PMLevyCOLPEm Resource

From: Spicher, Terri
Sent: Friday, February 25, 2011 5:24 PM
To: 'Waters, David'; 'Kitchen, Robert'
Cc: Anderson, Brian; LevyCOL Resource
Subject: LC 3 7 and 3 8 audit plan march 7-10 2011.docx
Attachments: LC 3 7 and 3 8 audit plan march 7-10 2011.docx

To all,

Attached is the **Draft** Levy County 3.7 and 3.8 audit plan. It was developed based on feedback from NRC staff and consultants.

A conference call is being planned for Wednesday, March 2nd, to discuss the contents of this plan.

Please let me know if you have any questions or concerns.

Thanks,
Terri Spicher
301-415-1670

Hearing Identifier: Levy_County_COL_Public
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AUDIT Plan FOR Levy County FSAR SECTION 03.07 and 03.08

March 8-10, 2011

DATES OF AUDIT: March 8-10, 2011

AUDIT LOCATIONS: Levy County Contractor, Paul Rizzo and Associates (Monroeville, PA)

Westinghouse Electric Headquarters (Cranberry, PA)

NRC REVIEW TEAM:

Brian Anderson, NRC Lead Project Manager

Terri Spicher, NRC Project Manager

Thomas Galletta, NRC Project Manager

Pravin Patel, NRC Technical Reviewer

Vaughn Thomas, NRC Technical Reviewer

Carl Costantino, NRC Contractor

Tom Houston, NRC Contractor

AUDIT REQUESTS:

Internet Access for all Team Members

AUDIT PURPOSE AND OBJECTIVE:

The overall objective of the audit was to accomplish the following:

- Discuss the basis for the response to RAI Question in 03.07 and 03.08.
- Review, LNG-1000-S2R-804 entitled "Levy Nuclear Island and RCC Bridging Mat - 3D SASSI SSI Evaluation Report" and RCC Testing Procedures

AUDIT PLAN SUMMARY:
A copy of the agenda for the Levy County audit is provided within Attachment 1 of this audit plan. A list of the letters from Levy County related to FSAR section 03.07 and 03.08 is contained in Attachment 2. The purpose of audit is to review and clarify: the RAI responses, the calculation package for the site specific seismic analysis, and the RCC testing procedures. A detailed list of review items is contained within Attachment 3

ATTACHMENT 1

Agenda for Levy County 03.07 and 03.08 Audit

Date: **March 8 - 10, 2011**

Location: **Paul Rosso Associates Office, Monroeville, PA and AP1000 Headquarters, Cranberry, PA**

Topic: **FSAR Sections 03.07 and 03.08**

1. Entrance Meeting (To be repeated Daily)

   a. Introductions

   b. Purpose and Objectives of Audit

   c. Review of Audit Plan and Schedule

   d. Contacts for LEVY CO and NRC

2. **Group 1 Questions:**

   Review of Questions remaining to clarify the planned procedures that are to be used for the SSI analyses.

3. **Group 2 Questions:**

   Review of NPD-NRC-2011-007, February 14, 2011 "SUPPLEMENT 3 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 085 RELATED TO SEISMIC SYSTEM ANALYSIS"

4. **Group 3 Questions:**

   NPD-NRC-2011-007, February 14, 2011 "SUPPLEMENT 3 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 085 RELATED TO SEISMIC SYSTEM ANALYSIS"

   NPD-NRC-2011-001, January 25, 2011 "SUPPLEMENT 2 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 086 RELATED TO FOUNDATIONS"

   NPD-NRC-2011-002, January 25, 2011 "SUPPLEMENT 2 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 055 RELATED TO FOUNDATIONS"

NPD-NRC-2010-041, June 8, 2010 “SUPPLEMENT 1 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 055 RELATED TO FOUNDATIONS”

5. Exit Meeting (Last Day)

   a. Summary of Audit

   b. Open Items

   c. Action Items

ATTACHMENT 2

Levy County

3.7 and 3.8

RAI Responses Summary

Date	**Levy Letter Number**	LC Ltr	**SRP**	**ML#**
September 12, 2008	NPD-NRC-2008-031	LWQ	3.8	0826606751
November 20, 2008	NPD-NRC-2008-064	013	3.8	0834602480
June 23, 2009	NPD-NRC-2009-109	029	2.5	0918100940
November 2, 2009	NPD-NRC-2009-222	046	3.7	0931003570
October 27, 2009	NPD-NRC-2009-223	029	2.5	0930603890
November 2, 2009	NPD-NRC-2009-224	064	2.5, 3.9	0931001100
November 17, 2009	NPD-NRC-2009-231	055	3.8	0932700410
January 19, 2010	NPD-NRC-2010-006	071	2.5	1002501400
June 8, 2010	NPD-NRC-2010-041	055	3.8	101650098
June 9, 2010	NPD-NRC-2010-054	088	2.5	101940386
June 10, 2010	NPD-NRC-2010-052	scope	3.7	101650100
July 19, 2010	NPD-NRC-2010-060	087	3.7	102030026
July 23, 2010	NPD-NRC-2010-063	085	3.7	1021000450
August 18, 2010	NPD-NRC-2010-068	086	3.7	10232005790
September 16, 2010	NPD-NRC-2010-075	Scope	3.7	1026400421
November 10, 2010	NPD-NRC-2010-086	085	3.7	103200399
November 2, 2010	NPD-NRC-2010-080 Paul Rizzo Report	086	3.8	1031200950 1031200960
November 10, 2010	NPD-NRC-2010-087	087	3.7	103200400
November 16, 2010	NPD-NRC-2010-088	046	3.7	103260240
January 25, 2011	NPD-NRC-2011-001	086	3.8	110310020
January 25, 2011	NPD-NRC-2011-002	055	3.7	110310018
January 25, 2011	NPD-NRC-2011-005	085	3.7	110310019
February 14, 2011	NPD-NRC-2011-007	085	3.7 and 3.8	110490222

ATTACHMENT 3

<u>Group 1:</u>

Questions remaining to clarify the planned procedures that are to be used for the SSI analyses (September 2010 Letter)::

1. The plan indicates that the LB, BE and UB columns will be selected from the results of the probabilistic site response calculations. Presumably, the LB and UB columns will be selected at the one-sigma level, layer by layer. No mention is made, however, of the recommendations in the SRP that the LB and UB columns must have a minimum COV from the BE column (at least 1.5 variation on the shear modulus). The SSI plan should so indicate.

2. The criteria to be used for selection of the LLB are not clear (e.g., how far should it be from the LB column to provide meaningful variations). The staff concern is development of the criteria to be used to envelope and broaden computed ISRS, including the impact of the LLB case on the resulting ISRS.

3. The plan indicates that the FIRS are to be developed at the bottom of the RCC bridge beam. There is no indication if the FIRS will be developed using the NEI or BNL outcrop definitions and whether the same procedure is to be used to develop corresponding surface motions for each of the four deterministic profiles.

4. Task 2 indicates that the SSI analyses will be performed using the SASSI subtraction method, with apparently an 8-layer site profile definition. There is no indication of the corresponding frequency cut-off from SSI that is associated with this layering assumption and how this process satisfies the 50 hz minimum frequency requirement specified in NRC's ISG.

5. To validate the subtraction method SSI calculation in SASSI, the plan indicates that they will compare results from the direct method, utilizing a 5-layer site profile. There is no basis provided in the document to justify such a procedure and how the different cut-off frequencies associated with the 8-layer and 5-layer models will be included in this assessment.

6. Task 2 indicates that it will include frequency assessments from the input time history PSD's and corresponding soil column (1D) frequencies. No mention is made of frequencies associated with the particular SSI problem being considered. In addition, if the input motions to the SSI problems are relatively broad-banded, how will the "frequency" content of these motions be assessed?

7. Tasks 2 and 3 mention the use of engineered fill in the SSI problem. How will the properties of this material be specified and how will they be used in selection of the fill material?

8. Task 3 mentions use of strain-iterated columns. It is presumed that the deterministic motions associated with the four SSI problems will not include additional strain iteration. In addition, it is not clear how Pwave damping will be specified in the SSI problems.

<u>Group 2:</u>

Review of Levy County NPD-NRC-2011-007, February 14, 2011 "SUPPLEMENT 3 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 085 RELATED TO SEISMIC SYSTEM ANALYSIS"

1. Editorial
    a. **Section 1.0, 2nd para.** Although the text refers to backfill material being presented in Figure 1.1-3, the figure does not clearly identify the backfill material.
    b. **Section 2.0, 1st bullet.** Reference is made to Figure 1.1-2 to show the soil and rock profiles. This Figure does not appear to be related to the profiles.
    c. **Section 2.0, Figures 2.1-1**. There are two figures showing the layering of the models, one for the 5 layer model and one for the 8 layer model. Both of these figures are labeled Figure 2.1-1.

2. **Section 1.0, 3rd para.** Both SASSI2000 and ACS SASSI are identified as being used in the 3D SSI analyses. It is not clear from the document which cases have been analyzed using which computer code. Please provide a listing which correlates the SSI case with the SASSI version used in the analyses.

3. **Section 2.0, penultimate bullet, and Section 3.5.**

   LNP FSAR, Rev. 2, Section 3.7.1 states that the top of competent rock is located 35 ft below the Table 2.5.2-226 foundation of the NI (e.g. at the base of the RCC bridging mat). A plot showing the FIRS motion, which is essentially the ground motion in the free field at the top of competent material, is provided in Figure 3.7-201. Section 3.7.1 indicates that where site specific analyses are performed that these motions are scaled to 0.1g at 100 hz for horizontal motion and 0.074g at 100 hz for vertical motion.

The input time histories at the base of the RCC bridging mat, shown in Figures 3.6-1 through 3.6-12 of this report appear to have peak accelerations consistent with the zpa shown in Figure 3.7-201. These accelerations are roughly half of the 0.1g minimum required by Appendix S of Part 50 as well as the scaling specified in Section 3.7.1 of the FSAR.

Since the RCC bridging mat is approximately the same size as the reinforced portion of the structure, from a seismic perspective, it is assumed to be essentially an extension of the structure down to competent material.

Please provide the justification that the input motions shown in Figures 3.6-1 through 3.6-12 which are used in the SSI satisfy the Appendix S requirement that the horizontal component of ground motion be at least 0.1g. In addition, provide justification that the Appendix S criteria can be applied at the bottom of the bridging mat as opposed to the bottom of the structural foundation.

4. **Section 3.5 and 3.6.** Time history inputs are described. Please indicate whether the time history records shown are "with-in layer" or outcrop motions. In addition, indicate whether the NEI or BNL outcrop assumptions were used in there development.

5. **Section 3.7, 1st para.** A statement is made that the NI20r embedded model was reviewed and approved. Please provide the reference for this review.

6. **Section 3.7, 2nd para.** The frequencies for which the layer discretization is adequate to pass without significantly "filtering" the input motion and response is described in this paragraph. The discussion does not clearly describe the soil profile that was ultimately used in the SSI analyses described in this report. It appears that an averaging of the soil velocity properties of the soils surrounding the "structure" with the soil velocity properties of the layers beside and under the RCC bridging mat was performed to develop a "replaced" soil column.

   If the replaced properties were used in the SSI analyses please provide the justification for how these averaged, and much stiffer, soil properties are adequate to represent both the computed motions and soil stiffness around the embedded structure. Note that the deformation response of the replacement column will be much different than the actual soil layering that is present at the site.

   Alternatively, if the soil velocity properties used in the SSI analyses are consistent with the site as described in Figure 3.2-1, the discretization used apparently violates the SASSI requirement (SASSI 2000, TM/Rev. 1) that the

maximum dimension of any finite element (brick or plane strain) be limited to $V_s/5f_{max}$ for frequencies above 4 to 9 hz, depending upon the soil case evaluated.

Please describe which of the above two approaches were implemented in the SSI analyses and provide the justification for the discretization appropriate for the approach taken.

7. **Section 5.1, 3rd para.** The discussion indicates that the responses shown in the Section 5 Figures are nearly exact. However, review of the figures indicates that the computed responses are different within some frequency ranges by as much as ~100%. Some examples, approximated by scaling off the figures are summarized below:

   Fig. 5.2-2 {subtraction 80% higher at 20 hz}
   Fig. 5.2-4 {subtraction 90% - 110% higher at 18 hz – 22 hz}
   Fig. 5.2-5 {direct 20% higher at 11 hz}
   Fig. 5.2-10 {direct 20% higher at 6 hz}
   Fig. 5.2-11 {direct 30% higher at 30 hz}
   Fig. 5.2-6 {subtraction 75% - 80% higher at 18 hz – 22 hz}

   Additionally, the statement is made that the only significant differences occur at frequencies higher than 15hz. Does this statement infer that the design of substructures and equipment are not affected by spectral amplifications in the frequencies higher than 15hz and are therefore unimportant?

8. **Section 5.5, Table 5.5-1.** The table indicates that the maximum pressure, including dead weight, is -20.07 ksf and the minimum pressure is -15.30 ksf. Given that the range between the maximum seismic pressure and the minimum seismic pressure is about 10 ksf (-5.07 ksf – 5.34 ksf), it is not clear how the range between the combined pressures can have a range of only 4.7 ksf. Please provide a description of how the pressure load is computed that demonstrates how the specific number in the table is developed.

9. **Section 5.6.** This section indicates that the maximum seismic base shear is 110.5 kips. This value appears to be very low given that the mass of the base-mat concrete alone multiplied by a zpa of 0.1g would be 80 to 100 times larger than the base shear reported.

   Please describe the mechanism for the transfer of load from the superstructure to the foundation base that supports such a low base shear and the corresponding movement that would be required to generate the lateral support that the surrounding soil would need to provide to the structure.

10. **Section 2.0, Figures 2.1-1.** In both figures there is a thin layer that appears to be located immediately beneath the bottom of the base mat of the foundation for the structure. It is not clear what material properties were used for the finite elements in this thin layer that supports the foundation. Additionally, there is a thin layer at the bottom of the 8 layer model that represents rock and is used apparently to extract bearing stresses. Please provide a description of the material properties used in the HOUSE model for these thin layers and the material properties in the SITE module for the corresponding layers.

<u>Group 3:</u>

Review of Levy County Letters:

- **NPD-NRC-2011-007, February 14, 2011 "SUPPLEMENT 3 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 085 RELATED TO SEISMIC SYSTEM ANALYSIS"**
- **NPD-NRC-2011-001, January 25, 2011 "SUPPLEMENT 2 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 086 RELATED TO FOUNDATIONS"**
- **NPD-NRC-2011-002, January 25, 2011 "SUPPLEMENT 2 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 055 RELATED TO FOUNDATIONS"**
- **NPD-NRC-2010-041, June 8, 2010 "SUPPLEMENT 1 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 055 RELATED TO FOUNDATIONS"**

The responses contained in the aforementioned 4 letters provide information needed to address the 7 questions asked in NRC RAI Number 03.08.05-3. In my view, contingent on satisfactory resolution of the questions related to NPD-NRC-2011-007, the responses provided by the applicant are adequate to address 6 of the 7 questions that relate to liquefaction and the associated response of the structures. These responses demonstrate the performance of the drilled piers and seismic gaps between structures are adequate to achieve the performance goal of 10^{-5} and specify remedial measures to control liquefaction. Additionally, the interaction between the piers (group action) has been adequately addressed.

Please indicate if the S&L proprietary version of SASSI2000 described in NPD-NRC-2011-001 incorporates a pile element.

The response to question 4, which was “what soil data will be recorded during pile test boring and how will this data be used to verify the seismic interaction analyses?” is apparently no soil data. The basis appears to be that the lateral support of the caissons below the engineered fill is not counted on to resist load and the earthwork is designed to prevent buildup of pore pressure. Therefore their conclusion is that the additional data is not required. Please confirm that soil data will be recorded during installation.

The design of the caissons and rock sockets is not complete. This item remains open since the procedure and results used to design these components has not been provided.