2 SITE CHARACTERISTICS

2.1 Conduct of Review

Chapter 2, "Site Characteristics," of the Safety Analysis Report (SAR) (Foster Wheeler Environmental Corporation, 2003a) discusses the geographical location of the Idaho Spent Fuel (ISF) Facility and meteorological, hydrological, seismological, geological, and volcanological characteristics of the site and the surrounding area. It describes the population distribution within and around the Idaho National Engineering and Environmental Laboratory (INEEL) site, land and water uses, and associated site activities. This chapter also evaluates site characteristics for safety, and identifies assumptions that need to be applied when evaluating safety, establishing installation design, and providing design bases for other evaluations in the SAR.

The information and analyses presented in Chapter 2, "Site Characteristics," of the SAR were reviewed with respect to the applicable siting evaluation regulations in 10 CFR Part 72, Subpart E, and 10 CFR §72.122(b). Where appropriate, findings of regulatory compliance are made for the specific 10 CFR Part 72 requirements that are fully addressed in Chapter 2 of the SAR. Findings of technical adequacy and acceptability are made for each section in Chapter 2.

As part of the license application, the applicant requested an exemption from the regulatory requirements in 10 CFR §72.102(f), which requires an applicant to use a deterministic methodology to develop the design earthquake (DE) ground motions. In the exemption request, the applicant proposed to use a probabilistic and risk-informed approach in which the design earthquake is based on the 2,500-year return period ground motions. These ground motions were derived from the most recent probabilistic seismic hazard analyses (PSHA) for the INEEL (Woodward-Clyde Federal Services, 1996a,b; Payne, et al., 2000; URS Greiner Woodward-Clyde Federal Services, et al., 2001, 2000, 1999) and modified to incorporate site-response effects at the ISF Facility site.

As discussed in Section 2.1.6.2 of this Safety Evaluation Report (SER), the staff agrees that the use of the PSHA methodology with a 2,500-year return period is acceptable and there is sufficient basis to grant an exemption to 10 CFR 72.102(f) at the time a license is issued for the facility. As discussed in Chapters 4 and 5 of this SER, the ISF Facility is designed to withstand a 2,500-year return period ground motion.

2.1.1 Geography and Demography

This section contains the review of Section 2.1, "Geography and Demography of Site Selected," of the SAR. Discussions included in the section are (i) site location, (ii) site description, (iii) population distribution and trends, and (iv) land and water uses. The staff reviewed the discussion about geography and demography against the following regulatory requirements.

- 10 CFR §72.90(a) requires site characteristics that may directly affect the safety or environmental impact of the Independent Spent Fuel Storage Installation (ISFSI) to be investigated and assessed.

- 10 CFR §72.90(b) requires proposed sites for the ISFSI to be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the ISFSI.

- 10 CFR §72.90(c) requires design basis external events to be determined for each combination of proposed site and proposed ISFSI design.

- 10 CFR §72.90(d) requires that the proposed sites with design basis external events for which adequate protection cannot be provided through ISFSI design shall be deemed unsuitable for the location of the ISFSI.

- 10 CFR §72.90(e) requires that pursuant to Subpart A of Part 51 of Title 10 for each proposed site for an ISFSI, the potential for radiological and other environmental impacts on the region must be evaluated with due consideration of the characteristics of the population, including its distribution, and of the regional environs, including its historical and aesthetic values.

- 10 CFR §72.90(f) requires the facility to 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.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI must be identified.

- 10 CFR §72.98(b) requires that the potential regional impact due to the construction, operation or decommissioning of the ISFSI must be identified. The extent of regional impacts must be determined on the basis of potential measurable effects on the population or the environment from ISFSI activities.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98(a) and (b) of this section must be investigated as appropriate with respect to (1) the present and future character and the distribution of population, (2) consideration of present and projected future uses of land and water within the region, and (3) any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR §72.100(a) requires that the proposed site must be evaluated with respect to the effects on populations in the region resulting from the release of radioactive materials under normal and accident conditions during operation and decommissioning of the ISFSI; in this evaluation, both usual and unusual regional and site characteristics shall be taken into account.

- 10 CFR §72.100(b) requires that each site must be evaluated with respect to the effects on the regional environment resulting from construction, operation, and decommissioning for the ISFSI; in this evaluation, both usual and unusual regional and site characteristics must be taken into account.

2.1.1.1 Site Location

Section 2.1.1, “Site Location,” of the SAR and relevant literature cited in the SAR describe the site location. The ISF Facility is adjacent to the Idaho Nuclear Technology and Engineering Center (INTEC) and is a part of INEEL. The INEEL is geographically located in Butte County, Idaho, and approximately 47 km [29 mi] west of Idaho Falls, Idaho.

The staff reviewed the description of the site location and finds it acceptable because it clearly describes the geographic location of the site, including its relationship to political boundaries and natural anthropogenic features. The maps provided in the SAR are acceptable because they provide sufficient detail, which is needed for review of the ISF Facility. This information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with the regulatory requirements in 10 CFR §72.90(a) and (e) and §72.98(a).

2.1.1.2 Site Description

Section 2.1.2, “Site Description,” of the SAR and relevant literature cited in the SAR describe the site with maps to delineate the site boundary and controlled area. The INEEL, where the ISF Facility is located, is designated as an exclusion area for nuclear reactors and associated facilities and, thus, is isolated to ensure maximum public safety. Ingress and egress of the site personnel and visiting personnel on official business is strictly controlled by U.S. Department of Energy-contracted security forces. The ISF Facility property site is owned by the U.S. Department of Energy and is leased to Foster Wheeler Environmental Corporation.

The proposed ISF Facility site is located in a broad, mostly flat plain in the Pioneer Basin and is approximately 1,215 m [3,986 ft] from the Big Lost River that flows through the INEEL. The Big Lost River is an intermittent flowing stream that, upon entering INEEL, sinks into the Snake River Aquifer. Topographic maps in the SAR provide the details of the site topography and surface drainage patterns as well as roads, railroads, transmission lines, wetlands, and surface water bodies on site. The SAR also indicates the absence of oil or gas pipelines in the INEEL area. There is no obvious way in which traffic on adjacent transportation links can interfere with ISF Facility operations.

The controlled-area boundary for the ISF Facility site is the boundary of the INEEL. The only activities that could impact the ISF Facility are those of the adjacent INTEC. The activities within the ISF Facility site security fence are only related to administration, operation, or maintenance of the ISF Facility.

Surface soils at the ISF Facility site are described as disturbed sandy gravel. The vegetation at INEEL is limited by soil type, meager rainfall, and extended drought periods. The natural plant life consists mainly of sagebrush and various grasses. The flat terrain precludes erosion. The SAR states the entire INTEC area is kept free from vegetation so there is no fuel for a range fire to the west of the ISF Facility site. Limited undergrowth range fires could approach the site from east and south that will be addressed by the INEEL fire suppression equipment, if necessary.

The staff reviewed the site description and relevant literature cited in the SAR. The staff finds the site description is adequate because the descriptive information and maps clearly delineate the site boundary and controlled area. The maps have a sufficient level of detail and are of appropriate scale and legibility required for the review of the site and ISF Facility. The information is also acceptable to determine distances between the ISF Facility and nearby facilities and cities. This information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.90(a) and (e) and §72.98(a).

2.1.1.3 Population Distribution and Trends

Section 2.1.3, “Population Distribution and Trends,” of the SAR and relevant literature cited in the SAR describe the population distribution and trends. The population data used in the SAR were derived based on year 2000 Census data. Population in the region within 80 km [50 mi], was determined to be approximately 128,000. The projected population listed in the SAR was based on the average annual growth rate of 0.8 percent (rate of growth between 1990 and 2000). A sector map of population in the SAR shows the distribution of population at various distances to as much as 80 km [50 mi] from the ISF Facility and notes there are no residents within 8 km [5 mi] of the ISF Facility. As described by the applicant, it is expected the construction, operation, and decommissioning of the ISF Facility will have a negligible effect on the overall population of the region. The maximally exposed individual is identified to be at Frenchman’s Cabin, at the southern boundary of the INEEL {17.7 km [11 mi] from the ISF Facility site}. This selection was based on work completed (approved license applications) for other INEEL nuclear facilities. Based on this information, the applicant concludes it is likely the effect of the ISF Facility on the regional population distribution and growth trends will be minimal, if any.

The staff reviewed the information presented in the SAR and concludes the population distribution and trends in the region have been adequately described and assessed. The source of the population data used in the SAR is appropriate, and the basis for population projections is reasonable. The staff finds 10 CFR §72.98(c)(1) is met because the region has been appropriately investigated for the present and future character and distribution of the population. This information also is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.90(e), §72.98(a) and (b), and §72.100(a) and (b).

2.1.1.4 Land and Water Uses

Section 2.1.4, “Uses of Nearby Land and Waters,” of the SAR and relevant literature cited in the SAR describe land and water uses. Categories of land use at the INEEL include facility operations, grazing, general open space, and infrastructure such as roads. Facility operations include industrial and support operations associated with energy research and waste management activities. Land is also used for recreational purposes, such as controlled permit hunting, and environmental research associated with the designation of the INEEL as a National Environmental Research Park. Much of the INEEL is open space not designated for specific uses. Some of this space serves as a buffer zone between the INEEL facilities and other land uses. Between 121,000 and 142,000 hectares [300,000 and 350,000 acres] are used for cattle and sheep grazing on INEEL land. Grazing is not allowed within 3 km [2 mi] of any INEEL nuclear facility, and, to avoid the possibility of milk contamination by long-lived radionuclides, dairy cattle are not permitted. Approximately 2 percent {4,600 hectares [11,400 acres]} of the INEEL is used for facilities and operations. Approximately 6 percent of the INEEL, 13,870 hectares [34,260 acres], is devoted to public roads and utility rights-of-way that cross the INEEL. Because INEEL is remote from most developed areas, the INEEL lands and adjacent areas are not likely to experience residential and commercial development. A U.S. Department of Energy–Idaho Operations Office (1993) study showed recreational and agricultural uses would increase in the surrounding area because of a greater demand for recreational areas and the conversion of range land to crop land.

The surface and subsurface water use in the affected environment at INEEL is described in a previous U.S. Department of Energy environmental impact statement (1995). The INEEL does not withdraw or use surface water for site operations, nor does it discharge effluents to natural surface water. The three surface-water bodies at or near the site (Big and Little Lost Rivers and Birch Creek), however, have the following designated uses: agricultural water supply, cold-water biota, salmonid spawning, and primary and secondary contact recreation. In addition, waters in the Big Lost River and Birch Creek have been designated for domestic water supply and as special resource waters.

The Snake River Plain Aquifer is the only source of water used at the INEEL. The proposed ISF Facility site is 140 to 146 m [460 to 480 ft] above the Snake River Plain Aquifer. The location and details of the wells where water is being withdrawn within 8 km [5 mi] of the ISF Facility site are described in Section 2.5.1 of the SAR. The wells withdraw water from the main body of the Snake River Plain Aquifer. The water withdrawn from each well is used for potable water, ground maintenance, and necessary INEEL operations. The ISF Facility will use groundwater provided from the INTEC and will not require any additional wells. The proposed ISF Facility would be constructed on the edge of the Big Lost River flood plain southeast of the main channel. The nearest boundary of the proposed ISF Facility is approximately 1,215 m [3,986 ft] from the Big Lost River. Other nearby surface water bodies include sewage treatment lagoons in the INTEC area and two percolation ponds south of INTEC. Because the treatment lagoons and percolation ponds are artificial and not intended to support aquatic life, the impact on surface and underground water quality is not examined in this section.

The staff reviewed the description of the land and water use in the SAR and information cited in the SAR for the region and finds the land and water use has been adequately described and assessed. The region has been investigated as appropriate for consideration of present and projected future uses of land and water within the region. This information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.98(a–c).

2.1.2 Nearby Industrial, Transportation, and Military Facilities

Section 2.2, “Nearby Industrial, Transportation, and Military Facilities,” of the SAR and relevant literature cited in the SAR describe nearby industrial, transportation, and military facilities and identify potential hazards from these facilities. This information is necessary to evaluate credible scenarios involving human-induced hazards that may endanger the proposed ISF Facility. The staff reviewed nearby industrial, transportation, and military facilities for the following regulatory requirements.

- 10 CFR §72.94(a) requires that the region must be examined for both past and present man-made facilities and activities that might endanger the proposed ISFSI. The important potential man-induced events that affect the ISFSI design must be identified.

- 10 CFR §72.94 (b) requires that information concerning the potential occurrence and severity of such events must be collected and evaluated for reliability, accuracy, and completeness.

- 10 CFR §72.94 (c) requires that appropriate methods must be adopted for evaluating the design basis external man-induced events, based on the current state of knowledge about such events.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI must be identified.

- 10 CFR §72.98(b) requires that the potential regional impact due to the construction, operation, or decommissioning of the ISFSI must be identified. The extent of regional impacts must be determined on the basis of potential measurable effects on the population or the environment from ISFSI activities.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98 (a) and (b) must be investigated as appropriate with respect to (1) the present and future character and the distribution of population, (2) consideration of present and projected future uses of land and water within the region, and (3) any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR §72.100(a) requires that the proposed site must be evaluated with respect to the effects on populations in the region resulting from the release of radioactive materials under normal and accident conditions during operation and decommissioning of the ISFSI; in this evaluation, both usual and unusual regional and site characteristics shall be taken into account.

- 10 CFR §72.100(b) requires that each site must be evaluated with respect to the effects on the regional environment resulting from construction, operation, and decommissioning of the ISFSI; in this evaluation, both usual and unusual regional and site characteristics must be taken into account.

There are no industrial and military facilities within 8 km [5 mi] of the proposed ISF Facility. The identification of potential hazards includes identification of facilities and determination of credible scenarios that may endanger the proposed ISF Facility. Nuclear facilities identified by the applicant include the facilities at INTEC and Advanced Test Reactor in the Test Reactor Area. INTEC has the Three-Mile Island Unit 2 (TMI-2) ISFSI, a U.S. Nuclear Regulatory Commission-licensed facility to store spent nuclear fuel (SNF) and debris from the TMI accident. Facilities at INTEC identified to have potential hazards to the proposed ISF Facility include High-Level Waste Tank Farm, New Waste Calcining Facility, Unirradiated Fuel Storage Facility, Irradiated Fuel Storage Facility, Fluorinel Dissolution Process and Fuel Storage Facility, and Calcined Solids Storage Facilities. Additionally, propane and gasoline storage tanks and delivery of flammable and combustible liquids, such as diesel, kerosene, gasoline, and propane, can potentially pose an explosion hazard to the proposed ISF Facility. The primary missions of these facilities at INTEC are to safely store SNF, prepare SNF for permanent storage in an offsite repository, develop technologies for safe treatment of high-level and liquid radioactive waste from reprocessing SNF, and remediate any past environmental release of radioactive materials.

The High-Level Waste Tank Farm has 11 underground stainless steel tanks to store the liquid radioactive waste generated from plant decontamination and reprocessing of SNF. The Unirradiated Fuel Storage Facility provides secure storage of various unirradiated fuels. The Irradiated Fuel Storage Facility is part of the Fuel Receiving and Storage Building and was constructed to store SNF. The Fluorinel Dissolution Process and Fuel Storage Facility is a fuel storage and a dissolution process facility. The New Waste Calcining Facility converts liquid high-level waste from the Tank Farm into granulated solids. There are seven Calcined Solids Storage Facilities near the proposed ISF Facility.

The staff finds that all nearby facilities that may present a hazard to the proposed ISF Facility have been adequately identified. The potential hazards from these facilities are assessed in Chapter 15 of this SER.

2.1.3 Meteorology

The staff has reviewed the information presented in Section 2.3, “Meteorology,” of the SAR. Subsections discussed in this section include (i) regional climatology, (ii) local meteorology, and (iii) onsite meteorological measurement program. The staff reviewed the discussion on meteorology with respect to the following regulatory requirements.

- 10 CFR §72.90(a) requires site characteristics that may directly affect the safety or environmental impact of the ISFSI be investigated and assessed.

- 10 CFR §72.90(b) requires proposed sites for the ISFSI to be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the ISFSI.

- 10 CFR §72.90(c) requires design basis external events to be determined for each combination of proposed site and proposed ISFSI design.

- 10 CFR §72.90(d) requires the proposed sites with design basis external events for which adequate protection cannot be provided through ISFSI design shall be deemed unsuitable for the location of the ISFSI.

- 10 CFR §72.90(e) requires that, pursuant to Subpart A of Part 51 of Title 10, for each proposed site for an ISFSI, the potential for radiological and other environmental impacts on the region must be evaluated with due consideration of the characteristics of the population, including its distribution, and of the regional environs, including its historical and aesthetic values.

- 10 CFR §72.90(f) requires the facility to 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.

- 10 CFR §72.92(a) requires that natural phenomena that may exist or that can occur in the region of a proposed site be identified and assessed according to their potential effects on the safe operation of the ISFSI. The important natural phenomena that affect the ISFSI design must be identified.

- 10 CFR §72.92(b) requires that records of the occurrence and severity of those important natural phenomena must be collected for the region and evaluated for reliability, accuracy, and completeness. The applicant shall retain these records until the license is issued.

- 10 CFR §72.92(c) requires that appropriate methods must be adopted for evaluating the design basis external natural events based on the characteristics of the region and the current state of knowledge about such events.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI must be identified.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98(a) and (b) be investigated as appropriate with respect to (1) The present and future character and the distribution of population, (2) Consideration of present and projected future uses of land and water within the region, and (3) Any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR 72.122(b) requires that (1) structures, systems, and components important to safety must be designed to accommodate the effects of, and to be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing of the ISFSI and to withstand postulated accidents. (2) Structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions. The design bases for these structures, systems, and components must reflect (i) appropriate consideration of the most severe of the natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated, and (ii) appropriate combinations of the effects of normal and accident conditions and the effects of natural phenomena. The ISFSI should also be designed to prevent massive collapse of building structures or the dropping of heavy objects as a result of building structural failure on the spent fuel or high-level radioactive waste or on to structures, systems, and components important to safety. (3) Capability must be provided for determining the intensity of natural phenomena that may occur for comparison with design bases of structures, systems, and components important to safety. (4) If the ISFSI is located over an aquifer which is a major water resource, measures must be taken to preclude the transport of radioactive materials to the environment through this potential pathway.

2.1.3.1 Regional Climatology

Section 2.3.1, "Regional Climatology," of the SAR and relevant literature cited in the SAR (Clawson, et al., 1989) describe the regional climatology associated with the ISF Facility site. The applicant used climatologic data collected at a National Oceanic and Atmospheric Administration observational station, Idaho Falls 46W, and at an INEEL research tower to characterize the climate in Butte County, Idaho. Both stations are located near the INEEL Central Facilities Area, approximately 3.2 km [2 mi] south of the proposed site. Long-term weather data and severe weather data from the National Oceanic and Atmospheric Administration and the research tower are discussed. The information presented includes (i) general climate, including terrain influences on regional climate, regional temperature, freeze-thaw cycles, degree days, subsoil temperatures, regional precipitation, regional atmospheric moisture, regional winds, sky cover, atmospheric pressure, air density, and other phenomena and (ii) severe weather, including maximum and minimum temperatures, extreme winds, tornadoes, dust devils, hurricanes and tropical storms, precipitation extremes, thunderstorms and lightning, snow storms, and hail and ice storms.

The staff reviewed the regional climate data and discussions presented in the SAR and finds them acceptable because reliable data sources, such as the National Weather Service, were used. In addition, all relevant data, including weather data from nearby regional and local meteorological stations, were appropriately summarized to define the expected climatology of the site region. The information about severe weather data (Clawson, et al., 1989) is an acceptable source of data for development of the structural design criteria in Chapter 3, "Principal Design Criteria," of the SAR regarding extreme winds, tornados, and windborne missiles.

After reviewing the information provided, the staff determined that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with the regulatory requirements of 10 CFR §72.90(a) and (b) and §72.122(b).

2.1.3.2 Local Meteorology

Section 2.3.2, "Local Climatology," of the SAR and relevant literature cited in the SAR (Clawson, et al., 1989) describe local meteorology of the site. Table 2.3-1 of the SAR provides the highest and lowest annual average temperatures for the INEEL facilities, as a part of the regional climatology information, based on the meteorological data between 1952 and August 2000 collected at the National Oceanic and Atmospheric Administration Idaho Falls 46W station. As shown in Table 2.3-1, the highest annual average temperature is 38 EC [101 EF] and the lowest annual average temperature is !44 EC [!47 EF]. The maximum and minimum normal temperatures for the proposed site are 37 EC [98 EF] and !32 EC [!26 EF]. Historical daily maximum and minimum air temperature extremes were 38 EC [101 EF] in July and !44 EC [!47 EF] in December.

The recorded maximum daily air temperature range varies between 28 to 33 EC [50 to 59 EF] from winter to summer (see Table 2.3-2 of the SAR). The mean daily air temperature range is 21EC [38 EF] in July and August and 13 EC [23 EF] in December and January.

Historically, May has the highest accumulated precipitation of 11.23 cm [4.42 in], and the highest precipitation average is 3.05 cm [1.20 in], based on the data collected at the INEEL Central Facilities Area (Clawson, et al., 1989). The average annual precipitation is 22.15 cm [8.72 in]. Highest precipitation extremes for 1-hour and 24-hour periods are 1.37 cm [0.54 in] and 4.17 cm [1.64 in]. Both were recorded in June. The maximum snowfall was recorded in December, with an amount of 56.64 cm [22.3 in], and the maximum snowfall in a 24-hour period was recorded to be 21.59 cm [8.5 in] in January.

The wind speeds and directions at the 6-m [20-ft] and 76-m [250-ft] levels are recorded near the proposed site. This information is provided in Table 2.3-10 of the SAR. The range for the highest monthly average wind speeds at the 6-m [20-ft] level recorded at the site is from 8.2 km/h [5.1 mph] to 15 km/h [9.3 mph]. The ranges for the highest hourly average wind speeds are from 56 km/h [35 mph] to 82 km/h [51 mph] at the 6-m [20-ft] level and from 74 km/h [46 mph] to 108 km/h [67 mph] at the 76-m [250-ft] level. The prevailing wind directions for all highest hourly speeds are southwest to west-southwest. Historic peak wind-speed gusts recorded at the INEEL Central Facilities Area from April 1950 to October 1964 are provided in Table 2.3-14 of the SAR. The maximum gust wind speeds at the 6-m [20-ft] and 76-m [250-ft] levels are 126 km/h [78 mph] and 135 km/h [84 mph].

The site-specific tornado and tornado-generated missiles hazards are discussed in Section 15.1.2.18 of this SER.

The staff reviewed the local meteorological data and discussions presented in the SAR and finds them acceptable because reliable data sources such as the National Oceanic and Atmospheric Administration were used, and the data are appropriately summarized.

The staff reviewed the topographic maps to determine the effects of meteorology on erosion at the site. The maps indicate there is approximately 3.6 m [12 ft] of relief across the proposed site, and the site slopes from southwest to northeast. Staff analysis of the slope and the expected meteorologic environment indicates the slopes will be stable and the site will not experience significant erosion. The staff determines the current information presented in the SAR is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with the regulatory requirements of 10 CFR §72.92(a), §72.98(a), §72.98(c)(3), and §72.122(b).

2.1.3.3 Onsite Meteorological Measurement Program

Section 2.3.3, "Onsite Meteorological Monitoring Program," of the SAR describes the onsite meteorological measurement program. The meteorologic instrumentation includes wind instrumentation at two levels {10 m and 61 m [32 ft and 200 ft]} and temperature measurements at three levels. Grid 3, a research-grade meteorological tower, is the wind station nearest the proposed site. This grid is integrated with the INEEL emergency dose prediction system maintained by National Oceanic and Atmospheric Administration. This onsite meteorologic measurement program was reviewed and accepted by the staff during the review of the INEEL

TMI-2 ISFSI SAR (U.S. Department of Energy, 1997). Because the proposed site is adjacent to the TMI-2 ISFSI facility, the onsite meteorologic measurement program accepted for the TMI-2 facility is also acceptable for the proposed ISF Facility.

The staff finds that the current information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with the regulatory requirements of 10 CFR §72.92(a), §72.98(a), §72.98(c)(3), and §72.122(b).

2.1.3.4 Atmospheric Diffusion Estimates

Foster Wheeler Environmental Corporation relied on dispersion modeling performed by the Air Resources Laboratory–Field Research Division of the National Oceanic and Atmospheric Administration for INEEL sources used in the TMI-2 ISFSI analysis as the basis for diffusion estimates for the proposed ISF Facility. The staff has determined that the TMI-2 ISFSI dispersion model is applicable for the proposed ISF Facility because of the close proximity of the proposed facility to the TMI-2 ISFSI.

2.1.4 Surface Hydrology

The staff reviewed the information presented in Section 2.4, "Surface Hydrology," of the SAR. Discussions presented in this section include (i) hydrologic description, (ii) floods, (iii) probable maximum flood on streams and rivers, (iv) potential dam failures, (v) probable maximum surge and seiche flooding, (vi) probable maximum tsunami flooding, (vii) ice flooding, (viii) flood protection requirements, and (ix) environmental acceptance of effluents. The staff reviewed the discussion about surface hydrology with respect to the following regulatory requirements.

- 10 CFR §72.90(a) requires that site characteristics that may directly affect the safety or environmental impact of the ISFSI be investigated and assessed.

- 10 CFR §72.90(b) requires proposed sites for the ISFSI to be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the ISFSI.

- 10 CFR §72.90(c) requires design basis external events to be determined for each combination of proposed site and proposed ISFSI design.

- 10 CFR §72.90(d) requires that the proposed sites with design basis external events for which adequate protection cannot be provided through ISFSI design be deemed unsuitable for the location of the ISFSI.

- 10 CFR §72.90(e) requires that, pursuant to Subpart A of Part 51 of Title 10, for each proposed site for an ISFSI, the potential for radiological and other environmental impacts on the region must be evaluated with due consideration of the characteristics of the population, including its distribution, and of the regional environs, including its historical and aesthetic values.

- 10 CFR §72.90(f) requires the facility to 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.

- 10 CFR §72.92(a) requires that natural phenomena that may exist or that can occur in the region of a proposed site must be identified and assessed according to their potential effects on the safe operation of the ISFSI. The important natural phenomena that affect the ISFSI design must be identified.

- 10 CFR §72.92(b) requires that records of the occurrence and severity of those important natural phenomena must be collected for the region and evaluated for reliability, accuracy, and completeness. The applicant shall retain these records until the license is issued.

- 10 CFR §72.92(c) requires that appropriate methods be adopted for evaluating the design basis external natural events based on the characteristics of the region and the current state of knowledge about such events.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI be identified.

- 10 CFR §72.98(b) requires that the potential regional impact due to the construction, operation or decommissioning of the ISFSI be identified. The extent of regional impacts must be determined on the basis of potential measurable effects on the population or the environment from ISFSI activities.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98(a) and (b) must be investigated as appropriate with respect to (1) the present and future character and the distribution of population, (2) consideration of present and projected future uses of land and water within the region, and (3) any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR §72.122(b) requires (1) structures, systems, and components important to safety must be designed to accommodate the effects of, and to be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing of the ISFSI and to withstand postulated accidents.
  (2) Structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions. The design bases for these structures, systems, and components must reflect (i) appropriate consideration of the most severe of the natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated, and (ii) appropriate combinations of the effects of normal and accident conditions and the effects of natural phenomena. The ISFSI should also be designed to prevent massive collapse of building structures or the dropping of heavy objects as a result of building structural failure on the spent fuel or high-level radioactive waste or on to structures, systems, and components important to safety. (3) Capability must be

provided for determining the intensity of natural phenomena that may occur for comparison with design bases of structures, systems, and components important to safety. (4) If the ISFSI is located over an aquifer which is a major water resource, measures must be taken to preclude the transport of radioactive materials to the environment through this potential pathway.

2.1.4.1 Hydrologic Description

The staff reviewed Section 2.4.1, “Hydrologic Description,” of the SAR, which provides a description of the hydrosphere, including the Mackay Dam and the INEEL Flood Diversion Facility. Section 2.4.1 also describes the Mud Lake–Lost River Basin (also known as the Pioneer Basin) and the three main streams of the basin, the Big and Little Lost Rivers and Birch Creek, where the proposed ISF Facility site is located. There is little surface water at the site other than the surface-water bodies formed from accumulated runoff during snowmelt or heavy precipitation and artificial infiltration and evaporation ponds. The surface water resources in the affected environment at the INEEL are described in the SAR and in U.S. Department of Energy (2002a, Section 4.8.1). Included in Section 2.4.1 and discussed in the supporting reports are descriptions of the surface drainage features, elevations of the proposed ISF Facility and site, measured precipitation, calculated evaporation, storm water pollution prevention program, and water quality (Wilhelmson, et al., 1993; U.S. Department of Energy, 1995, 2001, 2002a; Rodriguez, et al., 1997).

The staff reviewed the hydrologic description and found it acceptable because the basic information about the surface hydrology of the site and the vicinity has been described in sufficient detail for review of the license application. The staff determined that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.90, §72.92(a), §72.98(a), and §72.98(b).

2.1.4.2 Floods

The staff reviewed Section 2.4.2, “Floods,” of the SAR. There is no historical record of any flooding at the proposed ISF Facility site from the Big Lost River, although evidence of prehistoric flooding exists in the geologic sediments at the site.

The INTEC area may be subject to a 100-year flood. The estimated 100-year peak flow of the Big Lost River immediately upstream of the INEEL diversion dam is 106 m^3/s [3,750 cfs] with the upper and lower 95-percent confidence limits of 177 m^3/s [6,250 cfs] and 37 m^3/s [1,300 cfs] (Hortness and Rousseau, 2003).

The staff finds that sufficient information has been provided to describe the potential for flooding in the region, and that the applicant has met the requirements of 10 CFR §72.90(a), (b) (e) and (f) in that regard.

2.1.4.3 Probable Maximum Flood on Streams and Rivers

The staff reviewed Section 2.4.3, “Probable Maximum Flood on Streams and Rivers,” of the SAR, which provides discussion about the effects of a probable maximum flood on steams and rivers. The SAR and other supporting documents state the probable maximum flood represents the hypothetical flood considered to be the most severe flood event reasonably possible, based on hydro-meteorological application of maximum precipitation and other hydrologic factors.

The probable maximum flood is interpreted to result from an overtopping failure of the Mackay Dam caused by an extreme precipitation event (U.S. Department of Energy, 1997; Koslow and Van Haaften, 1986). The resulting peak flow from the probable maximum precipitation-induced overtopping failure is 8,685 m^3/s [306,700 cfs] in the reach immediately downstream of the Mackay Dam (Table 2.4-3 of the SAR), approximately 2,035 m^3/s [71,850 cfs] at the INEEL Diversion Dam, and 1,892 m^3/s [66,830 cfs] at INTEC. The flood wave is expected to reach the INTEC in 13.5 hours after dam failure. Flood water velocities are estimated to be 0.3 to 0.9 m/s [1 to 3 ft/s] downstream on the INEEL. The INEEL Flood Diversion Facility may serve to divert some flood water if the dam fails. The proposed ISF Facility is expected to be flooded, however. The potential flood accident and its consequence are discussed in Section 15.1.2.17 of this SER.

The staff reviewed the probable maximum flood analysis and finds it acceptable because the surface water flooding that may directly affect safety or result in an environmental impact has been sufficiently investigated and assessed. The staff has determined that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.90(c), (d), and (f), and §72.122(b).

2.1.4.4 Potential Dam Failures (Seismically Induced)

Section 2.4.4, "Potential Dam Failures (Seismically Induced)," of the SAR discusses the potential for flooding at the proposed ISFSI site as a result of seismically induced dam failure. The SAR states the Mackay Dam was classified as a high-hazard dam by the State of Idaho in a 1978 inspection that used the U.S. Army Corps of Engineers guideline for safety inspection of dams. The Mackay Dam is in a region where large earthquakes have occurred in the past, including the 1983 Borah Peak earthquake. The Mackay Dam was not damaged by this earthquake, demonstrating stability of the embankment during moderate vibratory ground motions. As noted in the SAR, however, the Mackay Dam was built without seismic design criteria, which led the applicant to conduct analyses of potential flooding impacts at the site in the event of seismically induced dam failure (Koslow and Van Haaften, 1986). This event is bounded by the flood characteristics described in Section 2.1.4.3 of this SER.

2.1.4.5 Probable Maximum Surge and Seiche Flooding

The staff reviewed Section 2.4.5, “Probable Maximum Surge and Seiche Flooding,” of the SAR. The SAR stated the ISF Facility is remote from major water bodies in the region. Therefore, surge and seiche flooding of the site is not possible.

The staff reviewed the discussion on probable maximum surge and seiche flooding and finds it acceptable because this phenomenon will not impact the site. The staff concludes the information provided is in compliance with 10 CFR §72.90(a-d) and §72.92(a).

2.1.4.6 Probable Maximum Tsunami Flooding

The staff reviewed Section 2.4.6, “Probable Maximum Tsunami Flooding,” of the SAR. The SAR stated that the ISF Facility is remote from major water bodies in the region. Therefore, tsunami flooding of the site is not possible.

The staff reviewed the discussion about probable maximum tsunami flooding and finds it acceptable because this phenomenon will not impact the site. The staff concludes the information provided is in compliance with 10 CFR §72.90(a-d) and §72.92(a).

2.1.4.7 Ice Flooding

The staff reviewed Section 2.4.7, “Ice Flooding,” of the SAR. As stated in the SAR, flow of the Big Lost River will be diverted to the Flood Diversion Facility in the winter months to avoid ice accumulation in the main channel downstream of the diversion dam. Ice jams upstream of the diversion dam are possible. The SAR indicates, however, that overflowing of the banks upstream of the diversion dam will not cause damage to the ISF Facility site.

The staff reviewed the discussion in the SAR about probable maximum ice flooding and finds it acceptable because the ice-jam induced flooding will not cause damage to the ISF Facility site. The staff concludes the information provided is in compliance with 10 CFR §72.90(a–d) and §72.92(a).

2.1.4.8 Flood Protection Requirements

The staff reviewed Section 2.4.8, “Flooding Protection Requirements,” and Section 8.2.5.3, “Flood,” of the SAR. Section 2.4.8 refers to Chapter 8 of the SAR, which addresses the flood protection requirements. The applicant has considered flooding a credible accident at the ISF Facility site. The limiting flood conditions assumed for the ISF Facility are the result of the probable maximum flood.

As discussed in Section 3.2.2 of the SAR, the applicant demonstrated that the structures, systems, and components important to safety for the ISF Facility are designed for flood protection to prevent changes in SNF or structural configuration. The radiological contamination source available for exposure to flood waters in the ISF Facility is shown to be limited in Section 8.2.5.3 of the SAR. In addition, the response time available upon warning of an impending flood is sufficient to permit actions to secure operations and to prevent local flooding of potentially contaminated areas to further limit any potential radiological releases.

The staff reviewed the information provided and finds that flood protection requirements have been adequately addressed.

2.1.4.9 Environmental Acceptance of Effluents

The staff reviewed Section 2.4.9, “Environmental Acceptance of Effluents,” of the SAR. The SAR states there are no liquid discharges to the environment. The ISF Facility liquid systems are designed to have limited interfaces with the environment to avoid an inadvertent release of effluents to the environment. If any inadvertent release of liquid effluent occurs, the liquid effluent is anticipated to be diverted to a storm ditch southeast of the ISF Facility site. Previous groundwater modeling conducted for the vadose (unsaturated) zone indicated the infiltration of the liquid effluents will have limited effect on the regional groundwater quality.

The staff reviewed the discussion on environmental acceptance of effluents and finds it acceptable because the ISF Facility is designed for no radioactive effluents and is in compliance with 10 CFR §72.90(e).

2.1.5 Subsurface Hydrology

The staff reviewed the information presented in Section 2.5, "Subsurface Hydrology," of the SAR. Discussions presented in this section include (i) regional characteristics, (ii) site characteristics, and (iii) contaminant transport analysis. The staff reviewed the discussion about subsurface hydrology for the following regulatory requirements.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI be identified.

- 10 CFR §72.98(b) requires that the potential regional impacts due to the construction, operation or decommissioning of the ISFSI must be identified. The extent of regional impacts must be determined on the basis of potential measurable effects on the population or the environment from ISFSI activities.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98 (a) and (b) must be investigated as appropriate with respect to (1) the present and future character and the distribution of population, (2) consideration of present and projected future uses of land and water within the region, and (3) any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR §72.122(b) requires that (1) structures, systems, and components important to safety must be designed to accommodate the effects of, and to be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing of the ISFSI and to withstand postulated accidents. (2) Structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions. The design bases for these structures, systems, and components must reflect (i) appropriate consideration of the most severe of the natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated, and (ii) appropriate combinations of the effects of normal and accident conditions and the effects of natural phenomena. The ISFSI should also be designed to prevent massive collapse of building structures or the dropping of heavy objects as a result of building structural failure on the spent fuel or high-level radioactive waste or on to structures, systems, and components important to safety. (3) Capability must be provided for determining the intensity of natural phenomena that may occur for comparison with design bases of structures, systems, and components important to safety. (4) If the ISFSI is located over an aquifer which is a major water resource, measures must be taken to preclude the transport of radioactive materials to the environment through this potential pathway.

A description of the subsurface water resources in the affected environment at the INEEL is provided in the SAR and in a previous U.S. Department of Energy EIS (2002a, Section 4.8). Subsurface water at the site occurs in the Snake River Plain Aquifer and the vadose zone. Generally, the term groundwater refers to usable quantities of water that enter freely into wells under confined and unconfined conditions within an aquifer.

2.1.5.1 Regional Characteristics

The staff reviewed Section 2.5.1, "Regional Characteristics," of the SAR, which discusses the regional characteristics of the subsurface hydrology at the proposed ISF Facility site. The Snake River Plain Aquifer underlies INEEL and is the largest aquifer in Idaho and the major source of drinking water for southeast Idaho. This section of the SAR and the supporting documents describe the Snake River Plain Aquifer, the drainage basin recharging the Snake River Plain Aquifer, aquifer recharge by infiltration of irrigation water, seepage from stream channels and canals, underflow from tributary stream valleys, and direct infiltration from precipitation (U.S. Department of Energy, 2002a). Also discussed are the groundwater flow regime, storage, and hydrologic characteristics of the Snake River Plain Aquifer.

The staff reviewed the discussion and information regarding regional subsurface hydrology characteristics and finds them acceptable because regional characteristics have been described adequately for use in other sections of the SAR to develop the design bases of the ISF Facility, to perform additional safety analyses, and to demonstrate compliance with the regulatory requirements in 10 CFR §72.98(c)(2) and §72.122(b).

2.1.5.2 Site Characteristics

The staff reviewed Section 2.5.2, "Site Characteristics," of the SAR, which discusses the site characteristics of the subsurface hydrology at the proposed ISF Facility site. This section of the SAR and the supporting documents describe the subsurface hydrostratigraphy, extent of vadose zone, and evidence of perched water bodies. Of particular interest are the perched water bodies that have been observed in the Big Lost River alluvium and the underlying basalt units (Rodriguez, et al., 1997). As reported in these documents, the sources of existing and former perched water bodies include infiltration from the sewage treatment ponds on the eastern side of INEEL, the Big Lost River, leaking fire water lines, precipitation infiltration, steam condensate dry wells, and lawn irrigation (U.S. Department of Energy, 2002a) in the northern area. A large body of perched water in the upper basalt has resulted primarily from discharge to the percolation ponds in the southern area (Rodriguez, et al., 1997).

Section 2.5.2 of the SAR discusses the hydrologic, physical, and water quality characteristics of the Snake River Plain Aquifer such as transmissivity, coefficients of storage, porosity, and water quality, including the major dissolved solids, water quality indicators (i.e., pH) and radioactive contamination concentrations.

The staff reviewed the discussion and information regarding the site characteristics and finds them acceptable because the groundwater characteristics have been described adequately for further assessment of external events. The staff determined that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, to perform additional safety analyses, and to demonstrate compliance with the regulatory requirements in 10 CFR §72.98(c)(2) and §72.122(b).

2.1.5.3 Contaminant Transport Analysis

The staff reviewed Section 2.5.3, "Contaminant Transport Analysis," of the SAR. As discussed in the SAR, the ISF Facility does not have any planned liquid discharges to the environment, therefore, there is no means during normal operation for contamination to be transported from the ISF Facility to the subsurface aquifer.

The staff reviewed the discussion about contaminant transport analysis and finds it acceptable because release of effluents from the ISF Facility is not planned. The staff concludes this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, perform additional safety analyses, and demonstrate compliance with regulatory requirements in 10 CFR §72.98(c)(2) and §72.122(b).

2.1.6 Geology and Seismology

Section 2.6, "Geology and Seismology," of the SAR describes the geological and seismological setting of the proposed site, geographically located within the INEEL. This review corresponds to the following Subsections: 2.6.1, "Basic Geologic and Seismic Information;" 2.6.2, "Vibratory Ground Motion;" 2.6.3, "Surface Faulting;" 2.6.4, "Stability of Subsurface Materials and Foundations;" 2.6.5, "Slope Stability;" and 2.6.6, "Volcanism." The staff reviewed the geology and seismology of the site with respect to the following regulatory requirements.

- 10 CFR §72.90(a) requires site characteristics that may directly affect the safety or environmental impact of the ISFSI to be investigated and assessed.

- 10 CFR §72.90(b) requires proposed sites for the ISFSI to be examined with respect to the frequency and severity of external natural and man-induced events that could affect the safe operation of the ISFSI.

- 10 CFR §72.90(c) requires design basis external events to be determined for each combination of proposed site and proposed ISFSI design.

- 10 CFR §72.90(d) requires the proposed sites with design basis external events for which adequate protection cannot be provided through ISFSI design to be deemed unsuitable for the location of the ISFSI.

- 10 CFR §72.92(a) requires that natural phenomena that may exist or that can occur in the region of a proposed site must be identified and assessed according to their potential effects on the safe operation of the ISFSI. The important natural phenomena that affect the ISFSI design must be identified.

- 10 CFR §72.92(b) requires that records of the occurrence and severity of those important natural phenomena must be collected for the region and evaluated for reliability, accuracy, and completeness. The applicant shall retain these records until the license is issued.

- 10 CFR §72.92(c) requires that appropriate methods must be adopted for evaluating the design basis external natural events based on the characteristics of the region and the current state of knowledge about such events.

- 10 CFR §72.98(a) requires that the regional extent of external phenomena, man-made or natural, that are used as a basis for the design of the ISFSI be identified.

- 10 CFR §72.98(b) requires that the potential regional impact due to the construction, operation or decommissioning of the ISFSI be identified. The extent of regional impacts must be determined on the basis of potential measurable effects on the population or the environment from ISFSI activities.

- 10 CFR §72.98(c) requires that those regions identified pursuant to paragraphs 10 CFR §72.98 (a) and (b) must be investigated as appropriate with respect to (1) the present and future character and the distribution of population, (2) consideration of present and projected future uses of land and water within the region, and (3) any special characteristics that may influence the potential consequences of a release of radioactive material during the operational lifetime of the ISFSI.

- 10 CFR §72.102 (b) requires that West of the Rocky Mountain Front (west of approximately 104E west longitude), and in other areas of known potential seismic activity, seismicity will be evaluated by the techniques of Appendix A of Part 100 of this chapter. Sites that lie within the range of strong near-field ground motion from historical earthquakes on large capable faults should be avoided.

- 10 CFR §72.102(c) requires that sites other than bedrock sites must be evaluated for their liquefaction potential or other soil instability due to vibratory ground motion.

- 10 CFR §72.102(d) requires that site-specific investigations and laboratory analyses must show that soil conditions are adequate for the proposed foundation loading.

- 10 CFR §72.102(e) requires that in an evaluation of alternative sites, those which require a minimum of engineered provisions to correct site deficiencies are preferred. Sites with unstable geologic characteristics should be avoided.

- 10 CFR §72.102(f) requires that the design earthquake for use in the design of structures must be determined as follows: (1) for sites that have been evaluated under the criteria of Appendix A of 10 CFR Part 100, the design earthquake must be equivalent to the safe shutdown earthquake for a nuclear power plant. (2) Regardless of the results of the investigations anywhere in the continental U.S., the design earthquake must have a value for the horizontal ground motion of no less than 0.10g with the appropriate response spectrum.

- 10 CFR §72.122(b) requires (1) structures, systems, and components important to safety must be designed to accommodate the effects of, and to be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing of the ISFSI and to withstand postulated accidents. (2) Structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, lightning, hurricanes, floods, tsunami, and seiches, without impairing their capability to perform safety functions. The design bases for these structures, systems, and components must reflect (i) appropriate consideration of the most severe of the natural phenomena reported for the site and surrounding area, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated, and (ii) appropriate combinations of the effects of normal and accident conditions and the effects of natural phenomena. The ISFSI should also be designed to prevent massive collapse of building structures or the dropping of heavy objects as a result of building structural failure on the spent fuel or high-level radioactive waste or on to structures, systems, and components important to safety. (3) Capability must be provided for determining the intensity of natural phenomena that may occur for comparison with design bases of structures, systems, and components important to safety. (4) If the ISFSI is located over an aquifer, which is a major water resource, measures must be taken to preclude the transport of radioactive materials to the environment through this potential pathway.

The staff has reviewed the information presented in Section 2.6, “Geology and Seismology,” of the SAR regarding the site. The documentation is acceptable because the breadth and depth of geological and geophysical investigations represent a comprehensive technical foundation of geological knowledge from which the potential for seismic and faulting hazards at the site can be adequately deduced. The applicant has sufficiently documented these investigations in the SAR and supporting documents.

The staff finds the description of the basic geologic and seismic information in the SAR to be acceptable, in part because much of the information was previously discussed and accepted by the staff in the U.S. Department of Energy’s license application for the TMI-2 ISFSI, which is located adjacent to the proposed ISF Facility. The regulations in 10 CFR §72.40(c) indicate a reevaluation of a site is not required for facilities covered by previous licensing actions, except where new information is discovered which could alter the original site evaluation findings. The staff has discovered no new information that would alter the original site evaluation findings. In addition, the staff reviewed information specific to the proposed ISF Facility site and finds it acceptable because the basic geologic and seismic characteristics of the site and vicinity have been described adequately to allow investigation of seismic characteristics. Consequently, the staff determined that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, to perform additional safety analyses, and to demonstrate compliance with regulatory requirements in 10 CFR §72.90(a–d), §72.92(a) and (b), §72.103(a–f), and §72.122(b).

2.1.6.1 Basic Geologic and Seismic Information

Basic geologic and seismic characteristics of the site and vicinity are presented in Section 2.6.1, “Basic Geologic and Seismic Information,” of the SAR. These discussions include physiographic background and site geomorphology, regional and site geological history, structural geologic conditions, and engineering evaluation of geologic features. Detailed static and dynamic engineering properties of soil and rock underlying the site are presented in Section 2.6.4, “Stability of Subsurface Materials and Foundations,” of the SAR.

Physiography and Site Geomorphology

The INEEL is located near the northwestern margin of the Eastern Snake River Plain in Southeastern Idaho. The Snake River Plain is a topographically subdued physiographic province bordered on the northwest, west, south, and southeast by the Basin and Range Province, on the northeast by the Yellowstone Plateau, and on the north by Idaho Batholith Provinces. These four physiographic provinces (Eastern Snake River Plain, Northern Basin and Range, Yellowstone Plateau, and Idaho Batholith) also correspond to defined tectonic or seismotectonic provinces (e.g., Burchfiel, et al., 1992).

Each physiographic province has a unique seismogenic potential determined by the nature of the underlying intrinsic tectonic processes. As part of the TMI-2 ISFSI SAR evaluation, the staff reviewed a wealth of relevant information in the literature, including Pierce and Morgan (1992), Malde (1991), Hackett and Smith (1992), Christiansen (1984), and work conducted by U.S. Department of Energy subcontractors (Woodward-Clyde Consultants, 1990, 1992a,b; Woodward-Clyde Federal Services, 1995, 1996a,b).

Figure 2.6-26 of the SAR shows earthquake epicenters of the Snake River Plain and surrounding areas based on a collection of regional and national earthquake catalogs. As shown on the figure, relatively few earthquakes occurred within the Snake River Plain. In contrast to the Snake River Plain, there are two adjoining seismically active belts known as the Intermountain Seismic Belt and the Centennial Tectonic Belt—to the southeast, east, and north.

Geomorphology of the Eastern Snake River Plain is characterized as rough, uneven topography caused by numerous basalt lava flows that make up the surface rock exposures. Pertinent topographic features include buttes, rivers, sinks, depressions, mounds, and vents for basaltic volcanism that are concentrated in volcanic rift zones and along the central axis of the plain (Kuntz, et al., 1992). The site is in a flat area near the Big Lost River in the south-central part of the INEEL. Landforms consist of braided channels of the Big Lost River to the west and north of the site and irregular flow lobes of basalt lavas to the east of the site.

The staff’s review confirmed that the SAR adequately described the physiography and site geomorphology. The description in the SAR is also consistent with previous and detailed descriptions provided in the TMI-2 ISFSI SAR. The staff’s findings based on its review of the TMI-2 ISFSI SAR are presented in the staff’s SER (Brach, 1999) and in Chen and Chowdhury (1998).

Regional and Site Geologic History

The SAR briefly discusses the Paleozoic, Mesozoic, and early Cenozoic histories of the region and provides more detailed discussions of the Late Cenozoic and Quaternary histories of the area. Precambrian through Mesozoic rocks are dominantly clastic (shale and quartzite) and carbonate (dolomite and limestone) sedimentary rocks. During the Mesozoic and early

Cenozoic, large volumes of granitic rock were emplaced by igneous intrusions into the upper crust.

The Snake River Plain is considered the continental scar of a mantle hotspot track. The hotspot now resides beneath the Yellowstone Plateau (Pierce and Morgan, 1992). The hotspot is a mantle plume that impinged on the base of the lithosphere directly under north-central Nevada approximately 17 million years ago. Because the plume is rooted deep in the mantle, it has remained stationary while the North American Plate drifted southwest across the plume at approximately 3.56 cm/yr [1.4 in/yr] as a result of plate tectonic movements. This relative movement of the North American Plate over the hotspot and the subsequent heating and cooling processes produced the basin of the Snake River Plain that extends from Yellowstone National Park to north-central Nevada.

Geologic processes that produced the Snake River Plain include (i) input of magma and heat into the continental lithosphere and crust from the mantle hotspot, crustal melting, and voluminous silicic volcanism from large calderas; (ii) cooling of the crust, solidification of midcrustal mafic magmas and upper crustal silicic batholiths, and subsidence caused by thermal contraction and densification of the crust in the wake of the hotspot as the plate moved to the southwest; and (iii) filling of the subsiding elongate basin with basalt lava flows and interbedded terrigenous clastic sediments in the Eastern Snake River Plain (Woodward-Clyde Federal Services, 1996a; Sparlin, et al., 1982; Brott, et al., 1981; Blackwell, 1989). The ISF Facility site is underlain by alluvial silts, sands, and gravels that lie on an alternating sequence of basalt lava flows and interbedded sediments.

The staff’s review confirmed that the SAR adequately described the regional and site geologic history. The description in the SAR is also consistent with previous and detailed descriptions provided in the TMI-2 ISFSI SAR. The staff’s findings based on its review of the TMI-2 ISFSI SAR are presented in the staff’s SER (Brach, 1999) and in Chen and Chowdhury (1998).

Structural Geologic Conditions

Previous analyses of the structural geologic conditions of the INEEL (U.S. Department of Energy, 1996; Chen and Chowdhury, 1998) show there is no evidence for folding or faulting in the subsurface. Although some basalt lava flows are present in parts of the INEEL area and absent in others, they have not been structurally disrupted. Their discontinuous distribution is caused by stratigraphic pinch-outs of lavas that flowed into the Big Lost River valley from vents to the southeast and southwest. Most significant earthquake sources are the Basin and Range faults that lie to the north of the Eastern Snake River Plain. Those fault sources are discussed in Section 2.1.6.2, “Ground Vibration and Exemption Request,” and specific structural geology conditions related to subsurface faulting are discussed in Section 2.1.6.3, “Surface Faulting,” of this SER. The staff’s review confirmed that the SAR adequately described the structural geologic conditions.

2.1.6.2 Ground Vibration and Exemption Request

Earthquake ground motion is discussed in Section 2.6.2, “Vibratory Ground Motion,” of the SAR. In the SAR, vibratory ground motion is addressed through discussions of historical seismicity and procedures to determine the DE, including identification of potential seismic sources and their characteristics, correlation of earthquake activity with geologic structures, maximum earthquake potential, and seismic wave transmission characteristics.

According to 10 CFR §72.122(b)(2), structures, systems, and components important to safety must be designed to withstand the effects of natural phenomena, including earthquakes, without impairing their capability to perform safety functions. For sites west of the Rocky Mountains, 10 CFR Part 72 requires that seismicity be evaluated by techniques set forth in Appendix A of 10 CFR Part 100 for nuclear power plants. This appendix defines the safe shutdown earthquake as the earthquake that produces the maximum vibratory ground motion at the site, and requires that the structures, systems, and components be designed to withstand the ground motion produced by the safe shutdown earthquake. This seismic design method implies use of a deterministic approach because it considers only the most significant event, and the method is a time-independent statement (i.e., it does not take into consideration the planned operating period of the ISF Facility or how frequent or rare the seismic events are that control the deterministic ground motion). Also, 10 CFR §72.102(f)(1) requires that analyses using the Appendix A methodology use a design peak horizontal acceleration equivalent to that of the safe shutdown earthquake for a nuclear power reactor.

The applicant submitted a request for an exemption to the seismic design requirement of 10 CFR §72.102(f)(1) to use a probabilistic approach along with considerations of risk to establish the design earthquake (DE) ground motion levels at the ISF Facility. The exemption request also proposed to design the ISF Facility to a DE load produced by 2,500-year return period ground motions. These ground motions were derived from the recent probabilistic seismic hazard analysis (PSHA) for the ISF Facility site (Woodward-Clyde Federal Services, 1996a,b, 1999; Payne, et al., 2000; URS Greiner Woodward-Clyde Federal Services, et al., 2001; 2000; 1999).

The staff agrees that the use of the PSHA methodology with a 2,500-year return period is acceptable and there are sufficient technical and regulatory bases to grant an exemption to 10 CFR §72.102(f) at the time a license is issued for the ISF Facility. These technical and regulatory bases are: (i) probability and risk-informed analyses performed by the applicant demonstrate that structures, systems, and components important to safety will maintain their capability to protect public health and safety in the event of earthquake ground motions beyond the proposed design basis event; (ii) similarity of the applicant's exemption request to previous exemption requests granted for the TMI-2 ISFSI and found acceptable for the Private Fuel Storage Facility; and (iii) comparison of the exemption request to the PSHA approach and corresponding design earthquake values with the amended regulations in 10 CFR §72.103 and associated regulatory guidance in Regulatory Guide 3.73 (U.S. Nuclear Regulatory Commission, 2003). Based on these considerations, the staff determined that the methodology proposed in the exemption request is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, to perform additional safety analyses, and to demonstrate compliance with the applicable regulatory requirements in 10 CFR Part 72.

Beyond Design Basis Earthquake Ground Motions

In the exemption request (Appendix A of the License Application) and in the response to staff requests for additional information (Foster Wheeler Environmental Corporation, 2003b), the applicant provided a series of analyses to show that systems, structures, and components important to safety are adequate to withstand a beyond design basis seismic event. In particular, the applicant showed that the reinforced concrete structures and heating, ventilation, and air conditioning (HVAC) system of the Fuel Packaging Area (FPA) are sufficient to withstand earthquake ground motions beyond the design basis earthquake ground motions. For the analyses, the applicant defined the beyond design basis event at 145 percent of the 2,500-year return period design basis, which is approximately equal to the 10,000-year return period earthquake ground motions. The applicant's analyses are consistent with the methodology outlined in DOE–STD–1020–2002 (U.S. Department of Energy, 2002b).

In addition, the applicant showed that any potential consequences of a failure of the FPA confinement structures or HVAC system during a beyond design basis seismic event are negligible. The applicant calculated that the offsite dose consequences from the 10,000-year return period earthquake are less than a fraction of a percent of the offsite dose limit of 0.05 Sv [5 rem] TEDE imposed by 10 CFR §72.106(b). Therefore, failure of the HVAC components important to safety or local failures of the FPA reinforced concrete structures will not lead to offsite dose consequences that exceed the limit specified in 10 CFR §72.106(b).

Prior Commission Exemption Request to 10 CFR §72.102(f)

The proposed probabilistic approach in the applicant's exemption request is similar to those approaches previously found acceptable by the staff, as documented in the NRC Safety Evaluation Reports for the TMI-2 ISFSI (Brach, 1999) and Private Fuel Storage Facility (U.S. Nuclear Regulatory Commission, 2002). In both previous exemption requests, the staff approved the use of a PSHA with a design basis ground motion associated with the 2,000-year return period earthquake. Therefore, the applicant's proposal to use a 2,500-year return period design earthquake exceeds the design levels previously found acceptable by the staff for these other spent fuel storage facilities.

Amended Regulations in 10 CFR §72.103

On October 16, 2003, the U.S. Nuclear Regulatory Commission amended the licensing requirements for dry cask storage of SNF, in which the seismic siting and design criteria were updated to be consistent with 1996 amendments that address uncertainties in seismic hazard analyses for nuclear power plants. In particular, the NRC issued 10 CFR §72.103, which requires that "uncertainties inherent in the estimates of the design earthquake (DE) be addressed through an appropriate analysis, such as a PSHA or suitable sensitivity analysis." Regulatory Guide 3.73 (U.S. Nuclear Regulatory Commission, 2003) recommends an acceptable mean annual probability of exceedance for the DE of 5×10^{-4}, which is approximately equal to the 2,000-year return period event.

The PSHA approach and corresponding DE values proposed by the applicant in the ISF Facility exemption request are consistent with the amended regulations in 10 CFR §72.103. Based on a review of the exemption request in reference to the requirements in 10 CFR §72.103 and corresponding regulatory guidance in Regulatory Guide 3.73, the staff concludes that the seismic hazard and design methodology proposed by the applicant in the exemption request meets or exceeds the revised requirements. As noted previously, the DE ground motions for the ISF Facility are based on the 2,500-year return period motions from the PSHA, which exceeds the 2,000-year return period ground motions recommended in Regulatory Guide 3.73 . This additional margin provides further assurance that public health and safety will not be adversely impacted by potential earthquakes near the ISF Facility.

Geological and Seismotectonic Setting

As indicated in the SAR, the physiographic provinces in the region also correspond to tectonic or seismotectonic provinces: Eastern Snake River Plain, northern Basin and Range, Yellowstone Plateau, and Idaho Batholith. Furthermore, the Eastern Snake River Plain is adjoined on its southeastern, eastern, and northern boundaries by two seismically active belts known as the Intermountain Seismic Belt and the Centennial Tectonic Belt. These are important seismic zones that contribute to estimates of ground motion at the INEEL. Other features significant to seismic ground motion that need separate consideration in seismic hazard analyses include some active fault zones in the northern Basin and Range Province and volcanic rift zones in the Eastern Snake River Plain.

The SAR also provides a brief summary of tectonics stress and strains, both in orientation of the principal stresses and in estimates of strain rates from Global Positioning Satellite information. Minimum principal stresses strike north northeast-south southwest in the Eastern Snake River Plain, which is consistent with the transition from the east-west extension in the Central Basin and Range to the northeast-southwest extension in the Northern Basin and Range. Strain rates are approximately 1×10^{-16}/year (Eddington, et al., 1987).

Historical Seismicity

Thousands of earthquakes with magnitudes of 2.5 or greater have occurred within 500 km [310 mi] of the INEEL since the first recorded earthquake in 1884. There were two significant earthquakes in the region: the 1959 Hebgen Lake earthquake [moment magnitude (Mw) = 7.3, surface wave magnitude (Ms) = 7.5] and the 1983 Borah Peak earthquake (Mw = 6.8, Ms = 7.3). The 1959 Hebgen Lake earthquake was the largest historical earthquake in the intermountain region. The mainshock appears to have consisted of two normal faulting subevents that reactivated existing Laramide thrust faults. Two faults appear to have ruptured during the earthquake: the Red Canyon fault and the Hebgen fault.

The 1983 Borah Peak earthquake is of particular interest because of its proximity to INEEL. The earthquake produced a surface rupture 37 km [23 mi] long, including all the nearly 20-km [13-mi]-long Thousand Springs segment of the Lost River fault. Another earthquake important to seismic hazard studies at INEEL, because of its proximity, is the 1905 earthquake near Shoshone, Idaho. Because the Shoshone earthquake occurred in 1905, there are significant uncertainties in both the location and magnitude of this earthquake. The estimated magnitude of the 1905 Shoshone earthquake, Mw = 5.5, however, was selected as the maximum magnitude in the Woodward-Clyde Consultants (1992a) probabilistic study and as the average maximum magnitude in the Woodward-Clyde Federal Services (1996a) PSHA for the Eastern Snake River Plain areal source. The 1975 Pocatello Valley earthquake (local magnitude = 6.0) is also a significant event because it ruptures a blind fault, with no evidence of surface deformation. The 1975 Pocatello Valley earthquake provided a reference for maximum magnitude of areal sources based on the concept of a random earthquake.

Evaluations of the U.S. Department of Energy analyses of historical seismicity by the staff indicate the analyses and information in the SAR provide reasonable assurance that an adequate set of historical seismic data was used in developing seismic recurrence relationships and determining the maximum earthquake potential in hazard analyses. All significant historical earthquakes were identified, and their effects on the site were evaluated based on available documents. The staff's review confirmed that the SAR provides an adequate description of the historical seismicity at the proposed ISF Facility site.

Potential Seismic Sources and Their Characteristics

Three types of seismic sources were discussed in the SAR: fault zones, an Eastern Snake River Plain volcanic zone, and regional areal source zones. Results from the Woodward-Clyde Federal Services PSHA (1996a) show that fault sources and regional areal sources contribute significantly more to the cumulative seismic hazard than volcanic source zones. Contributions from the fault sources become most significant at lower probability levels and for longer ground motion periods.

The SAR presents a complete summary of the necessary source parameters for each fault, areal, and volcanic zone. The SAR concludes that the most significant sources for the seismic hazard at the ISF Facility site are (i) a magnitude 7.15 earthquake at the southern end of the Lemhi fault, (ii) a magnitude 7.25 earthquake at the southern end of the Lost River fault, (iii) a magnitude 5.5 earthquake associated with dike injection in either the Arco or the Lava Ridge-Hell's Half Acre volcanic rift zone and the axial volcanic zone, (iv) a background magnitude 5.5 earthquake in the Eastern Snake River Plain, and (v) a background earthquake with magnitude of 6.75 in the northern Basin-and-Range Province (Woodward-Clyde Federal Services, 1996a). Contributions to the overall seismic hazard from other sources including the postulated Eastern Snake River Plain boundary fault, northern Basin-and-Range Province, Yellowstone Plateau, and Idaho Batholith are significantly lower because they are farther from the site and generally have smaller maximum magnitudes.

Based on its review, the staff concludes with reasonable assurance that the information provided in the SAR adequately characterizes the seismic sources and, therefore, provides acceptable inputs to the PSHA studies. All important seismic sources were identified, and their effects on the site were evaluated. The staff also concludes that the information provided in the ISF Facility SAR is consistent with the guidance for seismic source characterization provided in Regulatory Guide 3.73 (U.S. Nuclear Regulatory Commission, 2003). In addition, the information about seismic sources provided in the SAR is consistent with the review of fault sources for the INEEL given in Chen and Chowdhury (1998) and in the TMI-2 ISFSI SER (Brach, 1999). Those earlier reviews confirmed that the seismic sources for the TMI-2 ISFSI were characterized adequately, and that associated uncertainties were adequately described and appropriately included in an evaluation of the seismic ground motion hazard.

Ground Motion Attenuation

Modification to ground motion attenuation prompted an effort to recompute probabilistic seismic hazards at various INEEL facility sites, including the ISF Facility site. Two approaches were used for ground motion modeling for both previous and updated estimations of seismic ground motion at INEEL. The first approach relied on empirical ground motion attenuation relationships derived from California strong motion data. The second approach was based on a stochastic site-specific numerical model. For the hazard calculations, the empirical approach was assigned a weight of 0.4, and the stochastic approach was assigned a weight of 0.6. In the updated hazard calculations, both approaches for ground motion estimations were modified to model more accurately ground motions caused by earthquakes in extensional tectonic regimes.

These modified analyses were submitted with the SAR for the Naval Reactors Spent Fuel ISFSI at INEEL and were previously reviewed by the NRC (Stamatakos, et al., 2001).

Empirical Attenuation Modeling Approach

For the empirical attenuation modeling approach, the California strong-motion attenuation relationships were modified following the approach and results of the U.S. Department of Energy expert elicitation for the proposed Yucca Mountain repository (CRWMS M&O, 1998). According to URS Greiner Woodward-Clyde Federal Services, et al. (1999, 2000), the underlying technical bases for the applicability of the Yucca Mountain attenuation relationships to INEEL are that INEEL and Yucca Mountain lie in extensional tectonic environments (i.e., adjacent to or within the Basin and Range tectonic province). In addition, the analyses of worldwide ground motion from normal faults by Spudich, et al. (1997, 1999) suggest faulting in extensional tectonic regions produces 15 to 20 percent less ground motion than in compressional tectonic settings for the same magnitude of earthquake. The difference is attributed to lower stress drops in extensional tectonic settings compared with compressional or strike-slip settings (Stark, et al., 1992; Becker and Abrahamson, 1998).

Stochastic Modeling Approach

As discussed in Stamatakos, et al. (2001), the stochastic modeling of earthquakes incorporates site-specific information about normal faulting earthquakes, local crustal attenuation, and other local site conditions at the INEEL. This approach was necessary because the INEEL lacks sufficient measured strong motions from nearby earthquakes to generate reliable site-specific empirical attenuation models. In addition to stress drop, site-specific parameters for crustal attenuation, near-surface attenuation, and near-surface crustal amplification were developed for the stochastic model. These parameters were varied to incorporate the range of uncertainty based on current knowledge of site conditions at the INEEL, as described in Woodward-Clyde Federal Services (1996a). Earthquake attenuation relationships (as a function of source-to-site distance and earthquake magnitude) were then developed from the resulting spectral accelerations computed using the stochastic models.

Similar to the revision of the California–Yucca Mountain empirical attenuation modeling approach, the revised stochastic modeling of vibratory ground motion in URS Greiner Woodward-Clyde Federal Services, et al. (1999, 2000) incorporated recent scientific advances in earthquake seismology, particularly for dynamic stress drops associated with earthquakes in extensional tectonic regimes. In the modified seismic hazard computation (URS Greiner Woodward-Clyde Federal Services, et al., 1999, 2000), the stress drop has four values to represent parameter distribution; the median and three weighted values about the median. The median stress drop is 0.5 kPa [50 bar] (with 0.6 weight) compared to 0.75 kPa [75 bar] (0.5 weight) used in Woodward-Clyde Federal Services (1996a). The distribution around the median is 0.25 kPa [25 bar] (0.2 weight), 0.75 kPa [75 bar] (0.15 weight), and 1.5 kPa [150 bar] (0.05 weight). This revised distribution of stress drop is consistent with recently published values of expected stress drops associated with earthquakes in extensional tectonic settings (Stark, et al., 1992; Becker and Abrahamson, 1998; Spudich, et al., 1997, 1999).

Staff Review of Ground Motion Attenuation Models

The staff reviewed the characterization of strong ground motion in the ISF Facility seismic hazard analysis and finds it acceptable. The approach to modeling strong ground motion provides reasonable assurance that the site hazard is adequately (albeit conservatively) estimated. The Yucca Mountain study developed and implemented a methodology for evaluating earthquake ground motions in the Basin and Range that includes the results of scientific evaluations and expert elicitations from seven ground motion experts. The staff finds that the use of the Yucca Mountain methodology is appropriate because it reflects the state of current knowledge and predicts the earthquake-induced ground motions at the ISF Facility site reasonably accurately. Likewise, the staff concludes the stochastic modeling approach used by the U.S. Department of Energy also reflects the state of current knowledge and is adequate to predict earthquake-induced ground motions at the ISF Facility site.

In summary, the staff concludes that there is sufficient information about ground motion attenuation modeling for use in other sections of the SAR to develop the design bases of the proposed ISF Facility, to perform additional safety analyses, and to demonstrate compliance with the regulatory requirements of 10 CFR §72.90(b)–(d), §72.92(a)–(c), §72.98(b), §72.98(c)(3), and §72.122(b) for this issue.

Probabilistic Seismic Ground Motion Hazard

The evaluation of potential seismic hazards at various INEEL sites, including the INTEC site, started decades ago. Examples of the recent PSHA studies include those conducted by Woodward-Clyde Consultants (1992a), Woodward-Clyde Federal Services (1996a,b) and URS Greiner Woodward-Clyde Federal Services, et al. (1999,2000). The Woodward-Clyde Federal Services (1996b) results were used as the basis for the TMI-2 ISFSI SAR and were reviewed thoroughly by the staff during the licensing review for the TMI-2 ISFSI (Brach, 1999; Chen and Chowdhury, 1998). In light of the updated ground motion relationships for extensional tectonic regimes, URS Greiner Woodward-Clyde Federal Services, et al. (1999, 2000) recomputed seismic hazards for the INTEC site and for five other facility areas, including the Naval Reactors Spent Fuel ISFSI site, using the same methodology.

The URS Greiner Woodward-Clyde Federal Services, et al. (2000) results were used as the basis for the Naval Reactors Spent Fuel ISFSI SAR and were reviewed by the NRC staff (Stamatakos, et al., 2001). The URS Greiner Woodward-Clyde Federal Services, et al., report (1999) forms the basis for developing the design basis ground motion in the ISF Facility SAR (Foster Wheeler Environmental Corporation, 2003a).

The URS Greiner Woodward-Clyde Federal Services, et al. (1999, 2000) studies are for different facility areas in INEEL using the same methodology. The main differences between the Woodward-Clyde Federal Services (1996a) and the URS Greiner Woodward-Clyde Federal Services, et al. (1999, 2000) hazard evaluations are the selection of the stress drop median in the stochastic modeling, the modification of empirical attenuation relationships, and the weights assigned to various alternatives in ground motion modeling. These differences are summarized and discussed in detail in Stamatakos, et al. (2001). As a result of these differences, the PSHA results calculated in URS Grenier Woodward-Clyde Federal Services, et al. (1999, 2000) were generally lower (15–20 percent) than those calculated in Woodward-Clyde Federal Services

(1996a). Table 2-1 summarizes the differences in the mean horizontal peak ground acceleration for rock at the ISF Facility site (i.e., INTEC site).

The design basis ground motion for the ISF Facility was based on the horizontal mean of 5-percent damped uniform hazard spectra for rock at 2,000- and 10,000-year return periods, developed by URS Greiner Woodward-Clyde Federal Services et al. (1999). As listed in Table 2-1, this study yielded the peak horizontal ground accelerations for rock of 0.11 g and 0.18 g at 2,000 and 10,000-year return periods.

As mentioned previously, the staff had reviewed and accepted some of the probabilistic seismic hazard assessments at the INEEL. Specifically, the Woodward-Clyde Federal Services (1996a,b) methodology and results as applied to the TMI-2 ISFSI were reviewed and accepted by the staff (Brach, 1999). The methodology and results of URS Greiner Woodward-Clyde Federal Services, et al. (2000) as applied to the Naval Reactors Spent Fuel ISFSI were also found to be acceptable (Stamatakos, et al., 2001). The staff finds the PSHA of URS Greiner Woodward-Clyde Federal Services, et al. (1999), as applied to the ISF Facility site, applicable for two reasons: (i) it used the same methodology as the URS Greiner Woodward-Clyde Federal Services, et al. (2000) study and (ii) it used input information that is technically sound and applicable to the ISF Facility site.

Design Basis Ground Motion

The design basis ground motion at the ISF Facility site included development of design basis ground motion time histories for rock based on rock uniform hazard spectra, site-response analyses and development of horizontal design basis ground motion time histories for soil surface, and the development of vertical design basis ground motion time histories for soil surface. Details of each of these aspects are discussed in the following sections.

Design Basis Ground Motion on Rock

Payne, et al. (2000) determined rock DBE response spectra and peak accelerations for PC3 and PC4 based on the horizontal mean of 5-percent damped uniform hazard spectra at 2,000- and 10,000-year return periods, developed by URS Greiner Woodward-Clyde Federal Services, et al. (1999). To determine the rock DBE response spectra, the following steps were taken (Payne, et al., 2000):

First, the spectral ratios of other INEEL facility areas [developed by URS Greiner Woodward-Clyde Federal Services, et al. (2000)] versus INTEC [developed by URS Greiner Woodward-Clyde Federal Services, et al. (1999)] were calculated for the 2,000- and 10,000-year return periods horizontal mean of 5-percent damped rock uniform hazard spectral accelerations. These spectral ratios were used to obtain the adjusted uniform hazard spectra at 2,000- and 10,000-year return periods by multiplying the INTEC uniform hazard spectral accelerations by the highest spectral ratio values greater than one to account for higher spectral accelerations in other INEEL facility areas; so the design basis spectra are applicable to multiple facility areas at INEEL.

Table 2-1. Comparison of rock peak horizontal accelerations from PSHA conducted by Woodward-Clyde Federal Services (1996a) and URS Greiner Woodward-Clyde Federal Services, et al. (1999) for the INTEC site

Study	Mean Peak Horizontal Acceleration (g)			
	Annual Exceedance Probability (Return Period)			
	2×10^{-3} (500 year)	1×10^{-3} (1000 year)	5×10^{-4} (2,000 year)	1×10^{-4} (10,000 year)
Woodward-Clyde Federal Services (1996a)*	0.08	0.10	0.13	0.22
URS Greiner Woodward-Clyde Federal Services, et al. (1999)†	0.07	0.09	0.11	0.18

*Woodward-Clyde Federal Services. *Site-Specific Probabilistic Seismic Hazard Analysis for the INEEL*. Draft Letter Report. Idaho Falls, ID: Lockheed Martin Idaho Technologies Company. 1996a.
†URS Greiner Woodward-Clyde Federal Services, Geomatrix Consultants Inc., and Pacific Engineering and Analysis. *Development of Design Basis Earthquake Parameters for TMI-2 Independent Spent Fuel Storage Installation at the INEEL.* Final Report. INEEL/EXT–98–00619. Idaho Falls, ID: Idaho National Engineering and Environmental Laboratory. 1999.

Second, the adjusted uniform hazard spectrum at the 2,000-year return period for multiple facility areas was increased by 8 percent at all frequencies to account for the anticipated changes in U.S. Department of Energy regulations, such as the anticipated revisions to the U.S. Department of Energy–Idaho Operations Office Architectural Engineering Standards (U.S. Department of Energy, 2000), which will require a 2,500-year period for PC3-type facilities. The adjusted horizontal rock uniform hazard spectra at 2,500- and 10,000-year return periods are also referred to as the PC3 and PC4 horizontal rock uniform hazard spectra. Payne, et al. (2000) further demonstrated the adequacy of the site-specific uniform hazard spectra for developing the DBE response spectra using Newmark and Hall (1978) median amplification factors.

Third, the PC3 and PC4 horizontal rock DBE response spectra were derived from the adjusted PC3 and PC4 rock uniform hazard spectra by incorporating smoothed and broadened regions of the peak accelerations, velocities, and displacements defined by the site-specific uniform hazard spectrum. Portions of the rock DBE response spectra were adjusted to ensure conservatism for the structural design process. The DBE response spectral shape was developed with the peak ground acceleration (PGA), the spectral acceleration at 33 Hz, the peak spectral acceleration, and constant velocity defined by the site-specific uniform hazard spectrum. The final DBE response spectra are compared with the adjusted uniform hazard spectra in Figure 8 of Payne, et al. (2000).

Fourth, the PC3 and PC4 vertical rock DBE spectra also were derived from the adjusted PC3 and PC4 rock horizontal uniform hazard spectra, which include adjusting the PC3 uniform hazard spectrum for a 2,500-year return period and adjusting the PC3 and PC4 uniform hazard spectra to higher motions at other facility sites for broader application. URS Greiner Woodward-Clyde Federal Services, et al. (1999) developed a set of ratios for the vertical-to-horizontal ground motions applicable to INEEL. The PC3 and PC4 vertical rock uniform hazard spectra were obtained by multiplying the corresponding horizontal rock uniform hazard spectra by these ratios. Then the constant acceleration, velocity, and displacement portions of the vertical DBE response spectra were determined by enveloping the vertical uniform hazard spectrum. It is to be noted, however, that the development of soil surface vertical response spectra did not use the vertical rock DBE response spectra. Instead, the vertical-to-horizontal ground motion ratios applicable to the INEEL were applied to the horizontal soil surface DBE response spectra to develop target soil surface vertical DBE response spectra as described in detail in the vertical surface DBE ground motion time histories.

The resultant rock DBE peak horizontal acceleration for the INTEC facility area is 0.12g for PC3 (2,500-year return period) and 0.19g for PC4 (10,000-year return period). Rock DBE peak vertical acceleration is 0.09g for PC3 and 0.14g for PC4.

Finally, two statistically independent rock horizontal and one rock vertical acceleration time histories were developed from the rock DBE response spectra for each of the performance categories by URS Greiner Woodward-Clyde Federal Services, et al. (2001). These time histories served as input motions for the ISF Facility soil response analyses.

Site Response Analyses and Horizontal Surface DBE Ground Motion Time Histories

The soil characteristics at the ISF Facility site were investigated by seismic refraction studies and downhole geophysical studies (Shannon & Wilson, Inc., 2001). The measurements from four seismic refraction study lines were used to determine the compressional wave (P-wave) velocities and depths of stratigraphic units. The downhole testing results from two borings with depths of 13.84 m [45.4 ft] and 13.44 m [44.1 ft] were used to categorize stratigraphy underlying the ISF Facility site and determine shear wave (S-wave) velocities. It was concluded the ISF Facility is underlain by a dense sandy gravel and a very dense sandy gravel over basalt rock. A base case depth profile was developed for each stratigraphic unit along with the corresponding unit weight and S-wave velocities. In the base case profile, the dense sandy gravel extends from the ground surface to 0.79 m [2.5 ft], the very dense sandy gravel extends from 0.79 to 8.23 m [2.5 to 27 ft], and beyond 8.23 m [27 ft] is the basalt rock. The unit weights for dense and very dense soil layers were estimated to be 1.92 and 2.0 g/cm^3 [120 and 125 pcf] from laboratory measurements of disturbed samples. The unit weight of basalt was estimated to be 2.08 g/cm^3 [130 pcf] based on the average P-wave velocity.

Thirty randomized soil profiles were developed using the computer program RANPAR (Silva, 1995) from the base case profile. Shear wave velocity and total depth of stratigraphic layers were randomized from the base case profile, considering the variations in both the stratigraphic depth and S-wave velocity. Variations in total depth of soil profile were discussed in Shannon & Wilson, Inc. (2001, Section 3.3). The variation in S-wave velocity profile was simulated by RANPAR based on the measured data within 0.8 km [0.5 mi] of the ISF Facility site, as documented in Appendix D of Shannon & Wilson, Inc. (2001).

The responses of the 30 randomized profiles to each of the 2 horizontal components of the 2,500-year input rock DBE acceleration time history were calculated using the computer program ProShake (Edupro Civil Systems, Inc., 1999). Based on these response analyses, a mean surface ground motion level was established in the form of a 5-percent damped pseudo-acceleration response spectrum for each of the two components of the input horizontal time history.

Also, from response analyses of the 30 randomized profiles, strain-iterated shear modulus and damping ratio versus depth profiles were obtained using the soil degradation models of EPRI (1993). From these profiles (30 for each horizontal motion component), the mean, mean plus one standard deviation, and mean minus one standard deviation strain-iterated profiles were developed for each of the two horizontal motions. Using ProShake, site response analyses were performed again on the mean, mean plus one standard deviation, and mean minus one standard deviation strain-iterated profiles. The average response spectrum from these 3 strain-iterated profiles was compared with the mean response spectrum from the 30 random soil profiles. They were similar. Thus, it was concluded that the three horizontal acceleration time histories corresponding to the three response spectra from strain-iterated profiles in each of the two horizontal directions are consistent with and representative of the mean levels of surface ground motion expected at the ISF Facility. These time histories are the bases and input horizontal motions in facility seismic design and soil-structure interaction analyses.

Vertical Surface DBE Ground Motion Time Histories

Shannon & Wilson, Inc. (2001) developed the vertical surface acceleration time histories following the procedures outlined in Appendix S of U.S. Department of Energy Architectural Engineering Standards (2000) and criteria defined by various U.S. Nuclear Regulatory Commission regulations and regulatory guidance documents such as NUREG–0800 (U.S. Nuclear Regulatory Commission, 1996).

First, target vertical surface DBE response spectra were developed from the three pairs of horizontal surface ground motions corresponding to the mean, mean plus one standard deviation, and mean minus one standard deviation strain-iterated soil profiles. These developments were achieved by applying the empirical vertical-to-horizontal ratios of ground motion contained in the DOE guidance to the component of horizontal motion with higher spectral response.

Second, a previously recorded vertical acceleration time history with the characteristics desired in the final vertical ground motion (such as duration, magnitude, and distance from the source) was selected, and its phase spectrum was generated.

Third, initial acceleration, velocity, and displacement time histories were generated using the computer program RASCAL (Silva and Lee, 1987) with the vertical target spectra for 2-percent damping, the phase spectrum of the recorded earthquake, and the Brune spectrum parameters as input. The Brune spectrum parameters were selected according to URS Greiner Woodward-Clyde Federal Services, et al. (1999). The initial time histories were baseline corrected using the computer program BASECOR (Abrahamson, 1994a).

Finally, the response spectra of the baseline corrected time histories were compared to the target vertical spectra response spectra. Additional spectral matching of the time histories was performed using the program RSPMATCH (Abrahamson, 1994b) when necessary to improve the spectral match, and the corresponding time histories baseline was corrected to obtain a final set of vertical surface acceleration time histories corresponding to the mean, mean plus one standard deviation, and mean minus one standard deviation strain-iterated soil profiles. These time histories are the bases and input vertical motions in facility seismic design and soil-structure interaction analyses.

The staff finds that the PSHA results of URS Greiner Woodward-Clyde Federal Services, et al. (1999) were properly applied to developing horizontal rock DBE response spectra and corresponding acceleration time histories. The response of soil layers was evaluated and horizontal surface DBE response time histories were developed using the horizontal rock DBE response spectra, state-of-the-art methodologies, and site-specific soil properties. The site geotechnical surveys were thorough. Sufficient soil shear wave velocity and stratigraphic depth profiles were obtained from these surveys. The use of a 2,500-year return period for PC3 structures, systems, and components was conservative and consistent with general U.S. Department of Energy practices at INEEL. Methodologies used in generating DBE surface vertical ground motion time histories follow the U.S. Department of Energy recommended procedures and are technically sound.

2.1.6.3 Surface Faulting

In the SAR, the potential for surface faulting was evaluated through discussions of geologic conditions; investigations of evidence of site fault offset, capable faults, and earthquakes associated with the capable faults; and correlations of epicenters with capable faults.

Surface faulting refers to a rupture of the Earth's surface because of tectonic or magmatic activity. The SAR identified the southern tip of the Lemhi fault as the only possible structure capable of surface faulting in the INEEL, that could be related to tectonic activities of all capable faults that might affect the ISF Facility site, because it is conceivable that surface faulting associated with an earthquake on the Howe and Fallert Springs segments of the Lemhi fault could extend southward into the INEEL for a distance of several miles in the area just east of the Big Lost River Sinks. There is no direct evidence, however, of surface faulting at the TMI-2 ISFSI site. Other areas in which surface faulting is of concern are in volcanic rift zones related to dike intrusion. For example, areas in and near the Arco and the Lava Ridge-Hell's Half Acre volcanic rift zones have the greatest potential for such dike-induced surface faulting. Also, the fissures north of the Naval Reactors Spent Fuel ISFSI appear to be dike-induced fissures. The potential recurrence of such fissuring is determined by the annual probability of silicic volcano activity occurring near the TMI-2 ISFSI site, which is estimated to be less than 10^{-6}/year (Brach, 1999).

The staff reviewed the information presented in the SAR and finds reasonable assurance that surface or near surface faulting is not a potential hazard for the proposed ISF Facility.

2.1.6.4 Stability of Subsurface Materials

The stability of subsurface materials is discussed in Section 2.6.4, "Stability of Subsurface Materials and Foundations," of the SAR. Stability of subsurface materials is addressed through discussions of surface or subsurface subsidence, previous loading history, weak materials caused by rock jointing and weathering, residual stresses, excavation and backfill, groundwater conditions, and liquefaction potential. These discussions are supported by past site geotechnical investigations, including those described in the TMI-2 ISFSI SAR (U.S. Department of Energy, 1997)].

As indicated in the SAR, conditions that may contribute to subsidence include (i) lava tubes, which provide open pathways for lava flow; (ii) interflow rubble zones with large void volumes, which were observed in borings in part of the INEEL; and (iii) fine-grained sediments {a 1 to 2 meter-[3 to 7ft] thick clay layer identified below the adjacent INTEC just above the basalt bedrock in some borings}. As discussed in the SAR, none of these conditions are present at the immediate site of the proposed ISF Facility.

The staff reviewed the discussion and information provided in the SAR regarding subsidence at the ISF Facility site, and agrees with the applicant that the potential for subsidence is to occur at the site is acceptably low.

As indicated in the SAR and the site-specific geotechnical study at the ISF Facility site, the alluvial deposits above the basalt at the ISF Facility site are mostly sand and gravel and are above the groundwater table. The average gravel content for these alluvial deposits is approximately 44 percent.

The staff reviewed the discussion and information presented in the SAR regarding the liquefaction potential, and agrees with the applicant that the liquefaction potential at the ISF Facility site is not a concern because the alluvial deposits there are coarse and above the groundwater table.

The SAR presents properties of soil and sediments at the proposed ISF Facility, including grain-size classification, density information, moisture content, porosity, consolidation characteristics, strength characteristics, P- and S-wave velocities, and critical damping ratios. These properties are supported by the geotechnical study performed at the ISF Facility site (Foster Wheeler Environmental Corporation, 2001).

The staff reviewed the discussion and information regarding the stability of subsurface materials at the ISF Facility site, and has determined that the potential for any impact on the proposed ISF Facility is very low. The staff also concludes that this information is acceptable for use in other sections of the SAR to develop the design bases of the ISF Facility, to perform additional safety analyses, and to demonstrate compliance with regulatory requirements in 10 CFR §72.98(c)(2) and §72.122(b) for this issue.

2.1.6.5 Slope Stability

The staff reviewed Section 2.6.5, “Slope Stability,” of the SAR, which states that slopes at the ISF Facility site are gentle, a few feet per mile at the most and, therefore, pose no threat for instability or landsliding.

The staff reviewed the information provided and closely examined Figure 2.6-13 of the SAR and concurs with the applicant that slope stability is not a safety concern at the ISF Facility site.

2.1.6.6 Volcanism

Volcanism is a basic characteristic of the region surrounding the proposed ISF Facility site. Based on historical patterns of volcanic activity in the region, the potential impacts of the following volcanic events were considered: (i) fallout of ash from eruptions of volcanoes in the Cascade Range, (ii) deposits from eruptions of small silicic dome volcanoes, and (iii) basaltic lava flows from volcanoes away from the site. Each of these three types of volcanic activity could have potentially adverse effects on structures, systems, and components important to safety if such volcanic activity occurred during operation of the proposed ISF Facility and the hazards were not mitigated.

The staff reviewed information provided in Section 2.6.6, “Volcanism, ” of the SAR and the applicant’s responses to staff requests for information (Foster Wheeler Environmental Corporation, 2003b) regarding volcanic features of the site. The staff also reviewed relevant literature cited in the SAR, previous studies of volcanic hazards potentially affecting the INEEL (Kuntz, et al., 1992; Volcanism Working Group, 1990; Hackett and Smith, 1994), and other literature cited herein, to provide an independent evaluation of volcanic features and potential hazards at the proposed site.

To evaluate the hazards from ash eruptions of Cascade Range volcanoes, the staff used information in Hoblitt, et al. (1987) to consider the likelihood of Cascade Range eruptions producing ash deposits at the proposed site. Hoblitt, et al. (1987) conclude there is a 10^{-3} annual probability of a 1-cm [0.4-in]-thick ash deposit forming at the proposed site. This annual probability decreases to 10^{-6} for a 10-cm [4-in]-thick ash deposit. An annual probability of 10^{-6} was previously determined by the staff to be an acceptable lower limit for consideration of ash-fall hazards at the nearby TMI-2 ISFSI. In addition, the U.S. Department of Energy guidance (1994) establishes that events with annual probabilities of less than 10^{-6} do not result in unacceptable risks to public health and safety for facilities similar to the proposed ISF Facility. Thus, the use of this data and the threshold probability of occurrence supports the staff’s determination that a 10 cm [4 in]-thick ash deposit reasonably represents the maximum ash fall hazard from a Cascade Range volcano requiring evaluation for this facility. In contrast, Foster Wheeler Environmental Corporation (2003a) uses interpretations of deposits from Mt. Mazama (a Cascade Range volcano) to constrain the maximum ash-fall hazard as an 8 cm [3 in]-thick deposit.

Silicic dome volcanoes have formed infrequently near the southern border area of the INEEL during the past 1.2 million years (e.g., Volcanism Working Group, 1990; Foster Wheeler Environmental Corporation, 2003a). Silicic dome volcanoes are restricted to locations within the Axial Volcanic Zone and are at least 10 km [6.2 mi] from the proposed ISF Facility. Based on the SAR, the annual probability for the formation of a new silicic dome volcano within the Axial Volcanic Zone is estimated at 5×10^{-6}. Small-volume ash flows and tephra falls are common features of silicic dome eruptions (e.g., Heiken and Wohletz, 1987), although erosion and burial have likely obscured these features around INEEL volcanic domes. Silicic domes of comparable volume to those in the INEEL vicinity may have ash-fall deposits approximately 10 cm [4 in] thick within approximately 10 km [6.2 mi] of the volcano (e.g., Scott, 1987) with deposit thicknesses decreasing to several centimeters 2.54 cm [1 in] thick at distances of 25 km [15.5 mi] from the volcano (Heiken and Wohletz, 1987). Thus, a 10-cm [4-in]-thick ash-fall deposit is a credible upper limit for potential hazards from a new silicic dome volcano forming at least 10 km [6.2 mi] from the proposed ISF Facility.

Using data from Sarna-Wojcicki, et al. (1981), Mount St. Helens (a Cascade Range volcano) ash has a dry density of approximately 0.5 g/cm^3 [30 pcf], which is somewhat lower than the 0.8 g/cm^3 [50 pcf] density used by the applicant (Foster Wheeler Environmental Corporation, 2003b) to evaluate potential ash-fall hazards. However, ash deposit density increases to approximately 1.3 g/cm^3 [80 pcf] when wet. The proposed ISF Facility is designed for a minimum roof snow load of 1.44 kPa [30 psf]. A 10-cm [4-in]-thick deposit creates a dry-ash load of 0.48 kPa [10 psf], which is clearly within the design basis for roof loads. While wet, this 10-cm [4-in]-thick dry-ash deposit is expected to be compacted to reduce its thickness. Neglecting this compaction effect, a 10-cm [4-in]-thick wet-ash deposit creates a load of 1.29 kPa [27 psf]. Although this load appears close to, but still below, the minimum roof snow load, compaction during rainfall would necessarily decrease the resulting deposit thickness to less than 10 cm [4 in]. Thus, designed minimum roof snow loads for the proposed ISF Facility appear sufficient to withstand the loads resulting from wet-or dry-ash deposits reasonably possible from future eruptions of a Cascade Range or a new INEEL silicic dome volcano.

Some passive components of the proposed ISF Facility ventilation system are important to safety. Volcanic ash is a hard, abrasive substance that can obstruct openings and degrade performance of mechanical and electrical systems. During and after an ash-fall eruption, concentrations of airborne ash can increase levels of total airborne particulates by as much as 1,000 times above background levels (e.g., Bernstein, et al., 1986). Ventilation components important to safety in the proposed ISF Facility, however, can be isolated from the outside environment by a series of dampers or filters. As discussed in the applicant's responses to staff questions (Foster Wheeler Environmental Corporation, 2003b), any potential ash-fall eruption would provide several hours to days of advance warning, allowing the ISF Facility operating staff sufficient time to close the ventilation system to prevent ash influx. In the highly unlikely event that volcanic ash enters the annular gaps around the waste storage tubes, ash could potentially create obstructions to airflow. The applicant (Foster Wheeler Environmental Corporation, 2003b) provided an adequate basis to determine that a minimum of 9 days could elapse with a 50-percent reduction in airflow, before storage area temperatures could exceed the off-normal temperature limits for this system. This amount of time is sufficient to allow the operator to perform simple maintenance on the airflow system and remove the potential blockage by ash.

Recent (that is, within 10,000 years) basaltic volcanic activity occurs only in locations more than 15 km [9.3 mi] from the proposed ISF Facility. In addition, volcanoes younger than 400,000 years are restricted to tectonically controlled source zones that are located at least 10 km [6.2 mi] away from the proposed site (e.g., Volcanism Working Group, 1990). Within these source zones, the probability of a new volcano forming is approximately 10^{-5}/year

(Volcanism Working Group, 1990; Hackett and Smith, 1994; Foster Wheeler Environmental Corporation, 2003a). Based on the clear restriction of post-400,000-year-old volcanism to well-established source zones, and an approximately 10-km [6.2-mi] minimum separation between these volcanic source zones and the proposed ISF Facility site, staff concludes the information presented in the SAR is sufficient to determine the probability of a new basaltic volcano forming at the proposed ISF Facility site is less than 10^{-6}/year. This hazard is not considered further.

Nevertheless, a new basaltic volcano could form within a nearby volcanic source zone and emit a lava flow of sufficient length to potentially affect the proposed ISF Facility site (Foster Wheeler Environmental Corporation, 2003a,b). The Axial Volcanic Zone and Arco Volcanic Rift Zone are the two volcanic source zones located in areas that could potentially direct lava flows into the ISF Facility area. The probability of 5×10^{-5}/year that a new volcano would form within these zones (Foster Wheeler Environmental Corporation, 2003a) is consistent with previous studies for this part of the INEEL (e.g., Volcanism Working Group, 1990).

The staff reviewed the topographic characteristics of the INEEL area and agrees with the applicant that only approximately 30 percent of these zones are above topographic features that could channel lava flows to the ISF Facility site. In addition, the staff also agrees with the information presented in SAR that only 30-50 percent of future lava flows would extend sufficient distances from the source-zone volcano potentially to reach the proposed ISF Facility site. Thus, the staff agrees that the probability of a new lava flow reaching the proposed ISF Facility site is approximately 5×10^{-6}/year. This likelihood is sufficient to warrant consideration of a lava-flow hazard as a potential accident event. In Section 8.2.5 and Chapter 2 of the SAR, a series of mitigation strategies is proposed to divert lava flows from the proposed site, in the unlikely event of a hazardous eruption. The staff's review of these mitigation strategies is contained in Chapter 15 of this SER.

2.2 Evaluation Findings

The staff reviewed the site characteristics presented in the ISF Facility SAR and finds that the SAR provides an acceptable description and safety assessment of the site on which the ISF Facility is to be located, in accordance with 10 CFR §72.24(a). The staff also finds that the proposed site complies with the criteria of 10 CFR Part 72 Subpart E, as required by 10 CFR §72.40(a)(2), upon the granting of an exemption to 10 CFR §72.102(f), as discussed in Section 2.1.6.2 of this SER.

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