LILCO, July 7, 1983

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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

AFFIDAVIT OF
EDWARD J. YOUNGLING

Edward J. Youngling, being duly sworn, deposes and says as follows:

1. My name is Edward J. Youngling and I am employed by the Long Island Lighting Company (LILCO) as Startup Manager for the Shoreham Nuclear Power Station. My professional qualifications have been previously submitted to the Board. As Startup Manager, I am responsible for all preoperational test activities. I also coordinate Checkout and Initial Operation (C&IO) testing and preoperational testing. In this role I have been directly involved in the testing of Shoreham's diesel generators and in resolving related issues that developed during testing. Specifically, I am familiar with the County's contention regarding Shoreham's diesel generators.

2. I testified previously in this proceeding as a member of the LILCO panel on the Quality Assurance/Quality Control issues. I have also submitted two previous affidavits to the Board regarding Shoreham's diesel generators dated May 16, 1983 and June 3, 1983. On June 10, 1983, I appeared before the Board to answer questions regarding Shoreham's diesel generators.

3. This affidavit addresses that portion of SC's contention on diesel generators that alleges the diesel generators may not start or operate as required unless and until the cylinder head cracking issue is resolved for the Shoreham diesels. See Memorandum and Order Ruling on Suffolk County's Motion to Admit New Contention (June 22, 1983) at 37. This concern is based on LILCO's detection of a minor water leak in three of the 24 cylinder heads in the diesel generators. To remedy this situation, LILCO replaced the three cylinder heads with improved, current production model cylinder heads. In addition, LILCO intends to replace all the remaining cylinder heads as soon as practicable consistent with the schedule for preoperational testing and fuel load. In the interim, prior to replacement of all cylinder heads, LILCO will implement a surveillance ("barring over") procedure to insure that leaks are

promptly detected in the unlikely event any occur. Any head exhibiting leakage would be promptly replaced with a new head of the current production model. This affidavit demonstrates

> (1) that there is a reasonable assurance that there will be no further leaks in the remaining cylinder heads,
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> (2) that LILCO's surveillance procedure ("barring over") provides adequate assurance of reliable rapid start capability by insuring that leaks would be promptly detected in the unlikely event they do occur, and
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> (3) that leakage of the type previously detected at Shoreham, if any were to occur and remain undetected, would not affect the quick start capability or the safe and reliable operation of the diesel generators, nor would such leakage prevent the diesel generators from carrying their full design electrical load.

4. As noted in my May 16, 1983 affidavit, early in the preoperational testing process, three cylinder heads of the Shoreham diesel generators experienced cracks that resulted from manufacturing casting flaws. In that affidavit, I stated that improved casting techniques and nondestructive testing and inspection procedures have largely eliminated the possibility of casting flaws in current production models thereby greatly reducing the potential for cylinder head cracks. I also stated that LILCO will replace <u>all</u> cylinder heads with those produced

with improved casting and inspection techniques. Qualified LILCO personnel have conducted an inspection and audit of the improved Delaval process which confirmed that improved casting and inspection techniques have been implemented at Delaval to ensure that casting imperfections of the type previously identified in the three Shoreham cylinder heads will not occur in the current production model heads. The three cylinder heads that experienced cracks have been replaced with these improved, current production cylinder heads.

5. Failure analyses conducted by the vendor, Transamerica Delaval Inc. (TDI), determined that the cracks were caused by operating stresses from cylinder firing pressure. TDI has informed LILCO that casting flaws exist only in a small percentage of cylinder heads identical to those originally supplied with the Shoreham diesels and that based on experience, cylinder heads that develop leaks similar to those experienced at Shoreham do so prior to completing 600 hours of operation. Each of Shoreham's diesels now has over 600 hours of operation (DG 101 - 617 hours, DG 102 - 693 hours, DG 103 - 809 hours as of June 24, 1983). Because the generators have passed the 600 hour threshold, there is a reasonable assurance that there will be no leakage on any of the remaining originally supplied cylinder heads.

6. The failure analysis also determined that the cracks were of such a nature that they would not have affected the performance of the diesel generators. The cracks were self-relieving, nonpropagating, and of small size1/ so that they had no impact on the mechanical strength of the head. As noted in my May 16 affidavit, any water that would leak into the combustion chambers as a result of these cracks would be expelled via the exhaust system along with other combustion by-products. Thus, despite the small leaks that occurred, the reliability of the cylinder heads during operation was not affected. Additionally, there is no impact on the ability of the diesel generator or the individual cylinder head with a crack to carry its full load. For example, in marine applications, engines with cracked cylinder heads are operated for weeks without any effect on the reliability or operation of the engines.

1/ In my May 16, 1983 affidavit, I reported that the largest of the leaks was at a rate of 9.25 gallons per hour. This rate was during operation of the diesel and the water was expelled via the exhaust. When the combustion chamber was inspected after shutdown, only a small amount of water (approximately a cupful) was found in the combustion chamber. This confirms (i) that the water had in fact been expelled through the exhaust during operation and (ii) that the leakage rate after shutdown is very low and is no impediment to the rapid start capability of the diesel generator.

7. Even though LILCO and TDI believe that the number of operating hours on each engine makes it unlikely that any more cylinder heads will experience leaks, LILCO will institute a surveillance procedure ("barring over") by which water leakage will be promptly detected. This procedure gives further assurance that should a leak occur, it will have no impact on the quick start capability of the diesel generators. This surveillance or "barring over" requirement is contained in Shoreham's draft Station Procedure 27.307.02, "Emergency Diesel Generator Cylinder Leak Detection Test." In accordance with this procedure, the plant operator, using the barring device, will mechanically turn the engine over several complete revolutions. Water present in the cylinders will be forced out through the indicator cocks where it will be observed by the inspector. Water will not be forced out the exhaust system and go undetected because all four valves for each cylinder close prior to the piston reaching top dead center. The inspection intervals specified in SP # 27.307.02 are four, eight and twelve hours after the diesel generator is shut down. This is in accordance with the vendor's recommendation. The "barring over" practice is a well-established one in the large diesel generator industry for exactly the same reasons it is being implemented at Shoreham.

8. The surveillance or "barring over" intervals specified in the procedure are appropriate in light of the nature of the small leaks and low leakage rates involved in these instances. TDI's analysis of the three affected Shoreham cylinder heads indicates that these cylinder heads developed small cracks and leaks as a result of the action of high cylinder firing pressures on the rarely occurring casting flaws in the cylinder heads. After shutdown, and as the diesel generator cools, the cracks, if any exist, close and leakage stops. Thus, the first "barring over" is the four hours after shutdown because the temperature in the combustion chamber early in the four hour period following shutdown is sufficiently high that the characteristically small leakage will evaporate. At four hours, however, leakage would begin to be detectable. "Barring over" beyond 12 hours after shutdown is unnecessary because by this time the diesel generator has cooled to a steady state standby temperature and cracks, if any existed, would have closed and leakage ceased. Four hour intervals for surveillance and "barring over" are appropriate because post-shutdown leaks of this nature are characteristically of such a slow rate that more frequent "barring over" is not necessary.

9. In the unlikely event of any additional leaks at Shoreham, operating personnel, by observing the jacket water level instruments, will be able to detect water leakage during operation. Leakage occurring after shutdown will be detected by the surveillance ("barring over") procedure. If a leak occurs, the inspector is to notify the Watch Engineer who, in turn, will declare the diesel generator inoperable. The cylinder head must then be replaced. Once an engine is declared inoperable, the technical specifications dictate the course of action to be taken.2/

10. In summary, given that Shoreham's diesel generators have more than 600 hours of operation, there is reasonable assurance, in light of the experience of Delaval with large numbers of identical cylinder heads, that there will not be any additional cracks or leaks in the remaining cylinder heads. Moreover, LILCO's surveillance ("barring over") procedure provides reasonable assurance of reliable rapid start capability by ensuring that leaks would be promptly detected even in the unlikely event that such additional leaks were to occur. It is

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2/ During low power testing, only two diesel generators are required to be operable under Shoreham Technical Specification § 3.8.1.2. This further lessens any concerns regarding cylinder head cracking because if a leak develops, it will not hinder the low power testing.

also significant that leaks of the nature detected at Shoreham do not affect the safe and reliable operation of the diesel generators, including the quick start capability.

Edward J. Youngling

Subscribed and sworn to before me this ____ day of July, 1983.

Notary Public