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-4
	)	
(Shoreham Nuclear Power Station, Unit 1)	)	

NRC STAFF TESTIMONY OF JOHN L. KNOX ON SUFFOLK COUNTY AND THE STATE OF NEW YORK EMERGENCY DIESEL GENERATOR LOAD CONTENTION A (i) AND A (iv)

Q. What is your name?

A. My name is John L. Knox.

Q. What is your position?

A. I am a Senior Electrical Engineer (Reactor Systems) in the Power Systems Branch in the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. In this position I perform technical reviews, analyses, and evaluations of reactor plant features pursuant to the construction and safe operation of reactors.

Q. What are your qualifications?

A. In 1962, I received an Associate of Arts degree in Electrical Power System Technology from Montgomery College. In 1971, I received a Bachelor of Science degree in Electronic Systems Engineering from the University of

Maryland. Since 1974, I have taken a number of courses on PWR and BWR system operation, equipment qualification, and reactor safety.

From 1971-1974, I worked for Potomac Electric Company in Washington, D. C. I was assigned to the underground power Transmission Engineering Group and my duties included relocation and restoration of underground power and transmission cables due to the subway construction project. (Prior to this, I spent four years in the Air Force working on the F4 aircraft electronic weapons control systems.)

From 1974 to the present, I have worked for the Nuclear Regulatory Commission involved in the technical review of electrical systems (onsite and offsite power, instrumentation and control). Through 1976, I was a member of the Electrical Instrumentation and Control Systems Branch. This branch was split in January 1977 into an I&C branch and a power branch. Since this split, I have been a member of the Power Systems Branch. My present responsibilities include review and evaluation of onsite and offsite electric power systems.

Q. What is the purpose of your testimony?

A. The purpose of this testimony is to respond to Suffolk County and the State of New York emergency diesel generator load contention a (i) and a (iv), which are as follows:

Contrary to the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 17 -- Electric Power Systems, the emergency diesel generators at Shoreham ("EDGs") with a maximum "qualified load" of 3300 kW do not provide sufficient capacity and capability to assure that the requirements of clauses (1) and (2) of the first paragraph of GDC 17 will be met, in that

(a) LILCO's proposed "qualified load" of 3300 kW is the maximum load at which the EDG may be operated, but is inadequate to handle the maximum load that may be imposed on the EDGs because:

(i) intermittent and cyclic loads are excluded;

(iv) operators may erroneously start additional equipment;

Q. Define the safety function of the emergency diesel generators at Shoreham.

A. The emergency diesel generators are part of the onsite electric power system and as such their safety function was derived from the first paragraph of criterion 17 of Appendix A to 10 CFR 50. The onsite emergency diesel generators "shall be provided to permit functioning of structures, systems, and components important to safety. ...[and] shall...provide sufficient capacity and capability to assure..." this function.

Q. How does the staff determine that the emergency diesel generators have sufficient capacity and capability to perform their safety function?

A. The staff reviews the plant's design loads to ensure that they do not exceed the capacity and capability of the diesel generators.

Q. Define the plant's design load.

A. The plant's design load, as defined in Section 3.4 of IEEE Standard 387-1977, consists of a combination of electric loads, having the most severe power demand characteristic, which is provided with electric energy from a diesel generator unit for the operation of engineered safety features and other systems required during and following shutdown of the reactor.

Q. How can one ensure that the emergency diesel generators have sufficient capacity and capability to perform their safety function?

A. Diesel generator capacity and capability is verified through qualification, preoperational, and periodic testing.

Q. Describe industry recommended practice with respect to load capability qualification testing of diesel generators?

A. Load capability qualification testing as described in IEEE Standard 387-1977 includes, in part, operation of one diesel generator for 22 hours at its continuous rating followed by 2 hours of operation at its short time rating.

Q. Describe the load capability qualification testing performed at Shoreham?

A. Testing at Shoreham included operation of the diesel generator at a 3300 kW load for 750 hours.

Q. Is the 3300 kW load used during the load capability qualification test greater than the plant's design load?

A. Yes, except for intermittent and cyclic loads as indicated on Table 8.3.1-1 and 8.3.1-1A of the FSAR.

Q. What has been estimated to be the worst case kW magnitude and time duration loading for these intermittent and cyclic loads?

A. By letter dated November 19, 1984, the applicant identified the following loads that are automatically actuated, are intermittent/noncontinous, and are not considered to be part of the 3300 kW load used during qualification testing.

a. diesel generator air compressor (12 kW)

b. diesel generator fuel oil transfer pump (0.4 kW)

c. motor operated valves (65.7 kW)

Based on information presented in Table 8.3.1-1 of revision 34 to the FSAR, the staff concludes that the worst case maximum coincident demand of these loads will be 78.1 kW, which, when added to the total maximum emergency service loads tabulated in Table 8.3.1-1A of revision 34 to the FSAR, results in a maximum load of 3331.4 kW. Because the majority of

those loads are automatically actuated motor operated valves, they are short duration loads on the order of one to three minutes. Also, automatic actuated valves do not operate simultaneously; therefore, the actual diesel generator loading should be less than the aggregate value of 3331.4 kW but may be greater than 3300 kW for one to three minutes.

In order for each diesel generator to reach its required design basis voltage and frequency limits within the required time of ten seconds, the diesel engine's fuel rack position or fuel setting will move to the wide open position. This wide open fuel setting is greater than the fuel setting which would exist when the diesel generator is delivering steady state power at 3300 kW load. Thus, during this ten second plus time period, the diesel engine may be loaded such that its BMEP may be greater than that corresponding to a continuous electrical load of 3300 kW. Similarly, when individual loads or a block of loads are connected to the generator, the diesel engine's fuel setting will move towards the wide open position. This fuel setting movement maintains the frequency of the generator within the required limits specified in R.G. 1.9. Even though the output of the generator is less than 3300 kW, the diesel engine will be loaded for a short time such that its BMEP may be greater than that corresponding to a continuous electrical load of 3300 kW.

Based on the above, the worst case loading has been estimated to be 3900 kW for less than 60 seconds. The ability of the engines to handle all of the above loads is treated elsewhere in the staff testimony.

Q. It was stated above that diesel generator capacity and capability is verified through qualification, preoperational, and periodic testing. Is the 3300 kW load capability of the diesel generators verified as part of preoperational and periodic testing?

A. Yes.

Q. Describe these tests.

A. As part of the preoperational and 18 month periodic surveillance testing each diesel generator will be operated at 3300 kW for 24 hours. In addition, as part of 30 day periodic surveillance testing, each diesel generator will be loaded to 3300 kW for one hour.

Q. Will the diesel generator's capability to supply intermittent and cyclic loads be verified as part of preoperational and periodic testing?

A. Yes.

Q. Describe these tests.

A. As part of the preoperational and 18 month periodic surveillance testing, each diesel generator will be subject to a load acceptance test. The load acceptance test should demonstrate the capability of each diesel generator to accept the individual loads that make up the plant's design load in the required sequence and time duration. Because intermittent and cyclic loads are part of the plant's design load, the diesel generator's capability to supply these loads should be verified by this test. In addition, as part of six month periodic surveillance testing, each diesel

generator will be started within 10 seconds and loaded to 3300 kW within 60 seconds. For this test, the design loads are unavailable for connection to the diesel generator due to the operating mode of the plant. However, this test has been designed to simulate, as close as is practical, the plant's design load. Because the majority of intermittent and cyclic loads will be simulated, the diesel generator's capability to supply these loads will, in part, be verified.

Q. How can this 3300 kW loading, for which the diesel generator has been qualified and is to be periodically tested, be exceeded?

A. The total load that is connectable to the diesel generator exceeds this 3300 kW test loading. Table 8.3.1-1 of the Shoreham FSAR indicates that the total connectable loads are 4381.3 kW for diesel generator number 101, 4147.8 kW for diesel generator number 102, and 4493.7 for diesel generator number 103. These loads could be connected manually or by equipment failure.

In LILCO testimony of G. F. Dawe, J. A. Notaro, and E. J. Youngling on pages 32 through 35, it was indicated ~~stated~~ that the single worst case load that could be connected ~~started erroneously as a result of an operator error~~ following a LOOP/LOCA would result in the following loads on the diesel generators:

1. 3459.4 kW on DG 101
2. 3414.8 kW on DG 102
3. 3583.5 kW on DG 103

The single worst case load that could be connected ~~started erroneously as a result of an operator error~~ following a LOOP would result in the following loads on the diesel generator:

1. 3839.2 kW on DG 101
2. 3627.6 kW on DG 102
3. 3867.3 kW on DG 103

Q. How does the staff normally ensure that diesel generators have sufficient capacity and capability to handle intermittent/cyclic loads and additional loads that may be inadvertently connected to the diesel generator by operator error or equipment failure?

A. The staff normally ensures that the diesel generator has a two-hour short-term overload capability which encompasses these loads.

Q. Do the Shoreham diesel generators have such an overload rating?

A. No. The 3300 kW qualified load rating is the only rating. As indicated above, this 3300 kW rating includes the capability to handle intermittent and cyclic loads. The ability of the diesel generator to handle loads above 3300 kW is addressed elsewhere.

~~Q. Should diesel generators used for nuclear service have an overload rating in order to meet the capacity and capability requirement of Criterion 17?~~

~~A. Yes~~

Q. Why?

A. To ensure that the diesel generators have sufficient capacity and capability to supply the plant's design loads which include intermittent/cyclic loads and additional loads that may be inadvertently connected to the diesel generator by operator error or equipment failure.

Q. What provisions has LILCO proposed to prevent the 3300 kW loading from being exceeded?

A. LILCO has proposed procedures and training changes with a plant technical specification limit of 3300 kW on each diesel generator. The adequacy of procedures is addressed elsewhere in the staff's testimony.

Q. Will the technical specifications for Shoreham have a 3300 kW load limit on the diesel generators?

A. Yes

Q. Describe what a 3300 kW technical specification limit on the diesel generator means?

A. As part of the Shoreham technical specifications, a 3300 kW maximum limit on each diesel generator will be imposed as a condition to the Shoreham license. If 3300 kW is exceeded at any time by any amount, the associated technical specification action will require the plant to be shut down with a subsequent analysis and inspection performed to demonstrate the capability of the diesel generator before continued plant operation would be allowed. In addition, the calibration of the instrumentation used to monitor kW output of each diesel generator will be included in the Shoreham technical specifications.

Q. With these provisions proposed by LILCO, does one have reasonable assurance that disabling overloading of the diesel generators will be prevented during transient and accident conditions?

A. Yes, provided the diesel generator is qualified for the expected overloading during transient and accident conditions and for expected operation at 3300 kW following overloading. The qualification of the diesel generator is addressed elsewhere in the staff's testimony.

Q. In addition to these administrative provisions proposed by LILCO, what else would LILCO have to do to provide reasonable assurance that the diesel generators have sufficient capacity and capability to perform their safety function and meet the requirements of criterion 17 of Appendix A to 10 CFR 50.

A. LILCO must demonstrate that their diesel generators are qualified for an acceptable short-term overload capability as part of preoperational and 18-month periodic surveillance testing.

Q. What would be the magnitude and duration of loads for which the diesel generator would need to be qualified and periodically tested?

A. Design load analyzed for the Shoreham plant plus the sum of the following overloads:

1. A load equal to the worst case loading that could be connected to any one diesel generator by a single operator error or event, plus
2. A load or sum of loads that are to be added or connected to the diesel generator intentionally according to the plant procedures.

Q. Is there reasonable assurance that the diesel generators have sufficient capacity and capability to perform their safety function and meet the requirements of criterion 17 of Appendix A to 10 CFR 50?

A. Yes, because:

1. The diesel generators are qualified to the plant's design load,

2. The diesel generators have sufficient overload capability for cyclic and intermittent loads,

3. The onsite power system can withstand any single failure, and

4. The diesel generators required capacity and capability is periodically verified through testing.

Q. What is meant by the technical specification action requirement for analysis and inspection?

A. For any overload an engineering assessment must be performed. For major overloads a diesel generator inspection may be required. These action requirements are to be developed with our PNL consultants.

Q. What is meant by the 3300 kW maximum limit.

A. The 3300 kW maximum limit is a mean indicated value. During periodic testing the indicated load could swing from 3200 to 3400 kW.