REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8403130062 DOC.DATE: 84/03/07 NOTARIZED: NO DOCKET #
FACIL:50-400 Shearon Harris Nuclear Power Plant, Unit 1, Carolina 05000400
AUTH.NAME AUTHOR AFFILIATION
MCDUFFIE,M.A. Carolina Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards addl info re fuel handling bldg retaining wall design,in response to SER Open Item 1 from Structural & Geotechnical Engineering Branch.

DISTRIBUTION CODE: B001S COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 8
TITLE: Licensing Submittal: PSAR/FSAR Amdts & Related Correspondence

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	NRR/DL/ADL	1	0	NRR LB3 BC	1	0
	NRR LB3 LA	1	0	BUCKLEY,B 01	1	1
INTERNAL:	ELD/HDS1	1	0	IE FILE	1	1
	IE/DEPER/EPB 36	3	3	IE/DEPER/IRB 35	1	1
	IE/DQASIP/QAB21	1	1	NRR/DE/AEAB	1	0
	NRR/DE/CEB 11	1	1	NRR/DE/EHEB	1	1
	NRR/DE/EQB 13	2	2	NRR/DE/GB 28	2	2
	NRR/DE/MEB 18	1	1	NRR/DE/MTEB 17	1	1
	NRR/DE/SAB 24	1	1	NRR/DE/SGEB 25	1	1
	NRR/DHFS/HFEB40	1	1	NRR/DHFS/LQB 32	1	1
	NRR/DHFS/PSRB	1	1	NRR/DL/SSPB	1	0
	NRR/DSI/AEB 26	1	1	NRR/DSI/ASB	1	1
	NRR/DSI/CPB 10	1	1	NRR/DSI/CSB 09	1	1
	NRR/DSI/ICSB 16	1	1	NRR/DSI/METB 12	1	1
	NRR/DSI/PSB 19	1	1	NRR/DSI/RAB 22	1	1
	NRR/DSI/RSB 23	1	1	REG FILE 04	1	1
	RGN2	3	3	RM/DDAMI/MIB	1	0
EXTERNAL:	ACRS 41	6	6	BNL(AMDTS ONLY)	1	1
	DMB/DSS (AMDTS)	1	1	FEMA-REP DIV 39	1	1
	LPDR 03	1	1	NRC PDR 02	1	1
	NSIC 05	1	1	NTIS	1	1

TOTAL NUMBER OF COPIES REQUIRED: LTTR 53 ENCL 46

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

CP&L

Carolina Power & Light Company

SERIAL: NLS-84-110

MAR 07 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NO. 1 - DOCKET NO. 50-400
RETAINING WALL DESIGN

Dear Mr. Denton:

Carolina Power & Light Company hereby submits additional information concerning the Shearon Harris Nuclear Power Plant (SHNPP) Fuel Handling Building Retaining Wall design. This information is in response to Safety Evaluation Report (SER) Open Item 1 from the Structural and Geotechnical Engineering Branch.

If you have further questions or require additional information, please contact our staff.

Yours very truly,

M. A. McDuffie
Senior Vice President
Nuclear Generation

MAM/JHE/lcv (9583JHE)

Attachment

cc: Mr. B. C. Buckley (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
Mr. J. P. O'Reilly (NRC-RII)
Mr. Travis Payne (KUDZU)
Mr. Daniel F. Read (CHANGE/ELP)
Chapel Hill Public Library
Wake County Public Library
Mr. J. T. Chen (NRC-SGEB)
Mr. Wells Eddleman
Dr. Phyllis Lotchin
Mr. John D. Runkle
Dr. Richard D. Wilson
Mr. G. O. Bright (ASLB)
Dr. J. H. Carpenter (ASLB)
Mr. J. L. Kelley (ASLB)

B001
1/1

[illegible]

Shearon Harris Nuclear Power Plant
SER Open Item 1
Design of Retaining Wall

In response to NRC comments contained in the Safety Evaluation Report (SER) regarding the Retaining Wall, the following CP&L responses are provided (organized by SER Section).

Section 2.5.4

The staff will review the 400-foot-long retaining wall as a safety-related Category I structure because a postulated failure of the retaining wall could affect the safety of the adjacent seismic Category I fuel handling building. The stability analysis of the retaining wall is being reviewed by the staff, and the staff's evaluation of the analysis will be addressed in a supplement to the SER.

Response: The retaining wall west of Fuel Handling Building should not be reviewed as a safety related Category I structure for the following reasons:

a. The plant grade fill west of the retaining wall does not support any safety related structures, systems or subsystems, and as such, the retaining wall is not required for safe shutdown of the plant.

b. There is no safety related equipment in the Fuel Handling Building west of "N" line wall which is more than 75 feet east of the 45 foot high retaining wall. Any local damage to the retaining wall will not impair the integrity of the Fuel Handling Building and safety related equipment inside the Fuel Handling east of "N" line wall.

Therefore, the design of retaining wall in accordance with Position C-2 and C-4 of Regulatory Guide 1.29 which precludes any gross failure of the wall is considered adequate.

Section 2.5.5.2

In a letter to H. R. Denton, dated September 19, 1983, CP&L stated that these properties are based on tests performed on site for as-built backfills.

However, the staff finds that these properties are associated with selected impervious materials from Borrow Area Z, designated as "selected backfill" in accordance with EBASCO Specification CAR-SH-CH-8, and the staff does not consider them to be representative of the random fill to be used against the retaining wall. Thus, field and laboratory tests on random fill used in actual construction are needed to demonstrate that the design parameters used in the design are appropriate.

 (9583JHElcv)

Response: The properties of selected impervious material used as backfill against plant structures is given in FSAR Section 3.8.4.3.1 Page 3.8.4-11, as

Saturated unit weight	γ_s = 130 pcf
Submerged unit weight	γ_b = 67.6 pcf
Angle of internal friction	ϕ = 20°
Cohesion	c = 400 psf

These properties are based upon the tests discussed in FSAR Section 2.5.4.5.3.1.3. For simplicity of design, the combination of values for the angle of internal friction ϕ and cohesion c were conservatively modified to "ϕ" = 30° and c = 0, which coincidently happen to be the same as the properties of Borrow Area Z material. A review of the retaining wall design indicates that the factors of safety for tie rods for soil properties ϕ = 20 and c=400 psf are higher than those soil properties ϕ = 30° and c = 0.

Possible variations in the properties of backfill material were considered in the design of the retaining wall, and the design has been reviewed for the properties of random fill and modified random fill given in FSAR Section 2.5.6.5.5.3.

γ_s = 140 psf
ϕ = 25°
c = 120 psf

These values were used for slip circle analyses for stability of ESWS channel slopes, and are based upon the tests discussed in FSAR Appendix 2.5K. This fill has density higher than the one used for the design, i.e. γ_s = 135 pcf. With these soil properties, the factors of safety for the tie rods are reduced but are still adequate for the stability and safety of the wall (see response to Section 2.5.5.3).

Section 2.5.5.3

The lateral soil pressures against the wall include static and dynamic soil loads. The static and dynamic soil loads are obtained by assuming that the random fill is a cohesionless soil with an internal friction angle of 30°. This assumption may not be valid because the random fill as defined in EBASCO Specification CAR-SH-CH-8 may be any excavated unclassified material or rock. Because the strength characteristics of the random fill have not been determined, as discussed in the previous section, the staff is unable to conclude that the assumed lateral soil pressures against the wall are appropriate.

The dynamic soil load was calculated using a seismic coefficient of 0.17g. Because the random fill will have a depth of about 60 feet, soil amplification may take place under seismic conditions. Thus, the staff requires a soil amplification study to demonstrate that the seismic coefficient is conservative.

The design of the deadmen by the applicant utilized two approaches (EBASCO, 1983). A conventional approach described in NAVFAC DM-7 was used to design deadmen at elevation 250 feet, while a bearing capacity approach was used to design the deadmen at elevations 232 and 215 feet. Because the bearing capacity approach to design the deadmen is not conventional, the applicant must provide additional design analyses using NAVFAC procedures to demonstrate that the deadmen design is acceptable.

Response: For properties of backfill material see response to Section 2.5.5.2. As discussed in the response to Section 2.5.5.5 the random fill used as backfill against the wall has been changed to modified random fill.

The design of retaining wall has been reviewed for three sets of soil properties with no surcharge load (a realistic condition based upon the final layout of the area as shown in FSAR Figure 3.8.5-1), full groundwater hydrostatic pressure, and with and without corrosion of tie rods. The factors of safety for the most critical component for different conditions are given in the attached Table.

The factors of safety for the most critical tie rod for normal load condition is greater than 1.5 except for the worst combination of conditions, i.e. drainage system is clogged and full hydrostatic pressure is developed in the impervious type backfill material, and epoxy or other equivalent coating on tie rods is ineffective in protecting the tie rods against corrosion and the effective diameter of tie rods is reduced by 1/8 inch. For this extreme combination of loads the factor of safety of 1.43, based upon 90 percent of the yield point of the tie rod steel, is considered adequate.

Ground acceleration amplification through the soil above rock up to the plant grade was computed by a finite element model analyzed for an initially contemplated concrete gravity retaining wall utilizing the computer program FLUSH. Since the soil accelerations are not expected to change significantly with the type of retaining wall the soil accelerations obtained by the FLUSH program for the finite element model of concrete gravity retaining wall have been used for the design of this retaining wall. However, for the dynamic forces due to dead weight of the retaining wall, the amplified ground accelerations from the FLUSH program are further increased by 50%. For the dynamic soil loads on the retaining wall, an average value of the amplified acceleration from the FLUSH program is used.

The dynamic seismic load on the retaining wall was considered as a uniform load for the average horizontal acceleration due to DBE for simplication of computations. The computations have now been revised for the horizontal accelerations at different levels of the retaining wall.

The minimum factor of safety for the most critical tie rod for DBE load conditions is 1.13 which is greater than 1.1.

The deadmen for the retaining wall are designed in accordance with the criteria for deadmen anchorage given on page 7-10-20 of the Design Manual, Soil Mechanics, Foundations and Earth Structures NAVFAC DM-7, March 1971, Department of the Navy, Naval Facilities Engineering Command Washington, D.C. The design of deadmen at El 250 is governed by the criteria, height of deadmen is greater than the depth to fill above the deadmen; whereas, the design of other deadmen at El 232.83 and 214.5 is governed by the criteria, height of deadmen is smaller than the depth of the fill above the deadmen. In the former case, passive soil pressure is the controlling resistive force; whereas, in the latter case, bearing pressure on the deadmen is the controlling resistive force. Both conditions for the height of deadmen and depth of fill are given in Page 7-10-20 of NAVFAC DM-7.

Section 2.5.5.4

The retaining wall is supported mostly on modified random fill with thickness ranging from 10 to 20 feet. The modified random fill is subjected to consolidation under the load of the retaining wall. Differential settlements may take place that would affect the stability and performance of the retaining wall. Therefore, the applicant must provide settlement analyses to demonstrate that the differential settlements would not adversely affect the stability of the retaining wall.

Response: The modified random fill under the foundation of the retaining wall was placed before the end of October 1982 and the area was used as a platform for construction of the Fuel Handling Building prior to start of construction of the retaining wall in August 1983. Furthermore, the construction of the retaining wall and backfill operations are spread over a period of one year in stages. Therefore, additional differential settlement will be insignificant for the final retaining wall configuration. This is based upon the settlement observations made at cooling tower #1. The settlement under the ring beam foundation of the cooling tower #1, one year after completion of the cooling tower veil, has been observed to be about one inch where the depth of soil and backfill over the top of rock is approximately 25 feet and foundation pressure for dead and live load is 4 ksf. The average depth of backfill over top of rock under the foundation of the retaining wall is 22 feet and the average foundation pressure is 5.76 ksf. Therefore, the settlement of the retaining wall is not expected to be much different than that at the cooling tower.

Differential settlement of this order of magnitude between the retaining wall and the deadmen will not cause any significant additional stresses in the tie rods.

Section 2.5.5.5

During Construction

(1) Compaction control for moisture and density of the random fill should be placed in accordance with NAVFAC procedures.

(2) Settlement and lateral movement of the retaining wall should be monitored biweekly. At least five monitoring points along the wall are required.

(3) All tie rods must be inspected prior to installation to ensure that the tie rods are fully covered with epoxy coating. At least three retrievable tie rod specimens should be buried in the same environment as the top tie rod for future examination of those rods for signs of corrosion.

After Construction

(1) The settlements and lateral movements of the retaining wall should be monitored and evaluated until the movements have stabilized.

(2) The buried tie rod specimen should be retrieved at 5-to-10-year intervals to evaluate the effects of corrosion.

Response: (1) The classification of backfill has been changed from random fill to modified random fill to introduce moisture content control for the compaction of backfill. Small depth of random fill already placed above El 216 ft has been evaluated and results meet the modified random fill requirements.

(2) Settlement and lateral movement markers will be installed at five places on the retaining wall and six places on the top line of deadmen. The markers will be observed biweekly during construction and for the first year after construction, monthly for the next year, and quarterly thereafter until the movement stabilizes.

(3) Tie rods are coated with epoxy or equal material and installed in accordance with CP&L site procedure. Three specimens of tie rods will be installed in between the top tie rods in concrete pipes open at the base, and filled with the same backfill material. This will facilitate excavation for specimen retrieval without disturbing other tie rods or integrity of the wall. The tie rod specimen will be retrieved after 5, 10 and 15 years to monitor corrosion of tie rods.

Section 2.5.5.6

(1) Field and laboratory tests to confirm the assumed soil properties of the random fill used in design and actual construction (see Section 2.5.5.2).

(2) Analyses to confirm the appropriateness of assumed lateral soil pressures, soil amplification effects, and the design of the deadmen (Section 2.5.5.3).

(3) Settlement analyses to determine the effect of differential settlement on the design and performance of retaining wall (Section 2.5.5.4).

(4) Monitoring program during and after construction (Section 2.5.5.5).

Response: (1) See response to Sections 2.5.5.2 and 2.5.5.3. With the design review for these sets of properties of soil which cover a wide range of materials, and change of random fill to modified random fill, testing of in-place backfill material is not considered necessary.

(2) See response to Section 2.5.5.3. The design review for different soil properties and ample factors of safety both for static and dynamic conditions indicate that the wall is adequately designed and is stable.

(3) Settlement monitoring system and settlement experience with similar type of backfill under cooling tower #1 do not indicate any necessity of settlement analysis at this time. Also, please refer to response to Section 2.5.5.4.

(4) See response to Section 2.5.5.5. The monitoring program will be instituted.

TABLE FOR
FACTORS OF SAFETY
FOR DIFFERENT SOIL PROPERTIES

Soil Properties:	Selected Impervious Fill (SIF)	Design Parameters for SIF	Random or Modified Random Fill
γ_s (pcf)	130	135	140
∅ (degrees)	20	30	25
c (psf)	400	0	120
Factor of safety for the most critical component (Tie rods at El. 232.83 ft)			
I. Without hydrostatic pressure			
1. Normal load condition	2.50	2.45	2.15
2. DBE load condition	1.77	1.75	1.59
II. With hydrostatic pressure			
a. Without corrosion			
1. Normal load condition	1.87	1.70	1.60
2. DBE load condition	1.42	1.33	1.27
b. With corrosion (1/8 in. reduction in diameter)			
1. Normal load condition	1.67	1.52	1.43
2. DBE load condition	1.27	1.19	1.13

Notes:

1. The minimum acceptable factor of safety for the normal load condition is 1.5, and that for the DBE load condition is 1.1 (FSAR 3.8.5.5).

2. The factors of safety are based on 90 percent of the minimum yield strength of the tie rods material. The corresponding factor of safety, for all values listed above, based on minimum yield strength of the tie rods material would be increased by the ratio of 1.00/0.90, e.g. for load case IIb1, random or modified random fill, the factor of safety of 1.43 would be increased to 1.59.

[illegible]