Exhibit H

Geologic and Soil Stability

Bakeoven Solar Project

November 2019

Prepared for

Avangrid Renewables, LLC

Prepared by

Tetra Tech, Inc.

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Acronyms and Abbreviations

Applicant	Bakeoven Solar, LLC
BPA	Bonneville Power Administration
DOGAMI	Oregon Department of Geology and Mineral Industries
ESCP	Erosion and Sediment Control Plan
Facility	Bakeoven Solar Project
FEMA	Federal Emergency Management Agency
GIS	geographic information system
IBC	International Building Code
km^3	cubic kilometer
kV	kilovolt
Maupin Substation	BPA Maupin Interconnection Substation
MMI	Modified Mercalli Intensity
MW	megawatt
NRCS	Natural Resources Conservation Service
O&M	operation and maintenance
OAR	Oregon Administrative Rule
OSSC	Oregon Structural Specialty Code
PGA	peak ground acceleration
PV	photovoltaic
SLIDO	Statewide Landslide Information Database for Oregon
USGS	U.S. Geological Survey

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1.0 Introduction

Bakeoven Solar, LLC (Applicant) proposes to construct and operate a solar energy generation facility and related or supporting facilities in Wasco County, Oregon. This Exhibit H was prepared to meet the submittal requirements in Oregon Administrative Rule (OAR) 345-021-0010(1)(h).

2.0 Analysis Area

The analysis area for geologic and soil stability is the area within the proposed site boundary. The analysis area for historical seismic and potentially active faults included a 50-mile buffer around the proposed site boundary. The site boundary is defined in detail in Exhibits B and C and is shown on Figure H-1.

3.0 Geologic Report

> *OAR 345-021-0010(1)(h) Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020, including:*
>
> > *(A) A geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines. Current guidelines shall be determined based on consultation with the Oregon Department of Geology and Mineral Industries, as described in paragraph (B) of this subsection.*

The Applicant confirmed with the Oregon Department of Geology and Mineral Industries (DOGAMI) that Oregon State Board of Engineering Geology (2014) Reports are the current guidelines that would apply to the Facility. Other information from the DOGAMI consultation discussion is included as Attachment H-1.

The Applicant has reviewed and used existing published information to characterize the geologic conditions and potential seismic hazards in the vicinity of the Facility site. These materials included local, state, and federal government aerial photography, site photographs, published geologic maps, and geotechnical data reports. The findings are described in the following sections. Subsurface explorations, testing, and engineering analysis will be conducted prior to design and construction as described in Section 5.0. The Applicant's geologist completed a limited geological site reconnaissance of the area to observe the existing features at the site and look for evidence of past or potential geologic hazards. The site reconnaissance included visual evaluation of existing exposures of soil and rock, classification of soils, and observation of typical slopes in the proposed solar and transmission line areas where visible from roads.

The site boundary is located on the Columbia Plateau physiographic province, which consists of a large plateau formed by a series of basalt flows. The top of the plateau tends to be relatively flat but has been dissected by ephemeral streams into steep-sided canyons. The Applicant has selected this site for solar development due to its flat topography and southern exposure to sun.

The site boundary is bordered by Highway 97 to the east and the Deschutes River to the west. Elevations within the site boundary range from approximately 1,398 feet to 2,620 feet above mean sea level.

The Columbia Plateau province was formed by a series of layered basalt flows extruded from vents (located mainly in southeastern Washington and northeastern Oregon) during the Miocene epoch (between 7 and 16 million years before present) (Swanson et al. 1979). Collectively, these basalt flows are known as the Columbia River Basalt Group. These flood basalts cover an area of over 200,000 cubic kilometers (km^3) in Washington, Oregon, and western Idaho with a total estimated volume of over 224,000 km^3 (Hooper et al. 2002; Camp et al. 2003).

At the end of the most recent glaciation, massive outburst floods (the Missoula Floods) poured down the Columbia River. Elevations of floodwaters reached over 1,000 feet in the vicinity of the Facility site. The floods both scoured the bedrock in the area and deposited silt, sand, gravel, and boulders. Ice-rafted "erratics," i.e., boulders of distant origin transported by the great floods, provide evidence of inundation and maximum prehistoric flood heights. Wind reworked the sandy and silty material into a mantle of loess.

The lithology throughout the portion of the site boundary is primarily Columbia River Basalt Group unconformably overlying volcanogenic rocks of the ancestral Cascade Volcanic Arc, with the majority of the site boundary located on Wanapum Basalt and a small amount of Grande Ronde basalt in the northwestern corner. The results of the site reconnaissance of the site boundary are represented on the geologic map (Figure H-1), and no geologic hazards, such as landslides, were evident.

A geologic map of the Facility site vicinity, adapted using geographic information systems (GIS) and Oregon Department of Geology and Mineral Industries (DOGAMI) resources (Ma et al. 2009) is presented in Figure H-1.

Exhibit I describes properties of the site surficial soils based on Natural Resources Conservation Service (NRCS) data within the Facility site boundary, as well as the approximate thickness, formation setting, permeability, runoff potential, and potential hazard for erosion.

4.0 Consultation with DOGAMI

OAR 345-021-0010(1)(h)(B) A summary of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments, and the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.

The Applicant consulted with DOGAMI on December 21, 2018 during an in-person meeting. The general details of the Facility and the analysis area terrain and geology were discussed. Discussion focused on the document titled "DOGAMI Scope of Review for Energy Facility Siting Council" as provided by DOGAMI. Other topics included foundation types and design criteria, as well as hazards related to ground shaking and disaster resilience. The meeting notes of the consultation discussion and additional information provided by DOGAMI on December 27, 2018 and ODOE on April 3, 2019 were used to support development of this exhibit and are included as Attachment H-1.

5.0 Site-Specific Geotechnical Investigation

> *OAR 345-021-0010(1)(h)(C) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.*

At an appropriate stage in the development, additional subsurface explorations will be completed to confirm the anticipated soil conditions and provide final design recommendations. The site-specific geological and geotechnical investigation will address subsurface exploration plans, and testing plans. The geotechnical investigation will consist primarily of the following tasks:

- Reviewing available data from previous geotechnical explorations near the Facility site;
- Reviewing available geologic information from published sources;
- Reviewing data for evidence of active faults and landslides;
- Conducting a geotechnical field exploration, such as soil borings, test pits, and possibly geophysical testing.
- Collecting additional soil samples for classification and laboratory testing, if necessary.

Geotechnical analyses will be used to calculate bearing capacity of the soils, conduct stability analyses, and provide engineering recommendations for construction of the structures.

6.0 Transmission Lines and Pipelines

> *OAR 345-021-0010(1)(h)(D) For all transmission lines, and for all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends (for transmission lines), corners (for transmission lines), and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides, marginally stable slopes or potentially liquefiable soils that could be made unstable by the planned construction or experience impacts during the facility's operation.*

The 230-kilovolt (kV) transmission line will extend approximately 11 miles from the collector substation to the existing Bonneville Power Administration (BPA) Maupin Interconnection

Substation (Maupin Substation) that connects to the 230-kV BPA Big Eddy to Redmond transmission line (see Figure H-1). During final design, the Applicant plans to conduct geotechnical borings at dead end and turning structures, plus borings approximately every 1 mile of straight section of transmission line. For the proposed route shown in Exhibit C (Figure C-2), this would equate to 18 borings; however, the actual number of borings will be based on final design of the transmission line route. There are no railroad crossings, major road crossings, or river crossings along the transmission line route (see Figure C-2 in Exhibit C).

The Facility does not have a pipeline. Therefore, this provision is not applicable.

7.0 Seismic Hazard Assessment

> *OAR 345-021-0010(1)(h)(E) An assessment of seismic hazards, in accordance with standard-of-practice methods and best practices, that addresses all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection, and an explanation of how the applicant will design, engineer, construct, and operate the facility to avoid dangers to human safety and the environment from these seismic hazards. Furthermore, an explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring and emergency measures for seismic hazards, including tsunami safety measures if the site is located in the DOGAMI-defined tsunami evacuation zone.*

7.1 Methods

Topographic and geologic conditions and hazards within the site boundary were evaluated by reviewing available reference materials such as topographic and geologic maps, aerial photographs, existing geologic reports, and data provided by DOGAMI, the Oregon Water Resources Department, U.S. Geological Survey (USGS), and the NRCS.

This work was based on the potential for regional and local seismic activity as described in the existing scientific literature, and on subsurface soil and groundwater conditions within the site boundary based on desktop evaluations. The seismic hazard analysis consisted of the following tasks:

1. Detailed review of USGS, National Geophysical Data Center, and DOGAMI literature and databases.
2. Identification of potential seismic events for the site characterization of those events in terms of a series of design events.
3. Evaluation of seismic hazards, including potential for fault rupture, earthquake-induced landslides, liquefaction and lateral spread, settlement, and subsidence.

4. Mitigation recommendations based on the characteristics of the subsurface soils and design earthquakes, including specific seismic events that might have a significant effect on the site, potential for seismic energy amplification at the site, and the site-specific acceleration response spectrum for the site.

7.2 Maximum Considered Earthquake Ground Motion under IBC 2015

The 2018 USGS National Seismic Hazard Mapping project (USGS 2018a) developed ground motions using a probabilistic seismic hazard analysis that covered the area within the site boundary. Though these motions are not considered site-specific, they provide a reasonable estimate of the ground motions within the site boundary. For new construction, the site should be designed for the maximum considered earthquake, according to the most recently updated International Building Code (IBC; ICC 2015) as supplemented by the Oregon Structural Specialty Code (OSSC; ICC 2014). The USGS unified hazard tool analysis was re-run for the site boundary and the design event has a 2 percent probability of exceedance in 50 years (or a 2,475-year return period). This event has a peak ground acceleration (PGA) of 0.2202 acceleration from gravity at the bedrock surface, at the approximate center of the solar array. The values of PGA on rock are an average representation of the acceleration most likely to occur at the site for all seismic events (crustal, intraplate, or subduction; USGS 2018a).

Seismic design parameters were developed in accordance with the 2015 IBC. Following guidance from DOGAMI, until a site-specific geotechnical investigation is conducted the site should be designated Site Class D (Table H-1).

Table H-1. Seismic Design Parameters – Maximum Considered Earthquake

Site Class	Peak Horizontal Ground Acceleration on Bedrock	Soil Amplification Factor, F_a	Peak Horizontal Ground Acceleration at Ground Surface
S_D	0.187g	1.443	0.270g
g = acceleration from gravity.			

The following additional parameters for the Maximum Considered Earthquake may be used for structural design:

- Short period (0.2-second) spectral response acceleration, S_{MS} = 0.644g for Site Class S_D
- 1-second period spectral response acceleration, S_{M1} = 0.397g for Site Class S_D

The design spectral response acceleration parameters, S_{DS} and S_{D1}, for both short period and 1-second period, are determined by multiplying the Maximum Considered Earthquake spectral response accelerations (S_{MS} and S_{M1}) by a factor of 2/3. However, as stated in Section 5.0, the site-specific geological and geotechnical investigation, which will be conducted as a condition to the site certificate, will indicate which seismic design parameters to use in the final Facility layout and design.

7.2.1 Earthquake Sources

Seismicity in northern Oregon is generated from the convergence of the Juan de Fuca plate and the North American plate at the Cascadia Subduction Zone. These plates converge at a rate between 1 and 2 inches per year and accumulate large amounts of stress that are released abruptly in earthquake events. The four sources of earthquakes and seismic activity in this region are crustal, intraplate, volcanic, and the Cascadia Subduction Zone (DOGAMI 2010).

Regionally, seismicity has been attributed to crustal deformation resulting from the Cascadia Subduction Zone and volcanism. Faults are considered active if there has been displacement in the last 10,000 years, and potentially active if there has been movement over the Quaternary period (last 1.6 million years). Overall, earthquakes in Oregon are associated with active faults in four regional zones of seismicity: the Cascade Seismic Zone, Portland Hills (Portland, Oregon-Vancouver, Washington metropolitan area) Zone, South-Central (Klamath Falls) Zone, and Northeastern Oregon Zone (Niewendorp and Neuhaus 2003).

Earthquakes caused by movements along crustal faults, generally in the upper 10 to 15 miles of the earth's crust, result in the third seismic source mechanism. In the vicinity of the Facility site, earthquakes occur within the crust of the North American tectonic plate when built-up stresses near the surface are released through fault rupture.

No potentially active faults are mapped within the site boundary (USGS 2018b, Figure H-2). A number of middle- and late-Quaternary-age faults are mapped within 50 miles of the site boundary, as shown in Figure H-2. The DOGAMI Oregon HazVu: Statewide Geohazards Viewer earthquake hazard layer (DOGAMI 2019) and the USGS Geologic Hazards Science Center (USGS 2019; Figure H-2) show active faults near the Facility area. These faults depicted on Figure H-2, which are mapped within 50 miles of the Facility site boundary, present the largest potential for seismic contribution to the Facility. The results of a part of the desktop evaluation, as well as a review of historical fault lines, landslides, and a 1-foot contour map of the site show that there are no apparent landslides or faults in the project area. Based on this evaluation, investigation of potentially active faults within the site boundary will not be conducted as part of the site-specific geotechnical investigation for the Facility.

The 2013 Oregon Resilience Plan by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC 2013) identified simulated shaking for a magnitude 9.0 Cascadia scenario. This plan identifies the Facility site area as falling into the "very light" category, meaning that a magnitude 9.0 Cascadia scenario earthquake would produce a very light shaking event that would be felt outdoors, sleepers might be wakened, liquids disturbed or spilled, small unstable objects upset, doors might swing, and pictures might move (OSSPAC 2013).

Probabilistic seismic hazard deaggregation at 475-year intervals is shown in Attachment H-2, and at 2,475-year intervals in Attachment H-3.

7.2.2 Recorded Earthquakes

Figure H-2 displays the location and approximate magnitude of all recorded earthquakes within 50 miles of the Facility site boundary. The historical seismic events are grouped by magnitude and are displayed using different-sized icons based on the strength of the event. Because of the high number of events in the vicinity of the Facility site, several of the icons overlap in the figure. The National Earthquake Information Center data show three earthquakes at magnitudes between 2.6 and 3.2 have occurred within the site boundary (Figure H-2). A table listing significant historical earthquakes and the year they occurred within 50 miles of the Facility is provided in Attachment H-4 (Rukstales 2012).

Attachment H-4 and Figure H-2 provide a summary of all recorded earthquakes known to have caused Modified Mercalli Intensity (MMI) III shaking intensity or greater within the Facility site boundary, regardless of epicentral origin. For reference, an intensity of MMI III is associated with shaking that is "noticeable indoors but may not be recognized as an earthquake." An intensity of MMI V is "felt by nearly everyone; many awakened" (USGS 2018a).

The Ground Response Spectra Assessment on Attachment H-5 lists the design response spectrum based on the 2012/2015 IBC, which corresponds with the 2014 OSSC (USGS 2018a). Response spectra are provided for the Maximum Considered Earthquake at the location of the Facility. For the Maximum Considered Earthquake, separate response spectra modified by the amplification factors for Site Class D are provided. Based on the current DOGAMI guidance, it is recommended that the Facility be designed for Site Class D. However, examination of the geology mapped for the site suggests that shallow bedrock formations (Wanapum Basalt) may exist at certain locations, where the Site Class B response spectra would apply.

7.2.3 Hazards Resulting from Seismic Events

For facilities designed to the current IBC and OSSC guidelines for Site Class D, the design seismic event will have a 2 percent chance of exceedance in the next 50 years (or an event with an approximately 2,475-year recurrence interval). For this event, the Facility will be designed for no life-threatening structural damage from either the vibrational response of the structures or from secondary hazards associated with ground movement or failure (such as landslides, lateral spreading, liquefaction, fault displacement, or subsidence). It is generally assumed that if significant structural damage can be prevented, the risk to human safety will be minimal. Solar facilities have an inherently low risk to human safety since the structures are all close the ground, the solar arrays are composed of lighter weight materials compared to other energy generating facilities, and the arrays are supported on multiple pile-type foundations that distribute forces over a larger area of the array rather than concentrating seismic forces over a single tower (e.g., a wind farm).

Seismic hazards associated with a design seismic event could potentially include ground shaking and instability from landslides or subsurface movement. Impacts on the Facility from these hazards are anticipated to be low, as discussed below.

7.2.4 Seismic Shaking or Ground Motion

The design seismic event will have a 2,475-year recurrence interval. The Facility's structures will be designed to withstand the maximum risk-based design earthquake ground motions developed for the Facility site. The State of Oregon has adopted the IBC 2012 code for structural design. Specifically, this is Section 1613 (Earthquake Loads) of the 2014 OSSC, which is in Chapter 16. It should be noted that building codes are frequently updated; the IBC specifically is updated every 3 years. The Applicant will design, engineer, and construct the Facility in accordance with the current version of the latest IBC (ICC 2015), OSSC, and building codes adopted by the State of Oregon at the time of construction. Therefore, it is incumbent on the design engineers to ensure that the designs are in accordance with the current versions of the latest codes as adopted by the State of Oregon at the time of construction.

Based on geotechnical and geological information, a Site Class for the soil/bedrock at the site is assigned. In this case, as described previously in Section 7.2, Site Class D (stiff soil) will be assigned to the Facility until a site-specific geotechnical investigation has taken place.

Based on site-specific analyses, the original equipment manufacturer will provide the structural engineer with site-specific foundation loads and requirements. The structural engineer then completes the foundation analyses based on the design site-specific parameters. Generally, these include the following loads for solar foundation design: extreme loads, load cases for up-lift, shear failure, tension loads (for pile foundations), earthquake loads, fatigue loads, subsoil properties, spring constants, verification procedures, and maximum allowable inclination.

The geotechnical studies and analyses provide site-specific parameters including but not necessarily limited to: moisture content and density, soil/bedrock bearing capacity, bedrock depth, settlement characteristics, structural backfill characteristics, soil improvement (if required), and dynamic soil/bedrock properties including shear modulus and Poisson's Ratio of the subgrade. The foundation design engineer uses these parameters to design a foundation suitable for the Facility and verifies that the foundation/soil interaction meets or exceeds the minimum requirements stated by the original equipment manufacturer for the Facility.

7.2.5 Fault Rupture

The probability of a fault displacement within the site boundary is considered low because of the distance of known or mapped potentially active faults from the site boundary and the absence of faults within the site boundary (Figure H-2). Unknown faults could exist, or new fault ruptures could form during a significant seismic event such as the Cascadia event discussed above in Section 7.2.1. As a part of the desktop evaluation a review of historical fault lines, landslides, and a 1-foot contour map of the site, there are no apparent landslides or faults in the project area. In addition, the Applicant has inquired with DOGAMI if current fault mapping efforts in Wasco County are available for review. No response has been received from DOGAMI as of the date of this exhibit.

7.2.6 Liquefaction

Liquefaction is a phenomenon in which saturated, cohesionless soils temporarily lose their strength and liquefy when subjected to dynamic forces such as intense and prolonged ground shaking and seismic activity. The soils in the site boundary are not saturated and are generally clastic (loess) in nature. Along with the relatively low seismic event potential, this indicates that the liquefaction of soils within the site boundary is considered unlikely.

7.2.7 Seismically Induced Landslides

Seismicity in the region has the potential to trigger landslides and mass wasting processes within the site boundary; however, the potential is considered low because of the flat terrain of the site and shallow, stable bedrock. Known landslides are shown in Figure H-1 to the northwest of the site boundary. As discussed above, a review of historical fault lines, landslides, and a 1-foot contour map of the site, there are no apparent landslides or faults in the project area. The site-specific geotechnical investigation will include additional review of for evidence of active faults and landslides. More detailed discussion on the location and type of landslides is included in Section 8.1.

7.2.8 Subsidence

Subsidence is the sudden sinking or the gradual downward settling of the land surface, and is often related to groundwater drawdown, compaction, tectonic movements, mining, or explosive activity. Subsidence due to a seismic event is highly unlikely. In most areas, the bedrock is relatively shallow, and the overlying soils are not saturated.

7.2.9 Seismic Hazard Mitigation

The State of Oregon uses the 2012 IBC, with current amendments by the OSSC (ICC 2014). Pertinent design codes as they relate to geology, seismicity, and near-surface soil are contained in the IBC Chapter 16, Section 1613, with slight modifications by the current amendments of the State of Oregon. The Facility will be designed to meet or exceed the minimum standards required by these design codes.

A site-specific geotechnical exploration will be conducted to collect pertinent data for the design of the Facility to mitigate potential hazards that could be created during a seismic event. The hazard of a surficial rupture along a fault trace is anticipated to be low, given the low probability that a fault rupture would actually displace the ground surface at the location of any of the solar panel arrays or transmission structures. No mitigation for potential fault rupture is anticipated; the risk to human safety and the environment will be minimal, as the Facility will be located in a sparsely populated area. No structures will be built on steep slopes that could be prone to instability, thus avoiding potential impacts. Design guidelines related to disaster resilience are further described in Section 8.6.

8.0 Non-Seismic Geological Hazards

OAR 345-021-0010(1)(h)(F) An assessment of geology and soil-related hazards which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility, in accordance with standard-of-practice methods and best practices, that address all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection. An explanation of how the applicant will design, engineer, construct and operate the facility to adequately avoid dangers to human safety and the environment presented by these hazards, as well as:

(i) An explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters.

(ii) An assessment of future climate conditions for the expected life span of the proposed facility and the potential impacts of those conditions on the proposed facility.

Nonseismic geologic hazards in the Columbia Plateau region typically include landslides, volcanic eruptions, collapsing soils, and erosion potential. The area within the Facility site boundary consists of relatively flat-lying basalt with a very thin or absent cover of loess. The solar array, roads, and transmission line will be constructed on the flat-lying part within the site boundary and will avoid steep side slopes and drainages that could potentially be subject to landslides and soil creep. A discussion of potential geologic hazards is presented below.

8.1 Landslides

No active landslides are identified in the Statewide Landslide Information Database for Oregon (Burns et al. 2014) within the site boundary (Figure H-1). The closest mapped landslides on the SLIDO database are located approximately 1.5 miles to the west/northwest of the site boundary (see Figure H-1) as the uplands slope downward towards the Deschutes River and the town of Maupin, Oregon. No existing landslides were observed during the site reconnaissance.

The solar modules and roads, including the access road and service roads, will be situated on flat-lying areas and avoid steep slopes (see Figures C-2.1 through C-2.8 in Exhibit C). The transmission line will be located in areas with slopes that, based on geologic mapping and site reconnaissance observations, are formed in flay-lying basalt flows with very little soil cover. If slope stability issues are identified during the final design geotechnical investigations, either the structures will be relocated during the micrositing process or remedial measures to improve slope stability will be implemented.

8.2 Volcanic Activity

Volcanic activity in the Cascade Range is driven by the subduction of the Juan de Fuca Plate beneath the North American Plate. The closest volcano to the site boundary is Mount Hood located approximately 50 miles away to the northwest. Most of the potential volcanic hazard impacts would occur within a 50-mile radius of the erupting volcano. Depending on the prevailing wind direction at the time of the eruption and the source of the eruption, ash fallout in the region surrounding the Facility may occur. Because of the distance to the nearest volcano, impacts to the Facility from volcanic activity would be indirect and likely be limited to ash fallout. In addition, the Facility is not located near any streams that would likely be subject to pyroclastic flows from a volcanic eruption from these close volcanoes. It is unlikely that there would be any adverse effects from volcanic activity on the construction or operation of the Facility.

8.3 Erosion

As discussed in Exhibit I, erosion can be caused by increasing exposure to wind or water. The erosion factor (K) indicates the susceptibility of a soil to sheet and rill erosion by water. The K-factor is one of six factors used in the Universal Soil Loss Equation and the Revised Universal Soil Loss Equation to predict the average annual rate of soil loss by sheet and rill erosion in tons-per-acre-per-year. The estimates are based primarily on percentage of silt, sand, and organic matter, as well as soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Data from the NRCS Web Soil Survey (NRCS 2018) indicate that the soils within the site boundary have a K that ranges from 0.10 to 0.37. For the range of K at the Facility, the soils could be considered moderately to highly erodible, and subject to sheet erosion and rill erosion by water (NRCS 2018).

To reduce the potential for soil erosion, a construction Erosion and Sediment Control Plan (ESCP) will be developed for the Facility. The ESCP will include both structural and nonstructural BMPs. Examples of structural BMPs include the installation of silt fences or other physical controls to divert flows from exposed soils, or otherwise limit runoff and pollutants from exposed areas within the Facility site boundary. Examples of nonstructural BMPs include management practices such as implementation of materials handling, disposal requirements, and spill prevention methods.

The Applicant's application for a National Pollutant Discharge Elimination System Construction Stormwater Discharge General Permit 1200-C is attached to Exhibit I, and includes the draft ESCP. In addition, Exhibit I contains a comprehensive list of mitigation measures to avoid wind and water erosion and soil impacts.

8.4 Flooding

To evaluate flood hazards, the DOGAMI Statewide Flood Hazard Database for Oregon – Federal Emergency Management Agency (FEMA) Flood Insurance Study inundation zones (DOGAMI 2018) were compared to the site boundary. The site boundary is not within an identified FEMA 100-year or 500-year floodplain.

Seasonal thunderstorms can result in concentrated stormwater runoff and localized flooding. The engineered access roads and drainages will direct stormwater runoff away from structures and into drainage ditches and culverts as required in the ESCP. The Facility will be designed and constructed to meet the requirements of the zoning ordinances and building codes that establish flood protection standards for all construction, to avoid dangers to the infrastructure, as well as human safety and the environment, including criteria to ensure that the foundation will withstand flood forces. Therefore, the risks and potential impacts to the Facility as well as human safety and the environment from flood hazards are expected to be low.

8.5 Shrinking and Swelling Soils

Changes in soil moisture cause certain clay minerals in soils to either expand or contract. The amount and type of clay minerals in the soil influence the change in volume. Structures or roads built on shrinking or swelling soils could be damaged by the change in volume of the soil. Linear extensibility (shrink-swell potential) refers to the change in length of an unconfined clod as its moisture content is decreased from a moist state to a dry state.

There are no soils identified in the site boundary with potential for shrinking and swell (see Exhibit I). Prior to construction, the Applicant will include, as part of the geotechnical investigation, an investigation of the swell and collapse potential of loess soil in the site boundary. Based on the results of the investigation, the applicant will include mitigation measures including, as necessary: over-excavating and replacing loess soil with structural fill; wetting and compacting; deep foundations; or avoidance of specific areas.

The solar structures will be supported by steel posts; post depth will vary depending on soil conditions but is typically 8 feet below the surface. If soil conditions require it, concrete foundations will be used. Assuming steel posts are used, they will be driven into bedrock.

8.6 Disaster Resilience

The State of Oregon uses IBC 2012, with current amendments by the OSSC and local agencies. Pertinent design codes as they relate to geology, seismicity, and near-surface soils are contained in IBC Chapter 16, Section 1613, with slight modifications by the current amendments of the State of Oregon and local agencies. The Facility will be designed to meet or exceed the minimum standards required by these design codes. The Applicant acknowledges that DOGAMI encourages, but does not require, applicants to design and build for disaster resilience and future climate conditions using science, data and community wisdom to protect against and adapt to risks (see DOGAMI EFSC Scope of Review, in Attachment H-1). With this in mind, the Applicant has extensive experience building energy facilities and from a structural perspective, designs projects to withstand non-seismic geologic hazards such as the potential for changes in rainfall or temperature. Additional elements such as wind speeds, snow, dust, etc. are also considered in project designs depending on the location in the country.

A qualified engineer will assess and review the seismic, geologic, and soil hazards associated with the construction of the Facility. Construction requirements will be modified, as needed, based on the site-specific characterization of seismic, geologic, and soil hazards. The Facility will be designed, engineered, and constructed to meet all current standards to adequately avoid potential dangers to human safety presented by seismic hazards. Substation and operation and maintenance (O&M) building structures will be designed in accordance with the current version of the OSSC. Substation equipment will be specified in accordance with the latest version of the Institute of Electrical and Electronics Engineers 693. The Facility will be located in a sparsely populated area; therefore, the risks to human safety and the environment due to seismic hazards will be minimal.

The Facility will be designed, engineered, and constructed to meet or exceed all current standards. The Applicant proposes to design, engineer, and construct the Facility to avoid dangers to human safety–related and non-seismic hazards in many ways, including conducting site-specific geotechnical evaluations for the facilities. Typical mitigation measures for non-seismic hazards include avoiding potential hazards, conducting subsurface investigations to characterize the soils to adequately plan and design appropriate mitigation measures, creating detailed geologic hazard maps to aid in laying out facilities, and providing warnings in the event of hazards. Solar facilities are designed to be modular, with different circuits and disconnect switches between inverters. This allows for portions of a facility to be taken off line for repair following a disaster, while the remainder of the solar arrays can continue to operate in a reduced capacity. The Applicant plans to follow industry practice of installing excess cabling between strings to allow for splicing and repairs in the event of a disaster. Should Facility elements like the access roads or solar panels be damaged, they will be assessed, and repairs made to recover operations after a major storm event.

The Applicant's parent company, Avangrid, is a member of the North American Electrical Reliability Corporation and follows its standards for critical infrastructure protection, emergency preparedness and operations, and facility design. Avangrid operates a North American Electrical Reliability Corporation-compliant national control center in Portland, Oregon that could operate the Facility remotely in the event of on-site disaster. Avangrid also maintains a backup control center in Arizona to provide continuity of service in the event that the Portland center is disabled. Similarly, BPA confirmed that it has system recovery plans for Maupin Substation and its associated transmission lines.

Avangrid also operates 2,200 MW of northwest energy generation assets as a standalone Balancing Authority, and the Facility could be part of this network that serves regional energy markets. Avangrid has the unique ability to manage and deliver energy through its Balancing Authority. In the event of disaster at the Facility, Avangrid could re-dispatch resources from elsewhere in its Balancing Authority, such as the Klamath Cogeneration Facility in southern Oregon, to serve load in place of the Facility.

8.7 Climate Change

The University of Washington conducted a study to assess climate vulnerability and adaptation in the Columbia River Plateau, the region where the Facility is located (Michalak et al. 2014). The study involved downscaling five climate models (CCM3, CGM3.1, GISS-ER, MIROC3.2 and Hadley). Climate projections were downscaled to approximately a 1-kilometer resolution for over 40 different direct (mean annual temperature/precipitation) and derived (number of growing-degree days, actual and potential evapotranspiration) climate variables (Michalak et al. 2014). The downscaling of the climate models for this area led to future projections of greater annual average and summer temperatures, and more severe storm events and wildfires, among other changes. These specific changes are expected to increase stress to power lines in the region.

Reinforcing the local electric grid with solar power, battery storage, and a new transmission line will provide resilience to the overall energy grid in this part of Oregon. This reinforcement will be direct, by upgrading the system, which is anticipated to experience higher loads under rising temperatures and the related increases in power demand for summer cooling. It is also indirect, by supporting the delivery of power generated through a larger variety of sources, minimizing the potential reduction in hydro power's role under future conditions. All aspects of this Facility support resiliency in the face of future climate change. In addition, the Facility will be designed to withstand extreme events as explained above in Section 8.6.

9.0 Conclusions

The risk of seismic hazards to human safety at the Facility is considered low. The Applicant has adequately characterized the area within the Facility site boundary and surrounding vicinity in accordance with OAR 345-022-0020(1)(a) and has considered seismic events and amplification for the Facility's specific subsurface profile. The probability of a large seismic event occurring while the Facility is occupied is much lower than for a normal building or facility. This very low probability results in minimal risk to human safety. The risk to human safety is slightly higher at the O&M building, which is required to be designed to current seismic standards for structural safety.

The Applicant has demonstrated that the Facility can be designed, engineered, and constructed to avoid dangers to human safety in case of a design seismic event by adhering to recently updated IBC requirements, per OAR 345-022-0020(1)(b). These standards require that, for the design seismic event, the factors of safety used in the Facility design exceed certain values. For example, in the case of slope design, a factor of safety of at least 1.1 is normally required during the evaluation of seismic stability. This factor of safety is introduced to account for uncertainties in the design process and to ensure that performance is acceptable. Given the relatively low level of risk for the Facility, adherence to the IBC requirements will ensure that appropriate protection measures for human safety are taken.

The Applicant has provided appropriate site-specific information and demonstrated (in accordance with OAR 345-022-0020[1][c]) that the construction and operation of the Facility, in the absence of a seismic event, will not adversely affect or aggravate the geological or soil conditions within the Facility site boundary or surrounding vicinity. The risks posed by non-seismic geologic hazards are considered to be low because the Facility can be designed to avoid or minimize the hazards of landslides and soil erosion. Landslide and slope stability issues will be identified during final design and mitigated. Erosion hazards resulting from soil and wind action will be minimized with the implementation of an engineered erosion control plan.

Finally, the Applicant has demonstrated that the Facility can be designed, engineered, and constructed to avoid dangers to human safety resulting from the geological and soil hazards within the Facility site boundary, pursuant to OAR 345-022-0020(1)(d). Site-specific studies will be conducted, geotechnical work will be completed to inform final design, and adequate measures will be implemented to control erosion. Accordingly, given the relatively small risks these hazards pose to human safety, standard methods of practice (including implementation of the current IBC) will be adequate for the design and construction of the Facility.

10.0 Submittal Requirements and Approval Standards

10.1 Submittal Requirements

Table H-2. Submittal Requirements Matrix

Requirement	Location
OAR 345-021-0010(1)(h) Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020, including:	Section 3.0
(A) A geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines. Current guidelines shall be determined based on consultation with the Oregon Department of Geology and Mineral Industries, as described in paragraph (B) of this subsection.	Section 3.0
(B) A summary of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments, and the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete.	Section 4.0
(C) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions.	Section 5.0
(D) For all transmission lines, and for all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends (for transmission lines), corners (for transmission lines), and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides, marginally stable slopes or potentially liquefiable soils that could be made unstable by the planned construction or experience impacts during the facility's operation.	Section 6.0
(E) An assessment of seismic hazards, in accordance with standard-of-practice methods and best practices, that addresses all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection, and an explanation of how the applicant will design, engineer, construct, and operate the facility to avoid dangers to human safety and the environment from these seismic hazards. Furthermore, an explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. The applicant shall include proposed design and engineering features, applicable construction codes, and any monitoring and emergency measures for seismic hazards, including tsunami safety measures if the site is located in the DOGAMI-defined tsunami evacuation zone.	Section 7.0

Requirement	Location
(F) An assessment of geology and soil-related hazards which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility, in accordance with standard-of-practice methods and best practices, that address all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection. An explanation of how the applicant will design, engineer, construct and operate the facility to adequately avoid dangers to human safety and the environment presented by these hazards, as well as:	Section 8.0
(i) An explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters.	Section 8.6
(ii) An assessment of future climate conditions for the expected life span of the proposed facility and the potential impacts of those conditions on the proposed facility.	Section 8.7

10.2 Approval Standards

Table H-3. Approval Standard

Requirement	Location
OAR 345-022-0020 Structural Standard	
To issue the requested Site Certificate, the Council must find that: (a) The applicant, through appropriate site-specific study, has adequately characterized the seismic hazard risk of the site; and	Section 7.0
(b) The applicant can design, engineer, and construct the facility to avoid dangers to human safety and the environment presented by seismic hazards affecting the site, as identified in subsection (1)(a);	Sections 7.0 and 8.0
(c) The applicant, through appropriate site-specific study, has adequately characterized the potential geological and soils hazards of the site and its vicinity that could, in the absence of a seismic event, adversely affect, or be aggravated by, the construction and operation of the proposed facility; and	Section 8.0
(d) The applicant can design, engineer and construct the facility to avoid dangers to human safety and the environment presented by the hazards identified in subsection (c).	Section 8.0

11.0 References

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Figures

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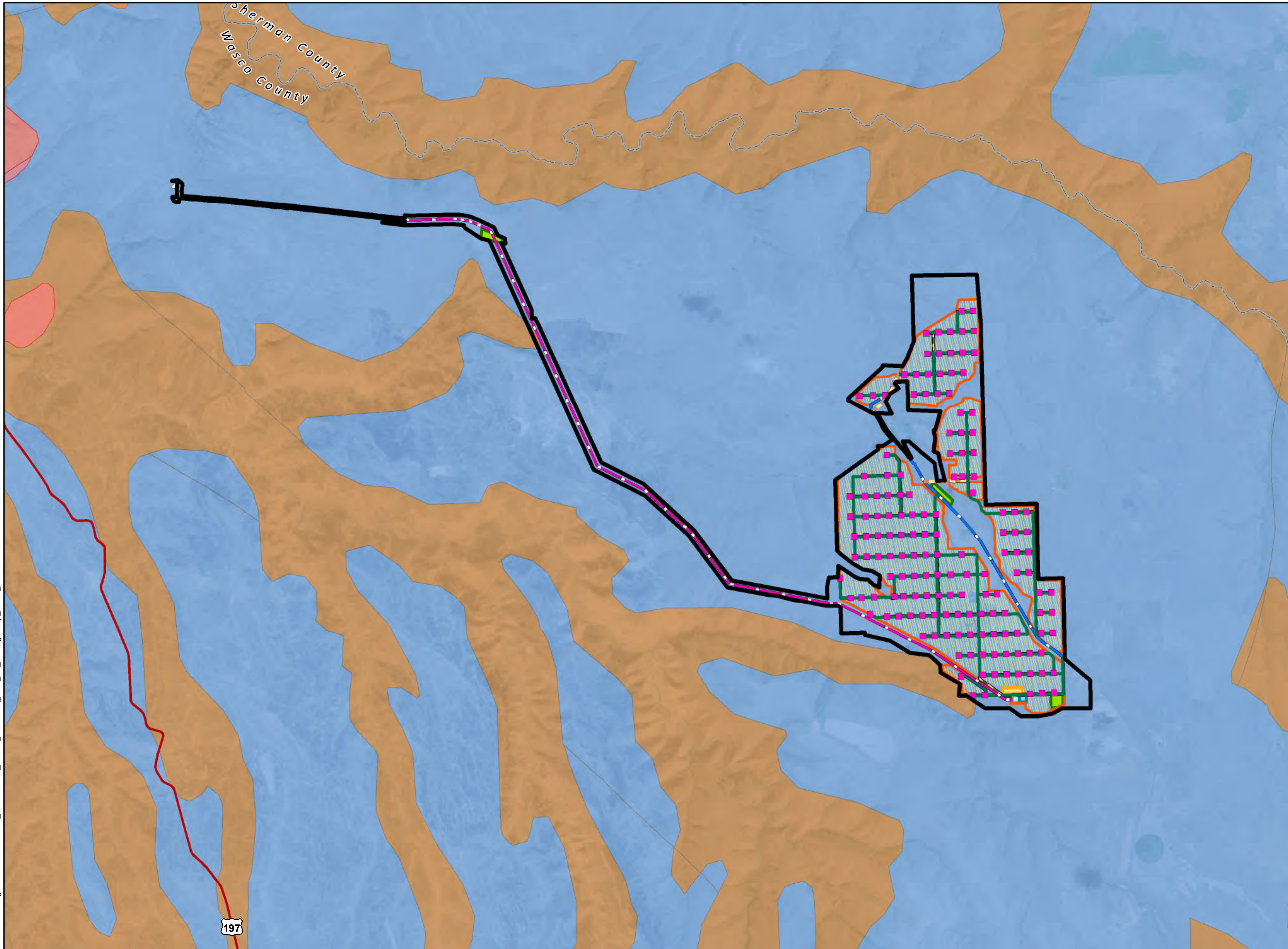
Bakeoven Solar Project

Figure H-1
Geologic Map

WASCO COUNTY, OREGON



- Proposed Site Boundary
- Proposed Micrositing Corridor

Basemap Features
- US Highway
- County Boundary

Proposed Facility Layout
- Inverter
- Permanent New Road
- Existing Road to Improve
- Transmission Line (230 kV)
- Overhead Collector Line
- Underground Collector Line
- Fence Line
- Solar Array Area
- Battery Storage System
- O&M Building
- Staging Area
- Collector Substation

Surface Geology
- Tcg - Grande Ronde Basalt (Middle and Lower Miocene)
- Tcw - Wanapum Basalt (Middle Miocene)
- Landslide

TETRA TECH
AVANGRID RENEWABLES

Data Sources

Avangrid-Project Infrastructure; USDA-Aerial Imagery; Tiger-Roads; USGS-Surface Geology

Reference Map

1:60,000 WGS 1984 UTM Zone 10N

0 0.5 1 2 3 4 Miles

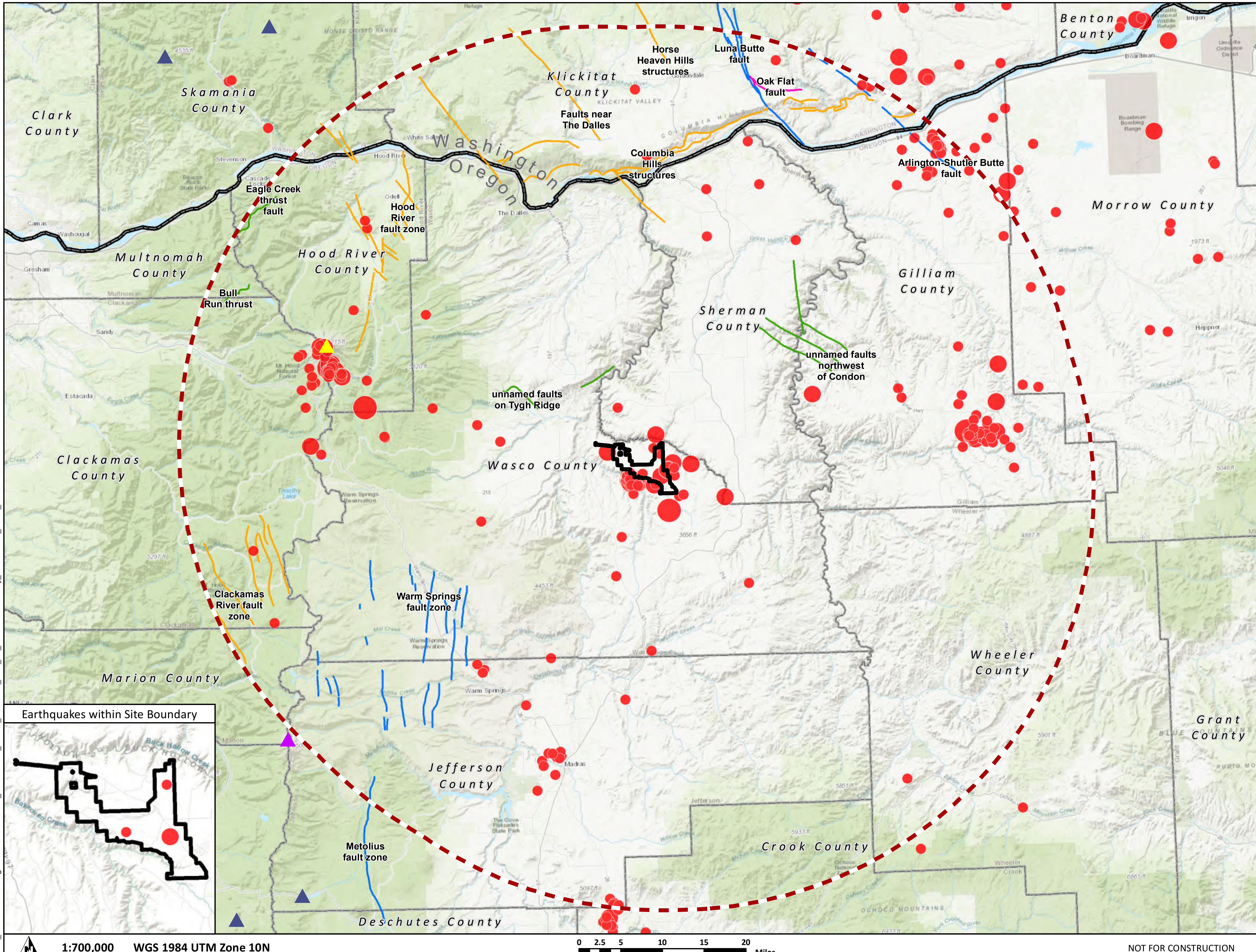
NOT FOR CONSTRUCTION

P:\GIS_PROJECTS\Avangrid\BakeOven\MXDs_fASC\Exhibit_H\AVG_Bakeoven_ASC_H1_GeologicMap_11i17i_20191031.mxd

Bakeoven Solar Project

Figure H-2
Historical Seismicity and Potentially Active Faults

WASCO COUNTY, OREGON



- Proposed Site Boundary
- Analysis Area (50-mile Buffer)

Basemap Features

- State Boundary
- County Boundary

Earthquakes by Magnitude

- 2.5 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0

Active Faults

- Class B (various age)
- Latest Quaternary (<15,000 years)
- Middle and Late Quaternary (<750,000 years)
- Undifferentiated Quaternary (<1.6 million years)

Volcanoes

- Last known eruption 1800-1899
- Last known eruption A.D. 1-1499
- Last known eruption B.C. (Holocene)

TETRA TECH

AVANGRID RENEWABLES

Data Sources

Avangrid-Project Infrastructure; USGS Geologic Hazards Science Center-Faults; NEIC-Earthquakes; Enterprise-Volcanos, States, Counties, ESRI-Topography

Reference Map

P:\GIS_PROJECTS\Avangrid\BakeOven\MXDs_fASC\Exhibit_H\AVG_Bakeoven_ASC_H2_HistoricalSeismicity_ActiveFaults_11i17_20191031.mxd

Attachment H-1. Evidence of Consultation with DOGAMI

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Bakeoven Solar Project
Consultation with Oregon Department of Geology and Mineral Industries (DOGAMI) Summary

Portland, OR (at Avangrid Renewables offices)

December 21, 2018

Attendees

- **DOGAMI** – Yumei Wang, P.E.
- **Oregon Department of Energy** – Sarah Esterson
- **Avangrid** – Brian Walsh, Matt Hutchinson, Ben Kester, Tom McNulty
- **Tetra Tech** – Carrie Konkol, Suzy Cavanagh (via phone)

Meeting Purpose

This meeting was intended to satisfy OAR 345-021-0010(1)(h)(B) that requires pre-application consultation with DOGAMI for new energy facilities. Accordingly, DOGAMI requested that notes be taken for review and comment by ODOE and DOGAMI and then included into Exhibit H to identify consultation.

Project Description:

- Avangrid plans to construct and operate a photovoltaic (PV) solar energy facility in southern Wasco County, Oregon. The project will interconnect to BPA's Maupin Substation. Other related facilities will include a substation, operations and maintenance building, 11-mile 230-kilovolt transmission line, and a battery storage system. General discussion of the project was shown on provided maps as well as an explanation of the general arrangement of a solar facility.
- Typical foundation design includes a metal racking system supported on driven piles. Avangrid stated that piles are generally driven 6 to 10 feet into the ground based on soil conditions. Embedment depths for piles are based on site specific geological conditions and expected wind loads and seismic hazards of the project site.

Project Description:

- DOGAMI requests that Avangrid complete a site-specific seismic hazard assessment that includes a site-specific probabilistic seismic hazard analysis. DOGAMI stated that site-specific studies are scalable and the DOGAMI is not prescriptive. For example, the analysis for a nuclear power plant would be more rigorous that a solar facility.

- There are faults in this area that are potentially active. DOGAMI recommend that Avangrid identify unmapped faults that could occur in the project area using lidar or other data source.
- Avangrid's geologist completed a limited site reconnaissance to observe the existing features at the site and concluded that no geologic hazards such as landslides or faults were evident.

LiDAR

- DOGAMI recommends the use of Lidar for identification of unmapped faults in the project areas, and notes that Lidar data for some portions of the state can be downloaded from its website.1
- Avangrid collected 1-foot contours data for entire project area that it can use to identify faults. DOGAMI expects the Applicant to look at what is existing. Much smaller and less active faults can generate high ground motions however, the likelihood is lower than larger, more active faults. DOGAMI noted that Lidar is not a filing requirement but find it particularly useful for site specific assessments, especially for heavily forested areas, which this area is not.
- DOGAMI may have other Lidar data that is not posted on its website and provided Avangrid with a contact (Jake Edwards) to follow up. Avangrid will get in touch with him to discuss Lidar work in the project area.

Design Basis

- Avangrid stated that this project will be designed to appropriate industry codes, standards, and guidelines. DOGAMI wants to make sure that Avangrid meets its due diligence and that the facility design consider disaster resilience for public safety. Avangrid has agreed to list applicable codes and design standards in Exhibit H as it is the Applicant's responsibility to identify applicable codes that could apply to the solar facility.
- DOGAMI stated that new energy generation facilities are especially important for post disaster relief and recommend that Avangrid consider design features that allow for quick recovery from a disaster. This is consistent with the OAR on disaster resilience.
- DOGAMI recommends that Avangrid state what codes they are designing to (names of codes) in Exhibit H. In addition to the structural standards in the Oregon Revised Statute, Avangrid needs to meet all relevant codes and DOGAMI expects to see state-of-practice and best practices used in the design.

[1] Avangrid has reviewed DOGAMI's lidar website (https://gis.dogami.oregon.gov/maps/lidarviewer) and verified that available or planned lidar data does not cover the project area.

- DOGAMI mentioned an upcoming code change which is anticipated to be adopted by mid-year 2019.

Avangrid is the largest owner/operator of renewable projects in Oregon and designs its facilities with the long-term interest in mind. Avangrid described that it is also in its best interest to return to full operations safely and responsibly after a disaster.

Exhibit H

- DOGAMI recommended the following items be included in Exhibit H
  - Applicable design standards, codes, and industries practices used for facility design, as outlined in OAR 345-021-0010(1)(h)(A). Including a description of where design exceeds codes and standard design loads.
  - Site specific geological risk assessment, including site-specific probabilistic seismic hazard analysis, as outlined in OAR 345-021-0010(1)(h)(E).
  - Description and schedule of future assessments (e.g., pre-construction geotechnical drilling), as outlined by OAR 345-021-0010(1)(h)(C) and OAR 345-021-0010(1)(h)(D).
  - Consideration of disaster resiliency and future climate, as outlined by OAR 345-021-0010(1)(h)(F).
- ODOE clarified that the site-specific seismic design parameters are not prescriptive, but should be explained in Exhibit H.

Action Items

- Avangrid will reach out to DOGAMI to get Jake Edward's contact information; then connect with Jake Edwards to discuss the contour and/or LIDAR data collected at the project.
- If Avangrid has LIDAR data for the project area they will share it with DOGAMI.
- Tetra Tech will prepare draft consultation meeting notes and share with DOGAMI for review prior to submittal of Exhibit H.

From:	WANG Yumei * DGMI
To:	matthew.hutchinson@avangrid.com; benjamin.kester@avangrid.com; brian.walsh@avangrid.com; Tom.mcnulty@avangrid.com; Konkol, Carrie; Cavanagh, Suzy
Cc:	WANG Yumei * DGMI; ESTERSON Sarah * ODOE
Subject:	EFSC DOGAMI followup on Bakeoven consultation
Date:	Thursday, December 27, 2018 5:52:30 PM
Attachments:	1706_cruz.pdf

Hello all,

I'm following up on the recent DOGAMI consultation with some additional information (below).

The site-specific geotechnical investigation and report should conform to the Oregon State Board of Geologist Examiners guidelines titled "Guidelines for Engineering Geologic Reports (2014). 2014 OSBOGE is at: https://www.oregon.gov/osbge/Documents/engineeringgeologicreports_5.2014.pdf

The appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments will vary by project. Typical contents of a site-specific geotechnical investigation report should include a site-specific probabilistic seismic hazards analyses, which includes:

- identification of unmapped Quaternary faults, such as using lidar or equivalent high-resolution base map data
- map and table with the major faults that could impact the facility
- identification and discussion of the maximum considered earthquake
- seismic design parameters including site-specific response spectra
- explanation of how the Applicant will address site specific ground motions that exceed the building code response spectra

Please be informed that there are geologists currently mapping faults to the west (in Hood County) of your proposed site. Here's a recent publication of these efforts—they found active faults using lidar as a base map.

Madin, I.P., Streig, A.R., Burns, W.J., Ma, L., 2017. The Mount Hood Fault Zone—Late Quaternary and Holocene Fault Features, Newly Mapped with High-resolution Lidar Imagery, In Scott, W.E., Gardner, C.A., 2017. Field-Trip Guide to Mount Hood, Oregon, Highlighting Eruptive History and Hazards, U.S. Geologic Survey, Scientific Investigation Report 2017-5022-G, p. 99-110 Https://pubs.usgs.gov/sir/2017/5022/g/sir20175022g.pdf

You can contact Jason McClaughry from DOGAMI to inquire about current mapping efforts, which may extend into Wasco County. Jason.MCCLAUGHRY@oregon.gov
For EFSC purposes, DOGAMI considers Quaternary faults as active.
You can contact Jake Edwards, DOGAMI lidar coordinator, to inquire if lidar already exists in

your proposed area. Jacob.EDWARDS@oregon.gov

I mentioned that the Applicant should list all appropriate industry codes, standards and guidelines that you would use for the proposed work. Current codes, standards and guidelines should be used as required, and when applicable, for best practices. Below are selected examples of standards that should be used when applicable. These examples do not serve as a comprehensive list. They have been selected based on design information that was lacking from prior Applicants' submissions. These examples are relevant for proposed projects with proposed electrical transmission or distribution. The Applicant should also provide IEC and ANSI standards for specific equipment.

Seismic
IEEE 693, Recommended Practice for Seismic Design of Substations
IEEE 1527, Recommended Practice for Design of Buswork Located in Seismically Active Areas
ASCE 113, Guide for Design of Substation Structures (Addresses the seismic design of non-equipment supports)
Lattice Transmission Line Towers
ASCE 10, Design of Latticed Steel Transmission Structures
Substation Structures
ASCE 113, Guide for Design of Substation Structures
Transmission Line Towers
IEEE 1307, Standard for Fall Protection for Utility Work
IEEE 751,Trial-Use Design Guide for Wood Transmission Structures
IEEE 977, Guide for Installation of Foundations for Transmission Line Structures
USDA/RUS Standards (https://www.rd.usda.gov/publications/regulations-guidelines/bulletins/electric)
Including but not limited to:
1724E-200 Design Manual for High Voltage Transmission Lines (12/2/15)
1724E-204 Guide Specifications for Steel Single Pole and H-Frame Structures (11/17/16)
Antennas
TIA 222 structural antennas, antenna-supporting structures, mounts, structural components, guy assemblies, insulators and foundations https://natehome.com/regulations-standards/standards/tia-222-g/

I mentioned the 2013 **Oregon Resilience Plan** by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC). This provides the State's road map for earthquake preparedness, and I believe that Tom was particularly interested
www.oregon.gov/gov/policy/orr/Documents/Oregon_Resilience_Plan_Final.pdf

Last, we discussed how you might address the disaster resilience requirement. You mentioned that as a company policy, you design to "above code" wind loads. This approach would lessen negative impacts to human safety including power outages, and if relevant, could be included in the Exhibit H submittal. I attached a relevant conference presentation about wind turbine codes in Chile, which from my understanding now addresses recovery times.

Happy 2019!

Yumei

Yumei Wang, P.E. | Resilience Engineer
Oregon Department of Geology and Mineral Industries (DOGAMI)
800 NE Oregon Street, Suite 965, Portland, Oregon 97232
Office: (971) 673-1551 | Mobile: (503) 913-5749
yumei.wang@oregon.gov | www.oregongeology.org

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Unless otherwise indicated, all information in this correspondence is classified as Level 1, "Published" according to State of Oregon statute and administrative policy.

From:	ESTERSON Sarah * ODOE
To:	WANG Yumei * DGMI; Cavanagh, Suzy
Cc:	Konkol, Carrie; Hutchinson, Matthew
Subject:	RE: Bakeoven Solar DOGAMI consultation notes
Date:	Wednesday, April 03, 2019 1:09:59 PM
Attachments:	image001.jpg

Suzy,

Apologies on the delayed response on the consultation notes.

The Department provides additional comments related to Exhibit H, not specifically discussed during the Dec 21 2018 consultation, for consideration:

- Prior to submittal of the preliminary ASC Exhibit H
  - Please obtain confirmation from DOGAMI on Oregon State Board of Geologist Examiners geologic report guidelines to be followed in preparation of the Geologic Report
  - Please provide, for DOGAMI and ODOE review, a description of the site specific geotech work to be conducted and used to inform Exhibit H
    - If site specific geotech work is not conducted to inform Exhibit H, it is recommended that the evaluation and proposed design be based on Site Class D; any assumptions used to evaluate seismic and non-seismic risk should be cited or representative of reasonably conservative assumptions for the area.
- In preliminary ASC Exhibit H, the description of pre-construction site-specific geotechnical work should identify, to the extent possible, the methods to be used to finalize the evaluation of seismic and non-seismic hazards, and inform design and/or necessary mitigation

These recommendations are based on OAR Chapter 345 Division 21 requirements but that are often comments provided during review of Exhibit H.

Let us know if there are questions or comments.

Thanks,
Sarah

Sarah T. Esterson
Energy Facility Siting Analyst
Oregon Department of Energy
550 Capitol St NE, 1st Floor
Salem, OR 97301
P:(503) 373-7945
C: (503) 385-6128

Oregon.gov/energy

ODOE logo

From: WANG Yumei * DGMI
Sent: Wednesday, April 3, 2019 10:51 AM
To: Cavanagh, Suzy <Suzy.Cavanagh@tetratech.com>; ESTERSON Sarah * ODOE <Sarah.Esterson@oregon.gov>
Cc: Konkol, Carrie <Carrie.Konkol@tetratech.com>; Hutchinson, Matthew <matthew.hutchinson@avangrid.com>; WANG Yumei * DGMI <Yumei.WANG@oregon.gov>
Subject: RE: Bakeoven Solar DOGAMI consultation notes

Hi Suzy,

Please see attached, and let both Sarah and me know if you have any questions.

Yumei

Yumei Wang, P.E. | Resilience Engineer
Oregon Department of Geology and Mineral Industries (DOGAMI)
800 NE Oregon Street, Suite 965, Portland, Oregon 97232
Mobile: (503) 913-5749
yumei.wang@oregon.gov | www.oregongeology.org

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From: Cavanagh, Suzy <Suzy.Cavanagh@tetratech.com>
Sent: Tuesday, April 02, 2019 3:42 PM
To: WANG Yumei * DGMI <Yumei.WANG@oregon.gov>; ESTERSON Sarah * ODOE <Sarah.Esterson@oregon.gov>
Cc: Konkol, Carrie <Carrie.Konkol@tetratech.com>; Hutchinson, Matthew <matthew.hutchinson@avangrid.com>
Subject: RE: Bakeoven Solar DOGAMI consultation notes

Hi Yumei,
I am checking in on the Bakeoven Solar DOGAMI consultation notes to see if you have any comments based on your review.

Also, please verify the current guidelines to follow for the geologic report as questioned below.

Thank you,
Suzy

From: Cavanagh, Suzy
Sent: Friday, March 8, 2019 11:26 AM
To: WANG Yumei * DGMI <Yumei.WANG@oregon.gov>; ESTERSON Sarah * ODOE <Sarah.Esterson@oregon.gov>
Cc: Konkol, Carrie <Carrie.Konkol@tetratech.com>
Subject: Bakeoven Solar DOGAMI consultation notes

Hi Yumei,
Please find attached the consultation notes from the December 21, 2018 consultation meeting for the Bakeoven Solar Project for your review/comment/approval.

Something that we didn't discuss during the call was the current guidelines to follow for the geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines per OAR 345-021-0010(1)(h)(A). Can we assume that the geologic report should follow the 2014 Oregon State Board of Engineering Geology Reports?

Please let me know if you have any questions.

Thank you,
Suzy

Suzy Cavanagh, P.G. | **Project Manager**
Direct: 208.489.2868 | Cell: 208.871.0720
suzy.cavanagh@tetratech.com

Tetra Tech | Complex World, Clear Solutions™
3380 Americana Terr. Suite 201 | Boise, ID 83706 | www.tetratech.com

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Attachment H-2. Probabilistic Seismic Hazard Deaggregation at 475-Year Intervals

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Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 201

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

45.13996

Time Horizon

Return period in years

475

Longitude

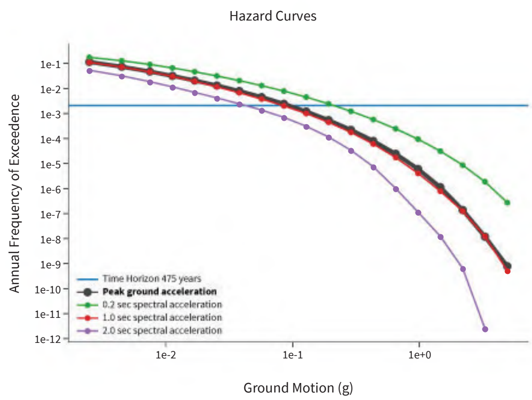
Decimal degrees, negative values for western lo…

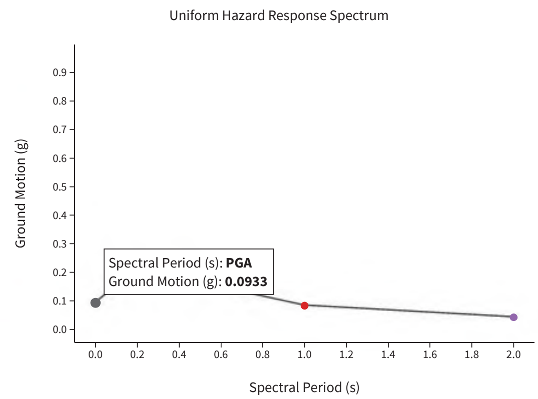
-120.88523

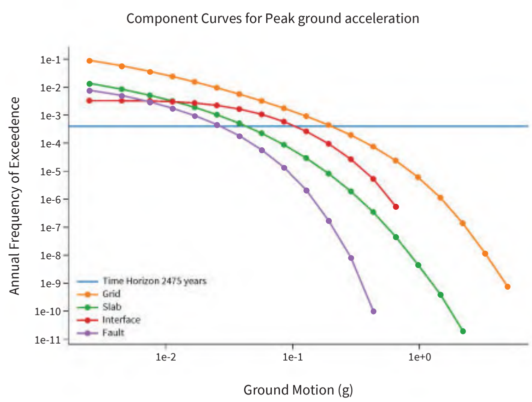
Site Class

537 m/s (Site class C)

Hazard Curve





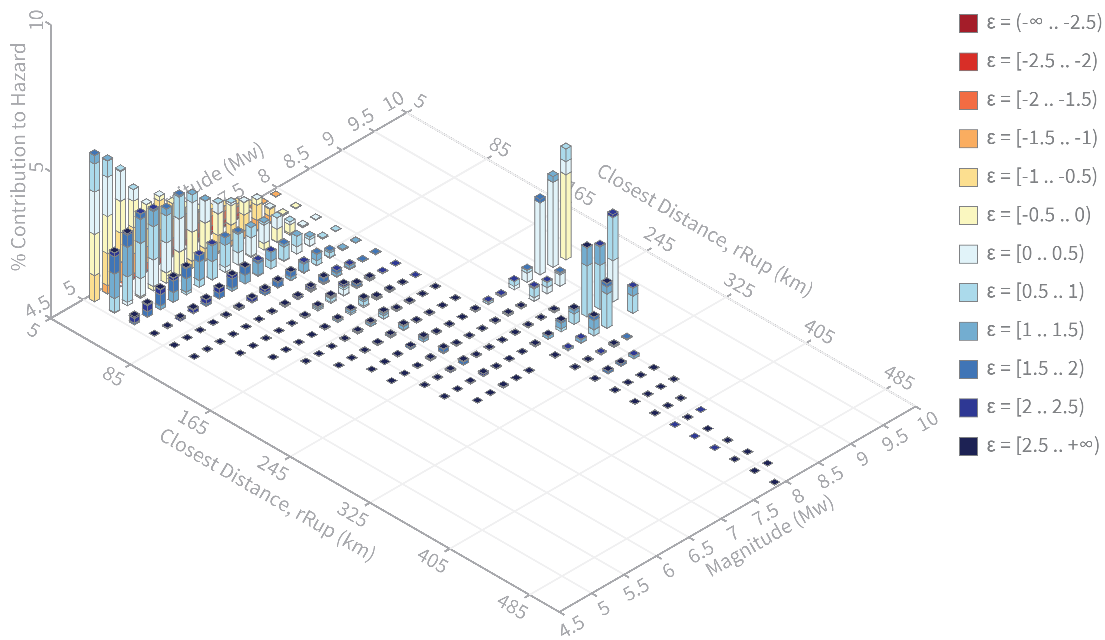


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs
Exceedance rate: 0.0021052632 yr^{-1}
PGA ground motion: 0.093298588 g

Recovered targets

Return period: 479.35706 yrs
Exceedance rate: 0.0020861276 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 1.07 %

Mean (for all sources)

r: 89.36 km
m: 6.8
ε_0: 0.27 σ

Mode (largest r-m bin)

r: 12.46 km
m: 5.1
ε_0: 0.09 σ
Contribution: 4.98 %

Mode (largest ε_0 bin)

r: 219.29 km
m: 9.34
ε_0: -0.08 σ
Contribution: 2.9 %

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
WUSmap_2014_fixSm.ch.in (opt)	Grid							9.68
noPuget_2014_fixSm.ch.in (opt)	Grid							9.68
WUSmap_2014_fixSm.gr.in (opt)	Grid							9.68
noPuget_2014_fixSm.gr.in (opt)	Grid							9.68
sub0_ch_bot.in	Interface							9.26
Cascadia Megathrust - whole CSZ Characteristic		219.29	9.10	0.20	123.599° W	45.501° N	281.69	9.26
sub0_ch_mid.in	Interface							6.99
Cascadia Megathrust - whole CSZ Characteristic		273.15	8.91	0.76	124.330° W	45.489° N	279.43	6.99
noPuget_2014_adSm.ch.in (opt)	Grid							6.32
WUSmap_2014_adSm.ch.in (opt)	Grid							6.31
noPuget_2014_adSm.gr.in (opt)	Grid							6.31
WUSmap_2014_adSm.gr.in (opt)	Grid							6.31
WUSmap_2014_fixSm_M8.in (opt)	Grid							2.37
noPuget_2014_fixSm_M8.in (opt)	Grid							2.37
sub0_ch_top.in	Interface							2.05
Cascadia Megathrust - whole CSZ Characteristic		288.52	8.81	0.93	124.549° W	45.485° N	278.92	2.05
noPuget_2014_adSm_M8.in (opt)	Grid							1.54
WUSmap_2014_adSm_M8.in (opt)	Grid							1.54
coastalOR_deep.in	Slab							1.18

Attachment H-3. Probabilistic Seismic Hazard Deaggregation at 2,475-Year Intervals

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Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 201

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

45.13996

Time Horizon

Return period in years

2475

Longitude

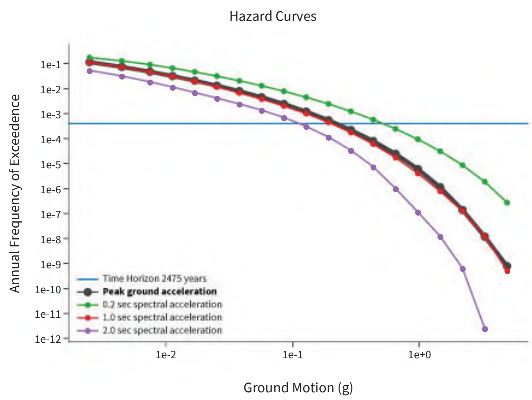
Decimal degrees, negative values for western lo…

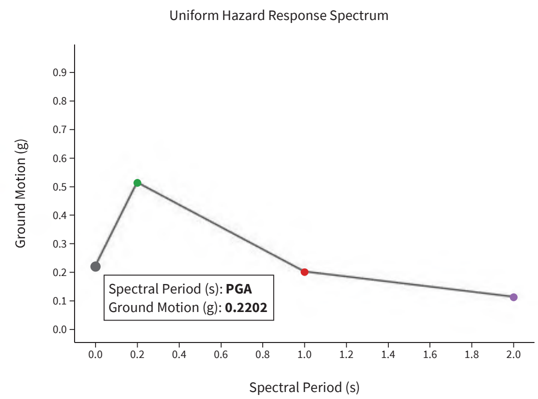
-120.88523

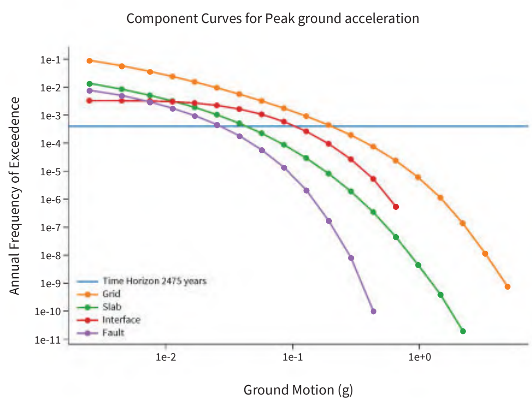
Site Class

537 m/s (Site class C)

Hazard Curve





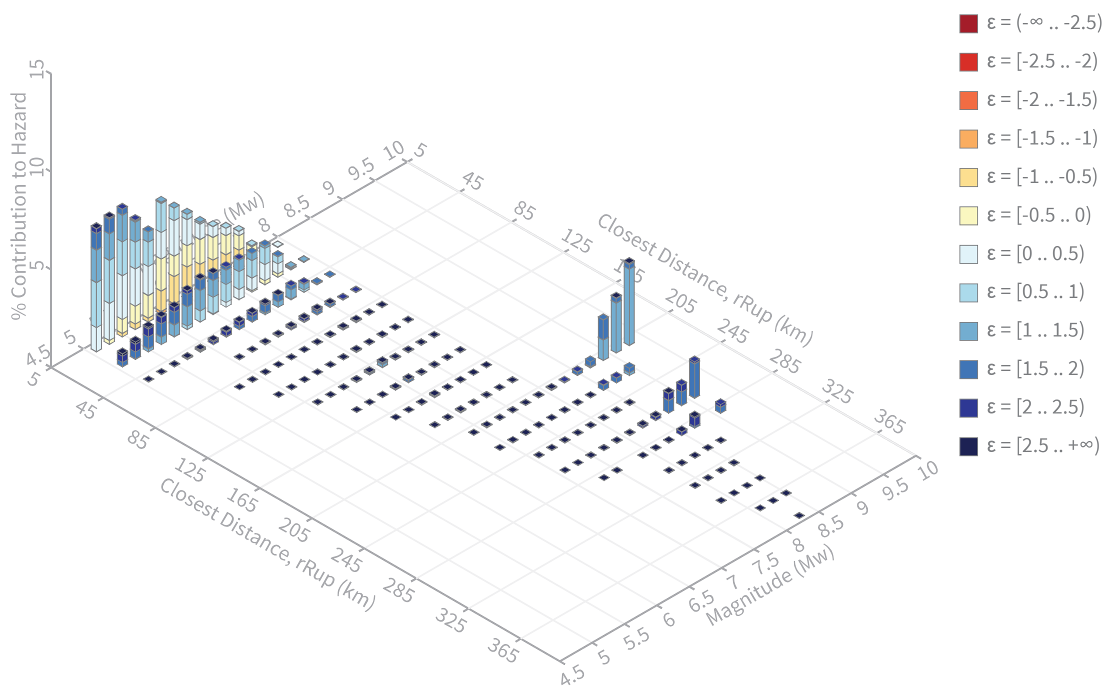


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.22023837 g

Recovered targets

Return period: 2525.0691 yrs
Exceedance rate: 0.00039602876 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.69 %

Mean (for all sources)

r: 55.75 km
m: 6.64
ε_0: 0.74 σ

Mode (largest r-m bin)

r: 11.7 km
m: 5.5
ε_0: 0.58 σ
Contribution: 6.52 %

Mode (largest ε_0 bin)

r: 219.29 km
m: 9.34
ε_0: 1.09 σ
Contribution: 3.9 %

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε0	lon	lat	az	%
WUSmap_2014_fixSm.ch.in (opt)	Grid							11.18
PointSourceFinite: -120.885, 45.180		6.84	5.70	-0.22	120.885° W	45.180° N	0.00	1.09
noPuget_2014_fixSm.ch.in (opt)	Grid							11.18
PointSourceFinite: -120.885, 45.180		6.84	5.70	-0.22	120.885° W	45.180° N	0.00	1.09
WUSmap_2014_fixSm.gr.in (opt)	Grid							11.18
PointSourceFinite: -120.885, 45.180		6.84	5.70	-0.22	120.885° W	45.180° N	0.00	1.09
noPuget_2014_fixSm.gr.in (opt)	Grid							11.18
PointSourceFinite: -120.885, 45.180		6.84	5.70	-0.22	120.885° W	45.180° N	0.00	1.09
sub0_ch_bot.in	Interface							8.89
Cascadia Megathrust - whole CSZ Characteristic		219.29	9.13	1.31	123.599° W	45.501° N	281.69	8.89
noPuget_2014_adSm.ch.in (opt)	Grid							7.14
noPuget_2014_adSm.gr.in (opt)	Grid							7.14
WUSmap_2014_adSm.ch.in (opt)	Grid							7.13
WUSmap_2014_adSm.gr.in (opt)	Grid							7.13
sub0_ch_mid.in	Interface							3.69
Cascadia Megathrust - whole CSZ Characteristic		273.15	8.94	1.91	124.330° W	45.489° N	279.43	3.69
WUSmap_2014_fixSm_M8.in (opt)	Grid							2.75
noPuget_2014_fixSm_M8.in (opt)	Grid							2.75
noPuget_2014_adSm_M8.in (opt)	Grid							1.76
WUSmap_2014_adSm_M8.in (opt)	Grid							1.76

Attachment H-4. Significant Historical Earthquakes within 50 Miles of the Facility

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Significant Historical Earthquakes within 50 Miles of the Project

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
1970	10	02	45.712167	-120.640167	2.7	37.62
1972	08	27	45.532833	-120.016167	2.5	47.79
1974	12	13	45.265000	-121.599000	4.1	27.86
1976	03	29	45.122167	-120.890333	3	0.21
1976	04	02	45.136167	-120.876333	3.2	0.00
1976	04	06	45.155333	-120.802333	3.2	2.91
1976	04	06	45.096667	-120.721000	3.4	5.86
1976	04	08	45.155333	-120.802333	3.8	2.91
1976	04	09	45.207667	-120.886667	3.5	1.20
1976	04	10	45.256167	-120.978833	2.8	4.43
1976	04	13	45.179500	-121.006833	3.3	0.67
1976	04	13	45.075667	-120.858833	4.6	2.06
1976	04	13	45.120667	-120.893667	3.4	0.38
1976	04	13	45.184500	-120.893667	2.6	0.13
1976	04	13	45.174500	-120.878333	2.6	0.00
1976	04	13	45.146500	-120.860333	3.1	0.08
1976	04	14	45.151667	-120.856833	2.8	0.47
1976	04	17	45.158500	-120.847333	4	1.11
1976	08	25	45.031833	-120.976667	2.7	6.93
1976	09	04	45.140500	-120.921667	2.9	0.00
1976	10	10	45.270333	-120.499500	3.6	18.89
1977	04	14	45.106167	-120.945500	2.8	1.97
1980	02	04	44.894167	-121.829000	2.6	43.93
1980	07	07	45.200000	-121.734333	3.2	34.05
1980	07	08	45.325667	-121.678333	2.9	32.59
1981	07	02	45.262167	-121.432833	2.6	19.88
1982	08	10	45.435167	-121.623333	2.5	33.10
1982	08	16	45.424833	-121.445500	2.5	25.54
1982	08	18	45.371667	-121.696667	3.4	34.44
1983	02	23	45.366667	-121.704167	2.7	34.67
1984	05	07	45.312500	-121.593667	2.9	28.37
1985	03	18	44.946167	-120.668667	2.53	13.85
1985	06	22	44.824667	-121.156167	2.8	23.65
1985	08	02	45.443000	-119.953333	2.6	47.94
1986	11	10	45.199667	-119.997167	2.5	41.67
1987	06	30	44.964500	-120.992833	2.8	11.19

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
1987	09	08	45.191167	-120.072000	3.1	37.97
1987	09	29	45.176167	-120.061167	2.7	38.36
1987	11	06	44.658833	-121.157667	2.5	33.74
1988	02	14	45.577000	-120.149333	2.5	44.03
1988	02	20	45.216333	-120.105667	2.7	36.65
1988	05	15	45.375000	-121.706833	2.5	34.99
1988	07	11	45.244667	-120.142167	2.9	35.36
1988	07	23	45.260167	-120.132833	2.6	36.09
1988	08	18	45.224000	-120.099500	2.7	37.05
1988	08	19	45.214500	-121.552833	2.5	25.21
1988	09	22	45.212833	-121.551667	2.6	25.15
1988	11	21	45.269667	-119.944167	2.5	45.14
1989	08	08	44.598333	-120.298333	2.8	44.01
1989	08	18	45.274500	-119.982667	2.7	43.41
1989	09	15	45.267000	-121.745000	2.8	34.92
1989	09	15	45.372667	-121.706833	3.5	34.93
1990	10	19	45.341000	-121.685833	3.5	33.25
1991	04	20	45.344500	-120.137833	2.8	37.25
1991	08	02	45.231667	-121.324667	2.5	14.27
1993	12	16	45.195833	-120.089833	3	37.16
1993	12	18	45.191833	-120.073167	2.9	37.92
1994	04	13	45.141667	-120.848000	2.8	0.60
1994	04	16	45.136167	-120.843000	2.6	0.61
1994	04	20	45.149667	-120.844500	2.5	0.82
1994	09	22	45.691500	-120.163333	2.9	48.70
1994	10	06	45.680667	-120.163500	2.7	48.17
1994	11	03	45.694000	-120.171833	2.6	48.53
1994	11	17	45.701167	-120.177500	2.7	48.70
1996	04	07	45.358833	-121.715333	3	35.00
1996	08	13	44.833167	-120.910833	2.8	18.88
1997	03	22	45.214000	-120.073667	2.7	38.15
1997	03	22	45.197333	-120.067167	3.9	38.27
1997	03	23	45.195167	-120.050833	3.1	39.03
1997	03	23	45.246333	-120.049333	3.1	39.78
1997	03	28	45.200500	-120.056167	2.6	38.83
1997	04	17	45.188500	-120.082000	3.2	37.46
1997	07	16	45.020000	-121.878500	2.6	42.86

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
1997	08	17	45.648333	-120.186333	2.8	45.83
1997	09	10	45.654333	-120.198000	2.7	45.71
1997	11	11	45.851000	-120.564667	2.8	47.87
1998	02	05	45.310333	-121.720833	2.6	34.32
1998	02	05	45.320667	-121.728000	2.5	34.83
1998	04	10	45.354833	-121.696167	2.6	34.02
1998	04	14	45.275833	-120.288833	2.7	28.97
1998	04	24	45.807667	-120.916000	2.5	42.57
1998	04	28	45.258833	-120.281000	2.7	29.14
1998	08	07	45.590000	-121.591000	2.5	38.46
1998	08	12	45.166333	-120.018500	2.8	40.36
1998	09	10	44.661667	-121.138333	2.9	33.18
1998	10	31	45.102333	-120.822500	2.7	0.89
1998	11	01	45.100000	-120.833167	2.9	0.51
1999	01	11	45.324500	-121.655500	2.5	31.50
1999	01	11	45.323167	-121.654333	3	31.42
1999	01	11	45.319500	-121.654500	3.2	31.35
1999	01	14	45.330333	-121.669833	3.2	32.28
1999	01	14	45.324167	-121.663833	3	31.88
1999	02	15	45.319500	-121.656333	2.6	31.44
1999	02	18	44.397000	-121.016333	2.9	49.42
1999	03	21	45.180333	-120.032333	2.9	39.79
1999	05	10	44.652000	-121.147667	3	33.98
1999	06	03	44.749500	-120.977833	2.7	25.06
1999	08	31	45.186333	-120.090833	3.5	37.01
1999	09	04	45.177500	-120.077167	2.9	37.60
2000	01	30	45.197167	-120.124833	4.1	35.48
2000	01	30	45.193333	-120.111833	2.6	36.07
2000	01	30	45.183167	-120.102833	3.4	36.40
2000	01	30	45.181667	-120.109167	2.8	36.08
2000	02	01	45.190000	-120.112667	3.6	35.99
2000	02	01	45.186667	-120.118000	2.8	35.70
2000	02	21	45.682833	-120.124833	2.5	49.63
2000	02	29	45.189500	-120.118333	2.5	35.71
2000	04	28	44.743667	-121.219833	2.7	30.04
2000	07	25	45.337167	-121.675833	2.6	32.70
2000	07	28	45.170167	-120.135000	2.6	34.73

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
2000	08	03	45.208667	-120.073333	2.8	38.10
2000	08	17	45.312000	-120.041500	3.2	41.29
2001	06	15	45.201667	-120.107667	2.5	36.36
2001	06	18	45.189667	-120.110167	2.6	36.11
2001	09	14	45.307167	-121.730667	2.9	34.74
2001	09	15	45.305833	-121.729333	2.5	34.66
2001	12	03	45.334833	-121.734333	2.6	35.39
2002	01	31	45.685167	-120.166000	2.7	48.30
2002	05	06	45.324500	-121.685667	2.5	32.91
2002	05	06	45.329667	-121.688000	2.8	33.12
2002	05	06	45.329500	-121.687833	2.5	33.11
2002	06	29	45.334833	-121.686333	4.5	33.14
2002	06	29	45.327500	-121.681500	3.2	32.77
2002	06	29	45.342333	-121.679833	3.8	33.00
2002	06	29	45.320167	-121.687500	2.5	32.92
2002	06	30	45.344167	-121.677000	2.7	32.90
2002	07	02	45.340500	-121.679833	2.9	32.96
2002	07	11	45.335667	-121.681500	2.5	32.93
2002	08	09	45.328833	-121.682667	2.6	32.85
2002	08	21	44.654000	-121.136167	3	33.63
2002	10	14	45.131167	-120.011333	2.6	40.56
2002	10	25	45.192667	-120.093667	2.7	36.94
2002	10	25	45.184333	-120.065000	2.5	38.24
2002	12	12	45.364333	-121.698667	2.7	34.36
2003	01	17	45.680167	-120.177500	2.9	47.66
2003	05	16	45.627833	-120.274833	2.6	41.78
2003	05	18	45.193833	-120.120333	2.7	35.66
2003	06	01	45.194000	-120.113167	2.8	36.01
2003	07	07	45.327333	-121.685667	3.3	32.96
2004	01	15	45.363833	-121.689167	2.5	33.91
2004	03	08	45.642333	-120.200500	2.5	45.04
2004	03	31	45.694167	-120.167167	2.6	48.70
2004	07	18	44.393000	-121.006000	2.6	49.62
2005	04	06	45.372833	-121.706333	2.8	34.91
2006	08	21	45.803500	-120.353333	2.6	49.13
2006	12	30	45.121500	-120.937167	2.6	0.90
2007	01	01	45.120333	-120.933333	2.5	0.93

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
2007	01	04	45.118833	-120.932333	3	1.03
2007	01	08	45.685500	-120.162000	2.7	48.46
2007	01	20	45.128167	-120.948667	3	0.55
2007	02	02	45.121667	-120.950167	2.5	0.98
2007	02	13	45.123667	-120.941667	2.9	0.75
2007	02	13	45.119000	-120.930667	2.7	1.01
2007	03	01	45.123833	-120.934167	3.6	0.70
2007	03	15	44.404500	-121.026833	3	48.98
2007	03	22	44.646167	-121.183500	3	35.06
2007	04	01	45.127000	-120.948667	2.6	0.62
2007	04	08	45.127167	-120.955667	3.2	0.84
2007	05	02	45.127167	-120.942000	3.3	0.51
2007	05	02	45.800000	-120.333667	2.6	49.42
2007	05	16	45.131667	-120.952667	2.5	0.56
2007	06	03	45.127333	-120.957333	2.7	0.90
2007	06	10	45.123833	-120.934667	2.6	0.71
2007	06	14	45.125667	-120.944000	3.8	0.62
2007	07	13	44.394833	-121.019167	2.6	49.58
2007	07	16	45.122500	-120.937333	2.5	0.83
2007	07	19	45.121333	-120.948667	2.6	0.97
2007	08	01	44.659000	-121.161833	2.9	33.81
2007	08	20	45.125667	-120.946000	2.9	0.65
2007	09	10	44.594667	-121.196167	2.6	38.56
2007	11	21	45.129833	-120.941333	3.3	0.33
2007	11	28	45.549167	-120.748167	2.5	25.36
2007	11	30	45.713833	-120.182167	2.8	49.17
2008	01	03	45.127000	-120.946000	2.7	0.56
2008	02	04	45.128833	-120.942333	3.3	0.40
2008	02	11	44.650667	-121.140833	2.7	33.93
2008	02	16	45.064000	-121.319500	2.6	16.41
2008	03	10	45.128000	-120.953333	2.5	0.72
2008	03	20	45.129500	-120.942833	3.1	0.35
2008	03	31	45.696833	-120.169667	2.8	48.75
2008	04	05	45.130000	-120.942500	3.6	0.32
2008	04	10	45.689167	-120.260000	2.5	45.38
2008	04	16	45.130833	-120.947000	2.9	0.36
2008	04	28	45.125833	-120.953833	3.1	0.84

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
2008	05	07	44.621833	-121.152333	2.7	35.99
2008	05	09	45.136667	-120.959833	2.7	0.51
2008	06	01	45.132000	-120.953500	3.4	0.59
2008	06	05	45.143667	-120.953500	2.6	0.06
2008	06	20	45.129333	-120.938667	3.2	0.36
2008	07	14	45.128667	-120.950000	4.2	0.56
2008	07	29	45.637000	-120.615333	2.7	33.13
2008	08	28	45.631333	-120.746167	2.9	30.93
2008	09	02	45.576500	-121.585833	2.5	37.62
2008	09	16	45.129500	-120.949167	2.7	0.50
2008	11	16	45.130667	-120.953500	3.4	0.62
2008	12	27	45.131000	-120.951333	3.6	0.52
2009	01	22	45.691333	-120.890833	2.6	34.49
2009	03	20	45.135167	-120.959000	3	0.56
2009	04	20	45.133500	-120.955000	3.6	0.58
2009	04	20	45.130167	-120.946333	2.5	0.37
2009	05	06	45.702333	-120.175500	2.6	48.82
2009	05	11	44.659167	-121.167833	2.5	33.92
2009	05	15	45.538333	-120.528833	2.7	29.12
2009	06	06	45.122500	-120.942833	2.6	0.83
2009	07	18	45.129167	-120.962667	2.8	1.01
2009	07	20	45.659000	-120.237500	2.5	44.58
2009	08	18	44.816000	-121.336500	2.6	29.12
2009	10	24	45.125833	-120.945667	2.5	0.63
2009	11	30	45.706167	-120.185167	2.6	48.69
2010	01	02	45.137000	-120.955500	3.6	0.36
2010	03	01	45.708667	-120.227833	2.5	47.42
2010	05	14	45.359500	-121.752167	3	36.72
2010	07	29	45.648500	-120.095333	2.7	49.15
2010	08	28	44.806833	-121.319500	2.7	29.13
2010	09	09	44.637500	-121.180500	2.5	35.54
2010	12	30	45.131500	-120.932000	3.6	0.17
2011	03	02	45.355667	-121.760667	2.6	37.03
2011	03	27	45.130667	-120.938167	2.5	0.27
2011	04	05	45.122000	-120.954333	2.7	1.06
2011	08	22	44.801667	-121.323500	2.6	29.54
2011	10	18	45.123167	-120.938667	2.9	0.79

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Site Boundary
2012	04	08	45.185333	-121.708500	2.66	32.79
2013	08	14	45.297667	-121.753833	2.73	35.71
2014	09	04	45.366500	-121.713833	2.56	35.10
2015	05	15	45.202167	-121.268500	2.92	11.29
2017	10	10	45.320667	-121.686167	2.75	32.86

Attachment H-5. Ground Response Spectra Assessment (Site Class D)

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EXHIBIT H

Attachment H-5 Ground Response Spectra Assessment

Source: USGS Seismic Design Web Service Documentation

Available at //earthquake.usgs.gov/ws/designmaps

Web services provided by the U.S. Geological Survey for computing seismic design parameters compatible with various building code reference documents. The seismic design parameter output was based on selection of the 2015 IBC Standards and the selection of a "Site Class D" for the Project. Site identification such as latitude, longitude and risk category are entered and the output includes the following seismic design parameters: mapped spectra response acceleration parameters (S_s and S_1), site coefficients (Fa and Fv) for adjusting S_s and S_1 to produce the MCE spectral response acceleration parameters (S_{MS} and S_{M1}), and the design spectral response acceleration parameters (S_{DS} and S_{D1}).

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