North Atlantic

North Atlantic Energy Service Corporation
P.O. Box 300
Seabrook, NH 03874
(603) 474-9521

The Northeast Utilities System

March 15, 2000

Docket No. 50-443

AR# 00000237

NYN-00024

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Seabrook Station
"Response to NRC Request for Additional Information Regarding the
Individual Plant Examination for External Events"

North Atlantic Energy Service Corporation (North Atlantic) has enclosed herein the responses to the request for additional information (RAI) regarding the Individual Plant Examination for External Events (IPEEE) transmitted by letter dated December 27, 1999. This RAI was issued to enable the Nuclear Regulatory Commission to complete its review of the IPEEE submittal for Seabrook Station.

Should you have any questions regarding this letter, 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

A011

cc: H. J. Miller, NRC Regional Administrator
R.M. Pulsifer, NRC Project Manager, Project Directorate 1-2
R. K. Lorson, NRC Senior Resident Inspector

ENCLOSURE 1 TO NYN-00024

Responses to the NRC Request for Information (RAI) on the Seabrook Individual Plant Examination of External Events (IPEEE) Submittal

Seismic

Question (1):

Section 6.3.2 of NUREG-1407 requests that the IPEEE program address the effects of seismically induced external and internal flooding on plant safety. NUREG-1407 further states that the scope of the evaluation of seismically induced floods should include, in addition to the external sources of water (e.g., upstream dams), an evaluation of internal flooding (e.g., tanks) consistent with the discussion in Appendix I of EPRI NP-6041. Confirm that you have addressed seismically induced floods in the IPEEE program consistent with NUREG-1407, and provide a description and the results of the evaluation.

Response to Question (1):

Seismically induced flooding was evaluated during the seismic plant walkdown and analysis, conducted in 1991 as part of the update of the seismic PRA. The walkdown was conducted according to "Seismic Event Plant Walkdown Procedure," (Yankee Nuclear Services Division, Safety Assessment Group Procedure No. PRA17, 8-9-91). This procedure included specific directions regarding observing and evaluating the impact of the failure of high-energy lines and other flooding/spray sources. This walkdown addressed seismically induced floods consistent with NUREG-1407.

This evaluation included a comprehensive walkdown of the Seabrook Station site. A number of comments and observations were recorded during this walkdown which required additional review and analysis. For example, the following comment was recorded in Electrical Tunnel No. 3:

> "The sprinkler system bracing is more than adequate for seismic. It is a threaded connection so it will have the tendency to fail over time in a seismic event but it is adequately braced. As far as the fire protection goes, the questions that have to be asked are, is the system pressurized now wet or do the detectors have to pick up smoke or heat before they open the valves to pressurize the system. If there is a question of the system being live now full of pressure, some of the threaded joints might, at a large enough earthquake, crack at the threads and create a leak... There are drains placed at about 20-foot intervals, so flooding should not be a major concern for minor cracking..."

This concern (the potential for the leaking of fire protection piping) was subsequently evaluated and resolved as follows:

"Per NHY Fire Suppression System Design Basis Document, DBD-FP-03 Rev. 0, all fire protection piping routed in Seismic Category 1 building areas are dry systems. The fire protection piping is either a deluge system design (i.e., piping is initially dry, deluge valve opens, water flows to all spray nozzles) or a pre-action system design (i.e., piping initially contains air under pressure, pre-action valve opens, water flows to opened sprinkler head)."

Similar observations and evaluations were performed for other potential seismically induced flooding scenarios, such as the boric acid tank, waste liquid drain tank, refueling water storage tank (RWST). The conclusion was that no seismically induced flooding scenarios were identified that would have the potential to fail other risk-important equipment or systems.

Question (2):

The Seabrook IPEEE submittal states that plant walkdowns were performed consistent with the guidelines described in EPRI NP-6041. However, the submittal did not describe how potential spatial and functional interactions were addressed by the walkdowns, as requested in NUREG-1407. Provide a discussion of the methods used to identify potential spatial and functional interactions and provide your findings from the seismic walkdowns pertaining to this topic.

Response to Question (2):

A seismic plant walkdown was conducted in 1991, as part of the update of the seismic PRA. The method used to identify potential spatial and functional dependencies included: (a) a walkdown procedure that directed participants regarding what to observe and (b) an experienced and diverse team that performed the walkdown.

The walkdown was conducted according to "Seismic Event Plant Walkdown Procedure," (Yankee Nuclear Services Division, Safety Assessment Group Procedure No. PRA17, 8-9-91). This procedure included directions regarding observing and evaluating spatial and functional interactions, such as the following:

- Spatial interactions,
- High temperature,
- Steam release,
- Impact of the failure of high energy lines and other flooding/spray sources,
- Fire due to combustible materials, and
- Fires due to other potential ignition sources.

In addition, the impact of the seismic event occurring when the plant is at power as well as in a shutdown mode was also considered.

A team of five engineers from Seabrook Station and a consultant conducted this walkdown. This team included system and design engineers, engineers experienced in assessing seismic fragilities, and a Probabilistic Risk Assessment (PRA) engineer. This team worked together during the walkdown to observe and evaluate any potential interactions that could occur in response to a seismic event.

Observations of the Seabrook seismic walkdowns in 1991 produced a series of 55 findings. These were issues that were raised during the walkdown that required additional research to resolve.

A number of these issues related to seismic interactions and seismic mounting/anchorage of equipment. It was concluded that these findings had been previously addressed. A program was implemented during the construction of Seabrook Station that dealt with seismic interactions. A review of mounting/anchorage for Class IE equipment was performed in 1985 to demonstrate that details were technically substantiated.

In addition, several items dealt with the potential seismic interaction of temporary equipment and safety-related equipment. Seabrook Station had a program to address these issues. None of the walkdown items were found in violation of these procedures.

The conclusion of the walkdown:

The resolution of seismic related items identified in a plant walkdown for the IPEEE program resulted in no reduction of seismic capacity for any structures, equipment and components evaluated in the IPEEE Report.

Question (3):

According to Generic Letter No. 88-20, Supplement 4, "A description of dominant functional/systemic sequences leading to core damage along with their frequencies and percentage contribution to overall seismic core damage frequencies" should be provided. This information should be provided in the IPEEE submittal using the seismic probabilistic risk assessment (PRA) methodology. NUREG-1407 also states that "the examination should focus on qualitative insights from the systematic plant examination..."

Although the 10 top seismic-initiated sequences are provided in Table 3-9 of the submittal, no discussion of these sequences is provided. This discussion provided in the Conclusion Section of the submittal (Section 3.9.1) is also very brief and does not mention any insights that were obtained from the analysis results.

Also, in accordance with Generic Letter 88-20, provide a description of the dominant functional/systemic sequences obtained from the PRA. Discuss the dominant component contributors to the total core damage frequency (CDF) and the insights obtained from the analysis results.

Response to Question (3):

Three sets of seismic sequences were identified as a result of this study. The dominant contributors to CDF and insights from the results are discussed below:

General Transients

The risk-significant seismically initiated general transient sequences involve loss of onsite and offsite AC power sources. These include offsite power (at 0.1g levels and above), emergency diesel generators (at 0.4g levels and above), and loss of 4kV essential buses due to relay chatter/failure (at 0.3g levels and above).

Table 3-9 in the IPEEE Report (Sept 1992) lists the top 10 sequences. Sequences #1, 2, 5, 7, and 9 are seismically initiated station blackout - offsite power loss (top event QY) due to the seismic event followed by seismic failure of both EDGs (top event QD) or followed by seismic chatter/failure of essential bus relays (top event QK). The sequences indicate failure of offsite power (top event OG) and EDGs (top events GA, GB) as well as other systems that depend on AC power. No credit is given for recovery of AC power for these sequences initiated by high-acceleration seismic events.

Sequences #3, 6, and 10 are seismically initiated loss of offsite power (top event QY) with subsequent hardware failure or maintenance unavailability of both EDGs. These are lower-acceleration seismic events where the EDGs are expected to remain functional with regard to the seismic event, but fail due to random hardware or maintenance reasons.

Anticipated Transient Without Scram (ATWS)

Seismically-initiated ATWS sequences involve a plant upset that requires a plant trip (e.g., a loss of offsite power) with failure of the control rods to insert due to seismic acceleration.

The final set of sequences illustrated in Table 3-9 are seismic ATWS sequences (#4, and 8). These sequences are initiated by high-acceleration seismic events, which will trip the plant (in fact, cause loss of offsite power) and fail the control rods in such a way that they are unable to insert (top event RT). This results in an ATWS; no credit is given for operator actions to mitigate the sequence because of the high seismic acceleration.

Large Break Loss of Coolant Accident (LOCA)

The final set of sequences are large LOCA initiated. These sequences are lower frequency and do not appear in the top 10. The seismically induced large LOCA is due to seismic accelerations on the reactor coolant pumps (at 0.5g levels and above) and/or steam generators (at 0.4g levels and above). The dominant system failure, given a large LOCA, is seismic rupture of the RWST (at 0.4g and above).

Conclusion

The primary conclusion from this analysis was that there are no key components, except offsite power, that have seismic fragilities below the Safe Shutdown Earthquake (SSE). The key components in the seismic fragility analysis include offsite power, essential AC power buses, EDGs, RWST, reactor internals, and SGs/RCPs (large LOCA). Non-seismic contributors are important only for lower-acceleration events, where offsite power fails but EDGs or essential AC buses remain functional (with regard to the seismic impact).

Question (4):

The results of the sensitivity studies performed in the seismic analysis are provided in Table 3-10 of the submittal. The CDFs for the three categories (e.g., Station Blackout (SBO) CDF, Large Loss of Coolant Accident (LOCA) CDF, and Anticipated Transients Without Scram (ATWS) CDF), and a "Seismic CDF Total, " are provided. The three categories shown in Table 3-10 are not quite the same as the three seismic initiators used in the seismic analysis (i.e., General Transients, ATWS, and Large Break LOCA). Since not all General Transient events would lead to Station Blackout (SBO) and subsequent core damage, there may be a finite CDF from General Transient events that do not involve SBO. Clarify and discuss the composition of the CDF obtained for General Transient events for the base case.

In addition, the summation of the CDFs from the three categories provided in Table 3-10 is not equal to the "Seismic CDF Total". For example, the CDFs for the Base Case (SSPSS-1990+ Model) in Table 3-10 are 9.07E-6/yr for Station Blackout, 6.27E-7/yr for Large LOCA (LLOCA) and 3.47E-6/yr for ATWS. The summation of these three CDFs is 1.32E-5/yr, which is greater than the "Seismic CDF Total" presented in table (1.10E-5/yr). Please clarify this apparent inconsistency.

Finally, the CDFs for the Base Case provided in Table 3-10 are not consistent with the results provided in Table 3-8 (Seismic Initiator Contributions to Core Damage Total). The CDFs provided in Table 3-8 are 7.84E-6/yr for General Transients, 1.29E-6/yr for LLOCA, and 2.88E-6/yr for ATWS. Please clarify this apparent inconsistency.

Response to Question (4):

The following addresses the presentation of materials in Table 3-10 presenting sensitivity results and Table 3-8 presenting CDF total results. The seismic initiators listed in Table 3-8 were defined to be "mutually exclusive." Thus, a seismically-induced General Transient initiator (e.g., E7T) includes the seismic hazard and the resulting plant trip but NOT seismically-induced LOCA initiators and NOT seismically-induced ATWS initiators. Similarly, a seismically induced ATWS initiator (e.g., E7AT) includes the seismic hazard and failure of control rod to insert but NOT the seismically induced LOCA. This mutually exclusive definition for initiators is illustrated on Figure 3-3. As a result of this definition, the individual seismic initiator contributions to CDF total in Table 3-8 can be summed to get an overall seismic CDF total (=1.20E-5/yr).

However, the sensitivity results presented in Table 3-10 are based on sequences, not initiators that are not necessarily mutually exclusive. This raises questions, such as, is a seismic sequence initiated by a Large LOCA where offsite power and both EDGs fail a "Large LOCA sequence" or a "Station Blackout sequence"? The convention in this table was to define any sequence with failure of offsite and onsite AC power a Station Blackout. Thus, the frequency of Station Blackout for the base case from Table 3-8 includes nearly all of the General Transient initiator contribution along with some of the LLOCA initiator contribution that also happened to be Station Blackout. Similarly, ATWS sequences included seismically initiated sequences where reactor trip failed. This includes the ATWS initiator contribution but also includes General Transient initiators with non-seismic failure of reactor trip breakers to open on demand. Finally, the total for Large LOCA CDF sequences is actually less than for the large LOCA IE CDF. This is also true for Seismic CDF Total for the base case from Table 3-10. The sensitivity results were evaluated using a saved set of seismic sequence (rather than re-evaluating the event tree model each time). The difference is due to truncation of this saved set versus the full model quantification that ran at much lower cutoff.

The purpose of the sensitivity table was to evaluate the change to seismic contribution based on changes to a number of parameters. The fact that the sequences were not defined to be mutually exclusive or that the evaluations were performed with a truncated set of sequences does not distract from the important results that came out of this sensitivity study.