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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).	)	

AFFIDAVIT OF MARC W. GOLDSMITH

Marc W. Goldsmith, duly sworn, deposes and says as follows:

1. My name is Marc W. Goldsmith. I am employed by and President of Energy Research Group, Inc. ("ERG"). I am currently one of the expert consultants for Suffolk County, New York. My professional qualifications are presented in the proceedings of the hearings following the transcript at page 1113. My professional qualifications as they relate to diesel generators are in Attachment A. I have been providing services directly to Suffolk County since 1979 on issues and technology related to the design, construction and operation of the Shoreham Nuclear Power Station. I have worked for ERG for over eight years on a variety of utility electric generation projects. Prior to founding ERG, I was with United Engineers and Constructors, Inc., an architectural/engineering firm, designing and constructing large electric power stations. I worked as a licensing engineer on a variety of systems including balance-of-plant and emergency systems for several

different types of plants. This effort included setting the design parameters for emergency diesel generators (e.g., load and time to full load). Prior to that I served in the United States Merchant Marine as both a third and second assistant engineer on merchant vessels.

2. The purpose of this affidavit is to demonstrate that the issues raised in Suffolk County's proposed contention on the Shoreham diesel generators were raised in a timely manner and to present significant issues about the ability of the Shoreham diesel generators to perform their safety functions. A chronology of the development of the County's concerns is provided and the bases for my technical judgments regarding these concerns are set forth.

3. The County has been concerned about the design, construction and operation of the Shoreham emergency diesel generators since 1977 when it filed a contention on the issue for discovery. During the 1979-1980 period, numerous discovery questions were asked and answered about both the offsite electric and emergency diesel systems. This process led to a focusing and a restatement of the contention. This contention focused on the issue of dirt in diesel generator relays. This was both a Staff (NUREG/CR-O660) and County concern. It was contended that dirt in the diesel generator relays had the potential to cause failures of relays when the diesel might be called upon to operate. This contention was settled by a

second stipulation agreement which included the resolving of Suffolk County Contention 2. This resolution can be found in the record following transcript page 1626. The settled contention focused on an issue generic to all diesel generators. This was done since the Shoreham diesels had little or no operating hours at the time. Without having operated at the time, there would have been no basis for the County to have alleged the kinds of design and operational deficiencies which have recently been revealed.

4. The three letters referenced by LILCO which reported emergency diesel generator deficiencies during 1981 and 1982, SNRC-549, dated March 27, 1981, SNRC-649, dated December 23, 1981, and SNRC-777, dated October 15, 1982, appear to be unrelated to current concerns as discussed below. The issues raised in SNRC-649 and SNRC-777 could, in retrospect, be vibration related. However, at the time they were issued (December 1981 and October 1982) both were assumed to be isolated occurrences. In both cases, the letters provide insufficient data to determine whether the potential failures in the washers were due to an underestimate of stress, a design defect or a materials problem. Neither LILCO nor the Staff has produced any data to demonstrate that these problems were related to the concerns alleged in the proposed contention.

5. A chronology of the new diesel concerns, which form the basis for the proposed contention, started in February

1983. On February 24, 1983, I&E Inspection Report 82-35 was issued. This Report, which my office received on March 8, 1983, transmitted inspection findings, including diesel generator findings, that had occurred between November 30 and December 31, 1982. This I&E Report raised several questions about the diesel generator preoperational startup testing program. These questions included those that led to Enforcement Action 83-20. An enforcement conference was held on March 24, 1983, but a notice of the action did not actually occur until April 12, 1983. During this same period, on March 8, 1983, LILCO verbally transmitted to the NRC a potential design deficiency as required by 10 CFR 50.55(e) relating to the emergency diesel generators. The written report for this particular potential deficiency (SNRC-873) was not filed with the NRC until on or about April 15, 1983. On March 30, 1983, a second potential design deficiency of the emergency diesel generators was reported pursuant to 10 CFR 50.55(e). A written report was filed on May 4, 1983. During this end of March/beginning of April time period, Region 1 also issued I&E Report 83-07 (issued March 24, received April 4) which listed numerous design deficiencies and four major areas of concern related to the diesels. This Report indicated new concerns on the part of I&E.

6. During the months of March and April, 1983, I spoke to NRC I&E Staff about a half dozen times by telephone in order

to better understand the diesel situation. Each time, I received an update on testing status and Staff concerns relative to diesel performance. Each time, the status changed. Each time, I received another piece of the puzzle. I also attended an "exit" interview on Saturday, April 16, 1983. This interview was attended or less than 24 hours' notice and lasted only about 20 minutes. Mentioned in passing at that interview was that the hot restart had failed to occur. No cause was known at that time. The following Monday, April 18, during discussions with the Resident Inspector, I was told that the cause had been identified and the problem rectified (return of power to the logics). The Resident Inspector also stated that the 22-hour and the two-hour tests had been rerun and that he had witnessed the successful accomplishment of hot restart. Nevertheless, this additional information increased my concerns with the diesel testing program.

7. As noted above, during March and April, 1983, I had numerous conversations with the NRC Chief Startup Inspector and with the NRC Resident Onsite Inspector relative to the diesel generators. These conversations were designed to obtain information relative to the filing of the 50.55(e) deficiencies, further details on I&E inspections (initially, particularly I&E Inspection 82-35) and later to get further information relative to the reasons for the increased concerns reported by I&E Report 83-07. This last I&E Report (83-07) forms an important part of the basis for the proposed diesel generator contention.

8. During my conversations in March, 1983, I was unable to obtain much specific information from the Staff. While helpful, the Staff stated that further detailed information was being developed and, accordingly, that the County should await this further information. I understood this further information to be the Staff decision to commence an enforcement action, which action was not taken until April 12, 1983.

9. During March and April, 1983, information concerning the diesels was received from a variety of sources (I&E Staff, County counsel reporting on conversations with I&E, and LILCO responses), in various formats (I&E reports, personal reports of tests, etc.). It was difficult to draw rapid conclusions. Therefore, it was not until sometime in mid-April that there were sufficient data available to me to advise the County that a contention should be drafted. Thereafter, I worked with County counsel to prepare the contention which was filed on May 2, 1983.

10. The data upon which this affidavit is based are primarily the I&E reports, responses by LILCO to the I&E reports, notably SNRC letters (859, dated March 16, 1983, and 844, dated May 12, 1983) and the 50.55(e) submittals by LILCO contained in SNRC letters 873 and 883. The affidavit also reflects numerous conversations with I&E personnel. It also discusses Mr. Youngling's affidavit.

I. Proposed Contention Paragraph 1 --  
Testing of Emergency Diesel Generators

11. Paragraph 1 on page 2 of the proposed SC contention states:

"LILCO has failed to test adequately the emergency diesel generators, and has failed to ensure adequate review and approval of test procedures and test results, as documented in I&E Reports 82-35, 83-02, 83-07 and 83-08 and I&E Enforcement Action 83-20. Without adequate testing, reliable operation cannot be assured."

Thus, this portion of the contention alleges that there was lack of care in the testing and in the review and approval of test procedures and results. The testing is an integral part of assuring that the emergency diesels can provide the necessary electrical power for emergency loads in both a timely and reliable manner.

12. Paragraph 1 on page 2 of the County's proposed contention is based primarily on I&E Report 82-35 and EA 83-20. I&E Report 82-35 identified that a testing problem existed at Shoreham but did not highlight the severity of the problem. I understand that during March 1983, the Staff examined the 82-35 situation further and, based upon that review, determined to issue EA 83-20. Thus, it was not until EA 83-20 was issued that the seriousness of the testing deficiencies could be appreciated.

13. I&E Report 82-35 lists several failures with respect to testing of the emergency diesel generators. One group of failures specifically relates to the emergency diesel generator

102 electric test. This test was performed in accordance with PT307.003. The Staff inspector reviewed this test and found that there was a failure of the test program. Testing was not performed in accordance with procedures and test requirements had not been satisfied. This failure in the test program led to I&E Enforcement Action 83-20. The failure and consequences have been addressed in detail in several LILCO/SNRC letters (specifically SNRC-859 and SNRC-884) ~~and Staff responses.~~

14. Four other discrepancies in the test results were noted by the Staff inspector in Report 82-35. These discrepancies were discussed in LILCO response letter SNRC-859, dated March 16, 1983. The first issue was cross-outs and write overs. This issue is not of specific concern relative to preoperational testing. The specific write overs, however, indicate a nomenclature problem with the diesel generator load instrumentation (e.g., the possibility to misread units on the instrument). The second issue raised is not of concern. The third issue is where engine parameters were required to be recorded every fifteen minutes versus every ten minutes. This is of some concern based on the startup procedure manual requirements that test engineers dryrun tests prior to the actual running of a test. Therefore, the data requirement timing was not identified and could have been. In any event, no justification for the deviations from procedures was provided as required by the startup manual and procedures. It appears that

the data requirements and readings were not walked through prior to the test. Moreover, while the absence of a test change notice or exception taken for the changing of the timing does not appear to be critical, it should not be treated cavalierly. If the test engineer was not responsible for setting the data interval, then he may not know if there was a reason for setting the 10-minute interval. In the LILCO response there is no basis given for the reevaluation and post-facto acceptance of the test engineer's opinion. No analysis is provided for the time interval decisions. The last concern relative to this particular test was related to the out-of-specification measurements on lube oil pressure and jacket water temperature. In both cases, lube oil pressure and jacket water temperature, no test exception was taken by the test engineer. Again, a post-facto justification was made after the Staff commented on the parameters being out-of-specification. While it is important that Transamerica DeLaval, the manufacturer of the diesels, concurred in the change, there are no data in the LILCO response backing up this decision. It is insufficient to say that it is covered, based on a review of field and factory data. The additional question occurs as to why a change to these parameters was made when other units appear to operate under more conservative ranges.

15. While post-facto changes in test acceptance criteria can and probably should be made based on test results, the

Staff should receive a far more adequate basis to make an independent judgment of the validity of a change in acceptance criteria previously developed, reviewed, and approved. This becomes significantly more important where no test exceptions or test changes are made or required. Also, there does not appear to be analytical data provided to support the decision or judgment granting an exception. It appears that NRC Staff has accepted the justifications without sufficient verification.

16. I believe the allegations of testing deficiencies contained in Paragraph 1 of the contention are serious. They imply a lack of care in the test process and do not indicate a rigor one would associate with Class 1E equipment. The test changes are undocumented to NRC Staff, reflecting a lack of concern and verification. These preoperational tests provide the bases for determining whether the diesels will perform at load for a continuous period. They verify that design is adequate and that procedures for operation are appropriate.

II. Proposed Contention Paragraph 2 --  
Vibration

17. Paragraph 2 on page 2 of the proposed contention states:

"The diesels have been subject to excessive vibration, as documented in I&E Report 83-07. Such vibration may reflect a design defect or a fabrication/erection deficiency or a combination thereof. In any event, such vibration prevents the diesels from reliably performing their intended functions."

Vibration is one of the primary causes of mechanical equipment failure and thus can directly affect the reliability of diesel operation. While vibration is unavoidable in certain equipment, excessive vibration in either amplitude or frequency can and has caused premature failure of equipment. The life-shortening aspects of excessive vibration have the ability to reduce the reliability of the diesel generators through a variety of failures.

18. The primary basis for this portion of the contention is I&E Report 83-07. Paragraph 3.3 of that Report, entitled "Diesel Generator Set Test Witnessing," lists four major concerns considered by the Staff inspector in observing and reviewing LILCO's documents and reports. These concerns relate to apparent excessive vibration and are discussed as issues in paragraph 2 of the proposed contention. The Staff inspector made the following finding:

"Although the 72 hour electrical test runs of the diesel generators were preliminary in nature and no violations or discrepancies were noted by the inspector, the testing of the diesel generator sets was accompanied by problems similar to the many problems that have occurred relating to the diesel generator sets in the past year of testing."

The Staff inspector then listed the tests completed to date, his concerns, and the LILCO deficiency reports reviewed during the inspection. Based on the above, he reached the following conclusion:

"The above findings constitute an immediate concern to the NRC and were presented to the licensee's representatives by the inspector at the exit meeting on March 4, 1983. The licensee acknowledged the inspector's findings and concerns and committed to pursue them. This item is designated Unresolved Item (50-322/83-07-02)."

This area is scheduled to be examined during subsequent Staff inspections so that these concerns and problems can be resolved prior to the performance of the integrated electrical test. The concerns of the NRC startup inspector are echoed in this affidavit because no solutions have been presented.

19. Vibration is one of the more difficult stress phenomenon that must be adequately designed for in terms of all equipment and its relationship to resonant frequencies that could cause fatigue and failure. Without firsthand observation of the analytical efforts evaluating vibration both in the short and long term on various components, it is difficult to determine the impact of vibration on the Shoreham diesels. However, several factors are apparent based on I&E Report 83-07 and the 50.55(e) reports. First, several apparently unrelated failures could have vibration as a common cause. The analyses presented on vibration (e.g., the Youngling affidavit) are conclusory. Second, bolt cracking in a cyclic fatigue mode as indicated by SNRC-873 could have a vibration component. Indeed, cyclic loadings are usually a result of vibration-based stress.

20. Mr. Youngling's affidavit is apparently based on data never made available to the County. I do not have data which allow me critically to assess Mr. Youngling's conclusions. His data apparently show that the Shoreham diesel generators are comparable in levels of vibration with two other diesels studied. The affidavit does not address, however, the important questions of resonance in particular locations, nor does it provide the methodology used to normalize differences in power levels and rpm. In addition, it is possible that the rapid loading requirements of nuclear emergency diesels make this type of diesel somewhat different than the average diesel in that the startup stress due to the rapid loading may be higher for the nuclear emergency diesel. Moreover, despite allegedly normal levels of vibration, there have been several failures due to resonances between equipment. As discussed in Mr. Youngling's affidavit, the cause of the failures were diesel design specific and based on the diesel firing rate (rpm) and the mass of the structure/component/fastening.

21. Mr. Youngling's affidavit alleges that there are over 97 diesels in operation that are essentially identical or similar to the Shoreham diesels. These diesels, according to Mr. Youngling, have over 1200 years of operating experience. Assuming the accuracy of Mr. Youngling's facts, it is unclear why there would be vibration problems or design deficiencies occurring with such a proven piece of equipment. The fact that

such failures have occurred, however, is additional reason for concern.

III. Proposed Contention Paragraph 3 --  
Component Cracking

22. Paragraph 3 of the proposed contention reads:

"The diesels have suffered from cracking of components, as documented by LILCO's verbal reports to PRC Region 1 on March 8 and 30, 1983, and LILCO's written report SNRC-873, dated April 15, 1983. These deficiencies have included water jacket leaks which have the potential to decrease power output and interfere with rapid startup of the diesels."

This contention concerns failures to specific components on what is supposed to be a proven design of the Shoreham diesels in marine and other applications. Certainly, the potential for unanticipated component cracking represents a serious concern about the reliability of the diesels.

23. The cracking portion of the contention is based on the two recent 50.55(e) reports (SNRC-873 and SNRC-883). The verbal reports were made during March 1983; the written more detailed reports became available April 15 and May 4, 1983.

24. The intermediate and intake rocker arm assembly holddown capscrew which broke causing a replacement of 96 capscrews in use at Shoreham indicates a high stress cycle fatigue. Rocker arms are not new components nor are holddown capscrews. Yet 46 capscrews showed indications of cracking out of the 96 capscrews. Replacement of the capscrews may be an appropriate solution to this specific problem of the capscrew

failure. This solution, however, does not seem to acknowledge that there is a larger problem that could be causing the failures. If this is a standard Transamerica DeLaval capscrew found on the other diesels, then why did it fail here and not on other units? No recommendations (e.g., bulletin or notice) were made.

25. The failure in the cooling water jackets in the cylinder heads is of little consequence in operation (e.g., loss of some power). The failure that allows water into the cylinder, however, does have significance if undetected, prior to a rapid start. Then, the piston, rather than compressing air and fuel, a compressible mixture, forces the incompressible water to a high pressure with the potential for something to fail in the process. This situation is exacerbated in a nuclear diesel because of its automatic quick start response while unmanned. This potential could decrease the reliability of a quick start or cause a failure to start with damage to the valves, pistons, or gaskets.

26. It is significant that, while these "latent casting defects occur only in a small percentage of the heads manufactured,"<sup>1/</sup> three of these heads have been on 24 Shoreham diesel cylinders. That is a 12.5% defect rate in units that are supposed to have significantly greater quality assurance

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<sup>1/</sup> See Youngling affidavit at 17.

than the commercial standard diesel. This does not provide the outside observer with confidence in either the quality assurance for the diesels or in the long-term reliability of the diesels.

IV. Proposed Contention Paragraph 4 --  
Hot Restart

27. Paragraph 4 of the proposed contention states as follows:

"One of the diesels "locked out"  
(i.e., would not restart) when hot restart  
was attempted during testing."

The County is here concerned about deficiencies in LILCO's operations and procedures. The key deficiency was a failure by LILCO to follow startup manual procedures that require a walk through to assure that equipment necessary for a successful test is available. I learned of this deficiency through my brief discussions with Staff on April 16 (exit interview) and April 18, 1983 (telephone conversation with J. Higgins, NRC). The Shoreham startup manual provides the procedures and methods to be followed prior to initiating a test.

28. The key problem is that while it appeared that startup had responsibility for the system operation, plant operations and maintenance could lock out the power supplies for the diesel generator restart logic without startup's knowledge. According to the Shoreham startup manual and procedures, those items that could prevent the test from reaching a successful conclusion are to be checked by the test engineer

prior to the test. This situation is clearly outlined in revision 16, dated January 28, 1982, to the preoperational phase of the startup manual which states that:

"appropriate instructions may be given pertaining to system configuration the components which should or should not be operating and other pertinent conditions that might affect the operation of the system under the test. System boundaries would be clearly defined and tagging will be specifically detailed."

Therefore, even though this issue does not specifically speak to the reliability of the diesels themselves, it does speak directly to the reliability of the personnel performing the testing.<sup>2/</sup> Considering the number of restarts that have been attempted on the Shoreham diesel generators, it does not appear that LILCO followed its own procedures for the April test. This again gives the outside observer cause for concern.

V. Proposed Contention Paragraph 5 --  
Trends

29. Paragraph 5 of the proposed contention reads as follows:

"LILCO has failed to prepare an adequate trend analysis of the diesel problems and occurrences, as documented by I&E Report 83-07. Such failure means that there can be no assurance that these diesels have

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<sup>2/</sup> I&E Information Notice 83-17, however, reported that control interlocks, preventing fuel from reaching the diesels after operation, have been found at a minimum of two plants. This Notice reveals a potential generic problem with the ability of the diesels to perform a hot restart. Based on the limited data thus far made available to the County, I have been unable to determine whether such interlocks exist at Shoreham.

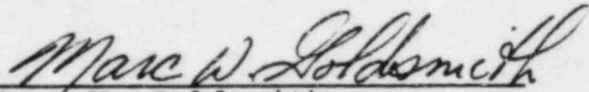
been adequately analyzed to ensure reliable performance of required functions."

The County contends that the occurrences that have led to the LILCO deficiency reports, when tabulated, could have indicated a trend in the failures. LILCO has presented in Mr. Youngling's affidavit a trend analysis that looks at the gross trending of failures in the diesels. The charts presented in Mr. Youngling's affidavit show a precipitous drop in the last few weeks in identified problems. Based on this, LILCO has decided that the diesel generator problems have decreased. While this may in fact be the case, it is clearly too soon to tell. It appears that no attempt has been made to determine whether the failures found and corrected have a common source. Analyses evaluating metal<sup>1</sup>urgy, vibration, design and manufacturing processes could be performed either to confirm or eliminate potential common causes.

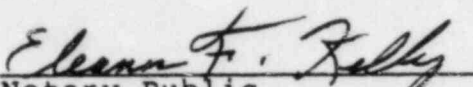
30. Much of what is said in Mr. Youngling's affidavit is in direct contradiction to the Staff's findings. This is particularly true with respect to the correctness of LILCO's response in running the electrical test on emergency diesel generator 102. The County, as both an interested party and an independent observer (independent of both Staff and LILCO), has had several concerns raised by NRC Staff either not responded to by LILCO or inadequately responded to so as to make an independent judgment impossible.

31. Currently, the County has no means by which to ascertain the validity of either the LILCO or Staff positions. The inability to get these data has impacted on the ability to write a more specific contention or to write one on an even more timely basis. It was my judgment that neither the single design deficiency reported verbally to Region 1 on March 8, 1983, nor the violation identified in Report 82-35, standing alone, was adequate to make a technical case for concerns relative to the reliability of the emergency diesel generators. However, two design deficiencies in a short time frame, the large number of failures and concerns enumerated in I&E Report 83-07, and the violation identified in Report 82-35, as elaborated by EA 83-20, do make a strong case for further investigation. Apparently, the Staff agrees with this assessment. In my opinion, the significance of the diesel problems recently experienced by LILCO is underscored by the actions taken by the Staff during the last two months. Those actions include the Staff's issuance of EA 83-20 (citing LILCO for a Level III violation) and its retention of an expert consultant to review ongoing diesel testing and the physical condition and operation of the diesels. The Staff's frequent review and witnessing of diesel testing during April and May, 1983, and its request that LILCO establish a Task Force to review the diesel problems are also significant measures that emphasize the Staff's concerns regarding the diesel situation. I therefore believe that

further investigation into the diesel problems at the Shoreham plant is warranted.

  
Marc W. Goldsmith

Subscribed and sworn to  
before me this 2nd day  
of June, 1983.

  
Notary Public  
ELEANOR F. KELLY, Notary Public  
My Commission Expires April 21, 1989

PROFESSIONAL QUALIFICATIONS OF  
MARC W. GOLDSMITH,  
ENERGY RESEARCH GROUP, INC.,  
RELATIVE TO DIESEL GENERATORS

My name is Marc W. Goldsmith. My business address is Energy Research Group, Inc., 400-1 Totten Pond Road, Waltham, Massachusetts 02154. Since 1979, I have been a consultant for Suffolk County, New York, on issues and technology related to the design, construction and operation of the Shoreham Nuclear Power Station. During this period of time, I have evaluated several technical issues on behalf of the County, including the County's proposed contention on the emergency diesel generators. Prior to co-founding Energy Research Group, Inc. in 1975, I worked for United Engineers and Constructors, Inc. For two years, while at United Engineers, I was responsible for licensing activities related to nuclear and fossil plants. For nuclear plants, I had responsibility not only for nuclear safety licensing but for balance-of-plant and equipment. I was part of the group that selected emergency electric equipment, including diesels, and set the requirements for the specification.

From June 1968 through 1971, I sailed as both a third assistant engineer and a second assistant engineer in the U.S. Merchant Marine while attending graduate school during off periods. During that period of time, I successfully completed a naval correspondence course in diesel engines. I worked for

several marine engineering firms as the engineer in charge-of-a-watch operating marine fossil power plants. This included responsibility for both operation and maintenance of emergency diesel generators. My duties as a marine engineer included maintaining both the diesel engine and generator, including auxiliary systems, and operating the diesels for both tests and under actual emergency conditions.

I graduated from the State University of New York Maritime College in 1968 with a Bachelor of Science Degree in Marine Nuclear Science. Upon graduation and after passing U.S. Coast Guard examinations, I received U.S. Coast Guard licenses for both diesel and steam engines. I was awarded two advance degrees in nuclear engineering from the Massachusetts Institute of Technology in 1972 and I am a licensed professional engineer in the State of California.

*Eleanor F. Kelly* 6/2/83  
ELEANOR F. KELLY, Notary Public  
My Commission Expires April 21, 1989