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Abstract: This document presents the natural phenomena hazard loads for use in implementing DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*, at the Hanford Site in south-central Washington state. The hazards covered are seismic, flood, wind, volcanic ash, lightening, and snow.

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CONTENTS

1.0 INTRODUCTION 1
1.1 SITE HAZARD ASSESSMENTS 1
1.2 SITE DESIGN HAZARD LEVELS 1

2.0 SEISMIC HAZARD 3
2.1 BACKGROUND 3
2.2 SEISMIC HAZARD ASSESSMENT 3
2.3 DESIGN-BASIS GROUND MOTION 3

3.0 WIND HAZARD 4
3.1 BACKGROUND 4
3.2 WIND HAZARD ASSESSMENT 4
3.3 DESIGN-BASIS WIND 8

4.0 VOLCANIC ASH CRITERIA 8
4.1 BACKGROUND 8
4.2 VOLCANIC ASH HAZARD ASSESSMENT 9
4.3 DESIGN-BASIS ASH FALL 10

5.0 FLOOD HAZARD 10
5.1 BACKGROUND 10
5.2 FLOOD HAZARD ASSESSMENT 13
5.3 DESIGN-BASIS FLOODS 18

6.0 LIGHTNING 21

7.0 SNOW LOAD 21

8.0 REFERENCES 22

LIST OF FIGURES

1 Hanford Site Location Map. 2
2 Seismic Hazard Curves 5
3 Equal-Hazard 5-Percent Damped Response Spectra for the Four DOE Performance Categories 6
4 Wind Hazard Curves with Design Wind Speeds 7
5 Annual Probability of 1 cm or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes 11
6 Annual Probability of 10 cm or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes 11
7 Cascade Range Volcanic Ash Hazard 12
8 Extreme 6-Hour Precipitation Hazard 16
9 Fractile Hazard Curves for Peak Flood Elevation at N Reactor 17
10 Extent of Probable Maximum Flood in Cold Creek Area 19
11 River Profiles for Each Performance Category 20

LIST OF TABLES

1 Seismic Hazard Exceedance Probabilities 4
2 Design-Basis Loads from Ashfall Criteria 10
3 Extreme Precipitation Estimates for the Hanford Site 14
4 Design-Basis Precipitation Levels 18
5 Approximate Elevations for Flooding Probabilities at N Reactor 21

NATURAL PHENOMENA HAZARDS
HANFORD SITE, WASHINGTON

1.0 INTRODUCTION

This document presents the natural phenomena hazard (NPH) loads for use in implementing DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*, at the Hanford Site in south-central Washington State. The purpose of this document is twofold.

- Summarize the NPH that are important to the design and evaluation of structures, systems, and components at the Hanford Site
- Develop the appropriate natural phenomena loads for use in the implementation of DOE Order 5480.28.

The supporting standards, DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities* (DOE 1994a); DOE-STD-1022-94, *Natural Phenomena Hazards Site Characteristics Criteria* (DOE 1994b; and DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria* (DOE 1995) are the basis for developing the NPH loads.

1.1 SITE HAZARD ASSESSMENTS

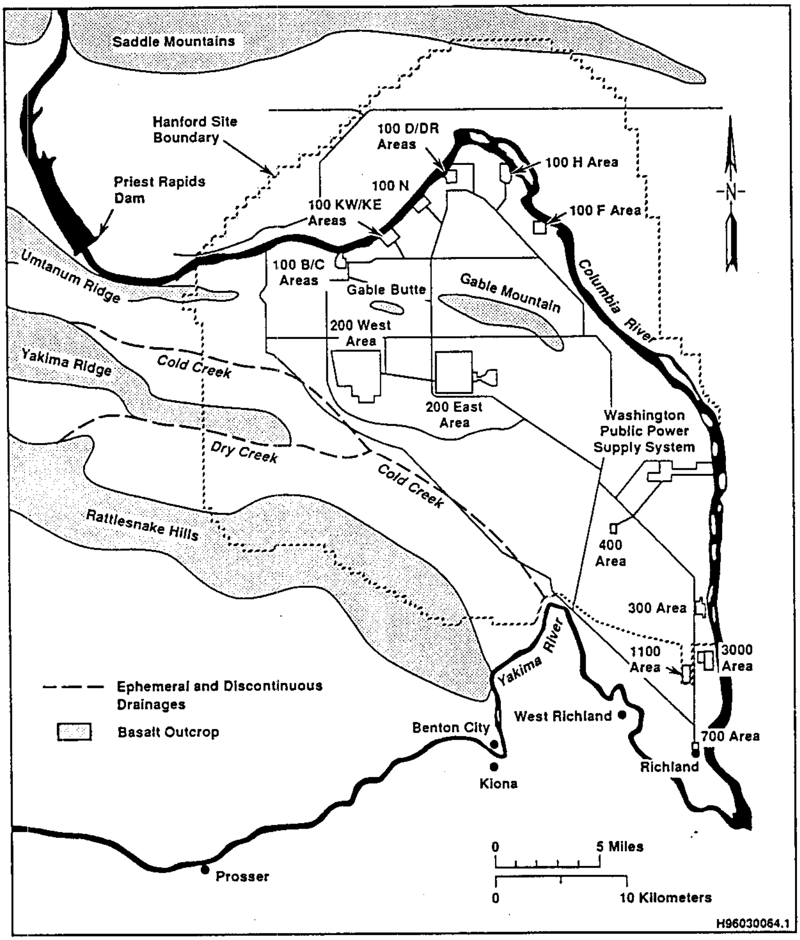
The hazards covered in this document are seismic, flood, wind, volcanic ash, lightning, and snow. Except for lightning and snow, the hazards are addressed in terms of the annual probabilities of exceeding discrete values. The bases for the probabilistic-based hazard values are summarized.

Except for seismic and flood hazards, the NPH are the same at all of the Hanford Site Areas: 100 K, 200 West, 200 East, 300, and 400 (Figure 1). The seismic hazard depends on the proximity of the site to potential earthquake sources and on the engineering properties of the soil. The river flooding hazard is directly related to site elevation and proximity to a river, while local storm runoff flooding is related to the site topography and constructed structures.

1.2 SITE DESIGN HAZARD LEVELS

DOE Order 5480.28 requires that each structure, system, and component be assigned to one of five performance categories with target performance goal probabilities. This performance goal serves as a measure of the level of the desired protection against potential hazards from natural phenomena. The performance goal is achieved by using the appropriate combination of design conservatism and NPH probability. This process is thoroughly discussed in DOE-STD-1020-94.

Figure 1. Hanford Site Location Map.



2.0 SEISMIC HAZARD

2.1 BACKGROUND

The Hanford Site lies in the Pasco Basin near the eastern limit of the Yakima Foldbelt. The Site is underlain by basalt of the Columbia River Basalt Group, which is covered by up to 213 m (700 ft) of relatively stiff sediments. It is in an area of low-magnitude seismicity and is under north-south compressional stress, which is reflected in the deformation of the Yakima folds. The following characteristics are major contributors to the seismic hazard in and around the Hanford Site:

- Fault sources related to the Yakima folds
- Shallow basalt sources that account for the observed seismicity within the Columbia River Basalt Group and not associated with the Yakima Folds
- Crystalline basement source region
- Cascadia Subduction Zone earthquakes.

2.2 SEISMIC HAZARD ASSESSMENT

A seismic hazard analysis was recently completed for the Hanford Site (Geomatrix 1996). Previous seismic hazard analyses were done for Washington Public Power Supply System's (Supply System) WNP-1/4 and WNP/2, which are also located on the Hanford Site (Power et al. 1981). The Supply System study was later applied to the Hanford Site areas controlled by the U.S. Department of Energy (DOE) by Woodward-Clyde Consultants (WCC 1989).

The following seismic hazard values are based on the current seismic hazard study by Geomatrix (1996), which incorporates seismo-tectonic data and interpretations that postdate the Supply System's earlier assessment. The mean seismic hazard curves for the 100 K, 200 West, 200 East, 300, and 400 Areas are shown in Figure 2. (See Geomatrix [1996] for details). The largest historical ground motion is estimated to be less than 0.03 g from the magnitude 5.7 s 1936 Milton-Freewater, Oregon, earthquake.

2.3 DESIGN-BASIS GROUND MOTION

The seismic hazard exceedance probabilities for each performance category are derived in DOE-STD-1020-94 and presented in Table 1. See Figure 2 to determine the peak horizontal ground motion for each category at each of the five Hanford Site areas plotted. For more detail, including seismic source characterization, attenuation relationships, and Site response, see Geomatrix (1996).

Table 1. Seismic Hazard Exceedance Probabilities.

Performance Category	Exceedance Probability	Return Period (yrs)
1	2×10^{-3}	500
2	1×10^{-3}	1,000
3	5×10^{-4}	2,000
4	1×10^{-4}	10,000

Horizontal and vertical equal-hazard response spectra were developed for each of the five Hanford Site areas. These are shown at 5-percent damping for the four performance categories shown in Figure 3. More detail and additional damping values are presented in Geomatrix (1996).

3.0 WIND HAZARD

3.1 BACKGROUND

The Hanford Site is located in a semiarid region of south-central Washington State. The Cascade Range to the west greatly influences the climate of the Hanford Site by causing a "rain shadow" effect. The Cascades also serve as a source of cold air drainage, which greatly affects the wind regime of the Hanford Site.

Data have been collected since 1945 at the Hanford Meteorological Station, located between the Hanford Site's 200 East and West Areas. These data include information on wind velocity and direction measured from six levels on a 125-m- (410-ft-) high tower. These data are supplemented with data collected from 26 monitoring stations on and around the Hanford Site. The most recent compilation of these data is in PNL-9809, *Hanford Site Climatological Data Summary 1993 with Historical Data* (Hoitink and Burk 1994).

3.2 WIND HAZARD ASSESSMENT

Two probabilistic wind hazard assessments have been completed for the Hanford Site. The first assessment was completed by Lawrence Livermore National Laboratory and reported in UCRL-53526, *Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy Sites* (Coats and Murray 1985). This assessment was based on more than 30 years of pre-1979 Hanford Site wind data. The results, shown in Figure 4, are the basis for the recommendations about wind speeds for the Hanford Site that are listed in DOE-STD-1020-94, Table 3-2. The wind missiles are listed in DOE-STD-1020-94, Table 3-1.

Figure 2. Seismic Hazard Curves.

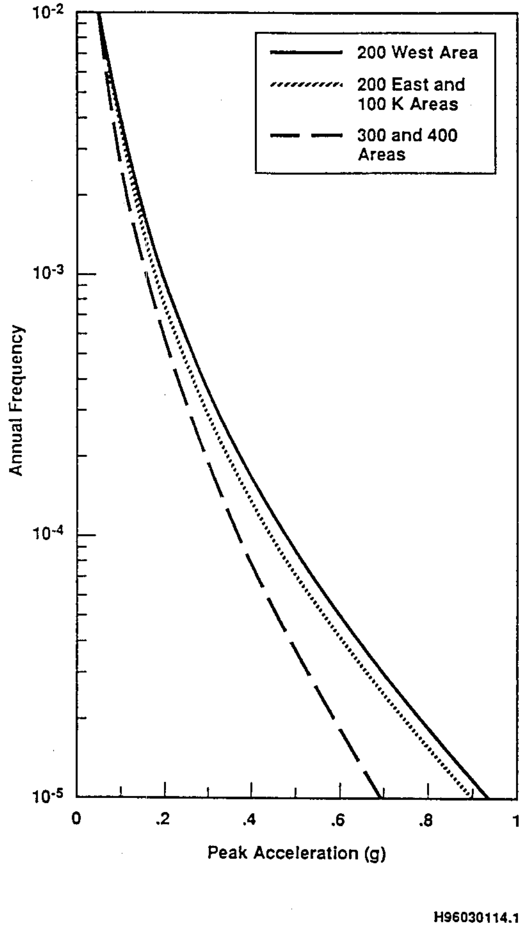


Figure 3. Equal-Hazard 5-Percent Damped Response Spectra for the Four DOE Performance Categories. (Horizontal spectra are shown by the higher thick lines and vertical spectra by the lower thin lines.)

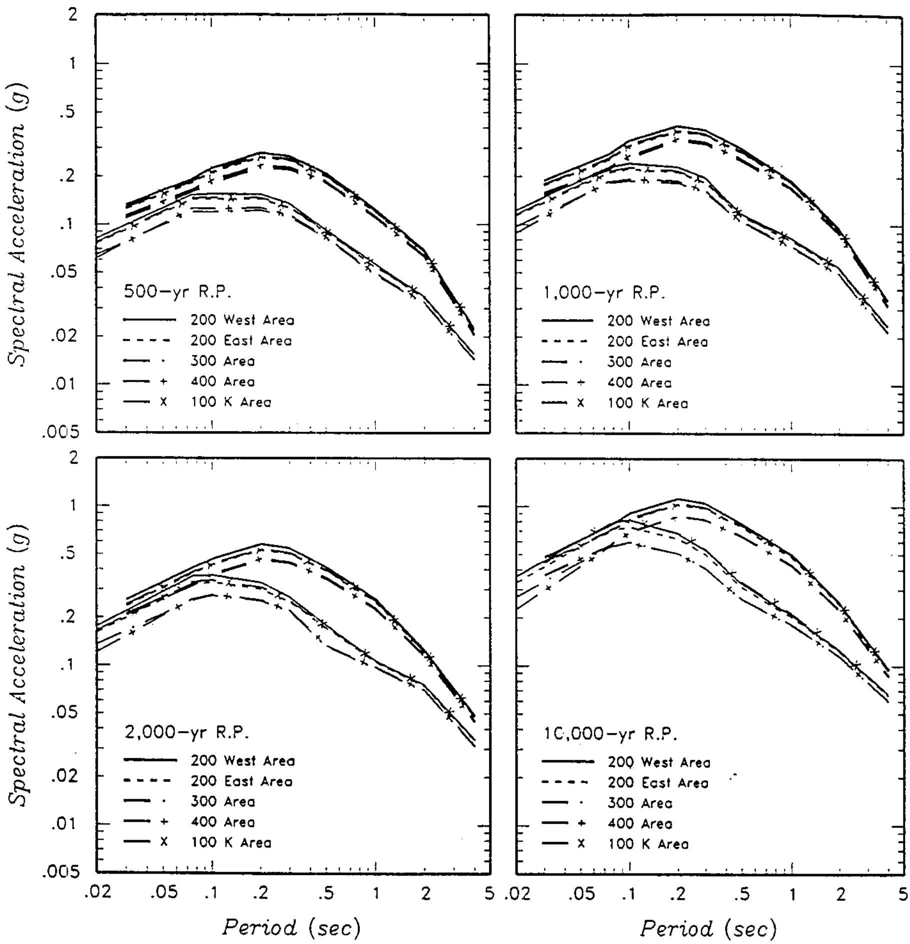
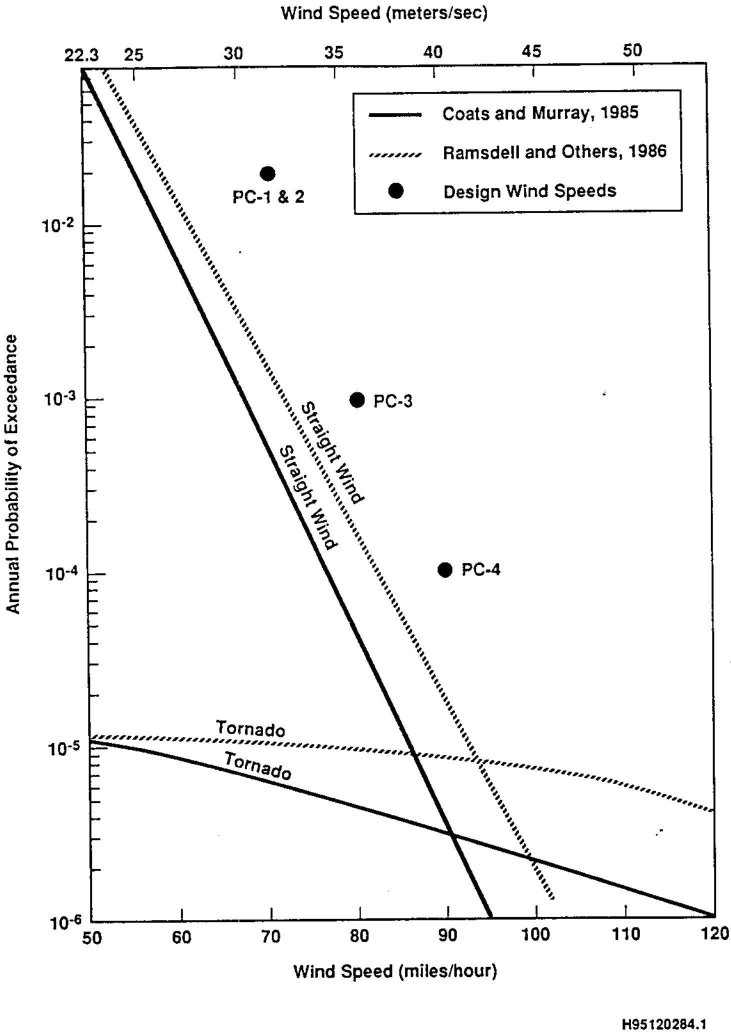


Figure 4. Wind Hazard Curves with Design Wind Speeds. (Wind speeds are in the fastest mile.)



A second study, NUREG/CR-4492, *Methodology for Estimating Extreme Winds for Probabilistic Risk Assessment* (Ramsdell et al. 1986), describes a procedure for estimating extreme wind probabilities. The application of this methodology to Hanford Site data, including post-1979 data, resulted in the hazard curves from the Coats and Murray (1985) assessment and the Ramsdell et al. (1986) assessment shown together in Figure 4.

3.3 DESIGN-BASIS WIND

The wind hazard annual probability of exceedance for Performance Categories 1 and 2 is 2 x 10^{-2} (DOE-STD-1020-94). In Figure 4, this is about 25 m/s (55 mi/h) on the Coats and Murray (1985) curve and about 26 m/s (58 mi/h) on the Ramsdell et al. (1986) curve. However, a minimum-design wind speed of 31.3 m/s (70 mi/h) is required by the American Society of Civil Engineers in ASCE-7, *Minimum Design Loads for Buildings and Other Structures* (ASCE 1988), and recommended by DOE-STD-1020-94. Therefore, the Hanford Site design-basis wind speed for Performance Categories 1 and 2 is 31.3 m/s (70 mi/h). All wind speeds are fastest mile speeds at 9 m (30 ft) off the ground.

The straight wind mean hazard exceedance probability for Performance Category 3 is 1 x 10^{-3}. On Figure 4, this is approximately 30 m/s (67 mi/h) (Coats and Murray 1985) and 32 m/s (72 mi/h) (Ramsdell et al. 1986). In DOE-STD-1020-94, the minimum straight wind speed for a Performance Category 3 design is 35.8 m/s (80 mi/h), which is higher than either of the wind hazard studies and is, therefore, the design basis for the Site. Being able to withstand a plank wind missile is required. The plank wind missile is described in DOE-STD-1020-94, Table 3-1.

The minimum Performance Category 4 (1 x 10^{-4} mean annual exceedance probability) wind speed is 40.2 m/s (90 mi/h). This exceeds values for both straight wind curves (Figure 4) and, therefore, is the design wind speed for Performance Category 4. The appropriate missile is described in DOE-STD-1020-94, Table 3-1.

The intersection of the straight-wind and tornado hazard curves determines whether tornadoes should be included in the design and evaluation criteria (Coats and Murray 1985). If the exceedance probability at the intersection is less than 2 x 10^{-5}, straight winds control the design criteria. In Figure 4, this intersection is at 3 x 10^{-6} (Coats and Murray 1985) and 8 x 10^{-6} (Ramsdell et al. 1986). Therefore, following DOE guidance, the Hanford Site does not have a DOE design-basis tornado.

4.0 VOLCANIC ASH CRITERIA

4.1 BACKGROUND

Two types of volcanic hazards have affected the Hanford Site in the past 20 million years:

- Continental flood basalt volcanism that produced the Columbia River Basalt Group, which underlies the Hanford Site, outcropping in the surrounding ridges
- Volcanism associated with the Cascade Range.

Several volcanoes in the Cascade Range are currently considered to be active, but activity associated with flood basalt volcanism has ceased.

The flood basalt volcanism that produced the Columbia River Basalt Group occurred between 17 million and 6 million years before present (BP). Most of the lava was extruded during the first 2 to 2.5 million years of the 11-million-year volcanic episode. Volcanic activity has not recurred during the last 6 million years, suggesting that the tectonic processes that created the episode have ceased. The recurrence of Columbia River basalt volcanism is not considered to be a credible volcanic hazard (DOE 1988).

Volcanism in the Cascade Range has been active throughout the Pleistocene Epoch (approximately 2 million years BP to 10,000 years BP) through the Holocene Epoch (10,000 years BP to present). The eruption history of the Holocene best characterizes the most likely types of activity in the next 100 years. Many of the volcanoes have been active in the last 10,000 years, including Mount Mazama (Crater Lake) and Mount Hood in Oregon, and Mount St. Helens, Mount Adams, and Mount Rainier in Washington State (Figure 5). The Hanford Site is approximately 150 km from Mount Adams, 175 km from Mount Rainier, and 200 km from Mount St. Helens, the three closest active volcanoes. At these distances, tephra (ash) is the only hazard. Mount St. Helens has been considerably more active throughout the Holocene than Mount Rainier or Mount Adams, which is the least active of the three.

4.2 VOLCANIC ASH HAZARD ASSESSMENT

Probabilistic volcanic hazard studies of the Cascade Range have been completed by the U.S. Geological Survey (Hoblitt et al. 1987, Scott et al. 1995). Figure 5 illustrates the annual probability of exceeding 1 cm of volcanic ash accumulation in Washington and Oregon following the eruption of a major Cascade Range volcano, and Figure 6 illustrates the annual probability of exceeding 10 cm of volcanic ash accumulation. The exceedance probabilities for 1 cm and 10 cm plotted in Figure 6 are from Scott et al. (1995) and are an order of magnitude lower than those from the older study (Hoblitt et al. 1987). Only Hoblitt et al. (1987) assigned a probability of exceedance for 100 cm of ash. The probability of exceeding 100 cm of ash was lowered by one order of magnitude, consistent with comparisons at 1 and 10 cm. Figure 7 presents this information as a volcanic ash hazard curve for the Hanford Site.

4.3 DESIGN-BASIS ASH FALL

A study was performed to develop ashfall hazard probabilities for use in design and evaluation of structural elements subjected to ashfall loads at the Hanford Site (Salmon 1996). The design ashfall loads are presented in Table 2. The ash load is determined by reading the depth of ash at the appropriate ash-hazard probability and assuming a 50-percent compaction ratio and an uncompacted ash density of 769 kg/m^3 ($48 lb/ft^3$)

Table 2. Design-Basis Loads from Ashfall Criteria.

Performance Category	Target Performance Goal (P_H)	Hazard Curve Slope Parameter (A_R)	Risk Reduction Factor	Ash Hazard Probability (P_H)	Design Ashfall Load (kg/m^2)
1	1×10^{-3}	5.0	2.1	2.1×10^{-3}	14.6 kg/m^2
2	5×10^{-4}	5.0	2.1	1.05×10^{-3}	24.4 kg/m^2
3	1×10^{-4}	3.1	3.0	3.0×10^{-4}	61 kg/m^2
4	1×10^{-5}	2.0	4.3	4.3×10^{-5}	146.5 kg/m^2

Operations that require air filtration or heating, ventilation, or air conditioning throughout an ashfall event must consider the impact of suspended ash on the operation. Unlike most other NPHs, some level of warning precedes volcanic hazards, especially distal ashfall. First, seismic activity at the volcano almost always increases from days to years before large eruptions. Further, heat gradients often increase, steam and smaller eruptions may be emitted from the volcano, and measurable deformation may occur on the volcano's surface. All these warnings provide a general alert and increase emergency preparedness in the immediate area of the volcano as well as downwind in an area like the Hanford Site. Second, it would take approximately 2 hours for ash from the closest active volcanoes to reach the Hanford Site. This shorter warning time is for the much higher probability that the ash will affect the Site. This warning lends itself to administrative controls for ashfall mitigation. Administrative procedures implemented after an eruption should be used when mitigation can be achieved through evacuation; reconfiguration of the structure, system, or component; shutdown of the operation; or other activities appropriate for the specific facility or operation. Should it be determined that a safe configuration cannot be achieved during the 2-hour warning time preceding the ashfall, the appropriate suspended ash load will be determined.

5.0 FLOOD HAZARD

5.1 BACKGROUND

The Columbia River, the second largest river in the contiguous United States in terms of flow, is the dominant surface-water body on the Hanford Site (Figure 1). The Yakima River flows along a short section of the southern

Figure 5. Annual Probability of 1 cm or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes.

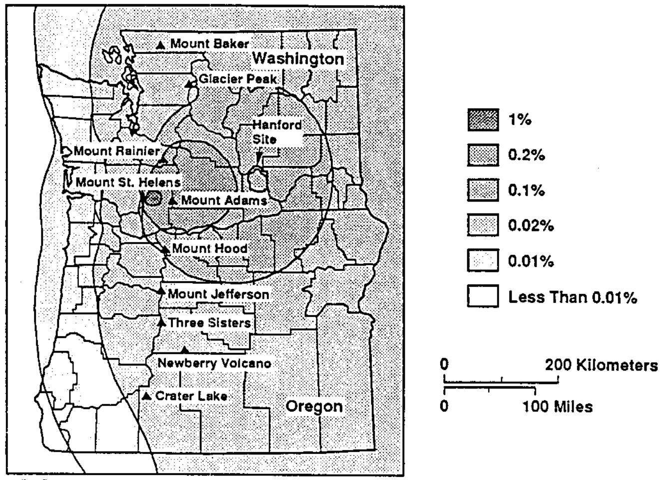


Figure 6. Annual Probability of 10 cm or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes.

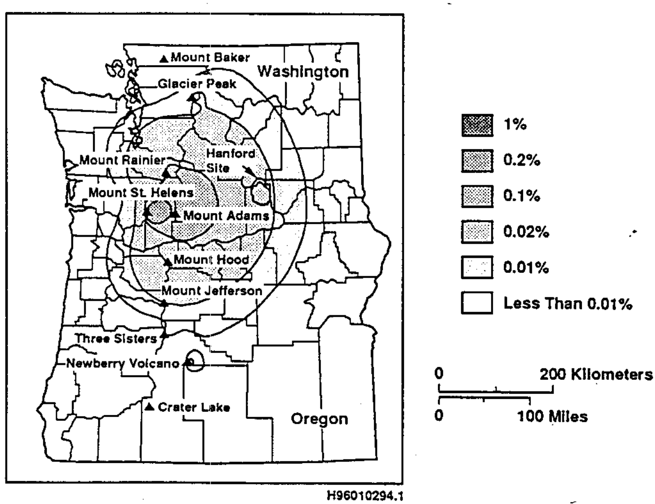
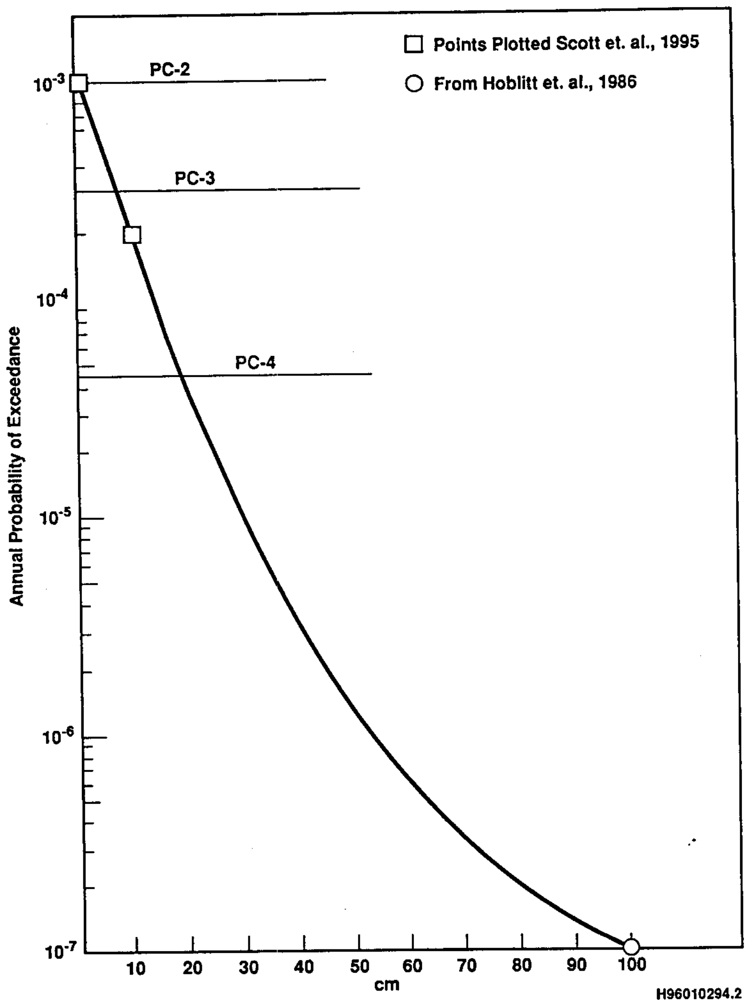


Figure 7. Cascade Range Volcanic Ash Hazard.



boundary of the Site. Cold Creek and Dry Creek, located in the southwestern part of the Site, are ephemeral streams in the Yakima River drainage basin.

5.2 FLOOD HAZARD ASSESSMENT

Both river flooding and local storm runoff must be addressed in the assessment of Hanford Site flood hazards. Each hazard is discussed separately in the following sections.

5.2.1 Local Storm Flood Hazard

A recent cooperative study by the National Oceanic and Atmospheric Administration, the Bureau of Reclamation, and the U.S. Army Corps of Engineers has updated the probable maximum precipitation (PMP) estimates for the Pacific Northwest (Hansen et al. 1994). This document supersedes earlier work done by these organizations and is the source used for the PMP shown in Table 3. The PMP values are estimates of the maximum precipitation physically possible for both general storms (large air mass interactions) and local storms (unstable air, thunderstorms). At the Hanford Site the 6-hour local storm produces more precipitation than the 24-hour general storm. The 6-hour local storm PMP is related to the area of the storm, the smaller area yielding the most intense storm and highest precipitation. Data are presented for the 1-mi^2 and the 10-mi^2 storm. No annual probability of exceedance is given in Hansen et al. (1994) for the PMP for either general or local storms. The PMP is conservatively assumed to have an annual probability of exceedance of less than 1×10^{-6} (ASCE 1988).

The 6-hour PMP for more frequent storms shown in Table 3 is from Stone et al. (1972) and is based on the analysis of extreme values from 22 years of meteorological data from the Hanford Site. The precipitation estimates for the 100- and 1,000-year return period are based on data from the Hanford Meteorology Station near the 200 West Area and include the frequency of precipitation at one location for both general and local storms. Although these values cannot be compare directly with either the 1-mi^2 storm or the 10-mi^2 storm, they provide a data-based estimate for extreme precipitation on the 200 Area Plateau. A 6-hour precipitation hazard curve is estimated using the 100-year and 1,000-year average return period values (10^{-2} and 10^{-3} annual probability exceedance respectively) of Stone et al. (1972) and the 6-hour PMP at an assumed frequency of 10^{-6} (Figure 8). The maximum daily precipitation recorded at the Hanford Site meteorological station was 4.1 cm in 1957 (Hoitink and Burk 1994).

5.2.2 River Flood Hazard

Columbia River. The free-flowing portion of the Columbia River flows through the Hanford Site and forms part of its eastern boundary. This section of the river, the Hanford Reach, extends from Priest Rapids Dam to the headwaters of Lake Wallula, which is the reservoir behind McNary Dam. The Columbia River originates in the mountains of eastern British Columbia, Canada, and drains an

Table 3. Extreme Precipitation Estimates for the Hanford Site.

Time	PMP 24-hour general storm (10 mi^2)[a]	PMP local storm (1 mi^2)[a]	PMP local storm (10 mi^2)[a]	25-year average return period[b]	100-year average return period[b]	1,000-year average return period[b]
15 minutes	--	4.0	3.2	--	--	--
20 minutes	--	--	--	0.47	0.60	0.80
30 minutes	--	6.0	4.8	--	--	--
45 minutes	--	7.2	5.8	--	--	--
1 hour	1.6	8.0	6.4	0.62	0.81	1.11
6 hours	4.7	9.2	7.4	1.21	1.59	2.20
24 hours	8.0	--	--	1.56	1.99	2.68
48 hours	9.6	--	--	--	--	--
72 hours	10.4	--	--	--	--	--

Note: Precipitation depths are in inches. To convert to centimeters, multiply by 2.54.

[a]Hansen, E. M., D. D. Fenn, P. Corrigan, Vogel, L. C. Schreiner, and R. W. Stodt, 1994, Probable Maximum Precipitation - Pacific Northwest States, Hydrometeorological Report No. 57, National Weather Service, Silver Spring, Maryland.

[b]Stone, W. A., J. M. Thorp, O. P. Gifford, and D. J. Hoitink, 1983, Climatological Summary for the Hanford Site, PNL-4622, Pacific Northwest Laboratory, Richland, Washington.

PMP = probable maximum precipitation.

area of approximately 70,800 km^2 (27,300 mi^2) en route to the Pacific Ocean. Flow on the Columbia River is regulated by seven upstream dams within the United States and several in Canada. The three dams with the largestreservoirs upstream from the Hanford Site are: Mica and Hugh Keenleyside (formerly Arrow Dam) in Canada and Grand Coulee in the United States. The controlled flow of the Columbia River caused by these dams results in a lower flood hazard in the relatively high-probability floods (e.g., 100-year flood). However, for very-low-probability floods, dam-failure scenarios are significant contributors and result in an extremely high hazard.

A probabilistic flood hazard assessment of the Columbia River was performed as part of a safety evaluation of the Hanford Site N Reactor (McCann and Boisonnade 1988). The most extreme floods on the Columbia River occur as a result of dam failure. Specifically, failure of Grand Coulee and Mica dams pose the greatest threat. The results of this assessment show that the greatest contribution to the likelihood of flooding is dam failure initiated by seismic events. Conservative estimates of the seismic capacity of upstream dams were based primarily on engineering judgment. Further, the likelihood of random dam failure was based primarily on engineering judgment and the historic frequency of dam failures. See McCann and Boisonnade (1988) for a detailed discussion of the hazard assessment.

Extreme flooding on the Columbia River can also occur during extreme meteorologic and hydrologic events. Historically, the largest floods have occurred when rapid snow melt is accompanied by spring rain and frozen ground. Such floods are controlled by the dam system and are predicted to be less severe than comparable pre-dam record floods.

The probabilistic flood hazard curve at the N Reactor is presented in Figure 9. The curve shows the annual frequency of exceeding flood elevations above mean sea level. The maximum historical flood occurred in 1894, with a peak discharge of about 21,000 m^3/sec. The 500-year unregulated flood-discharge at Priest Rapids is equivalent to the 1894 flood (COE 1989). The regulated 500-year flood, appropriate for dam-controlled flow, is 15,300 m^3/sec. Section 5.3.2 covers the river rating curves that are used to determine the elevation at appropriate probabilities along the Columbia River.

Yakima River. The Yakima River borders the southern boundary of the Hanford Site (Figure 1). The head of the Yakima River is in the Cascade Range. As for the Columbia River, flooding generally occurs when rapid snow melt accompanies rain. The western third of the Hanford Site is part of the Yakima River drainage basin. Probabilistic flood hazard analysis has not been done for the Yakima River. Extremely low-probability flooding (10^{-4} and 10^{-5}) by the Yakima River is expected to affect only the southernmost part of the Hanford Site where the major impact is expected to be road closures between the Tri-Cities/Benton City area and the Site. The exception may be the flooding of parts of the 700, 1100, 3000, and perhaps the 300 Areas. Such flooding is covered by Columbia River scenarios.

Cold Creek. The Cold Creek watershed, located in the southwestern portion of the Hanford Site, extends about 16 km (10 mi) up the Cold Creek and Dry Creek Valleys. A flood risk analysis of Cold Creek was conducted in 1980 (Skaggs and Walters 1981) to determine the PMF for the Cold Creek System (Figure 10). The recurrence interval is not estimated for this flood, however each occurrence would be a flash flood of short duration. The PMF reaches an

Figure 8. Extreme 6-Hour Precipitation Hazard.

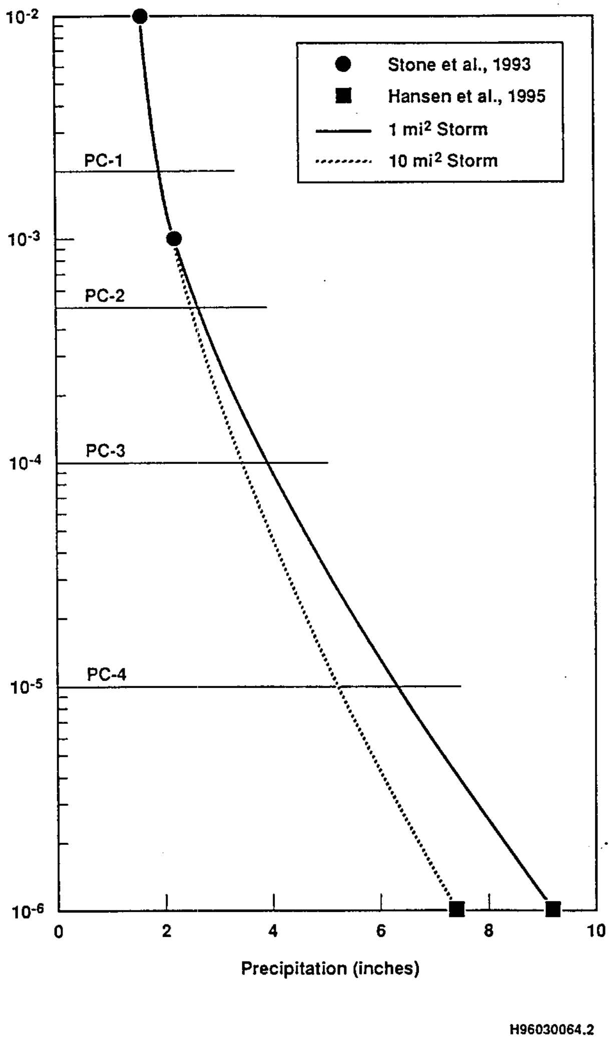
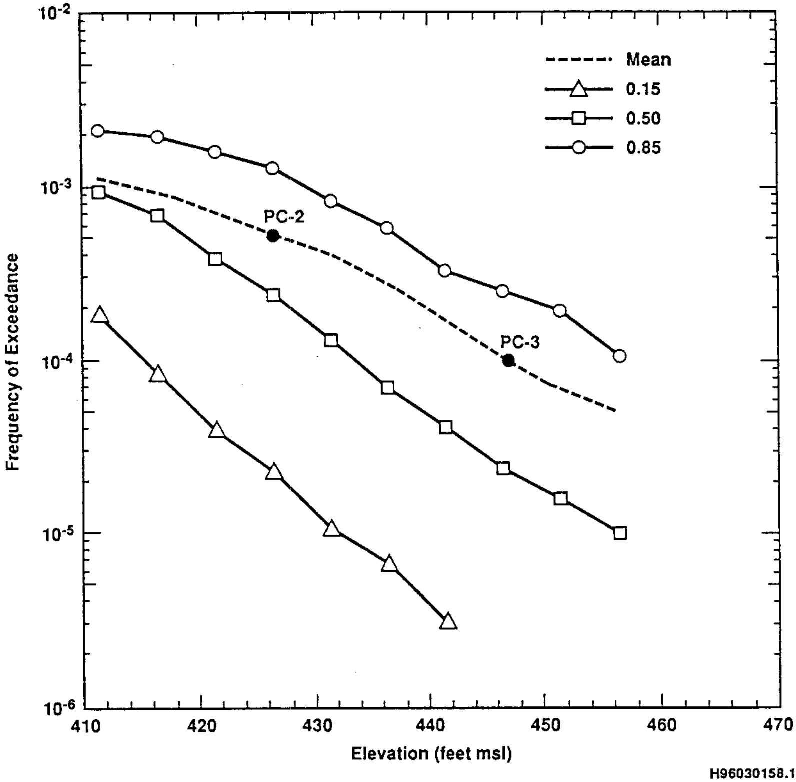


Figure 9. Fractile Hazard Curves for Peak Flood Elevation at N Reactor (McCann and Boisonnade 1988).



elevation of about 195 m (640 ft) on the southwestern portion of the 200 West Area. The maximum historical flood has not been recorded.

5.3 DESIGN-BASIS FLOODS

5.3.1 Local Storm Runoff

The precipitation amounts and rates used in the drainage design for facilities and surrounding topography are determined based on the target performance goal or performance category of the facility. For new facilities, Performance Category 1 probability is two times the performance goal probability. The performance goal probability defines the annual rainfall probability of exceedance for Performance Categories 2, 3, and 4 (DOE-STD-1020-94). The design-basis 6-hour maximum precipitation levels, as derived from Figure 8, for the four performance categories are shown in Table 4.

Table 4. Design-Basis Precipitation Levels.

Performance Category	Probability	Amount (in.)
1	2×10^{-3}	1.8
2	5×10^{-4}	2.5
3	1×10^{-4}	4.0
4	1×10^{-5}	6.3 (1 mi^2) 5.0 (10 mi^2)

5.3.2 Stream Flooding

Columbia River. The Performance Category 1 flood level is based on the U.S. Army Corps of Engineers 500-year flood. The flooding hazard curve for the N Reactor (Figure 9) was used as the elevation datum for Performance Categories 2 and 3 flood hazard annual probability of exceedance. The Performance Category 4 flood level was estimated by extrapolation. The flood hazard probabilities are the same as those presented for precipitation in Section 5.3.1. The approximate elevations for each probability at the N Reactor are presented in Table 5. River surface profiles developed by the U.S. Army Corps of Engineers (COE 1970) were used to extrapolate the river profile through the Hanford Site for each performance category shown in Figure 11.

Figure 10. Extent of Probable Maximum Flood in Cold Creek Area (after Skaggs and Walters 1981).

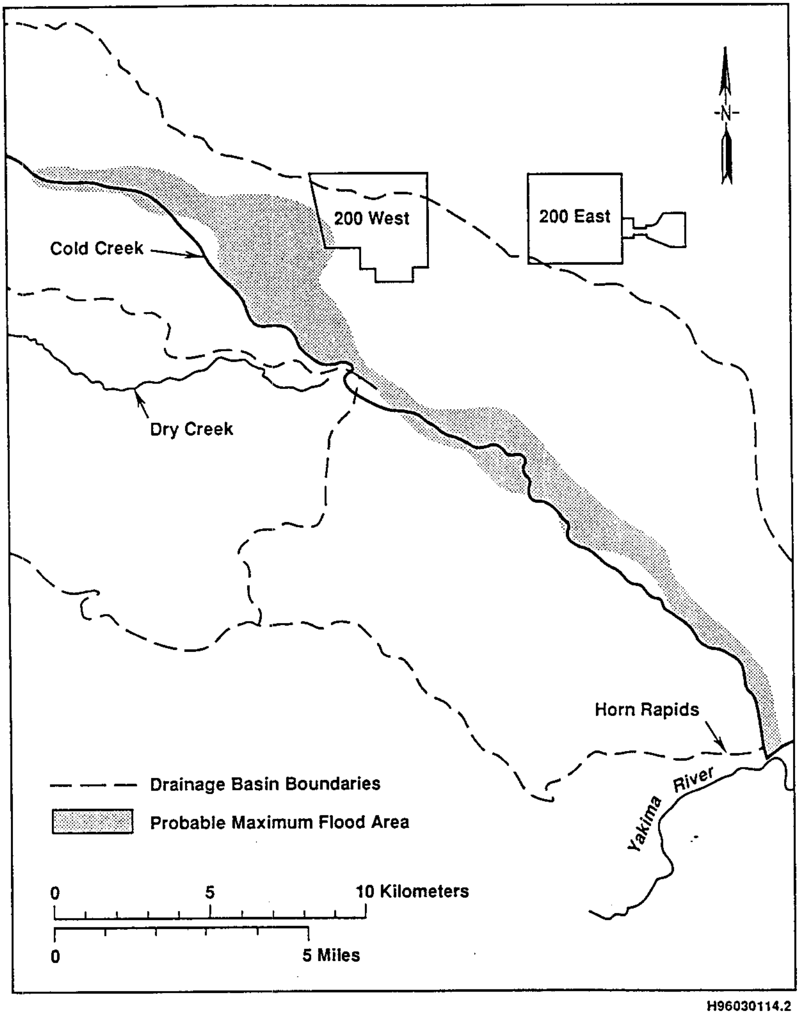


Figure 11. River Profiles for Each Performance Category.

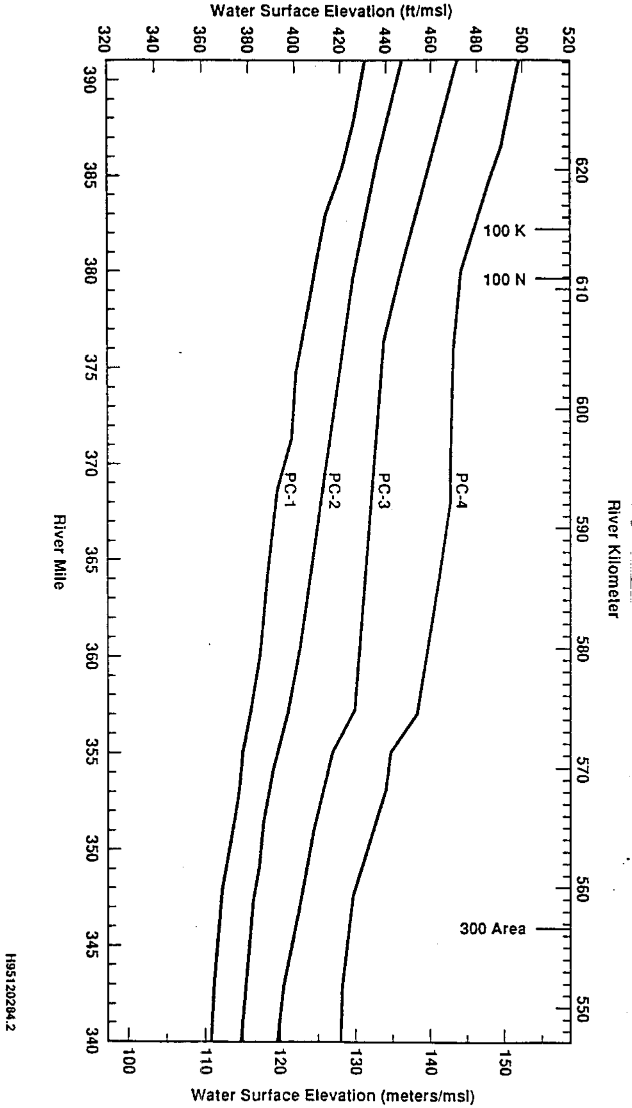


Table 5. Approximate Elevations for Flooding Probabilities at N Reactor.

Performance Category	Probability	Elevation (ft)
1	2×10^{-3}	395
2	5×10^{-4}	426
3	1×10^{-4}	447
4	1×10^{-5}	475

All of the 100, 300, 3000, and 1100 Areas are flooded at the Performance Category 4 flood levels and some of those areas are flooded by the Performance Category 3 flood. The Performance Category 3 flood level is about 10 ft lower than the 25-Percent Breach of Grand Coulee Scenario (ERDA 1976) and Performance Category 4 is approximately the same as the 50-percent breach scenario. The Performance Category 2 level is approximately equal to the PMF. Performance Category 1 flood levels are equal to the 500-year flood and are considerably below the PMF.

Yakima River. No Yakima River flood criteria have been developed for the Hanford Site. No extremely low probability floods, i.e., 10^{-4} and 10^{-5} mean probability of exceedance, have been estimated. The potential flooding of the 300, 700, 1100, and 3000 Areas is addressed with the Columbia River flood criteria.

Cold Creek. Based on the Cold Creek System PMF, Performance Category 2, 3, and 4 facilities should not be located below an elevation of approximately 195 m (640 ft) in the southwestern portion of the 200 Area.

6.0 LIGHTNING

Neither DOE nor the Nuclear Regulatory Commission has developed specific requirements for dealing with lightning. The National Fire Protection Agency (NFPA) bulletin NFPA 780, *Lightening Protection* (NFPA 1992), is recommended as guidance for developing lightning protection for the CSB.

7.0 SNOW LOAD

Both DOE and the Nuclear Regulatory Commission recommend following ASCE-7 (ASCE 1988) for ground snow loads and design guidance. At the Hanford Site, this ground snow load is 98 kg/m^2 (15 lb/ft^2).

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