	**Lens of Eye[a]**	**Any Organ[a]**	**Approval Required to Exceed this Level[b]**
500	15,000	4,500	15,000	Level 3 Project/Activity Line Manager and RCM[c]
1,000	22,500	6,750	22,500	Level 2 Project/Activity Line Manager and FH Radiological Control Director
1,500	30,000	9,000	30,000	FH VP of S&H
2,000	--	--	--	RL Site Manager
Age x 1,000 = lifetime TEDE				Level 1 Line Manager and RCM

[a]The values are based on the nonstochastic limit and are calculated as committed doses.
[b]Approvals are sequential.
[c]Approval may be delegated within the Radiological Control organization.

FH = Fluor Hanford.
RCM = Radiological Control Manager.
RL = U.S. Department of Energy, Richland Operations Office.
S&H = Safety and Health.
TEDE = total effective dose equivalent.
VP = Vice President.

Table 7-2. Summary of Radiation Exposure Dose Limits.

Summary of Dose Limits	
Type of Exposure	**Annual Limit**
General employee: whole body TEDE (internal + external)	5 rem
General employee: lens of eye	15 rem
General employee: skin and extremities (shallow dose equivalent)	50 rem
General employee: any organ or tissue (other than lens of eye) (internal + external)	50 rem
Declared pregnant worker: embryo/fetus (internal + external)	0.5 rem per gestation period
Minors occupationally exposed: whole body TEDE (internal + external)	0.1 rem
Minors occupationally exposed: lens of eye, skin and extremities	10% of general employee limits

TEDE = total effective dose equivalent.

Table 7-3. Collective Dose.

Year	Person-rem*
1997	118 rem
1998	103 rem
1999	145 rem
2000	172 rem
2001	166 rem

*Collective dose includes the U.S. Department of Energy, Office of River Protection through September 30, 1999.

Table 7-4. Calculated Dose to the Hypothetical, Maximally Exposed Individual.

Year	mrem
1997	0.011
1998	0.022
1999	0.0079
2000	0.014
2001	0.048

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8.0 HAZARDOUS MATERIAL PROTECTION

8.1 INTRODUCTION

This section provides a summary of the programs that provide protection from hazardous materials specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The hazardous material protection programs described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200). Facility- or activity-specific DSAs will identify hazardous material concerns and any unique controls to prevent or mitigate the spread of these materials.

In summary, the key attributes of the FH hazardous material protection program for safety analysis purposes are as follows.

- The Integrated Environment, Safety, and Health Management System (ISMS) process identifies the work to be performed, potential hazards with immediate or latent effects, and required controls to prevent or mitigate accidents.
- A hazard communication program is implemented that is consistent with the requirements of 29 CFR 1910.1200.
- Administrative and engineering controls are implemented to reduce planned exposures to hazardous materials below the exposure levels authorized by the Occupational Safety and Health Administration (OSHA), the DOE, or other competent authority.
- Controls to limit exposure are applied with the following hierarchy: (1) engineered controls, (2) work practices and administrative controls that limit worker exposures, and (3) personal protective equipment.
- Chemicals are tracked from acquisition, through storage and use, to their final disposition, and appropriate chemical hazard analyses are performed.
- Work place hazards and job hazards are evaluated.
- Employees receive introductory training with respect to hazardous materials in the Hanford General Employee Training. Facility-specific training is provided as required to meet the requirements of 29 CFR 1910.1200.
- FH employees and subcontractors working onsite who potentially are exposed to hazardous substances during covered hazardous waste operations receive initial and refresher training consistent with the requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."
- A respiratory protection program is implemented based on the requirements of ANSI Z88.2, *Respiratory Protection*, and 29 CFR 1910.134, "Respiratory Protection."
- Fitness-for-work physicals, monitoring worker exposures, and first aid services are provided through an occupational medical program.

8.2 REQUIREMENTS

The hazardous material protection requirements for the Project Hanford Team are provided in the following:

- 10 CFR 850, "Chronic Beryllium Disease Prevention Program"
- HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*
- Occupational safety and health chapter of HNF-8663, *Standards/Requirements Identification Document.*

Compliance with 10 CFR 850 is a statutory requirement, and compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

8.3 HAZARDOUS MATERIAL PROTECTION PROGRAM AND ORGANIZATION

Hazardous material protection is implemented as part of the FH ISMS described in HNF-MP-003. The ISMS process is used to identify the work to be performed and potential hazards associated with that work, including potential exposures to hazardous materials and carcinogens. The potential exposures to hazardous materials associated with this work are evaluated and appropriate engineered and administrative controls established to ensure personnel are not exposed in excess of exposure limits. In addition, each employee receives an Employee Job Task Analysis (EJTA). The EJTA identifies potential exposures to hazardous materials and carcinogens associated with the work performed by this employee. The EJTA is used to identify monitoring and training requirements, and aids in the development of engineered and administrative controls to limit exposures to hazardous materials.

A guiding principle of the FH ISMS is that line management is responsible for safety and environmental performance. Line management includes those managing or supervising workers performing work. Organizational structure, roles and responsibilities, and interfaces are further described in Chapter 17.0 and in HNF-MP-001, *Fluor Hanford Management Plan.*

The primary mechanism for integrating S&H controls and requirements into work being performed is the job hazard analysis process described in HNF-PRO-079, *Job Hazard Analysis.* The job hazard analysis process describes how:

- The scope of work is defined
- Hazard, environmental impacts, and S&H requirements are identified
- Hazards are analyzed and controls implemented
- Work is performed within controls
- Feedback and continuous improvement are achieved.

Requirements for controlling exposure to potentially hazardous chemicals also are specified in HNF-PRO-10468, *Chemical Management Process.* The FH chemical management program includes the following requirements.

- Chemical management operations are maintained in compliance with the facility authorization agreement.

- Personnel who use chemicals, or potentially could be exposed to chemicals, are provided with appropriate training.
- Chemical information, such as inventory, hazards, and Material Safety Data Sheets (MSDS), is available.
- Chemicals are tracked from acquisition, through storage and use, to their final disposition.
- Appropriate hazard analyses are performed.
- Controls are applied in the following hierarchy: (1) engineering controls, (2) administrative controls, and (3) personal protective equipment.
- New hazardous chemicals are tracked when created and not immediately used.
- Use of chemicals is covered by procedures and/or MSDS as appropriate.
- Chemicals are appropriately used for their intended purposes as specified in an applicable hazards assessment.
- Chemicals are appropriately stored.
- Performance of the FH Chemical Management Program is routinely reviewed.

Exposure monitoring is performed as required by regulatory and FH requirements (e.g., occupational exposure to lead) and where identified as necessary by industrial hygienists during evaluation of EJTA or specific work activities during the job tasks analysis.

In support of the line management, FH has established functional managers, discipline leads, and interpretive authorities for hazardous material protection-related disciplines. The roles and responsibilities for these categories of personnel are defined in HNF-MP-001. The S&H organization establishes and maintains the Occupational Safety and Health Program, which includes hazardous material protection activities.

8.4 ALARA POLICY AND PROGRAM

FH implements administrative and engineering controls to reduce planned exposures below the exposure levels authorized by OSHA, the DOE, or other competent authority. The *Threshold Limit Values and Biological Exposure Indices, Threshold Limit Values for Chemical Substances*, and *Threshold Limit Values for Physical Agents*, issued by the American Conference of Governmental Industrial Hygienists (ACGIH), are used when the ACGIH Threshold Limit Values are lower (more protective) than OSHA Permissible Exposure Limits. Controls to limit exposure are applied with the following hierarchy: (1) engineered controls, (2) work practices and administrative controls that limit worker exposures, and (3) personal protective equipment.

Sometimes radioactive materials are mixed with hazardous materials in FH processes. As a result, limiting exposure to radioactive materials as described in Chapter 7.0, including application of the ALARA program, can result in controlling exposure and maintaining exposure to hazardous materials ALARA.

Pollution prevention and waste minimization requirements that reduce releases of hazardous materials to the environment are described in Section 9.4.1.

8.5 HAZARDOUS MATERIAL TRAINING

FH training requirements are defined in HNF-RD-11061, *Training Requirements*, as further described in Chapter 12.0. The training process systematically establishes individual training requirements and the required training frequencies.

Employees receive introductory training with respect to hazardous materials in the Hanford General Employee Training. Facility-specific training is provided in some cases and as required to meet the requirements of 29 CFR 1910.1200.

FH employees and subcontractors working onsite who potentially are exposed to hazardous substances during covered hazardous waste operations receive initial and refresher training consistent with the requirements of 29 CFR 1910.120. The initial training is 40 hours in length.

Training is provided for special hazardous materials. Special training requirements have been established consistent with 29 CFR 1910, "Occupational Safety and Health Standards;" 29 CFR 1926, "Safety and Health Regulations for Construction;" 40 CFR 763.92, "Training and Periodic Surveillance;" and 10 CFR 850 for materials such as carcinogens, asbestos, and beryllium.

The industrial hygiene program is implemented by technically qualified industrial hygienists. Training requirements for industrial hygienists are established in accordance with the FH training program described in Chapter 12.0.

8.6 HAZARDOUS MATERIAL EXPOSURE CONTROL

This section summarizes the plans and procedures for controlling (1) occupational exposure to hazardous materials, and (2) spread of hazardous material contamination.

8.6.1 Hazardous Material Identification Program

FH implements an ISMS that meets the requirements of the PHMC, Clause I.99, DEAR 970.5223-1, *Integration of Environment Safety, and Health Into Work Planning And Execution*. This system requires that before work is performed, the associated hazards are evaluated and an agreed-upon set of S&H standards and requirements are established, which if properly implemented, provide adequate assurance that the employees, the public, and the environment are protected from adverse consequences. Administrative and engineering controls are tailored to the work being performed. The FH ISMS is documented in HNF-MP-003.

At the facility level, FH facility staff identify potential hazards, including hazardous materials, through performance of hazard baseline assessments that meet the requirements of CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. FH facility staff also perform hazards identification and analysis when developing a safety basis pursuant to the requirements of 10 CFR 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements." At the facility level, these analyses identify chemical and other hazardous materials associated with facility operations.

At the task level, hazards are identified and evaluated using the job hazard analysis process. For medium- and high-risks tasks, the Automated Job Hazard Analysis is the primary tool for identifying hazards and task-related requirements. For low-risk tasks, alternate methods of identifying hazards and conveying hazard information may be used. The job hazard analysis process includes field walk downs to assess and confirm existing work conditions, constraints, and inherent hazards. Pre-job briefings include a description of the hazards associated with the work scope.

In addition to assessing specific hazards associated with a specific task performed by the Automated Job Hazard Analysis, EJTA is used to document work place hazards assessments and provide data to determine training needs and appropriate levels of medical monitoring for the general duties and work places of the employee. The EJTA is further described in Section 8.6.3.

As described in Section 8.3, the FH Chemical Management Program also requires identification of hazards associated with potentially hazardous chemicals.

8.6.2 Administrative Limits

FH limits exposure by workers to hazardous materials to those limits specified by DOE requirements provided in CRD O 440.1A as described in Section 8.4, which includes implementation of OSHA requirements. Additional exposure limits for beryllium are provided in 10 CFR 850.

Controls for hazardous material exposure to onsite workers and the public also are developed and implemented as required by U.S. Department of Energy, Richland Operations Office (RL) letter 02-ABD-0053, *Contract Number DE-AC-06-96RL13200 – Fluor Hanford Nuclear Safety Basis Strategy and Criteria.*

8.6.3 Occupational Medical Programs

RL has specified the occupational medical health provider and program used by FH. The scope for the occupational health program includes the following.

- Determine the medical qualifications to perform work in environments that may contain chemical, biological, physical, and/or radiological hazards.
- Monitor worker safety and health.
- Provide first aid services.
- Provide occupational primary care and case management.
- Provide emergency response support.
- Assist in protecting employees from health hazards in work environments.

The occupational medical health provider provides medical examinations that include pre-placement evaluations, medical surveillance examinations and health monitoring, qualification examinations, voluntary periodic examinations, return-to-work health evaluations, and termination health evaluations.

The EJTA is used to collect data necessary to implement a risk-based approach to medical qualification and monitoring. The EJTA provides data requirements for the *Americans with Disabilities Act of 1990* and supplies information for fitness for duty. The EJTA provides information to identify where additional employee exposure assessment and monitoring data are needed. The EJTA also provides information that aids in determining the necessary health and safety training. Use of the EJTA facilitates compliance with CRD O 440.1A, which requires employee job task and hazard analysis information be provided to the medical contractor. The frequency of medical examinations and medical or monitoring requirements for specific job assignments is developed by the occupational medical health provider drawing on information provided by FH in the EJTA.

The RL occupational medical health provider maintains occupational medical records. Access to employee records is managed in accordance with the requirements of the *Privacy Act of 1974* as codified in 10 CFR 1008, "Records Maintained on Individuals (Privacy Act)" and 29 CFR 1910.1020, "Access to Employee Exposure and Medical Records."

8.6.4 Respiratory Protection

FH implements a respiratory protection program that is based on the requirements of ANSI Z88.2 and 29 CFR 1910.134. The elements of the FH respiratory protection program include the following.

- Evaluate hazards and select respiratory protection to address these hazards.
- Conduct exposure assessments as required to ensure the adequacy of respiratory protection.
- Ensure that only respiratory protection equipment approved by the National Institute for Occupational Safety and Health, Los Alamos National Laboratory, Department of Defense, or other cognizant authority is procured.
- Maintain respiratory protection equipment, which includes inspecting respiratory protection equipment at the respirator maintenance facility.
- Perform periodic oversight and technical review of respiratory protection activities.
- Ensure that respiratory protection training and fit testing meets the requirements of the ANSI Z88.2 and 29 CFR 1910.134.
- Periodically review and validate hazard evaluation and respirator selection processes.
- Ensure the quality of cylinder compressed breathing air.
- Ensure workers using respiratory protections are (1) medically qualified, (2) trained for the equipment to be used, and (3) have been fit for the mask to be used.

See Chapter 7.0 for a discussion of the application of respiratory protection for airborne contamination.

8.7 HAZARDOUS MATERIAL MONITORING

Where necessary, hazardous material monitoring requirements are defined in the facility- or activity-specific DSA based on hazard and accident analyses. These requirements would be described in Chapter 2.0 of the facility- or activity-specific DSA. Hazardous material monitoring requirements for individual tasks that represent standard industrial hazards are specified during the performance of the job hazard analysis. Monitoring requirements also may be established as a result of the EJTA. The monitoring is performed using established procedures. Employees are notified within 15 days or less of receiving an exposure report as specified in 29 CFR 1910.1020.e.

8.8 HAZARDOUS MATERIAL PROTECTION INSTRUMENTATION

Where necessary, hazardous material protection instrumentation is defined in the facility- or activity-specific DSA based on hazard and accident analyses. These systems would be identified in Chapter 2.0 of the facility- or activity-specific DSA. Hazardous material instrumentation requirements for individual tasks that represent standard industrial hazards are specified during the performance of the job hazard analysis. Maintenance and calibration of measuring and test equipment (M&TE) is described in Section 10.3.

8.9 HAZARDOUS MATERIAL PROTECTION RECORDKEEPING

FH documents and records are maintained as specified by HNF-MP-599, *Quality Assurance Program Description* (see Chapter 14.0 of this document). Records are maintained that are consistent with the requirements of CRD O 440.1A and 29 CFR 1910.1020.

The results of employee monitoring for exposures to potentially hazardous materials performed by industrial hygienists are retained. The National Archive and Records Administration retains employee exposure records for at least 75 years as specified. Employee exposure measurements are treated as "business sensitive" information as specified by DOE M 471.2-1B, *Classified Matter Protection and Control Manual.* Whenever an employee or designated representative requests access to a record, FH ensures that access is provided in a reasonable time, place, and manner.

Chemicals are tracked from acquisition, through storage and use, to their final disposition.

8.10 HAZARD COMMUNICATION PROGRAM

FH implements a hazard communication program consistent with the requirements of 29 CFR 1910.1200. This program includes the following.

- Develop, implement, and maintain a written hazard communication program that includes a list of the hazardous chemicals known to be present.
- Maintain copies of the MSDS for each hazardous chemical used.
- Ensure each container of hazardous chemicals is labeled, tagged, or marked with the identity of the hazardous chemical(s) that are in the container.
- Provide employees with effective information and training on hazardous chemicals at the time of initial assignment and whenever a new physical or health hazard to employees is introduced into their work area.

The elements of the hazard communication training include the following:

- Identification of operations in the facilities and projects where hazardous chemicals are present
- Procedures or other measures implemented by the facilities and projects to protect the employee from exposure to hazardous chemicals, including types and availability of personal protective equipment

- Facility and project emergency and first aid procedures to address applicable hazardous chemical exposure
- Location and availability of the facility/project Hazard Communication Program
- Contents of the facility/project written Hazard Communication Program, including MSDS and chemical inventory locations and hazardous container labeling information
- Methods and observations which can be used to detect the presence and/or release of the hazardous chemicals present in the facilities and projects
- Physical and health hazards of the hazardous chemicals present in the facilities and projects.

8.11 OCCUPATIONAL CHEMICAL EXPOSURES

Exposure monitoring for occupational exposure to chemicals is performed to ensure the adequacy of preventive and mitigative controls. The need for monitoring is defined by regulatory drivers and as a result of hazards identified during the EJTA process described in Section 8.6.3 or the job task analysis described in Sections 8.3 and 8.6.1.

8.12 REFERENCES

10 CFR 1008, "Records Maintained on Individuals (Privacy Act)," *Code of Federal Regulations*, as amended.

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 850, "Chronic Beryllium Disease Prevention Program," *Code of Federal Regulations*, as amended.

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response," *Code of Federal Regulations*, as amended.

29 CFR 1910.134, "Respiratory Protection," *Code of Federal Regulations*, as amended.

29 CFR 1910.1020, "Access to Employee Exposure and Medical Records," *Code of Federal Regulations*, as amended.

29 CFR 1910.1200, "Hazard Communication," *Code of Federal Regulations*, as amended.

29 CFR 1926, "Safety and Health Regulations for Construction," *Code of Federal Regulations*, as amended.

40 CFR 763.92, "Training and Periodic Surveillance," *Code of Federal Regulations*, as amended.

Americans with Disabilities Act of 1990, 42 USC 12101, et seq.

ANSI Z88.2, *Respiratory Protection*, American National Standards Institute/American Nuclear Society, Washington, D.C.

CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DEAR 970.5223-1, *Integration of Environment Safety, and Health into Work Planning and Execution*, Clause I.99 of *Project Hanford Management Contract*, Richland, Washington.

DOE M 471.2-1B, *Classified Matter Protection and Control Manual*, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-001, *Fluor Hanford Management Plan*, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-599, *Quality Assurance Program Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-079, *Job Hazard Analysis*, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-10468, *Chemical Management Process*, Fluor Hanford Inc., Richland, Washington.

HNF-RD-11061, *Training Requirements*, Fluor Hanford, Inc., Richland, Washington.

Letter 02-ABD-0053, 2002, *Contract Number DE-AC-06-96RL13200 – Fluor Hanford Nuclear Safety Basis Strategy and Criteria* (from K. A. Klein, DOE Manager, to E. K. Thomson, President of Fluor Hanford, February 5), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Privacy Act of 1974, 5 USC 552a, et seq.

Threshold Limit Values and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

Threshold Limit Values for Chemical Substances, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

Threshold Limit Values for Physical Agents, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

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9.0 RADIOACTIVE AND HAZARDOUS WASTE MANAGEMENT

9.1 INTRODUCTION

This section provides a summary of the radioactive and hazardous waste management programs specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* The programs described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200). Facility- or activity-specific DSAs will identify projected radioactive and hazardous waste projections and any unique radioactive or hazardous waste management controls being applied to the activities.

In summary, the key attributes of the FH radioactive and hazardous waste management program for safety analysis purposes are as follows.

- Hazardous wastes are managed in accordance with applicable federal and state regulations including WAC 173-303, "Dangerous Waste Regulations." Radioactive waste is managed as required by CRD O 435.1, *Radioactive Waste Management.*
- Waste inventories are maintained.
- Each Hanford Site waste management facility has solid waste acceptance criteria that have been established in HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria.*
- FH facility staff implement a pollution prevention and waste minimization program consistent with the requirements specified in 48 CFR 970.5204-2, "Integration of Environment, Safety and Health into Work Planning and Execution," and 48 CFR 970.5204-78, "Laws, Regulations, and DOE Directives."
- Configuration, location, and quantities of hazardous waste are controlled.
- Waste container integrity is ensured under all normal operational conditions as required by DOE/RL-2000-25, *Richland Operations Office Implementation Plan for DOE Order 435.1.*

9.2 REQUIREMENTS

The radioactive and hazardous waste management requirements for the Project Hanford Team are provided in the following:

- *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement [Ecology et al. 1989])
- HNF-EP-0063
- Waste management chapter of HNF-8663, *Standards/Requirements Identification Document.*

The PHMC requires compliance with these requirements.

9.3 RADIOACTIVE AND HAZARDOUS WASTE MANAGEMENT PROGRAM AND ORGANIZATION

Radioactive and hazardous waste programs are implementing mechanisms for the ISMS described in HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*. FH policy specifies that operations and activities are conducted in a way that minimizes the quantity and toxicity of wastes; generates, eliminates, or minimizes pollutant released to the environment; and minimizes the use of toxic substances. Program priorities in descending order are source reduction, environmentally safe recycling, waste treatment, and environmentally safe disposal.

Hazardous wastes are managed in accordance with applicable federal and state regulations including WAC 173-303. Radioactive waste is managed as required by CRD O 435.1. These requirements include the following.

- Protect the public from exposure to radiation from radioactive materials. Requirements for public radiation protection are in DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*
- Protect the environment. Requirements for environmental protection are in DOE Order 5400.1, *General Environmental Protection Program*, and DOE Order 5400.5.
- Protect workers. Requirements for radiation protection of workers are in 10 CFR 835, "Occupational Radiation Protection;" requirements for industrial safety are in CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*
- Comply with applicable federal, state, and local laws and regulations. These activities also shall comply with applicable Executive Orders and other DOE directives.

Waste at the Hanford Site consists of newly generated wastes that are the result of facility operations or legacy wastes present at the Hanford Site due to past operations and waste management activities. The Site also accepts some offsite wastes. The major categories of wastes at the Site include hazardous waste, low-level waste, mixed low-level waste, high-level waste, transuranic[1] waste, mixed transuranic waste, and liquid wastes to be processed in the FH liquid waste processing facilities. FH identifies or develops disposition paths for waste streams present at the Site within the scope of the PHMC. In addition, as directed by the DOE, Hanford Site facilities dispose of waste generated by other DOE facilities. In addition, FH disposes of U.S. Department of Defense wastes in Hanford Site facilities.

Each Hanford Site waste management facility has solid waste acceptance criteria that have been established in HNF-EP-0063. Some waste acceptance criteria also are specified in permit conditions established by the licensing authority. These criteria specify under what conditions waste may be accepted at the facility for treatment, storage, and/or disposal. The waste acceptance criteria also limit waste acceptance to conditions analyzed in the composite analysis and performance assessments performed as required by CRD O 435.1 and which form the basis for DOE's disposal authorization. DOE approval is required to alter these solid waste

[1]Waste materials contaminated with 100 nCi/g of transuranic materials having half-lives longer than 20 years.

acceptance criteria as specified by the PHMC, Clause C.2.2.11. Waste generators characterize, package, and limit waste contents as necessary to meet the requirements of HNF-EP-0063 and other acceptance criteria. Waste management facility staff develop facility- or activity-specific DSAs based on the defined waste acceptance criteria. Liquid waste acceptance criteria are established by each of the FH liquid waste processing facilities as specified by their environmental permits. The organizational summary for waste management activities is provided in Chapter 17.0. Additional definitions of organizational roles and responsibilities are provided in HNF-MP-001, *Fluor Hanford Management Plan*. Training requirements are summarized in Chapter 12.0.

Waste transportation on the Hanford Site is the subject of a separate DOE transportation safety document or safety analysis report for packaging.

9.4 RADIOACTIVE AND HAZARDOUS WASTE STREAMS AND SOURCES

FH facilities manage, store, generate, treat, and dispose radioactive and hazardous waste streams. These waste streams include solid, liquid, and gaseous forms.

Radioactive solid waste forecasts are developed and maintained in the Solid Waste Integrated Forecast Technical database. Projected waste inventories are updated approximately every 6 months. This database also identifies some hazardous waste, although much of the hazardous waste is shipped directly offsite for treatment and disposal at permitted facilities.

Liquid waste forecasts are developed in support of the development of the annual budget cycle for each of the liquid waste storage and treatment facilities. Staff at permitted liquid waste facilities record and report liquid waste discharges to ensure conformance with permit conditions.

Air effluents from FH facilities and activities are controlled under air permits issued by the U.S. Environmental Protection Agency, the State of Washington Department of Health, and the Washington Department of Ecology. Air effluent discharges are reported to ensure conformance with permit conditions.

9.4.1 Waste Management Processes

Facility- or activity-specific DSAs identify waste management processes associated with the facility or activity.

FH has established administrative and operational practices to ensure effective management of wastes. As described in Section 9.3, waste generators must meet defined waste acceptance criteria before shipping waste. The chemical management program ensures that before new chemicals are brought to the FH facilities the ultimate waste treatment and disposition path is identified. To minimize wastes, FH facility staff implement a pollution prevention and waste minimization program consistent with the requirements specified in 48 CFR 970.5204-2 and 48 CFR 970.5204-78. As part of waste minimization, chemical inventories are evaluated before new chemicals are brought onto the Site.

9.4.2 Waste Sources and Characteristics

Facility- or activity-specific DSAs will identify waste streams associated with the facility or activity. FH is required to identify disposition paths for waste streams within the scope of the PHMC.

9.4.3 Waste Handling or Treatment Systems

Facility- or activity-specific waste handling or treatment systems are described in the facility- or activity-specific DSA. The Hanford Site waste treatment systems, in combination with offsite waste management processes, provide waste treatment for FH-generated wastes. Waste handling or treatment facilities used and operated by FH include the following.

Central Waste Complex. The Central Waste Complex stores and treats low-level, mixed waste, and transuranic waste pending ultimate disposal.

2336-W Waste Receiving and Processing Facility. The Waste Receiving and Processing Facility supports waste verification, inspection, repackaging, and treatment of contact-handled transuranic, mixed transuranic, low-level waste, and mixed low-level waste.

T Plant Complex. The T Plant Complex provides decontamination, waste storage, repackaging and waste verification, transuranic waste characterization, and waste treatment capabilities.

Low-Level Burial Grounds. The low-level burial grounds provide storage and disposal for low-level radioactive wastes, and they provide storage for transuranic wastes.

Environmental Restoration Disposal Facility. The Environmental Restoration Disposal Facility provides a permitted disposal for non-transuranic *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) wastes. The facility is not operated by FH.

Waste Encapsulation and Storage Facility. The Waste Encapsulation Storage Facility provides pool-type storage for cesium and strontium capsules.

Canister Storage Building. The Canister Storage Building provides canister storage for spent nuclear fuel from the Hanford Site K Basins and commercial fuel from the Shippingport reactor. The Canister Storage Building also will, in the future, store vitrified tank waste. The Canister Storage Building complex includes an outdoor storage pad that stores commercial and research reactor fuel from various sources.

Liquid Effluent Retention Facility. The Liquid Effluent Retention Facility consists of three permitted storage basins used as storage for wastewater until the liquid waste processing facilities can provide wastewater treatment.

200 Area Effluent Treatment Facility. The 200 Area Effluent Treatment Facility is a non-nuclear facility that provides treatment and disposal of 242-A Evaporator process condensate effluent and waste liquid stored in the Liquid Effluent Retention Facility.

200 Area Treated Effluent Disposal Facility. The 200 Area Treated Effluent Disposal Facility is a disposal system where treated effluents are collected and diverted to a common disposal area.

300 Area Treated Effluent Disposal Facility. The 300 Area Treated Effluent Disposal Facility was designed and built to provide "best available technology" treatment for industrial wastewaters.

9.5 REFERENCES

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

48 CFR 970.5204-2, "Integration of Environment, Safety and Health into Work Planning and Execution," *Code of Federal Regulations*, as amended.

48 CFR 970.5204-78, "Laws, Regulations, and DOE Directives," *Code of Federal Regulations*, as amended.

Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 USC 9601, et seq.

CRD O 435.1, *Radioactive Waste Management*, Change 1 (Supp Rev 0), U.S. Department of Energy, Washington, D.C.

CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE Order 5400.1, *General Environmental Protection Program*, Change 1, U.S. Department of Energy, Washington, D.C.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, Change 1 and Change 2, U.S. Department of Energy, Washington, D.C.

DOE/RL-2000-25, 2001, *Richland Operations Office Implementation Plan for DOE Order 435.1*, Rev. 2, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-EP-0063, 2003, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 9, Fluor Hanford Inc., Richland, Washington.

HNF-MP-001, *Fluor Hanford Management Plan*, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*, Fluor Hanford, Inc., Richland, Washington.

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

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10.0 INITIAL TESTING, IN-SERVICE SURVEILLANCE, AND MAINTENANCE

10.1 INTRODUCTION

This section provides a summary of the initial testing, in-service surveillance, and maintenance programs specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The programs described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200).

In summary, the key attributes of the FH programs for initial testing, in-service surveillance, and maintenance for safety analysis purposes are as follows.

- Procedures are developed that govern inspection and acceptance testing.
- Tests are controlled, planned, performed, and documented. Inspection points are identified in the inspection procedures. Characteristics to be inspected, methods of inspection, and acceptance criteria are specified. Acceptance parameters and other inspection or acceptance test requirements are specified as part of the design documentation and work planning process. Technically qualified personnel, other than those who performed or directly supervised the work, perform inspections and acceptance tests.
- M&TE that is used to verify conformance to requirements, or collect data, is controlled, calibrated at specified intervals, and maintained to required accuracy limits using consensus standards.
- FH has a maintenance implementation plan that implements CRD O 433.1, *Maintenance Management Program for DOE Nuclear Facilities*, and which provides a high degree of confidence that facility equipment degradation is appropriately identified and corrected.
- Post-maintenance testing is performed to verify that components fulfill their design function when returned to service after maintenance.

10.2 REQUIREMENTS

The testing, in-service surveillance, and maintenance requirements for the Project Hanford Team are provided in HNF-8663, *Standards/Requirements Identification Document*. Applicable sections of the document for this chapter include QA, engineering, and maintenance.

Compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

10.3 INITIAL TESTING PROGRAM

The FH QA program described in Chapter 14.0 specifies the requirements for inspections and acceptance testing. Initial testing performed in FH facilities would meet these requirements. The QA program requires that procedures be developed that govern inspection and acceptance testing. The requirements for acceptance parameters, inspection, or test requirements are specified as part of the design engineering process and included in the design documentation. The requirements for tests are drawn from drawings, system descriptions, DSAs, component purchase specifications, vendor manuals, design basis documents, and engineering standards. The Construction Specification Institute, or equal system of specifications, may be used in lieu of

Hanford Site-generated construction and testing procedures, provided they are definitive and tailored to meet the application.

Tests are required to be controlled, planned, performed, and documented. Test prerequisites include, as applicable, calibrated instrumentation, appropriate equipment, trained personnel, condition of test equipment and items to be tested, suitable environmental conditions, and provisions for data acquisition. Inspection points are identified in the inspection procedures. Characteristics to be inspected, methods of inspection, and acceptance criteria are specified. Acceptance parameters and other inspection or acceptance test requirements are specified as part of the design documentation and work planning process. Technically qualified personnel, other than those who performed or directly supervised the work, perform inspections and acceptance tests.

M&TE that is used to verify conformance to requirements, or collect data, is controlled, calibrated at specified intervals, and maintained to required accuracy limits. Calibrations are performed using approved procedures in order to control the performance of calibrations, provide repeatable calibrations, and provide correct acceptance criteria. The calibration frequency for each device is established based on the type of equipment, manufacturer's recommendations or specifications, inherent stability, required accuracy, intended use (including environmental conditions), assigned tolerances, calibration history, or other factors as appropriate. A recall list for devices requiring calibration is maintained. Calibrations of M&TE are performed using reference or working standards traceable to the National Institute of Standards and Technology or other approved standards. Calibrated equipment has a label affixed showing the calibration status or employs other alternative methods to identify calibration status. Calibration of equipment, including M&TE used to verify conformance to requirements as part of any testing program, is governed by maintenance requirements specified in HNF-RD-10859, *Maintenance Management*, and identified sub-tier documents.

Readiness for initial operations, including restart after significant facility modification, is confirmed through the graded performance of operational readiness reviews as specified in CRD O 425.1B, *Startup and Restart of Nuclear Facilities.*

10.4 IN-SERVICE SURVEILLANCE PROGRAM

FH facility staff perform in-service surveillance in two ways. The conduct of operations matrices developed by FH nuclear facilities as required by DOE Order 5480.19, *Conduct of Operations Requirements for DOC Facilities*, specify the development of shift operating round sheets. Round sheets are required to identify equipment to be monitored and where appropriate the range of acceptable values for readings that are taken. Operators report when equipment parameters exceed maximum or minimum values. Supervisory personnel review the round sheet data, including looking for trends. Identified trends are evaluated to determine if immediate corrective action is required, and appropriate cognizant personnel are informed of the trend to identify if other actions are required. The conduct of operations matrices is maintained by each Hazard Category 2 and 3 nuclear facility. M&TE or installed instrumentation used in the performance of in-service surveillance is maintained and calibrated as described in Chapter 14.0. Training for personnel is summarized in Chapter 12.0.

Additional in-service surveillance is performed as part of the FH maintenance program described in the following section.

10.5 MAINTENANCE PROGRAM

The FH maintenance program requirements are defined in HNF-RD-10859. This program requires that FH facilities develop a maintenance implementation plan. The facility maintenance program establishes a balance between corrective and preventive maintenance that provides a high degree of confidence that facility equipment degradation is identified and corrected, that equipment life is optimized, and that the maintenance program is optimized. Maintenance procedures and other work-related documents are prepared and used to provide appropriate work direction and to ensure that maintenance is performed safely and efficiently. Maintenance is planned, scheduled, and coordinated to improve efficiency and reduce exposure to radiation and other hazards ALARA for those potentially exposed. (See Chapter 7.0 for a discussion of the ALARA program.) Post-maintenance testing is performed to verify that components fulfill their design function when returned to service after maintenance. M&TE is controlled, calibrated, and maintained as specified by the QA program (see Chapter 14.0). Maintenance history and trending is performed where appropriate to document data, provide historical information for maintenance planning, and support performance trending of facility systems and components.

Organizational responsibilities are summarized in Chapter 17.0. Additional information on roles and responsibilities is provided in HNF-MP-001, *Fluor Hanford Management Plan*. Training for personnel is summarized in Chapter 12.0.

10.6 REFERENCES

CRD O 425.1B, *Startup and Restart of Nuclear Facilities*, Supp Rev 1, U.S. Department of Energy, Washington, D.C.

CRD O 433.1, *Maintenance Management Program for DOE Nuclear Facilities*, Change 1, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE Order 5480.19, *Conduct of Operations Requirements for DOC Facilities*, Change 1, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-001, *Fluor Hanford Management Plan*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-10859, *Maintenance Management*, Fluor Hanford, Inc., Richland, Washington.

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11.0 OPERATIONAL SAFETY

11.1 INTRODUCTION

This section provides a summary of the operational safety program specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* The operational safety program described in this section is applicable within the scope of the PHMC (DE-AC06-96RL13200).

In summary, the key attributes of the FH operational safety program for safety analysis purposes are as follows.

- FH nuclear facilities implement the requirements of DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, and FH nuclear facilities have an implementing matrix for the guidelines specified in DOE Order 5480.19.
- The fire hazards for FH nuclear facilities are defined in the facility-specific fire hazards analyses (FHA), which meet the requirements of CRD O 420.1A, *Facility Safety.*
- FH implements a fire prevention program that meets or exceeds the minimum requirements established by the NFPA including NFPA 1, *Uniform Fire Code*, in order to provide an acceptable degree of life safety to DOE and contractor personnel, and to ensure that there are no undue hazards to the public from fire and its effects in DOE facilities.
- The FH fire protection program includes maintaining a fully staffed and trained fire protection engineering organization; maintaining a fully staffed, trained, and equipped fire department; and maintaining a fully staffed and trained fire protection system testing and maintenance staff.
- Hanford Site fire alarm and suppression systems are functionally tested, inspected, and maintained to meet NFPA and DOE standards and requirements.
- Permits are required for use and occupancy of a new facility or re-occupancy or change in use of an existing facility including portable structures; installation or deactivation of automatic suppression systems; installation, modification, or deactivation of a fire hydrant; installation or deactivation of fire alarm and detection systems and related equipment; outdoor burning; designated cutting and welding operations; and possessing specified inventories of chemicals, compressed gases, explosives, and flammable and combustible liquids.
- Nuclear facilities control combustible material loading and ignition sources below levels assumed in the Safety Basis or FHA by performing periodic inspections, which use specific quantitative criteria if assumed or specified in the Safety Basis or FHA for important parameters.
- Fire safety drills and other emergency exercises are completed each year.

11.2 REQUIREMENTS

The operational safety requirements for the Project Hanford Team are provided in the operations and fire-fighting chapters of HNF-8663, *Standards/Requirements Identification Document.*

Compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

11.3 CONDUCT OF OPERATIONS

FH nuclear facility staff implement the requirements of DOE Order 5480.19. As required, each FH nuclear facility has established an implementing matrix for the guidelines specified in DOE Order 5480.19. These implementing matrices identify the specific implementing procedures for each of the DOE Order 5480.19 guideline requirements, and they identify any specific deviations from the guidelines of DOE Order 5480.19 that have been approved. These conduct of operations implementing matrices are approved by RL. The facility implementing matrices address the following areas:

- **Shift Routines and Operating Practices.** Shift routines and operating practices have been established that address the key elements of DOE Order 5480.19, including roles and responsibilities of the on-shift crew; operators, operations management, personnel working in the facility; responding to indications; personnel protection and ALARA; resetting protective devices; authority to operate equipment, and shift operating bases.
- **Control Area Activities.** Control area activities are conducted in a manner that achieves safe and reliable facility operations.
- **Communications.** Personnel are responsible for conducting emergency and operational communications in accordance with procedure and for reporting defective communication equipment to their manager. The proper use of audible communication equipment is essential during emergencies and for operational clarity. Approved communication terminology and methods are specified.
- **Control of On-Shift Training.** The on-the-job training program ensures that FH trainees satisfactorily achieve required training objectives and receive maximum learning benefit from hands-on training, while maintaining safe facility and field operations.
- **Control of Equipment and System Status.** Facility equipment and system status is controlled to ensure that facility configuration is maintained in accordance with procedural requirements.
- **Lockouts and Tagouts.** Personnel are instructed in the implementation of specific lockout and tagout activities. Lockout and tagout procedures apply to all personnel working in FH facilities. FH implements the requirements of DOE-RL-SOD-INST-L&T.001, *Hanford Site Lockout/Tagout Program.*
- **Independent Verification.** Independent verification is used for the correct positioning of components considered critical to process, system, or facility safety.
- **Log Keeping.** Formal written documentation of facility operations activities occurs through logbook maintenance.
- **Operations Turnover.** Guidelines are provided for shift turnover to ensure that the information required to adequately perform shift responsibilities is documented by the current shift and reviewed by the oncoming shift. The primary purpose of turnover is to ensure that oncoming personnel have an accurate picture of overall facility status.

- **Operations Aspects of Facility Chemistry and Unique Processes.** Where unique processes or facility chemistry control considerations exist, these requirements have been implemented in procedures.
- **Required Reading.** A method exists to establish and implement the requirements for selection and management of required reading materials and to ensure timely and effective tracking of required reading.
- **Timely Orders to Operators.** Requirements exist for issuing, communicating, documenting, and reviewing timely orders to operators. Timely orders will be used when activities or conditions are limited in time and do not require plant-operating procedures. Timely orders provide a method for management to rapidly distribute essential information and administrative instructions to personnel. Timely orders do not supersede approved procedures.
- **Operator Aid Postings.** Instructions for requesting, reviewing, and approving operator aids are provided to ensure that these are current, correct, and useful.
- **Equipment and Piping Labeling.** A standardized facility equipment and piping labeling program has been implemented.

An additional component of the FH operational safety program is assurance of safe hoisting and rigging activities. FH implements DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual.*

11.4 FIRE PROTECTION

11.4.1 Fire Hazards

The fire hazards for FH facilities are defined in the facility-specific FHAs and DSAs. FHAs are developed to meet the requirements of CRD O 420.1A, which include requirements for integration with DSA development efforts. The FHA addresses description of construction; protection of essential safety-class and safety-significant equipment; fire protection features; description of fire hazards; life safety considerations; critical process equipment; high-value property; damage potential; fire department response; recovery potential; potential for toxic, biologic, and/or radiation incident due to a fire; emergency planning; security considerations related to fire protection; natural phenomena hazards impact on fire safety; exposure fire potential, including the potential for fire spread between fire areas; and efficiencies or recommendations that are required to be corrected to meet fire protection objectives. The focus of the FHA is individual fire areas that comprise the facility unless deterministic modeling methods demonstrate a lesser or greater fire potential.

The FHA is integrated with the facility DSA so that there are common fire hazards identified and evaluated in the FHA and DSA. The FHA author and the safety analyst jointly identify fire-related hazards and evaluate the postulated fire scenario(s). Initially, the hazardous conditions evaluated do not reflect prevention or mitigation by engineered barriers except for passive design features, facility systems, manual intervention, or administrative controls. Credible initiating events that can cause one or more fires and define or influence their characteristics and severity are identified. Any credit taken for fire department response in the FHA and the safety basis is concurred with by the fire department with the appropriate fire department response consistently reflected in the facility pre-fire/action plan. The final FHA is referenced by the facility safety basis.

11.4.2 Fire Protection Program and Organization

The FH fire prevention program is described in HNF-RD-10606, *Fire Protection Program Requirements*, and HNF-RD-9717, *Fire Prevention for Construction/Occupancy/Demolition Activities*. This program implements the requirements of CRD O 420.1A.

The objectives of this program are as follows.

- Minimize the potential for the occurrence of a fire or related perils.
- Ensure fire does not cause an unacceptable onsite or offsite release of hazardous material or threaten public health and safety or the environment.
- Develop and implement a fire prevention program that meets or exceeds the minimum requirements established by the NFPA including NFPA 1 in order to provide an acceptable degree of life safety to DOE and contractor personnel, and ensure that there are no undue hazards to the public from fire and its effects in DOE facilities.
- Ensure property damage from fire and related perils does not exceed DOE-established levels.
- Ensure process control and safety systems are not damaged by fire or related perils.
- Fulfill the requirements for the best-protected class of industrial risks.

The fire protection program requirements include the following:

- Maintenance of a fully staffed and trained fire protection engineering organization
- Maintenance of a fully staffed, trained, and equipped fire department
- Maintenance of a fully staffed and trained fire protection system testing and maintenance staff
- A system to ensure that the requirements of the DOE fire protection program are documented and incorporated in the plans and specifications for new facilities and for significant modifications to existing facilities.

The fire protection program also establishes design requirements that include the following:

- A reliable water supply of adequate capacity for automatic and manual fire suppression
- Noncombustible or fire resistive construction where appropriate
- The protection of special hazards
- A means to summon the fire department in the event of a fire and to ensure immediate physical access capability for intervention
- A means to notify and evacuate building occupants in the event of a fire
- Redundant fire protection systems in areas where safety-class systems are vulnerable to fire damage
- Assurance that inadvertent operation of fire protection systems will not affect safety-class systems.

The FH fire prevention program addresses the complete life cycle of FH facilities including construction, occupancy, and demolition activities. The FH fire prevention program specifies additional measures for construction activities that include meeting the requirements of

HNF-RD-9717. The Hanford Fire Marshal approves tie-ins to FH water systems to support construction activities.

The fire prevention program establishes the requirement to use and occupy FH facilities. Permits are required to be obtained from the Hanford Fire Marshal before conducting certain activities in FH facilities as specified in HNF-RD-8589, *Hanford Fire Marshal Permits*. Activities requiring permits from the Hanford Fire Marshal include use and occupancy of a new facility or re-occupancy or change in use of an existing facility including portable structures; installation or deactivation of automatic suppression systems; installation, modification, or deactivation of a fire hydrant; installation or deactivation of fire alarm and detection systems and related equipment; outdoor burning; designated cutting and welding operations; and possessing specified inventories of chemicals, compressed gases, explosives, and flammable and combustible liquids. The fire prevention program also establishes requirements for portable fire extinguishers, use of portable heaters, control of flammable/combustible liquids, flammable liquid storage, control of combustibles, building exits, and fire barriers. Special combustible control requirements are established for nuclear facilities (see Section 11.4.3).

A permit must be received from the Hanford Fire Marshal before demolition, deactivation, or decommissioning any fire protection system or feature. Before demolition, deactivation, or decommissioning of any fire protection system or feature, an analysis is completed that meets the requirements of CRD O 420.1A. Demolition activities are performed in accordance with HNF-RD-9717.

The Hanford Fire Department has the overall responsibility for developing, administering, and enforcing the fire and life safety program for the Hanford Site. These roles and responsibilities include the following.

- Comply with the applicable fire department provisions of NFPA codes and standards; CRD O 420.1A; CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*; and DOE G 440.1-5, *Fire Safety Program for Use with DOE O 420.1 and DOE O 440.1*, Section 6.0.
- Maintain mutual aid agreements with surrounding fire districts.
- Maintain self-contained breathing apparatus.
- Provide appropriate Sitewide fire protection system inspection, testing, and maintenance of fire alarm and suppression systems.
- Develop and maintain pre-fire plans.
- Be the designated incident command agency for the Hanford Site except during declared security events.
- Act as the lead emergency response organization (ERO) and provide incident command as required by 29 CFR 1910, "Occupational Safety and Health Standards," and NFPA codes and standards for fire suppression, emergency, medical, and ambulance service; special emergency rescue including confined space, high-angle, and low-angle technical rescue; and hazardous material events for Hanford Site operations.
- Perform fire prevention, investigation, and employee education.

- Perform and document facility inspections and ignitable and reactive waste site inspections as required by WAC 173-303-395, "Dangerous Waste Regulations – Other General Requirements."

The Hanford Fire Marshal develops, administers, and enforces the fire prevention program. The roles and responsibilities of the Hanford Fire Marshal include the following.

- Assist the RL Fire Protection Engineer by making code interpretations and initial reviews of fire safety exemptions.
- Develop fire protection programs that include programs for fire protection water supply.
- Conduct maintenance testing and inspection record audits.
- Establish and issue permits, certificates, approvals, or orders pertaining to fire control and fire hazards.
- Review and approve of new fire protection system designs and modifications/upgrades to existing fire protection systems.
- Approve pre-fire plans.

11.4.3 Combustible Loading Control

FH nuclear facilities control combustible loading as required by HNF-RD-9717. Use of combustible materials in the construction of facilities and associated equipment is ALARA. Combustible solid waste and residue from handling flammable and combustible liquids is stored in approved, closed metal containers. Combustible waste, either manmade or dry vegetation, is not permitted to accumulate adjacent to buildings. The selection and use of new insulated electrical wire for installation in cable trays is approved by the project fire protection engineer. Wood, sheet plastic, and paper materials are strictly limited and only are used in temporary applications that are essential to facility operations when acceptable noncombustible substitute materials are not available. Essential permanent combustible materials, including written material, are maintained ALARA. Wood scaffolding, if used, is not staged, stored, or stockpiled in the facility. Wood used for temporary applications is pressure-treated with fire retardant material, or it is coated with Underwriters Laboratories or Factory Mutual-approved fire retardant coatings. Where appropriate, facility-specific FHAs also impose specific combustible loading limits that are implemented through facility-specific housekeeping programs or other procedures.

Protecting assumed combustible loading may be important to preserving accident analysis assumptions in the DSA or the FHA, or important controls may be identified to prevent or mitigate postulated fire accidents. In these cases, the combustible loading controls may become elements of the facility-specific TSRs.

11.4.4 Fire-Fighting Capabilities

The Hanford Fire Department has fully staffed and equipped stations located strategically across the Hanford Site. The station contains the necessary equipment for responding to emergencies, including fire suppression, explosion, hazardous materials response, emergency medical response, and special rescue support activities. The Hanford Fire Department can respond with a self-contained water source to support fire suppression. The Hanford Fire Department also is supported by mutual aid agreements that have been negotiated with other local agencies that can provide fire-fighting capability.

The Hanford Fire Department is responsible for the development, content, and periodic update of pre-fire plans. The pre-fire plans are developed by the department captains and approved by the Hanford Fire Marshal. As required by CRD O 420.1A, where credit is taken for fire department response in the FHA and the DSA, the fire department must concur in the fire response time, and this fire response time must be consistently reflected in the pre-fire plans.

The Hanford Fire Department training programs are based on nationally recognized or state-certified materials and standards. Elements of the training program include apprenticeship, professional development, standards awareness and compliance, physical fitness, and medical qualifications.

Physical fitness and medical qualifications for Hanford Fire Department personnel consist of a comprehensive health enhancement program that includes functional fitness assessments and individualized exercise, physical training, rehabilitation, and health intervention programs. A physical performance standard ensures that emergency response personnel remain physically fit to perform their duties. Medical qualifications for emergency response personnel are specified by various codes and standards of the NFPA and coordinated through physicians at the Hanford Environmental Health Foundation. Permanent individual health files, which include medical examination results, are accessible and maintained by the Hanford Environmental Health Foundation.

The Hanford Fire Department functions as the designated response and incident command agency for hazardous materials events that occur within the boundaries of the Hanford Site. These potential emergency response needs are identified and evaluated. The Fire Department baseline needs assessment is provided in HNF-SP-1180, *Hanford Site Emergency Needs*. Emergency response personnel receive special radiological worker training commensurate with the situations they are likely to encounter.

11.4.5 Fire-Fighting Readiness Assurance

This section summarizes the fire prevention inspection program, the types and frequencies of fire safety drills and exercises, and the fire protection program recordkeeping requirements.

The Hanford Fire Department is responsible for the functional testing, inspection, and preventive and repair maintenance activities for Hanford Site fire alarm and suppression systems to meet NFPA and DOE standards and requirements. In addition, the Hanford Fire Department performs annual inspections of Site fire extinguishers. Work is performed in accordance with Site-approved procedures and frequencies. Inspection records are retained as required by the FH QA program summarized in Chapter 14.0.

Fire protection system discrepancy corrective actions are the responsibility of the building manager. The building manager is notified immediately of any fire protection system discrepancy. When a problem is identified in a fire protection system, the Hanford Fire Department schedules and performs the necessary corrective maintenance. In the case of an emergency impairment, the facility Fire Protection Engineer works with facility management to develop and implement compensatory measures until the impairment is corrected.

Fire safety drills and other emergency exercises are completed each year. The drill coordinator, facility manager, or shift manager can initiate a facility drill. Minor drills may be initiated by the shift manager with no prior approvals. Fire drills follow a pre-approved plan. The drill coordinator prepares a report on the drill and identifies the objectives accomplished and any system deficiencies can be included. The fire drill can be done concurrently with other required annual drills.

Fire Department records are retained in accordance with the FH QA program requirements summarized in Chapter 14.0.

11.5 REFERENCES

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

CRD O 420.1A, *Facility Safety*, Supp Rev 0, U.S. Department of Energy, Washington, D.C.

CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE G 440.1-5, *Fire Safety Program for Use with DOE O 420.1 and DOE O 440.1*, U.S. Department of Energy, Washington, D.C.

DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, Change 1, U.S. Department of Energy, Washington, D.C.

DOE-RL-SOD-INST-L&T.001, *Hanford Site Lockout/Tagout Program*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-92-36, 2002, *Hanford Site Hoisting and Rigging Manual*, Release No. 34, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-10606, *Fire Protection Program Requirements*, Fluor Hanford, Inc., Richland Washington.

HNF-RD-8589, *Hanford Fire Marshal Permits*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-9717, *Fire Prevention for Construction/Occupancy/Demolition Activities*, Fluor Hanford, Inc., Richland Washington.

HNF-SP-1180, 2003, *Hanford Site Emergency Needs*, Fluor Hanford, Inc., Richland Washington.

NFPA 1, *Uniform Fire Code*, National Fire Protection Association, Quincy, Massachusetts.

WAC 173-303-395, "Dangerous Waste Regulations – Other General Requirements," *Washington Administrative Code*, as amended.

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12.0 PROCEDURES AND TRAINING

12.1 INTRODUCTION

This section provides a summary of the procedures development program and the training program specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The procedure development and training programs described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200).

In summary, the key attributes of the FH programs for procedures and training for safety analysis purposes are as follows.

- Work processes are controlled by approved instructions, procedures, design documents, technical standards, or other hazard controls appropriate to the specific tasks to be performed.
- Procedures are maintained under change control.
- Procedures are periodically reviewed for accuracy and applicability.
- The FH training program ensures the work force is trained and qualified, with the knowledge, skills, and abilities to effectively perform their work while protecting themselves, coworkers, the public, and the environment.
- Procedure development includes consideration of human factors.
- Training includes incorporation of results from a formal lessons learned process.

12.2 REQUIREMENTS

The training requirements for the Project Hanford Team are provided in the following:

- The training functional area of HNF-8663, *Standards/Requirements Identification Document*
- HNF-MP-599, *Quality Assurance Program Description* (also see Chapter 14.0 of this document)
- PHMC, Section C.5.6.

The procedure requirements for the Project Hanford Team are provided in the following:

- The management systems, operation, maintenance, and QA functional areas of HNF-8663
- HNF-MP-599.

Compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5. Compliance with HNF-MP-599 is a regulatory requirement.

12.3 PROCEDURE PROGRAM

HNF-MP-599 requires on a graded basis that work processes are controlled by approved instructions, procedures, design documents, technical standards, or other hazard controls adopted to meet regulatory or contractual requirements appropriate to the specific tasks to be performed.

The features of work process documents (e.g., procedures) are as follows:

- Developed, reviewed, and approved by personnel technically knowledgeable of the work
- Contain a level of detail appropriate for the complexity of specific tasks and the work environment and worker proficiency
- Are readily accessible for the worker
- Provide administrative and technical direction to enable conducting the intent of the procedure effectively
- Are written in such a manner as to minimize the risk to the public, worker, the environment, and equipment.

Human factors are considered during work process document preparation. The human factors portion of the procedure development process ensures that operators can successfully and reliably perform the work identified in the procedure in the manner specified.

12.3.1 Development of Procedures

FH has defined the methods for developing procedures. FH maintains administrative procedures that define and control the format, development process, and approval authorities for technical procedures under the FH cognizance, which includes normal, abnormal, and emergency operations, and surveillance testing and maintenance as described above.

Personnel who write procedures receive procedure process training or procedure writer training. Technical procedures specify the documents required to be "in hand" when performing the process. Each procedure step contains only one action. Where potential hazards exist, warning or caution statements are provided in the procedure. The procedure is written with a level of detail necessary to safely perform the activity. Independent verification signoff is provided for when required. Acceptance criteria and other requirements in the procedure are identified so the user can determine if the results are within the acceptable range. ALARA principles for hazardous waste, chemicals, and radiological contamination are considered when developing the procedure. Applicable radiological hold and survey points are identified. TSRs and other applicable requirements or limits are identified.

Technical correctness and compliance with regulatory standards are verified through review by the assigned technical authority and, depending on the approval designator assigned to the procedure, also may require review by a representative of QA, Safety, Environmental Compliance, and/or Radiological Control. The draft procedure then is subjected to user validation where appropriate. The validation process, simulating use of the procedure in the field, ensures that the procedure effectively accomplishes its intended purpose and is usable by the intended personnel. After completion of review and validation, the designated approval authorities approve the procedure.

Company-level procedures are issued through the Project Hanford Management System (PHMS). The PHMS provides an electronic-controlled location for company-level procedures. In addition to identifying FH applicable procedures, PHMS also incorporates those functions necessary to develop, change, cancel, or waive procedures using a controlled process that develops and maintains required records (see Chapter 14.0). Facility-specific procedures are issued using processes adopted at each facility or project.

12.3.2 Maintenance of Procedures

Procedures are maintained under change control. Procedures are periodically reviewed for accuracy and applicability at a frequency determined by the responsible manager. The periodicity of the review varies as determined by the responsible manager depending on the content of the procedure. Revisions to procedures are required when a procedure has been affected by changes to the point that the procedure is difficult to follow, or if a single change is so extensive that the procedure is difficult to follow. The review and approval process for each procedure change is documented within the PHMS records as required by the QA program described in Chapter 14.0. Changes to procedures are validated to ensure they can be successfully performed. The USQ process is applied where required to determine if the procedure revision is a change to the safety basis of a nuclear facility. Staff at FH facilities have a process to use when making urgent changes to procedures. Personnel are trained on procedure revisions before use.

12.4 TRAINING PROGRAM

As required by the PHMC, FH develops, implements, and manages a training program that maintains a qualified workforce in sufficient numbers and skill levels to meet Hanford Site requirements and that fulfills *Recommendation 93-3, Improving DOE Technical Capability in Defense Nuclear Facilities*. This work includes identification of known requirements, definition of training standards, implementation of program training classes, certification of required skills, and verification of ongoing job qualifications.

The training program implemented by FH is described in HNF-GD-11236, *Developing Training Qualification and Certification Programs;* HNF-RD-11061, *Training Requirements*; and HNF-PRO-175, *Training Program Descriptions*. The training program provides employees with the training to meet the ISMS Guiding Principle of "Competence Commensurate with Responsibility." The training program provides workers with the knowledge, skills, and attitudes to support the FH mission of safely accelerating restoration or remediation of the Hanford Site by completing complex and high-risk tasks efficiently and effectively while protecting themselves, coworkers, the public, and the environment.

Training Program Descriptions are used to describe selected training processes required to ensure personnel are trained to perform assigned tasks in accordance with federal or state laws, DOE directives, agreements, and management directives. Training Program Descriptions ensure that employees are trained in accordance with the applicable training drivers identified in HNF-RD-11061. Training Program Descriptions are reviewed and approved by the cognizant interpretive authority/technical authority and functional area manager to ensure that the training program appropriately addresses regulatory and FH requirements. Changes to requirements also are reviewed by interpretive authorities and functional area managers to ensure that Training

Program Descriptions reflect these changing requirements. Training courses that will meet training drivers are identified by the interpretive authority/technical authority, and training is identified as mandatory or optional.

Managers or their designees complete the EJTA described in Chapter 8.0. Based on the work to be performed by the employee, the required training courses developed by the interpretive authority/technical authority are identified. Facility-specific training requirements also are identified. A matrix of training requirements for the individual employee is established. The matrix is used to help monitor progress to ensure the required training is completed in the specified time frames.

The features of the FH training program are as follows:

- Establishes training standards and procedures that meet valid requirements and regulations and are consistent with industry-proven good practices
- Holds managers accountable for training, leading, and coaching their employees, to ensure their employees' proficiency
- Oversees crosscutting training provided to the Site by the training provider to evaluate whether it meets regulatory requirements and applicable standards
- Evaluates employee training continually and formally, and uses evaluation results to improve training
- Ensures that instructional staff are qualified and that they continually develop their instructional and subject-area skills and knowledge.

Specific training requirements are specified in a training implementation matrix. Initial and continuing training requirements are specified. Subcontractor personnel meet the same training requirements as FH personnel.

12.4.1 Development of Training

Applying a graded approach, FH uses a systematic approach to develop training using the Analysis, Design, Development, Implementation, and Evaluation model. During the analysis phase, determination is made whether training is the right course of action, and if so, to gather information on what the content of the training will be. In the design phase, information about the job tasks is used to create a detailed road map of what the students will be able to do at the completion of training and the events of instruction that will help the students learn. Development is the phase where the instructional materials needed to support the teaching methods selected in the design phase are created, adapted from existing sources, and/or procured. During the implementation phase, instruction is provided by individuals that have subject matter knowledge and communication skills. Evaluations are performed to assess the quality and effectiveness of the training. The evaluation may include student feedback, testing of students, transference of what was learned to the job environment, and return on investment.

The purpose of the training analysis is to ensure training programs are based on the requirements of the job, the associated tasks, and the improvement of facility operations. Training programs and courses developed using this model, as follows.

- Identify training, qualification, education, and experience requirements for individual and facility positions that promote safe and reliable operation and support of the facilities.
- Identify a continuing program to maintain and improve the knowledge and skills of job incumbents.
- Base training requirements for technical staff personnel on an assessment of duties and responsibilities.

The training design process determines the overall direction and desired outcomes of the training program. Terminal objectives are developed using the data obtained during the analysis process. The skills and knowledge identified during the task analysis process are translated into enabling objectives.

The training development process is used to produce the lesson plans and guides, training aids, and student materials. Technical and instructional reviews of the products of the training development are conducted to ensure they are accurate, support the learning objectives, and promote the effective delivery of training. Training is evaluated during implementation to ensure the training objectives have been satisfied.

Specific training and qualification requirements have been established for functional areas, including the following.

- Criticality safety training is discussed in Chapter 6.0 and is provided in accordance with HNF-7098, *Criticality Safety Program.*
- Radiological training is provided in accordance with the requirements of HNF-5173, *PHMC Radiological Control Manual.*
- Hazardous material training is provided in accordance with OSHA as required by HNF-RD-7769, *OSHA Compliance*, and implementing procedures dealing with hazard communication or health and safety plans.
- Surveillance and maintenance training requirements are identified in HNF-RD-10859, *Maintenance Management*, and the requirements of the QA program.
- Fire protection training is performed in accordance with the requirements of HNF-RD-10606, *Fire Protection Program Requirements.*
- QA training is provided in accordance with HNF-PRO-599.
- Emergency preparedness training is provided in accordance with HNF-RD-7647, *Emergency Preparedness Program Requirements.*

Additional on-shift or in-facility training is performed to meet facility-specific needs, such as that required to implement procedure and process changes.

12.4.2 Maintenance of Training

As described in Section 12.4.1, the systematic training approach used by FH incorporates an evaluation phase, which in part is focused on ensuring the training is up-to-date, reflective of current job conditions, and improves employee performance. In addition, periodic assessments of the compliance and adequacy of requirements-driven training and the effectiveness of training processes are performed. Concerns, observations, and findings submitted by workers or discovered during an evaluation or assessment that do not comply with requirements of FH contractor training are reviewed, then placed and tracked in a corrective action tracking system.

FH requirements for maintaining training records and documentation are provided in HNF-RD-11061. Training records are retained for 1 year beyond the last date of employment.

12.4.3 Modification of Training Materials

As described in Section 12.4.2, there is a systematic approach to maintaining the training program that includes evaluation of training and periodic compliance assessments. This combination of programs is used to ensure continuing improvement and correct deficiencies.

12.5 REFERENCES

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-5173, 2002, *PHMC Radiological Control Manual*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-7098, 2003, *Criticality Safety Program*, Rev. 3, Fluor Hanford, Inc., Richland, Washington.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-GD-11236, *Developing Training Qualification and Certification Programs*, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-599, *Quality Assurance Program Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-175, *Training Program Descriptions*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-7647, *Emergency Preparedness Program Requirements*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-7769, *OSHA Compliance*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-10606, *Fire Protection Program Requirements*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-10859, *Maintenance Management*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-11061, *Training Requirements*, Fluor Hanford, Inc., Richland, Washington.

Recommendation 93-3, Improving DOE Technical Capability in Defense Nuclear Facilities, 1993, Defense Nuclear Facilities Safety Board, Washington, D.C.

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13.0 HUMAN FACTORS

13.1 INTRODUCTION

This section provides a summary of human factors engineering specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The human factors engineering activities described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200).

The general human factors considerations that are important in ensuring the safe operation of the FH facilities are discussed in this chapter. The emphasis is on the human-machine interfaces where personnel are entrusted to perform actions safely and reliably during postulated operational conditions. In this respect, human factors and the human-machine interface are an integral part of facility and personnel safety. In general, human factors engineering is specific to individual processes and facilities as such. Specific human factors engineering or human-machine interface attributes important to safety are identified in the facility- or activity-specific DSA. This section provides general information and examples.

In summary, the key attributes of the FH human factors program for safety analysis purposes are as follows.

- Human factors considerations are incorporated into engineering designs and procedures, and the human factors process addresses such subelements as instrumentation, communications, operator aids, controls and displays, labels, physical access, protective equipment, and environmental factors.
- NUREG-0700, *Human-System Interface Design Review Guidelines*, or MIL-STD-1472, *Human Engineering Design Criteria for Military Systems, Equipment, and Facilities*, is used as criteria for designs requiring status indicators of systems and components if there is no SSC-specific standard.

13.2 REQUIREMENTS

The human factors requirements for the PHMC are provided in the engineering functional area of HNF-8663, *Standards/Requirements Identification Document*.

Compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

13.3 HUMAN FACTORS PROCESS

The FH engineering process incorporates human factors considerations, and the human factors process is sensitive to the capabilities, limitations, and needs of personnel. Human factors design pertains to the engineering of the interfaces among plant operators, equipment, and the work environment. Human factors are considered in facility design to enhance safety, promote efficient operation, reduce downtime, and facilitate orderly maintenance. Specific application of this process is described in facility- or activity-specific DSAs because the factors are important to enhancing safety.

The FH engineering process incorporates human factors consideration as a design input. Human factors considerations may be evaluated using checklists developed from consensus standards or other specifications containing human factors considerations. The human factor elements considered include equipment labeling, work place environment (temperature and humidity, lighting, noise, etc.), human dimensions, operating panels and controls, component arrangement, warning and annunciator systems, and communication systems. Where the designs include status indicators for systems and components, and there is no SSC-specific standard, NUREG-0700 or MIL-STD-1472 is used. The implementation of this engineering process is described in the facility- or activity-specific DSA as required by DOE-STD-3009-94 where human factors consideration is important to ensuring safety of the facility or activity.

Chapter 12.0 discusses incorporation of human factors considerations into procedures and training.

13.4 IDENTIFICATION OF HUMAN-MACHINE INTERFACES

Human-machine interfaces for many FH facilities and equipment are similar to those found in other standard industrial environments focused on the processing, receipt, assay, handling, and storage of various containerized hazardous materials. Additional human-machine interfaces for FH facilities include handling, disposal, storage, and retrieval of radioactive wastes; decontamination, decommissioning, and demolition; and waste treatment, reduction, and packaging. Some facilities employ relatively unique human-machine interfaces such as with gloveboxes or underwater fuel movement and processing equipment. Computer/operator interfaces are included as a human-machine interface because of the immense quantities of computer-generated records, reports, databases, and schedules and the frequently employed computer controllers for operating equipment.

Chapter 3.0 of each facility-specific DSA documents any applicable safety-class or safety-significant SSCs at the FH facilities. The analyses take into account the reliability of interfaces and identify the need for specific human-machine emphasis in avoiding hazards and minimizing risks. DOE or consensus standards or databases on reliability or other human factors are used when evaluating the likelihood of occurrence. The human-machine interfaces for new facilities and for changes to existing facilities are studied and the design accommodates those interface needs. Design accommodations range from bar-coding and data entry systems to crane controls and automated assay equipment. Each application takes into account applicable industry and DOE experience as well as the requirements of the specific application.

Facility operations at many facilities must focus on the decontamination of equipment, tools, and machinery. These operations involving human-machine interfaces are specific to these decontamination activities. As FH facilities transition into the decommissioning and demolition process, facility-specific local decontamination activities will be planned and accomplished. This may generate previously un-encountered human-machine interfaces that are unique to specific facilities and even specific equipment. Experience at other DOE Complex facilities will be incorporated into D&D approaches and the human-machine interfaces.

Human factors analysis performed for each facility are separately documented and summarized in the facility- or activity-specific DSA as specified by DOE-STD-3009-94 where particularly important to the safety of the facility are described in the safety management program discussion for the facility.

13.5 OPTIMIZATION OF HUMAN-MACHINE INTERFACES

Human factors design engineering assists facility operation by providing the plant personnel with efficiently designed workstations, a comfortable work environment, and an adequate plant layout. Human-factors design engineering topics include the following:

- System and component displays
- System and component controls
- Alarms
- Labeling
- Communications
- Work environment
- Equipment layout and design
- Lighting
- Noise
- Vibration
- Safety
- Protective equipment
- Aesthetics.

General considerations of human-machine interfaces with safety SSCs for FH nuclear facilities are discussed below. Specific implementation of these topical areas and their relationship to safety SSCs is provided as required by DOE-STD-3009-94 in the facility- or activity-specific DSA where the impact is important to safety.

The operator-station is designed to provide adequate space, lighting, and equipment to accommodate operators with critical body dimensions ranging from small to large. The general facility design provides overall compliance with requirements to promote safe, reliable operations in a low-fatigue work environment.

System and component displays and controls are designed to provide operators with displays having clear, complete information and adequate controls to perform the required operational tasks. Control panels meet light and coding standards of applicable guidelines. The layout, labeling, and locations of control panels, keyboards, and computer screens provide easy access to operators ranging in size from small to large.

Emergency audible alarms, local and area alarms, and audio alarms are provided in the control area. Audio alarms are designed to operate at intensities and frequencies compatible with the working environment. Emergency alarms include evacuation and telephone "crash" alarms. Each alarm is designed to provide easily distinguishable tones and sounds. For example, red flashing lights are provided on gloveboxes to indicate glovebox pressure-differential problems and in each area for local and area alarms.

Facility design includes the use of ladders, stairs, ramps, platforms, and emergency doors. Ladders, stairs, ramps, and platforms are designed in accordance with applicable building standards (29 CFR 1910, "Occupational Safety and Health Standards") to ensure safe use and to prevent injury to personnel. Adequate lighting (including emergency lighting) is provided at workstations and areas as needed. Doors used for personnel exit are designed for easy opening in the direction of travel.

The major contributors to the facility noise levels are the heating, ventilation, and air conditioning equipment and hydraulic power units. Hydraulic power units in process areas are required (according to applicable specifications) to meet noise emission standards acceptable to the working environment. Noise levels at or below 85 dB at 1 m are considered acceptable for normally occupied areas. Higher levels may be considered acceptable because a room is not normally occupied, a hearing protection program is in place, and maintenance activities appropriately consider hazards identified in the job hazard analysis and addressed in pre-job briefings.

Heat stress to workers in some FH facilities is a concern because work areas are in high heat, humidity, and radiant environments; protective clothing is required; respirators are used; and multiple sets of protective clothing, including plastics suits, are required for some tasks. The planning stages and radiation work procedures for these tasks emphasize heat-stress controls through reduced work time and body cooling devices. Workers are encouraged to leave areas when symptoms of heat stress are felt.

Facilities are designed to protect operational personnel from electrical, mechanical, toxic, and radiological hazards. Protective equipment is provided as required in each area of the facility. Respirators are provided as required. Emergency eyewash and showers are located where needed.

Facility managers are responsible for determining minimum staffing levels to ensure efficient and safe operation of the facility processes, taking into account the necessary human-machine interface requirements. Overtime standards are established to ensure personnel are able to function in the specific task in a reliable manner.

Many FH facilities are operated on a single-shift basis. Where shift operation is performed, interface between incoming and outgoing staff must be given appropriate consideration to maintain safety functions and control of hazards. Checklists and formalized processes are established where needed to ensure safety.

Provisions for specific levels of control, such as a building emergency director (BED), are identified in the facility-specific safety basis and in staffing requirements. Identification of control responsibilities and interfaces also is identified where specific individuals are relied upon for their training or for their organization's responsibility (e.g., facility person in charge or incident commander [IC]). These provisions are identified in the facility-specific safety document where they provide a unique prevention or mitigation function in the facility hazard evaluation.

Where needed, specific provisions for minimum staffing and for shift work and turnover are described in the safety basis for a specific facility where those are important considerations to maintaining a safe work environment beyond those features normally provided in an industrial work setting (e.g., a fire watch to compensate for absence of a required detection system normally would be identified in a nuclear facility safety basis where it would not normally be the case in an industrial facility).

13.6 REFERENCES

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

MIL-STD-1472, *Human Engineering Design Criteria for Military Systems, Equipment, and Facilities*, U.S. Department of Defense, Washington, D.C.

NUREG-0700, 1981, *Human-System Interface Design Review Guidelines*, Washington, D.C.

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14.0 QUALITY ASSURANCE

14.1 INTRODUCTION

This section provides a summary of the QA program specified by DOE-STD 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The QA program described in this section is applicable within the scope of the PHMC (DE-AC06-96RL13200).

In summary, the key attributes of the FH QA program for safety analysis purposes are as follows.

- FH implements a QA program meeting the requirements of 10 CFR 830, "Nuclear Safety Management," Subpart A, "Quality Assurance Requirements," in accordance with HNF-MP-599, *Quality Assurance Program Description*.
- Processes to detect and prevent quality problems are implemented.
- Documentation and record control processes are established that ensure documents and records are accurate and complete, and in a form that can be controlled, protected, retained, and retrieved for the required duration.
- Procurements and acquisitions are planned, documented, and executed, and prospective suppliers are evaluated. Processes are in place to prevent procurement of suspect counterfeit items. Supplier performance is monitored during the life of the contract to ensure they continue to satisfy the requirements of 10 CFR 830.122, "Quality Assurance Criteria."
- M&TE that is used to verify conformance with requirements, monitoring processes, or collecting data is controlled, calibrated at specified intervals, and maintained to required accuracy limits.
- Computer software used in applications important to safety, health, environmental, and quality aspects of work is subject to appropriate controls, including configuration management, throughout the software life cycle.
- Managers at all levels plan, schedule, and conduct assessments of their management systems and processes important to achieving objectives.
- Independent assessments are performed to measure the adequacy of work performed in complying with applicable requirements, and independent assessments are performed that evaluate the quality of the Project Hanford Team items and services and that promote improvement.
- QA audits are performed that include verification of QA program compliance.

14.2 REQUIREMENTS

The QA requirements for the Project Hanford Team are provided in the following:

- 10 CFR 830
- CRD O 414.1A, *Quality Assurance*
- QA functional area of HNF-8663, *Standards/Requirements Identification Document*.

Compliance with 10 CFR 830 is a statutory requirement, and compliance with CRD O 414.1A and the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

The primary document that incorporates the top-level quality requirements is HNF-MP-599, which is applicable to FH facilities. Additional QA program requirements exist for specific Project Hanford Team activities, and these specific QA program requirements are specified in quality assurance program plans (QAPP) as required by HNF-MP-599. HNF-MP-599 requires that FH develop QAPPs to define the organization, responsibilities, and interfaces with Project Hanford Team activities. HNF-MP-599 requires that activities involving the collection, generation, acquisition, and use of environmental data shall meet the requirements of the U.S. Environmental Protection Agency's quality assurance management standards as identified in the Tri-Party Agreement (Ecology et al. 1989). These additional requirements and others governed by the *Washington Administrative Code* and Federal Environmental Regulations are incorporated into appropriate QAPPs. Likewise, QAPPs control activities such as those within the scope of the Office of Civilian Radioactive Waste Management; DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*; and the Waste Isolation Pilot Plant QA program.

14.3 QUALITY ASSURANCE PROGRAM AND ORGANIZATION

HNF-MP-599 describes implementation of the QA requirements of 10 CFR 830, Subpart A; CRD O 414.1A; and the QA functional areas; and it is separately approved by the DOE as required by 10 CFR 830.121, "Quality Assurance Program (QAP)." HNF-MP-599 specifies requirements for the Project Hanford Team QA program, personnel training and qualification, quality improvement, documents and records, work processes, design, procurement, inspection and acceptance testing, management assessment, and independent assessment. The following sections provide a summary of the DOE-approved program and its requirements.

Effective implementation of the QA program requirements involves management and provides tools to support the principles and functions of ISMS. The fundamental quality expectation is that work meets established requirements. The ISMS fundamental expectation is that personnel will perform work safely. In this regard, the quality management system described in HNF-MP-599 ensures compliance with the approved standards set so the expectation for safe and environmentally protective work within controls is met.

The organizational structure for the QA program is described in HNF-MP-599. The organization summary is provided in Chapter 17.0.

14.4 QUALITY IMPROVEMENT

The Project Hanford Team QA program establishes quality improvement requirements that establish and implement processes to detect and prevent quality problems. Using a graded approach, the Project Hanford Team QA program requires evaluating and reporting deficiencies, determining the cause of deficiencies, identifying and segregating nonconforming items, establishing and monitoring performance indicators, and implementing a feedback and improvement process.

14.5 DOCUMENTS AND RECORDS

The Project Hanford Team QA program establishes document and record control processes that ensure documents and records are accurate and complete, and in a form that can be controlled, protected, retained, and retrieved for the required duration. The Project Hanford Team QA program requires that records be dispositioned using schedules established by the National Archives and Records Administration or in accordance with DOE-unique schedules.

14.6 QUALITY ASSURANCE PERFORMANCE

This section presents an overview of the processes used to ensure that the performed work meets requirements.

14.6.1 Work Processes

The Project Hanford Team QA program establishes work process requirements. Using a graded approach, the Project Hanford Team QA program requires that work processes be controlled using approved instructions, procedures, design documents, technical standards, or other hazard controls (see Chapter 12.0). Work process documents provide a level of detail appropriate for the complexity of the specific task and the work environment and worker proficiency, and these work process documents are readily accessible to the worker. Items used are identified and controlled to prevent use of incorrect or defective items. Process monitoring or data collection instruments are controlled, calibrated, and maintained. Computer software used in applications important to safety, health, environmental, and quality aspects of work is subject to appropriate controls, including configuration management, throughout the software life cycle.

14.6.2 Design

The Project Hanford Team QA program establishes design requirements. Using a graded approach, the Project Hanford Team QA program requires that the design input is identified, documented, and approved before use at a level of detail adequate to support design decisions. Designs incorporate applicable requirements and design basis into design documents, and the design identifies those aspects of the design that are important to safety, reliability, or environmental considerations. Designs are verified to an extent commensurate with the design's complexity and importance to safety, the environment, degree of standardization, state of the art, and similarity with previously approved designs. Changes to the design input and design are identified, documented, and approved.

14.6.3 Procurement

The Project Hanford Team QA program establishes procurement requirements. Using a graded approach, the Project Hanford Team QA program requires that procurements and acquisitions be planned, documented, and executed, and prospective suppliers are evaluated to verify their capability to meet performance and schedule requirements. This evaluation determines whether the prospective supplier has QA practices and procedures that enable conformance to the QA requirements that will be requested under the procurement. A list is maintained of qualified suppliers along with designation of areas for which the supplier has been approved to provide services and materials (e.g., software QA). Supplier performance is monitored during the life of the contract to ensure they continue to satisfy the requirements of 10 CFR 830.122. Suppliers also are evaluated to prevent procurement of suspect counterfeit items.

14.6.4 Inspection and Testing for Acceptance

The Project Hanford Team QA program establishes inspection and acceptance testing requirements (see Chapter 10.0). Using a graded approach, the Project Hanford Team QA program requires that acceptance inspection and testing is performed using procedures, and the inspection requirements and acceptance test criteria are based on specified requirements. The tests are controlled, planned, performed, and documented. M&TE that is used to verify conformance with requirements, monitoring processes, or collecting data is controlled, calibrated at specified intervals, and maintained to required accuracy limits.

14.6.5 Management and Independent Assessments

The Project Hanford Team QA program establishes management and independent assessment requirements. Using a graded approach, the QA program requires that managers at all levels plan, schedule, and conduct assessments of their management systems and processes important to achieving objectives. Independent assessments are performed to measure the adequacy of work performed in complying with applicable requirements, and independent assessments are performed that evaluate the quality of Project Hanford Team items and services and that promote improvement.

QA audits also are performed in accordance with FH procedural requirements based on audit schedules developed annually. These audits include verification of QA program compliance.

14.7 PERSONNEL TRAINING AND QUALIFICATION

FH has developed, and is implementing and managing, a training program that maintains a qualified workforce in sufficient numbers and skill levels to meet Hanford Site requirements and that fulfills *Recommendation 93-3, Improving DOE Technical Capability in Defense Nuclear Facilities*. This work includes identification of known requirements, definition of training standards, implementation of program training classes, certification of required skills, and verification of ongoing job qualifications. Section 12.4 of this document describes the training and qualification program.

14.8 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 830.121, "Quality Assurance Program (QAP)," *Code of Federal Regulations*, as amended.

10 CFR 830.122, "Quality Assurance Criteria," *Code of Federal Regulations*, as amended.

CRD O 414.1A, *Quality Assurance*, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE/RL-96-68, 1998, *Hanford Analytical Services Quality Assurance Requirements Document*, Rev. 2, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-599, *Quality Assurance Program Description*, Fluor Hanford, Inc., Richland, Washington.

Recommendation 93-3, Improving DOE Technical Capability in Defense Nuclear Facilities, 1993, Defense Nuclear Facilities Safety Board, Washington, D.C.

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15.0 EMERGENCY PREPAREDNESS PROGRAM

15.1 INTRODUCTION

This section provides a summary of the emergency preparedness program specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The provisions described in this section are applicable to the PHMC (DE-AC06-96RL13200) D&D work scope.

Assessments of the types of emergencies considered credible at the FH facilities and analysis of the bounding scenarios are provided in Chapter 3.0 of each facility- or activity-specific DSA.

In summary, the key attributes of the FH emergency preparedness program for safety analysis purposes are as follows.

- FH implements DOE/RL-94-02, *Hanford Emergency Management Plan*.
- FH prepares an Emergency Preparedness Hazards Survey, which identifies the scope of the Operational Emergency Base Program by ensuring that all hazards are identified and analyzed as required. The Hazards Survey serves as a basis for identifying which facilities require an Emergency Preparedness Hazards Assessment (EPHA).
- FH projects prepare EPHAs. The facility staff annually reviews and revises the EPHA before changes are made or upon discovery of any conditions that affect the analyses in the EPHA. Site- or facility-specific Emergency Action Levels (EAL) are developed for the spectrum of potential operational emergencies identified in the EPHA (DOE/RL-94-02, Section 4.0). The EALs are revised as necessary when an updated EPHA has been issued.
- FH project staff develops and maintains BEPs or facility response plans (FRP) as required by DOE/RL-94-02.
- Emergency response on the Hanford Site is modeled after the NFPA Incident Command System.
- Predetermined protective actions are developed in accordance with DOE/RL-94-02. Protective actions are taken to preclude or reduce the exposure of workers and the public following an accidental release of hazardous material at the Hanford Site.
- FH project staff appoints BEDs or building wardens and maintains a Facility Emergency Response Organization (FERO) where required.
- FH BEDs evaluate events or conditions to determine if they meet the EAL criteria. If the event or condition meets the EAL criteria, then the actions of DOE-0223, *Emergency Plan Implementing Procedures*, are taken.
- Emergency response facilities and equipment are maintained in a state of readiness.
- FH employees, vendors, contractors, and unescorted visitors receive training on emergency response, including familiarization with facility and Site sirens and alarms, and accompanying actions required during an emergency.

- Emergency preparedness training for emergency response personnel includes Sitewide exercises and facility drills to maintain program proficiency and continuous improvement.

15.2 REQUIREMENTS

The emergency preparedness requirements for the Project Hanford Team are provided in the following:

- DOE/RL-94-02
- Emergency preparedness functional area of HNF-8663, *Standards/Requirements Identification Document.*

Compliance with DOE/RL-94-02 and the agreed-upon set of S&H standards is required by the PHMC (DE-AC06-96RL13200), Clause I 99.b.5.

15.3 SCOPE OF EMERGENCY PREPAREDNESS

RL maintains DOE/RL-94-02, which is designed to address the full scope of emergencies that may occur at the Hanford Site. These potential emergencies include building and range fires, earthquakes, accidental release of radiological and toxicological materials from FH facilities and transportation incidents, and other external events.

The areas addressed by emergency planning include the following:

- ERO
- Hazards analysis and consequence assessment actions
- Notification and communication
- Protective actions and incident response
- Emergency facilities and equipment
- Training, drills, and exercises
- Recovery and re-entry.

15.4 EMERGENCY PREPAREDNESS PLANNING

The Hanford Site implements an integrated emergency response approach based on DOE/RL-94-02. FH implements the requirements of this plan through DOE-0223 and the management requirements specified in HNF-RD-7647, *Emergency Preparedness Program Requirements* and HNF-RD-7648, *Emergency Preparedness Drill Program Requirements*. As part of this program, individual FH facilities develop and maintain BEPs or FRPs as required by DOE/RL-94-02. When issued, a BEP or FRP is used to demonstrate compliance with emergency preparedness planning requirements.

The emergency preparedness planning process includes the performance of hazard surveys when conditions warrant and at intervals not to exceed 3 years. EPHAs are prepared by FH project staff, as discussed in Section 15.1.

Facility staff also develop alarm response procedures and emergency response procedures (ERP). Alarm response procedures and ERPs provide facility-specific mitigative actions for abnormal plant conditions with the potential for adverse health, safety, or environmental impacts.

15.4.1 Emergency Response Organization

The Hanford Site ERO and its roles and responsibilities are specified in DOE/RL-94-02, Section 2.0. Emergency response on the Hanford Site is modeled after the NFPA Incident Command System. As such, the Hanford Site Incident Command System is an integrated emergency management system with defined roles and responsibilities and communication pathways that allows pre-designated, trained individuals to jointly determine and implement incident mitigation strategies.

The Hanford Site ERO has two distinct components: the Incident Command Organization and the Hanford Site EOC. The Incident Command Organization consists of the facility/building ERO with responsibility for implementing emergency response activities at the event facility, and affected surrounding facilities (areas), with assistance from the Hanford Fire Department and the Hanford Patrol, who also have responsibility for on-scene mitigation, depending on the event. The Incident Command Organization has the authority to commit the resources necessary for emergency response, and is required to be familiar with the applicable plans, procedures, operations, activities, and layout of the facility.

The Hanford Site EOC is an emergency response facility maintained by RL for providing an area where personnel may convene during emergency conditions to provide essential response functions. These functions may include public information, offsite protective action recommendations, field monitoring and sampling, hazards assessment, oversight of onsite mitigative activities, and oversight of onsite protective actions. The Hanford Site EOC is activated within 1 hour upon declaration of an Alert or higher emergency.

The Hanford Site EOC consists of several teams. The Policy Team provides oversight of onsite activities, approval and communication of offsite protective action recommendations, approval of reclassification recommendations, oversight of public information activities, and coordination with offsite agencies. The Joint Information Center disseminates accurate and timely information to the media, public, and employees. The Site Management Team provides support to the Incident Command Organization by providing resources not easily obtained by the IC, tracking the status of onsite protective actions, developing and directing implementation of additional onsite protective actions away from the event scene as required, and providing communications support. The Site Emergency Director is responsible for coordination of Site Management Team activities. As part of the Site Management Team, the Security Operations Coordinator Team interfaces with local law enforcement agencies, coordinates with the Federal Bureau of Investigation, and oversees onsite patrol activities. The Unified Dose Assessment Center (UDAC) supports the Site Management Team by monitoring and evaluating existing emergency conditions in order to develop additional protective action recommendations. The UDAC is responsible for field team activities that include plume tracking, monitoring, and sampling.

FH ERO requirements are specified in HNF-RD-7647. Each FH project identifies management and technical staff to support the Hanford Site EOC ERO. These employees may be assigned to support the Hanford Site EOC, Joint Information Center, Field Monitoring Team, Emergency Duty Officer (EDO), FH Executive-on-Call, and Site Emergency Director. Hanford Site EOC ERO members assigned on-call responsibilities must meet fitness-for-duty requirements.

The contractor provides facility and management support to the Hanford Site EOC for response to DOE and non-DOE events that may impact the Site. These events range from Hazardous Material Operational Emergencies to situations that require monitoring, but which are not emergencies (e.g., power outage, water line break). The EOC is entirely integrated with the RL organization, as described in Site emergency planning documents.

FH projects with hazardous facilities appoint a minimum of two BEDs and maintain a FERO. The FERO has the overall responsibility for timely initial response to mitigate facility emergencies, while completing required emergency management activities. The FERO staff includes operators and radiation control technicians as necessary. The FERO interfaces with the Hanford Site EOC using a graded approach based on facility hazards and operations. FERO personnel having checklist duties are formally documented by name and position.

A BED must be present onsite or within reasonable proximity to the facility if work is being performed which could generate an Alert or higher emergency classification. On-call BEDs, where designated, may be used for facilities where hazardous materials are in storage and stable, and the work being performed only involves surveillance. Hazardous facilities that do not maintain 24-hour BED staffing at the facility maintain a 24-hour on-call BED for timely incident response. The Occurrence Notification Center (ONC) has a list of all on-call personnel who are assigned to the FEROs.

BEDs performing on-call duties have emergency preparedness procedures, facility ERPs, plant operating procedures, FERO rosters, and other documentation needed for an effective and timely incident response. BEDs assigned to on-call duties must meet fitness-for-duty requirements.

Administrative and low-hazards facilities appoint at least two building wardens and maintain a FERO to effectively implement protective actions for their occupants using a graded approach based on hazards and operations.

To support the DOE, agreements have been established with local and regional emergency management organizations to support potential Hanford Site needs. These agreements provide for additional fire-fighting capabilities and emergency health care services. These agreements also provide for defined roles and responsibilities in the event of an emergency, for example, identifying emergency notification methods.

15.4.2 Consequence Assessment Actions

The initial onset of a Base Program Operational Emergency is recognized through notifications provided by employees and the BEDs. Notifications are made to the Hanford Patrol by calling 9-1-1 or alternatively through the ONC. Onset of a Base Program Operational Emergency also may be recognized as a result of alarm response procedures. FH project and facility staff evaluate the event or condition to determine if it meets the EAL criteria. If the event or condition meets the EAL criteria, then the actions of DOE-0223 are taken. Events or conditions that do not meet the EAL criteria are evaluated to determine if they represent a Base Program Operational Emergency or other lesser occurrence. Actions specified in HNF-PRO-060, *Reporting Occurrences and Processing Operations Information*, are taken in response to these events and conditions.

When the Hanford Site EOC has been activated, the UDAC monitors and evaluates emergency conditions to develop additional protective action recommendations. The UDAC is responsible for field team activities that include plume tracking, monitoring, and sampling, as well as the following.

- Acquire the necessary data and measurements to evaluate personnel radiation doses and chemical exposures resulting from the event.
- Assess the potential for onsite and offsite consequences of a release of radioactive or nonradioactive materials based on meteorological conditions, source term, location, and dispersal of the hazardous material.
- Assist the event contractor or other Hanford Site contractors in onsite hazard assessment or development of onsite protective actions.
- Analyze the consequences associated with evacuating versus remaining in a take-cover situation for onsite personnel and recommend appropriate additional protective actions if necessary.
- Develop offsite protective action recommendation in coordination with representatives from the states of Washington and Oregon.
- Coordinate and direct emergency environmental monitoring teams that are not assigned to the event facility.

The consequence assessment models used are the Hanford Unified Dose Utility, which provides rapid initial assessment of radiological emergency situations. The Air Pollutant Graphical Environmental Monitoring System provides atmospheric dispersion and dose assessment modeling. The Emergency Prediction Information provides rapid assessment of chemical emergency situations.

15.4.3 Notification

The notification process for emergencies is specified in DOE/RL-94-02, Section 5.0. Notifications are made for Hanford Site events according to the event category. Notifications are made in order of the urgency with Operational Emergency notifications performed first. The initial event classification (Alert, Site Area Emergency, or General Emergency) is made by the BED, IC, or EDO (for non-facility events). The BED, IC, or EDO initiates immediate notifications via the 9-1-1 emergency number to request emergency response assistance and to notify onsite personnel within their geographic area of responsibility via sirens, the onsite crash alarm telephone system, or plant telephone so that they can take protective actions. The BED, IC, or EDO is responsible for ensuring a completed copy of the Hanford Emergency Notification Form is transmitted to the ONC. For an event classified as Alert, Site Area Emergency, or General Emergency, the ONC notifies Benton County, Franklin County, Grant County, Washington State, Oregon State, and Energy Northwest via the DOE Crash Alarm Telephone System, and also notifies the DOE-Headquarters EOC. Once an event is declared, the facility staff is responsible for submitting the initial report on the emergency to the Occurrence Reporting and Processing System by the close of the next business day.

Upon declaration of activation, the Hanford Site EOC has the responsibility for reclassifying or terminating emergencies, disseminating additional protective action decisions to onsite personnel, and performing offsite notifications that include protective action recommendations.

Following termination of emergency response, FH facility staff submits a final report on the emergency to the Occurrence Reporting and Processing System.

15.4.4 Protective Actions

Predetermined protective actions are developed in accordance with DOE/RL-94-02, Section 7.0. Protective actions are taken to preclude or reduce the exposure of individuals following an accidental release at the Hanford Site. Emergencies at Site facilities may require actions only on the Hanford Site or may affect offsite areas. EPZs are designated areas, based on hazards assessments, in which predetermined protective actions may be required. The DOE develops EPZs, as determined necessary by hazard assessments, and submits them to affected states and counties for their use in emergency planning.

The predetermined protective actions for onsite personnel and the public include the following:

- Methods for controlling, monitoring, and maintaining records of personnel exposures to hazardous materials (radiological and nonradiological)
- Plans for timely sheltering and/or evacuation of workers
- Methods for controlling access to contaminated areas and for decontaminating personnel or equipment exiting the area
- Actions to be taken to increase the effectiveness of protective actions
- Methods for providing timely protective action recommendations, such as sheltering, evacuation, and relocation, to appropriate offsite agencies
- Protective Action Guidelines and Emergency Response Planning Guidelines prepared in accordance with DOE-approved guidance applicable to actual or potential release of hazardous materials to the environment for use in protective action decision making
- Administration of medications and addressing other emergency medical needs. The Hanford Environmental Health Foundation provides onsite medical support to augment Hanford Fire Department emergency medical capabilities.

Evacuation routes for the Hanford Site are provided in DOE/RL-94-02, Section 7.0. Specific routes are determined at the time of an event based on the event magnitude, location, and meteorology conditions.

Initial offsite protective actions appropriate for each emergency classification have been predetermined by RL and adjacent counties. These initial, preplanned protective actions, as indicated by the event classification and location, are included on the initial notification form to offsite agencies. The determination for the need for additional protective actions are based on consequence assessments.

Immediate protective action decisions within the plume exposure pathway are the responsibility of the applicable county. The decision and notification process to populations within the plume EPZ also is the responsibility of the counties and is primarily provided using the Emergency Alert System (EAS). Benton and Franklin County residents within the radiological EPZs receive the EAS messages via tone-alert radios in their homes. Grant County residents within the radiological plume EPZs are notified to tune to the EAS via telephone calls from the Hanford Site automated Emergency Notification System.

Notifications to populations within the ingestion EPZ are accomplished by the affected counties and states using the EAS, as appropriate, and news media reports.

Relaxation or lifting of protective actions is based on facility conditions and consequence assessments. Based on recommendations from the Site Emergency Director, the Hanford Site ERO Policy Team will decide when onsite protective actions can be modified. The Policy Team will provide recommendations to affected counties and states for relaxation of offsite emergency protective actions. The states are responsible for decisions on relaxation of offsite ingestion protective actions.

15.4.5 Emergency Facilities and Equipment

Emergency facilities include the Hanford Site EOC, Hanford Patrol Operations Center, ONC, medical emergency facilities, protective clothing cleaning facilities, and state and county EOCs. Emergency equipment is used for the following activities: monitoring, fire control, personal protection, spill and contamination control supplies, decontamination, Hanford Patrol, and Hanford Fire Department, e.g., ambulances, hazardous material response vehicle, and mobile incident command vehicle.

15.4.6 Training and Exercises

DOE/RL-94-02 specifies a range of training and exercise requirements. FH employees, vendors, contractors, and unescorted visitors receive training on emergency responses, including familiarization with facility and Site sirens and alarms, and the accompanying actions during an emergency. BEDs, hazardous facility FERO members, building wardens, and personnel assigned to the Hanford Site EOC attend initial and annual refresher training as specified in HNF-RD-7647. BEDs also attend Incident Command System training and facility-specific emergency response training.

Projects implement a drill program plan to maintain specific operational and emergency response capabilities. Drill programs provide supervised, "hands-on" training for ERO members and include the range of emergency response and emergency management activities that could be performed by the organizations, based on the hazards analysis at the facility. Each project conducts at least one protective action drill annually (Take Cover or Evacuation). Personnel assigned formal checklist FERO responsibilities participate in at least one drill annually, or a number sufficient to demonstrate proficiency at their respective FERO position.

Information on the Hanford Site's potential hazards and ERPs are provided to the public residing within the EPZ through a brochure distributed by county emergency management organizations. Offsite agencies participate in their functional areas annually in Hanford Site exercises. Area hospitals and local ambulance providers receive training on the handling and care of radiological-contaminated patients from Energy Northwest and county emergency management organizations. The EAS and the tone-alert radios periodically are used during exercises to provide information to the public.

15.4.7 Recovery and Reentry

Before event termination, the BED and IC are responsible for determining appropriate protective measures for personnel reentering the event facility or area and for authorizing reentry. Reentry planning includes contingency planning to ensure the safety of reentry personnel, such as planning for the rescue of reentry teams. Individuals involved in reentry receive a hazards/safety briefing before emergency response activities.

The BED/IC and EOC staff determine the resources needed and the accessibility of the Site areas during and after the emergency. They also evaluate the advisability of reentry operations as required. The BEPs also specify the development of a recovery plan where further risk could be introduced to personnel, the facility, or the environment through the recovery action, and/or to maximize the preservation of evidence. The recovery actions for the facility are implemented by the BED or an onsite recovery organization. During recovery, the onsite recovery manager or the BED/IC authorizes any reentry activities.

15.5 REFERENCES

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE-0223, *Emergency Plan Implementing Procedures*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-94-02, *Hanford Emergency Management Plan*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-060, *Reporting Occurrences and Processing Operations Information*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-7647, *Emergency Preparedness Program Requirements*, Fluor Hanford, Inc., Richland, Washington.

HNF-RD-7648, *Emergency Preparedness Drill Program Requirements*, Fluor Hanford, Inc., Richland, Washington.

16.0 PROVISIONS FOR DECONTAMINATION AND DECOMMISSIONING

16.1 INTRODUCTION

This section provides a summary of the provisions for D&D provisions specified by DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. The provisions for D&D described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200). This section provides general types of provisions that may be employed in individual facilities. The D&D provisions applicable for each facility declared surplus will be summarized in the facility-specific DSA.

The D&D process will conform to the Tri-Party Agreement (Ecology et al. 1989). The process may be primarily regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA) or CERCLA.

In summary, the key attributes of the FH D&D process for safety analysis purposes are as follows.

- D&D activities will be performed in compliance with applicable federal and state environmental laws and regulations. The planned D&D activities for each specific facility will include a process to identify and evaluate relevant requirements for the project.
- The D&D provisions applicable for each facility declared surplus will be developed as the D&D work plan and safety basis are developed for that facility, and these provisions will be summarized in the facility-specific DSA.
- Facility modifications or newly constructed facilities have features to simplify their future D&D that are incorporated into the facility or modification during the design phase.

16.2 REQUIREMENTS

The D&D requirements for the Project Hanford Team are provided in the following:

- 10 CFR 830, "Nuclear Safety Management," and 10 CFR 835, "Occupational Radiation Protection"
- CRD O 430.1A, *Life Cycle Asset Management*
- CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*
- Environmental Regulations, especially RCRA; WAC 173-303, "Dangerous Waste Regulations;" and CERCLA
- Tri-Party Agreement
- D&D functional area of HNF-8663, *Standards/Requirements Identification Document*.

Compliance with the environmental requirements is a statutory requirement, and compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

16.3 DESCRIPTION OF CONCEPTUAL PLANS

The facilities and process equipment will be decontaminated and decommissioned in compliance with applicable regulations, when equipment is obsolete, or there is no continuing need for the facilities. D&D activities will be planned and evaluated to address the decontamination of the buildings and the process equipment required to eliminate the need for active maintenance of the facilities being decommissioned. If any FH facilities are identified for future use, an appropriate maintenance plan will be instituted.

The potential for personnel, equipment, or building contamination within FH facilities being decommissioned is minimized by design, by administrative controls, by radiological contamination surveys, and by work controls defined in operating procedures and radiation work permits. General operating practices are in place to minimize the spread of contamination, simplify D&D operations, and help minimize Site and environmental contamination. Controls and practices used at FH facilities to accomplish D&D are described in this section, and in the facility- or activity-specific safety basis where those controls or practices are relied upon for safety.

Hazardous and radioactive materials, which are identified by location and classification in Chapter 3.0 of the facility-specific DSA, are contained and controlled during normal operating conditions. Because the potential exists for release of hazardous or contaminated materials during abnormal conditions, a monitoring program is in place and special instruments are used to monitor for hazardous materials where appropriate. These monitoring practices help operations limit the spread of contamination, thus simplifying future D&D activities. However, older design methodologies and past practices have resulted in significant contamination spread in some FH facilities slated for D&D.

Facility modifications or newly constructed facilities have features to simplify their future D&D that are incorporated into the facility or modification during the design phase as part of the FH engineering process. As required by CRD O 420.1A, *Facility Safety*, the FH engineering process, HNF-RD-1819, *PHMC Engineering Requirements*, requires that facilities are designed to facilitate safe deactivation, decommissioning, and decontamination at end of life. Facilitating safe and effective D&D is a design input requirement for the FH engineering process. The final design criteria evaluation considers the vulnerabilities to normal and abnormal events and operational plans to minimize contamination and prevent an increase in residual risk during or after decommissioning. Design features that may be included to simplify future D&D include the use of catch pans where overflows are possible, impermeable coatings or liners to simplify decontamination, and doubly contained systems. Other design features that may be incorporated are features to reduce the amount of material that is potentially contaminated, or features that reduce the amount of waste material during D&D that cannot be efficiently decontaminated, e.g., heat exchangers that separate contaminated from uncontaminated systems. For new facilities or major modifications, specific D&D design features important to reducing future D&D effort will be addressed in the facility- or activity-specific DSA.

In accordance with CRD O 430.1A, and DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, D&D activities will be performed in compliance with applicable federal and state environmental laws and regulations. The planned D&D activities for each specific facility will include a process to identify and evaluate relevant requirements for the project. At a minimum, the following regulations will be considered:

- RCRA
- CERCLA
- *National Environmental Policy Act of 1969* (NEPA)
- *National Historic Preservation Act of 1966*
- *Clean Air Act*
- *Clean Water Act of 1977*
- *Safe Drinking Water Act of 1974*
- Tri-Party Agreement.

Some existing FH facilities are permitted under RCRA to operate dangerous waste management units. Some existing FH facilities also operate "less than 90-day" accumulation areas. WA780008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit*, requires a closure plan that incorporates the features designed into FH facilities. It also is possible that planned D&D activities will generate new dangerous waste products in existing facilities that may require RCRA permits.

FH facilities contain cribs, french drains, septic tanks, and buried storage tanks that potentially require remediation or removal under CERCLA requirements. Likewise, the facilities are part of the Hanford Site, which is listed on the National Priorities List, and facility D&D must be evaluated for the conditions that exist after the activity, in accordance with NEPA.

Many FH facilities have environmental impact statements and the resulting record of decision, in accordance with NEPA, that govern the stabilization process and final disposition of special nuclear materials. Many of the planned D&D activities are covered under the existing Sitewide categorical exclusions NEPA determinations that govern the demolition of surplus buildings and process deactivation activities. Planned D&D activities at each specific facility will have to be evaluated for compliance under existing NEPA requirements.

The Hanford Site contains a multitude of buildings and structures that have been determined to be historically important and eligible for inclusion in the National Register of Historic Places under the provisions of the *National Historic Preservation Act of 1966*. Planned D&D activities must interface with the Building Mitigation Project and be cognizant of appropriate requirements and decisions regarding these historic buildings, structures, and equipment.

D&D activities, especially dismantlement that has the potential to create radioactive air emissions, will be evaluated for compliance with *Clean Air Act* regulations, which require any major source of hazardous air pollutants to obtain a permit. AOP 00-05-006, *Hanford Site Air Operating Permit*, covers existing operations and activities in compliance with air emissions permitting requirements.

The *Clean Water Act* requires any source that discharges a pollutant into a surface water body to operate in compliance with a National Pollution Discharge Elimination System permit. Planned D&D activities will be evaluated for potential discharges. Washington State Waste Discharge permits are required for any liquid wastes that are discharged to drains, septic tanks, tile fields, etc. D&D plans typically will address the elimination of existing liquid waste streams.

The Tri-Party Agreement is the result of negotiation among RL, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency that defines key project milestones, applicable regulatory compliance methods, and responsibilities for the Hanford Site cleanup efforts. This is an agreement for achieving compliance with CERCLA remedial action provisions and with RCRA treatment, storage, and disposal unit regulations and corrective action provisions under an agreed-upon plan of action among the three affected parties. D&D activities will involve highly complex RCRA and CERCLA regulatory issues that will be negotiated under the Tri-Party Agreement.

During D&D activities, there will be processing of hazardous and/or radioactive materials generated by facility cleanup processes. After proper characterization, waste will be packaged and labeled in accordance with HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria.*

Transportation of materials will be accomplished in accordance with the requirements of hazardous material packaging and shipping procedures and DOE/RL-2001-0036, *Hanford Sitewide Transportation Safety Document.*

Low-level radioactive waste will be shipped to onsite disposal. Transuranic wastes will be packaged and certified for permanent disposal in the Waste Isolation Pilot Plant. Hazardous waste will be disposed at a permitted hazardous waste treatment, storage, and disposal facility. The specific treatment, storage, and disposal facility will be identified in the specific facility D&D plans.

When D&D activities are complete, the D&D structures and equipment (e.g., foundations, weather enclosures, support buildings, and equipment used in the D&D process) will be removed from the operation area. Typically, no residual structures or equipment will remain at the Site. The structures and equipment used by the D&D contractor may be used for additional D&D activities. Any foundations not reclaimed will be left in place. D&D activities performed at each specific facility will proceed toward a predefined and agreed-upon end point for completion of Site restoration.

16.4 REFERENCES

10 CFR 830, "Nuclear Safety Management," *Code of Federal Regulations*, as amended.

10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, as amended.

AOP 00-05-006, *Hanford Site Air Operating Permit.*

Clean Air Act, 1955, 42 USC 7401, et seq.

Clean Water Act of 1977, 33 USC 1251, et seq.

Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 USC 9601, et seq.

CRD O 420.1A, *Facility Safety*, Supp Rev 0, U.S. Department of Energy, Washington, D.C.

CRD O 430.1A, *Life Cycle Asset Management*, U.S. Department of Energy, Washington, D.C.

CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, U.S. Department of Energy, Washington, D.C.

DE-AC06-96RL13200, 1996, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Daniel Hanford, Inc.*, U.S. Department of Energy, Richland Operations Office, Richland, Washington, as amended.

DOE/RL-2001-0036, *Hanford Sitewide Transportation Safety Document*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-STD-1120-98, 1998, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, U.S. Department of Energy, Washington, D.C.

DOE-STD-3009-94, 2002, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, CH-2, U.S. Department of Energy, Washington, D.C.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

HNF-EP-0063, 2003, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 9, Fluor Hanford Inc., Richland, Washington.

HNF-RD-1819, *PHMC Engineering Requirements*, Fluor Hanford Inc., Richland, Washington.

National Environmental Policy Act of 1969, 42 USC 4321, et seq.

National Historic Preservation Act of 1966, 16 USC 470, et seq.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

Safe Drinking Water Act of 1974, 42 USC 300, et seq.

WA780008967, *Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit.*

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended.

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17.0 MANAGEMENT, ORGANIZATION, AND INSTITUTIONAL SAFETY PROVISIONS

17.1 INTRODUCTION

This section provides a summary of the management, organization, and institutional safety program provisions specified by DOE-STD 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* The organization and safety management processes described in this section are applicable within the scope of the PHMC (DE-AC06-96RL13200).

In summary, the key attributes of the FH management, organization, and institutional safety provisions are as follows.

- FH implements an ISMS based on DOE P 450.4, *Safety Management System Policy*; DOE P 450.5, *Line Environment, Safety and Health Oversight*; and DOE P 450.6, *Secretarial Policy Statement Environment, Safety and Health.*
- The responsibility for safe operation of each FH facility lies with line management, culminating with the facility manager or equivalent.
- Organizational roles and responsibilities for performing the FH scope of work are specified.
- Safety performance is evaluated.
- Configuration control and document control provisions are implemented.
- FH implements a USQ process that meets the requirements of 10 CFR 830.203, "Unreviewed Safety Question Process."
- FH maintains occurrence-reporting processes that implement the requirements of CRD O 232.1A, *Occurrence Reporting and Processing of Operations Information.*
- The FH lesson-learned program transmits information from onsite and offsite occurrences to FH personnel to reduce the likelihood of repetition within FH.
- FH implements an assessment and corrective action process.
- Occupational safety and Industrial Hygiene programs for workers are implemented in accordance with the requirements of CRD O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.*

17.2 REQUIREMENTS

The requirements for the Project Hanford Team are provided in the following:

- 48 CFR 970.5204-2, "Integration of Environment, Safety and Health into Work Planning and Execution"
- HNF-8663, *Standards/Requirements Identification Document.*

Compliance with 48 CFR 970.5204-2 is required by the PHMC, Clause I.99, and compliance with the agreed-upon set of S&H standards is required by the PHMC, Clause I 99.b.5.

17.3 ORGANIZATIONAL STRUCTURE, RESPONSIBILITIES, AND INTERFACES

This section describes the FH organizational structure, responsibilities, and interfaces. The organizational structure and the allocation of roles and responsibilities within the organizational structure are subject to change. Changes to the organizational structure, assigned personnel, titles, and allocation of roles and responsibilities are not subject to the USQ process because there is no change in the work or the requirements associated with the work resulting from reorganization activities. Organization structure, responsibilities, and interfaces are identified in the following:

- HNF-MP-001, *Fluor Hanford Management Plan.* This plan describes how FH manages the PHMC work scope, and it provides guidance to FH managers, employees, and subcontractors on the safe, efficient conduct of operations.
- HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description.* This system description describes how S&H are integrated into the work planning and execution for the PHMC scope of work.
- HNF-MP-599, *Quality Assurance Program Description.* This document defines the Project Hanford Team implementation of 10 CFR 830, "Nuclear Safety Management," and CRD O 414.1A, *Quality Assurance.*

17.3.1 Organizational Structure

The DOE owns and has overall responsibility for the Hanford Site. The Hanford Site has two major missions: (1) cleanup and (2) science and technology. Two DOE Offices of Environmental Management programs are associated with cleanup: the River Protection Project and the Project Hanford Team. The River Protection Project, which entails cleaning up Hanford Site high-level tank waste, is managed by DOE's Office of River Protection. The Project Hanford Team focuses on cleaning up the remainder of the Hanford Site and is managed by RL.

Through the PHMC, FH is the prime contractor responsible to RL for overall coordination and operation of the Project Hanford Team portion of the Hanford Site operations. FH plans, integrates, manages, and executes its major subprojects, services, and other activities at the Hanford Site as described in the PHMC. In addition, FH coordinates with other Site prime contractors in the performance of infrastructure services provided to the other prime contractors. Figure 17-1 shows the FH functional organization chart. The functions of some of these organizational elements are described below. Additional discussions of roles and responsibilities and the organizational structure are provided in HNF-MP-001, HNF-MP-003, and HNF-MP-599.

Spent Nuclear Fuel

The mission of the Spent Nuclear Fuel Subproject is to (1) provide safe, economic, environmentally sound management of spent nuclear fuel and related material in a manner that stages it for final disposition; and (2) deactivate the K Basin facilities.

Waste Management

The mission of the Waste Management Subproject is to provide safe, compliant, and cost-effective waste management services for the Hanford Site and the DOE Complex. These services include storage, treatment, and disposal of a broad spectrum of waste types, including solid waste and management of liquid effluents. In addition, the Subproject provides crosscutting support services that include waste generator services, transportation and packaging (including offsite shipment), and waste minimization.

Nuclear Material Stabilization

The mission of the Nuclear Material Stabilization Subproject is to provide for the safe stabilization, interim storage, repackaging, and shipment of the PFP inventory of plutonium-bearing materials, spent nuclear fuel, and other nuclear material to other locations for reuse, long-term storage, and/or final disposition. The mission also includes deactivating and dismantling systems and structures of the PFP Complex.

Central Plateau Remediation

The mission of the Central Plateau Remediation Subproject is to stabilize contaminated facilities on the Central Plateau, decontaminate and decommission selected facilities, and demolish selected facilities. The Subproject mission also includes providing minimum safe surveillance and maintenance of assigned facilities on the Central Plateau, to reduce risks to workers, the public, and the environment, until they are in a low-cost, long-term surveillance and maintenance state, and ultimately demolished. The Subproject also is responsible for management and remediation of selected waste sites in the Central Plateau as well as integration, monitoring, and remediation of the Groundwater/Vadose Zone for the Site.

Fast Flux Test Facility

The mission of the Fast Flux Test Facility Subproject is to complete a safe, economic, and environmentally sound deactivation of the Fast Flux Test Facility to a condition suitable for long-term surveillance and maintenance before final D&D.

In addition to the Subproject organizations, FH also has functional organizations. These functional organizations provide services to the subprojects, but do not report to the subprojects. Some of these functional organizations are discussed below.

Regulatory Compliance

FH Regulatory Compliance is a functional organization that directs the FH self-assessment activities; establishes and maintains a self-reporting process for nuclear safety noncompliances; establishes and maintains the FH Corrective Action Management System; administers the FH Deficiency Tracking System; provides QA leadership; maintains the FH QA program, requirements, procedures, and processes; provides independent acceptance services to the DOE for construction performed by Hanford Site contractors; establishes and maintains the FH Nuclear and Criticality Safety Program; provides leadership, procedures, and processes for requirements management and configuration management; provides leadership, procedures, and processes for the coordination of lessons-learned and restart activities; maintains the PHMS; and establishes and maintains the Environmental Compliance Program.

Safety and Health

S&H is a functional organization that provides S&H leadership, requirements, procedures, and processes; establishes and maintains the ISMS; establishes and maintains the Occupational Safety and Health Program; establishes and maintains the FH Radiation Protection Program; and coordinates, integrates, and maintains the Tri-Party Agreement (Ecology et al. 1989).

Support Services

At the Hanford Site, there are a variety of services that support the Site. These services furnish products and services needed by FH major subprojects and other Site prime contractors to accomplish their work scope. The FH Deactivation and Decommissioning organization provides essential Site services, including Electrical and Water Utilities, Facilities and Land Management, Central Maintenance, Fabrication shops, and Technical Support that includes Analytical Services. The S&H organization provides the services of the Hanford Fire Department, Radiation Protection, Emergency Preparedness, Hanford Patrol, and Response Readiness Training. The Project Maintenance Center provides an integrated approach to maintenance to ensure consistency in providing services to the major subprojects for maintenance programs, resource allocation, technical expertise, and centralized Site services.

17.3.2 Organizational Responsibilities

Organizational responsibilities are described in Section 17.3.1. Additional responsibilities are described below. Further discussions of roles and responsibilities and the organizational structure are provided in HNF-MP-001, HNF-MP-003, and HNF-MP-599.

The responsibility for safe operation of each FH facility lies with line management, culminating with the facility manager or equivalent. Because of the broad scope and magnitude of facility project operations, many responsibilities that are directed at the facility manager may be delegated to other managers and special assistants.

Specific operating personnel responsibilities and conduct of operations requirements are defined in Chapter 11.0. The minimum operations shift complement for FH facilities is defined in the facility-specific TSR where required.

Facility managers may have QA or safety specialists assigned to routinely assess the facility and assist management to ensure programs are effective.

- The safety representative serves as a single point of contact to ensure that concurrence is obtained from required safety specialty areas before safety approval is given. Safety provides coordination and communication with respect to discovery, management, and resolution of safety issues internal to the facility. Safety may report directly to the facility manager, which may be on a shared basis, and receive guidance and direction from FH Health and Safety, or may report directly to Health and Safety.
- The facility QA specialist has independent authority to assess the systematic implementation of the requirements specified for application to the facility activities. The QA representative may report to the facility manager, which may be on a shared basis, and receive guidance and direction from FH QA, or may report directly to QA.
- The emergency preparedness specialist, when assigned, assists the facility manager in preparing emergency plans or emergency response guides and may assist in conducting training exercises or operational drills to prepare for potential events. The emergency preparedness specialist may report directly to the facility manager, which may be on a shared basis, and receive guidance and direction from FH Health and Safety, or may report directly to Health and Safety.
- The CSR responsibilities are specified in HNF-7098, *Criticality Safety Program*. These responsibilities include serving as a liaison for criticality matters between organizations having custody of fissionable material; advising operating personnel and supervision on

questions concerning conformance to criticality safety requirements; reviewing and approving drawings related to criticality safety; reviewing and approving new or revised CSERs; and preparing and/or approving CPSs.

The following support organizations do not generally report directly to the facility manager but provide functions essential to operations.

- Maintenance provides centralized maintenance, planning, and scheduling support for FH facilities, including preventive and corrective maintenance and administration of the computerized maintenance management system.
- Project Support responsibilities include training and procedures. Training is based on the development and use of individual training plans that identify the specific knowledge and training requirements applicable to the responsibilities of each employee. Training is responsible for ensuring that the contents of the training program and qualification programs are administered, improved, and maintained consistent with and applicable to the facility configuration. This training support is essential for each manager to maintain a qualified staff. Procedure support also is essential in maintaining procedures accurate, up-to-date, and compliant with the safety basis. Specific responsibilities are described in Chapter 12.0.
- Operations Technical Management responsibilities include planning, tracking, and coordination of waste package shipments and documentation, including maintaining the Solid Waste Information and Tracking System database. This requires close coordination with Operations at each FH nuclear facility as well as interfaces with Generator Services and the generating facilities, on and off site.
- Generator Services provides support to generators, on and off site, to prepare waste packages and documents for shipment. They validate packages before shipment and inspect packages from offsite to ensure compliance with regulatory and facility requirements.
- Packaging and Transportation activities include the development of company-wide policies and procedures that cover hazardous materials transportation and packaging; support for institutional transportation programs; transportation programs; transportation and policy direction; qualification requirements and shipper training; preparation and maintenance of required shipping container safety documentation; hazardous materials packaging; design procurement support; analysis and testing; field support to the DOE-Headquarters Transportation Management Program; and other transportation management activities.
- Analytical Services provides laboratory analysis of samples to meet required protocols.

The Hanford Fire Department is a vital part of Hanford Site infrastructure support to FH facilities and provides the following fire protection functions:

- Maintains command of emergency response forces to perform the necessary actions to control and terminate fire-related incidents, provides emergency medical patient care, and acts as the incident command agency for hazardous materials emergency incidents
- Conducts fire protection system functional testing for Hanford Site facilities and maintains self-contained breathing apparatus

- Maintains an active fire prevention program through facility tours and inspections of flammable and reactive waste sites
- Provides fire protection engineers, on a matrix basis, to support facility management needs
- Maintains a highly trained emergency response team certified under a 3-year Washington State approved fire-fighter apprenticeship program.

The Hanford Fire Department is party to mutual aid agreements with ten surrounding fire departments and fire districts as well as contractual responsibilities for fire suppression and ambulance service to Energy Northwest. More detailed information is provided in Chapter 11.0.

The Hanford Site provides coordination for Site emergencies. The facility emergency response requirements are identified in Site-, company-, and facility-level procedures. The facility manager is responsible to ensure that the facility emergency response list is maintained and facility personnel are trained to understand their responsibilities. Specific responsibilities for emergency preparedness are discussed in Chapter 15.0.

The S&H and Regulatory Compliance organizations provide the functional area interpretive authorities and infrastructure procedures for environmental regulation, industrial safety and health regulations and standards, and the radiological control program regulations and standards. Functional area evaluations and crosscutting issue resolution are provided for the subprojects as requested.

Engineering responsibilities include configuration management and maintaining the safety basis for the facility, including the USQ process.

The radiological control organization implements the requirements of HNF-5173, *PHMC Radiological Control Manual*. Project-specific documents provide the detailed requirements for work performed in the facility. Additional information is provided in Chapter 7.0.

Environmental Compliance has a support responsibility for operations to provide procedures, permits, analysis, and reporting to ensure compliance with environmental regulations and requirements. Facility management is directly responsible for compliance with the applicable environmental regulations and facility-specific permits.

The QA organization provides the functional area interpretive authorities and implementing procedures for FH implementation of 10 CFR 830, Subpart A, "Quality Assurance Requirements," and other applicable quality-controlling requirements. QA activities are described in Chapter 14.0.

The Nuclear and Criticality Safety organization provides the functional area interpretive authorities and implementing procedures for FH implementation of 10 CFR 830, Subpart B, "Safety Basis Requirements," and other applicable nuclear and criticality safety requirements. The Nuclear and Criticality Safety organization also provides independent review for new and revised safety basis documents.

Company-level oversight and inspection are provided to promote compliance with environmental, safety, and quality requirements. Management assessments are performed by FH organizations as described in Chapter 14.0. Independent assessment also is performed. FH provides the primary routine independent assessment to ensure nuclear facilities implement S&H requirements. FH periodically assesses nuclear facilities using criteria developed by the functional areas (e.g., radiological control). In addition to these assessments, functional areas schedule and perform vertical and crosscutting assessments of specific topical areas (e.g., USQ process). The yearly assessment schedule is captured in the Integrated Evaluation Plan (DE-AC06-96RL13200, Modification M174, Part I, "The Schedule," Section E, "Inspection and Acceptance," Clause E.5), which is updated quarterly.

17.3.3 Staffing and Qualifications

Operation of FH facilities requires a staff of trained, qualified, and/or experienced personnel in a variety of disciplines. The FH ISMS requires that personnel performing work have the requisite knowledge, skills, and abilities to perform the assigned work. Facility staffing levels for normal day-to-day activities include a mix of management, administrative, maintenance, operations support, radiological control, and engineering personnel. Not all personnel are required to be located at the facility to operate the facility safely and in compliance with procedures, regulations, and orders; nor, is it necessary to have all staff functions present during any particular operation. Where a minimum staffing complement has been established, the minimum number of staff required is specified in facility- or activity-specific safety basis.

FH qualification requirements are established through initial hiring processes and maintenance of training requirements as described in Chapter 12.0. Safety and health training and qualification requirements are developed using the EJTA described in Chapter 8.0. The EJTA identifies potential work place hazards associated with employment for which training must be provided. Minimum training and qualification requirements are specified as part of the hiring process. Ongoing training and qualification requirements also are established as part of the training matrix described in Chapter 12.0. The training and qualification for personnel addresses Sitewide and facility-specific training and qualification requirements, and meets the requirements of DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*.

Minimum safe staffing levels will vary depending on the activities being performed. Minimum staffing is determined by management, based on the ability to safely perform required functions in accordance with written procedures and to identify, respond to, and report potential off-normal conditions.

Training for FH facilities is addressed in Chapter 12.0. The job category and assigned work determine the qualification requirements for each position and the training requirements for each employee. Company training meets essential qualification requirements for continued employment, given acceptable performance.

Each facility maintains documentation of staff qualifications and any changes in qualifications as a result of continued training.

Safety performance of the staff is evaluated through a combination of activities. Supervisory oversight of work performance, management assessments, and FH self-assessment programs evaluate the safety performance of workers. RL, other regulators, Defense Nuclear Facilities Safety Board oversight, DOE-Headquarters review groups, operational readiness reviews, each also evaluate the safety performance of FH projects, functional groups, and activities.

17.4 SAFETY MANAGEMENT POLICIES AND PROGRAMS

This section identifies and describes the programs used to enhance facility safety.

17.4.1 Safety Review and Performance Assessment

The FH QA program described in Chapter 14.0 requires the performance of management and independent assessment. Safety performance is assessed by line management and functional area experts. Performance indicators have been established for key safety performance areas as specified in HNF-PRO-4294, *Performance Indicator Process*. Performance in these areas is reported monthly, and performance trends are evaluated. Where adverse trends are identified, corrective actions are assigned.

In addition, external reviews are performed by organizations such as RL, Washington State Departments of Ecology and Health, DOE-Headquarters, and FH. Action items from their reviews are tracked and addressed within the FH Corrective Action Management System.

17.4.2 Configuration and Document Control

FH configuration control and document control provisions are established in HNF-PRO-599. The QA program is described in Chapter 14.0. Engineering configuration control requirements (e.g., drawings) are further described in engineering implementing procedures.

The document and record control programs require the following.

- Documents that define processes, specify requirements, or establish design are identified, prepared, reviewed, approved, issued, used, and revised when necessary.
- Major changes to documents are reviewed and approved by the same organizations that performed the original review and approval, unless other organizations are specifically designated.
- Records are specified, identified, prepared, reviewed, approved, authenticated, maintained, and the final disposition specified.
- Records are dispositioned in accordance with the General Records Schedule published by the National Archives and Records Administration or in accordance with DOE-unique schedules.
- Records for projects driven by programs based on ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, are classified as lifetime or nonpermanent, and retention periods documented.

Managers for the Project Hanford Team organizations are responsible for the following:

- Defining specific document and record control record requirements for their organizations
- Establishing processes for controlling documents and records
- Providing adequate and proper documentation and records of Project Hanford Team work
- Identifying and controlling documents and records generated in the course of their activities.

Configuration control over design input and design media is specified in FH procedures, including the following.

- Design inputs are identified and documented.
- Changes to design inputs, including the reasons for the changes, are identified and documented, approved by the responsible design organization, and controlled.
- The organization accomplishing the design ensures that the design meets design input requirements and that any deviations have been approved and documented.
- Design changes are controlled by measures equal to those applied during the original design.
- Design change control measures include assurance that the design analyses for the SSCs remain valid.

FH also implements a USQ process that meets the requirements of 10 CFR 830.203. This process requires evaluating proposed changes, tests, and experiments to a Hazard Category 1, 2, or 3 nuclear facility to determine whether the proposed change, test, or experiment is within the existing approved safety basis for the facility. Annual updates to facility safety basis documents are made to incorporate changes to the facility design into safety basis documentation where necessary.

17.4.3 Occurrence Reporting

CRD O 232.1A establishes a system for reporting and processing operations information related to emergencies, unusual occurrences, and off-normal occurrences. FH maintains occurrence-reporting processes that implement the requirements of CRD O 232.1A.

In the occurrence-reporting process, once the appropriate response is initiated by personnel to stabilize or return a facility to a safe condition, the ONC duty officer is notified in the event of unusual occurrences or emergencies, following FH procedures. The facility manager or designee also contacts the RL facility representative. The event is classified using DOE guidance, and the event information is entered into the DOE Occurrence Reporting and Processing System.

Occurrences are evaluated to determine if they represent a potential failure to adhere to requirements. Risk ranking is performed. Appropriate corrective actions are established, and specific personnel are assigned responsibilities for the corrective action. Corrective action can take the form of procedural changes, training, design modifications, or changes to administrative controls. The corrective action system tracks the completion of corrective actions. Corrective action system information is evaluated for trends. Performance indicators have been established that also trigger further evaluation of adverse trends.

Facility management evaluates in-house events to determine if the event should be included in the lesson-learned or other training program for FH personnel. The lesson-learned program reviews information from onsite and offsite occurrences. Information from these sources is evaluated to determine its potential applicability to FH activities. The lessons learned are transmitted to FH personnel to reduce the likelihood of repetition within FH.

External and internal events are evaluated to consider whether they need to be incorporated into facility or other training programs.

17.4.4 Safety Culture

The FH safety culture is developed and maintained through implementation of an ISMS. The Project Hanford Team ISMS is based on DOE P 450.4; DOE P 450.5; and DOE P 450.6. The FH ISMS is described in HNF-MP-003.

The Project Hanford Team ISMS incorporates the best practices from the following:

- Voluntary Protection Program
- Responsible Care[1]
- Enhanced work planning
- Hanford Site occupational health process (see Section 8.6.3).

Guiding principles and core functions have been identified for implementation within the FH ISMS. The guiding principles are as follows:

- Line management responsibility for safety
- Clear roles and responsibilities
- Competence commensurate with responsibilities
- Balanced priorities
- Identification of safety standards and requirements
- Hazard controls tailored to work being performed
- Operations authorization
- Worker involvement
- Communication and stakeholder involvement
- Continuous improvement
- Senior management involvement.

The core functions are as follows:

- Establish S&H policy
- Define scope of work
- Identify hazards and requirements
- Analyze hazards and implement controls
- Perform work within controls
- Provide feedback and continuous improvement
- Management review.

Further descriptions of these guiding principles and core functions are provided in HNF-MP-003, and the roles and responsibilities for implementing the Project Hanford Team ISMS are described in HNF-MP-003. HNF-MP-003 also identifies the implementing mechanisms within the FH procedure system for each of the ISMS core functions and guiding principles. Each of the major projects (e.g., Spent Fuel, Nuclear Material Stabilization) also develops and maintains an ISMS description that identifies the specific implementation of the FH ISMS within that project.

The Project Hanford Team uses an automated hazards analysis tool to provide for review of work activities in order to identify worker hazards and provide for controls to protect workers. The Automated Job Hazard Analysis (AJHA) system is designed to facilitate the review process

[1]Responsible Care is a trademark of the American Chemistry Council, Arlington, Virginia.

associated with analyzing hazards before, during, and after a job. The AJHA incorporates an extensive listing of possible hazardous scenarios, such as heat stress, confined space entry, and exposure monitoring. Each hazard listed is automatically associated with mandatory and optional controls (such as the need for personal protective equipment) as driven by federal law, local codes, standards, or FH policies.

For a work activity, the AJHA is used to analyze possible hazards and provide for controls to lessen worker hazards. Working through a hazardous scenario often requires completing a form or permit. AJHA triggers required forms and permits when certain hazards are determined to be present. Hazard scenarios are supported with help screens that explain the hazard, list the driver requirements with links to the source documents, provide guidance on hazard controls, and include facility-specific details. Required reviews and approvals are triggered based on the hazards that apply to a job. The results of the review/approvals are documented and any required controls that lessen job hazards become part of the work control document package.

17.5 REFERENCES

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HNF-8663, 2003, *Standards/Requirements Identification Document*, Rev. 2, Fluor Hanford, Inc., Richland, Washington.

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HNF-MP-003, *Integrated Environment, Safety, and Health Management System Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-MP-599, *Quality Assurance Program Description*, Fluor Hanford, Inc., Richland, Washington.

HNF-PRO-4294, *Performance Indicator Process*, Fluor Hanford, Inc., Richland, Washington.

FIGURES

Figure 17-1. Fluor Hanford Organization.

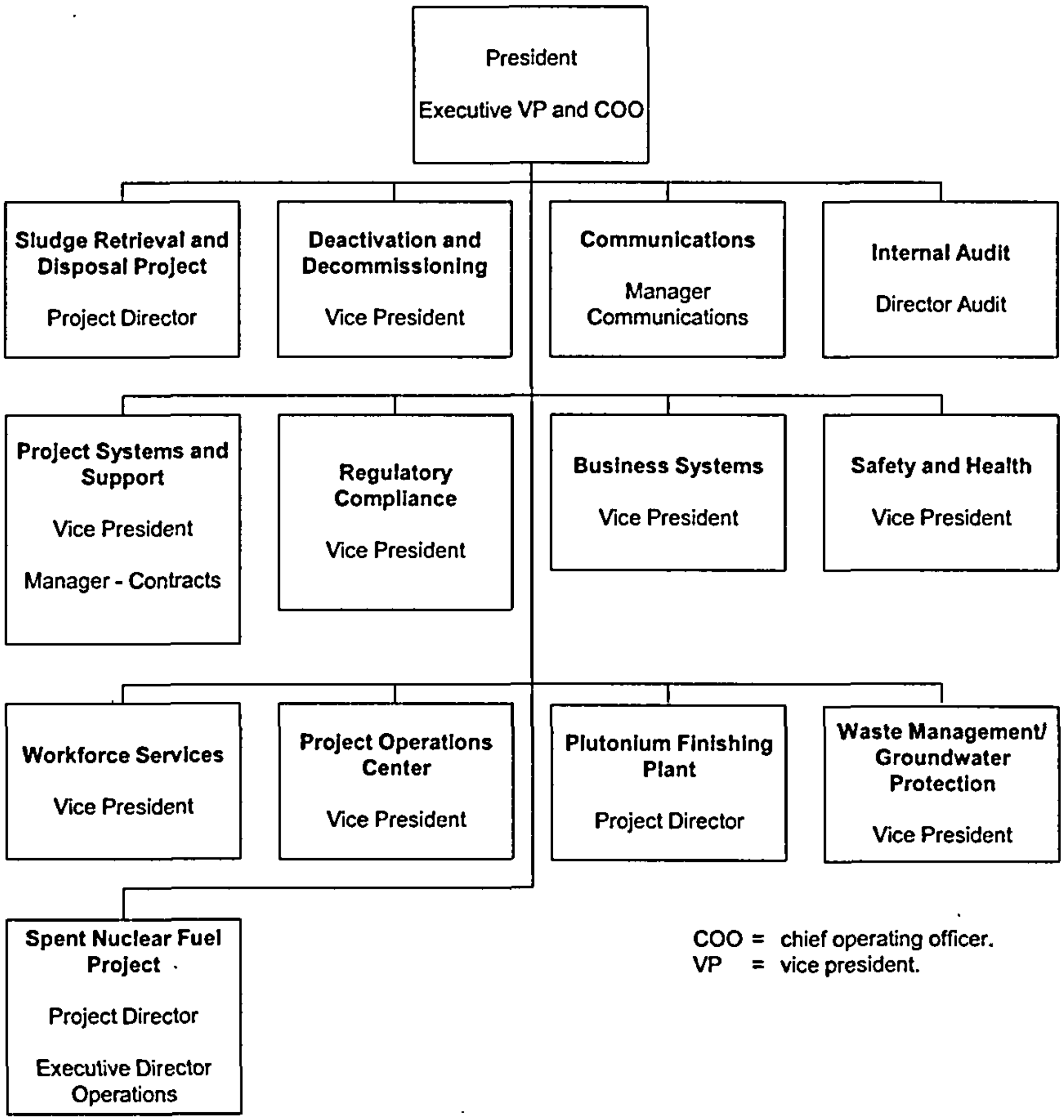

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Figure 1-3. 200 West Area