North Atlantic

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The Northeast Utilities System

August 12, 2002

Docket No. 50-443
NYN-02079

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555-0001

Seabrook Station
"Response to Request for Additional Information
Regarding License Amendment Request 01-12"

Reference: North Atlantic letter NYN-02024, Seabrook Station License Amendment Request 01-12 "Changes to Spent Fuel Assembly Storage Technical Specification 3/4.9.13," dated March 22, 2002.

North Atlantic Energy Service Corporation (North Atlantic) was requested by the Nuclear Regulatory Commission (NRC) to provide additional clarifying information regarding License Amendment Request (LAR) 01-12 "Changes to Spent Fuel Assembly Storage Technical Specification 3/4.9.13" during a telephone conference conducted on July 17, 2002. Specifically, the NRC requested additional technical information concerning the use of BORAL® and of BORAFLEX® fuel assembly storage racks. The North Atlantic responses to the subject requests are enclosed.

Should you have any questions concerning this response, please contact Mr. James M. Peschel, Manager - Regulatory Programs, at (603) 773-7194.

Very truly yours,

NORTH ATLANTIC ENERGY SERVICE CORP.

Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer

A001

cc: H. J. Miller, NRC Region I Administrator
R. D. Starkey, NRC Project Manager, Project Directorate I-2
G. T. Dentel, NRC Senior Resident Inspector

STATE OF NEW HAMPSHIRE

Rockingham, ss. DATE 8/12/02

Then personally appeared before me, the above-named Ted C. Feigenbaum, being duly sworn, did state that he is the Executive Vice President and Chief Nuclear Officer of the North Atlantic Energy Service Corporation, that he is duly authorized to execute and file the foregoing information in the name and on the behalf of North Atlantic Energy Service Corporation and that the statements therein are true and accurate to the best of his knowledge and belief.

Marilyn R. Sullivan

Marilyn R. Sullivan, Notary Public
My Commission Expires: April 17, 2007

MARILYN R. SULLIVAN MY COMMISSION EXPIRES APR. 17, 2007 NOTARY PUBLIC NEW HAMPSHIRE

Enclosure to NYN-02079

Request for Additional Information
SEABROOK NUCLEAR POWER STATION UNIT NO. 1
Based on Discussion with Lambros Lois July 17, 2002

Q. Was the criticality analysis performed in accordance with "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants?"

R. Yes, the criticality analysis followed the NRC guidance.

Q. Describe the Seabrook fuel assembly used in the criticality analysis and the empty lattice locations.

R. The Seabrook criticality analysis used the fuel rod and fuel assembly parameters provided in Table 1. The unit cell used for the criticality analysis is provided in Figure 1. This figure provides the location of the empty lattice location (guide tube).

Q. Provide information on benchmarking and the bias and uncertainty.

R. The CSAS25 criticality sequence was benchmarked against the 21 B&W critical experiments described in B&W-1484-7, "Critical Experiments Supporting Close Proximity Water Storage of Power Reactor Fuel," N. M. Baldwin, G. S. Hoovler, R. L. Eng and F. G. Welfare, July 1979. The results of the benchmarking are provided in Attachment A along with the bias and uncertainty.

Q. Provide results for the eccentricity analysis.

R. Two eccentric assembly placements were evaluated: fuel residing in the corner and fuel centered on an inside edge. These two cases were run with mirror and periodic boundary conditions. The results are presented in Table 2 and show that fuel positioned in the center of a storage cell (the base case) is the most limiting.

Q. Provide results for the credible accidents.

R. Accident analysis was performed with the CSAS25 criticality sequence of codes on both the Boral and Boraflex poisoned spent fuel racks fully loaded with fresh fuel at the maximum allowable enrichment for the rack type. The accidents considered a fresh 5.0 w/o assembly being misplaced within a Boral or Boraflex storage racks and being placed outside the racks at various pool locations. Even though placing an assembly outside the rack may not be possible, this accident configuration was still analyzed. An assembly dropped on top of the racks is sufficiently separated from the active fuel and is bounded by the other accident configurations. The spent fuel pool layout is presented in Figure 2 and the results of the accident cases are summarized in Table 3. As can be seen from Table 3, the limiting case is a fresh 5.0 w/o assembly outside Module 10 in an inner corner. The limiting case was then analyzed as a function of boron in the spent fuel pool water. The results are provided in Table 4 and show that 810 ppm provide a k_{eff} of 0.92686 or 0.95 with uncertainty. This is the minimum boron concentration needed in the spent fuel pool to ensure that no single fuel handling accident will cause k_{eff} with uncertainties to be greater than 0.95.

Q. Was analysis done for fuel consolidation?

R. Seabrook does not have consolidated fuel. Therefore, no analysis was performed.

TABLE 1

Nominal Fuel Assembly Design Specifications

Assembly Mechanical Design	
Assembly Pitch, in core	8.466 in
Rod Pitch	0.496 in
Number of Grids, in core	7
Grid Material	Inc718 & Zirc
Active Core Height	144.0 in
Fuel Rod Mechanical Design	
Outside Diameter	0.374 in
Diametral Gap	0.0065 in
Pellet Diameter	0.3225 in
Pellet Compositions	UO_2
Clad Thickness	0.0225 in
Clad Material	Zirc-4
Pellet Stack Density	10.412 g/cm
Guide Tube Mechanical Design	
Outside Diameter	0.484 in
Inside Diameter	0.448 in
Tube Material	Zirc-4

TABLE 2

Boral Storage Rack Eccentric Fuel Analysis

Case Description	Boundary Conditions	k_{eff}
Base	Mirror	0.98951 ± 0.00072
Fuel in Corner	Mirror	0.98715 ± 0.00073
Fuel in Corner	Reflective	0.98456 ± 0.00071
Fuel on Edge	Mirror	0.98785 ± 0.00071
Fuel on Edge	Reflective	0.98677 ± 0.00070

TABLE 3

Accident Analysis Summary

Accident Description	k_{eff}
Outside Module 10 Near Module 2	1.02899 ± 0.00074
Outside Module 10 in Inner Corner	1.06067 ± 0.00072
Outside Modules 7/12 Corner	1.04732 ± 0.00078
Outside Module 12, Assemblies Lined Up	0.92686 ± 0.00054
Outside Module 12, Assemblies Not Lined Up	0.92686 ± 0.00054
In Boraflex Module 4	1.00313 ± 0.00060
In Boraflex Module 1 Near Boral Module 9	0.98241 ± 0.00063
In Boral Module 9 Near Boraflex Module 1	0.92662 ± 0.00056
In Boral Module 12	0.92630 ± 0.00051

TABLE 4

Limiting Accident Soluble Boron Analysis Summary
Outside Module 10 in Inner Corner

Soluble Boron Concentration (ppm)	k_{eff}
400	0.98438 ± 0.00084
500	0.97034 ± 0.00070
600	0.94901 ± 0.00093
700	0.94317 ± 0.00067
750	0.93318 ± 0.00072
800	0.92851 ± 0.00067
810*	0.92686 ± 0.00054
900	0.91124 ± 0.00075
1000	0.90154 ± 0.00073
1100	0.88897 ± 0.00068
1200	0.87997 ± 0.00066
1300	0.86550 ± 0.00075
1400	0.85576 ± 0.00065

*Interpolated

FIGURE 1

Storage Rack Unit Cell for Criticality Analysis

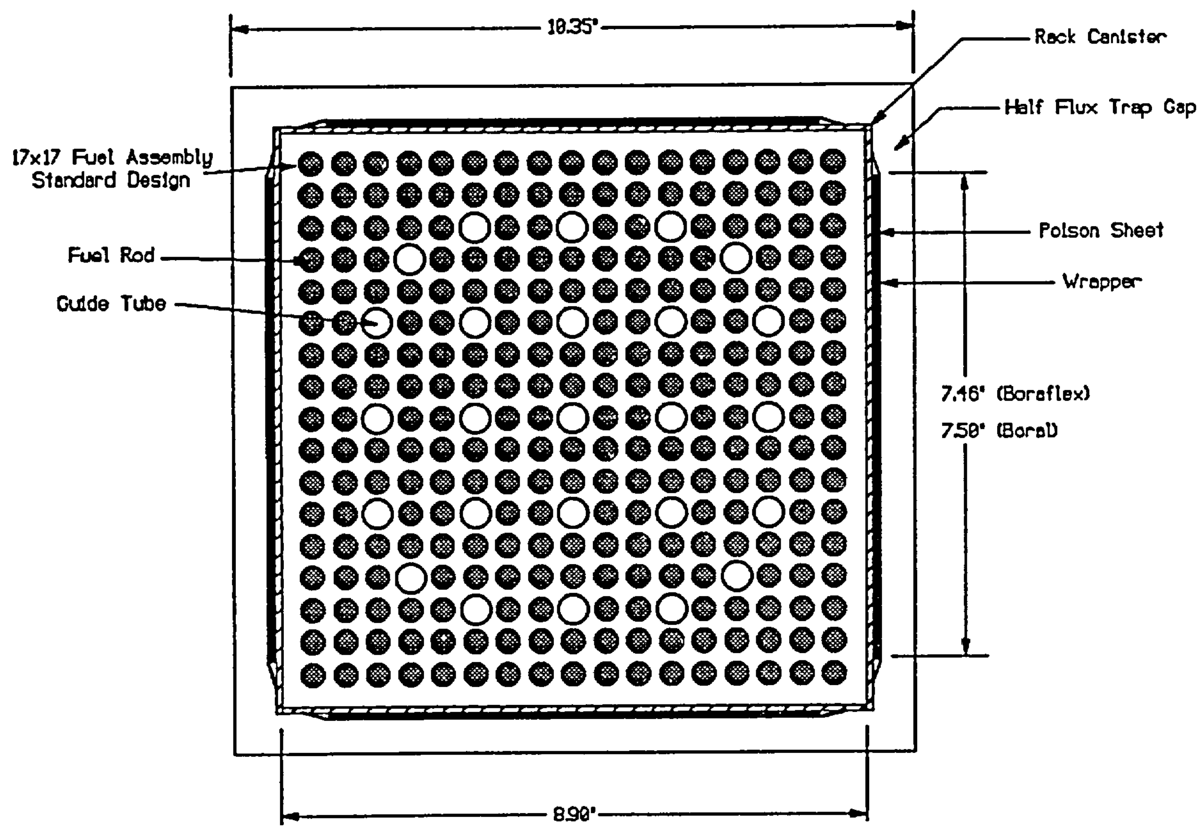
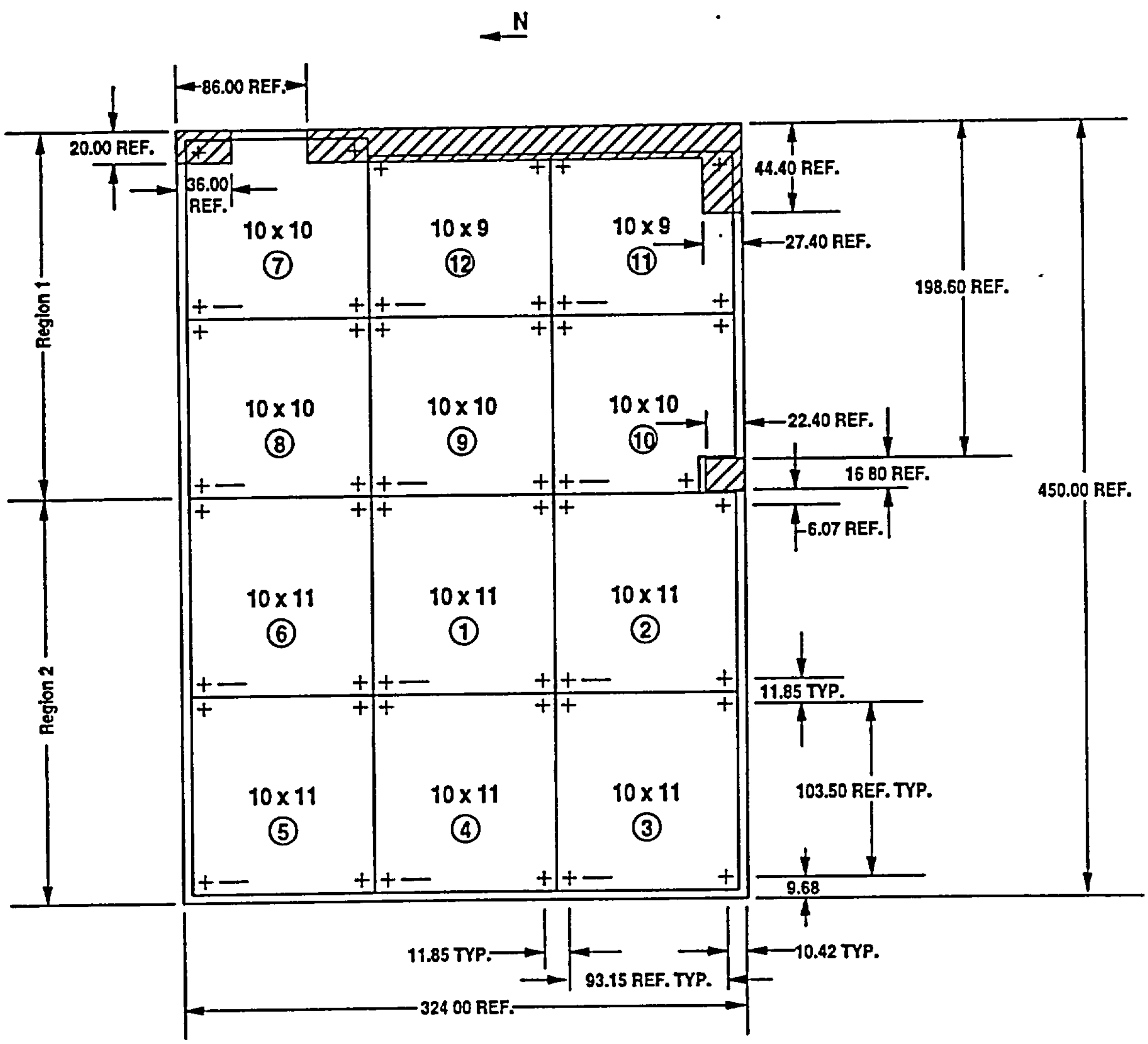


FIGURE 2

Seabrook Spent Fuel Pool Layout



ATTACHMENT A

The 21 B&W critical experiments described in BAW–1484-7 were modeled and run with the SCALE 4.3 CSAS25 criticality sequence. Table A.1 shows the k_{eff} results and the calculation of the KENO V.a uncertainties using the CSAS25 sequence and the 44 group ENDF/B-V library. The equations used to calculate the uncertainties are shown below. The 95/95 one-sided tolerance factor for the 21 cases is 2.371.

k_{eff} is calculated at the 95/95 probability/confidence level by the following equation:

$$K_{95/95} = K_{nom} + \Delta K_{cb} + \sqrt{(\Delta K_c)^2 + (2\sigma_k)^2 + (\Delta K_m)^2} \qquad \text{(A-1)}$$

where:

K_{nom} = K_{eff} of the nominal configuration

ΔK_{cb} = calculational bias

ΔK_c = 95/95 calculational uncertainty

σ_k = KENO V.a uncertainty (deviation), and

ΔK_m = 95/95 mechanical uncertainty.

From Table A.1 ΔK_{cb} = 0.00540 and ΔK_c = 0.00796

TABLE A.1
KENO V.a k_{eff} Results and Uncertainty Calculation

Core	Measured k_{eff}	Calculated k_{eff}
1	1.0002 ± 0.0005	0.99561 ± 0.00063
2	1.0001 ± 0.0005	0.99675 ± 0.00051
3	1.0000 ± 0.0006	0.99994 ± 0.00053
4	0.9999 ± 0.0006	0.99308 ± 0.00062
5	1.0000 ± 0.0007	0.99329 ± 0.00062
6	1.0097 ± 0.0012	1.00257 ± 0.00063
7	0.9998 ± 0.0009	0.99339 ± 0.00061
8	1.0083 ± 0.0012	1.00206 ± 0.00062
9	1.0030 ± 0.0009	0.99836 ± 0.00059
10	1.0001 ± 0.0009	0.99660 ± 0.00057
11	1.0000 ± 0.0006	0.99955 ± 0.00056
12	1.0000 ± 0.0007	0.99583 ± 0.00059
13	1.0000 ± 0.0010	0.99714 ± 0.00061
14	1.0001 ± 0.0010	0.99437 ± 0.00062
15	0.9998 ± 0.0016	0.99030 ± 0.00057
16	1.0001 ± 0.0019	0.98980 ± 0.00061
17	1.0000 ± 0.0010	0.99426 ± 0.00057
18	1.0002 ± 0.0011	0.99231 ± 0.00060
19	1.0002 ± 0.0010	0.99492 ± 0.00054
20	1.0003 ± 0.0011	0.99562 ± 0.00057
21	0.9997 ± 0.0015	0.99228 ± 0.00059
$K \pm \sigma$	1.0006 ± 0.0010	0.99567 ± 0.00059
σ_m		0.00336
ΔK_{cb}		0.00540
$\Delta K_c = \sigma_m$ 95/95		0.00796