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SUBJECT: Forwards summary of facility geology program, in support of 810127 meeting w/NRC in Bethesda,MD.

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Washington Public Power Supply System
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January 21, 1981

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Attention: Mr. B. J. Youngblood, Chief
Licensing Branch 1
Division of Licensing

Gentlemen:

Subject: WPPSS NUCLEAR PROJECT NO. 2
BACKGROUND MATERIAL FOR JANUARY 27, 1981 MEETING
ON GEOLOGY

Attached is a brief summary of the program being implemented by the Supply System to address geology issues related to WNP-2. This material may be useful to personnel in the Geosciences Branch as background information for the upcoming meeting on January 27, 1981, in Bethesda.

Very truly yours,

G. D. Bouchey
Director - Nuclear Safety

ew
Attachment

cc: MD Lynch - NRC-DOL
RE Jackson - NRC-GSB
P Justus - NRC-GSB - telecopy
A Toth - NRC Regional Inspector
JJ Verderber - B&R/NY
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WASHINGTON PUBLIC POWER SUPPLY SYSTEM
HANFORD GEOLOGY PROGRAM
January 1981

A geotechnical program has been developed to investigate geological and seismological issues relating to Hanford and to provide the necessary licensing support to obtain Operating Licenses for WNP-2 and WNP-1/4. It is the Supply System's position that, given the existing data, the present safe shutdown earthquake (SSE), based on an intensity VIII (MM) occurring at the site, is adequate and conservative. The geotechnical program is being undertaken to evaluate geological/seismological information.

The Hanford Geology Program is being conducted by the Supply System's Technical Directorate organization for both the WNP-2 and WNP-1/4 Projects. A Working Group and Senior Management Review Committee have been formed to provide program overview and direction. The Technical, Nuclear Safety, WNP-2 and WNP-1/4 Projects organizations are represented on each committee to assure that the program is properly focused, capable of attaining the required objectives, and progressing satisfactorily. The program is managed on a full time basis by Mr. W.W. Waddel, who is responsible for planning, budgeting, scheduling and implementation of the program. Technical direction of the program is provided by Mr. D.D. Tillson.

The program has been scheduled to support submittal of one amendment to the WNP-2 FSAR in April 1981 and a follow-on amendment in September 1981 at the conclusion of the ongoing field studies. A complete Chapter 2.5 will be produced for submittal with the WNP-1/4 FSAR in December 1981.

The Hanford geology program consists of five broad activities. These activities, planned to be completed in FY 81 and early FY 82, are

discussed below. Other potential geotechnical issues which have previously been addressed by the Supply System and are adequately understood for the present are discussed briefly in Attachment 1.

1. Regional Studies - The purpose of the regional studies is to augment our understanding of the regional geologic-tectonic framework and document recent updated material for inclusion in the FSAR. Three issues which are addressed by the present program are:

   a. Toppenish Ridge - The USGS and the Washington State Department of Natural Resources recently reported faulting on Toppenish Ridge (Campbell and Bentley, 1979; Bentley, 1980). Initial investigations by the Supply System on Toppenish Ridge will be of a reconnaissance nature with limited detailed geological mapping and some trenching to determine, if possible, whether the faults are tectonic or gravity in origin. If it is indicated that the faults are tectonic, additional studies will be undertaken to the extent necessary for determining capability. If the faults are gravity in origin (e.g., result of landslides), additional studies may be undertaken to determine if this process is typical of all the fold structures and, therefore, possibly the process responsible for the faults on Gable Mountain.

   b. Cle Elum-Wallula Lineament - The Cle Elum-Wallula Lineament (CLEW) lies between the east side of the Cascades and the west side of the Blue Mountains. This lineament is an apparent structural zone that could be a potential source for an earthquake. The significant geologic features that will be investigated are Umtanum Ridge-Gable Butte-Gable Mountain, Rattlesnake-Wallula, Manashtash-Saddle Mountains. The regional geologic-tectonic framework, within which the source and size of

any potential earthquake on CLEW can be understood, will be developed. An understanding of the seismicity, or lack thereof, in the Columbia Plateau will be developed.

c. Completion of Regional Data Sets - A number of tasks are required to complete the regional geologic-tectonic description and evaluate new information developed since 1978 when the WNP-2 FSAR was filed. No new studies are proposed and all work is considered to be clean-up and preparation of final maps and text for inclusion in the revised WNP-2 and new WNP-1/4 SAR's.

2. Area Studies - The purpose of the area studies is to understand in sufficient detail the geological structures in the immediate area surrounding the site to permit establishing unequivocally the capability of the structures and the potential for future damaging earthquakes that might impact the seismic design. The three most important structures associated with the area studies for which tasks are proposed in the present program are the Manashtash-Saddle Mountain System, Rattlesnake-Wallula System, and Umtanum Ridge-Gable Butte-Gable Mountain System.

a. Manashtash-Saddle Mountain System - The Manashtash-Saddle Mountain system structures have evidence of faulting and are geologically similar to the other structures in the Hanford area. Saddle Mountain is the most probable location of the 1918 Corfu earthquake and presently exhibits the most microseismic activity of any structure in the Columbia Plateau. The Manashtash-Saddle Mountains are not expected to be the controlling source of the SSE because of the distance of this structure from the site and the similarity to other structures closer to the site. Hence, no further geologic work directly related

to this feature is planned at this time. However, we are installing additional seismic stations between Saddle Mountain, Gable Mountain-Gable Butte and the site to study in more detail microearthquake occurrences in the area and to help identify any potential source structures at depth under the Hanford area.

b. Rattlesnake-Wallula System - The Rattlesnake-Wallula system is defined in the WNP-2 FSAR as the source of the SSE. The Supply System will reevaluate the earthquake potential for this system in order to be assured that the present seismic design is adequate and conservative. A number of factors will influence the size and location of an SSE on this system. These factors include knowledge of the:

- origin of any faults to establish if they are tectonic,
- length, depth and dip of fault planes that might be postulated to rupture,
- amount and sense of fault displacement and/or slip rates,
- time of last significant fault movement,
- closest location on the structure (both laterally and in terms of depth) relative to the site of any potential earthquake sources.

The program to assess these factors is:

(1) Development of a more detailed geologic map from the southeast end of Rattlesnake Mountain to Wallula Gap.

(2) Trenching along Bingham's linear in the area of Warm Springs (Wallula Fault) to either show the fault does not extend through this area or, if faulting is confirmed, to determine the time of last fault movement, the sense and amount of displacement, and determine the slip rates for the fault.

(3) Study the Pasco Basin Quaternary formations (such as clastic dikes) which are associated with faulting to bracket age of movement.

(4) Additional quantitative analysis of the aeromagnetic data to assist in determining the distribution of shallow potential faulting.

(5) Additional quantitative analysis of the gravity data to assist in determining fault location and distribution at depth and determine if and/or how the surface faults are connected to any faults at depth.

(6) Analyze existing seismic reflection data along the Columbia River to determine its applicability for showing sub-basalt structures. If this analysis indicates the technique is applicable, then consideration will be given to collecting additional reflection data on the Yakima River where it cuts the Rattlesnake-Wallula structure and the Columbia River on the east side of the Hanford Project area and through Saddle Mountain at Sentinel Gap.

(7) Perform additional analysis of microearthquake data to determine the significance and to define, if possible, source locations more accurately. If the microearthquakes are relocated and found to be primarily random it would support the position that they are a low stress drop phenomena unrelated to any significant faults.

c. Umtanum Ridge-Gable Butte-Gable Mountain System - New geologic information has recently come to our attention on the Umtanum Ridge-Gable Butte-Gable Mountain structures. At the present time, NESCO is responsible for all geological and geophysical studies of these structures in full cooperation with the Supply System. It is anticipated that the NESCO program when completed will provide sufficient information upon which reliable judgments can be made about the capability of the Umtanum Ridge-Gable Mountain lineament. The following tasks will be conducted by the Supply System to support and supplement the NESCO studies:

(1) Install approximately six additional short period seismograph stations between Saddle Mountain, Gable Butte-Gable Mountain, and the WNP sites to permit better resolution and location of the shallow microearthquakes and determine if there is any relationship with potential faults. Relocate the microearthquakes using a three-dimensional velocity model developed from the joint inversion of gravity and seismic data.

(2) Reprocess and analyze seismic reflection data along the Columbia River between Wallula Gap and The Dalles to determine its applicability for showing

inter-basalt and sub-basalt structures. If this work shows the technique to be useful, then collection of additional reflection data will be considered for the north-south stretch of the Columbia River along the east side of the Hanford Reservation to determine the eastward extension of the Gable Mountain structure and its sub-surface manifestations.

(3) Study the Pasco Basin Quaternary formations (e.g., clastic dikes) which are associated with faulting to bracket age of movement.

3. Site Studies - The purpose of the site studies is to further assess the feasibility and practicality of developing a site dependent response function given the geologic and seismic data available. Three issues are being addressed in this part of the program:

a. Source Function - The source energy that would be produced by specific faults presumed for an SSE will be estimated. This will be accomplished to the extent possible using strong motion records taken from earthquakes which have occurred worldwide. These data from similar size earthquakes recorded in soils and structures similar to the Hanford source site conditions will be emphasized. Additional data from local earthquakes which may possibly be obtained from the broadband seismographs and, if available, strong-motion seismographs will be used.

b. Attenuation - The source function estimated for potential SSE's will need to be attenuated between the source and the site. Depending on the local characteristics and geometry of

the soils and rock layers, both vertical and lateral inhomogenities may have to be considered. A limited amount of these data are presently available. Additional data on the propagation characteristics of local earthquake generated sources may need to be obtained depending on results of an early sensitivity analysis.

c. Soil/Structure Interaction - The potential effect and sensitivity of the site to soil/structure interaction will be considered. Initially the study will essentially be a state-of-the-art assessment and determination of applicability to the Hanford Area.

4. SAR AND LICENSING:

The purpose of these activities is to produce a unified and consistent Chapter 2.5 of the FSAR for WNP-2 and WNP-1/4 and to provide licensing support until OL's are obtained.

5. RESPONSE TO NEW INFORMATION:

The purpose of this activity is to permit the Supply System to be in a position to identify and analyze new geotechnical information as it becomes available and to determine any potential impact on the current design.

a. Analyze Reports and Data from Outside Sources - Reports of information, data and analyses relative to geotechnical issues which have the potential for impacting the Hanford SSE are occasionally developed by various entities. A partial listing of the sources includes USGS, National Waste Terminal Storage Program, DOE and Hanford Contractors (United Nuclear, Westinghouse, Rockwell, Battelle), NESCO, and various academic institutions. In most cases, the new information, upon evaluation,

will not impact the SSE and can be incorporated with our present data base with some ease or dismissed as erroneous based on our information. However, some of the data and reports may need extensive evaluation to determine the significance and materiality relative to the SSE. Some of the present new information we will be addressing includes:

- o DOE/Rockwell multilevel aeromagnetic, magnetotelluric and seismic reflection data.

- o Western Geophysical seismic reflection data along the Columbia River.

b. Local Earthquake Monitoring - Should a moderate to large earthquake occur in the Columbia Plateau, it would be important to know as much about the source as possible. The capability to deploy a portable seismic array for aftershock monitoring is being pursued. In addition, the Supply System will install and operate seven additional strong-motion seismographs on and around the Columbia Plateau to provide, if an earthquake occurs, as much data on source functions and attenuation of seismic energy in the Columbia Plateau as possible.

ATTACHMENT 1

GEOTECHNICAL ISSUES PRESENTLY RESOLVED

The following geotechnical issues have previously been addressed by the Supply System and are adequately understood.

1. Plate Tectonics - The interactions between the North American continental plate and the Juan de Fuca oceanic plate appear to be a major driving function for contemporary geological processes in the Pacific Northwest. A basic understanding of northwest plate tectonics presently exists, although a number of the details are not well understood. No active program for improving our knowledge of plate tectonics is proposed as part of the Hanford Studies. We will continue to follow developments in this area as they occur through the normal course of our licensing work.

2. Olympic-Wallowa Lineament - Numerous investigations going back to pre-FFTF siting at Hanford have proposed a fault system extending from the Olympic Mountains in northwest Washington, southeast across the Cascades, along the Yakima Ridges encompassing Rattlesnake Mountain and across the northern edge of the Wallowa Mountains in Oregon. Some proposals have even extended this system into Idaho. Such a system, if it existed, would have the potential for producing large earthquakes. Previous work by the Supply System supports our contention that the Olympic-Wallowa lineament is not a continuous fault system. The system length, if it exists, has been limited geographically by studies of the Blue Mountains-LaGrande graben area on the southeast and by studies of the Straight Creek-Snoqualmie Pass area in the Cascade Mountains. Analysis of gravity data west of the Hanford project area indicates that any movement in the last 10+ million years has been limited to less than 0.5 km.

3. Straight Creek Fault - The Straight Creek fault that runs north-south along the Cascade Mountains axis has been postulated as a northern divergent extension of a portion of the hypothetical Olympic-Wallowa system. The northern extension of the Straight Creek fault in Canada is believed by some to be the source of the December 14, 1872 Earthquake. Geologic mapping near the southern end of the Straight Creek fault by the Supply System found no positive evidence for recent deformation along the Straight Creek fault trend. Recent reconnaissance mapping in the Chilliwack Batholith by Joe Vance (University of Washington), could find no evidence that this part of the fault is active.

4. Chiwaukum-Methow-Republic Grabens - These three distinct northern trending grabens occur at the north-northwest edge of the Columbia Plateau. It has been postulated that bounding faults extend for significant distances south under the Columbia Plateau and may converge into a single larger graben. Geologic studies demonstrated that these grabens are composed entirely of pre-Miocene materials and no significant post-Miocene faulting has occurred. No further direct studies are proposed on this issue.

5. Brothers Fault Zone - The Brothers Fault Zone is believed to form the southern boundary of the Columbia Plateau tectonic province. While there is a lack of detailed geologic mapping along this zone, there is sufficient evidence to support the position that it is the divide between the Columbia Plateau and the Basin and Range province to the south. Should future information challenge this position, additional studies of this area would be considered.