UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Appeal Board

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

AFFIDAVIT OF DALE G. BRIDENBAUGH AND GREGORY C. MINOR IN SUPPORT OF MOTION FOR STAY

1. My name is Dale G. Bridenbaugh. I am president of MHB Technical Associates ("MHB"), a technical consulting firm specializing in nuclear power plant safety and licensing matters, located at 1723 Hamilton Avenue, Suite K, San Jose, California 95125. I received a Bachelor of Science degree in mechanical engineering from South Dakota School of Mines and Technology in 1953 and am a licensed professional nuclear engineer. I have more than 30 years experience in the engineering field, primarily in power plant analysis, construction, maintenance and operations. Since 1976, I have been employed by MHB and have acted as a consultant to domestic and foreign government agencies and other groups on nuclear power plant safety

and licensing matters. Between 1966 and 1976, I was employed by the Nuclear Energy Division of General Electric Company ("GE") in various managerial capacities relating to the sale, service and product improvement of nuclear power reactors manufactured by that company. Between 1955 and 1966, I was employed in various engineering capacities working with gas and steam turbines for GE. Included in my duties at GE was supervision of startup testing of equipment in fifteen to twenty fossil or nuclear power plants. I also was responsible for various nuclear fuel projects ranging from the remote disassembly of irradiated fuel to the supply of reload fuel for operating nuclear plants. I have written numerous technical papers and articles on the subject of nuclear power equipment and nuclear power plant safety and have given testimony on those subjects.

2. My name is Gregory C. Minor. I am vice president of MHB. My education background is in electrical engineering (with a power systems option) in which I received Bachelor of Science (University of California, Berkeley, 1960) and Master of Science (Stanford, 1966) degrees. I have over 24 years of experience in the nuclear industry, including design and testing of systems for use in nuclear power plants. Since 1976, I have been employed by MHB and have acted as a

consultant to domestic and foreign government agencies and other groups on nuclear power plant safety and licensing matters. Between 1965 and 1976, I was employed by the GE Nuclear Energy Division as a design engineer and manager of engineering design organizations. My responsibilities included the design, testing, qualification and pre-operation testing of safety equipment and control rooms for use in nuclear power plants. While with GE, I participated in the pre-startup testing of the instrumentation and control systems for a nuclear test reactor and in numerous system tests.

3. Our experience with the Shoreham plant started when we were employed by GE. At that time we were involved with the design of reactor system components for Shoreham and implementation and resolution of problems related to that design. After leaving GE, we have been involved with the Shoreham case on a virtually continuous basis since 1977, when we were originally retained as consultants to Suffolk County. As consultants on the Shoreham plant, we have performed diverse assignments, focusing primarily on technical reviews and analysis of safety and cost issues. Over the course of the Shoreham proceedings, we have visited the plant on numerous occasions and have testified on diverse issues before the NRC's Atomic Safety and Licensing Board and the State of New York Public Service Commission.

4. This Affidavit is to explain the technical reasons why low power testing to 5 percent power at Shoreham is of little value and, in fact, incurs several irreversible losses while producing no electrical power.

TIMING OF LOW POWER OPERATION

5. Every nuclear plant needs to have fuel loaded and systems tested before it is permitted to operate at power levels where the turbine can be turned and electric power generated. In general, most of the testing is performed at power levels of 5 percent power or less; if the testing is completed satisfactorily and other requirements are satisfied, then the plant is permitted to operate at higher power levels at which sufficient steam may be generated to allow production of electricity.

6. The NRC action to permit Shoreham low power operation at this time represents a deviation from the practice at most other plants. Where nuclear plants are granted an operating license as a result of a single licensing action, fuel loading and low power test activities are then performed and integrated with the approach ("ascension") to full power. Where plants have first been granted a low power license so as to complete the fuel loading and low power testing by the time the full power license is issued, usually the low power testing and the full power licensing are relatively close together in time.1/

1/ Of 15 plants licensed for low power operation between March 1979 and June 1984, and also receiving a full power

(Footnote cont'd next page)

7. In the case of Shoreham, the low power license has been requested in not one, but four separate phases: Phase I is fuel loading and no criticality (i.e. irradiation of the fuel) is achieved; Phase II is cold criticality testing wherein extremely low levels of criticality (.001% power) are achieved for a very short period of time; Phase III is initial heatup and operation at up to 1% of full power; and Phase IV is low power testing and subsequent heatups involving operation at up to 5% of full power. LILCO obtained on December 7, 1984 a license for Phases I and II only. LILCO completed its fuel loading on January 19, 1985; it began cold criticality testing on February 15, 1985 and completed it roughly 36 hours later, on February 17, 1985.

IRREVERSIBLE CHANGES IN STATUS QUO RESULTING FROM LOW POWER OPERATION

8. Before a reactor "goes critical" as it does for the first time during low power testing, neither the nuclear fuel

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license, the average time between the low power and full power licenses was less than 5 months. The average time from initial criticality -- which Shoreham achieved in February, 1985 -- to award of the full power license is only 1/2 month (excluding Grand Gulf which was indefinitely delayed). Attachment to Letter from NRC Chairman Palladino to Congressman Edward Markey, June 15, 1984.

nor the reactor or its components, are irradiated or contaminated by radiation. Low power testing, however, necessarily causes irreversible changes to a nuclear reactor and its supporting systems.

9. There is necessarily significant irradiation of the nuclear fuel as a result of low power testing. This irradiation results in the build-up of quantities of fission products within the fuel which requires that the fuel subsequently be handled, transported, and treated as irradiated fuel. Once these fission products have been produced, they cannot be removed from the fuel by any usual means. Thus, the irradiation from low power testing is irreversible. During low power testing other components of the Shoreham plant would also be irreversibly irradiated. These include the 137 control rods and control rod drives, the 31 local power range monitors, a number of source and intermediate range neutron monitors, and other reactor components, equipment, and piping. Once contaminated by substantial quantities of radioactive fission products, special care would be required in handling these items.

10. Because of the unavoidable irradiation and contamination described above, the conduct of low power testing of necessity requires some worker exposure to harmful radiation

during the course of the testing as well as after the testing is completed. The amount of exposure may not be large and unless errors were made, probably would not exceed allowable limits. However, it is an additional unavoidable impact which results from low power testing.

11. During Phases I and II of LILCO's low power testing program for Shoreham, a small amount of irradiation of the fuel and contamination of reactor internals and components occurred. However, the amounts of irradiation and contamination that are involved in Phases III and IV of LILCO's low power testing program are greater by many orders of magnitude. LILCO's cold criticality (Phase II) testing in February, 1985 involved criticality, at 0.001 percent of power, for roughly 36 hours. The amount of fuel irradiation and resulting contamination from Phase II is insignificant when compared to that which would occur during operation at 5% power for roughly two months as contemplated by LILCO's low power testing program.2/ The fuel

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2/ In fact, LILCO has predicted that the amount of time it would operate Shoreham at 5% power could be much greater than that necessary to complete its low power tests. In its Startup Test Program Evaluation for a 5% Reactor Power Limitation (at 4), LILCO stated: "if a delay in receipt of a full power license well beyond the two months [of low power testing] is anticipated, frequent operation at 5% reactor power will be necessary to reactivate startup sources."

irradiation, measured in megawatt days per ton of fuel, was 0.00036 MWDT/Ton from the February 1985 Phase II criticality; it would be over 70 MWDT/Ton, assuming only 60 days of 5% operation. Furthermore, the radiation levels resulting from the brief criticality in February for Phase II, at this time would be even lower than that stated above following initial criticality, since the minimal fission products produced have already had approximately four months to decay. Even if additional criticalities, subsequent to that performed in February, were performed within the Phase II low power license limits of .001% power, the performance of Phases III and IV testing at Shoreham would nonetheless result in a substantial and irreversible change in the status quo.

12. In addition, in its non-irradiated condition, the fuel loaded into the Shoreham core probably had a recovery (or salvage) value nearly equal to the original purchase value (about $65 million) for that fuel. This fuel, if not irradiated, likely could have been sold to other nuclear plants to use as is, or, if necessary, to have it reconfigured for a different reactor. (For example, some bundles might have required manual disassembly and rod rearrangement or reconfiguration of the pellets for the necessary pattern of enrichment.) The fuel still probably has a salvage value even after the light

irradiation involved in Phases I and II. However, once the fuel is substantially irradiated and there is a substantial build-up of fission products as would occur during Phases III and IV, it makes fuel reconfiguration, and therefore most opportunities for reuse of the fuel, more complicated and costly and therefore far less likely to be implemented. According to LILCO, the cost to LILCO of the Shoreham fuel is $65 million. Thus, we believe that positive salvage value could be realized from the fuel in its post-Phase II condition (although not as much as if the fuel were not irradiated at all). There would be no such value if the fuel were used for testing up to 5% power.

13. Phases III and IV would also result in the loss of potential salvage value for other plant components that would be substantially irradiated (<u>i.e.</u>, control rods, control rod drives, local power range, source, and intermediate range neutron monitors). We estimate the replacement value of these components to be at least $2 - 6 million. These components are virtually identical in all BWRs and are periodically replaced. Thus, a resale market for them should exist unless they are heavily irradiated. The NRC Staff appears to agree with our opinion. (See Affidavit of Edward G. Goodwin, dated February 20, 1985, filed by the NRC in U.S. Court of Appeals, at 10).

Although as a result of the minimal Phase II criticality, these components have been irradiated to a minor extent, the radiation levels now present would not, in our opinion, preclude altogether their transfer and installation in other reactors, although it would be more difficult and complicated than if they were not irradiated at all. Additional irradiation during Phases III and IV, however, would reduce their marketability to practically nothing.

14. Additional costs resulting from a decision to perform low power testing are the costs of defueling, decontaminating, decommissioning, and disposal of the fuel as well as portions of the primary reactor system following a low power testing period in the event that a full power license is not obtained. The cost of necessary removal/disposal/decontamination efforts could be tens of millions of dollars, depending on the specific disposal requirements. Such efforts also carry with them the potential for additional worker radiation exposure. The irradiated fuel must be disposed of as high level radioactive waste. The U.S. Department of Energy has published expected costs for the receipt and ultimate disposal of irradiated fuel. The costs are currently being collected at a rate of $.001/kwhr of generation for fuel exposed now to be disposed of by DOE in the future. For fuel with a design exposure of 15,000 MWD

(t)/ton this cost is equivalent to approximately $120,000 per ton. The potential cost for disposal by DOE of the 100+ tons at Shoreham is therefore approximately $12,000,000, not counting transportation or possible cost increases. In addition, no disposal facility is planned or expected before about the year 2000, some 15 years in the future. LILCO would therefore be required to store and safeguard the spent fuel on site until that time. Assuming an operations and security staff of at least 10-15 people for this chore, an annual cost of $500,000 to $1,000,000 is not unreasonable and is probably low. The cost of spent fuel disposal alone thus becomes a $20 to 30 million obligation. Reactor component removal, handling and disposal would be additionally required.

TESTING IN PHASES III AND IV IS VERY LIMITED

15. Although according to LILCO 54 systems will be "in service, operated and tested" during Phases III and IV testing, 41 of those systems are already operational and have been checked out as part of Phase I and Phase II testing. Thus, in theory Phases III and IV provide the opportunity to check out only 13 additional systems. However, not even that many systems can be thoroughly or properly checked during Phases III and IV. The main turbine would not be operated during Phases

III and IV. Mr. Gunther, a LILCO employee, stated under oath that LILCO did not intend to try to operate the main turbine during its Phase III and IV testing. Tr. 776, 780; SCLP Ex. 2. And, even if LILCO did intend to operate the turbine, it is highly unlikely that the main turbine could be operated during Phases III and IV. According to LILCO's Vice President-Nuclear, John D. Leonard, Jr.:

> When you bring steam down the pipes at five percent, you can test every component of that plant except the main turbine. . . . It's conceivable we are going to look very, very carefully to see if we could possibly spin the turbine. I don't think we can with that small amount of steam. I don't think we can overcome its inertia.

Transcript of Feb. 8, 1985 Oral Argument to the NRC, at 89. And, in an internal evaluation of 5% power tests, LILCO stated:

> Certain tests in the Low Power Testing phase, such as turbine roll and HPCI, are normally performed at about 20% CTP [Core Thermal Power]. . . .
>
> The modified schedule moves tests requiring nuclear steam flow to the end of 5% testing. These tests (main turbine roll, HPCI fine tuning, heatup of related piping, etc.) are ordinarily conducted prior to TC-1, but with the system at about 10-15% reactor power. Stable operation of the nuclear plant at 5% power may be difficult and has not been demonstrated during operation of other BWR plants.

"A Startup Test Program Evaluation for a 5% Reactor Power Limitation," SR2-K71-393, Oct. 25, 1983, at p.2. Therefore, the Turbine Generator and the turbine control portion of the EHC systems could not be operated in Phases III and IV. In addition, the support systems, consisting of the Turbine Lube Oil System, Generator Seal Oil Systems, and Steam Seal System, could not be completely or finally checked out until the turbine generator is actually run. Thus, only 8 additional systems could be checked out during Phase III and IV testing.

16. In addition, there are several tests which cannot be properly or completely performed at low power levels (5% or less). These include:

- APRM/IRM calibration at overlap point
- Set APRM trip reference point at 55%
- APRM calibration (inaccurate at very low readings and would have to be repeated at higher pow levels)
- Turbine roll and balance at 1800 RPM
- Generator exciter test
- Moisture separator-reheater and drains (dynamic test)
- Extraction steam (dynamic test)
- Local power range monitor calibration

Although there are non-standard methods available to permit partial performance of some of these tests and partial testing of some other systems at 5% power, the tests would have to be substantially repeated at higher power levels.

17. Considering that Phases III and IV would only add a few systems to those already checked out, and that other systems require higher power levels for testing, there is relatively little benefit to be gained by pursuing Phase III and IV operation for the sole purpose of system testing. Furthermore, many of the tests in Phases III and IV are one time tests. That is, they must be done at some point prior to higher levels of operation but exactly when they are performed is not particularly important. However, some of the tests which involve the calibration of two systems at their point of overlap would need to be performed again if the approach to full power were substantially delayed (assuming that at some point a full power license were authorized). Accordingly, while it is difficult to be precise, it appears likely that at least some of the proposed Phase III/IV activities would have to be repeated after a full power license were authorized, if the Phase III/IV activities were conducted soon and then followed by a delay prior to full power operation.

THERE IS NO PURPOSE SERVED, AND NO BENEFITS PRODUCED, BY LOW POWER TESTING TO OUTWEIGH THE ADVERSE AND IRREVERSIBLE CHANGES IN THE STATUS QUO

18. The essential purpose of a low power license is to test reactor systems which cannot be effectively tested in non-critical conditions. It is necessary to conduct such testing prior to operating the plant at higher power levels (i.e., greater than 5% power). However, during Phase III and IV testing, the Shoreham reactor would never be put in the "run" mode. Therefore there would be no electric power supplied to the grid as a result of the testing, and there would be no displaced oil or fuel cost savings. Instead, power from the grid would be required to run the plant during the tests. Thus, none of the benefits assumed in the NRC's 1977 EIS for Shoreham would be achieved by low power testing; however, as noted, low power operation would result in environmental impacts, such as plant contamination with radioactive material, the likely loss of the resale value of the fuel and other components once they become irradiated, the cost of decontamination, decommissioning and disposal, and worker exposure.

19. Because low power testing standing alone produces no benefits but does have serious adverse effects, it is our

opinion that there is no reason to conduct low power testing just for its sake alone. Rather, low power testing can be rationally justified only in circumstances where there is no substantial doubt that the plant subsequently will operate at higher power levels so that its benefits (i.e., generation of electricity) will be available to offset the adverse effects (fuel irradiation, radioactive contamination, potential worker exposure) which cannot be avoided. In our technical opinion, the optimum time for performing low power testing of any nuclear reactor is shortly before full power operation is reliably anticipated to begin.

Dale G Bridenbaugh
DALE G. BRIDENBAUGH

Gregory C Minor
GREGORY C. MINOR

Subscribed and sworn to before me
on this 17th day of June, 1985.

Catherine Citrigno-Norris
Catherine Citrigno-Norris
NOTARY PUBLIC

OFFICIAL SEAL
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My Comm. Expires Nov. 18, 1988

My Commission expires: 1988

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Commission

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CERTIFICATE OF SERVICE

I hereby certify that copies of Suffolk County and State of New York Motion for Stay of Low Power License have been served on the following this 20th day of June 1985 by U.S. mail, first class, except as otherwise noted.

James L. Kelley, Chairman
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Date: June 20, 1985

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