ClinchRiverESPHFNPEm Resource

From: Fetter, Allen
Sent: Wednesday, July 19, 2017 1:31 PM
To: Schiele, Raymond Joseph
Cc: Sutton, Mallecia; pshastings (pshastings@tva.gov); ClinchRiverESPSafRAINPEm Resource; Colaccino, Joseph; Dudek, Michael; Rodriguez, Ricardo; Wang, Weijun; Stieve, Alice; Stirewalt, Gerry; Bauer, Laurel; Heeszel, David
Subject: Draft RAIs pertaining to Section 2.5.1, Basic Geologic and Seismic Information (RAI Number 5, eRAI-8991) and Section 2.5.4, Stability of Subsurface Materials and Foundations (RAI Number 6, eRAI-9035)
Attachments: CRNS ESP Draft RAI GEO-05_8991.pdf; CRNS ESP Draft RAI GE-06 9035.pdf

Good Afternoon,

Attached are draft RAIs pertaining to Section 2.5.1, Basic Geologic and Seismic Information (RAI Number 5, eRAI-8991), and Section 2.5.4, Stability of Subsurface Materials and Foundations (RAI Number 6, eRAI-9035), for the Clinch River Nuclear Site ESP application review.

These is the 5th and 6th draft safety RAIs prepared (Number 5 & 6) for the Clinch River Nuclear Site ESP application review, and they have unique e-RAI identifying numbers of eRAI-8891 and eRAI-9035, respectively.

TVA has ten working days to review these draft RAIs and to decide whether a conference call is needed to clarify any of portion of the RAIs and/or if TVA identifies any proprietary information or security-related information (SRI) located in the question(s). After the call, or after ten days, NRC will finish processing the RAIs through the eRAI system and issue them to TVA as a final RAIs. Subsequent to receipt of the final RAIs, TVA will have 30 calendar days to respond to the RAIs unless additional time is specifically requested.

Please let me know if you have any questions.

Thanks,

Allen H. Fetter, Senior Project Manager
U.S. Nuclear Regulatory Commission
Office of New Reactors
Division of New Reactor Licensing
Licensing Branch 3
Washington, D.C.

301-415-8556 (Office)
301-385-5342 (Mobile)

Hearing Identifier: ClinchRiver_ESP_HF_NonPublic
Email Number: 196

Mail Envelope Properties (Allen.Fetter@nrc.gov20170719133000)

Subject: Draft RAIs pertaining to Section 2.5.1, Basic Geologic and Seismic Information (RAI Number 5, eRAI-8991) and Section 2.5.4, Stability of Subsurface Materials and Foundations (RAI Number 6, eRAI-9035)
Sent Date: 7/19/2017 1:30:44 PM
Received Date: 7/19/2017 1:30:00 PM
From: Fetter, Allen

Created By: Allen.Fetter@nrc.gov

Recipients:
"Sutton, Mallecia" <Mallecia.Sutton@nrc.gov>
Tracking Status: None
"pshastings (pshastings@tva.gov)" <pshastings@tva.gov>
Tracking Status: None
"ClinchRiverESPSafRAINPEm Resource" <ClinchRiverESPSafRAINPEm.Resource@nrc.gov>
Tracking Status: None
"Colaccino, Joseph" <Joseph.Colaccino@nrc.gov>
Tracking Status: None
"Dudek, Michael" <Michael.Dudek@nrc.gov>
Tracking Status: None
"Rodriguez, Ricardo" <Ricardo.Rodriguez@nrc.gov>
Tracking Status: None
"Wang, Weijun" <Weijun.Wang@nrc.gov>
Tracking Status: None
"Stieve, Alice" <>
Tracking Status: None
"Stirewalt, Gerry" <Gerry.Stirewalt@nrc.gov>
Tracking Status: None
"Bauer, Laurel" <Laurel.Bauer@nrc.gov>
Tracking Status: None
"Heeszel, David" <David.Heeszel@nrc.gov>
Tracking Status: None
"Schiele, Raymond Joseph" <rjschiele@tva.gov>
Tracking Status: None

Post Office:

Files	Size	Date & Time
MESSAGE	1351	7/19/2017 1:30:00 PM
CRNS ESP Draft RAI GEO-05_8991.pdf	121484	
CRNS ESP Draft RAI GE-06 9035.pdf	89741	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Draft Request for Additional Information, Number 5, eRAI-8991
Draft Issue Date: 07/19/2017
Application Title: Clinch River Nuclear Site, ESP
Operating Company: Tennessee Valley Authority
Docket No. 52-047
Review Section: 02.05.01 - Basic Geologic and Seismic Information
Application Section: 2.5.1

QUESTIONS

02.05.01-01

Prior Earthquake Effects

SSAR (Rev 0) Section 2.5.1.2.6.6 *Prior Earthquake Effects,* states that "because it (CRN) is within a zone of elevated seismicity, the CRN site vicinity (25 mile radius) has been extensively evaluated for the presence of paleoseismic features such as those resulting from paleoliquefaction". The SSAR (Rev 0) indicated that this evaluation included geologic field reconnaissance, geologic and geomorphologic mapping, and trench logging of Quaternary terrace deposits along the Douglas Reservoir, Tellico Reservoir and Watts Bar Reservoir. Supplemental information provided in CNL-16-162 and CNL-16-170 provides details regarding the Douglas Reservoir investigation, about 50+ mi to the east of the CRN site.

The presence of paleoliquefaction features is a potentially significant contributor to the demonstration of compliance with 10 CFR 100.23 (c-d). Because insufficient paleoliquifaction feature data were included in the SSAR (Rev 0) sections associated with the Watts Bar and Tellico Reservoirs, please provide details regarding the specific investigation of the paleoliquefaction evaluation within the 25 mile radius of the CRN site. In particular, provide the field reconnaissance information obtained along the Clinch River arm of the Watts Bar and Tellico Reservoirs and provide the associated relevant source documentation.

02.05.01-02

Residual Stresses in Bedrock

SSAR (Rev 0) Section 2.5.1.2.6.7 *Residual Stresses in Bedrock* and in SSAR section 2.5.1.2.5.2 *Other Local Geologic Hazards* indicates that the natural state of stress in a rock is caused by three main factors (Reference 2.5.1-270): previous tectonic forces, current tectonic forces, and weight of the rock. The SSAR provides discussion of previous tectonic forces and the weight of the rock. However, this SSAR section does not discuss the third factor, the current tectonic forces in the area, such as the ETSZ or the current (since Miocene) regional uplift in the southern Appalachians. An understanding of rock stress is a fundamental component of compliance with 10 CFR 100.23 (c-d). Consequently, please provide a discussion of current tectonic forces and develop a rationale for how they might affect residual stress in bedrock and the site.

02.05.01-03

Geophysical Data

SSAR (Rev 0) Section 2.5.1.2.4.2.1 *Geophysical Data*, identifies two seismic reflection surveys, SRL-1 and SRL-2, conducted at the CRN Site. The SSAR (Rev 0) concludes that the many anomalies in the data could not be resolved by various processing routines and that none of the Alleghenian thrust faults that are located within the site location were identified in these data.

In addition, SSAR (Rev 0) Section 2.5.1.2.5.1 *Karst Hazards*, uses the same seismic reflection profiles to conclude that continuous, uninterrupted bedding at depth beneath the site suggests that large hypogenic karst collapse features are not present.

Staff notes that SSAR (Rev 0) Section 2.5.1.2.5.1.1 *Karst in the Site Vicinity and Area,* describes seismic reflection and seismic refraction data at the ORR used to identify buried sinkholes (Doll et al., 2005). Doll et al conclude that seismic reflection was less successful detecting voids within the bedrock; that seismic reflection data do not accurately represent the structure of the karst features; and that karst was found to significantly influence the quality of stacked seismic reflection profiles.

These features (tectonic faults and karst related voids) represent potentially adverse site conditions that affect compliance with 10 CFR 100.23 (c-d). However, based on the information provided in the SSAR (Rev 0), as well as the Doll et al. 2005 publication, it seems that neither karst voids nor known thrust faults at the site can be reliably identified by this geophysical method. Provide a technical basis for the applicability of the CRN seismic reflection investigations to resolve thrust structures (blind or otherwise) and voids and draw conclusions based on the seismic reflection. Including limits at which such features may be present but undetected at the site.

02.05.01-04

Shear Fracture Zone

SSAR Section 2.5.1.2.4.3.4 *Shear Fracture Zones*, as revised in supplement CNL-16-162, Enclosure 2, concludes that the shear fracture zones (SFZ) developed during Alleghenian Valley and Ridge shortening (orogeny); that the SFZs represent interbed slippage estimated to be on the order of inches; that stylolites that truncate the shear zones developed diagenetically during active deposition and lithification of sediments in the Appalachian basin; that the stylolites also post-date the shear zone. This Section concludes that this indicates a Paleozoic rehealed shear zone. Characterizing tectonic structures at the CRN site location is a fundamental component of compliance with 10 CFR 100.23 (c-d). Therefore please address staff’s concerns regarding your assessment of the SFZ.

a. The SSAR indicates that the bedding-conformable nature of the stylolites indicates that they developed diagenetically during active deposition and lithification of sediments deposited in the Appalachian foreland basin. Staff notes that this implies formation of stylolites prior to Alleghanian orogeny. The SSAR then states that the SFZ developed during the Alleghanian deformation. If the diagenic stylolites formed during limestone deposition they would certainly pre-date the shear zone that shows severe warping and brecciation (Drakulich). Reconcile these inconsistent statements.

b. Figure 2.5.1-68 shows a schematic of the Shear Fracture zone and proposed diagenetic stylolites. Staff notes that the stylolites do not penetrate the whole shear zone and there are slickensides on the hanging wall boundary of the shear zone with country rock with no cross-cutting stylolites. The conclusion that the stylolites post-date the shear zone is not supported based on this conceptual figure of interpretations. Please clarify this interpretation with respect to timing on stylolite formation and movement on the SFZ.

c. SSAR Section 2.5.1.2.5.1.2 *Karst Processes and Features at the Clinch River Nuclear Site*, indicates that Kummerle and Benvie (Reference 2.5.1-257) mention geologic mapping for CRBRP but that these geologic records were not available to the CR SMR Project. However, staff notes that Drakulich (1984) reported on geologic mapping of CRBRP excavation, described the SFZ and indicated that the SFZ bedding plane slip transitions into upright and overturned folds. Please provide a discussion of information in Drakulich (1984) as it relates to the SFZ exposure in the excavation, including the related folding. Provide a geologic cross section of the excavation showing the SFZ and the stratigraphic units that crop out in the excavation such as shown in App C, Rizzo Report. Also annotate Figure 2.5.1-54 with the location of the SFZ.

d. The SSAR characterizes the SFZ, Chestnut Ridge fault, and the Whiteoak Mountain and Copper Creek thrust faults as Alleghanian structures which implies that they are coeval. SSAR descriptions show that these features have distinct and unique characteristics from one and other. The SSAR has not provided a synthesis of their interrelationship which discusses how these tectonic structures are related to each other, with the tectonic setting of the site, and to the timing of formation. Please provide this evaluation.

e. Figure 2.5.3-6 illustrates the mapped location of one of the SFZs that have been identified in core (CBRP and CR ESP), within the 0.6 mile radius of the CR site. Please provide a closer view (larger scale) of SFZ across the site area on a geologic map of Paleozoic stratigraphic units such as Figure 2.5.1-29 (as revised in CNL-16-162).

f. The SSAR indicates that the shear zone crops out to the northeast of the CRBRP along the right bank of the Clinch River arm of the Watts Bar Reservoir striking parallel to bedding planes. Please indicate this location on the figure prepared for item (f).

g. Figure 2.5.3-9 indicates the SFZ on the cross section. However, there is no indication where the SFZ is located on the map section. Please indicate the projected location of the SFZ on the map section.

02.05.01-05

Karst

TVA letter CNL-16-162, Enclosure 2 discusses the nature of karst and limestone dissolution at the CRN site. The potential for karst development and the presence of undetected voids directly affects the demonstration of compliance with 10 CFR 100.23 (d) (2). Additional information is needed to support the SSAR's technical basis for karst development.

a. SSAR (Rev 0) 2.5.3.2.3 *Karst*, indicates that seismic refraction surveys at the site were used to characterize carbonate dissolution features. Becasue no data were presented in the SSAR (Rev 0) regarding the characterization of the seismic refraction surveys, please discuss the specific evaluation of the seismic refraction data with respect to detecting carbonate dissolution features.

b. The SSAR (Rev 0) 2.5.1.2.5.1 CRN site karst conceptual model indicates under item 9: "Evidence of hypogene processes is not documented at the CRN Site". The SSAR indicates that some deep phreatic groundwater circulation may be occurring in the Chickamauga carbonate rock beneath the ORR area, and dissolution conduits and cavities may be present to depths of more than 800 ft. (Reference 2.5.1-213, Ausich & Meyer, 1990). Although not discussed in the karst conceptual model, other sections of the SSAR have discussed other possible instances of hypogene karst systems in the area such as: Doll et al, reference 2.5.1-244, 2.5.1-245; TDEC hydrogeologists reference 2.5.1-299; Nativ and others, reference 2.5.1-300 and 2.5.1-301; Wolf et al., 1997. Please provide a discussion of the potential for hypogene systems or features at the CRN site within TVA's conceptual model which also includes relevant information from these citations.

02.05.01-06

River Terrace Profiles for French Broad and Clinch Rivers

CNL-16-162 and CNL-16-170 describe a method of analysis of longitudinal river profiles and associated paleo-river terraces that is a basis for concluding an absence of neotectonic deformation (areal uplift or fault offset) with respect to the Clinch and French Broad Rivers, and indicates an absence of possible active tectonic structures/features within the CRN area and out to 50 miles from CRN. The presence or absence of active tectonic features directly affects compliance with 10 CFR 100.23(c-d).

The SSAR indicates that sources of error such as erroneous inclusion of unrelated terrace surfaces under a single profile and projection inaccuracies along the river profile might affect the results of this type of analysis. The SSAR also indicates that the longitudinal terrace profiles were evaluated for systematic, along-profile irregularities that would suggest repeated fault displacements.

a. Please describe possible tectonic uplift/displacements rates that could be detected with the terrace deformation method described in SSAR. Provide a minimum deformation rate that could be present but undetected by this method.

b. Discuss how uncertainties for projection and grouping errors are evaluated and propagated in the analysis and how these uncertainties affect the minimum deformation rate in the analysis.

Draft Request for Additional Information, Number 6, eRAI-9035
Draft Issue Date: 07/19/2017
Application Title: Clinch River Nuclear Site, ESP
Operating Company: Tennessee Valley Authority
Docket No. 52-047
Review Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS

02.05.04-01

Rock mass properties determination

In SSAR (Rev 0) Section 2.5.4.2.4.4, it states that the rock mass properties are developed using the Geological Strength Index (GSI) classifications of the stratigraphic units. The site investigation data indicates the presence of rock discontinuities and fractures in the stratigraphic units, and shear-fracture zones exist at the interface of inclined rock formations at the CRN sites. These shear fracture zones may result in pre-determined shear failure surfaces. Because the GSI chart may not be applicable when structural planes of the rock control the failure of rock mass [Ref.1], and the rock mass property is a key input for the evaluations of foundation stability, please discuss how the inclined rock formation interfaces were taken into account when determining the rock mass properties to ensure the proper evaluations of subsurface material and foundation stability to meet the requirements of 10 CFR 100.23 (d)(4).

Reference 1: Hoek, E. and Marinos, P. (2000): Predicting Tunnel Squeezing. Tunnels and Tunnelling International. Part 1 – November 2000, Part 2 – December, 2000.

02.05.04-02

Bearing capacity and settlement determination

In SSAR (Rev 0) 2.5.4.10, it states that for evaluations of bearing capacity and settlement of rock at the CRN site, each stratigraphic unit within the depth of influence of a respective foundation is considered separately as a single infinite rock layer below the foundation. The actual subsurface of the CRN site consists of multiple inclined layers of different rock formations with possible weaker interface between the formations. These geologic characteristics were considered in the "Foundation Assessment Clinch River Nuclear Site" report by Rizzo Associates. Please justify why the simplified assumptions and associated methods can be used in evaluation of bearing capacity and settlement for the CRN site where specific subsurface conditions do not meet the basic assumptions of those methods. Site specific and realistic bearing capacity and settlement evaluations are needed to insure the suitability of the site for future new reactor construction and stability of subsurface materials and foundations to meet the requirements of 10 CFR 100.23 (d)(4).