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CANISTER STORAGE BUILDING NATURAL PHENOMENA DESIGN HAZARDS

WHC-SD-SNF-DB-009
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Canister Storage Building Natural Phenomena Design Loads

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Abstract: This document presents the natural phenomena design loads for the canister storage building in the 200 East Area of the Hanford Site.

Approved for Public Release

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BP	before present
CSB	Canister Storage Building
DOE	U.S. Department of Energy
NPH	natural phenomena hazard
NRC	U.S. Nuclear Regulatory Commission
PMP	probable maximum precipitation
Supply System	Washington Public Power Supply System
WNP-2	Washington Public Power Supply System Nuclear Plant 2

CANISTER STORAGE BUILDING NATURAL PHENOMENA DESIGN HAZARDS

1.0 INTRODUCTION

This document presents natural phenomena hazard (NPH) loads for use in the design and construction of the Canister Storage Building (CSB), which will be located in the 200 East Area of the Hanford Site. U.S. Department of Energy (DOE) regulatory policy for these design and construction activities requires a level of nuclear safety comparable to that of U.S. Nuclear Regulatory Commission (NRC) licensed facilities. The DOE requirements are based on DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*; and supporting standards, DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*; DOE-STD-1022-94, *Natural Phenomena Hazards Site Characteristics Criteria*; and DOE-STD-1023-95, *Natural Phenomena Hazards Assessment Criteria*. DOE Order 5480.28 requires that each structure, system, and component be assigned to one of five performance categories based on safety class and hazard category. Each performance category has an associated NPH goal that serves as a measure of the level of protection against potential natural phenomena. The CSB has been designated a Performance Category 3 facility (WHC-SD-SNF-DB-004). The NRC requirements are based on Title 10, *Code of Federal Regulations*, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

With the exception of earthquake-induced ground motion, the compliance to both NRC and DOE requirements is accomplished by using the more stringent of the requirements for the design. The seismic design for this complex is thoroughly discussed in WHC-SD-SNF-DB-004, *Spent Nuclear Fuel Project Seismic Design Criteria*. The NPH design loads for the CSB are summarized in Table 1. The remainder of this document reviews the derivation of these loads.

2.0 SEISMIC CRITERIA

2.1 BACKGROUND

A comparison of the NRC and DOE seismic design requirements and a discussion of the CSB seismic design strategy are presented in WHC-SD-SNF-DB-004 and are not repeated here. The DOE seismic design requirements are being used for the CSB and are summarized in this section.

2.2 U.S. DEPARTMENT OF ENERGY DESIGN REQUIREMENTS

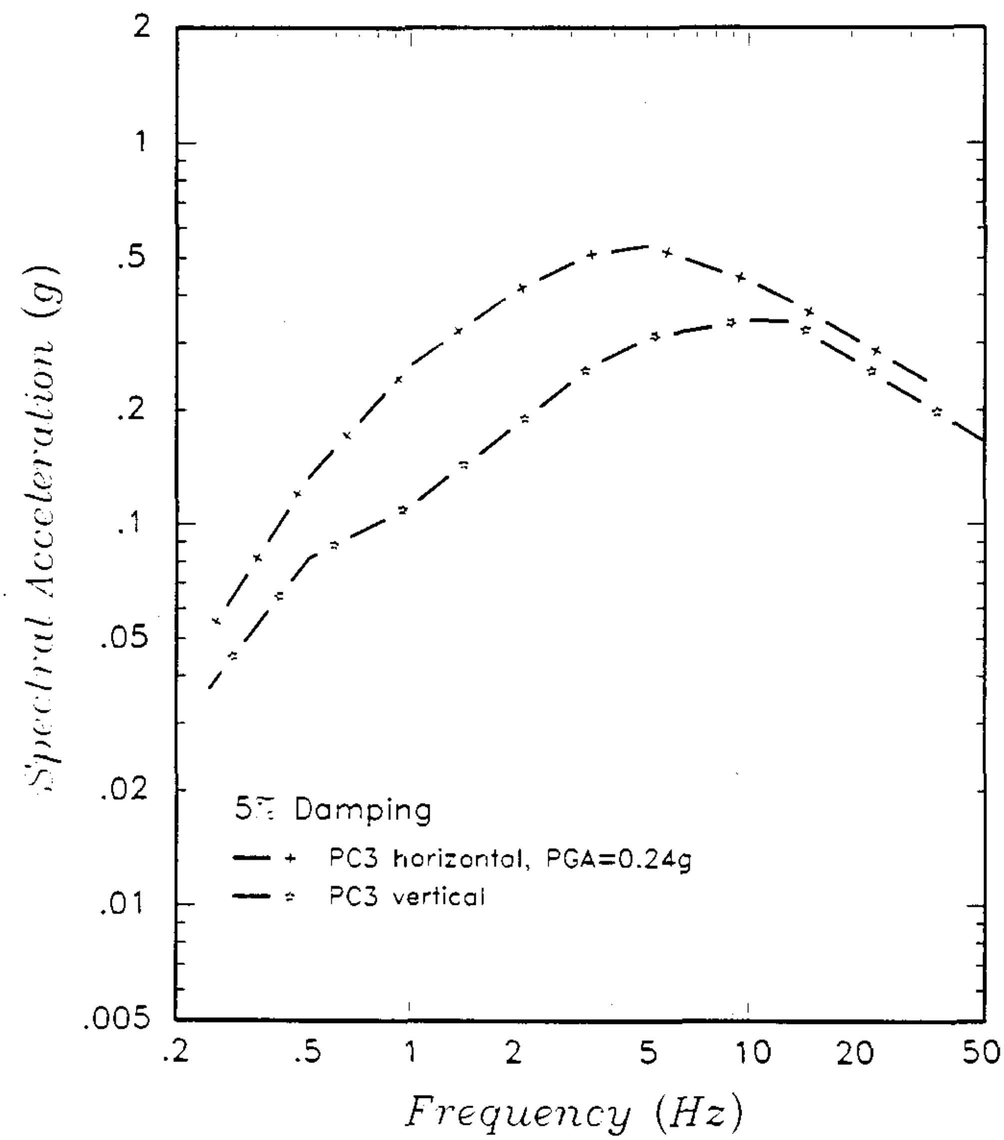
Seismic design for Performance Category 3 projects shall follow DOE Order 5480.28 and supporting standard DOE-STD-1020-94, Chapter 2 and Appendix C. The seismic response spectra for Performance Category 3 at the location of the CSB (Youngs 1996) are shown in Figure 1.

Table 1. Performance Category 3 Natural Phenomena Design Loads for the Canister Storage Building.

Hazard	Load	Design guidance
Seismic	Median response spectra:[a] 0.35g horizontal 0.23g vertical	DOE Order 5480.28[b] DOE Standard 1020-94[c]
Straight wind	129 km/h (80 mi/h), fastest mile at 9 m (30 ft)	ASCE-7[d] DOE Standard 1020-94 (including missiles)
Tornado	Wind speeds 322 km/h (200 mi/h) total 257 km/h (160 mi/h) rotational 64 km/h (40 mi/h) translational	NRC Standard Review Plan[e] 3.3.2 Tornado Loading 3.5.1.4 Missiles Generated by Natural Phenomena NRC SECY-93-087[f]
Volcanic ash	117 kg/m^2 (24 lb/ft^2) ground ash load	SDC 4.1, Rev. 12, for ash load combinations[g]
Flooding	Dry site for river flooding Site drainage basin: 19 cm (7.4 in.) for 6-hour probable maximum precipitation Site drainage: 23 cm (9.2 in.) for 6-hour probable maximum precipitation	ANSI/ANS-2.8-1992[h] NRC Regulatory Guide 1.59[i] NRC Standard Review Plan[e] 2.4.2 Floods
Lightning	Lightning protection shall be considered for facility.	NFPA 780[j]
Snow	98 kg/m^2 (20 lb/ft^2) ground load	ASCE-7[d]

[a] Newmark, N. M. and W. J. Hall, 1978, Development of Criteria for Seismic Review of Selected Nuclear Power Plants, NUREG/CR-0098, U.S. Nuclear Regulatory Commission, Washington, D.C.
[b] DOE Order 5480.28, Natural Phenomena Hazards Mitigation, U.S. Department of Energy, Washington, D.C.
[c] DOE Standard 1020-94, Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities, U.S. Department of Energy, Washington, D.C.
[d] ASCE, 1988, Minimum Design Loads for Building and Other Structures, ASCE-7, American Society of Civil Engineers, New York, New York.
[e] NRC, 1981, Standard Review Plan, NUREG-0800, U.S. Nuclear Regulatory Commission, Washington, D.C.
[f] NRC, 1993, Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs, SECY-93-087, U.S. Nuclear Regulatory Commission, Washington, D.C.
[g] SDC 4.1, 1993, Hanford Plant Standards Design Criteria, "SDC 4.1 Standard ARCH-CIVIL Design Criteria for Design Loads for Facilities," HPSDCM, Rev. 12, Westinghouse Hanford Company, Richland, Washington.
[h] ANSI/ANS, 1992, Determining Design Basis Flooding at Power Reactor Sites, ANSI/ANS-2.8-1992, American Nuclear Society, La Grange Park, Illinois.
[i] NRC, 1977, Design Basis Floods for Nuclear Power Plants, Regulatory Guide 1.59, U.S. Nuclear Regulatory Commission, Washington, D.C.
[j] NFPA, 1992, Lightning Protection, NFPA 780, National Fire Protection Association, Quincy, Massachusetts.

Figure 1. Canister Storage Building, Performance Category 3 Horizontal and Vertical Design Response Spectra with 5% Damping.



Performance Category 1 and 2 structures, systems, and components shall use the *Uniform Building Code* (ICBO 1991), Zone 2B, as discussed in DOE-STD-1020-94.

The CSB originally was designed to serve as part of the Hanford Waste Vitrification Plant and construction on the foundation has been partially completed (WHC-SD-HWV-PSAR-001). Newmark and Hall (1978) median response spectra at 0.35g horizontal and 0.23g vertical were developed for this facility. Those spectra are shown to envelop the Performance Category 3 response spectra for the location of the CSB (Figure 2). The CSB design response spectra are conservative compared to the Performance Category 3 design criteria and shall be used for the completion of the CSB design and construction. The various damping levels and time histories for the CSB design response spectra are included in WHC-SD-W236A-TI-020, *Position Paper - Seismic Design Criteria* (Farnworth 1995).

3.0 WIND AND TORNADO CRITERIA

3.1 BACKGROUND

The Hanford Site is located in a semiarid region of southeastern Washington. The Cascade Range to the west greatly influences the climate of the Hanford Site by causing a "rain shadow" effect. This mountain range also serves as a source of cold air drainage, which has considerable effect on 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. This includes wind data from six levels on a 125-m- (410-ft-) high tower. These data are supplemented with data 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 U.S. DEPARTMENT OF ENERGY DESIGN REQUIREMENTS

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 are shown in Figure 3 and are the basis for the recommended wind speeds for the Hanford Site listed in DOE-STD-1020-94, Table 3-2. The wind missiles are listed in DOE-STD-1020-94, Table 3-1.

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 shown Figure 3. There are no known local meteorological events

Figure 2. Canister Storage Building, Newmark and Hall Median Response Spectra at 0.35g Horizontal and 0.23g Vertical Compared to Performance Category 3 Spectra, 5% Damping.

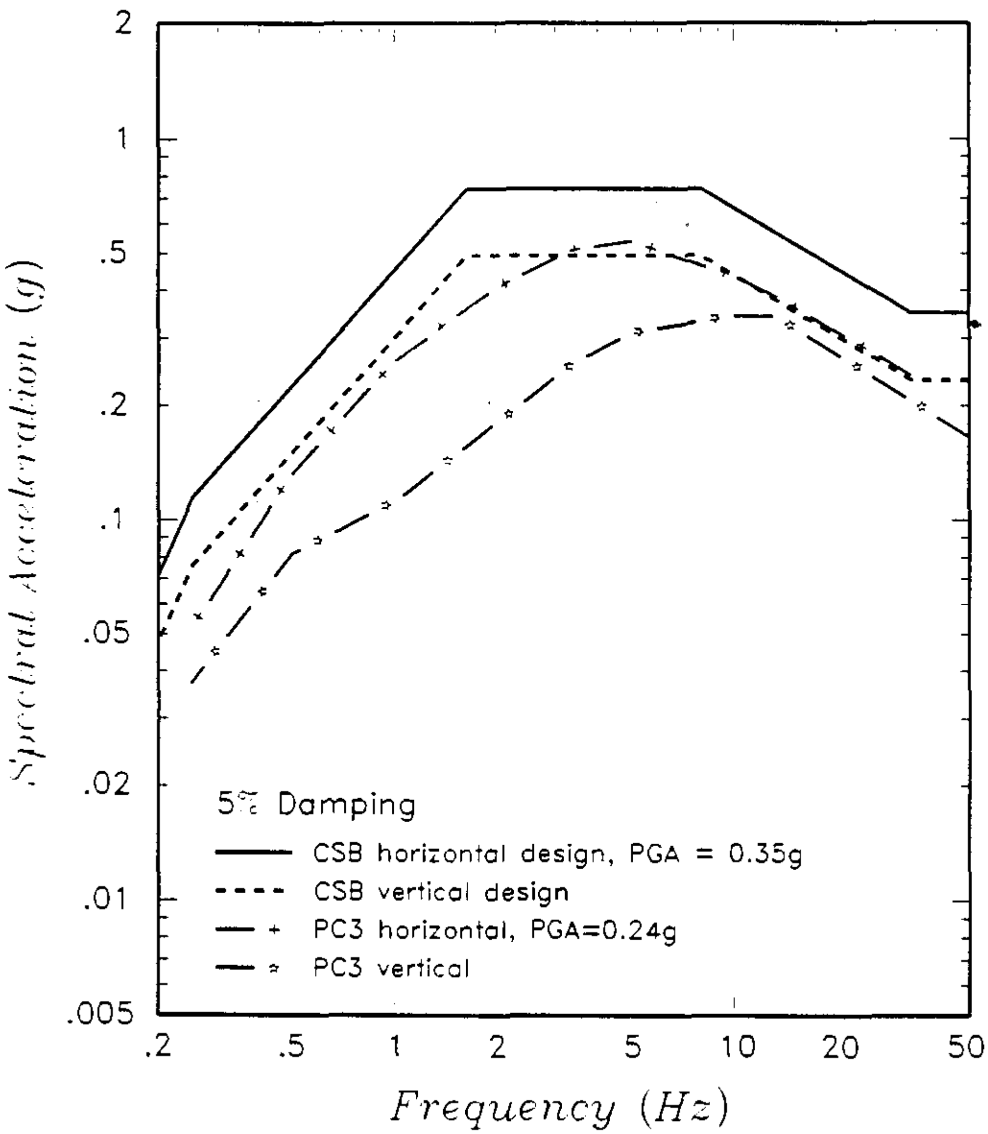
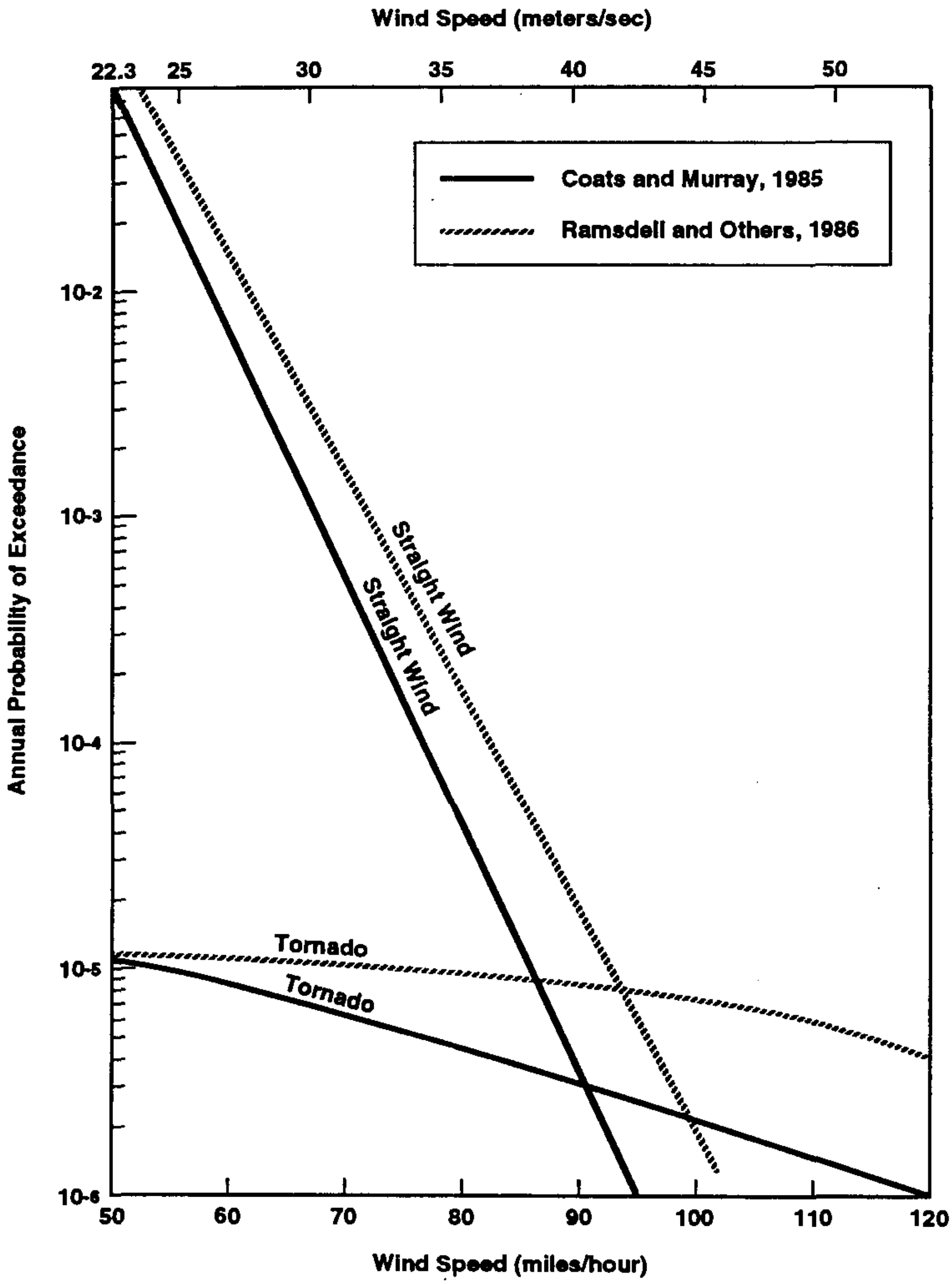


Figure 3. Straight Wind and Tornado Hazards.



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or changes in methodology since 1986 that would cause significant changes to the Hanford Site wind hazard.

The wind hazard annual probability of exceedance for performance categories 1 and 2 is 2×10^{-2} (DOE-STD-1020-94). On Figure 3, 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 American Society of Civil Engineers in ASCE-7, *Minimum Design Loads for Building 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 hazard exceedance probability for Performance Category 3 is 1×10^{-3}. On Figure 3, 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 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.

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 2×10^{-5}, straight winds control the design criteria. In Figure 3, this intersection is at 3×10^{-6} (Coats and Murray 1985) and 8×10^{-6} (Ramsdell et al. 1986). Therefore, following DOE guidance, the Hanford Site does not have a DOE design basis tornado.

3.3 U.S. NUCLEAR REGULATORY COMMISSION DESIGN REQUIREMENTS

The guidance in 10 CFR 72 with respect to straight wind and tornado hazard mitigation is very general and nonprescriptive (10 CFR 72.122[b]). Power reactor criteria (NRC 1981, 3.3.1, "Wind Loading") are specific and serve as a basis for determining appropriate straight wind and tornado values for the CSB because they have been accepted by the NRC for issuing the materials licenses for such facilities. The 100-year, fastest-mile wind speed is used for the straight wind calculations using American Society of Civil Engineers methodology (ASCE 1988, ASCE 1961). The 100-year, fastest-mile wind at the Hanford Site is about 105 km/h (65 mi/h) (Figure 3). However, because DOE-STD-1020-94 requires a minimum of 129 km/h (80 mi/h) for Performance Category 3, the higher DOE value will be used for the design of the CSB.

Washington Public Power Supply System (Supply System) Nuclear Plant 2 (WNP-2), located on property within the boundaries of the Hanford Site, was licensed to use tornado design wind speeds of 483 km/h (300 mi/h) rotational and 97 km/h (60 mi/h) translational, with a pressure drop of 2,109 kg/m^2 (3 lb/in^2) occurring at 703 $kg/m^2/s$ (1.0 $lb/in^2/s$). These wind speeds are higher than would be required by Regulatory Guide 1.76 (NRC 1974). Regulatory Guide 1.76 indicates that the Hanford Site is in tornado Region III for which the criteria are 305 km/h (190 mi/h) rotational and 80 km/h (50 mi/h) translational, with a 1,055 kg/m^2 (1.5 lb/in^2) pressure drop at 422 $kg/m^2/s$ (0.6 $lb/in^2/s$). The NRC staff have proposed dividing the United States into two regions and making the total rotational and translation wind speeds for sites west of the Rocky Mountains 322 km/h (200 mi/h) (NRC 1993). The basis for this consideration is a tornado hazards study, NUREG/CR-4461, *Tornado Climatology of the Contiguous United States* (Ramsdell and Andrews 1986). With this basis and the recent revision of the WNP-2 tornado criteria by NRC (Clifford 1996, Parrish 1995), the following criteria are recommended for the CSB:

- Wind speed
  - 322 km/h (200 mi/h) total
  - 257 km/h (160 mi/h) rotational
  - 64 km/h (40 mi/h) translational.
- Pressure drop
  - 6,205 Pa (0.90 lb/in^2) at 2,068 Pa (0.30 lb/in^2/s)
- Missiles
  - Wood plank
    52 kg (115 lb)
    0.09 m x 0.29 m x 3.66 m (3.6 in. x 0.94 ft x 12 ft)
    49.3 m/s (161.7 ft/s) horizontal impact velocity
  - 6-in. schedule 40 pipe
    130 kg (287 lb)
    0.17 m diameter x 0.91 m (6.6 in. diameter x 3 ft)
    8.2 m/s (27.0 ft/s) horizontal impact velocity
  - 1-in. steel rod
    4 kg (8.8 lb)
    0.03 m diameter x 0.91 m (1 in. diameter x 3 ft)
    7.6 m/s (24.9 ft/s) horizontal impact velocity
  - Utility pole
    510 kg (1,124 lb)
    0.34 m diameter x 10.67 m (13.5 in. diameter x 35 ft)
    9.4 m/s (30.7 ft/s) horizontal impact velocity
  - 12-in. schedule 40 pipe
    340 kg (750 lb)
    0.32 m diameter x 4.57 m (12.75 in. diameter x 15 ft)
    6.6 m/s (21.8 ft/s) horizontal impact velocity
  - Automobile
    1810 kg (3,990 lb)
    5.0 m x 2.01 m x 1.31 m (16.4 ft x 6.6 ft x 4.3 ft)
    32.1 m/s (105.2 ft/s) horizontal impact velocity.

The missiles are considered to strike surfaces in any direction, and the vertical velocities are 70% of the horizontal velocities except for the 1-in. steel rod, which has the same velocity in any direction. The utility pole and automobile are considered to strike surfaces up to a maximum of 9.1 m (30 ft) above the highest finished grade within .8 km (0.5 mi) of the plant. The other missiles can strike at any elevation.

The NRC has not released proposed new missile spectrum data that would take advantage of the proposed reduced tornado wind speeds (NRC 1993). Therefore the designer may either use the missile spectrum of NRC Standard Review Plan 3.5.1.4 for Region III (NRC 1981) or develop a missile spectrum that takes advantage of the reduced tornado wind speeds.

4.0 VOLCANIC ASH CRITERIA

4.1 BACKGROUND

Volcanic hazards that have affected the Hanford Site in the past 20 million years are of two types: (1) continental flood basalt volcanism that produced the Columbia River Basalt Group, which underlies the Hanford Site, outcropping in the surrounding ridges; and (2) 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 cessation of the tectonic processes that created the episode. 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. 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, the 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. The remainder of this discussion addresses the criteria for volcanic ash.

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 4 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 5 illustrates the annual probability of exceeding 10 cm of volcanic ash accumulation. Figure 6 presents this information as a volcanic ash hazard curve for the Hanford Site.

Figure 4. Annual Probability of 1 Centimeter or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes.

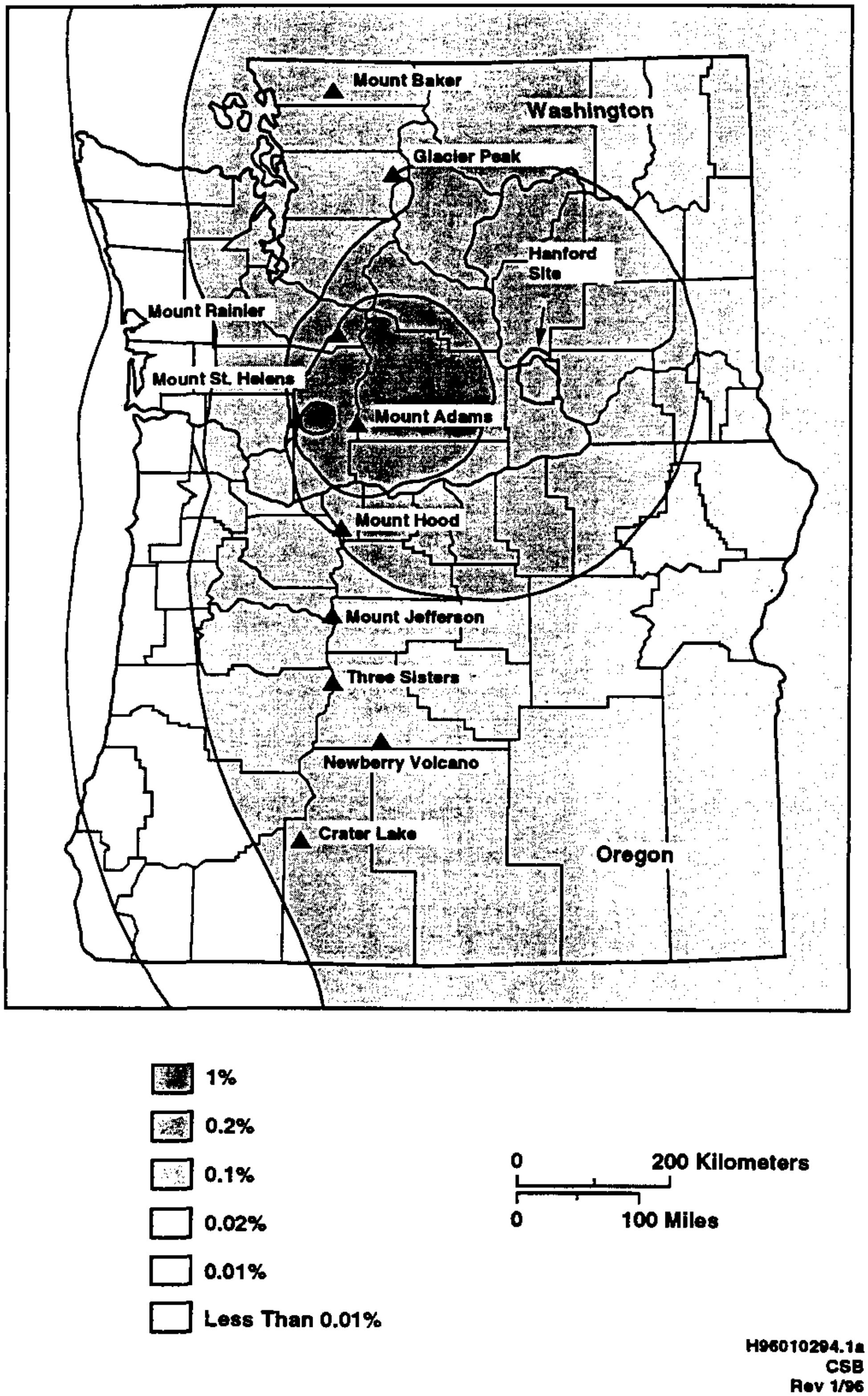


Figure 5. Annual Probability of 10 Centimeters or More of Volcanic Ash Accumulation in Washington and Oregon from Major Cascade Volcanoes.

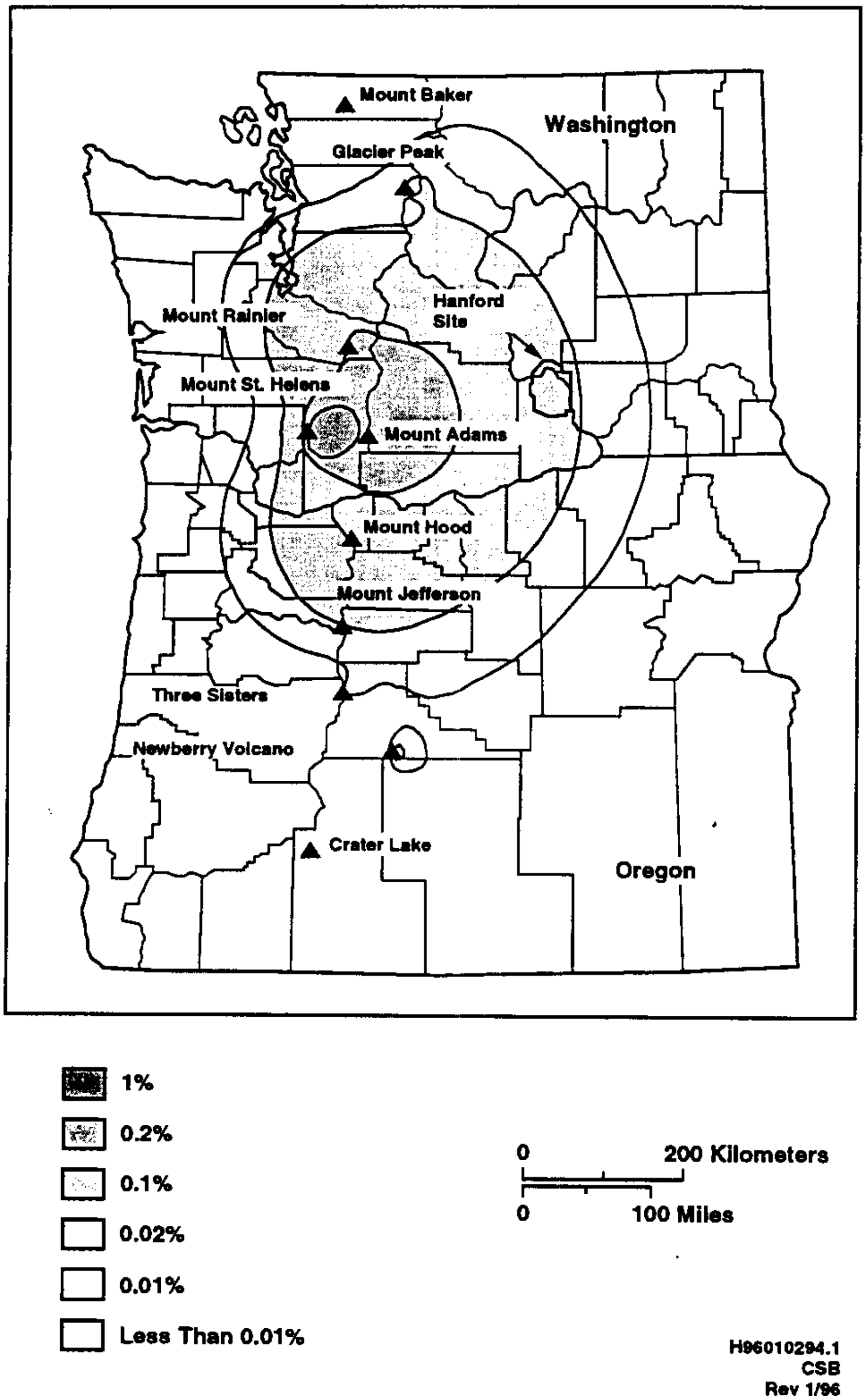
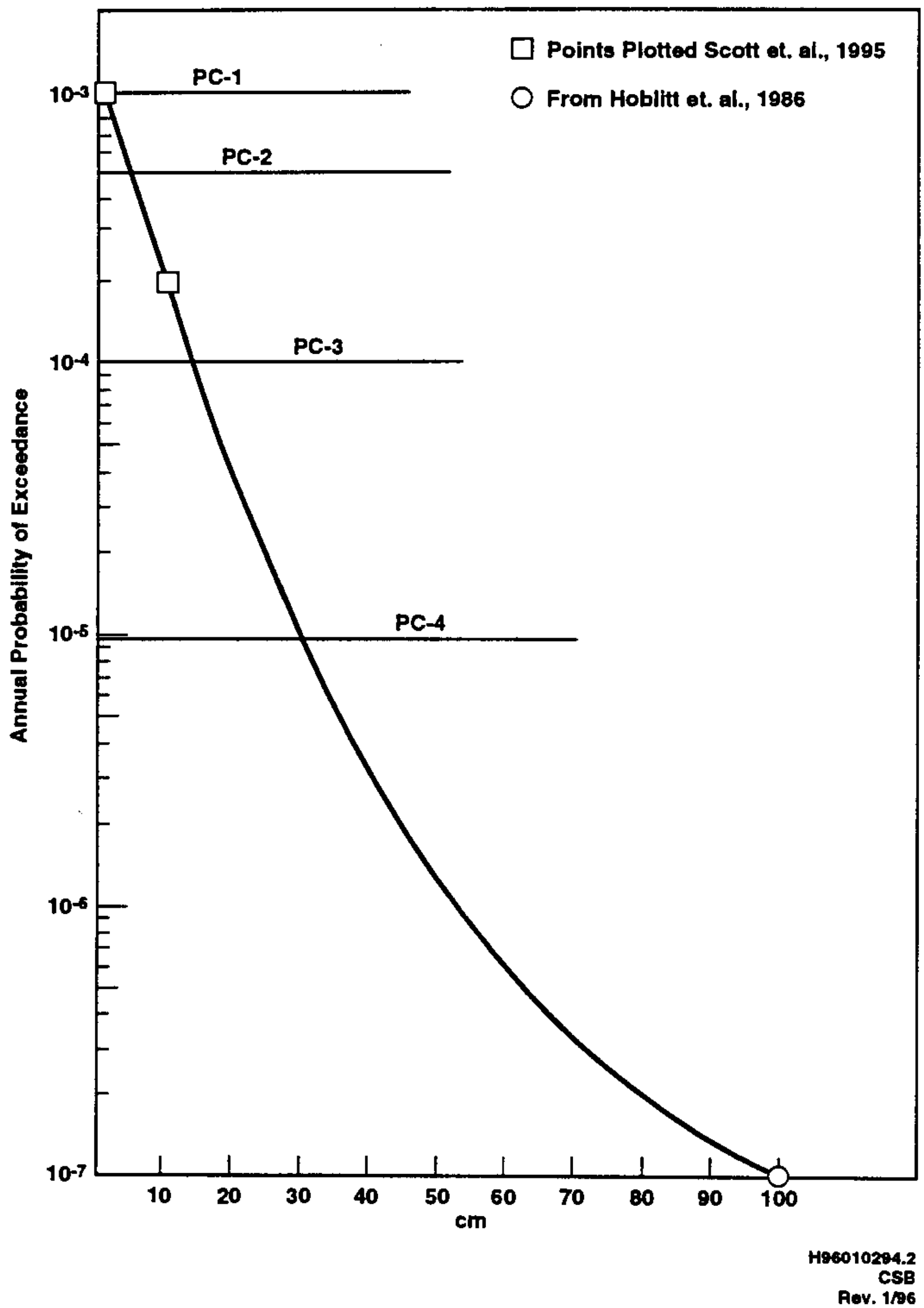


Figure 6. Cascade Range Volcanic Ash Hazard.



4.2 U.S. DEPARTMENT OF ENERGY DESIGN REQUIREMENTS

DOE has no specific orders or standards setting design criteria for ash loads. The DOE NPH design criteria are based on performance goals that are graded according to the safety class and hazard category of the structure, system, or component. The appropriate hazard annual probability for the NPH (ashfall, in this case) is dependant upon the risk reduction achieved in mitigative design or administrative control. There is currently no accepted risk reduction factor for design in the case of ground ash loads. Therefore the ground ash load is the same as the performance goal. As shown in Figure 6, the ashfall goal at the Hanford Site for a Performance Category 3 facility such as the CSB (1×10^{-4}) is 15 cm (6 in.) of uncompacted ash, which represents 7.5 cm (3 in.) of compacted ash. Using an average density for compacted ash of 1,538 kg/m^3 (96 lb/ft^3), the ground ash load of 7.5 cm (3 in.) of compacted ash is 117 kg/m^2 (24 lb/ft^2). Following the same procedure, the Performance Category 2 ground ash load is 2.5 cm (1 in.) of compacted ash or 39 kg/m^2 (8 lb/ft^2), and the Performance Category 1 ground ash load is 0.5 cm (0.2 in.) of compacted ash or 7.8 kg/m^2 (1.6 lb/ft^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, there is almost always increased seismic activity at the volcano 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 (Scheidegger et al. 1982). 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; operation shutdown; 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.

4.3 U.S. NUCLEAR REGULATORY COMMISSION DESIGN REQUIREMENTS

There is no NRC design requirement or regulatory guide for volcanic hazards, namely ashfall. The Supply System's Hanford site design basis for ashfall for safety related structures, systems, and components is 7.4 cm (3 in.) of compacted ash (NRC 1982) with a dry compacted density of 1,538 kg/m^3 (96 lb/ft^3). This is the same as the ground ash load for DOE Performance Category 3.

As with the DOE requirements, the appropriate suspended ash load will be determined if required.

5.0 FLOOD CRITERIA

5.1 BACKGROUND

The CSB site is at an elevation of about 213 m (700 ft) above mean sea level. The Columbia River is closest to the CSB at river kilometer 595 (mile 370) where the normal flow is at approximately 115 m (375 ft) above mean sea level. At the same river kilometer, the estimated flood level at a mean annual probability of 1×10^{-4} (the annual probability of exceedance for Performance Category 3 design) is 133 m (435 ft) above mean sea level (McCann and Boissonnade 1988). This is about 80 m (265 ft) below the CSB. The CSB is also about 78 m (250 ft) above the Grand Coulee Dam failure flood (BOR 1982). Cold Creek and Dry Creek are ephemeral streams on the western portion of the Hanford Site. These streams are not of concern for the CSB site as they are in the Yakima River drainage basin and the CSB is in the Columbia River drainage basin. The probable maximum flood is approximately 30 m (100 ft) below the elevation of the divide between the Columbia River and the Yakima River (Skaggs and Walters 1981). The CSB site is a flood-dry site with respect to river flooding, so only flooding caused by precipitation runoff need be considered.

5.2 U.S. DEPARTMENT OF ENERGY DESIGN REQUIREMENTS

DOE guidance in *DOE-STD-1020-94* states that the performance goals for structures, systems, and components must be satisfied when subjected to the design basis flood level for local precipitation. This can be done through design features to provide sufficient runoff capacity and through facility strengthening. The performance goal is 1×10^{-4} for a Performance Category 3 structure such as the CSB.

A recent cooperative study by the National Oceanic and Atmospheric Administration, the Bureau of Reclamation, and the Corps of Engineers has updated the probable maximum precipitation (PMP) estimates for the Pacific Northwest (Hansen et al. 1994). This document supersedes other earlier work done by these organizations and is the source used for the PMP shown in Table 2. 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. No annual probability of exceedance is given in Hansen et al. (1994) for the PMP for either general or local storms. The PMP is generally judged to have an annual probability of exceedance of 1×10^{-6} or less. If the 6-hour local storm has an annual probability of 1×10^{-6}, the PMP values for an annual probability of 1×10^{-4} are extrapolated to be approximately 13 cm (5 in.) when considering a 1-mi^2 area and approximately 9 cm (3.5 in.) when considering a 10-mi^2 area.

Table 2. 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.

5.3 U.S. NUCLEAR REGULATORY COMMISSION DESIGN REQUIREMENTS

NRC guidance in 10 CFR 72 says that "the facility must be sited so as to avoid to the extent possible the long-term and short-term adverse impacts associated with the occupancy and modification of floodplains." No guidance is given for the probabilities of flooding or precipitation to be addressed. The potential for flooding of the dry cask storage sites licensed under 10 CFR 72 has not been a significant concern as the casks can withstand flood waters that submerge the casks (Pacific Nuclear 1993, Sierra Nuclear 1991). The CSB will be more sensitive to flooding, so using nuclear power reactor guidance is proposed. For nuclear power reactors, the 24-hour PMP estimates are suggested for use in constructing runoff models to estimate the discharge to the site's storm drainage system (NRC 1981, ANSI/ANS 1992). At the Hanford Site, using the PMP for the local storm is more conservative than using the PMP for the general storm, which occurs over a larger area. Using NRC reactor criteria, the local 1-mi^2, 6-hour storm rate be used for the CSB (Table 2). The slightly lower 10-mi^2 rate can be used for calculating the surrounding watershed runoff.

6.0 LIGHTNING

Neither DOE nor NRC have developed specific requirements for dealing with lightning. NFPA 780, *Lightning Protection* (NFPA 1992), is recommended as guidance for developing lightning protection for the CSB.

7.0 SNOW LOAD

Both DOE and NRC 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 (20 lb/ft^2).

8.0 REFERENCES

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