UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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

# DIRECT TESTIMONY OF MARC W. GOLDSMITH

# ON BEHALF OF SUFFOLK COUNTY REGARDING

# SUFFOLK COUNTY CONTENTION NO. 9 - ECCS PUMP BLOCKAGE

April 13, 1982

SUMMARY OUTLINE OF SUFFOLK COUNTY

CONTENTION 9 TESTIMONY*

Suffolk County contends that the potential sources of Emergency Core Cooling pump suction strainer blockage at Shoreham have not been adequately analyzed with respect to their ability to cause suction strainer blockage during an accident. LILCO has not adequately demonstrated that drywell piping and equipment insulation loosened and/or damaged during a postulated loss-of-coolant accident will not unduly degrade the ECCS flow, preventing adequate core cooling.

This testimony outlines the basis for the Contention 9 concern, and identifies the specific problems and the actions necessary to remedy them. LILCO and Staff have assumed in an accident that the suction strainers would be no more than 50 percent blocked and will demonstrate adequate cooling capability even with 50 percent blockage prior to fuel load. However, neither LILCO nor the Staff have performed a systematic analysis to demonstrate that the 50 percent blockage assumption is appropriate. Absent a survey and analysis of drywell insulation which identifies the sources, quantities and characteristics of debris available for blockage such that the 50 percent blockage assumption is assured of being conservative, LILCO will not have demonstrated compliance with 10 CFR Part 50, Appendix A, General Design Criterion 35.

Exhibits*

1. NUREG-0606, Vol. 3, No. 4, November 16, 1981, pgs. 36 & 37.

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*/ ASLB Memorandum and Order, March 15, 1982, p. 30.

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# DIRECT TESTIMONY OF MARC W. GOLDSMITH

## REGARDING SUFFOLK COUNTY CONTENTION 9 -

## ECCS PUMP BLOCKAGE

Q Please state your name, address, occupation, and qualifications.

A My name is Marc W. Goldsmith, and my business address is 400-1 Totten Pond Road, Waltham, Massachusetts. I am the President of Energy Research Group, Inc. My qualifications have been separately provided to the Board.

Q Would you please state the contention on which you are testifying?

A Suffolk County Contention 9 reads as follows:

Suffolk County contends that LILCO has not adequately demonstrated that drywell piping and equipment insulation loosened and/or damaged during a postulated loss-of-coolant accident will not unduly degrade the ECCS flow through the ECCS suction strainers located in the suppression pool. Therefore, the Shoreham design does not satisfy 10 CFR 50, Appendix A, General Design Criteria 35.

Q What is the purpose of your testimony?

A The purpose of my testimony is to discuss the concern that Shoreham Emergency Core Cooling pump suction strainers may be blocked during an accident, thus preventing adequate core cooling and possibly leading to severe degradation of fuel. LILCO and the Staff have assumed that in an accident the suction strainers would be no more than 50 percent blocked and will have demonstrated adequate cooling capability even with such blockage prior to fuel load. However, neither LILCO nor the Staff to my knowledge has performed a systematic analysis to demonstrate that the 50 percent blockage assumption is appropriate. Therefore, a survey and analysis of drywell insulation should be made to determine the quantity of material available for blockage. Absent such analysis, LILCO will not have demonstrated compliance with GDC 35.

Q Please provide background on the ECCS pump suction blockage concern.

A The NRC in NUREG-0510 "Identification of Unresolved Safety Issues Relating to Nuclear Power Plants" revised and elevated the Containment Emergency sump issue to the highest priority as Generic Task A-43. Task Action Plan A-43 recognized this suction blockage problem initially, specifically with respect to containment emergency sump performance in pressurized water reactors and then expanded the concern to boiling water reactor suppression pool suction strainers.

During a loss-of-coolant accident, water is recirculated from the suppression pool back to the reactor through the emergency core cooling system pumps. These pumps take water through a suction strainer located in the suppression pool and pump the water back into the reactor or into the containment. This cooling is fundamental to the successful operation of both emergency core cooling systems (needed to cool the core) and the containment spray system (needed to reduce iodine and assist in maintaining containment integrity following a loss-of-coolant accident).

The potential sources of debris blockage of the suppression pool pump suctions are equipment and pipe insulation in the drywell that may fail as a result of an accident. "In the event of a piping break, the subsequent violent release of the high pressure water in the reactor coolant system could rip off the insulation in the area of the break. This debris could then be swept into the sump, potentially causing damage." (NUREG-0510). Therefore, insulation (which is not classified as safety-related) may fail due to the impingement of high pressure water or steam within the drywell and that failed insulation may be carried through the downcomers into the suppression pool causing the strainers to be blocked.

General Design Criterion 35 of Appendix A to 10 CFR 50 requires that:

> a system to provide abundant emergency core cooling shall be provided. A system safety function shall be to transfer heat from the reactor core following any loss of reactor cooling at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts.

> Suitable redundancy and components and features and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation . . . the system safety function can be accomplished assuming a single failure.

This GDC specifies the need to assume a single failure. In this particular case, it could be a common mode failure that causes loosened insulation to fall into the suppression pool, blocking all of the suction strainers designed with the same size grids at roughly the same heights above the floor of the suppression pool, such that pump flow could be impeded or in fact shut off. This event, of course, would prevent compliance with GDC 35.

Q What are the specific problems of concern at Shoreham?

A At Shoreham, there are four residual heat removal pumps (LPCI mode), one high pressure coolant injection pump and two core spray pumps all of which take suction from the suppression pool. In addition, the reactor core isolation cooling pump suction strainer is also located in the suppression pool with a similar suction strainer arrangement (FSAR Section 6.3.2.20.2). In the event of a loss-of-coolant accident, blockage of these pump suctions could prevent adequate core cooling.

The specific concern is that there appears to be no basis for the choice of the 50% blockage assumed by LILCO as an appropriate design base for the strainers. The quantities, types and densities of insulation within the drywell of the Shoreham containment which might fail are not sufficiently known to determine the appropriateness of the strainer blockage assumption.

Q What actions are necessary to remedy the above problems?

A Since the prime source of material to plug the strainers is the piping and equipment insulation, it is necessary to inventory the quantity of this insulation in the Shoreham drywell and determine its potential failure probability and modes under accident conditions. This would determine whether the 50% assumption is appropriate.

In addition, an analysis of the insulation should be conducted to assure that there are either insufficient quantities, insufficient density, or too great a density for the particles to float into the strainer to assure that blockage would not exceed 50 percent or if not, to modify the 50% figure.

According to the status summary of Task Action Plan A-43, provided in NUREG-0606 Vol. 3, No. 4, Nov. 16, 1981, a calculational methodology has been developed for estimating quantities of debris generation due to a pipe break, and PWR plant specific calculations have been performed. The results show that plant specific characteristics may affect the blockage potential. This further indicates the need for this type of analysis at Shoreham.

Q What LILCO actions have you reviewed?

A I have reviewed LILCO commitment to verify the flow capability of both the HPCI and the RCIC pumps with the suction strainers 50% plugged during the preoperational test program (LILCO ltrs/SNRC-598 & SNRC-602). I have also reviewed the Response of LILCO to Suffolk County Interrogatories and to Suffolk County Second Set of Interrogatories, dated 3/26/82, where it states that LILCO correlated the strainer grid size with potential openings in RHR, RCIC, HPCI and containment spray nozzles to assure that any debris entering through the strainer would be smaller than the nozzle sizes or any important pump equipment. I have also reviewed FSAR sections and responses to NRC questions. However, LILCO still needs to verify, pending the results of the preoperational tests, the quantity and characteristics of insulation that is potentially vulnerable to failure, thus resulting in suction strainer blockage.

Q What would satisfy the concerns expressed relative to ECCS suction strainer blockage?

A The concern can be resolved by LILCO's performing a systematic inventory of the drywell insulation to identify the sources, quantities and characteristics of debris available for blockage during a postulated loss-of-coolant accident. Such an inventory would be for the purpose of assuring that a strainer blockage assumption of 50 percent is conservative.

EXHIBIT 1

NUREG-0606, Vol. 3, No. 4

November 16, 1981, pgs 36 & 37

NUREG-0606
Vol. 3, No. 4
November 16, 1981

# UNRESOLVED SAFETY ISSUES SUMMARY

## AQUA BOOK

Manuscript Completed: November 1981
Date Published: December 1981

Prepared for: OFFICE OF NUCLEAR REACTOR REGULATION

Prepared by: OFFICE OF MANAGEMENT AND PROGRAM ANALYSIS
U.S. NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

# CONTAINMENT EMERGENCY SUMP PERFORMANCE (A-43)

**KEY PERSONNEL**

TASK MANAGER
A. SERKIZ (DST) X24217

Aw Serkiz 11/27/81

MPA ANALYST
D. SCHWARZ X27108

**TASK REVIEWERS**

| NAME | BRANCH |
|---|---|
| P. ORR • | RSB/DSI |
| P. NORIAN | GIB/DST |
| W. BUTLER | CSB/DSI |

AS OF WEEK ENDING NOVEMBER 16, 1981

**SCHEDULED COMPLETION**

ORIGINAL April 1982

CURRENT # 11-30-82

## • PROBLEM DESCRIPTION

Following a Loss of Coolant Accident (LOCA) in a PWR, water flowing from the break in the primary system would collect on the floor of containment. During the injection mode, water for core cooling and containment spray is drawn from a large supply tank. When the water reached a low level in the tank, pumps are realigned to draw from the containment. This is called the recirculation mode wherein water is drawn from the containment floor or sump and pumped to the primary system or containment spray headers. This program addresses the safety issue of adequate sump or suppression pool function in the recirculation mode. It is the objective of this program to develop improved criteria for design, testing, and evaluation which will provide better assurance that emergency sumps will function to satisfy system requirements.

The principal concerns are somewhat inte related but are best discussed separately. One deals with the various kinds of insulation used on piping and components inside of containment. The concern being that break initiated debris from the insulation could cause blockage of the sump or otherwise adversely affect the operation of the pumps, spray nozzles, and valves of the safety systems.

The second deals with the hydraulic performance of the sump as related to the hydraulic performance to safety systems supplied therefrom. Preoperational tests have been performed on a number of plants to demonstrate operability in the recirculation mode. Adverse flow conditions have been encountered requiring design and procedural modifications to eliminate them. These conditions, air entrainment, cavitation, and vortex formation, are aggravated by blockage. If not avoided or suppressed, they could result in pump failure during the long term cooling phase following a LOCA.

The concerns relative to debris, blockage, and hydraulic performance also apply to boiling water reactors during recirculation from the suppression pools, and will also be addressed.

## • RES INTERFACE INFORMATION

\# None; USI A-43 being managed by the Generic Issues Branch (GIB).

## • ACRS INTERFACE INFORMATION

\# The ACRS staff is kept abreast of findings and developments on an informal basis. A briefing on the current findings and status of resolution is being scheduled for December 1981.

## • TECHNICAL ASSISTANCE CONTRACTS

\# FIN No. A1237, "Containment Emergency Sump Performance", and FIN No. A1296, "Technical Assistance for Resolution of USI A-43", are being funded by RES and NRR respectively. This work is managed by the GIB Task Manager and these combined efforts are expected to be concluded in FY82.

| FIN NO. | CONTRACTOR | OBLIGATED | EXPENDED |
|---|---|---|---|
| FY 81: | | | |
| # A1237 | Sandia | $226,000 | $158,000* |
| # A1296 | Sandia | $120,000 | $ 49,000* |
| | | $346,000 Total | $207,000* Total |
| # FY 82 PLANS: | | | |
| A1237 | Sandia | ($275,000 Planned) | |
| A1296 | Sandia | ($160,000 Planned) | |

* These expended costs do not include an obligation of $167,000 for subcontracted work, the carryover is therefore $29,000.

## • POTENTIAL PROBLEMS

\# 1) Delays in receipt of plant insulation & layout info. (Subtask 3) will result in further slippage of compiling the plant survey; continued delays may result in dropping several plants (eg. Turkey Pt. 3 & St. Lucie 1).

\# 2) Issuance of the NUREG on PWR recirc. tests (Subtask 1) has become a non-critical path element due to experimental findings from the ARL program, & is not deemed a necessary item for resolution. A revised (i.e. condensed) version of the current report is felt to be useful as background for A-43, & will be developed in QTR (II) FY82, for issuance as a NUREG by GIB.

## • STATUS SUMMARY

\# 1) Alden Research Laboratory (ARL) test results continue to show very low levels of air ingestion (even for "bottom suction" sump designs). The final ARL testing has been agreed upon and will emphasize vortex suppressor testing. An April 1982 testing completion is projected.

\# 2) Calculational methodology for est. quantities of debris generation due to pipe break has been dev. (Subtask 6), and 3 plant specific calc. have been completed. The methodology and results have been submitted to MEB, CSB and RSB for review of methodology & comments regarding use in A-43 resolution. The results show dependence on plant specific (particularly layout) and potential adverse blocking conditions where large quantities of unencapsulated fiberglass insulation is are employed. These results are undergoing final assessments.

\# 3) The effect of air ingestion & particulates on pump performance aspects are being assessed under Subtask 5. Although ARL test results show low levels of air ingestion, dev. of an information base for RHR and Containment Spray pumps was deemed advisable for resolving A-43.

\# 4) The results of findings to date, & accelerated schedules indicate that tech. resolution of USI A-43 in FY82 is feasible.

# CONTAINMENT EMERGENCY SUMP PERFORMANCE (A-43)