PMComanchePekNPEm Resource

From: Monarque, Stephen
Sent: Thursday, October 01, 2009 8:13 PM
To: ComanchePeakCOL Resource
Subject: FW: Geology Safety Site Visit Information
Attachments: TXNB-09050 GSV-03.pdf

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Sent: Thursday, October 01, 2009 3:55 PM
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Subject: Geology Safety Site Visit Information

Luminant has submitted the attached letter that provides information resulting from discussions at the Geology Safety Site Visit. Please contact me or contact Don Woodlan (Donald.Woodlan@luminant.com, 254-897-6887) if there are any questions regarding the submittal.

Thanks,

John Conly
COLA Project Manager NuBuild
Luminant Power
(254) 897-5256

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Email Number: 1132

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From: Monarque, Stephen

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October 1, 2009

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555
ATTN: David B. Matthews, Director
Division of New Reactor Licensing

SUBJECT: COMANCHE PEAK NUCLEAR POWER PLANT, UNITS 3 AND 4
DOCKET NUMBERS 52-034 AND 52-035
SUBMITTAL OF INFORMATION DISCUSSED DURING GEOLOGY
SAFETY SITE VISIT

Dear Sir:

Luminant Generation Company LLC (Luminant) hereby submits the enclosed information to facilitate the safety review of the Combined License Application for Comanche Peak Nuclear Power Plant Units 3 and 4 as discussed with the Staff during the recent Geology Safety Site Visit. The particular topic involved the extent of excavation and how the soil-structure interaction accommodates the subsurface material. Should you have any questions regarding this information, please contact Don Woodlan (254-897-6887, Donald.Woodlan@luminant.com) or me.

There are no commitments in this letter.

I state under penalty of perjury that the foregoing is true and correct.

Executed on October 1, 2009.

Sincerely,

Luminant Generation Company LLC

Rafael Flores

Rafael Flores

Enclosure: Extent of Excavation and Explanation of how the SSI Accommodates the Subsurface Material

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Extent of Excavation and Explanation of how the SSI Accommodates the Subsurface Material

Extent of Excavation

Two criteria are used to establish the minimum extent of the excavation:

1. Geometric Criterion - requiring a safe slope (2H to 1V in native soil or existing fill is considered a safe slope for a temporary excavation), with presence of benches every 20 ft in elevation and enough room around the structure for formwork and dewatering operations. The sketch in Figure 1 illustrates these requirements. Note: This criterion is being considered with respect to areas with native soil or existing fill. As permitted in FSAR Subsection 2.5.4.5.2, steeper slopes may be used where rock is cut.

2. Stability Criterion - when subjected to dynamic loads, the structure may be acted on by active pressure plus dynamic surcharge on one side and by passive pressure minus dynamic surcharge on the opposite side. As it is understood that native soil/existing fill is weaker than the compacted backfill to be placed in the excavation, the size of excavation in the horizontal direction must ensure containment of the passive wedge within the compacted backfill. Under the assumptions of Rankine's Theory, the minimum extension of the excavation at grade (L) is:

$$L = \frac{H}{\tan\left(45^0 - \frac{\phi'}{2}\right)} \qquad (1)$$

where $H = 40$ ft, the depth of excavation, and ϕ' is the effective friction angle of the compacted fill. For the situation at hand, it is conservative to consider the upper range of values for ϕ', which for a well-compacted backfill, can be taken as about 42^0. This upper-bound value for the internal friction angle for the granular backfill is used to provide a conservative estimate of the horizontal extent of the failure surface. For this value, eq. (1) yields:

$$L_{min} = \frac{H}{\tan 24^0} \cong 90\text{ft} \qquad (2)$$

This value is less than L = 120 ft resulting from the first criterion, and the Rankine's passive failure surface is contained within the compacted backfill.

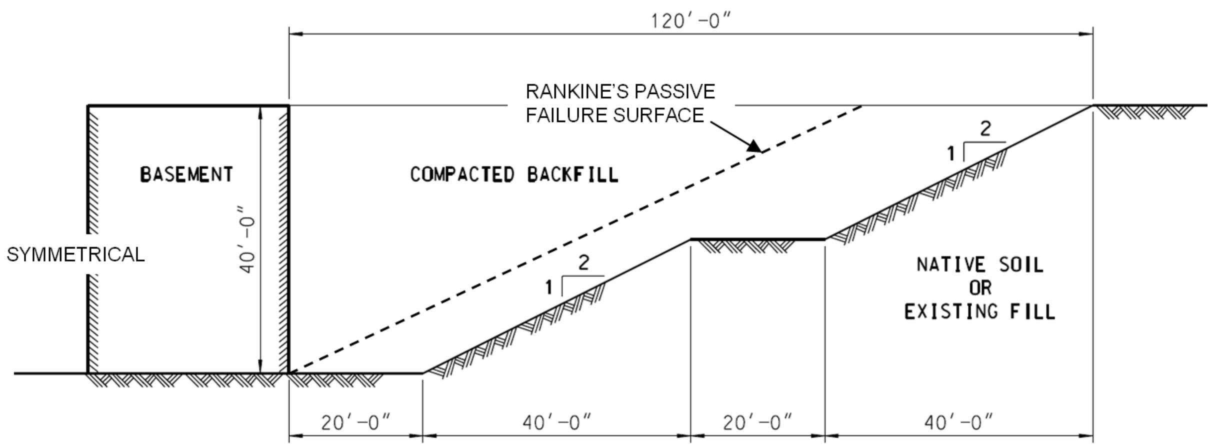

FIGURE 1. PROPOSED EXCAVATION FOR US APWR CPNPP

Modeling of Embedment in SSI Analyses

The site-specific soil-structure interaction (SSI) analyses of Seismic Category I buildings and facilities of CPNPP Units 3 and 4 considered a wide range of conditions regarding the embedment of the structures in order to account for the effects of variability of surface soil conditions throughout the plant. The following embedment conditions were considered:

1. No-fill (surface foundation) condition
2. Foundation embedded in soil with Lower Bound (LB) properties
3. Foundation embedded in soil with Best Estimate (BE) properties
4. Foundation embedded in soil with Upper Bound (UB) properties
5. Foundation embedded in soil with High Bound (HB) properties

The no-fill condition represents the bounding case where the SSI analysis considers the building with surface foundation while the effects of the backfill on the seismic response of the building are neglected. The consideration of no-fill conditions in combination with lower bound subgrade properties provides the response of the building considering the lowest estimate of the SSI stiffness. The SSI analyses of no-fill conditions neglect to consider the dissipation of energy in the embedment material and yield a conservative estimate of the building seismic response.

In addition to the no-fill condition, the SSI analyses considered foundation embedded in a 40-ft thick layer of soil. The best estimate (BE) properties of the embedment soil were defined based on the properties of a typical granular material. The variation of embedment soil properties were accounted for by considering three additional sets of embedment soil properties:

- Lower Bound (LB) representing variance from the BE shear modulus $Cv^{(LB)} = 0.69$
- Upper Bound (UB) representing variance from the BE shear modulus $Cv^{(UB)} = 0.69$
- Higher Bound (HB) representing variance from the BE shear modulus $Cv^{(HB)} = 1.25$

Based on SRP 3.7.2, the LB, UB and HB values of the soil dynamic shear modulus are calculated as:

$$G_{LB} = \frac{G_{BE}}{\left(1 + Cv^{(LB)}\right)} \qquad G_{UB} = G_{BE} \cdot \left(1 + Cv^{(UB)}\right) \qquad G_{HB} = G_{BE} \cdot \left(1 + Cv^{(HB)}\right)$$

The BE values for soil shear modulii (G_{BE}) are obtained from Table 2.5.2-227 of the CPNPP Units 3 and 4 FSAR. The maximum variations of the embedment stiffness considered a Cv = 1.25 for the HB and the no-backfill condition. These variations envelope the variations of embedment stiffness specified in Table 2.5.2-227 for use in the site response analysis.

The table below lists the values of the small-strain shear wave velocity of the four profiles considered in the SSI analyses.

The SSI analyses used stiffness and damping properties of the embedment soil that are compatible with the strains generated by the input design SSE motion. The strain compatible properties were obtained from a set of SHAKE 1-D wave propagation analyses that used as input the small-strain LB, BE, UB and HB embedment soil properties and acceleration time histories compatible to the SSE design ground motion. The free-field site response analyses considered the strain compatibility of the embedment soil by using degradation curves provided in FSAR Figure 2.5.2-232 that represent the stiffness and damping properties of the embedment soil as a function of strain. The table below lists the strain compatible properties used as input for the SSI analyses.

			Small-Strain Properties				Strain Compatible Properties							
Elevation (ft)	Unit Weight (pcf)	Poisson's Ratio	S-Wave Velocity (fps)				S-Wave Velocity (fps)				Damping Ratio (%)			
			LB	BE	UB	HB	LB	BE	UB	HB	LB	BE	UB	HB
822	125	0.35	500	650	845	975	475	633	834	969	3.00	2.40	2.00	1.80
819	125	0.35	615	800	1040	1200	540	739	999	1174	4.75	3.65	2.70	2.25
815	125	0.35	615	800	1040	1200	477	691	958	1143	7.45	5.15	3.70	3.00
811	125	0.35	615	800	1040	1200	425	649	925	1113	10.05	6.55	4.45	3.55
806	125	0.35	615	800	1040	1200	383	618	900	1088	12.45	7.55	5.10	4.05
802	125	0.35	769	1000	1300	1500	623	890	1213	1431	6.25	4.10	3.00	2.50
797	125	0.35	769	1000	1300	1500	603	871	1199	1419	7.00	4.60	3.25	2.70
792	125	0.35	769	1000	1300	1500	587	855	1188	1409	7.60	4.95	3.50	2.90
787-782	125	0.35	769	1000	1300	1500	576	842	1180	1400	8.10	5.25	3.70	3.00

Impact of Embedment Conditions on Site-Specific SSI Analyses and Seismic Design

The site-specific SSI analyses of CPNPP 3 and 4 Seismic Category I buildings used a set of different site models that considered a wide range of embedment conditions ranging from no-fill (surface foundation) to stiff backfill. The results from the different SSI analyses of site-specific facilities were enveloped and then used for seismic design of Category I structures, systems and equipment. The envelope of the acceleration response spectra (ARS) results obtained from the site-specific SSI analyses of the Reactor Building Complex were used to verify the applicability of the standard design for CPNPP site conditions. The comparison of the ARS results with the standard design in-structure response spectra (ISRS) documented in the US-APWR DCD verified that the standard design envelopes the site-specific response by a large margin of safety.

The proposed extent of the excavation of 120 ft (approximately equal to 3 x the embedment depth) will minimize the effects that native soil or existing fill materials present beyond the excavation can have on the seismic response of the embedded foundations and the earth pressure design loads. Even if these materials (native soil or existing fill) influence the seismic response, this situation is enveloped in the SSI calculations by the embedment conditions considered in the site-specific SSI analysis by the no-fill condition.