UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
LONG ISLAND LIGHTING COMPANY	)	Docket No. 50-322 (OL)
	)	
(Shoreham Nuclear Power Station,	)	
Unit 1)	)	

TESTIMONY OF ALBERT YAO CHEE WONG FOR THE LONG ISLAND LIGHTING COMPANY ON SOC CONTENTION 19(e) -- SEISMIC DESIGN

PURPOSE

This testimony shows that the design response spectra and the corresponding damping values used for the seismic design of Shoreham ensure that the seismic design is conservative. The total damping values in the Shoreham design are more conservative and provide more safety than the structural damping values suggested in Regulatory Guide 1.61.

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TESTIMONY OF ALBERT YAO CHEE WONG
FOR THE LONG ISLAND LIGHTING COMPANY
ON SOC CONTENTION 19(e) --
SEISMIC DESIGN

1. Q. What is your name and business address?

A. My name is Albert Yao Chee Wong. My business address is Stone & Webster Engineering Corporation, 245 Summer Street, Boston, Massachusetts, 02107.

2. Q. By whom and in what capacity are you employed?

A. I am employed by Stone & Webster Engineering Corporation as a Senior Structural Engineer.

3. Q. Would you briefly summarize your professional qualifications?

A. I am the Principal Structural Engineer on the Shoreham project, responsible for providing technical guidance in the design and analysis of all structures, resolving field problems during

construction and interfacing with other engineering disciplines. My complete resume appears on pages 9-12.

4. Q. Are you familiar with SOC Contention 19(e)?

A. Yes.

5. Q. What is the basic issue of the contention?

A. The thrust of the contention is that LILCO has not complied with 10 CFR Part 50, Appendix A, Criterion 2, and 10 CFR Part 100, Appendix A in regard to the seismic design of Shoreham because (1) the design response spectra for the seismic design are not based on Regulatory Guide 1.60, and (2) a damping value of 5 percent, rather than 4 percent as suggested in Regulatory Guide 1.61, was used.

6. Q. What are design response spectra?

A. Design response spectra are mathematical representations of an earthquake to be used in structural analysis and design. They are envelopes of prescribed maximum responses of a structure to seismic excitation. This response depends upon such factors as natural frequency, peak ground acceleration, and damping values. Natural frequency is the rate at which the structure completes one cycle of

motion per unit of time. Put simply, natural frequency describes how fast the structure vibrates. The peak ground acceleration rate describes how fast the ground moves in terms of percentage of gravity. The damping factor describes the amount of energy dissipated by the system during motion.

7. Q. Did Shoreham incorporate the design response spectra established in Regulatory Guide 1.60?

A. Shoreham did not incorporate the Regulatory Guide 1.60 spectra because it was designed before the issuance of Regulatory Guide 1.60.

8. Q. What design response spectra were used in the analysis at Shoreham?

A. The design response spectra used are shown in Shoreham FSAR Fig. 3.7.1A-1 and Fig. 3.7.1A-2.

9. Q. How do they differ from the spectra proposed by Regulatory Guide 1.60?

A. The Regulatory Guide 1.60 design response spectra are developed so that they can be used universally; that is, they can be applied to many sites in the United States. Accordingly the design response spectra are overly conservative. The Shoreham spectra were developed specifically for Shoreham.

10. Q. What is the basis of Shoreham design response spectra?

A. Shoreham's design response spectra were developed based on the studies of Dr. H. B. Seed and Dr. R. V. Whitman, and the recommendation of NRC Consultant, Dr. Newmark, whose publication is the basis of Regulatory Guide 1.60. The Shoreham design response spectra were reviewed by the NRC and found to be adequately conservative.

11. Q. Let's further explore the Shoreham design. What is the basis of the Shoreham's safe shutdown earthquake (SSE) design?

A. The design was based on the extrapolation of historical data of seismic activity in the Shoreham area. Shoreham is designed to Intensity VII of the Modified Mercalli scale. The intensity scale is a subjective measure of structural damage at a given location.

12. Q. How was the Mercalli Scale VII figure derived?

A. It was a conservative estimate based upon se history in the area. Over 300 years of historical records in Southern New England, New York and New Jersey were used. The largest intensity earthquake that has occurred on Long Island was Intensity V. These data are discussed in the FSAR.

13. Q. If the largest intensity earthquake was a V, why is Shoreham designed to withstand a VII?

A. To add an extra margin of safety, the Shoreham design used a Intensity VII earthquake as the maximum credible earthquake.

14. Q. How much greater is an Intensity VII earthquake than an Intensity V earthquake?

A. Using the peak ground acceleration as the criterion, an Intensity VII earthquake is a factor of about 3 greater than an Intensity V earthquake.

15. Q. What is the maximum ground acceleration to be expected at Shoreham?

A. With an earthquake intensity of VII, the maximum ground acceleration rate of an SSE is 0.13g. However, for an added margin of safety, Shoreham used a 0.2g maximum ground acceleration as the design basis for its SSE. The OBE is defined as one-half the SSE.

16. Q. So Shoreham is designed to meet much greater ground acceleration than would be expected.

A. Yes.

17. Q. How do the Shoreham design response spectra compare to the Regulatory Guide 1.60 requirements?

A. It is inappropriate to compare the Shoreham and Regulatory Guide 1.60 design response spectra. In total, the conservative inputs into Shoreham's design assure adequate safety.

18. Q. Why is it inappropriate to compare the Regulatory Guide 1.60 and Shoreham's design response spectra?

A. Regulatory Guide 1.60 is based on data from various sites that do resemble Shoreham. For example, because Shoreham is on a soil site, the major contributing structural frequencies are below 5 Hertzs (Hz). Seismic input above 5 Hz will have an insignificant contribution to the structural response. Therefore, frequency inputs above 5 Hz, which are included in Regulatory Guide 1.60, are insignificant.

19. Q. Let us move to the second part of the contention. What is the issue involved?

A. Regulatory Guide 1.61 provides that a 4 percent material damping value should be used for the operating basis earthquake (OBE) analysis of Category I reinforced concrete structures. Shoreham, however, used a 5% total system damping value. SOC contends that this value is insufficient.

20. Q. What is the difference between material damping and total system damping?

A. Material damping is the damping associated with a particular kind of material and a particular type of structure. The total system damping is a weighted average of the damping factors of the structural system, including the subgrade soil damping.

21. Q. How is the total system damping determined?

A. The total system damping is a weighted average damping of the structure system. The weighting factor is based on the amount of energy stored by each part of the structural system, including the subgrade soil.

22. Q. Did the Shoreham seismic OBE analysis use the 4 percent material damping value as suggested by Regulatory Guide 1.61?

A. No. The 4% structural damping value proposed by the Regulatory Guide is not applicable to the approach taken for Shoreham. The Shoreham OBE seismic analysis used 5 percent total system damping which is more conservative than 4 percent reinforced concrete material damping as suggested by Regulatory Guide 1.61.

23. Q. What is the justification for using the 5 percent total system damping value?

A. Typical soil subgrade damping is 10% or more. Using the weighted average scheme as discussed, the use of 4% structural damping with 10% soil damping is equivalent to total system damping of 8%. Shoreham, by using a 5% total system damping value, is conservative.

24. Q. Would you summarize your conclusions regarding Shoreham's seismic design?

A. The use of the Shoreham design response spectra, the peak ground acceleration rate of 0.2g and the corresponding damping values ensure that the seismic design of Shoreham is sufficiently conservative.

PROFESSIONAL QUALIFICATIONS

Albert Y. C. Wong

Senior Structural Engineer/Structural Division

STONE & WEBSTER ENGINEERING CORPORATION

My name is Albert Wong. My business address is 245 Summer Street, Boston, Massachusetts, 02107. I am employed by Stone & Webster Engineering Corporation as a Senior Structural Engineer in the Structural Division and have held this position since September 1979. I am assigned as the Principal Structural Engineer on the Shoreham project. In this capacity, I am responsible for providing technical guidelines in the design and analysis of all structures, resolving field problems during construction, and interfacing with various vendors and other engineering disciplines. My responsibility also includes preparing manpower budgets and engineering schedules, attending technical committee meetings, and liaison with, and representation of Long Island Lighting Company at various hearings.

I received my Bachelor of Science degree with honors, in civil engineering, from the University of Hong Kong in 1968; Master of Science and Doctor of Philosophy in civil engineering in 1970 and 1973 from the University of Illinois at Champaign-Urbana; and Master of Business Administration from

Boston College in 1981. In 1974 I successfully completed a course on multiprotection design conducted by the U.S. Civil Defense Preparedness Agency. In the area of power plant engineer, I have completed three graduate courses in power plant design at Northeastern University.

Prior to joining Stone & Webster Engineering Corporation, I was a research assistant in the Department of Civil Engineering at the University of Illinois at Champaign-Urbana. My research included study of the durability of concrete, and the analytical study of load distribution in highway bridges.

I joined Stone & Webster Engineering Corporation as a computer Applications Engineer in December 1972, and in that capacity I was responsible for the implementation, development and modification of various structural analysis systems and programs in the areas of finite element analyses and dynamic analyses. I transferred to the Structural Division in September 1973 as a support engineer. From September 1973 to June 1978, I was assigned to different projects working on different aspects of the design and analysis of power plant structures. My experience included the design of containment building, internal structure, foundation mat, and other structures; design of tornado missile barrier; seismic analysis of

containment structure, polar crane supporting structure, and other buildings; vibration analysis of fan foundation and stress analysis of piping penetrations and liner. I also performed a study on the effects of damping on structural response and the sliding of building under seismic excitation.

I was promoted to Structural Engineer in 1977 and Senior Structural Engineer in 1979. From 1978 to April 1980, I was assigned to various responsible positions on different projects. I performed various conceptual studies of containment internal structure layout; developed structural design criteria; established engineering schedules, manpower requirements, and various budget estimates. I was the responsible engineer in a seismic reanalysis task force supervising the seismic analysis of all the buildings and presenting the SWEC approach and method of analysis to the U.S. Nuclear Regulatory Commission. I was assigned to Shoreham project as the Principal Structural Engineer in April 1980.

I am a Registered Professional Engineer in Massachusetts and a Member of both the American Society of Civil Engineers and the American Concrete Institute.

My publications include:

"The Effects of Drying on the Freeze-Thaw Durability of Concrete," University of Illinois Engineering Experiment Station, Bulletin 506, by A. Y. C. Wong, C. L. Anderson, and H. K. Hilsdorf.

"Effects of Diaphragms on Load Distribution on Continuous Slab Girder Bridges," by A. Y. C. Wong and W. L. Gamble - University of Illinois Structural Research Series, SRA 391.

"Probabilistic Prediction of Floor Response Spectra," by Manas K. Chakravorty, A. Y. C. wong, and D. C. Foster - Third Canadian Conference on Earthquake Engineering, June 4-6, 1979, Montreal, Canada.

"A Frequency Domain Approach to Seismic Analysis of Multiple Supported Secondary Systems." by Manas K. Chakravorty, A. Y. C. Wong, and M. B. Stetson - International Meeting on Fast Reactor Safety Technology, August 19-23, 1979, Seattle, Washington.

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CERTIFICATE OF SERVICE

I hereby certify that copies of the following testimony:

KASCSAK'S TESTIMONY ON SUFFOLK COUNTY CONTENTION 24 AND SHOREHAM OPPONENTS COALITION CONTENTION 19(d)--CRACKING OF MATERIALS;

FORTIER'S AND MIEHLE'S TESTIMONY ON SUFFOLK COUNTY CONTENTION 26--ALARA;

STARK'S TESTIMONY ON SUFFOLK COUNTY CONTENTION 28(a)(i) AND SHOREHAM OPPONENTS COALITION CONTENTION 7A(1)--ECCS CUT-OFF;

SCHMITT'S TESTIMONY ON SUFFOLK COUNTY CONTENTION 28(a)(iii) AND SHOREHAM OPPONENTS COALITION CONTENTION 7A(3)--IODINE MONITORING;

McCAFFREY'S TESTIMONY ON SUFFOLK COUNTY CONTENTION 31 AND SHOREHAM OPPONENTS COALITION CONTENTION 19(g)--ELECTRICAL SEPARATION;

HILL'S TESTIMONY ON SHOREHAM OPPONENTS COALITION CONTENTION 16--CLADDING SWELLING AND FLOW BLOCKAGE;

ZEUTHEN'S TESTIMONY ON SHOREHAM OPPONENTS COALITION CONTENTION 19(c)--FERRITE CONTENT OF WELDING MATERIALS; and

WONG'S TESTIMONY ON SHOREHAM OPPONENTS COALITION CONTENTION 19(e)--SEISMIC DESIGN

were served upon the following people by first-class mail, postage prepaid, on May 6, 1982, except for those with an asterisk who were served by hand on May 4, 1982. Due to a power failure in Richmond, Virginia, on May 4 and 5, 1982, the documents were not able to be produced.

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