JUN 3 1983

DISTRIBUTION
Document Control 50-400/401
NRC PDR
L PDR
NSIC
PRC System
LB#3 Reading
JLee
NPKadambi
Attorney, OELD
Jordan, IE
Taylor, IE
ACRS (16)
TMNovak
Sang Kim
Norman Romney

Docket Nos.: 50-400
and 50-401

Mr. E. E. Utley
Executive Vice President
Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

Dear Mr. Utley:

Subject: Transmission of Results of Structural Audit and Open Items

NRC staff conducted a Structural Audit on Shearon Harris at Ebasco in New York City between March 7 to March 11, 1983. Enclosed is the staff report of the results thereof. Included are a list of open items and lists of attendees at the meetings. Please incorporate the open items in the enclosure into the Open Items list of Chapter 1 of the Draft Safety Evaluation Report for Shearon Harris.

Sincerely,

Original signed by
George W. Knighton

George W. Knighton, Chief
Licensing Branch No. 3
Division of Licensing

Enclosure:
As stated

cc: See next page

OFFICE	DL:LB#3 NPK	DL:LB#3					
SURNAME	NPKadambi/yt	GWKnighton					
DATE	6/3/83	6/3/83					

Shearon Harris

Mr. E. E. Utley
Executive Vice President
Power Supply and Engineering and
Construction
Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

cc: George F. Trowbridge, Esq.
Shaw, Pittman, Potts &
Trowbridge
1800 M Street, NW
Washington, D. C. 20036

Richard E. Jones, Esq.
Associate General Consel
Carolina Power & Light Company
411 Fayetteville Street Mall
Raleigh, North Carolina 27602

M. David Gordon, Esq.
Associate Attorney General
State of North Carolina
Post Office Box 629
Raleigh, North Carolina 27602

Thomas S. Erwin, Esq.
115 W. Morgan Street
Raleigh, North Carolina 27602

Mr. George Maxwell
Resident Inspector/Harris NPS
c/o U.S. Nuclear Regulatory Commission
Route 1, Box 315B
New Hill, North Carolina 27562

Charles D. Barham, Jr., Esq.
Vice President & Senior Counsel
Carolina Power & Light Company
Post Office Box 1551
Raleigh, North Carolina 27602

Mr. John Runkle, Executive Coordinator
Conservation Council of North Carolina
307 Granville Road
Chapel Hill, North Carolina 27514

Mr. Wells Eddleman
718-A Iredell Street
Durham, North Carolina 27705

Mr. George Jackson, Secretary
Environmental Law Project
School of Law, 064-A
University of North Carolina
Chapel Hill, North Carolina 27514

Dr. Phyllis Lotchin
108 Bridle Run
Chapel Hill, North Carolina 27514

Mr. Travis Payne, Esq.
723 W. Johnson Street
Post Office Box 12643
Raleigh, North Carolina 27605

Mr. Daniel F. Read, President
CHANGE
Post Office Box 524
Chapel Hill, North Carolina 27514

Bradley W. Jones, Esq.
U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street
Atlanta, Georgia 30303

Richard D. Wilson, M. D.
725 Hunter Street
Apex, North Carolina 27502

Regional Adminstrator - Region II
U.S. Nuclear Regulatory Commission
101 Marietta Street
Suite 3100
Atlanta, Georgia 30303

Karen E. Long, Esq.
Staff Attorney
Public Staff - NCUC
Post Office Box 991
Raleigh, North Carolina 27602

STRUCTURAL AUDIT REPORT
SHEARON HARRIS PLANT

1. Introduction

Between March 7 and March 11, a structural design audit of the Shearon Harris plant was conducted at the Ebasco New York office. Ebasco is the architect and engineering firm for the Carolina Power and Light Company who is the owner of the Shearon Harris Plant. We reviewed the design calculations of the major Category I structures and discussed verification of the computer codes used for the plant evaluation. During the audit, any lack of information or insufficient explanation of the data was classified as an open item for later clarification and resolution. These items are discussed in the report and summarized in the section entitled as open items. Attendance lists are attached at the back of the report for all five days of the meeting.

2. Structural Audit

(a) Dynamic Model and Earthquake Analysis

Time history input was used in the Shearon Harris earthquake analysis. The input bounds the R. G. 1.60 response spectra anchored at 0.15g. All the major Category I structures are founded on sound rock with the exception of manhole structures. The foundation rock is modeled with translational and rotational springs. However, in the FSAR, such model is described erroneously as fixed base. The applicant agreed to amend the description in a future amendment. (open item 1).

In evaluating earthquake responses of the Category 1 Structures, a dynamic code developed by Ebasco was used. The structures, modeled as a mass-spring system, were secured at the foundation mat. More detailed analysis was performed using commercially available STARDYNE code. The detailed evaluations by the STARDYNE code consisted of torsional analysis and uplift of the structures. There were two items that required further explanation regarding the STARDYNE code dynamic modeling: modal damping of the structures and spring representation of the bed rock. It was not clear that the STARDYNE modal damping is same as the one used in the Ebasco in-house dynamic code (open item 2). For the springs, analytical representation of one-way spring mechanism is not well explained (open item 3). No physical anchor exists between the foundation mat and the bed rock. Therefore, only downward compression load is transmitted to the bed rock. An uplift of the foundation mat is a possibility when the compressive load is no longer present as in the case of an earthquake when an excessive horizontal load is developed. Indeed, it was stated in the FSAR that a partial uplift is expected. This one-way spring is a characteristic of a non-linear spring and a careful verification of the code is needed. It should be noted that the design criteria allows only 10% margin against the worst case overturning moment.

(b) Containment Building and Internal Structures

The major code used for the stress analysis of the containment building and internal structure is the SHELL code. This is an in-house developed axisymmetric code which accounts for concrete cracks in tension. The cracked model may reduce forces and moments as much as 80% from uncracked model. An iteration process was used to obtain a final crack size of the concrete. There were several comparisons of the SHELL code of uncracked cross sections with other available codes and closed form solutions. However, we were unable to find any verification results for the cracked model (open item 4). Once the extent of the crack was estimated by the SHELL code, static and stress analyses were performed using the STARDYNE code. We observed an impressive finite element representation of the internal structure. The applicant incorporated the crack size from the SHELL code into the STARDYNE. Its exact procedure was unclear and left as an open item (open item 5). We also found that the STARDYNE model used a flat plate element to represent a thick wall. We requested an estimate of error, if any, in using their plate model, especially, with regard to rather localized loads (open item 6).

Mainsteam and feedwater lines were physically anchored at the containment wall and, as a result, there was considerable local reinforcement. They were unable to obtain a list of the loads that are imposed on the wall including the resultants from the piping analysis (open item 7).

In the drawing, it was specified that the hole of the leak chase channel be plugged after the local pressure test is completed. They were informed of the issue of plugging raised by the containment system branch while we were reviewing the Shoreham plant. We did not raise the issue ourselves at this time.

In evaluating the response of the steamline break the load was treated as a static load. We questioned if there is any dynamic effect of the pressure load on the structure (open item 8). Also, in view of possible asymmetric distribution of the pressure, shell oval modes may be important. The containment and some of the cylinder like structures (support to the steam generator) were modeled as a beam which assumes a rigid cross section. Justification of such an assumption was requested (also open item 8).

(c) Tank Buildings

Dynamic analysis of the tank building was reviewed. This particular building houses Category I tanks including a condensate storage tank. The building and the tank were modeled first by a series of spring, mass and damper systems. Dynamic response of the model provides time history motion at the base of the tank as well as forces and moments. Next, a detailed dynamic analysis was performed for the tank alone using the base floor motion as an input. More springs and masses were provided. Reasonable models would provide approximately close results at common points, namely, at the base and at the top of the tank. However, the detailed model resulted, in some cases, more than twice the value (i.e., acceleration) of the combined building-tank model. We requested an explanation (open item 9). We were surprised to learn that they did not perform such comparisons in the past.

(d) Other Category I Structures

We also reviewed cable tray, emergency cooling water systems, fuel handling building, auxiliary building and electric cable manholes. The manhole is a narrow reinforced concrete structure and it is the only Category I structure resting on soil. In our first round of questions, two questions were raised on the SHAKE code for the manhole dynamic evaluation. After discussing the function of the manhole, which is to provide space for installing and maintaining electric cables, it was apparent that the safety significance of the manholes is relatively minor compared with other Category I structures discussed elsewhere.

Open item 10 was identified during the fuel handling building review where the applicant neglected to include sloshing effect on the earthquake response analysis.

3. Conclusion

In general, the applicant was responsive to our specific question and well prepared for the audit with few exceptions. Open items 2 and 7 constitute such exceptions. It should be noted that the non-linear aspects of the computer code have not been well verified (open items 3 and 4). It seemed that a sophistication needed to use the non-linear code was lacking.

4. List of Open Items

1. Amendment of the statement in FSAR, page 3.7.2-6, from a fixed base to a spring-mass system in representing the bed rock.

2. Discussion of STARDYNE damping expression.

3. Discussion and verification of bed rock representation as one-way spring by STARDYNE when the stability (overturning moments) analysis was performed.

4. Discussion and verification of the concrete crack model in SHELL code. (Ebasco in-house code used for containment axisymmetric analysis).

5. Discussion of concrete crack model in STARDYNE static analysis (transfer of crack size from SHELL code).

6. Justification of use of thin flat plate application to a thick structural member in the STARDYNE code.

7. Tabulation of loadings at the anchor point of mainsteam and feedwater pipes on containment wall.

8. Justification for not using dynamic factor on LOCA pressure loading in containment analysis and also for not considering an oval mode of shell dynamic response.

9. Explanation of difference in acceleration and moment at common points between detailed tank analysis and overall tank-building analysis.

10. Changes in margin of safety when a sloshing effect is included in the fuel handling building earthquake analysis.

STRUCTURAL DESIGN AUDIT

ATTENDANCE LIST FOR 3-7-83

JOHN F GARIBALDI	EBASCO - NUCLEAR LICENSING
VINCENT J ROSSETTI	EBASCO - NUCLEAR LICENSING
JOHN H EADS	CP&L - NUCLEAR LICENSING
JOHN MANCHAK	EBASCO - CIVIL
TIM J McCARTHY	EBASCO - CIVIL
N D ROMNEY	U.S. NUCLEAR REGULATORY COMMISSION
S B KIM	U.S. NUCLEAR REGULATORY COMMISSION
MURRAY WEBER	EBASCO - CIVIL - SUPERVISOR
JOSEPH WOMER	EBASCO - CIVIL - LEAD DISCIPLINE ENGINEER ARCHITECTURAL - STRUCTURAL
SHIAM GOYAL	EBASCO - CIVIL - LEAD DISCIPLINE ENGINEER CONCRETE-HYDRAULIC

STRUCTURAL DESIGN AUDIT

ATTENDANCE LIST FOR 3-8-83

VINCENT J ROSSETTI	EBASCO - LICENSING
JOHN EADS	CP&L - LICENSING
H LEE WILLIAMS	CP&L - HPES
KAO DING CHIU	EBASCO - CIVIL CONSULTING
T McCARTHY	EBASCO - CIVIL DESIGN
S KIM	USNRC - SGEB
J LENAHAN	USNRC - CIVIL ENGR - R II
N D ROMNEY	USNRC - SGEB
MURRAY WEBER	EBASCO - CIVIL ENGR
SHIAM GOYAL	EBASCO - CIVIL ENGR
E S KOWALSKI	EBASCO - CIVIL ENGR
J MANCHAK	EBASCO - CIVIL ENGR
J SHIEH	EBASCO - CIVIL DESIGN
J F GARIBALDI - part-time	EBASCO - LICENSING
D PATEL	EBASCO - CIVIL DESIGN
DEAN SHAH	EBASCO - MECHANICAL ENGINEERING

ATTENDANCE 3-9-83

JOHN EADS	CP&L - LICENSING
VINCENT J ROSSETTI	EBASCO - LICENSING
H LEE WILLIAMS	CP&L - HPES, A/S
J LENAHAN	NRC - R II
S KIM	NRR
M WEBER	EBASCO - CIVIL
E KOWALSKI	EBASCO - CIVIL
R SONI	EBASCO - CIVIL
T McCARTHY	EBASCO - CIVIL
L Y CHU	EBASCO - CIVIL
J SHIEH	EBASCO - CIVIL
S GOYAL	EBASCO - CIVIL
N D ROMNEY	USNRC
J MANCHAK	EBASCO - CIVIL
W L RESNANSKY	EBASCO - PIPE RUPTURE
A I TURNER	EBASCO - CIVIL DESIGN
A BAUZEK	EBASCO - CONCRETE HYDRAULIC
J F GARIBALDI	EBASCO - LICENSING

ATTENDANCE OF 3-10-83

VINCENT J ROSSETTI	EBASCO - LICENSING
JOHN EADS	CP&L - LICENSING
J LENAHAN	NRC - R II
S KIM	NRC/NRR/SGEB
A BAIG	EBASCO - CIVIL
J F NEVILL	CP&L - CIVIL ENGINEERING
M WEBER	EBASCO - CIVIL ENGINEERING
J MANCHAK	EBASCO - CIVIL ENGINEERING
E S KOWALSKI	EBASCO - CIVIL ENGINEERING
N P KADAMBI	NRC/NRR/DL
N D ROMNEY	NRC/NRR/SGEB
L Y CHIU	EBASCO - CIVIL
SHIAM GOYAL	EBASCO - CIVIL
I LAI	EBASCO - CIVIL
Y HUANG	EBASCO - CIVIL
E WANG	EBASCO - CIVIL
C SHIH	EBASCO - CIVIL-SAG
W HSU	EBASCO - CIVIL-SAG
A BOEHM	EBASCO - STRESS ANALYSIS
P FIALA	EBASCO - MECHANICAL ENGINEERING
M GAGLIARDI	EBASCO - MECHANICAL ENGINEERING
R SONI	EBASCO - STRUCTURAL ENGINEERING
M KUTCHER	EBASCO - MECHANICAL DESIGN
D PATEL	EBASCO - CIVIL DESIGN
Z T SHI	EBASCO - SPECIAL ANALYSIS
T J McCARTHY	EBASCO-CIVIL DESIGN - ~~SAG~~

ATTENDANCE 3/11/83

John Eads	CP&L Licensing
Vincent J. Rossetti	Ebasco Licensing
James T. McGuinness	Ebasco Structural Engineering
E. S. Kowalski	Ebasco Civil Engineering
W. Chao	Ebasco Civil Engineering
N. P. Kadambi	NRC/NRR/DL
Sang Bo Kim	NRC/NRR/DE/SGEB
N. D. Romney	NRC/NRR/DE/SGEB
R. Soni	Ebasco
T. J. McCarthy	Ebasco Civil Design
J. Grim	Ebasco Civil Engineering
Z. T. Shi	Ebasco SAG
J. Lenaham	NRC - R II
Shiam N. Goyal	Ebasco Civil Engineering
Joseph Womer	Ebasco Civil Engineering
J. Manchak	Ebasco Civil Engineering
R. Matzalle	Ebasco Project Manager
J. Garibald	Ebasco Licernsing
M. Weber	Ebasco Civil Engineering