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LILCO, August 31, 1984

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
	)	(Low Power)
(Shoreham Nuclear Power Station, Unit 1)	)	

LONG ISLAND LIGHTING COMPANY'S PROPOSED FINDINGS OF FACT

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DATED: August 31, 1984

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Long Island Lighting Company (LILCO), by counsel, proposes that the Licensing Board make the following findings of fact based upon the evidence presented on April 24 and 25 and July 30 through August 8, 1984 and those findings made in its July 24, 1984 Order Granting in Part and Denying in Part LILCO's Motions for Summary Disposition on Phases I and II of Low Power Testing:

I. The Proposed Testing Program

1. The four phases of low power testing for which a license is sought by LILCO are established milestones in the startup program for the Shoreham Nuclear Power Station (Shoreham). The testing involved is described in Chapter 14 of the FSAR. (Tr. 200, Gunther).

A. Phase I[1]

2. Phase I includes fuel loading and precriticality testing. Fuel loading and precriticality testing involve placing fuel in the vessel and conducting various tests of reactor systems and support systems. (Tr. 162, 164, 201-202, Gunther).

3. The testing during initial core loading which takes at least 288 hours to accomplish, includes: (a) water chemistry surveillance testing; (b) control rod drive stroke time and friction tests; (c) installation, calibration and utilization of special start-up neutron instrumentation; and (d) core verification instrumentation operability check. (Tr. 202, 214-215, Gunther).

4. Following placement of the fuel in the vessel, a number of tests must be performed to verify the operability of systems prior to going critical in the reactor. This testing includes: (a) gathering local power range monitor sensitivity

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[1] Many factual findings concerning Phases I and II were made by the Board in its Order Granting in Part and Denying in Part LILCO's Phase I and II Summary Disposition Motions, dated July 24, 1984, as indicated by the reference in the finding. They have been incorporated verbatim in these Proposed Findings for completeness.

data; (b) performing zero power radiation surveys for background readings; (c) recirculation system instrument calibration checks; (d) control rod drive scram time testing; and (e) cold main steam isolation valve timing checks. (Tr. 202, 216-17, Gunther).

5. During all of the activities in Phase I, the reactor will remain at essentially ambient temperature and atmospheric pressure. The reactor will not be taken critical. Any increase in temperature beyond ambient conditions will be due only to external heat sources such as recirculation pump heat. There will be no heat generation by the core. (July 24 Order at 10).

6. Reactor criticality is prevented during Phase I by a hardware interlock which permits only one control rod to be withdrawn at any time while the reactor mode switch is in the "Refuel" mode. The reactor mode switch position is controlled by administrative procedures. (Tr. 203, Gunther).

B. Phase II

7. Phase II entails cold criticality testing. It involves a specified control rod withdrawal sequence that results in achieving reactor criticality at extremely low power

levels, in the range of .0001% to .001% of rated thermal power. This testing verifies fuel design calculations and shutdown margin and provides important empirical data that is used by reactor engineering personnel in the fuel management program. Cold criticality testing requires plant maintenance personnel to install vessel internals in accordance with station procedures and with all refuel floor constraints in place. Also performed at this time is the installation of the expansion and vibration instrumentation. Cold baseline data are obtained at this point to determine pipe movement as heatup occurs later in the low power test program. The data provide a benchmark against which subsequent test results can be assessed. (Tr. 164-165, 204-05, Gunther).

8. Criticality is maintained for short periods of time during Phase II. The power level is monitored by the source range monitoring instrumentation. Procedural requirements dictate that rod insertion commence when source range monitor indication reaches 1×10^5 counts per second. This limits power to the range of .0001% to .001% of rated power. (Tr. 205-206, Gunther).

C. Phase III

9. Phase III of low power testing involves reactor heatup and pressurization and the power level is taken in progressive steps to rated pressure and temperature conditions (approximately 1% of rated power). Along the way, the heatup and pressurization of the reactor vessel and associated piping systems enable the plant staff to perform important tests relating to thermal expansion of piping and integrated system operation under actual operating conditions. The principal testing accomplished during this phase includes: (a) high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) system operability demonstrations with manual starts and hot quick starts; (b) nuclear steam supply system thermal expansion testing; (c) motor operated valve dynamic testing; (d) offgas system performance testing; (e) safety relief valve functional tests; (f) drywell piping vibration data; and (g) control rod drive scram time testing. (Tr. 207, Gunther; see also, Tr. 220-24, Gunther).

10. During Phase III heatup, power is monitored on the Intermediate Range Monitor. The power level is maintained by control rod manipulation. Once rated pressure and temperature conditions are obtained, rod withdrawal is terminated to

prevent further power increases. The turbine bypass valve then automatically maintains a constant reactor pressure. (Tr. 208, Gunther).

D. Phase IV

11. During Phase IV of low power testing, the power level is taken in progressive steps from 1% to 5% of rated thermal power. With the reactor coolant system at rated temperature and pressure, the operator will withdraw control rods so that one main turbine bypass valve automatically opens to establish steam flow such that core thermal power is less than 5% rated thermal power. This allows sufficient steam to be supplied to demonstrate further the operability of the two high pressure, steam driven injection cooling systems -- HPCI and RCIC -- at full reactor pressure conditions along with other normal operating systems. In addition, calibrations, testing, and plant cooldowns and heatups are performed during this phase. (Tr. 166, 209-10, 224-26, Gunther).

12. Controlled cooldowns and heatups are then performed in Phase IV to demonstrate the stability of RCIC and HPCI controller settings and to verify system thermal expansion data. In addition, the production of reactor steam at 5% power

permits additional testing such as (a) hot hanger sets on plant systems; (b) alignment of the traversing in-core probe; (c) calibration of the bottom reactor pressure vessel head drain line flow indicator; and (d) main steam isolation valve functional test. (Tr. 209-10, 225-26, Gunther).

13. Fuel loading and low power testing are procedurally controlled activities. LILCO operators will be trained in applicable procedures before conducting them. Power limitations imposed by license will be addressed in this training. (Tr. 186-87, 189, 193, Gunther).

14. The plant operator can monitor the power level by means of turbine bypass valve position, neutron monitoring, and feedwater flow instrumentation. Since control of the turbine bypass valve position is the primary method of verifying that the power level does not exceed 5%, LILCO will ensure proper limitation on bypass valve position by means of a standing order. (Tr. 177-82, 210-11, Gunther.) During testing, at least four people in the control room are monitoring test activities, and thus the power level, at any one time. (Tr. 192-94, 210-11 Gunther).

II. Safety Analysis: How Soon AC Power Is Needed

15. Chapter 15 of the Shoreham FSAR provides the results of analyses for the spectrum of accident and transient events that must be accommodated by the Shoreham plant to demonstrate compliance with the NRC's regulations. The results of the safety analysis demonstrate the ability of the plant to operate without undue risk to the health and safety of the public, even in the event of such accidents and transients. (Tr. 275, Rao, et al.).

16. The Shoreham FSAR was approved by the NRC Staff in its Safety Evaluation Report for Shoreham (NUREG-0420). (Tr. 276, Rao, et al.). Regulatory Guide 1.70, which describes on the standard format and contents for FSARs, lists the transients and accidents to be analyzed. LILCO used the transients and accidents listed in Reg. Guide 1.70 in its analysis of possible low power transients and accidents. (Tr. 1789, Hodges).

17. For the accidents and transients analyzed in Chapter 15 of the FSAR, operation with the enhanced offsite power supply at 5% power is as safe as operation with fully qualified TDI diesels at 5% power. With the enhanced offsite power, the deterministic thermal and radiological success

criteria are met assuming no qualified diesels. For most transients and accidents, no fuel failures occur whether or not TDI diesels are available. For those few instances, such as a fuel handling accident in which fuel failure can occur, the activity available for release to the environment is negligibly small whether or not TDI diesels are available. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-1).

A. Phase I

18. Of the 38 accident or transient events addressed in FSAR Chapter 15, 18 of the events could not occur during Phase I because of the operating conditions of the plant. An additional six events could physically occur, but given the plant conditions, would not cause the phenomena of interest in the Chapter 15 safety analysis. The remaining 14 events could possibly occur, although such occurrences are highly unlikely given the plant conditions. The potential consequences of these 14 events would be trival. (July 24 Order at 10-11).

19. During Phase I fuel loading and precriticality testing, there are no fission products in the core and no decay heat exists. Therefore, core cooling is not required. In addition, with no fission product inventory, there are no fission product releases possible. (July 24 Order at 11).

20. Even a loss of coolant accident would have no consequences during Phase II since no core cooling is required. No fission products exist and therefore no decay heat is available to heat up the core. The fuel simply would not be challenged even by a complete drain down of the reactor vessel for an unlimited period of time. (July 24 Order at 11).

21. No core cooling is required during Phase I and, therefore, no AC power is necessary during Phase I to cool the core. (July 24 Order at 11).

B. <u>Phase II</u>

22. Under the plant conditions present in Phase II, many events analyzed in FSAR Chapter 15 could not occur or would be very unlikely. Even the possible Chapter 15 events would have no impact on public health and safety regardless of the availability of the TDI diesels. (July 24 Order at 11-12).

23. Because of the extremely low-power levels reached during Phase II testing, fission product inventory in the core will be only a small fraction of that assumed for the Chapter 15 analysis. The FSAR assumes operation at 100% power for 1,000 days in calculating fission product inventory; inventory during Phase II low-power testing will be less than

1/100,000 (0.00001) of the fission product inventory assumed in the FSAR. (July 24 Order at 12).

24. If a LOCA did occur during the cold criticality testing phase (Phase II), there would be time on the order of months available to restore make-up water for core cooling. At the power levels achieved during Phase II, fission product inventory is very low. At most, the average power output will be a fraction of a watt-per-rod, with no single rod exceeding approximately 2 watts. With these low decay heat levels, the fuel cladding temperature would not exceed the limits of 10 CFR § 50.46, even after months without restoring coolant and without a source of AC power. Thus, there is no need to rely on the TDI diesel generators, or any source of AC power. (July 24 Order at 12).

25. During Phase II cold criticality testing conditions, there is no reliance on the diesel generators for mitigation of the loss of AC power event or the feedwater system piping break event. For these events, no loss of coolant occurs and the decay heat is minimal. Core cooling can be achieved for unlimited periods of time without AC power using the existing core water inventory and heat losses to ambient. (July 24 Order at 12-13).

26. The LOCA and the feedwater system piping break postulate the double-ended ruptures of a piping system. Because the reactor will be at essentially ambient temperature and atmospheric pressure during Phase II, it is extremely unlikely that such a pipe break would ever occur. The NRC Staff does not require double-ended ruptures to be postulated for low temperature and low pressure systems in safety analyses. (July 24 Order at 13).

27. None of the events analyzed in Chapter 15 could result in a release of radioactivity during cold criticality testing that would endanger the public health and safety. (July 24 Order at 13).

28. Even if AC power were not available for extended periods of time, fuel design limits and design conditions of the reactor coolant pressure boundary would not be approached or exceeded as a result of anticipated operational occurrences, and the core would be adequately cooled in the unlikely event of a postulated accident. (July 24 Order at 13).

C. Phases III and IV

29. With respect to Phases III and IV of the low power testing program, there is no undue risk to the public health and safety. Even if the Shoreham TDI diesels are assumed to be unavailable, there is ample assurance that fuel design limitations and design conditions of the reactor coolant pressure boundary will not be exceeded as a result of anticipated operational occurrences, and that the core will be cooled and containment integrity and other vital functions will be maintained in the event of any postulated accident. (Tr. 297, 312-13, Rao, et al.).

30. Phases III and IV can be considered together for convenience of evaluation. However, they are separable. At the lower power level (1% vs. 5%) there is a consequential reduction in any effects of transients and accidents. There is more time to restore AC power following a LOCA in Phase III than in Phase IV. (Tr. 297, Rao et al; Tr. 251-52, Dawe).

31. Except for the loss of coolant accident, all of the transients and accidents analyzed in the FSAR, even with no AC power available at 5% power, are less restrictive than for the design bases cases analyzed in Chapter 15 of the FSAR. (Tr. 1789, Hodges). Of the 38 accident or transient events

addressed in Chapter 15, at least three events cannot occur during these phases. (Tr. 298, 320-22, Rao, et al.; see also, Tr. 1789, Hodges; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-4).

32. For all events evaluated, other than the LOCA, operation of the plant up to 5% rated power will be bounded by the Chapter 15 analysis of the FSAR. Operation at low power results in several factors contributing to enhanced safety: (1) reduced fission product inventory; (2) increased time for preventive or mitigating action; and (3) reduction in required capacity for mitigating systems. (Tr. 1789-92, Hodges; Tr. 298-301, Rao et al.; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-4, 15-5).

33. For an accident other than a LOCA during Phases III and IV, water in the vessel would boil-off very slowly. The level would drop from the normal range to the top of the fuel over an extended period of time. If either the Reactor Core Isolation Cooling System (RCIC) or the High Pressure Coolant Injection System (HPCI) acts to restore water level to the normal range at least once during the first four days, then heat losses to ambient will equal the decay heat being generated before the fuel would ever uncover. For that condition, a

peak cladding temperature of 2200° F. would never be reached. (Tr. 1785, Hodges).

34. If all AC power were lost, with no LOCA, the reactor would immediately isolate and both HPCI and RCIC would be available to provide reactor coolant makeup. Each of the systems has adequate coolant makeup capability to provide any required core cooling. The HPCI and RCIC systems are seismically qualified and would operate automatically to assure core cooling. These systems are steam driven and utilize DC power supplies which will last a minimum of 24 hours. DC power can be maintained beyond 24 hours using an onsite portable generator and the battery chargers. This assures continued operation of HPCI or RCIC. Containment and suppression pool limits would not be exceeded for approximately 30 days without AC power. Even if DC power is lost after 24 hours, available vessel inventory is sufficient for at least 2 more days of core cooling. (Tr. 309-11, Rao, et al.). Therefore, absent a LOCA, AC power is not needed for at least 30 days.

35. Modifications are being made to the HPCI system to ensure it is capable of withstanding a seismic event. LILCO decided to make the modifications due to the discovery of some problems with a similar turbine during testing at another

plant. Completion of these modifications will be required by the license before entering Phase III testing. (Tr. 1766-67, Hodges; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-7).

36. The most significant or limiting transient or accident during Phases III and IV would be the loss of coolant accident (LOCA). (Tr. 252, 297-98, 302, 313, Rac, et al.; Tr 1785, Hodges).

37. For loss of coolant accidents, 10 CFR § 50.46 gives five limits to be satisfied. First, the calculated maximum fuel element cladding temperature shall not exceed 2200° F. Second, maximum cladding oxidation shall nowhere exceed 17% of the total cladding thickness before oxidation. Third, the calculated total amount of hydrogen generated from chemical reaction of the cladding with water or steam shall not exceed 1% of the hypothetical amount that would be generated if all metal in the cladding cylinder surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react. Fourth, calculated changes from core geometry shall be such that the core remains amenable to cooling. Fifth, after any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time

required by the long-lived radioactivity remaining in the core. (Tr. 1784, Hodges).

38. An analysis using conservative Appendix K models but treating decay heat and natural convection heat transfer assumptions more realistically and using a core power peaking factor of 3.38 based on the actual control rod withdrawal pattern, shows that greater than 24 hours would be available to restore core cooling in the event of a LOCA during Phase III. Even using the conservative Appendix K model without any modification to the conservative regulatory assumptions, 370 minutes would be available to restore core cooling. (Tr. 252, 298, 302-06, Rao).

39. In the event of LOCA during Phase IV, greater than three hours would be available under the analysis using conservative Appendix K models with some realistic assumptions, and 86 minutes would be available under the Appendix K models with conservative regulatory assumptions. (Tr. 252, 298, 307-09, Rao; Tr. 1786, Hodges). Using the most conservative Appendix K evaluation model and assumptions, and not allowing for the actual rod withdrawal pattern, but using a peaking factor of 5.0, there are approximately 55 minutes before the peak cladding temperature would exceed the 2200° F. limit. (Tr. 308, Rao; Tr. 1744, 1786, Hodges).

40. For the limiting LOCA at 5% power, the peak cladding temperature would be reached prior to any other limit of 10 CFR § 50.46. For lower power, an oxidation limit could possibly be reached before the fuel temperature limit is reached. But at lower power, a substantially longer period of time is available before limits are approached. Thus, the 55 minutes described for the most conservative case at 5% power bounds the time available to restore power to prevent reaching any of the 10 CFR §50.46 limits. (Tr. 1795, Hodges; see also, Tr. 252, 298, 302-06, Rao).

41. For the bounding LOCA calculation at 5% power, the calculated rod internal pressure at 2200°F is less than the rupture pressure for 2200°F. Therefore, even using the very conservative bounding analysis, no fuel rod rupture is expected. Thus, there should be no large release of activity because the cladding retains the fission products. (Tr. 1787, Hodges; see also, Tr. 307, 309, Rao). Even if the 2200° F. temperature limit were exceeded at 5% rated power, nothing drastic would happen. Temperatures as high as 2700° F. will not melt the fuel and will allow the fuel cladding to retain some ductility. (Tr. 1786-87, Hodges).

42. During a LOCA in Phases III and IV the cladding should remain ductile and should not fracture due to thermal stresses when the fuel is quenched by cold water. Therefore, the core remains coolable. Because there is no cladding rupture, the fission products are retained in the fuel. (Tr. 1787-88, Hodges).

43. If AC power is restored within 55 minutes, even without qualified diesels, the plant is as safe as the case with qualified diesels because the cladding integrity is maintained and all fission products are retained in the fuel. (Tr. 1744-45, 1749-52, 1788, Hodges).

44. For low power testing up to 5% power, the fission product inventory in the core will not exceed 5% of the values assumed in the FSAR. Almost all of the fission products will be retained in the pellets. (Tr. 1790, Hodges).

45. The standby gas treatment system (SGTS) is a post-accident mitigative system designed to reduce the quantity of radioactive iodine released to the environment following certain postulated accidents. Since there would be no fuel failures in the event of a LOCA, there would be no need for the SGTS at 5% rated power. (Tr. 1745, 1797, Quay).

46. With respect to the fuel handling accident, those fission products which are in the fuel cladding gap are subject to release from fuel assemblies damaged during handling. The fission products which remain in the fuel pellets are not subject to release. At 5% power, not only is the total fuel inventory 20 times smaller than at full power, but also only a fraction of that inventory has left the fuel and entered the gap. This reduction of fission products in the fuel cladding alone compensates for a loss of the SGTS due to the unavailability of onsite diesels. (Tr. 1745-46, 1797, Quay). Additionally, it is highly unlikely that LILCO will be moving fuel during low power testing. (Tr. 1746, 1767-68, Quay).

III. Ability to Restore AC Power

A. LILCO's Normal Offsite Power Sources

47. LILCO's present generating capacity is 3,721 megawatts, consisting of 2,240 megawatts of base load steam turbine units, 432 megawatts of mid-range and peaking steam turbine units and 1,049 megawatts of internal combustion peaking units. The internal combustion units include both gas turbines and diesel generators. (Tr. 487-88, Schiffmacher).

48. "Blackstart" means that when a loss of power exists, the system operator, from a local or remote location, can start a gas turbine to restore power. (Tr. 333, 524, Schiffmacher).

49. The term "deadline blackstart" means that the gas turbine recognizes through its own circuitry that there has been a loss of power and automatically starts without operator activation. (Tr. 333, 524, Schiffmacher).

50. Each of LILCO's 4 major steam generating stations is equipped with a backup blackstart gas turbine to provide starting power under blackout conditions. (Tr. 488, Schiffmacher). In addition, there are blackstart gas turbines located at Holtsville, Southold, and East Hampton. (Tr. 488-89, 508, Schiffmacher).

51. LILCO's ability to deliver power to Shoreham is not limited to its own generating capacity. The LILCO system is interconnected to the New York Power Pool and the New England Power Exchange. There is one interconnection with the New England Power Exchange (a 138 KV line normally rated at 285 MW) and three with the New York Power Pool (two 138 KV and one 345 KV lines normally rated at 238, 271 and 581 MW respectively) (Tr. 524-23, Schiffmacher).

52. LILCO also has in place automatic load shedding procedures for removing load from the grid and reducing voltage to prevent cascading outages on the system. (Tr. 521, Schiffmacher).

53. Only once since the Northeast Blackout of 1965 has power been lost to any substantial portion of LILCO's grid. That one outage occurred prior to institution of procedures LILCO has currently in place for restoration of power. Even following that outage, without the benefit of today's procedures and blackstart power sources, power to the Shoreham area was restored in slightly more than one hour. (Tr. 520, Schiffmacher).

54. The Shoreham plant is connected to the LILCO system through seven 138 KV and 69 KV circuits. Four separate 138 KV transmission lines serve the 138 KV Shoreham switchyard, approximately 1300 feet south of the plant. The four circuits enter the 138 KV switchyard on two separate and independent rights of way, each containing two of the four 138 KV circuits. (Tr. 519-18, Schiffmacher). The 138 KV switchyard is arranged in a two bus configuration with circuit breakers and switches arranged to permit isolation and/or repair of either bus section. This permits continuation of 138 KV power supplied from separate rights of way even in the event a bus section is out of service. (Tr. 515, Schiffmacher).

55. Additionally, three 69 KV circuits feed the Wildwood substation, approximately one mile south of Shoreham. They enter the Wildwood substation through two separate rights of way. From Wildwood, a single 69 KV circuit enters the site. (Tr. 445, 518, Schiffmacher). The 69 KV line from Wildwood to the Shoreham 69 KV switchyard has been placed underground in the vicinity of the 138 KV line from the 138 KV switchyard to the normal station service transformer (NSST). The 69 KV line serves the reserve station service transformer (RSST). Thus, independence of supply between the NSST and the RSST is maintained and the likelihood of simultaneous loss of supply to both transformers by a common event is minimized. (Tr. 445-46, 517, Schiffmacher). There is also a bypass 69 KV circuit, bypassing the 69 KV switchyard and its associated cable, running directly from the 69 KV overhead line from Wildwood to the RSST. Thus, power could be restored to the RSST following failure of the underground 69 KV circuit without having to repair the underground cable or route power through the Shoreham 69 KV switchyard. (Tr. 371-74, 517, Schiffmacher).

56. LILCO's offsite circuits enter the plant in two different corridors with no common points between the transmission corridors and no crossing or meeting. They do not pass through a common switchyard which is allowed by GDC 17. This

design exceeds NRC requirements for offsite power systems. (Tr. 2353-54, Knox, Tomlinson).

57. LILCO has ten 50 MW gas turbines at Holtsville, two of which are equipped with blackstart capability and three of which were scheduled to have such capability as of April, 1984. These are located approximately 15 miles southwest of the Shoreham site. Power from these gas turbines is capable of being supplied to Shoreham through various transmission paths ultimately leading to any of the four 138 KV lines or the three 69 KV lines to Shoreham. Any one of the five blackstart gas turbines at Holtsville would be sufficient to supply power to Shoreham. Under simulated conditions, actual tests have shown that power can be restored to Shoreham from Holtsville in six minutes via 69 KV lines to Riverhead and the 69 KV or 138 KV lines to Shoreham. (Tr. 488-89, 508, Schiffmacher).

58. LILCO has a 14 MW gas turbine with blackstart capability at Southold, approximately 27 miles east of Shoreham. Power can be restored to Shoreham from Southold in approximately ten minutes via 69 KV lines to Riverhead and then 69 KV or 138 KV lines to Shoreham. (Tr. 506-05, Schiffmacher).

59. LILCO has a 20 MW gas turbine with blackstart capability at East Hampton, approximately 35 miles from Shoreham. Power from East Hampton can be restored to Shoreham in approximately 15 minutes via 69 KV lines to Riverhead and 69 KV or 138 KV lines to Shoreham. The transmission system from East Hampton to Riverhead is independent of that from Southold to Riverhead. (Tr. 503-02, Schiffmacher).

60. A 16 MW gas turbine is located at Port Jefferson which is approximately 11 miles west of Shoreham. Power from this gas turbine could be restored to Shoreham in approximately 25 minutes or less via 69 KV or 138 KV lines. (Tr. 501, Schiffmacher).

61. LILCO's transmission system is designed to withstand winds in the range of 100 to 130 miles per hour, in excess of the National Electrical Safety Code requirements. (Tr. 514, Schiffmacher).

62. LILCO's transmission system has not been adversely impacted by tornados or earthquakes in the last 20 years. Similarly, there have been no outages on the transmission system of such magnitude as to cause the loss of power to a facility such as Shoreham from hurricanes in the last ten years, although there may have been outages to individual lines during major storms. (Tr. 513, Schiffmacher).

63. Other natural phenomena, such as ice storms and lightening strikes, have not historically had a significant impact on LILCO's transmission system. (Tr. 511, Schiffmacher).

64. LILCO has committed to initiate steps promptly to place the plant in a cold shutdown condition in the event of any of the following during Phases II, III and IV of the low power testing program, thus further minimizing the probability that a loss of the normal offsite transmission system will occur and adversely affect operation of the plant from a safety standpoint:

(a) a "hurricane warning" for the Shoreham area issued by the National Weather Service;

(b) a "tornado watch" or a "severe thunderstorm watch" for the Shoreham area issued by the National Weather Service;

(c) a "winter storm watch" for the Shoreham area issued by the National Weather Service, including ice storms;

(d) a coastal flood warning for the Shoreham area issued by the National Weather Service predicting that a high tide greater than 5 feet above normal high water will occur within 24 hours;

(e) an indication of seismic activity of .01g on the Shoreham seismic monitors;

(f) the outage of two of the four LILCO interconnections to The New York Power Pool and The New England Power

Exchange (except short outages of less than 8 hours of a second intertie required for inspection, testing or minor maintenance where the intertie could be restored to service if needed); and

(g) a low electrical frequency condition on the LILCO transmission system which reaches the alarm set point.

(Tr. 558, 561-62, 574, Museler).

65. A cold shutdown condition can typically be reached in six hours from 5% power. (Tr. 562, Museler; Tr. 412-13, Gunther; Gunther, ff. Tr. 1214, at 17).[2] The procedures direct immediate commencement of a controlled reactor shutdown upon notification from the system operator that any of the foregoing weather conditions is predicted. (Gunther, ff. Tr. 1214, at 16). Upon notification, the operator is expected to begin insertion of control rods taking the reactor subcritical within 15 minutes. The operator is not precluded from initiating a more rapid shutdown if he feels an unsafe condition exists. (Tr. 414-15, 471-72, Gunther).

66. As a result of preplanning, including preassigning equipment and training of overhead lines personnel, LILCO could restore a mile of the 69 KV transmission

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[2] The second portion of William Gunther's prefiled testimony was not numbered when bound into the transcript. It may be found following page 1214 of the transcript.

facility to Shoreham within 24 hours. (Tr. 510-09, Schiffmacher).

67. LILCO's ability to restore power from Holtsville to Shoreham will be tested on a bi-weekly basis. This will demonstrate both the starting reliability of the gas turbines and the ability of the system operator to restore power to Shoreham within 15 minutes. (Tr. 577, Museler; Tr. 507-06, Schiffmacher).

68. The Southold gas turbine will be tested bi-weekly with respect to its ability to start and accept load. A test will be performed annually of LILCO's ability to provide power to Shoreham from Southold. (Tr. 503, Schiffmacher; Tr. 577, Museler).

69. The East Hampton gas turbine will also be tested on a bi-weekly basis demonstrating its ability to start and pick up load. The express isolation of a transmission line to Shoreham will be tested on an annual basis. (Tr. 502, Schiffmacher; Tr. 577, Museler).

70. Ability to route power to Shoreham from the Port Jefferson gas turbine will be tested annually. (Tr. 501, Schiffmacher).

71. The ability to restore power rapidly to Shoreham was demonstrated following a loss of offsite power to the Shoreham plant on April 14, 1984. An unintended relay operation at the 69 KV substation in Wildwood precipitated the outage. Power was restored to the RSST within 7 minutes. At the time of the outage, Shoreham was not in the configuration in which it would be operated during low power testing. Specifically, the NSST was deliberately tagged out of service which meant that the 138 KV circuit was out of service. Additionally, the 20 MW gas turbine was unavailable as it was being tested. Finally, work was ongoing on the EMD diesels and they were not available. Only the 69 KV to the RSST line was supplying the plant. LILCO identified the cause of the relay operation, and believes it is only the second such occurrence in the past 30 years. In any event, LILCO is initiating action to monitor the type of equipment for similar occurrence. (Tr. 369-71, Schiffmacher; Tr. 447-48, Gunther).

B. Offsite Enhancements at Shoreham

1. The 20 MW Gas Turbine

72. A deadline, blackstart 20 MW gas turbine at the Shoreham site is located in the 69 KV switchyard. (Tr. 332, 489, 500, Schiffmacher). The 20 MW gas turbine provides power

to the plant electrical systems through the RSST. It provides sufficient AC power to meet Shoreham's emergency needs. (Tr. 500-499, Schiffmacher; Tr. 1868, Knox; Gunther ff. Tr. 1214, at 20).

73. With its newly installed low pressure air start system and field control system, the 20 MW gas turbine at Shoreham is virtually identical to the gas turbine at East Hampton which has an operational availability of 97.9%. During 1982-83, there were 84 start attempts of the East Hampton 20 MW gas turbine of which 82 were successful, for a total availaility of 97.6%. In addition, the Shoreham gas turbine has been refurbished since being relocated to the site, which enhances its reliability. (Tr. 497, Schiffmacher; Tr. 2346, Knox, Tomlinson).

74. The 20 MW gas turbine at Shoreham will be tested bi-weekly to demonstrate the capacity to start and pick up load, and monthly to demonstrate that it will start automatically on loss of grid voltage and isolate from the grid. (Tr. 498, Schiffmacher; Tr. 577, Museler; see Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-2, 8-4).

75. The 20 MW gas turbine operates on No. 2 fuel oil supplied from a 1,000,000 gallon capacity storage tank located at the Shoreham site. There is adequate storage capacity for 20 days of operation at maximum output of the gas turbine generator. Since the fuel tank for the 20 MW gas turbine is not seismically qualified, LILCO will provide two additional 9,000 gallon fuel oil tank trucks on site at all times on a standby basis to provide fuel to the 20 MW gas turbine. The NRC Staff will require as a technical specification requirement that LILCO maintain a minimum stored volume of fuel for seven days of operation at maximum continuous output of the gas turbine generator. (Tr. 2346-47, Knox, Tomlinson; Tr. 491, 496, Schiffmacher).

76. A conservative estimate of the time necessary to have the gas turbine into operation and operating cooling equipment within the Shoreham plant is ten minutes. This conservative estimate includes time for the control room operator to respond by opening and closing switches. Realistically, it should only take five minutes for the gas turbine to provide power to have the cooling equipment operating. (Tr. 2351-52, Knox, Tomlinson).

77. Indicating lights for the 20 MW gas turbine output breaker position and the RSST supply breaker position have been installed in the main control room so that the operator has direct knowledge of the availability of the 20 MW gas turbine. (Tr. 804-05, 856, Gunther; Tr. 1812-1813, Clifford). The RSST supply breaker opens automatically on loss of offsite power to ensure power from the 20 MW gas turbine is dedicated to Shoreham's use. (Tr. 804-05, 856, Gunther).

2. <u>The GM EMD Diesel Generators</u>

78. LILCO has also installed at the Shoreham site four 2.5 MW General Motors Electro-Motive Division (EMD) deadline blackstart diesels which were previously in service since 1967 at New England Power Company (NEPCO) in Lynn, Massachusetts as peaking units. (Tr. 332, 489, 493-92, Schiffmacher). These diesels are routed directly into the plant's four KV buses, bypassing both the RSST and the NSST. These diesels start deadline and are ready to accept load within ten minutes. They will be able to provide power to the plant's emergency systems within thirty minutes of loss of power, assuming conservatively time for control room and field operators to respond by opening and closing switches. Realistically, this process should take only 15 minutes. (Tr.

493-91, Schiffmacher; Tr. 2352, Knox). Actual testing has shown that it can be done in less than 9 minutes. (Tr. 857-58, Gunther).

79. At 5% reactor power output, one of the EMD generators provides sufficient power to run two redundant ECCS subsystems, either of which is sufficient to cool the core. (Tr. 492, Schiffmacher; Gunther, ff. Tr. 1214, at 19-20).

80. The four EMD diesels will be tested by-weekly to demonstrate the capacity to start and pick up load. (Tr. 577, Museler; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-3, 8-4).

81. The fuel for the EMD diesels will be provided in a fuel tank truck with a capacity of approximately 9,000 gallons, enough to operate the four machines at full load for about nine hours and a quarter load for about 36 hours. A second truck will be on site and available to supply fuel. (Tr. 491, Schiffmacher).

82. The four EMD diesel generators are capable of operating totally independently of one another. However, they share one control cubicle, one fuel line, one fuel equalizing line, one set of batteries and one power cable running from the generator block to the four KV buses. (Tr. 1881-82, 2348,

Knox, Tomlinson). Each of the units has its own independent starting motors which are powered by the common battery. (Tr. 1154, 1116, Lewis; Tr. 2540, Eley).

83. EMD diesel engines have been widely used in industry. They are used, for example in locomotives, ships, drill rigs, hospitals, military bases, utilities and nuclear plants. These include both skid mounted and housed units, such as those at Shoreham. (Tr. 1167, Iannuzzi; see also, Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-7).

84. The EMD diesel generators installed at Shoreham do not strictly comply with all technical requirements for qualified nuclear grade diesels. Tr. 1170, 1166-68, 1188-89, 1192, Iannuzzi, Lewis).

85. The difference between the Shoreham units and diesel generators which have been fully qualified for use at nuclear plants is the auxiliary equipment which supports the operation of the engines. That auxiliary equipment includes such items as piping, valves, pumps, heat exchangers, tanks, supports and electrical equipment. (Tr. 1180-81, Iannuzzi, Lewis).

86. While the requirements for auxiliary equipment are different, the systems and the design parameters remain the same. There have been no catastrophic failures of the type of auxiliary equipment in use at Shoreham of which LILCO's witnesses were aware. (Tr. 1181-82, Iannuzzi, Lewis). The extensive experience of LILCO's witnesses concerning the diesel generators makes it likely that they would be aware of any failure if one had occurred. (Tr. 1166-68, 1188-89, 1192, Iannuzzi, Lewis).

87. Unlike qualified nuclear diesels necessary for full power operation which must reach their rated speed in a matter of seconds, the EMD diesels do not have to "fast start." The EMDs at Shoreham can idle for several minutes and supply power in a timely fashion. This reduces excessive wear on the engine and reduces stress on the auxiliary package. (Tr. 1182-83, Iannuzzi, Lewis).

88. The factors by which one would evaluate the reliability of diesel generators are (a) whether the design has been proven through operating history; (b) evidence of proper manufacturing processes; (c) whether the application of the unit is consistent with its design and intended purpose; (d) the inspection and maintenance history of the specific

unit; (e) the operating history of the specific unit; and (f) whether the manufacturer's recommendations of replacement schedules have been followed. (Tr. 1170, Iannuzzi, Lewis). Consideration of these factors demonstrate the reliability of the EMD diesel generators at Shoreham.

89. The design has been proven through operating history. The diesel generator units at Shoreham are EMD 645E4 engines, which are widely used and well accepted in the industry. The engines and generators on the four EMD units at Shoreham are the same as those in nuclear service at several nuclear plants including Sequoya, Watts Bar, Browns Ferry, St. Lucie 1 & 2, Washington Public Power Supply System (Unit 2), Davis Bessie, Nine Mile Point One, Connecticut Yankee, Beaver Valley, Turkey Point, Surry and others. (Tr. 1151-52, 1167, 1170-71 Iannuzzi, Lewis). Overall industry experience with the type of engines and generators in use at Shoreham has been positive and indicates their general reliability. (Tr. 1170-71, Iannuzzi, Lewis; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-9).

90. The EMD diesel generators at Shoreham use the same model diesels as were used on National Oceanic and Atmospheric Administration vessels. Those engines logged in excess

of 100,000 hours with no known failures. (Tr. 1897, Tomlinson).

91. Evidence of a proper manufacturing process is confirmed by audits performed by the quality assurance department of Morrison & Knudsen's Power Systems Division (PSD), as far back as 1974. Through those audits, EMD has been qualified as a supplier of equipment to PSD's nuclear program. Experience indicates that both the EMD engines and replacement parts are manufactured properly and are highly reliable. (Tr. 1171-72, Iannuzzi).

92. The application of the EMD diesel generators at Shoreham is consistent with the design and intended purpose of the unit. The same generator and engine is in use at a number of nuclear plants as an emergency AC power source. (Tr. 1172, 1151-52, Iannuzzi, Lewis). These units were designed for emergency duty and for use as peaking units. (Tr. 1172, Iannuzzi, Lewis).

93. The inspection and maintenance history of the specific units found at Shoreham further attests to their reliability. (Tr. 1175-76, Iannuzzi, Lewis). Since 1978, the EMD diesel generators now at Shoreham have been maintained in accordance with the PSD maintenance service contract which

meets or exceeds the maintenance schedule published by EMD. (Tr. 1173, Iannuzzi, Lewis). All recommended maintenance has been performed and any conditions which were discovered during these visits and which required additional service were taken care of except for a recommendation to change the viscous dampers. On three of the four units, the viscous damper has not been changed. Even a failure of the viscous damper, however, would not cause the units immediately to shut down. They could run approximately 150 hours after such a failure -- greater than the number of hours one would expect in a year on an emergency diesel generator at a nuclear plant at full power. There is no evidence of any problem with the three original-design viscous dampers still in place. (Tr. 1173-74, Iannuzzi, Lewis). Industry experience does not indicate that any damper actually failed. (Tr. 1090-92, Lewis).

94. The operating history of the EMD units indicates that they operated very reliably, there were few problems and no shutdowns for major repairs because of an operating condition while the units were operating as peaking units at NEPCO. The historic availability of these units has been very high. (Tr. 1178-79, Iannuzzi, Lewis).

95. Logbooks indicated some problems with turbochargers in the EMD units, but did not indicate that the condition caused the diesel generator to shut down. (Tr. 1062-67, 1118, Lewis; SC Exhibit LP-4, SC Exhibit LP-5).

96. The logbooks and maintenance records indicated failure of a generator and a dust bin blower on February 20, 1974; however, the logbooks and maintenance records did not indicate whether the units, which would have been operating at the time of the problem, actually shut down as a result of the failure of the components. The engine would have been shutdown to remove the parts for changeout and repair. (Tr. 1067-68, 1124-25, Lewis; SC Exhibit LP-6.)

97. The standard EMD turbocharger, if used and maintained properly, performs as it should. (Tr. 1122, Lewis). If the EMD diesel generators at Shoreham are surveillance tested properly and in excess of 50% load, there should be nothing that would be detrimental to the turbochargers. (Tr. 1121-24, Lewis). SSER No. 6 calls for the EMDs to be tested at a minimum of 50% of load. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-3).

98. Since 1981, when witness Lewis began servicing the EMD units at NEPCO, he has not been aware of any failure of the turbochargers. (Tr. 1118-19, Lewis).

99. NEPCO always replaced parts on the EMD diesel generators with new parts, when available. It only used UTEX parts, which are remanufactured or rebuilt parts produced by the Electro Motive Division of General Motors, when new ones were not available. UTEX parts are reliable. PSD has experienced no problems with UTEX parts and sells UTEX parts to nuclear plants for their diesel generators. (Tr. 1125-26, Lewis).

100. Test data, industry reports and the witnesses' experience with GM EMD engines confirm that the EMD 645E4 diesel engines are extremely reliable in starting regardless of the type of starting motors used. (Tr. 1093-95, 1176-78 Iannuzzi, Lewis). In the years 1968-70, fast start tests were performed by EMD on 645E4 type engines with a 99 9% success rate. In the years 1971-73, fast start tests were performed on Model 20-645E4 EMD engines with a 100% success rate. The engines subject to these two tests are of the same type as the engine at Shoreham with the exception that the starting motors on the tested units used redundant air start motors rather than

the electric motors used on the Shoreham units. Additionally, the test engines were fitted with a backup electric fuel pump which would be used in the event of a failure of the engine driven pump. (Tr. 1176-77, Iannuzzi).

101. In 1967, EMD reported a success rate of 29,136 starts and 29,362 attempts on an electric start unit, or 99.23% success rate. (Tr. 1177, Iannuzzi).

102. There are two electric start EMD diesel generator sets installed at nuclear power plants for onsite emergency power. The two units in nuclear service are basically identical to the Shoreham units including piping valves, pumps, heat exchangers, tanks, supports and electrical equipment. The two units in nuclear service employ separate control cubicles for each machine. (Tr. 1151-54, Lewis).

103. During 1982-83, the EMD diesels started 279 times out of 279 attempts. In four instances the unit did start and synchronize, but was removed from service. In one instance, a unit removed itself, restarted, and came back on line. In the other three instances, the operator on site noticed some minor difficulties and decided to take one of the units out of service. If these four instances are considered failures to start, each individual EMD unit has a conservative

reliability of 98.6%. (Tr. 463 Schiffmacher; Tr. 1882-84, 1863, Knox, Tomlinson).

104. The likelihood that all four diesel units will start and operate in an emergency situation is very high; the likelihood that one of the four will start and operate in an emergency situation is virtually assured. (Tr. 1184, Iannuzzi, Lewis). When viewed as a block of four engines, the reliability approaches 100%. (Tr. 1863, Tomlinson; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-9).

105. Given the previous starting history of these units, their overall condition, their maintenance records and industry experience with EMD engines, the reliability of the four units at Shoreham will continue to be good for the foreseeable future. (Tr. 1184, Iannuzzi, Lewis).

106. Failure of the EMD diesels would not affect the ability of the 20 MW gas turbine to supply AC power to the plant. (Tr. 2462-63, 2465-66, 2471, Eley; 2478, Smith).

107. Applying the single failure criterion, if a failure of the 20-MW gas turbine is postulated, an additional failure of the EMD diesels is not postulated because that would be a double failure. (Tr. 2479, 2482, 2484, 2501, Eley, Smith).

108. Fires are very rare events with stationary diesel units of the Shoreham type. (Tr. 1183, Iannuzzi, Lewis).

109. The EMDs at Shoreham have not suffered any fire since they have been in operation. (Tr. 2484-85, Smith).

110. The operating histories of the Shoreham EMD diesels do not indicate that any fires have been caused by the battery charger. (Tr. 2490-91, Smith).

111. It is unlikely that a fire would start on the one of the EMDs unless the machine were operating. When the machines are operating, cooling air would be flowing through the engine which would vent the smoke and permit persons monitoring the surveillance cameras to detect a fire in one of the units. (Tr. 2487-89, Eley, Smith).

112. The EMD diesel generators at Shoreham are located at such a distance from the 20 MW gas turbine that a fire in the EMD diesels would not incapacitate the 20 MW gas turbine in any way. (Tr. 2493, Eley).

113. The lack of alarms on the EMDs would not have any effect on the operation of the 20-MW gas turbine. (Tr. 2500-01, Smith).

114. It is not necessary for operators manually to manage the load of the EMDs from the EMD control cubicles. The EMD machines will have automatic load adjusting systems. (Tr. 2505-06, Smith). If one of the machines went into reverse current and tripped off, the other machine still running would pick up the load being carried from the machine that had tripped out. Eventually there would be sufficient machines running to carry the load comfortably. (Tr. 2506-08, Smith).

115. The NRC Staff has suggested the following conditions to allow low power operation with the gas turbine and EMD diesel generators:

> (a) The automatic transfer between the two normal offsite power circuits at Shoreham must be removed or disabled during low power operation.
>
> (b) A fire barrier or 50 feet of separation must be provided between the cables associated with the mobile diesel generators and the RSST and NSST.
>
> (c) A quality assurance program for the gas turbine, the EMD diesel generators and their associated circuits commensurate with their importance to safety must be provided.
>
> (d) The circuits associated with the gas turbine and the 4 EMD diesel generators located in the non-essential switchgear room must be protected in accordance with the requirements of Appendix R or a procedure must be available so that

> power can be reestablished around the switchgear room within the 30 days from one of the alternate AC power sources.

(Tr. 2354-55, Knox).

116. With the imposition of the Staff's conditions, the 20 MW gas turbine and the EMD diesels have a level of reliability currently demonstrated for onsite safety related diesel generator power supplies qualified for full power operation of nuclear plants. For normal onsite safety related diesel generators, the demonstrated reliability is within 92% to 99%. The 20 MW gas turbine generator has a demonstrated reliability of approximately 97.6%, while the EMD diesel generators have a demonstrated reliability approaching 100% for this application. The combined reliability of the 20 MW gas turbine and the EMD diesels, therefore, also approaches 100%. (Tr. 2356, Tomlinson).

117. The independence of the 20 MW gas turbine, the EMD diesels and the offsite power systems meets the single failure criterion that would be required for the normal safety related diesel generators located in an operating nuclear power plant at full power. (Tr. 2342, Tomlinson).

118. With the conditions the Staff seeks to impose, it is not credible that all sources of power could be lost so as to prevent restoration of power to run cooling pumps and other emergency equipment within 55 minutes of a loss of offsite power. Each of the three sources of AC power -- the offsite system, the 20 MW gas turbine and the EMD diesels--has sufficient capacity, capability and reliability to assure that the structures, systems and components important to safety perform as intended. (Tr. 2357, Knox).

3. Procedures

119. LILCO has procedures for restoration of AC power, including emergency procedures, normal operating procedures and test procedures. (Tr. 853, Gunther). The NRC Staff has reviewed the necessary procedures and found that the operators are capable of taking the necessary actions within the specified time frame. (Tr. 1807, Clifford). If LILCO implements the license conditions outlined in SSER No. 6 at 13-2 and 13-3, the Staff considers LILCO's procedures acceptable (Tr. 1835, 1838, Clifford).

120. A loss of offsite power would automatically sequence the TDI diesel generators to start. Concurrently, the numerous offsite gas turbines, the 20 MW gas turbine, and the four EMD diesel generators at Shoreham would start. In other words, all of the gas turbines, both offsite and at the site, and the EMD diesel generators would be brought into operation immediately. (Tr. 495, Schiffmacher).

121. There is no need to establish formal procedures for the system operator to route power on the LILCO grid to Shoreham other than LILCO's order to make Shoreham the first priority in restoring power. The system operator will route power to Shoreham through the fastest and best means available to him and will do so based on the circumstances facing him in the event of an outage. Nevertheless, certain procedures have been established for restoration of power to Shoreham. The system operator is trained to react to any transmission system problem on an ad hoc basis; these procedures only enhance an already very reliable mechanism for restoring power. (Tr. 505-04, 854, Schiffmacher).

122. If the TDI diesel generators did not start and provide power, the plant operator would have two procedures available. The procedures will be followed sequentially. One

pertains to the loss of all AC power and calls for the plant operator to contact the system operator to determine the nature of the problem causing the loss of offsite power and the prognosis for restoring power to the site. That procedure involves verification of the availability of either the 20 MW gas turbine or one of the many alternate offsite power sources and requires the plant operator to connect loads to either the gas turbine, if it has come on line as expected within two to three minutes, or an alternate power source. If an alternate power source is not available and the gas turbine has not come on line, the plant operator follows the second procedure which utilizes the EMD diesels. (Tr. 2926-27, Gunther; Tr. 1850, Clifford; Tr. 2350-51, Knox).

123. The first AC power source available will generally be employed. Decisionmaking as to which source to use does not delay restoration of power. Within approximately 10 minutes of the loss of power, the control room will have clear indication of the sources available from the system oerator. At that time, the EMD diesels will be at rated speed able to supply the plant upon manual closure of a single breaker. A plant operator will have already been dispatched to accomplish this action when directed by the control room. Closing in power from the EMD diesels can be accomplished within 30

minutes of the loss of power, regardless of the outcome of the system operator's attempts to restore power by other means. (Gunther, ff. Tr. 1214, at 21).

124. If the 20 MW gas turbine starts on a loss of voltage, it will automatically isolate from the system and provide power to the plant. The plant operator need only to close a breaker to pick up load. (Tr. 359-61, 365, 367, 498-99, Schiffmacher; see also, Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-2 to 8-3).

125. The EMD diesels start automatically on a loss of voltage signal. If the gas turbine is unavailable, the control room operator would dispatch a field operator to the nonemergency switchgear room to determine the status of the diesel generator and to open and close breakers as required by procedures. The control room operator then, by procedure, would open and close breakers from the control room as required to supply power to safety loads. (Tr. 1850-51, Clifford; Tr. 2350-51, Knox, Tomlinson; Tr. 2480-81, Smith; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-4).

126. LILCO's plant procedures for restoration of AC power have been communicated to plant staff and operators. Training has been provided to all six operating crews and to

management license holders; training included a detailed description of the EMD diesels and their auxiliaries, the procedures associated with operating them during surveillance testing and in an emergency condition, and a walk through for hands-on experience. The training also covered surveillance procedures associated with the 20 MW gas turbine. (Tr. 788-90, 855, Gunther).

127. On July 2, 1984, tests were conducted and witnessed by NRC Staff personnel and Suffolk County personnel to demonstrate the procedures utilized to restore power to emergency loads using the GM EMD diesels and the 20 MW gas turbine. All four EMD diesels started on the loss of power. Despite minor problems with one diesel failing to synchronize within allowable time and because of this returning to an idle condition, two RHR pumps were started and operated at rated flow conditions throughout the demonstration. Rated flow on one RHR pump was achieved in 8 minutes and 12 seconds, well within the 30 minute acceptance criteria. A second RHR pump was started and at rated flow within 9 minutes of the loss of power initiation. These times included opening of the NSST disconnect switch which would only need to be done if a fault exists on the low side of the NSST. Restoration would be achieved more rapidly without this step. (Tr. 857-58, Gunther).

128. During the July 2 demonstration, the NRC Staff requested that the engine that had not synchronized be started and synchronized. When the unit fault annunciator was reset to allow this to be done, a voltage signal resulted in the trip of a second and third engine. The remaining engine successfully picked up and carried the entire test load. (Tr. 858-59, Gunther). A minor wiring modification has been made to the annunciator reset circuitry of the EMD diesels to eliminate the possibility of this type of diesel trip from reoccuring. Additionally, a second minor modification has been completed that increases the time available for the engines to synchronize. Both of these modifications had been identified during preoperational testing but had not yet been implemented at the time of the demonstration. They were, however, scheduled to be completed prior to turning over the EMDs to the plant staff. (Tr. 810-11, Gunther; Tr. 860-61, Gunther, Schiffmacher).

129. During the test of the 20 MW gas turbine, the gas turbine output breaker closed in 2 minutes and 31 seconds after its start signal and an RHR pump was at rated flow within 3 minutes and 50 seconds of the loss of power initiation. These times were within the proposed technical specifications included in the NRC Staff's Safety Evaluation Report of having power available to the RSST within 2-3 minutes following a loss

of power. (Tr. 859-60, Gunther; Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-3, 13-1).

130. There will be sufficient personnel during low power testing to perform the necessary functions in the event of a loss of offsite power. During the July 2 drill, only one field operator was used to place the EMD diesels on line. He performed all field manipulations which included opening the manual disconnect on the plant side of the NSST which must be done only if there is a fault on that transformer. (Tr. 2927-28, Gunther).

131. The minimum operator complement for any shift consists of two supervisors, a watch engineer and a watch supervisor (both of whom are licensed, qualified senior reactor operators), three operators in the control room, one nuclear station operator with two assistants and three field operators. (Tr. 2923, Gunther). During the low power testing program and during the entire power ascension program, there will be additional personnel on site strictly devoted to the test program. There will be a test director on every shift, as well as data takers, engineers from General Electric or from Stone & Webster who are there to witness specific tests. In addition, LILCO plans to bring in additional operators to assist in testing. (Tr. 2925, Gunther; <u>see also</u>, Tr. 184-86, Gunther).

132. LILCO would have a minimum of three field operators available during any shift of low power testing. (Tr. 2928, Gunther).

133. Contact between the control room and the field operators would be made by the plant communications system which would still be in service after a loss of AC power. (Tr. 2929, Gunther).

134. LILCO has committed to, and will ensure that, the following surveillance testing procedures are followed to provide yet additional assurance of AC power reliability for Shoreham during Phases III and IV of low power testing. LILCO will:

(a) demonstrate on a biweekly basis through an actual test that the Holtsville blackstart gas turbines can supply power to Shoreham in less than 15 minutes;

(b) demonstrate on a biweekly basis through an actual test that the 20 MW gas turbine at Shoreham can be manually started, synchronized and loaded to at least 13 MW on the grid;

(c) demonstrate on a monthly basis that the 20 MW gas turbine at Shoreham will start automatically on a loss of grid voltage signal;

(d) demonstrate on a biweekly basis that the East Hampton and Southold gas turbines can be manually started, synchronized and loaded to at least 50% capacity of the grid; and

(e) demonstrate on a biweekly basis that at least 3 of the 4 GM EMD diesel generators onsite can be manually started and can supply power to plant systems.

(Tr. 577, Museler; see also, Staff Exhibit LP-2, SSER 6 ff. Tr. 721, at 8-2 to 8-5).

135. If any one of the surveillance tests is unsuccessful, corrective action will be taken within 72 hours or the plant will immediately initiate procedures to place the reactor in a cold shutdown condition. (Tr. 578, Museler).

4. Seismic Resistance

136. A loss of offsite power is not likely to concur with a seismic event. Nevertheless, the NRC assumes a loss of offsite power concurrently with a seismic event as a conservatism. (Tr. 1894-95, Knox).

137. If a seismic event were to occur simultaneously with a loss of offsite AC power, there would be at least 30 days before AC power would be needed at the site. Thus, it is not necessary that the EMD diesel generators or the 20 MW gas turbine be seismically qualified. In the event that either

failed to survive a seismic event, repairs could be made or additional souces of AC power could be made available to the site within the thirty-day time frame. (Tr. 2343, Knox, Tomlinson).

138. One of the additional sources of AC power which could be made available in the event of a seismic event would be from the Army Corp of Engineers, the non-tactical generator program. The NRC Staff understands that the Army would truck in these generators to the plant based upon the Staff's interpretation of the Atomic Energy Act and discussions between the Staff and the Corp of Engineers and with FEMA. (Tr. 1867, Tomlinson).

139. Even if damage occurred to sources of offsite power, such damage could be repaired well within the 30 days available to restore such power. For example, LILCO could restore a mile of the 69 KV transmission line in 24 hours. (Tr. 510-09, Schiffmacher). Replacements for the RSST and NSST transformers are available onsite. These transformers could be completely replaced within several days. (Tr. 376-378, 475-77, Schiffmacher). Replacement of portions of transformers would take much less time, on the order of four to six hours for six insulators for example. (Tr. 457-58, 475-77, Schiffmacher)

140. Those portions of the RCIC system required for injection are seismically qualified. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-7; Tr. 310 Rao *et al*). The HPCI system is also designed to be seismically qualified. (Tr. 310, Rao *et al*). Modifications to the system to ensure these seismic capabilities are in progress and will be completed prior to Phase III AC testing. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-7; Tr. 1766-67, Hodges).

141. It is not necessary to assume the simultaneous occurrence of a LOCA and a seismic event. The piping systems are designed to withstand seismic loads in combination with other loads. Therefore, seismic loads will not cause a piping failure causing a LOCA. Thus, a LOCA and an earthquake are independent events. As both an earthquake and a LOCA are low probability events, their combination is an extremely low probability event. (Tr. 1763, 1794, Hodges).

142. Although the 20 MW gas turbine and the four GM EMD diesels need not be seismically qualified, they do have significant seismic capabilities and are likely to be available following a seismic event. (*See*, *e.g.*, Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-7 to 8-8).

143. The manufacturer of the 20 MW gas turbine has provided assurance that the machine would remain structurally sound during a design basis seismic event at Shoreham and would be available after the event to perform its design function. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 8-7; see also, Tr. 2787, Meyer ("[t]he gas turbine itself is probably capable of withstanding the stipulated loads.")).

144. Sargent & Lundy performed a study of the seismic capabilities of the four GM EMD diesels at Shoreham. (Tr. 972-73, Christian et al.). Sargent & Lundy had previously performed seismic qualifications for more than 12 GM EMD diesels that are similar to the diesel generators sets installed at Shoreham. (Tr. 968, Meligi). As part of this work, Sargent & Lundy investigated structural integrity and operability of (1) the diesel engine, (2) its accessory items, and (3) electrical equipment associated with the diesel generators. (Tr. 976, Meligi).

145. Seismic capabilities of the diesel engine were evaluated using a combination of analyses and test results. Shock tests performed by the U.S. Navy on EMD engines similar to those at Shoreham confirmed that the engine block and internals could withstand loads in excess of the Shoreham SSE. In

addition, supplemental analysis was performed to address external components attached to the engine. This combination of testing and analysis demonstrated that the engine assembly and all of its integral components would be able to function properly following an SSE level earthquake at Shoreham. (Tr. 981-84, Meligi). The EMD diesels which were used for the testing and analysis were comparable to the EMD diesels at Shoreham. (Tr. 956-57, Meligi).

146. Accessory components are those items that are not an integral part of the engine assembly. These components were analyzed using bounding calculations which demonstrated that stresses and deflections of the components were within allowable limits. With some exceptions, all accessory items were found to be suitable to withstand a SSE level earthquake and remain operable following the event. For the exceptions noted, Sargent & Lundy made recommendations for modifications which will result in those components being able to withstand the SSE. (Tr. 980-81, Meligi).

147. LILCO has accepted the recommendations of Sargent & Lundy. The recommendations either have been completed or will be after an exemption is granted. Upon completion of recommendations made by Sargent & Lundy, the four EMD diesel

generators at Shoreham are capable of surviving a SSE level earthquake and remaining operable following the event. (Tr. 986, Meligi).

148. Electrical equipment was also analyzed as part of the Sargent & Lundy study of the seismic capabilities of the EMD diesels. First, a detailed finite element analysis was performed on the worst case electrical panel to demonstrate the structural integrity of the panels. (Tr. 984, Meligi). Second, the operability of electrical equipment was confirmed by determining that the elevated response spectra for Shoreham were bounded by the response spectra used by Sargent & Lundy in qualifying other EMD diesels. By confirming that certain electrical devices installed on Shoreham were similar to devices previously analyzed by Sargent & Lundy, it was possible to conclude that these devices would withstand the SSE. For electrical equipment that could not be analyzed using this technique, Sargent & Lundy used methods set out in NUREG/CR-2405, "Subsystem Fragility." Additionally, a detailed check was performed of the mounting bolts on many of the instruments. The overall results of the analysis demonstrated that electrical components and devices on the Shoreham EMD diesels will withstand the SSE. (Tr. 984-85, Meligi).

149. In addition to the Sargent & Lundy study, Stone & Webster performed analyses of any aspects of the seismic capabilities of the machines not covered by Sargent & Lundy's study that would affect their ability to operate under seismic conditions. (Tr. 988, Christian, Wiesel). The scope of the Stone & Webster work coupled with the Sargent & Lundy work was adequate to determine the overall seismic capabilities of the machines. (Tr. 958, Wiesel).

150. A static sliding and overturning analysis was performed on the EMD diesel mounting. Earthquake induced sliding forces were compared to the support system's capability to resist those sliding forces with friction. This analysis showed that sliding of the EMD diesels will not occur during an SSE. A similar analysis was done for overturning forces and demonstrated that the EMD diesels would not overturn in the event of an SSE. (Tr. 941, 989-991, Wiesel).

151. Analysis also demonstrated that the wooden beam support structure for the diesel engines would not slide either (1) at the contact between the wooden beams and the gravel or (2) at a failure surface passing below this contact point through the gravel and soil. (Tr. 992-993, Christian). Suffolk County's witnesses agreed that Stone & Webster had

correctly concluded that the EMD diesels would not slide or overturn. (Tr. 2793-94, Meyer).

152. Similar analyses demonstrated that the switchgear cubicle for the EMD diesels could resist sliding or overturning for a ground input of up to 0.13 g. (Tr. 991, Wiesel).

153. Stone & Webster evaluated the EMD diesel fuel oil line installation and recommended it be buried to improve its ability to withstand a seismic event. (Tr. 991-92, Wiesel). Buried, it will have adequate seismic resistance. (Tr. 998, Christian, Wiesel).

154. Stone and Webster also performed an assessment of the potential for soil liquifaction in the vicinity of the EMD diesel generators. Soils in that vicinity can withstand up to 0.13 g, which exceeds the operating basis earthquake of 0.1 g, without liquifaction. This does not mean that liquification will occur above 0.13 g; it only means that it cannot be predicted with confidence that liquifaction will not occur. (Tr. 993-995, Christian).

155. The ability of the GM EMD diesels and switchgear to withstand, at a minimum, an earthquake of 0.13 g

is significant because that level of earthquake exceeds the operating basis earthquake for Shoreham of 0.1 g. (Tr. 995, Christian). Moreover, although Shoreham uses a safe shutdown earthquake of 0.2 g, the procedures currently used for determining design basis earthquakes for nuclear power plants set out in 10 CFR Part 100, Appendix A, would only require an SSE of 0.13 g. In other words, if the NRC's existing standard procedures for relating earthquake intensities to peak ground acceleration had been applied to Shoreham, which they were not, Shoreham would have an SSE of 0.13g. (Tr. 955, Christian).

156. The capability will exist to connect the EMD switchgear directly to Emergency Switchgear Room 102, through a cable routing independent of, and bypassing, the normal feed and normal switchgear room. Power can then be provided to the other Emergency Switchgear rooms from Room 102. This will provide added assurance of AC power availability in the event the normal switchgear room is unavailable. Installed raceway for the alternate feed will either be supported to withstand a seismic event, or installed after a seismic event. Conceptual design has been completed and feasibility has been verified. Final engineering and construction of pre-installed portions will be done if a low power license exemption is granted, prior to commencing Phase III testing program. (Tr. 813-15, Gunther,

Schiffmacher; Tr. 818-20, 832-37, 842, 863-65, Schiffmacher; Tr. 832, 862-63, Gunther; Tr. 1890, Knox, Tomlinson).

157. LILCO has committed to completing selected portions of this alternate tie-in prior to commencement of Phase III of the low power testing program. Other elements of the modification will be installed after a seismic event if this tie-in is needed. (Tr. 865, Schiffmacher).

IV. Exigent Circumstances

A. Stage of the Facility's Life

158. The plant is physically completed and is being maintained in a condition that would allow fuel load within two to three weeks of the grant of a low power license. (Tr. 866, Gunther).

159. The major activity to be completed prior to fuel load is the installation of neutron sources into the reactor vessel. These sources will be shipped upon receipt of a license and will be installed within 2-3 weeks. Final pre-fuel load testing will be completed during that period so that fuel load activities may commence. (Tr. 866, Gunther).

160. If a low power license is granted, LILCO will have selected portion of the emergency tie-in for the EMDs completed prior to Phase III of low power testing. These routine modifications could be completed within four weeks. (Tr. 864-65, Schiffmacher).

161. Modifications to the HPCI System, now in progress, will be completed prior to Phase III low power testing. (Staff Exhibit LP-2, SSER 6, ff. Tr. 721, at 15-7; Tr. 1766-67, Hodges).

B. Financial or Economic Hardship to LILCO

162. There are a number of financial uncertainties facing LILCO at this time. (Tr. 1377-82, 1385-86, Nozzolillo).

163. Various rating services have substantially decreased their rating of LILCO's securities. (Tr. 1378, Nozzollilo).

164. Without additional external financing, LILCO might be unable to meet its financial obligations, including a September 1, 1984, bond payment. (Tr. 1379, Nozzolillo).

165. The sooner the financial market gets a signal that the Shoreham issue has been resolved, the sooner LILCO might gain access to the capital markets. (Tr. 1395, 1398, Nozzollilo).

166. The granting of the requested exemption would send a positive signal to the capital markets that the Shoreham issue had been resolved and, therefore, would help to alleviate LILCO's financial hardships. (Tr. 1395, 1398, Nozzolillo).

C. LILCO's Good Faith Efforts to Comply with GDC-17

167. LILCO's efforts to comply with GDC-17 include:

> (1) The original design of the Shoreham plant included an onsite power source that was intended to meet the requirements of GDC 17.
>
> (2) When problems with the TDI diesel generators were discovered, LILCO undertook extensive efforts to ensure that these diesels would reliably perform the functions required of them by GDC 17.
>
> (3) As a contingency, LILCO is installing at the Shoreham plant three additional diesel generators manufactured by Colt Industries to ensure that there will be a qualified onsite source of emergency power as required by GDC 17.
>
> (4) LILCO has also provided enhancements to its offsite system to assure that AC power will be available in event offsite power is lost during low power testing.

(Tr. 1440, 1703-04, McCaffrey).

168. LILCO's exemption request is an interim measure allow fuel load and low power testing prior to completion of the litigation concerning the reliability of the TransAmerica Delaval, Inc. (TDI) diesel generators. Shoreham will be provided with fully qualified diesels prior to full power operation. (Tr. 1704-05, McCaffrey).

169. Prior to the crankshaft failure on one of the TDI diesel generators in August 1983, LILCO included in Shoreham's design three emergency diesel generators intended to meet all applicable regulatory requirements for onsite power sources. LILCO purchased three diesel generators from TransAmerica Delaval, Inc. (TDI), requiring that these machines be manufactured in accordance with approved specifications. (Tr. 1705, McCaffrey). To ensure that TDI produced a machine that met the performance rating required in the FSAR and specifications, LILCO provided a specification which called for certain performance standards and assured through a pre-operational test program that the machines were capable of running at the performance rating. (Tr. 1440-41, 1467-68, McCaffrey). LILCO utilized its own and its architect/engineer's quality assurance program to oversee TDI's quality assurance programs. (Tr. 1459-60, 1468-69, McCaffrey).

170. The preoperational test program identified problems needing correction and LILCO responded by correcting individual problems and by initiating a Diesel Generator Operational Review Program in March 1983 to review problems and make recommendations to improve reliability of the TDI diesel generators. (Tr. 1706-08, 1492-93, McCaffrey).

171. Within a few days of the failure of the crankshaft of diesel generator 102 in August 1983, LILCO engaged the services of Failure Analysis Associates (FAA) to conduct a comprehensive investigation into the cause of the failure. (Tr. 1708, 1470-71, McCaffrey). That effort included:

> (a) inspection of the crankshafts on DG 101 and 103 for indications of similar problems;
>
> (b) complete metallurgical analysis of the failed crankshaft;
>
> (c) strain gauge and torsiograph testing of one of the remaining original crankshafts to determine actual stresses on the shaft;
>
> (d) complete disassembly and inspection of all three diesel engines to replace the original crankshafts with crankshafts of an improved design and to assess any damage to the engines as a result of the crankshaft problem; and
>
> (e) design analysis using finite element modeling/modal superposition analysis to ascertain dynamic torsional response of the original crankshafts.

(Tr. 1708-09, McCaffrey).

172. At a November 1983 meeting with the NRC Staff, LILCO further announced it would undertake a comprehensive diesel generator recovery program consisting of four phases:

> (a) disassembly, inspection, repair and reassembly of each diesel;
>
> (b) failure analysis of defective components;
>
> (c) design review and quality revalidation (DRQR) program; and
>
> (d) expanded qualification testing.

(Tr. 1531, 1709-10, McCaffrey).

173. The DRQR program is a detailed review of the design and quality of the TDI diesel engines including an assessment of the design of important components in the diesels and verifies important quality attributes for the requisite engine components. It has involved over 120 people from LILCO, Stone & Webster, Failure Analysis Associates, Impell and other consultants. (Tr. 1710, McCaffrey).

174. LILCO's DRQR program eventually was adopted and implemented by a group consisting of other owners of TDI diesel generators. LILCO assumed a lead role in this group. (Tr. 1512, 1710-11, McCaffrey).

175. As a precaution, LILCO has also undertaken to procure and install at Shoreham three diesel generators manufactured by Colt Industries. These machines are of the type in use at other nuclear power plants and are designed to satisfy the requirements of GDC 17. Incident to this effort, Stone & Webster has been retained to design a new building for the Colt diesels, to design support systems and to analyze how to integrate the system into the existing plant. The Stone & Webster engineering effort alone had consumed 216,000 manhours as of the end of May 1984. (Tr. 1712-13, McCaffrey).

176. The procurement of and engineering for the Colt diesels were pursued on an expedited basis. Construction of site facilities for the Colt diesel generators started in November 1983, almost immedidately after the August 1983 failure of the crankshaft in diesel generator 103. All three Colts have now been manufactured and delivered to Shoreham. Engineering work for the installation of the Colts is essentially complete and construction work is well underway. Construction and testing are now scheduled to be complete in May 1985. (Tr. 1713-14, McCaffrey).

177. The total cost for the Colts is now estimated at approximately $93 million. (Tr. 1714, McCaffrey).

D. Fairness to the Applicant: Length and Expense of Licensing Proceedings

178. LILCO filed its Application for an Operating License when the Final Safety Analysis Report was submitted in August 1975. The FSAR was officially submitted for docketing in January 1976 and the Application was publicly noticed on March 18, 1976. Thus, this licensing proceeding has been under way for over 8 years. (Tr. 1715, McCaffrey).

179. Emergency planning discovery started in 1982 and still continues. Extensive document requests and interrogatories have been answered in the Phase I (onsite) and Phase II (offsite) emergency planning proceedings. These proceedings have involved over 65 depositions. (Tr. 1720, McCaffrey).

180. Diesel generator discovery commenced in June, 1983. Following the crankshaft failure, the scope of diesel discovery was greatly expanded. After a conference of the parties in February 1984, diesel discovery intensified. To date, LILCO and TDI have produced more than 50,000 documents in response to County requests. Depositions of 28 LILCO personnel,

LILCO consultants and TDI personnel have been conducted. (Tr. 1720-21, McCaffrey).

181. The low power proceeding has also seen a great deal of discovery. LILCO has produced over 11 boxes (on the order of 30,000 pages) of documents. LILCO deposed 10 County consultants and the County has deposed 8 LILCO witnesses and consultants incident to the low power proceedings. (Tr. 1721, McCaffrey).

182. Formal ASLB hearings on the health and safety issues commenced on May 4, 1982. Out of the original 37 issues, plus subparts, to be litigated, 26 were settled and the rest litigated. The 11 health and safety contentions decided by the ASLB consumed approximately 29 weeks of hearings, over 110 days of hearings with over 21,000 pages of transcript. Over 100 witnesses testified in the proceedings that led to the Licensing Board's September 21, 1983, Partial Initial Decision. (Tr. 1721-22, McCaffrey).

183. The emergency planning hearings, which began in December 1983, had as of mid-July 1984 consumed 55 hearing days and generated over 12,000 transcript pages. Over 7,000 pages of prefiled testimony have been submitted. (Tr. 1724-25, McCaffrey).

184. These licensing proceedings have been conducted at great expense to LILCO, both in terms of time and resources. (Tr. 1722-23, McCaffrey).

185. As of June 1984, there have been a total of almost 15,000 pages of written testimony and almost 400 exhibits in these proceedings. There have been over 180 days of prehearing conferences and hearings with more than 310 witnesses taking the stand. There have been over 34,000 pages of transcript. The rulings of various licensing and appeal boards and the Commission have exceeded 2,900 pages. In addition, over 160 people have been deposed. To date, the licensing proceedings have cost LILCO more than $33 million. (Tr. 1726-27, McCaffrey).

V. Public Interest

A. Additional Training Benefits

186. Beyond the normal training benefits gained during low power testing, LILCO intends to give the operators additional training during the low power test program. (Tr. 846, Gunther).

187. During the low power testing program, reactor operators will have the opportunity to perform many of the ten

reactivity control manipulations that they must perform annually. (Tr. 849, Gunther).

188. During the cold criticality phase of low power testing, an additional 72 hours has been allotted in the schedule to provide all operating crews with the experience of taking the reactor critical. (Tr. 766, 770-771, 849, Gunther). This will result in hundreds of manhours of additional training (Tr. 829, Gunther). This experience provides additional training for reactor operators in the use of appropriate instrumentation and equipment to determine when criticality is achieved during the withdrawal of control rods. (Tr. 764-66, 773, 849, Gunther).

189. At the conclusion of Phase IV, LILCO has scheduled additional reactor heatups to give all operating crews the experience and training benefit of performing a reactor heatup and to experience plant response to the transients involved with heatup and pressurization of the vessel and operation of important systems such as HPCI and RCIC. (Tr. 775-77, 851-52, Gunther).

190. If a low power license is granted, LILCO will have flexibility to perform additional testing and training. (Tr. 830, Gunther).

B. Reduction of Dependence on Oil

191. All of LILCO's power plants now in operation are oil-fired. Natural gas can also be burned, when available during the warmer months, at the E.F. Barrett and Glenwood steam generator units and E.F. Barrett internal combustion units. The total capacity of all dual fired units is less than one-quarter of the total LILCO system capacity. (Tr. 1331, Szabo).

192. Ninety-nine percent of the oil burned by LILCO at its generating facilities is residual oil with the remainder being middle distillates. There has been a trend accelerating since the beginning of this decade to convert residual oil to other higher-valued products, such as gasoline and diesel oil. (Tr. 1222, 1331, 1335-36, Szabo).

193. The oil used by LILCO is approximately 80% high sulfur residual oil, essentially all of which is foreign oil, and 20% low sulfur residual oil, approximately one-half of which is foreign oil. Overall, LILCO's estimated dependence on foreign oil is 90%. (Tr. 1333, Szabo).

194. Even the availability and price of the domestically derived residual oil burned by LILCO is affected by events related to foreign oil to a very great, if not total extent. (Tr. 1269-70, 1333-40, Szabo). The United States has little leverage in controlling world oil markets and in insulating itself from disruption in world oil markets. (Tr. 1333-34, Szabo).

195. Production of domestic crude oil is declining and there is small potential for large new oil discoveries. (Tr. 1335, Szabo).

196. Structural changes in the U.S. refining industry will decrease the amount of U.S.-produced residual oil available to LILCO. Within the next few years, additional major residual conversion will come on stream and unprofitable refining capacity will be shut down, further reducing the percentage yield of low sulfur residual oil derived from the declining supplies of domestic crude oil. (Tr. 1222, 1335-36, Szabo).

197. A major cutoff of oil supplies from the Persian Gulf oil producers would increase the price of oil, but the amount and duration of the increase is subject to great uncertainty. (Tr. 1337-38, Szabo).

198. There is dispute among oil analysts as to the effect of a cutoff of oil from the Persian Gulf. There have been estimates that such a disruption could affect the price and make it as high as $100. Other observers state that the cutoff might have no affect. (Tr. 1280, 1337-38, Szabo; SC Exhibit LP-12, 13(A)-13(I); LILCO Exhibit LP-3(A)-3(O)).

199. There is a potential for serious disruption in the oil markets at any time. Three-quarters of the world's spare production capacity lies within 100 to 150 miles of Iran. Any escalation of the Iran-Iraq war into the Persian Gulf could have an immediate adverse effect. Similarly, any change in the Saudia Arabian regime could have an immediate adverse effect. (Tr. 1240-41, 1273-76, Szabo).

200. A disruption in the Middle East would affect oil world-wide in terms of price and availability. Oil is fungible and any shortage in the Persian Gulf, which currently produces 20% of the world's oil and three-quarters of its spare capacity, would cause an increase in price. (Tr. 1277, Szabo).

201. If there were a major disruption in foreign oil markets, LILCO would find it very difficult, if not impossible, to buy residual oil derived from domestic crude oil. Refiners would convert as much residual oil as possible to urgently

needed transporation fuel oil, such as diesel oil and gasoline. (Tr. 1339, Szabo).

202. New York State burns more oil to produce electricity than any other state. (Tr. 1307-09, Stipulation).

203. The latest version of the New York State Energy Master Plan emphasizes that New York's consumption of petroleum products must be reduced and calls for the utilization of the Shoreham Plant to provide electricity for New York State. (Tr. 2886-87, Kessel). New York has also taken numerous other steps to attempt to reduce the State's dependence on foreign oil. Reduction in dependence on foreign oil is in the public interest. (Tr. 2889-91, Kessel).

204. The national policy of the United States is to reduce dependence on foreign oil. (Tr. 1270, Szabo).

205. If Shoreham were to achieve commercial operation, it would displace approximately 7,000,000 barrels of oil a year, assuming that no gas was available and no power was being generated from the Nine Mile Point plant. Otherwise, the savings would be in the neighborhood of 4,000,000 to 5,000,000 a year. (Tr. 1322, Szabo).

206. In contrast to the uncertainties of oil, LILCO has already purchased the initial core of nuclear fuel for the reactor. (Tr. 1323, Szabo).

207. The possibility of early commercial operation resulting from the granting of the requested exemption would decrease the dependence of LILCO, and New York State, on foreign oil for the generation of electricity at an earlier date. (Tr. 1237, Szabo).

208. On the other hand, potential earlier termination of Shoreham's operation would not necessarily result in an earlier return to oil dependence. Because of the depleting nature of oil, it is very unlikely that the next plant replacing Shoreham would be an oil-fired plant. It is against the law to build an oil-fired base load plant now. Most probably, some other technology, such as coal, solar, nuclear or other will replace Shoreham. (Tr. 1270, 1299-1300, Szabo).

C. Potential Benefits to LILCO's Ratepayers

209. LILCO's customers would receive an economic benefit in terms of present worth of revenue requirements if Shoreham achieves commercial operation three months earlier as a result of the granting of the requested exemption. (Tr. 1354, 1405, Nozzolillo).

210. A three month earlier commercial operation date could result in an economic benefit on the order of $8 million to $45 million in terms of present worth of revenue requirements assuming that Shoreham receives conventional rate treatment. (Tr. 1354, 1407, Nozzolillo).

211. If, on the other hand, a rate moderation plan goes into effect for Shoreham, the $8 million benefit would be approximately $45 million. (Tr. 1390, Nozzolillo).

212. The economic benefit was computed in terms of present worth of revenue requirements because (1) in analyzing expenditures that occur in different time frames and different years, the only method of comparing the expenditures from different time periods is to bring them back to a common period or common point (Tr. 1355, Nozzolillo), and (2) under normal circumstances, revenue requirements determine the customers' rates. (Tr. 1355, 1405-06, Nozzolillo).

213. The economic benefit analysis compares a July 1, 1985, commercial operation with a commercial operation of October 1, 1985. (Tr. 1354, 1358, 1406, Nozzolillo). Even if these dates were changed, however, the savings resulting from the three-month spread would be in the same order of magnitude. (Tr. 1391-92, 1407, Nozzolillo).

214. The range of benefits results from analyzing two different synchronization dates in connection with the July 1, 1985, commercial operation date. If the plant is synchronized for federal income tax purposes in 1984, the benefit, assuming conventional ratemaking, would be in the neighborhood of $45 million. If the plant is synchronized after December 31, 1984, the benefit will be in the $8 million range, assuming conventional ratemaking. (Tr. 1357-62, 1406, 1410, Nozzolillo).

215. In order to achieve synchronization for federal income tax purposes, Shoreham would have to operate its generators and would have to be connected to the LILCO grid. (Tr. 1359, Nozzolillo). This will not occur during low power testing. Nevertheless, given the uncertainties attendant to the other licensing proceedings concerning the Shoreham plant, a 1984 synchronization is possible, though, perhaps, not likely. (Tr. 1373, Nozzolillo; Tr. 1984, 1988-92, Dirmeier).

216. The elements constituting the economic benefit include fuel savings and a lower total investment. The earlier Shoreham operates, the sooner consumers start realizing the benefits resulting from the displacement of fossil fuel. Also, the sooner the plant goes commercial, the lower the ultimate

cost of the facility. A lower total investment translates into lower annual revenue requirements for return on net investment, depreciation, associated federal income taxes and gross revenue taxes, all of which comprise the revenue requirements on the basis of which rates are set. This is a benefit that will continue over the life of the facility. (Tr. 1409, Nozzolillo).

217. Included in the potential savings is a $50 million savings in fuel or $16.7 million per month over the three month earlier commercial operation period. This savings results from the cost of oil that Shoreham displaces. (Tr. 1393-94, Nozzolillo).

Respectfully submitted,
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