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)

QA/QC AND EQ SUPPLEMENT TO SUFFOLK COUNTY'S PROPOSED OPINION, FINDINGS OF FACT, AND CONCLUSIONS OF LAW IN THE FORM OF A PARTIAL INITIAL DECISION

April 7, 1983

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Lawrence Coe Lanpher
Michael S. Miller
KIRKPATRICK, LOCKHART, HILL,
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1900 M Street, N.W.
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VOLUME ONE OF TWO

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SUMMARY TABLE OF CONTENTS

Page No.

PRELIMINARY STATEMENT 1

OPINION 1

A. SUFFOLK COUNTY CONTENTIONS 12, 14 AND 15: QUALITY ASSURANCE/QUALITY CONTROL DURING THE DESIGN AND CONSTRUCTION OF SHOREHAM 1

B. SUFFOLK COUNTY CONTENTION 13(a): OPERATING QUALITY ASSURANCE 148

C. SUFFOLK COUNTY CONTENTION 8: ENVIRONMENTAL QUALIFICATION 156

FINDINGS OF FACT 180

A. QUALITY ASSURANCE/QUALITY CONTROL 180

B. OPERATING QUALITY ASSURANCE 504

C. ENVIRONMENTAL QUALIFICATION 511

APPENDICES

Volume One

Detailed
Table of Contents

Page No.

PRELIMINARY STATEMENT..... 1

OPINION..... 1

A. SUFFOLK COUNTY CONTENTIONS 12, 14 AND 15: QUALITY ASSURANCE/QUALITY CONTROL DURING THE DESIGN AND CONSTRUCTION OF SHOREHAM..... 1

I. Summary of Opinion..... 1

II. The NRC's Quality Assurance Requirements..... 12

III. Deficiencies in Scope of the LILCO QA/QC Program..... 18

A. The LILCO QA Program Fails to Cover Nonsafety-Related SS&Cs Which Are Important to Safety..... 18

B. LILCO's Audit Program Fails to Comply With 10 CFR Part 50, Appendix B, Criterion 18..... 21

IV. The Evidence Documents a Pattern of LILCO Failures to Comply With the NRC's QA/QC Requirements..... 28

A. Preliminary Considerations..... 28

1. The Definition of a QA/QC Violation or Deficiency..... 28

2. The Need to Link QA/QC Deficiencies to a Safety Defect..... 33

B. The Evidence Documents LILCO's Failure to Implement Its QA/QC Program in Accordance with 10 CFR Part 50, Appendix B.....39

1. LILCO Has Failed to Adhere to Procedural Requirements for Control of Manual and Computerized Calculations..... 40

2. LILCO Has Failed to Control Engineering and Design Change Reports..... 48

3. LILCO Has Failed to Implement Programs For Storage and Housekeeping in Accordance with 10 CFR Part 50, Appendix B..... 59

(a) Storage Deficiencies..... 60

(b) Housekeeping Deficiencies..... 66

4. LILCO has Not Maintained Manuals Up-to-Date..... 71

5. LILCO Has Not Maintained the FSAR Up-to-Date and Accurate..... 73

6. Lilco Has Failed to Comply with Electrical Separation Criteria..... 78

7. The Staff's Readiness Assessment Team Inspection Further Confirms That LILCO's QA/QC Program Has Not Been Properly Implemented..... 82

(a) Introduction..... 82

(b) LILCO's Overreliance on the Final Inspection Program to Identify Construction Discrepancies..... 83

(c) The Violations Identified by the Staff..... 91

(i) Violation A -- Failure to Provide Adequate Verification of Completed Construction in Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports..... 91

Violation A(1) -- Welds on CRD Piping Supports..... 91

Violation A(2) -- Completed Residual Heat Removal System Hangers..... 92

-- Improper Bolt Torque..... 93

-- Bearing Gaps..... 94

Violation A(3) -- Cable Tray Supports..... 96

(ii) Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification Under Operational QA Jurisdiction..... 100

(iii) Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment..... 102

(iv) Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation..... 105

Violation C(1) -- Failure to Control Changes Following Final Inspection Per QC Procedure 15.4..... 105

Violations C(2) and C(3) -- Procedure and Document Control Violations..... 109

V. The NRC Staff Inspection Program..... 110

VI. Torrey Pines..... 118

A. Introduction..... 118

B. Torrey Pines Was Not Independent from LILCO, Nor Did It Operate Under an Acceptable Protocol..... 120

C. The Scope of Torrey Pines' Review Was Not Adequate to Support the Conclusions Reached by Torrey Pines..... 121

D. Torrey Pines' Discrepancy/Finding Process was Deficient..... 132

E. Torrey Pines' Review Demonstrated That Shoreham's QA/QC Inspection Process Is Inadequate..... 137

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate..... 140

G. Statistically Valid Sampling Techniques Were Not Used by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid..... 141

VII. Conclusion..... 147

B. SUFFOLK COUNTY CONTENTION 13(a): OPERATING QUALITY ASSURANCE..... 148

C. SUFFOLK COUNTY CONTENTION 8: ENVIRONMENTAL QUALIFICATION.....156

A. Section 50.49(b)(1) - Safety-Related Equipment..... 159

1. Equipment Included in EQ Program..... 159

2. Staff Review..... 160

B. Section 50.49(b)(2) - Nonsafety-Related Equipment..... 163

1. Staff Guidance and Review..... 163

2. LILCO Position..... 165

C. Section 50.49(b)(3) - Regulatory Guide 1.97 Equipment..... 167

D. Actions Necessary For Compliance with Section 50.49..... 168

E. Conclusion..... 169

FINDINGS OF FACT

A. QUALITY ASSURANCE/QUALITY CONTROL.....180

I. Procedural Matters.....180

II. Overview.....185

III. Calculations.....193

A. Procedural Requirements.....193

B. Audit Results.....199

1. Ready Traceability.....199

2. Other Audit Findings.....204

3. Audit Observation 120.....207

4. Early Project Audits.....211

IV. E&DCRs.....214

A. General.....214

B. E&DCR Control Problems.....219

1. Field Audits.....222

2. SWEC Audits of E&DCRs.....240

3. I&E Reports Concerning E&DCRs.....247

C. E&DCR Verification.....255

V. Storage/Housekeeping.....257

A. General.....257
B. LILCO/SWEC Audit Findings.....265
C. I&E Storage Inspections.....273
D. Housekeeping.....282
E. LILCO Storage Surveillances.....300
VI. Manuals Not Up-To-Date.....304

Volume Two

VII. FSAR Control.....312
A. General.....312
B. SWEC Audit Findings.....314
C. Staff FSAR Concerns.....315
VIII. Electrical Separation.....329
IX. Welding.....337
X. NRC Review and I&E Program.....340
A. General.....340
B. CAT Inspection.....343
C. NRC Design Review.....345
D. Staff Review of LILCO and SWEC Audits.....353
E. Statistics.....358
F. RAT Inspection.....363
1. Introduction.....363
2. LILCO's Overreliance on the QA/QC Final Inspection Program to Identify Construction Deficiencies.....367

3. Violation A -- Failure to Provide Adequate Verification of Completed Construction in the Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports.....376

(a) Violation A(1) -- Welds on CRD Piping Supports.....377

(b) Violation A(2) -- Completed Residual Heat Removal System Hangers.....381

(i) Bolt Torque on Pipe Support E11-PSA-109.....382

(ii) Bearing Gaps between Lugs and Pipe Clamps.....386

(c) Violation A(3) -- Cable Tray Supports.....391

(i) Support RB100B.....393

(ii) Support RB208A.....395

(iii) Support RB131.....396

(iv) Conclusion.....399

4. Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification under Operational QA Jurisdiction.....402

(a) Failure to Perform Weld as Required and Use of Nonqualified Welding Technique.....403

(b) Inadequate High Strength Bolting Installations.....404

(c) Conclusions.....406

5. Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment.....407

6. Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation.....410

(a) Violation C(1) -- Failure to Control Changes Following Following Final Inspection Per QC Procedure 15.4.....410

(b) Violations C(2) and C(3) -- Procedure and Document Control Violations.....415

7. Unacceptable Plant Housekeeping.....416

G. Important to Safety.....419

H. Number of I&E Violations.....424

XI. Torrey Pines.....427

A. Introduction.....428

B. Torrey Pines Was Not Independent from LILCO, Nor Did It Operate Under an Acceptable Protocol.....431

C. The Scope of Torrey Pines' Review Was Not Adequate To Support the Conclusions Reached by Torrey Pines.....436

D. Torrey Pines' Discrepancy/Finding Process Was Deficient.....456

E. Torrey Pines' Review Demonstrated that Shoreham's QA/QC Inspection Process Is Inadequate.....472

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate.....481

G. Statistically Valid Sampling Techniques Were Not Utilized by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid.....491

XII. Remedy.....502

B. OPERATING QUALITY ASSURANCE.....504

C. ENVIRONMENTAL QUALIFICATION.....511

A. Compliance with Section 50.49(b)(1).....516

1. Identification of Safety-Related Equipment in the Shoreham EQ Program.....516

2. Status of Qualification of Safety-Related Equipment and Staff Review.....520

3. Justifications for Interim Operation and Staff Review.....522

B. Compliance with Section 50.49(b)(2).....524

1. No Criteria or Guidance for Compliance Provided by Staff.....524

2. Future Staff Review Undefined.....526

3. Shoreham Category (b)(2) Equipment.....528

C. Compliance with Section 50.49(b)(3).....530

D. Actions Necessary for a Finding of Compliance With Section 50.49.....530

Appendix 1: SWEC Audit Observations Concerning Calculations Particularly Concerning Compliance with EAP 5.3 "Control of Computerized and Manual Calculations"

Appendix 2: Courter E&DCR Deficiencies

Appendix 3: Storage and Housekeeping, Index to Categories

Appendix 4: Failure to Keep Manuals Up-to-Date

PRELIMINARY STATEMENT

These volumes continue Suffolk County's briefing of health and safety issues. The County previously served on January 31, 1983, a Proposed Opinion, Findings of Fact and Conclusions of Law in the Form of a Partial Initial Decision. This submission covers the additional issues of:

SC Contentions 12, 14 and 15: QA/QC During Design and Construction of Shoreham

SC Contention 13: Operating QA

SC Contention 8: Environmental Qualification

OPINION

A. SUFFOLK COUNTY CONTENTIONS 12, 14 AND 15: QUALITY ASSURANCE/QUALITY CONTROL DURING THE DESIGN AND CONSTRUCTION OF SHOREHAM

I. Summary of Opinion

Suffolk County Contentions 12, 14 and 15 question whether LILCO, including its contractors, properly developed and implemented quality assurance/quality control ("QA/QC") programs during Shoreham's design, procurement, fabrication, construction and installation phases. Suffolk County contends that there has been a pattern of QA/QC deficiencies pertaining to the managerial and administrative controls at Shoreham, from which it concludes that mandatory QA/QC regulatory requirements have not been satisfied. The County therefore requests that comprehensive independent design, physical inspection and QA/QC

reviews be conducted so that the actual quality of the Shoreham facility can be determined. In the County's opinion, these independent reviews should use objective, statistically-based methodologies so that valid data can be developed that will permit projection of the review results to all structures, systems and components ("SS&Cs") important to safety at Shoreham. (Findings QA:1-3). LILCO and the NRC Staff, on the other hand, believe that LILCO has satisfactorily complied with applicable QA/QC regulations.

An extensive QA/QC record has been compiled. This record includes: testimony by LILCO, the Staff and Suffolk County on SC Contentions 12, 14 and 15; testimony by LILCO and Suffolk County on the Torrey Pines Technology ("Torrey Pines" or "TPT") inspection of Shoreham; and testimony by LILCO and the Staff on the Inspection and Enforcement ("I&E") Readiness Assessment Team ("RAT") inspection (I&E Inspection 83-02), conducted in January, 1983. (Findings QA:4-7). The QA/QC record also includes testimony and exhibits from Contention 7B, concerning LILCO's compliance with QA/QC requirements for SS&Cs important to safety but not safety-related. Altogether, the prefiled testimony and exhibits exceed 1000 pages and the transcript of hearings and related depositions exceed 10,000 pages.

For reasons set forth in detail in the remainder of this Opinion and in the Findings, the Board reaches the following legal and factual conclusions on these contentions:

1. The NRC's regulations pertaining to QA/QC, 10 CFR Part 50, Appendix A, GDC 1 and 10 CFR Part 50, Appendix B, constitute an essential component of the NRC's defense-in-depth scheme designed to ensure that nuclear power plants, if operated, will not constitute an undue risk to the health and safety of the public. Accordingly, when assessing a licensee's compliance with QA/QC requirements, a Licensing Board must demand a convincing demonstration of actual compliance with the regulations. (Section II).

2. In assessing compliance with the QA/QC regulations, two inquiries must be made: whether a QA/QC program of correct scope and content has been established; and, if so, whether that program has been timely and effectively implemented. With two exceptions discussed in Item No. 3 below, the parties' focus regarding SC Contentions 12, 14 and 15 has been on the implementation issue. The Board encouraged this focus (Finding QA: 8), since the existence of a program per se is of no benefit if the essential implementation of the program requirements has not occurred. (Finding QA:14).

3. In two respects, the evidence indicates that the QA/QC program for Shoreham was deficient in scope and content. First, as discussed in our Opinion and Findings on Contention 7B, LILCO has failed to implement a QA program which systematically applies to all SS&Cs important to safety but not

safety-related, as required by 10 CFR Part 50, Appendix A, GDC 1. Instead, LILCO's QA program applies to safety-related SS&Cs, with other SS&Cs receiving QA-type attention on a nonsystematic, ad hoc basis. This fails to satisfy the GDC 1 requirement that a QA program be established and implemented for all SS&Cs important to safety. (See generally Section III.A; Findings 7B: 41-64; QA:562-74). This deficiency is compounded by the fact that the Staff has failed to review any alleged LILCO QA program, or implementation thereof, for SS&Cs important to safety but not safety-related. (Staff Finding 7B:82).

Second, the LILCO audit program does not verify compliance with all aspects of the QA program or determine the effectiveness of the QA program, as required by 10 CFR Part 50, Appendix B, Criterion 18. Rather, the LILCO audit program only verifies compliance or noncompliance of the specific items which are audited, due to the nonrandom, subjective selection methodology used by LILCO to choose the items which are audited. Accordingly, the audit results cannot be extrapolated to other items with any measurable level of confidence, and compliance with Criterion 18 cannot be demonstrated. (Findings QA:404-21, 711-32).

4. Aside from the deficiencies in scope described in Item No. 3, the Board also finds that the LILCO QA program has

not been implemented in compliance with 10 CFR Part 50, Appendix B. Rather, based upon internal audit reports of LILCO and Stone and Webster Engineering Corporation ("SWEC"), NRC I&E Reports, the TPT inspection effort and other evidence in the record, the Board finds repetitive instances where LILCO has failed to comply with requirements designed to implement LILCO's Appendix B program, indicating further a failure to institute effective corrective and preventive action. These deficiencies cover a wide range of activities covered by the LILCO Appendix B program, including:

(a) Repeated instances of noncompliance with procedural requirements for control of design calculations. These noncompliances began in the early 1970's and have continued to the present time. (Findings QA:26-66; Appendix 1).

(b) Noncompliance with procedural requirements for control of Engineering and Design Change Reports ("E&DCRs"), a basic design document for the Shoreham project. These noncompliances were particularly severe in the 1976-78 period, but the evidence indicates inadequate control continuing to the present time. (Findings QA:68-161; Appendix 2).

(c) Noncompliance with requirements for storage and housekeeping. In these areas, there has been no

effective corrective action. Indeed, in early 1983, after repeated failures by LILCO to devote necessary management attention to housekeeping requirements, the NRC Staff was forced to issue a Corrective Action Letter to LILCO. (Findings QA:162-266; 553-61; Appendix 3).

(d) Noncompliance with requirements for keeping controlled copies of manuals up-to-date. (Findings QA:267-84; Appendix 4).

(e) Noncompliance with requirements for control of the Shoreham FSAR, resulting in the FSAR differing repeatedly from the configuration of the as-built plant. The problems became so severe in late 1981 that the Staff could not recommend issuance of a license for Shoreham unless action was taken to improve the accuracy of the Shoreham FSAR. (Findings QA:285-329).

(f) Repeated instances of failure to control the installation of electrical cables, conduit and raceway in accordance with design specifications. This has resulted in I&E citations for violation of electrical separation criteria and for failure to take necessary corrective action. (Findings QA:330-346).

(g) Widespread welding deficiencies, particularly during the 1977-79 time period. The I&E RAT inspection discovered additional welding problems which had not been detected by LILCO, raising further concern regarding the adequacy of the quality of the as-built plant. (Findings QA:347-56, 454-64, 517-18, 522-23).

(h) Evidence that the LILCO final inspection program has not been successful in detecting deficiencies in the quality of items. The findings of the Staff's RAT inspection in January, 1983 indicate noncompliance with Appendix B, Criteria 5 and 10. (Findings QA:431-49). (See also Section IV.B.7.) infra.

5. The deficiencies in LILCO's QA program implementation cannot be dismissed or ignored on the basis that they had no safety significance. First, there have been QA deficiencies at Shoreham which would have reduced the margin of safety if they had not been discovered. Indeed, Torrey Pines identified 19 Findings which involved conditions that had the potential to constitute substantial safety concerns. (Findings QA:588).

Second, in assessing a licensee's QA/QC compliance, the appropriate inquiry does not focus on whether the QA deficiency, if not corrected, would have resulted in a safety hazard. QA represents, most fundamentally, a process by which one defines a program for ensuring quality and then, through

rigorous management attention, discipline and implementation, ensures that all aspects of the defined program are performed. It is inconsistent with the QA process to accept any deficiencies from the required discipline, even if those deficiencies, by themselves, result in no safety concern. Such deficiencies, if allowed to expand because of lack of discipline, can then affect other plant areas where safety may be directly affected. Further, since an audit program cannot recheck all steps in a process, the fact that a deficiency results in no safety hazard does not mean that other undiscovered deficiencies will not result in safety concerns. This particularly is the case since neither LILCO nor the Staff uses a statistically-based methodology which permits extrapolation of audit results to the population of SS&Cs which are not specifically audited. Thus, it is essential that the QA process be vigorously enforced to establish the level of discipline required to produce a high quality product. (See Sections III.B, IV.A.2, VI.G, infra).

6. The Staff's I&E inspection program has identified more than 80 violations at Shoreham since the grant of the construction permit in 1973. (Findings QA:579, 581). These violations, coupled with other I&E findings and the results of SWEC and LILCO audits of the Shoreham project, demonstrate further that the QA/QC program at Shoreham was not properly implemented.

7. While the I&E program applied to Shoreham documents deficiencies in QA/QC implementation, the Staff has testified that it is not aware of any continuing pattern of QA/QC deficiencies. The Board cannot accord great weight to this Staff conclusion. The I&E inspection program is quite limited in scope and resources. Indeed, it does not even address the full scope of QA required by the regulations, since the Staff program ignores the QA for SS&Cs important to safety but not safety-related. (Staff Finding 7B:82; Section V). These facts, plus the Staff's failure to use a methodology which permits extrapolation of the Staff's audit results to SS&Cs which are not specifically audited, limits sharply the Staff's conclusions. Furthermore, the evidence in this proceeding does not document any detailed I&E design review/inspection effort applicable to Shoreham. In the few instances where the Staff has devoted substantial inspection resources, the Construction Assessment Team ("CAT") (I&E Inspection 82-04) and RAT inspections, widespread QA/QC deficiencies were discovered. In short, the I&E program results do not satisfy this Board that the high QA/QC standards mandated by the NRC's regulations have been satisfied by LILCO.

8. The deficiencies in QA/QC implementation found by this Board compel a remedy which will provide confidence in the actual quality of the design and construction of the Shoreham

facility. The Board finds that the Torrey Pines inspection commissioned by LILCO was not sufficient to provide confidence in the quality of construction at Shoreham. First, the TPT inspection was insufficient in scope, since it covered only safety-related SS&Cs and thus did not address the quality of construction for the wider group of SS&Cs important to safety but not safety-related. Second, as detailed in our Opinion and Findings hereafter, the actual inspection conducted by TPT had serious deficiencies in independence, methodology and in the actual conduct of the review program. Because of these deficiencies, the Board cannot conclude, based upon the evidence before it, that the Shoreham facility has been constructed in accordance with design requirements. (Section VI).

9. There is no evidence in this record from which the Board can conclude that the design bases for the Shoreham facility were actually translated into the final design documents. The Board notes that LILCO has commissioned Teledyne Engineering Services ("Teledyne") to perform a design analysis of one loop of the core spray system at Shoreham. The Board believes that the Teledyne analysis offers the possibility of providing some additional confidence, depending on outcome, concerning the adequacy (or lack thereof) of the design of the Shoreham facility. However, the results of the Teledyne

effort are not part of the record and, accordingly, we cannot consider them at this time. Nevertheless, on its face, the Teledyne effort appears too narrow in scope. The Teledyne review encompasses only a single mechanical system, one loop of the Shoreham core spray system, which was designed by SWEC. The Teledyne review thus does not cover any systems designed predominantly by General Electric Company ("GE"), and does not address any electrical or HVAC systems. (Findings QA:736, 738).

10. Based upon the evidence before us, we agree with the County witness, Mr. Hubbard, that in order to produce convincing evidence regarding the actual quality of the design and construction at Shoreham, a comprehensive design review and physical inspection of the Shoreham facility is required. (Findings QA: 733-35). This Board will not define precisely what is required in terms of physical inspection and design review. However, such a review must be conducted under a satisfactory protocol to ensure independence of the reviewer, and must be sufficient to cover all SS&Cs important to safety. Furthermore, the review must be conducted in a manner that makes the results applicable beyond the particular items actually inspected. In that manner, a clear indication of the actual quality of design and construction of all SS&Cs important to safety at Shoreham can be provided. (Section VII).

II. The NRC's Quality Assurance Requirements

It is important in assessing LILCO's QA/QC compliance to understand clearly what is meant by the terms "quality assurance" and "quality control." The definitions are provided in Part 50, Appendix B:

> As used in this appendix, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to the physical characteristics of a material, structure, component, or system which provide a means to control the quality of the material, structure, component, or system to predetermined requirements. 10 CFR Part 50, Appendix B, Introduction (emphasis added).

The essence of the QA definition -- the requirement for planned and systematic actions necessary to ensure quality -- is echoed in Criterion 2 of Appendix B, which directs that an applicant must establish a QA program at the earliest practicable date which complies with Appendix B requirements. (Findings QA:14, 24; 10 CFR Part 50, Appendix B, Criterion 2.) This program, in turn, must be implemented:

> This [QA] program shall be documented by written policies, procedures, or instructions and shall be carried out throughout plant life in accordance with those policies, procedures, or instructions. The applicant shall identify the structures, systems, and components to be covered by the quality assurance program . . . . 10 CFR Part 50, Appendix B, Criterion 2 (emphasis added).

The implementation of the QA program is then required to be documented. 10 CFR Part 50, Appendix B, Criterion 17.

The importance of QA has been emphasized by the Commission and in adjudicatory decisions. For instance, in its 1980 Annual Report, the NRC stated:

> The application of disciplined engineering practices and thorough management and programmatic controls to the design, fabrication, construction, and operation of nuclear power plants is essential to the protection of public health and safety and of the environment. QA provides this necessary discipline and control. Through a QA program that meets NRC requirements, all organizations performing work that is ultimately related to the safety of plant operation are required to conduct that work in a preplanned and documented manner; to independently verify the adequacy of completed work; to provide records that will confirm the acceptability of work and manufactured items; and to assure that all individuals involved with the work are properly trained and qualified to carry out their responsibilities. (Finding QA:18) (emphasis added).

Similarly, the NRC's adjudicatory boards repeatedly have emphasized the importance of QA/QC as an essential part of the NRC's defense-in-depth approach to nuclear safety. Thus, in the McGuire proceeding, the Appeal Board stated:

> In an area as significant as quality assurance, the record should leave no doubt as to whether the applicant is in full compliance with applicable criteria and, if not, the basis upon which the regulatory staff authorizes any departure from such criteria. Duke Power Company (William B. McGuire Nuclear Station, Units 1 and 2), ALAB-128, 6 AEC 399, 410 (1973) (emphasis added).

The Board in the Surry proceeding also emphasized QA:

> This proceeding highlights the paramount importance of effective quality assurance and quality control programs and the imperative need for such programs from the very inception of a project. The hearing record provides a graphic illustration of inadequate implementation of an effective quality assurance and quality control program during the early but vital phase of plant construction and it should serve as an object lesson for all applicants, the nuclear industry and the Atomic Energy Commission. Virginia Electric and Power Company (Surry Power Station, Unit No. 1), 4 AEC 825, 826 (1972) (emphasis added).

See also Consumers Power Company (Midland Plant, Units 1 and 2), ALAB-106, 6 AEC 182, 183 (1973) ("One of the most significant elements of the Commission's 'defense-in-depth' approach to nuclear safety is its emphasis upon quality assurance and quality control in the construction of nuclear power plants;" the QA program is essentially meaningless without timely, continuous and proper implementation); Vermont Yankee Nuclear Power Corp. (Vermont Yankee Nuclear Power Station), ALAB-124, 6 AEC 358, 361-62 (1973) (emphasizing paramount importance of QA and need for timely, continuous and proper implementation); Duquesne Light Company (Beaver Valley Power Station, Unit 2), ALAB-240, 8 AEC 829, 840, n.22 (1974) (extensive and systematic QA is a primary assurance of safety). (Finding QA:9, 16).

Thus, the Appendix B QA/QC requirements are mandatory as to certain essential things:

-- The applicant must establish a systematic and planned program of actions designed to provide confidence in the quality of SS&Cs. 10 CFR Part 50, Appendix B, Introduction and Criterion 2.

-- The applicant must identify the SS&Cs to be covered by the QA program. Id. Criterion 2.

-- The precise actions which must be part of a QA program are not prescriptively set forth in Appendix B. Rather, the applicant must establish QA activities for particular SS&Cs "to an extent consistent with their importance to safety." Id. Appendix B does specify certain types of actions which must be taken. See, e.g., id. Criteria 3 (design control); 9 (control of special processes); 10 (inspections); 18 (auditing).

-- The QA program must be documented by written policies, procedures or instructions. Id. Criteria 2 and 5.

-- The QA program, once documented in writing, must be carried out in accordance with these documented requirements in a timely and effective manner. Id.

-- The applicant must document in writing that the program has in fact been implemented. Id. Criterion 17.

The proper implementation of the foregoing regulatory requirements is not something which may be casually performed. Rather, the regulations emphasize that applicant management must play an essential role in QA. Id. Criterion 1 (last sentence); Criterion 2 (last sentence). This need for management involvement has been stressed by the NRC. Thus, Chairman Palladino has stated that an effective QA program "must have the full support and attention of the nuclear industry managers responsible for design and construction." (Finding QA:10). Mr. Dircks, the NRC's Executive Director for Operations, similarly has stated that QA programs require "heavy emphasis and active involvement of top licensee management . . . ." (Finding QA:11). Indeed, Mr. Dircks attributed the severe QA/QC deficiencies at Marble Hill, Midland, Zimmer, South Texas and Diablo Canyon most directly to a lack of effective management control of the QA program. (Finding QA:20).

Active management involvement in QA program development and implementation is fundamental because management in any organization sets a leadership standard which others likely will follow. Thus, if management imposes a realistic but comprehensive QA/QC program and insists that the program be faithfully implemented in all respects, this leadership will likely have salutory effects. In contrast, it makes no sense to prescribe a set of QA requirements which cannot be satisfied. The

repeated failure to achieve program goals may condition personnel to believe that compliance with QA requirements is unimportant. Thus, a sound QA program will have full management attention and will specify a set of achievable policies and procedures. Once these policies and procedures have been established, they must be vigorously enforced to ensure that the necessary discipline is achieved. Any deviation from these policies or procedures -- particularly repeated deviations -- must be considered serious from a QA point of view in terms of management's failure to ensure proper program implementation. (Findings QA:9-15, 253-54).

A QA program, proper in scope and vigorously implemented, will not eliminate all errors. In a facility as complex as a nuclear plant, some errors are inevitable. The purpose of QA/QC is to impose necessary controls to reduce errors wherever possible and to detect those which, nevertheless, may occur. This process, if properly implemented, will ensure that required standards are met. (Finding QA:17). This QA function was emphasized by the Indian Point Licensing Board:

> [N]o quality assurance program, however thorough, can guarantee that there will be no errors in design and construction, or failures of equipment, or misoperation in a nuclear plant. It can, however, provide substantial assurance that the number of faults will be greatly reduced and that they will not be of such magnitude as to jeopardize the health and safety of the public. Consolidated Edison Company of New York, Inc. (Indian Point Station Unit No. 2), LBP-73-33, 6 AEC 751, 755-56 (1973).

Accordingly, the NRC's regulations, and this Board in reviewing compliance with these regulations, place high emphasis on proper development and implementation of QA/QC programs for nuclear plants. As described below, we have substantial concern that LILCO has not satisfied the high level of attention required by the NRC's regulations.

III. Deficiencies in Scope of the LILCO QA/QC Program

A. The LILCO QA Program Fails to Cover Nonsafety-Related SS&Cs Which Are Important to Safety

Suffolk County has contended that in order to meet NRC regulatory requirements, LILCO must establish a QA/QC program not only for safety-related SS&Cs, but also for nonsafety-related SS&Cs which are important to safety. Suffolk County has further contended that the evidence in this proceeding has documented only that LILCO has a QA program for safety-related SS&Cs. For SS&Cs which are important to safety but not safety-related, Suffolk County contends that LILCO has no systematic QA program. This is not to say that LILCO has no QA activities for nonsafety-related SS&Cs. Suffolk County agrees that there are some such activities, but they are not conducted in a planned and systematic manner, such that the Board can find that a QA program in fact exists. LILCO disagrees with the County and Staff interpretation of the term "important to safety" but has also argued that it has nevertheless applied

appropriate QA to all SS&Cs, including those which are not safety-related.

This matter was addressed in that portion of our Opinion and Findings on Suffolk County Contention 7B. Accordingly, it is not necessary to address the matter again in detail. We reiterate briefly our conclusions:

-- The term "important to safety," as set forth in 10 CFR Part 50, Appendix A, GDC 1, does encompass more than just safety-related SS&Cs. In this regard, we accept the definition of SS&Cs important to safety which is set forth in the Denton Memorandum, which is in evidence as an attachment to the County's Contention 7B testimony. See Goldsmith et al., ff. Tr. 1114.

-- The Commission's regulations, 10 CFR Part 50, Appendix A, GDC 1, require the establishment of a QA program for all SS&Cs important to safety.

-- The evidence in this proceeding does not support a finding that LILCO has established a systematic and comprehensive QA program for SS&Cs important to safety but not safety-related. LILCO has some activities which apply to those SS&Cs but there is no systematic identification of those items to which the program applies or, in fact, evidence that a systematic

program exists. Since the essence of QA/QC is a systematic and planned approach to QA and QC activities, the absence of evidence of such a program is a critical deficiency.

-- On the question of QA/QC compliance for SS&Cs important to safety but not safety-related, the Staff is in no position to provide any substantial opinion regarding LILCO's compliance. Rather, as admitted by the Staff (Staff Finding 7B:82), neither the Office of Nuclear Reactor Regulation ("NRR") nor the I&E program of the NRC Staff has conducted any systematic effort to identify, assess or evaluate the establishment or implementation of any QA program by LILCO for SS&Cs important to safety but not safety-related.

In view of the foregoing, this Board finds that the scope of the QA program established by LILCO has not been demonstrated to be sufficient and in compliance with 10 CFR Part 50, Appendix A, GDC 1.1/

1/ One Staff member, Mr. James Conran, has altered his prior opinion regarding LILCO's substantive compliance with regard to regulatory requirements applicable to SS&Cs important to safety. Mr. Conran now expresses serious misgivings regarding LILCO's understanding of the regulatory requirements. See Affidavit of James Conran. Mr. Conran's affidavit, as well as testimony by other parties, is scheduled for hearing commencing April 5, 1983. The County, therefore, will await the further briefing on SC Contention 7B to provide any further detailed views on the "important to safety" matter.

B. LILCO's Audit Program Fails to Comply With 10 CFR Part 50, Appendix B, Criterion 18

LILCO is required by Criterion 18 of Appendix B to implement an audit program to verify compliance with, and determine the effectiveness of, the Shoreham QA/QC program. (Finding QA:736). Criterion 18 requires:

> A comprehensive system of planned and periodic audits shall be carried out to verify compliance with all aspects of the Quality Assurance Program and to determine the effectiveness of the Program. 10 CFR Part 50, Appendix B, Criterion 18 (emphasis added).

Criterion 18 requires that the audit program provide a basis for concluding that all aspects of the LILCO QA/QC program have been effectively implemented. (Finding QA:417). Since the LILCO audit program does not audit 100 percent of Shoreham's QA/QC records and activities (Finding QA:414), it is essential that there be a basis for extrapolating the results of the audits which are conducted to activities which are not actually audited. (Findings QA:414, 416). We conclude that for accurate extrapolation to be possible, the audit program must include statistical methodology regarding sample selection. Since LILCO does not use such methodology, we conclude that LILCO has not established an audit program which complies with 10 CFR Part 50, Appendix B, Criterion 18. (Findings QA:417, 732).

In LILCO's view, statistical sampling techniques are not appropriate with respect to an audit program for a nuclear power plant. Instead, under LILCO's auditing methods, particular items and activities to be audited are selected by judgment sampling techniques. Thereafter, based on the specific audit findings or observations drawn from the judgment samples, LILCO makes judgmental inferences regarding the total population, including that portion of the population that is not subject to the specific audit findings or observations. (Finding QA:415).

The Staff agrees with LILCO that it is not necessary to choose an audit or inspection sample using statistical methodology. Thus, although I&E does not perform 100 percent inspections (the Staff I&E program looks at between one and five percent of the possible activities), it also does not use statistical methods for selecting samples for inspection. (Findings QA:21, 406, 419). And even in major inspections, such as the Shoreham CAT and RAT inspections, the items inspected are not selected by the Staff on the basis of random sampling techniques. (See, e.g., Findings QA:420, 466). Moreover, the Staff, like LILCO, believes that the use of such statistical methodology is not required in order to extrapolate conclusions to the total population. (Finding QA:419).

We do not agree. On the basis of the evidence presented,2/ we conclude that the audit programs of LILCO and the Staff suffer from the same deficiencies reflected in the Torrey Pines review of the Shoreham plant. (See Section VI.G for further discussion re statistics).

Extrapolations which are reliable and verifiable require the use of statistical techniques. (Finding QA:721). Correspondingly, an audit program that selects samples on the basis of judgment and then attempts to extrapolate the results beyond the specific population being audited has no validity. (Findings QA:716, 718). Samples selected on the basis of judgment carry a high risk of being statistically biased and may lead to results that are neither reliable nor verifiable. (Finding QA:715). In particular, the direction of the bias is often unpredictable and the magnitude of the bias can be substantial. (Finding QA:717). By using statistically valid random sampling techniques, however, such biases may be controlled or even eliminated. Moreover, such techniques make possible

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2/ Only the County presented testimony by a qualified statistician. While LILCO acknowledged Dr. Samaniego's qualifications as a statistician (LILCO Finding QA:727), it asserted that his unfamiliarity with the nuclear industry precluded his testimony from being of assistance to this Board. (LILCO Finding QA:727). We do not agree. The science of statistics is fully applicable to other disciplines and areas and can be applied without the statistician being knowledgeable in those other areas or disciplines. (Findings QA:418, 726-28).

probability and confidence statements regarding the populations being sampled, and introduce a measure of control and precision to inferences which can be drawn regarding such populations. (Finding QA:717).

This Board recognizes that it is not feasible to inspect every component or examine every document at a nuclear facility. Thus, choosing to audit only a sample of components and documents is entirely appropriate. However, unless random sampling methods are used, it is not possible to draw valid inferences from a sample of the total population, since there is no valid methodology for extrapolating from a judgment sample to a population. (Findings QA:711, 716). It is not the conclusions regarding the areas specifically audited which are invalid, but the process of extrapolating to the entire population. (Findings QA:416, 716). In short, while LILCO's audit program permits valid judgments to be made with respect to the specific items audited, it does not allow for extrapolating to the entire plant, and any conclusions regarding areas not specifically audited have no validity. (Finding QA:718).

Contrary to the assertions of LILCO (LILCO Findings QA:862, 864, 867-68), the use of random sampling techniques would not reduce the auditors' flexibility, force auditors to accept nonconforming items if the audit indicated only a small number were deficient, or prevent LILCO or the Staff from

auditing items not included in the random samples. Indeed, samples still could be selected by judgment and be included in any general conclusions or judgments that are drawn. However, items audited, but not drawn from random samples, cannot be used in drawing inferences about the total populations. To make valid inferences about a population from a sample, the sample must be drawn randomly. (Finding QA:718). Thus, LILCO's failure to use valid sampling techniques in its audit program makes impossible any valid extrapolation of the results of the audit program to the entire Shoreham plant. (Finding QA:416).

Furthermore, and again contrary to assertions made by LILCO (LILCO Findings QA:861, 869), we find that neither the diversity nor the complexity of a nuclear power plant precludes the use of statistical methodology. There are well-defined statistical methods for sampling from a heterogeneous or diverse population and obtaining statistically valid conclusions from such a study. With a diverse or heterogeneous population, the population can be divided into strata, or subpopulations, that have a higher degree of homogeneity. Information can then be gathered about subpopulations and combined with information from other subpopulations to obtain an overall measure of the heterogeneous population. Thus, a basis for extrapolation from a sample, within a given subpopulation, to the entire

population is provided by stratified random samples, and the diversity of the population presents no particular difficulty to the extrapolation process. (Finding QA:722).

Similarly, the complexity of a population does not preclude the use of statistical methodology. Within the context of stratified sampling, it is possible to identify subpopulations that are more complex than others, and to sample these subpopulations more heavily. Nothing precludes this difference in sampling emphasis. (Finding QA:723).

Finally, contrary to LILCO's assertion (LILCO Findings QA:865, 868), the use of statistical techniques does not exclude the use of judgment in the audit process. Rather, statistical sampling techniques, combined with the auditor's judgment, can provide the mechanism for an effective audit program in which results from audited items can be extrapolated to the entire plant. (Finding QA:726). Thus, as pointed out by Dr. Samaniego on behalf of Suffolk County, the areas of statistics and engineering judgment complement each other in an audit program, with statistics primarily used in the selection of samples to be audited. The engineer must decide what populations are of interest and which questions are worth asking. Thereafter, once the audit is complete, the engineer may identify followup areas based upon the obtained data. (Finding QA:727).

In short, the role of the statistician is to obtain scientifically valid information on the populations of interest. Thereafter, other disciplines can use this information to reach conclusions concerning the population under study. (Findings QA:726-27). Thus, LILCO and the Staff err in assuming that the use of statistical sampling techniques excludes the use of judgment in the audit process. Quite to the contrary, the use of statistical sampling techniques is vital to provide necessary data to which informed engineering judgment then can be applied. (Finding QA:727).

In summmary, without the use of random sampling to select specific items to be audited, it is impossible to assess the reliability of, or have confidence in, any extrapolation from a sample to a total population. (Finding QA:730). Thus, the methodology used by LILCO and the Staff in their audit programs, just like the methodology used by Torrey Pines in its review of the Shoreham plant (Section VI.G), is seriously flawed and provides no basis for extrapolation to the entire Shoreham plant. (Findings QA:416, 730). Accordingly, we find that LILCO has failed to satisfy the requirements of Criterion 18 of Appendix B. LILCO's failure to verify compliance with all aspects of the Quality Assurance program and to determine the effectiveness of the program is exacerbated by the Staff's similar failure to use statistically valid sampling techniques

in its inspections of the Shoreham plant, and is a further reason for our conclusion that a full physical inspection and design review of the Shoreham plant is required.

IV. The Evidence Documents a Pattern of LILCO Failures to Comply with the NRC'S QA/QC Requirements

A. Preliminary Considerations

1. The Definition of a QA/QC Violation or Deficiency

Suffolk County has contended, particulary in SC Contention 12, that LILCO has failed to implement its QA program in compliance with 10 CFR Part 50, Appendix B. In essence, the County asserts that there have been repeated instances of failure to comply with Appendix B requirements, and that these repetitive instances, when they involve the same type of Appendix B problem (for example, the same type of storage deficiency), document a failure in the timely and effective implementation of the required QA program.

This Board agrees with Suffolk County. Some QA/QC implementation problems are inevitable (Finding QA:17); however, if the same type of deficiency recurs, this evidence may support a finding that the QA program has not been properly implemented and that necessary corrective action has not been effected. The final determination as to whether particular deficiencies are sufficient to constitute a failure to meet Appendix B implementation requirements depends upon the facts and

circumstances of the specific deficiencies which are examined. The bulk of the rest of this portion of this Opinion considers whether the evidence of deficiencies adduced before us in the Shoreham proceeding documents such a QA/QC implementation failure.

Before considering specific deficiency evidence in detail, we first define what constitutes a QA/QC violation or noncompliance. This issue is important because Suffolk County documented many instances where LILCO or SWEC auditors identified failures to comply with either QA procedures or ANSI standards which are committed to in the Shoreham FSAR and which implement LILCO's Appendix B QA program. The County believes such failures to comply with a QA procedure or an ANSI standard constitute failures to comply with Appendix B. LILCO disagrees. (LILCO Finding QA:180; Finding QA:71).

The LILCO QA/QC program for compliance with Appendix B is implemented by means of QA manuals, procedures and other documents. Several of the manuals and procedures were attached to the prefiled LILCO QA/QC testimony. The question then arises whether a failure to comply with a requirement of a manual, procedure or other document implementing a portion of LILCO's Appendix B QA program is a noncompliance with or a violation of Appendix B, which is pertinent to our inquiry whether a pattern of QA/QC noncompliances exist at Shoreham.3/ We

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3/ LILCO's witnesses indicated that audit observations by SWEC indicate a failure to comply with a procedure or

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conclude that it is.

For example, in I&E Inspection Report 79-05, the Staff cited LILCO for a violation of 10 CFR Appendix B, Criterion 5, for failing to have Engineering QA Procedures ("EQAPs") up-to-date, which was contrary to the requirement of EQAP 5.1. LILCO's failure to follow its own internal procedures was cited as a violation of Appendix B, Criterion 5, which specifies that activities affecting quality will be carried out in accordance with prescribed procedures. Thus, the failure to comply with an internal procedure implementing the Appendix B program constituted a violation of Appendix B. (Findings QA:270-72).

Similarly, in the CAT inspection, LILCO was cited for another Criterion 5 violation because LILCO had not complied with Construction Site Instruction ("CSI") 13.1, which required work areas to be kept sufficiently clean. Since the Staff believed the CSI constituted a part of LILCO's Appendix B program to comply with Criterion 5, and since LILCO had not complied with CSI 13.1, the Staff found this to be in violation of Appendix B, Criterion 5. (Finding QA:225).

Finally, in Inspection Report 79-16, it is noted that LILCO had committed in the FSAR to comply with ANSI N45.2.2,

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control mechanism or indicate a condition that needs to be improved. (Finding QA:28).

which concerns requirements for receiving, storing and handling safety-related components. The Staff found that this commitment to the ANSI standard implemented LILCO's program for compliance with Appendix B, Criterion 2. Because LILCO had failed to comply with certain requirements of this standard, the Staff cited LILCO for violation of Appendix B, Criterion 2. (Finding QA:203).

The foregoing examples support our conclusion that a violation of, or noncompliance with, Part 50, Appendix B, can be demonstrated when an applicant establishes an Appendix B compliance program, but then fails to comply with the program requirements.4/ We must add, however, that in considering whether there has been a failure of timely and effective implementation of Appendix B requirements, we do not consider only evidence of "violations" or "noncompliances," as we have discussed above. Rather, other evidence must also be considered. For example, during the Staff's CAT inspection, LILCO

4/ For purposes of our review of LILCO's QA/QC compliance, the fact that LILCO auditors may have caught an item before I&E inspectors identified it does not result in the item not being considered a QA/QC deficiency. Appendix B sets requirements. If they are not met, that constitutes a noncompliance with Appendix B, no matter who finds it. The fact that LILCO has found a problem before I&E is some evidence that the audit program is working but it does not negate the fact that an Appendix B noncompliance has occurred. If that noncompliance recurs repeatedly, then a pattern of deficiencies is established, even if LILCO repeatedly identifies the noncompliance.

was not cited for an electrical separation "violation" but was cited for a "weakness" for failure in four instances to comply with separation requirements specified in an E&DCR. (Findings QA:331-32). While there is some evidence that this situation did in fact constitute an Appendix B violation (Findings QA:331-36), the noncompliance with an E&DCR requirement certainly evidences a failure to prevent nonconforming installation into the as-built plant. Such evidence is relevant to an overall determination as to whether the QA program has been properly implemented. (Finding QA:394; Section IV.B.6).

Similarly, again in the CAT inspection, the Staff identified an interference between the drywell spray nozzles and the HVAC system. The interference reduced the effectiveness of the spray nozzles. The interference apparently had not been identified by the LILCO QA program, or subjected to any engineering evaluation, although the nozzles had been classified by LILCO as safety-related. While this matter eventually was determined by the Staff not to be a safety concern, the failure of the LILCO QA organization to have identified the interference again evidences a QA/QC problem which must be considered in any assessment as to whether LILCO has properly implemented its QA/QC program. (Findings QA:317, 319-20; Section IV.B.5).

Accordingly, in considering whether a pattern of QA deficiencies exists, this Board will consider audit or

inspection observations which evidence actual noncompliance with/violation of Appendix B requirements, as well as other evidence which bears upon the adequacy of LILCO's implementation of its QA/QC program.

2. The Need to Link QA/QC Deficiencies to a Safety Defect

LILCO apparently takes the position that QA/QC deficiencies, even if proven, should not be considered significant unless the County also proves that a safety concern would have resulted if the deficiency had been allowed to persist. Hence, LILCO witnesses often referred to matters as "administrative" concerns, leaving the impression that these matters were not of significance. (See, e.g., Findings QA:39, 42, 52). The County takes the opposite view, arguing that all QA deficiencies must be considered significant and that only full QA/QC compliance can be considered acceptable. Under the County's view, compliance with so-called "administrative" QA/QC requirements is essential, because otherwise, the necessary discipline needed for effective QA/QC implementation cannot be achieved. (Findings QA:9, 15).

To our knowledge, this issue has not received careful attention in the NRC's decisions. Two cases which address this subject matter were instances where licensing boards were ruling on the admissibility of QA/QC contentions. There was no

occasion for, or evidence of, detailed consideration or analysis of the NRC's QA/QC requirements. In one case, the Board indicated that an intervenor had the burden of showing that the QA/QC deficiencies had led, or might have led, to some safety defect in the plant. See Cleveland Electric Illuminating Co. (Perry Nuclear Power Plant, Units 1 and 2), LBP-81-24, 14 NRC 175, 212 (1981). In the other case, the Board conditioned admission of the contention on some showing that the QA deficiencies had an "import . . . for the proper construction of the plant and for the ability of Applicant to implement a proper Operational QA program." Philadelphia Electric Co. (Limerick Generating Station, Units 1 and 2), LBP-82-43A, 15 NRC 1423, 1518 (1982).

At the outset, the Board stresses that some QA deficiencies are of course more significant than others. See "General Statement of Policy and Procedure for Enforcement Actions," 47 Fed. Reg. 9987 (1982) (adopted as Appendix C to 10 CFR Part 2), which ranks the severity of regulatory violations (from Levels 1 to 5) in terms of potential safety significance. We note, however, that even Level V deficiencies are not asserted to have no safety significance.5/

5/ Severity Level 1 violations pertaining to facility construction are "[v]ery significant violations involving a structure or system that is completed [including review and acceptance by construction QA] in such a manner that it would not have satisfied its intended safety-related

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The Perry decision, cited above, if applied literally, and the Limerick decision, by implication, would seemingly find QA/QC deficiencies to have little or no significance to a judgment on the adequacy of a licensee's Appendix B implementation, unless the deficiencies are linked to actual or potential safety defects. We decline to follow the literal language of Perry or the implications of Limerick. Appendix B to 10 CFR Part 50 specifies mandatory QA requirements. Indeed, each of the 18 QA criteria of Appendix B contains the mandatory language "shall," which connotes Commission intention that all of Appendix B's QA requirements must be followed. The NRC case law previously discussed (Section II) additionally stresses the need for full compliance with the Appendix B requirements. Accordingly, the plain requirement of the NRC regulations is to comply with Appendix B, whether or not a direct linkage to a safety problem is shown. This, of course, makes sense because one should not wait until a safety problem actually exists or is imminent to raise questions about the adequacy of QA implementation.

We find direct support for the foregoing holding in the Appeal Board's decision in Consumers Power Co. (Midland Plant,

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purpose." 47 Fed. Reg. at 9993-94. At the other end of the spectrum, Severity Level V violations "have minor safety or environmental significance." Id. at 9994.

Units 1 and 2), ALAB-106, 6 AEC 182 (1973). In that case, the Appeal Board concluded that QA requirements had not been satisfied, but that the actual structural work did not appear to have been affected by the QA deficiencies. The Board stressed, however, that the lack of substantive effect on the structure "must be accredited to pure luck or happenstance" and did "not mitigate the seriousness of the deviations from proper quality assurance practices . . . . " Id. at 186.

This Board recognizes that the overall purpose of Appendix B compliance is to ensure that a facility can be operated safely. This is achieved by ensuring that all activities affecting safety-related functions of SS&Cs are conducted in accordance with QA/QC requirements. Thus, the purpose of all QA/QC requirements is ultimately premised on this goal of safety. In this regard, some QA requirements have a more direct relationship to safety than others. For example, a requirement for a final QA/QC inspection of a weld in a safety-related piping system is certainly an activity which affects quality more directly in a safety sense than, for example, a requirement that a QA manual be updated at specified intervals.

However, it must be recognized that all QA activities, be they directly related to a component's integrity or more administrative in nature, do constitute activities which may affect the quality or operation of safety-related SS&Cs. Thus, while

some QA activities are undoubtedly more important than others (and thus deficiencies in particular activities may be viewed as having greater seriousness), the overall conclusion reached by the Board is that all of the NRC's QA requirements, including the administrative ones, must be satisfied.

Our reluctance to require an intervenor to link QA deficiencies directly to a possible safety defect is heightened by the fact that it is often difficult to determine whether a particular QA deficiency could or did result in a safety concern. For example, there was considerable evidence of repeated violations by LILCO of storage and housekeeping requirements. (Section IV.B.3). The County's QA witness testified that excessive dirt (one of the frequent storage/housekeeping deficiencies) has the potential to cause damage to components, but the damage, for instance premature aging, is difficult to detect. (Findings QA:245, 247).6/ pointed out that excessive dirt (one of the frequent storage/housekeeping deficiencies)

6/ Mr. Hubbard submitted supplemental QA/QC testmony to address his view of the significance of LILCO's repeated housekeeping deficiencies. See SC Ex. 89D. In this testimony, Mr. Hubbard stressed three points: that housekeeping deficiencies such as excessive dirt may lead to problems that are hard to identify; that the housekeeping deficiencies documented at Shoreham did constitute regulatory violations; and that the deficiencies at Shoreham were indicative of LILCO's lack of strong management attention to complete QA/QC implementation. SC Ex. 89D. Neither LILCO nor the Staff cross-examined Mr. Hubbard on this testimony.

has the potential to cause damage to components, but the damage, for instance premature aging, is difficult to detect. (Findings QA:247, 249).

Furthermore, we believe it is essential to proper implementation of the overall QA program to ensure that all QA requirements are in fact implemented. It is inconsistent with the creation of the necessary discipline and management attention, which are essential components of a successful QA program, to accept any discrepancies from the required QA program. Management certainly has leeway in defining the precise elements of a QA/QC program. Indeed, Criterion 2 of Appendix B specifies that QA activities shall be established "to an extent consistent with [SS&Cs'] importance to safety." 10 CFR Part 50, Appendix B, Criterion 2. Thus, Appendix B provides management the means to set up a workable program which is feasible to implement. However, once management has established the contours and particular requirements of the QA program, it is essential in our opinion that these be enforced; otherwise, personnel may come to believe that QA requirements may be selectively implemented. (Findings QA:9, 15, 253-54).

The foregoing discussion should not be construed to imply that the deficiencies discussed hereafter have (or if undetected would have had) no safety impact. That is not the case. For example, there were welding deficiencies that, if

undetected, perhaps could have impacted the safety of the facility. (Finding QA:351). Similarly, the Torrey Pines review made a series of Findings, which, by definition, represent matters of significant safety concern. (Finding QA:589). Finally, in a number of instances, the audit findings clearly did relate to matters well beyond so-called "administrative" concerns. (See e.g., Findings QA:42, 54-61; Appendix 1 (calculation items LILCO agrees are in "Miscellaneous Important Concerns" category)). However, we emphasize that it is our view that a showing of an actual or potential safety defect linked to a QA deficiency is not a prerequisite to a determination that an applicant has failed to meet NRC requirements for proper implementation of a QA program.

B. The Evidence Documents LILCO's Failure to Implement Its QA/QC Program in Accordance with 10 CFR Part 50, Appendix B

During the QA/QC hearing, extensive examination was conducted into many audits and inspections of the LILCO QA/QC program. In the discussion below, we address those matters which, in our opinion, highlight the QA/QC implementation deficiencies which have occurred at Shoreham.

1. LILCO Has Failed to Adhere to Procedural Requirements for Control of Manual and Computerized Calculations

In the FSAR, LILCO commits to implement QA activities designed to control manual and computerized calculations. These QA activities are part of the LILCO program for compliance with Appendix B. (Finding QA:27). In furtherance of this LILCO commitment, SWEC adopted EAP 5.3, entitled "Control of Computerized and Manual Calculations." The purpose of EAP 5.3 is to "[e]stablish[] the methods for the preparation, review and storage of calculations." (Findings QA:27, 38).

It is clear that EAP 5.3 constitutes a part of the total LILCO/SWEC program for compliance with 10 CFR Part 50, Appendix B, particularly Criterion 5. Accordingly, if there is a noncompliance with the requirements of EAP 5.3, there is also a noncompliance with Criterion 5 of Appendix B. If noncompliances are numerous or otherwise are indicative of repeated deficiencies of the same kind, they constitute evidence that the Appendix B program relating to Criterion 5 has not been effectively implemented.

Suffolk County presented persuasive evidence that EAP 5.3 has not been properly implemented. The County examined LILCO's witnesses concerning SWEC Engineering Assurance ("EA") audits, which had been conducted by SWEC personnel to assess whether

the requirements of EAP 5.3 had been followed. The County evidence documented more than 40 instances between 1970[7/] and 1982 where SWEC auditors discovered noncompliances with EAP 5.3 requirements. These noncompliances vary greatly in detail, and often have multiple parts. Only a few can be said to have the potential to create a potential safety problem, with the majority being more administrative in nature, e.g. failing to identify sources of calculation input data in the manner required by EAP 5.3.

We have summarized these calculation nonconformances in our Findings and in Appendix 1 to this Decision. (See Appendix 1 and Findings QA:34, 39-66). We hold that the repeated noncompliance with EAP 5.3 establishes a pattern of Criterion 5 deficiencies, because activities affecting quality -- the preparation, review and use of design calculations -- were not accomplished in accordance with documented instructions and procedures. See 10 CFR Part 50, Appendix B, Criterion 5. We add several observations.

7/ The deficiencies in control of calculations began in 1970, with EA Audits 0, 00 and 1. However, these were, in essence, pilot audits, since the SWEC EA program was just getting under way. While these audits indicate deficiencies in calculation control, the Board cannot determine the significance of these deficiencies since the auditing process appears to have gone forward before the calculations were fully prepared, and thus ready for auditing. The audits indicate, however, that SWEC was certainly on notice from early in the project that design calculations would need close control. (Findings QA: 62-66).

First, LILCO has suggested that a pattern of deficiencies should be found to exist in the calculation area only if the same problem has been recurrent within the same design discipline. Thus, for example, LILCO would have this Board search for a pattern of similar problems within pipe support calculations. If similar problems existed in another discipline (for example, mechanical calculations), these would have to be separately considered. (Finding QA:29). We disagree. EAP 5.3 is applicable to all SWEC disciplines which work on the Shoreham project, and the SWEC EA Division has responsibility for auditing all of these disciplines. (Findings QA:26, 30). If there are similar problems in many disciplines, and if the SWEC QA Organization has not taken effective action to control these problems, then a pattern of nonconformances must be found to exist.8/

Second, one EAP 5.3 deficiency occurred far more often than any other. EAP 5.3 requires that a person using a calculation be readily able to trace the source of the input data used in the calculation. This "ready traceability" requirement has become progressively stricter over the years. The requirement is specified primarily so that engineers or other persons

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8/ We note, however, that there were repeated instances of calculation control problems within the same disciplines. See Appendix 1.

needing to use the calculation in future years will be able to identify the source of input data with no trouble. Without compliance with EAP 5.3, the tracing of calculation input data might take as much as ten hours. (Findings QA:32-37, 40, 44).

The evidence documents repeated failures by SWEC disciplines to comply with the ready traceability requirement of EAP 5.3. Indeed, since 1973 there have been at least 25 instances,9/ continuing to the present, where auditors identified ready traceability deficiencies.10/ This clearly has been a recurrent problem which has affected many SWEC disciplines. (Appendix 1; Finding QA:49).

SWEC witnesses testified that the reason for many of the ready traceability noncompliances was that EAP 5.3 changed to a

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9/ LILCO states there have been 29 instances of "ready traceability" audit observations. (LILCO Finding QA:196).

10/ The audits and observations in which ready traceability deficiencies were found, and which are summarized in Appendix 1, are as follows: EA Audit 4, February 1973, at 1; EA Audit 5, May 1973, at 1-2; EA Audit 7, October 1973, at 2; EA Audit 14, August 1975, at 2; EA Audit 9, December 1976, at 3; EA Audit 20, February 1977, Observations 002, 007; EA Audit 21, May 1977, Observations 014, 016; EA Audit 22, August 1977, Observation 016; EA Audit 23, November 1977, Observations 030, 031, 032, 034; EA Audit 24, March 1978, Observation 050; EA Audit 26, September 1978, Observation 067; EA Audit 27, December 1978, Observation 072; EA Audit 28, April 1979, Observation 079; EA Audit 31, February 1980, Observation 107; EA Audit 34, November 1980, Observations 119, 120; EA Audit 36, June 1981, Observation 131; Site Engineering Audit 11, April 1981, Observation 129; and EA Audit 40, June 1982, Observations 023, 154.

stricter standard over time and that engineers devoted attention to the technical adequacy of calculations, rather than to administrative details. (Findings QA:36, 44). These "reasons" do not justify the noncompliance. There is no evidence that the EAP 5.3 requirement is particularly difficult to satisfy; rather, it appears that the basic reason for noncompliance is that engineers have not bothered with "mere" administrative detail.

This disregard for a requirement of the QA program is unacceptable. LILCO's witnesses agreed that full implementation of the QA/QC program is one of the keys to ensuring a quality plant. While there are different levels of importance among QA/QC requirements, the tracability of input data is important. (Finding QA:48). If the EAP 5.3 requirement for ready traceability was unnecessary, it should have been eliminated. The requirement must be complied with as long as it remains a part of the QA program. The fact that there have been repeated noncompliances in this regard demonstrates, in our opinion, that management was unwilling or unable to take the steps necessary to enforce discipline so that EAP 5.3 was satisfied. This evidences a lack of the management attention which is crucial for correct implementation of the QA program. (Findings QA:9-13, 15). This lack of attention carries over into other calculation matters where additional "administrative" problems have been found. (See Appendix 1).

LILCO testified that it believed that adequate corrective action for the ready traceability deficiencies had been taken. This included training sessions and emphasis to personnel on the need for full compliance with EAP 5.3. (Finding QA:45). We cannot agree. The ready traceability problems began in 1973 and have continued to the present. We do not doubt LILCO's testimony that corrective and, indeed, preventive action has been taken. We just cannot conclude that it has been effective.

LILCO also testified that these ready traceability noncompliances were not of concern because: (1) the ready traceability requirement is administrative in nature; (2) the correct input data were in fact used in the calculations, making the findings generally not significant in terms of plant safety; and (3) while ready traceability may have been impossible, actual traceability of input data was possible. (Findings QA:33, 41, 42). These arguments support the view that the deficiencies are not serious.

We agree that from purely a "safety" point of view, the ready traceability problems have not been shown to have caused safety defects. However, for reasons previously discussed, this does not alter the fact that no effective action to eliminate this problem was taken by LILCO, indicating a failure of the QA program to effectively control the situation.

The evidence adduced on control of calculations also showed, however, that a failure to follow rules strictly can lead to safety concerns. Indeed, there were a number of calculation-related audit findings, resulting from failure to follow procedural requirements, which clearly had potential to affect safety.11/ Furthermore, since auditors cannot completely recheck all calculations (Finding QA:39), there is no certainty that other problems do not exist.

An example of our concern for calculation control is EA Audit 34, dating from November, 1980. In that audit, it was discovered that large bore pipe supports were often being installed at locations slightly different from those assumed in supporting calculations. The calculations were not being revised to support the revised location. Rather, based on engineering judgment, engineers concluded that design margins would still be achieved by installation at the new location. The QA/QC inspectors had apparently not questioned such installations. In fact, however, it was determined that in some instances, design margins were entirely eliminated. The result was that 1800 calculations (out of approximately 10,000 large

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11/ LILCO agreed that the following audit observations in the Calculation area constituted potential safety concerns: EA Audit 14, at 7, item 3d; EA Audit 28, Observation 808(1); EA Audit 30, Observation 101(3); EA Audit 31, Observation 107(2); EA Audit 34, Observation 120(4). LILCO Ex. 24, at 3. (See Appendix 1; Finding QA:51).

bore pipe supports) needed to be reworked, and modifications had to be made to about one percent of the supports which were reviewed. The work to correct this concern has taken more than two years. (Findings QA:54-61; Appendix 1).

In the Board's opinion, the situation documented in EA Audit 34 could not have occurred if strict QA discipline had been imposed. Such discipline would have documented the basis for any change, and would have required a revised calculation if the situation was at all questionable.

The concerns identified in EA Audit 34 cause this Board to reach a further conclusion. Audit Observation 120 involved use of unsupported engineering judgment in the pipe support design discipline. To correct this problem, LILCO has reworked a large number of calculations, all in the same discipline. Its corrective action did not extend to a review of calculations in other disciplines to check for the same kind of problems, even though field design changes similar to those that led to the problems in Audit Observation 120 are used in other disciplines. LILCO's reason for not extending its corrective/preventive action to other disciplines was its belief that audits in the other disciplines would have found the problems if any had existed. (Finding QA:58).

We are not satisfied with LILCO's response. Audit Observation 120 represented a serious concern which affected a

large number of calculations. Given this fact, we believe it was incumbent upon LILCO/SWEC to take action to ensure that the same problems did not exist elsewhere. Mere reliance on regular quarterly EA audits, which by their nature do not review all calculations, is not sufficient. Rather, a specific review program for evidence of improper use of engineering judgment in other disciplines should have been instituted.

In conclusion, we find that during the design and construction of Shoreham, there have been repeated instances of failure to comply with EAP 5.3. These instances lead the Board to conclude that the SWEC/LILCO QA program was not effective in implementing the requirements of Criterion 5, as embodied in EAP 5.3, or in taking necessary corrective and preventive action.

2. LILCO Has Failed to Control Engineering and Design Change Reports

An Engineering and Design Change Report ("E&DCR") constitutes a basic LILCO/SWEC design control document. As the name implies, E&DCRs constitute a means of altering the design or clarifying a requirement once the original design is established. (Findings QA:67-68, 76). E&DCRs have been used extensively on the Shoreham project, with about 70,000 having been issued as of October, 1982. (Finding QA:158).

The design change control process used by SWEC and LILCO was described in LILCO's Prefiled QA/QC Testimony:

> Design changes are controlled by procedures that require the changes to a design document be approved by the same individuals or groups that approved the original document (thus responsibility for design change approval has been specifically delegated to a different organization). These procedures require that changes be formally documented in the revision or addendum to the issued design document or by an officially approved advance change document (such as an E&DCR . . .). . . .
>
> When revisions or addenda to the documents are issued, they are distributed to the same individuals and groups that received the original documents. When advance change documentation (E&DCR) is used, methods are implemented for tracking the change to the basic design document. These methods provide for maintaining E&DCR logs for the design documents (e.g., drawings, specifications and welding procedures) and identifying on the E&DCR log all advance changes that have been authorized against the specific document. These logs are made available to the individuals and groups who use the design documents so that they are aware of the latest approved design . . . . LILCO Ex. 21, at 97-98.

The LILCO/SWEC E&DCR system constitutes a part of the LILCO program for implementation of compliance with 10 CFR Part 50, Appendix B. The Appendix B criteria which are implemented by the E&DCR system are Criterion 3, concerning design control, Criterion 5, concerning implementation of required drawings, instructions and procedures, and Criterion 6, concerning document control. (Findings QA:68, 70).

The LILCO/SWEC E&DCR control program is implemented primarily through EAP 6.3. (Finding QA:68). That procedure requires, among other things: that a master E&DCR log be maintained; that when an E&DCR is issued, the E&DCR will be noted on affected drawings (a posting requirement); and that specifications and procedures which are impacted by an E&DCR will also note the existence of that E&DCR. In addition, there are detailed requirements for filing and maintaining E&DCRs in close proximity to the affected document, be it a drawing, procedure, or specification. (Findings QA:68, 73-74, 77-81).

Suffolk County has alleged that LILCO and SWEC have failed to implement the design change control program adequately insofar as E&DCRs are concerned. Suffolk County alleges that the evidence reveals widespread failure to control E&DCRs, particularly during the period from 1977-79, but continuing to the present time. We conclude that the evidence does document widespread noncompliance with E&DCR control requirements. We describe these noncompliances below, in our Findings and in Appendix 2.

During the 1977-79 time period, there were repeated instances of noncompliance with the requirements of EAP 6.3 and other E&DCR procedural requirements. (See, e.g., Findings QA:84, 86, 89, 91, 94-95, 97-101, 106-16, 119-22, 126-32, 136-37, 139, 142-43; Appendix 2). The LILCO witnesses

testified that it would be adequate, in their opinion, if E&DCR control deficiencies were identified no more than five percent of the time that E&DCRs were examined. (Finding QA:86). Thus, if one looked at 100 drawings to determine whether E&DCRs were properly noted thereon, the LILCO witnesses would be generally satisfied if no more than five drawings had failed to note the applicable E&DCRs. (Finding QA:89).

In fact, the evidence shows that during the period from 1977-79, the noncompliance rate regularly exceeded this five percent goal. Indeed, there were repeated instances where as many as ten to more than 25 percent of E&DCRs had not been handled in accordance with LILCO requirements. For example, in Field Audit 602, the auditor found that 28.08 percent of the drawings which were audited were missing applicable E&DCRs. Discrepancies exceeding ten percent were also found regarding controlled procedures and specifications. In addition, there were repeated instances where the master E&DCR log, designed to maintain overall accounting of all the E&DCRs on the project, was not up-to-date and complete. Thus, in Field Audit 602, the master log did not list 26 percent of the E&DCRs. (Findings QA:94, 97-99, 101). These deficiencies continued in succeeding audits. For instance, in Field Audit 654, dated November 1977, 37.5 percent of the drawings had discrepancies. (Finding QA:111).12/

12/ LILCO took corrective and preventive action for the E&DCR deficiencies. (See, e.g., Findings QA:101-103, 106,

(Footnote cont'd next page)

The E&DCR control problem during 1977-79 was particularly acute with respect to Courter and Company ("Courter"), the LILCO contractor in charge of all ASME piping. Beginning with Field Audit 602 in November 1977 and continuing well into 1979, Courter repeatedly had problems in complying with the E&DCR requirements. (See Appendix 2 for summary of Courter E&DCR deficiencies; Findings QA:91, 100, 108, 111, 113-16). These problems were sufficiently severe to cause the LILCO QA organization to highlight these problems on its Quarterly QA Reports to Management. (See Findings QA:119-21; Appendix 2, at 2-4).

With respect to Courter, the worst of the deficiencies appeared to have been rectified by sometime in 1979. (Appendix 2, at 4; Finding QA:118). However, even in 1980 and 1981, there were new instances in which Courter had failed to comply with the procedural requirements concerning E&DCRs. Indeed, the auditors in one instance in 1981 noted that certain Courter personnel did not appear to fully understand the requirements for E&DCRs. (Appendix 2, at 4-5).

(Footnote cont'd from previous page)

108-09, 114, 120, 140). However, given the continuing noncompliances, the corrective action, while perhaps adequate to address the specific problems which were identified, was insufficient in our opinion to get to the root causes and thus to eliminate the problems rapidly.

The failure to properly control E&DCRs has further been reflected in the Staff's I&E reports. For example, in I&E Report 76-06, dating from early 1976, the Staff noted that LILCO had already identified in Field Audits several instances of noncompliance with the procedural requirements for E&DCR control. The Staff cited LILCO for a Criterion 16 violation because LILCO had failed to take proper corrective action to eliminate the problem. (Findings QA:142-43). As demonstrated by the subsequent problems in 1977-79, proper and sufficiently comprehensive corrective action was not taken after I&E Report 76-06.

In the last two years, I&E reports have again made clear that the control of E&DCRs remains a continuing QA/QC deficiency. First, in the 1982 CAT inspection, the NRC Staff cited LILCO for a weakness in E&DCR control. This weakness, in the Staff's opinion, resulted from the fact that there was a large number of E&DCRs outstanding which had not been incorporated into the underlying design documents (e.g., into a drawing or specification).13/ It was the Staff's view that without such incorporation, there were too many E&DCRs outstanding, leaving

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13/ The CAT inspectors also expressed concern in the electrical separation area where an installation requirement specified in an E&DCR had not been implemented in the as-built plant. This was not cited as a violation because work was continuing in the area. (See discussion in Section IV.B.6).

the possibility of work being performed without personnel being cognizant of all necessary design changes which had, in fact, been approved. Thus, the Staff believed that the Shoreham E&DCR system failed to provide for the kind of clear, concise and timely distribution of technical and design information which, in the Staff's view, was essential to error-free engineered construction. (Findings QA:145-46).14/ The Torrey Pines inspection also expressed concern about the lack of timely incorporation of E&DCRs into Shoreham's design documents. (Finding QA:618).

Later in 1982, in I&E Report 82-26, the Staff again noted problems with the control of E&DCRs at Shoreham. In that instance, drawings had been revised in 1981 and the master E&DCR log indicated that the underlying E&DCRs had been incorporated into the revised drawing. In fact, however, LILCO had not incorporated the E&DCRs.15/ While not directly related to the weaknesses identified in the CAT inspection, this item was not totally unrelated either. The CAT inspection had concerned the timely incorporation of E&DCRs. Inspection Report 82-26

14/ Previously, in EA Audit 23, dated December 28, 1977, SWEC auditors had similarly noted failure to effect timely E&DCR incorporation. (Finding QA:128). Also, in I&E Report 81-22, the Staff had already identified E&DCR control weaknesses. (Finding QA:156).

15/ In Report 82-26, I&E also noted deficiencies in maintenance of the master E&DCR log. (Finding QA:150).

involved an E&DCR which had not been incorporated, when in fact it seemed as if it had been incorporated. (Findings QA:147-49). All of these problems, however, demonstrate the importance of the careful control of E&DCRs, something which clearly has been lacking on the Shoreham job.16/

Finally, I&E's 1983 RAT inspection (discussed in detail in Section IV.B.7) has once again documented deficiencies in LILCO E&DCR control. In RAT, the E&DCR deficiencies involved:

-- Misuse of different E&DCRs that specified different requirements for bearing between pipe clamps and lugs (Finding QA:485);

-- Errors in orientation of reference points for a cable tray support (Finding QA:501);

-- Failure by Field Quality Control ("FQC") to request engineering approval and issuance of an E&DCR prior to relocating hardware attached to a final inspected and accepted cable tray support (Finding QA:506); and

-- Failure to incorporate E&DCRs into a revised design drawing (Finding QA:548).

LILCO has acknowledged that during the period from 1977-79, there were problems with E&DCR control and, indeed,

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16/ In I&E Report 82-29, Mr. Higgins identified E&DCR problems similar to those identified in Report 82-26. (Finding QA:571).

that it considered the situation to be unacceptable. (Findings QA:91, 109). However, LILCO does not believe these are serious concerns because it found no instance where the E&DCR change had not in fact been implemented in the as-built plant. First, after the problems in mid-1977 were identified, LILCO reviewed a random sample of 200 E&DCRs for adequate implementation. While several E&DCRs had posting-type administrative problems, all E&DCRs that required implementation had in fact been implemented. (Finding QA:103). This sample does provide some assurance that the E&DCR problems did not affect the actual safety of the plant. However, a one-time sample of 200 E&DCRs does not demonstrate that all E&DCRs (and we repeat that there have been about 70,000 on the project) have in fact been properly implemented. Furthermore, the recent RAT inspection findings (Section IV.B.7), which specifically found E&DCRs which had not been properly implemented (even after final QA/QC inspection), demonstrate that there is no assurance that the E&DCR control problems did not affect the as-built plant.17/

Second, LILCO is not deeply concerned about a potential safety impact from the E&DCR control problems because all E&DCRs are subject to in-process and final FQC inspection,

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17/ The substantive concerns identified in the RAT inspection echo substantive E&DCR-related concerns also noted in I&E Reports 76-06 and 80-14. (Findings QA:154-55).

which has not identified any instances where the proper design documents were not being used. (Findings QA:87-88, 104). However, such reliance on final inspection cannot be given great weight. As demonstrated later in this Opinion (Section IV.B.7), in the recent RAT inspection, the NRC Staff raised substantial concerns about the adequacy of the final inspections and over-reliance thereon. The Board, as explained in that Section, shares this concern. (See also Finding QA:135 concerning FQC Audit 33 where final inspection missed inconsistency between an E&DCR and the as-built plant). Further, as demonstrated by the Torrey Pines inspection, there have been repeated instances where inspections or "gates" in the LILCO process have failed to identify QA/QC deficiencies. (Findings QA:673-84). This evidence further supports our view that the inspection process does not provide sufficient assurance to overcome the concerns raised by the E&DCR problems experienced at Shoreham.

Finally, LILCO has relied upon the E&DCR verification program, which was instituted in 1976, as an additional reason to believe that there has been adequate implementation of the underlying E&DCR changes, even if the E&DCRs were not properly controlled. (Findings QA:105-56). However, while a large number of E&DCRs issued for Shoreham required physical work, the verification program is designed to cover only

approximately 8,000 E&DCRs, out of the 70,000 which have been written for Shoreham. (Findings QA:158-59). Accordingly, this program does not ensure that all E&DCRs were actually implemented properly.

Our concern with respect to E&DCRs is similar to that with respect to calculations. The E&DCR requirements were mandatory aspects of the Appendix B QA/QC program implemented by LILCO. There is repeated evidence that these E&DCR requirements, even if they are designated "administrative," were not effectively implemented over a long period of time, and that, in fact, lack of control of E&DCRs has continued into 1983.

One final observation should be added. LILCO has suggested that one reason for the widespread E&DCR problems in 1977 was that much additional work was being performed on the project at that time. (Finding QA:83). However, it is clear that some of the organizations which exhibited these problems (such as Courter) had been on the project for a long period of time, and thus should have been familiar with the E&DCR process, even if personnel were changing. (Finding QA:123). Furthermore, it is also clear that LILCO could have anticipated the increased amount of work, and the QA program should have taken steps to ensure that the increased work did not lead to increased problems. This certainly should have been the case after I&E Report 76-06, which cited LILCO for a Criterion 16

violation for lack of E&DCR control and for a further E&DCR-related design control violation. (Findings QA:142-44). Accordingly, we hold that there has been a pattern of QA/QC problems in the E&DCR program, commencing in 1976 and continuing to the present.

3. LILCO Has Failed to Implement Programs for Storage and Housekeeping in Accordance with 10 CFR Part 50, Appendix B

10 CFR Part 50, Appendix B, Criterion 13, sets forth the basic requirements which LILCO must meet for storage, receiving and handling of materials and equipment during the construction phase. Criterion 2 of Appendix B specifies that activities that affect quality must be accomplished under suitably controlled conditions, such as adequate cleanness. LILCO in the FSAR has committed to comply with these Appendix B criteria. Furthermore, LILCO commits in the FSAR to comply with ANSI Standard N45.2.2, issued in 1972, which pertains to receiving, storaging and handling of safety-related components. (Findings QA:162-64, 174).

The foregoing regulatory requirements and the ANSI standard, as implemented further by LILCO procedures, specify a variety of requirements, all of which are designed to protect equipment and materials, either in storage or installed in place. The kinds of activities which thus must be conducted include: providing adequate drainage for items being stored,

such as having them on dunnage; specifying covers on equipment and material to ensure protection from weather and other kinds of damage; specifying end caps for pipes, conduit and other items, again to ensure adequate protection; and specifying the maintenance of proper environmental conditions for items, such as necessary heat for certain kinds of equipment. In addition, the procedural requirements include maintaining documented records for equipment. LILCO has chosen to comply with this requirement, at least in part, by having storage history cards, which include information such as where an item is to be stored and also specifying the necessary tests or maintenance activities which must be performed. (Findings QA:165-69, 172-73, 175).

In addition, as part of its Appendix B program, LILCO has established requirements to keep storage areas and other areas of the plant free from excessive litter and debris. These housekeeping requirements are imposed for the same basic reason as are the storage requirements, namely to ensure that there is less opportunity for deterioration or damage of materials and components due to dirt, debris and other soil. (Findings QA:221-23, 251-52).

All of the foregoing activities are part of the LILCO program for compliance with 10 CFR Part 50, Appendix B. (Findings QA:162-63, 221). Suffolk County has alleged that LILCO has

failed to implement these requirements in a systematic manner, thereby constituting a pattern of noncompliances with 10 CFR Part 50, Appendix B, Criteria 2 and 13. We agree.

(a) Storage Deficiencies

The evidence documents repeated instances where LILCO failed to comply with procedural requirements for storage of components and equipment. The noncompliances identified in LILCO and SWEC audits are summarized in Appendix 3[18]/ to this Decision and also in our Findings. The storage noncompliances identified in I&E Reports are summarized in the Findings. We summarize in this Opinion some of the more salient findings.

i. There were repeated instances where the storage history cards contained errors or were missing. (Appendix 3, at 1). In addition, there were repeated instances where the storage history cards specified some requirement, such as an inspection or a maintenance activity to be performed, but the storage history card requirements had not been carried out at all or in a timely manner when the auditor made his findings. (Appendix 3, at 1-2; Finding QA:178).

18/ Appendix 3 consists of a five-page index separating LILCO and SWEC audit findings into storage and housekeeping categories, followed by a 19-page summary of the audit findings themselves. In our citations to Appendix 3, we cite to the five-page summary.

ii. There were repeated instances identified in SWEC, LILCO and I&E audits where necessary protective coverings and tarpaulins were not provided, exposing equipment and material to possible deterioration due to weather, dirt or other causes. (Appendix 3, at 2; Findings QA:203, 207, 215, 216).

iii. There were more than 30 instances where end caps were required to be installed, but when the auditors or inspectors visited, the end caps were not in place. (Appendix 3, at 3; Findings QA:174, 184-86, 196, 199, 201, 203).19/

iv. There were repeated instances where adequate environmental protection (such as heaters) was not provided. (Appendix 3, at 4-5; Findings QA:209-11).

v. There were repeated instances of other storage problems related to such matters as a lack of proper dunnage, poor drainage and leaking roofs. (Appendix 3, at 2-3, 3-4; Findings QA:179, 181-82).

19/ It appears that one reason end caps often were off was that work was being performed but not at the time the auditor visited. Thus, the auditor observed the end cap not in place and wrote the audit observation. If this is the case, the program, in our opinion, should have instituted a tagging system or some other device to show that QA/QC requirements were being met and that the situation was a justified occasion to have caps off. (Finding QA:185; LILCO Finding QA:397). This particularly would have been necessary since ANSI N45.2.2, to which LILCO is committed, requires that caps and covers be on at all times. When caps are removed for work, they must be immediately replaced after the purpose for removal is completed. (Finding QA:203).

vi. There were nine instances where actual damage was reported. (Appendix 3, at 5; Finding QA:187).

We emphasize that the problems in this regard were not isolated instances.20/ For instance, the failure to provide protective coverings or tarpaulins was identified as early as 1975 in FQC Audits and in 1976 in LILCO Field Audits. These problems have continued until at least 1981. (Appendix 3, at 2). Furthermore, the failure to provide necessary coverings was a problem which was documented repeatedly in I&E Inspection Reports. Indeed, I&E Reports 76-07, 76-09, 78-16, 79-06 and 79-16, each involved the failure to provide protective coverings for installed equipment. The Staff was sufficiently concerned by these problems that it insisted upon LILCO giving greater attention to elimination of storage-related deficiencies. (Finding QA:216). In addition, this situation was of sufficient note so that it was documented by LILCO in its quarterly QA reports to management. In fact, in each quarterly report to management from May, 1980 to December, 1981, it was reported that adequate environmental protection for installed equipment had not been provided. (Findings QA:188-90, 192).

20/ LILCO suggests that corrective action was taken for all these instances. (See, e.g., Findings QA:193-95). The Board does not doubt this but again must question the effectiveness of the LILCO response since similar problems continued to be identified. (See, e.g., Appendix 3; Findings QA:264-66).

Furthermore, the 1982 CAT inspection also documented the same kinds of storage problems. (Findings QA:174, 199 (valves not plugged or capped to prevent entry of dirt); QA:200, 205-06 (free electrical terminals not protected); QA:201 (electrical components not sealed to prevent entry of moisture); QA:245-46 (scaffolding hung from pipe supports contrary to requirements)). I&E has also identified recurrent problems with failing to tag items where leads were lifted. (Findings QA:199, 204 concerning I&E Reports 81-14, 81-20, 82-04 and 82-13). These all reflect a general inattention by LILCO to full implementation of its QA program.

Suffolk County also introduced evidence that the LILCO storage surveillance program identified repeated instances of the same kinds of problems that were identified in the audit programs of LILCO, SWEC and the Staff. Thus, over the time period of 1976-81, 9.85 percent of the time that covering of equipment (called environmental protection in the surveillance program) was inspected, it was found unsatisfactory. The comparable unsatisfactory marks in some of the other areas discussed above were: storage history cards, 6.04 percent; dunnage, 15.21 percent; internal heaters, 11.9 percent; and openings capped, 12.64 percent. These percentages indicate again, in our opinion, that proper attention was not devoted to strict compliance with the storage requirements of the LILCO QA/QC program. (Findings QA:259-66).

LILCO has taken the view that the number of audit observations and I&E Inspection Reports related to storage are not out of line, considering the large number of components and materials which needed to be stored over a long period of time. The NRC Staff has basically agreed with this position. (Findings QA:177, 218, 220). We are mindful that the storage problem at a large construction site is very difficult, particularly over a long period of time. However, the repeated instances of similar noncompliances with procedural requirements demonstrate to us that adequate care was not taken. Indeed, the NRC Staff itself indicates that storage deficiencies had become a serious concern by 1979, since as a result of I&E Report 79-16, it brought the matter to the attention of LILCO's management and requested increased LILCO attention to storage problems. (Finding QA:216). However, audit observations concerning inadequate storage continued thereafter, indicating that proper corrective action was not taken.

LILCO also takes the position that the storage observations are not significant because no damage was observed in most instances, and in those few instances where there was damage, the items were repaired. (Findings QA:194-96, 202). First, for reasons we have discussed already in this Opinion, the fact that a safety defect (in this instance damage) was not identified is not reason for lack of concern if QA/QC

noncompliance is documented. More important, in the area of storage, it is impossible to be sure that damage did not in fact occur, particularly premature aging, since testing will not always identify the damage. (Finding QA:184, 249). Accordingly, we conclude that a pattern of noncompliance with Appendix B storage requirements has been established.

(b) Housekeeping Deficiencies

The foregoing discussion addresses what we have called the storage area. We address now the related area of housekeeping, which concerns those procedural and other requirements that ensure that the plant is kept sufficiently free of litter, dirt and debris so that activities affecting quality will not be adversely impacted. In the housekeeping area, we find that LILCO compliance with Appendix B requirements has been completely unsatisfactory. This conclusion is based upon a series of housekeeping deficiencies that reflect a lack of LILCO management attention to full Appendix B QA/QC implementation.

In the housekeeping area, LILCO auditors have repeatedly identified noncompliances over the years.21/ (Appendix 3, at 4; Findings QA: 255-58). Some involved damage or the risk of damage. (Findings QA:256-58). In addition, serious housekeeping deficiencies have been identified by the I&E inspectors.

21/ LILCO suggests there were 16 housekeeping deficiencies identified by LILCO and SWEC. (LILCO Finding QA:415).

In I&E Report 79-16, the NRC Staff identified serious housekeeping deficiencies, particularly dirt and debris near equipment. The auditor noted:

> [T]he inspector noted on tours conducted between October 3 and October 11, 1979, that many Category I components were not maintained with adequate cleanness. Discrepancies noted included accumulations of dust, dirt, grease, trash, and broken glass. Some of the affected components were: Standby Liquid Control Pumps and Motors, High Pressure Coolant Injection Pump and Turbine, Reactor Core Isolation Cooling Pump and Turbine, and the Battery Room. Staff Ex. 8, Attachment 2.b.

(Finding QA:244). As noted earlier, as a result of this audit, the NRC Staff required LILCO to take steps to rectify the situation. The Staff believed that the situation was rectified. (Finding QA:216).

In fact, however, LILCO's corrective action after I&E Report 79-16 can only be viewed as ineffective. First, in 1980 and 1981, LILCO Field Audits and SWEC FQC audits identified further housekeeping deficiencies. These noncompliances included:

-- Filters being used to store a welder's helmet, piping, tubing, rain coats, and various debris and accumulation of debris behind filter (FA 1086; Appendix 3, at 4);

-- Accumulations of dirt and debris in a Level B warehouse (FQC 34; Appendix 3, at 4);

-- Pipe storage area had excessive paper (FA 1275; Appendix 3, at 4);

-- Violation in Field Audit 1275 not cleaned up by next audit (FA 1325; Appendix 3, at 4);

-- Debris in cable storage area (FQC 40 Appendix 3, at 4).

Subsequently, in the 1982 CAT inspection, the Staff again identified widespread housekeeping deficiencies, including some involving fire hazards and certain areas which were extremely dirty. Indeed, when these deficiencies were first identified in early February, 1982, LILCO did not immediately take steps to rectify them. Rather, the CAT inspectors, who were on site for three weeks, identified repeated instances of the same kind of noncompliance later in the inspection. The situation observed in February, 1982, stemmed from lack of management control for housekeeping, cleanliness and fire prevention. (Findings QA:225-27, 233). This lack of management attention has persisted.

As a result of the CAT inspection, LILCO promised to take strong and effective corrective action. Thus, LILCO assigned a ten-person cleanup crew to buildings and issued memoranda to personnel directing them to strictly comply with housekeeping requirements. Indeed, LILCO even threatened personnel with dismissal if compliance were not forthcoming. (Findings

QA:226, 228-30). The Staff was not fully satisfied with these actions, however, and in early September, 1982, had management meetings with LILCO to stress again the importance of proper housekeeping. (Findings QA:233, 242-43). At that time, LILCO made additional commitments in the housekeeping area. (Finding QA:243).

However, in I&E Inspection Report 82-27, reporting an inspection conducted in October, 1982, the Staff <u>again</u> identified the same kinds of extensive housekeeping deficiencies identified in CAT -- extensive litter and debris -- which indicated that the prior corrective action, that resulting from the CAT inspection, had not been properly implemented. The Staff noted:

> Inspection of battery and emergency switchgear rooms revealed many unacceptable items such as wood, rags, paper, metal, poly bottles, drop cords, welding lead, air hose, a damaged ammeter on a battery charger which had been damaged since May 1982, a 24 VDC battery cell which has been jumpered cut with a damaged connector since July 1982, and all three battery doors unlocked and propped open . . . .
>
> The reactor building and containment were very dirty with debris, hardware, wood, rags, paper and dirt on components, piping, and in electrical trays.
>
> It was noticed that a concerted effort was being made in the containment drywell, but is not evident in the reactor building. In screenwell room A, a ladder was against the electrical cabinet and no fire extinguisher is present in the room. In screenwell room B, a large workbench is up

against the electrical cabinet also. (Finding QA:231).

The observations in I&E Report 82-27 were not cited as an additional Appendix B violation in I&E Report 82-27 because the violation from the CAT inspection had not been closed out. (Finding QA:232).

The Staff's RAT inspection team visited the Shoreham site in January, 1983. During that inspection, the Staff identified another series of widespread housekeeping deficiencies. The Staff observed an "overall prevalent attitude among site personnel of inattention to housekeeping." (Findings QA:554-55). The deficiencies observed by the Staff are described in our Findings. (Findings QA:554, 558). These deficiencies resulted in the Staff issuing a Corrective Action Letter to LILCO and having yet another management meeting. (Finding QA:550). The concern of the Staff was that if LILCO permitted these deficiencies to continue, safe startup and operation of the plant could be affected. (Findings QA:240, 559).

LILCO has taken the position that the differences between the Staff and LILCO concerning housekeeping requirements represent mostly differences in philosophy and not a substantive QA/QC problem. We disagree. While there clearly are differences in philosophy between LILCO and the Staff (Findings QA:222, 237, 555-57), the fact is that after the CAT inspection and, again at the September, 1982 meeting, LILCO management

agreed that it would take strong measures to ensure that proper housekeeping measures were effected. (Findings QA:228-30, 243, 254). The fact that repeated noncompliances in the same area continued to be found demonstrates not only that proper corrective action was not implemented, but also that the LILCO management commitments in this regard could not be fully counted upon. (Finding QA:558). This is unacceptable given the key role of management in QA/QC implementation. Based upon the foregoing, we find that the LILCO program for housekeeping, and corrective action in that regard, was unsatisfactory and not in compliance with 10 CFR Part 50, Appendix B, Criterion 2.

4. LILCO Has Not Maintained Manuals Up-to-Date

LILCO's program for compliance with 10 CFR Part 50, Appendix B, requires that the latest revision of documents be used for work. Included in this Appendix B program is the requirement that controlled copies of manuals be kept up-to-date. (Findings QA:267-70).

The evidence documents numerous occasions where LILCO has failed to comply with this requirement to keep manuals up-to-date. This evidence was observed both in the audits by SWEC of the EA Division and the FQC Division, as well as in I&E inspections.

With respect to the SWEC audits, we have summarized in Appendix 4 to this Decision, as well as our Findings, those audit findings which indicate failures to maintain controlled manuals up-to-date. (Appendix 4; Findings QA:278-80, 284). This evidence documents numerous occurrences between June, 1975, and December, 1981, where manuals were not being kept up-to-date. These instances constitute violations of LILCO procedures and its Appendix B program for updating controlled documents.22/

Further, the NRC Staff has identified a number of cases where manuals were not being kept up-to-date. Of particular importance is the fact that beginning in mid-1981 and continuing into 1982, the NRC Staff identified repeated instances where the Startup Manual was not being updated properly by LILCO. These instances were first identified by the NRC Staff in the summer of 1981 in I&E Report 81-13. As a result of that inspection, it was determined that 42 of the 59 copies of the Startup Manual had updating deficiencies. (Findings QA:273, 275).

As a result of Inspection 81-13, LILCO was required to take corrective action. In a subsequent audit, I&E Report 82-02, conducted in January, 1982, the I&E inspector determined

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22/ I&E Report 79-05 involved LILCO's failure to keep the Engineering Quality Assurance Procedures Manual up-to-date, an occurrence similar, in our view, to the noncompliances summarized in Appendix 4. (Findings QA:270-72).

that the control room and Operating Quality Assurance ("OQA") copies of the Startup Manual had not been properly updated. Accordingly, as of January, 1982, the prior corrective actions instituted after I&E Report 82-13 had not been effectively completed. This was not cited as a violation because the prior audit violation in 81-13 had still not been closed. (Finding QA:276).

Subsequently, in May, 1982, in I&E Report 82-08, the NRC Staff again audited the LILCO Startup Manual to find whether it was then up-to-date. It was determined at that time that there was a repeat violation of the failure to control the Startup Manual. Because of this repeat observation of the same problem, the NRC in May, 1982, did cite LILCO for a violation. (Findings QA:273-77). Subsequent to I&E Report 82-08, LILCO apparently instituted effective action to control the Startup Manual. (Finding QA:277). However, this corrective action, while welcome, does not alter our view that the LILCO program for corrective action has not been completely effective. Accordingly, we find that this is further evidence of noncompliance with Appendix B requirements.

5. LILCO Has Not Maintained the FSAR Up-to-Date and Accurate

The FSAR is an important document in the licensing of Shoreham and a primary document which the Staff reviews. The

Staff also reviews underlying design documents, but believes the statements and details in the FSAR should be completely accurate. (Findings QA:293, 295, 306, 316).

The evidence documents that there have been widespread deficiencies in the control of the Shoreham FSAR. LILCO procedures require that when design changes are made, such as by an E&DCR, that review has to be made to determine whether the FSAR also needs to be amended so that it remains completely accurate. (Findings QA:285-287, 290-93, 298). In fact, however, the FSAR has not been maintained in an accurate condition.

The lack of accuracy of the FSAR has been a concern of the Staff for some time.23/ Indeed, in November, 1981, the NRC Staff advised LILCO that the FSAR would have to be made more accurate or I&E would not be in a position to recommend licensing of the plant. (Findings QA:294, 297).

Subsequent to November, 1981, LILCO has embarked on the Shoreham Plant Configuration Review ("SPCR") Program. Under this program, the safety systems at Shoreham will be reviewed to determine whether the as-built plant complies with the FSAR description. (Findings QA:294, 302-303). As of the time of the hearing on this matter, seven SPCR reports were available,

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23/ LILCO's internal audits also have reported, over the years, a number of instances where the FSAR has not been kept fully accurate. (Findings QA:290-92).

although final review had not been completed. The evidence indicates that in each SPCR report, differences between the as-built plant and the FSAR were identified. (Findings QA:305, 309-13). While these differences in no instance appear to be major, they constitute the kinds of details that the Staff believes should be fully accurate. Indeed, contrary to LILCO, the Staff believes all aspects of the FSAR constitute FSAR commitments which are required to be fully accurate. (Findings QA:300-01, 316).

The FSAR does not constitute the primary design document from which the plant is constructed. Rather, the detailed design documents from which the plant is constructed are underlying drawings, procedures, specifications and other documents. However, the FSAR interfaces closely with the detailed design documents. (Finding QA:288-89). Accordingly, we conclude that the FSAR is a part of the overall design process for the power plant and thus should be maintained fully up-to-date. Further, since LILCO has a program for keeping the FSAR up-to-date, and since that program clearly has been ineffective (at least into early 1982), we consider this situation to be further evidence of a lack of discipline during design and construction of Shoreham.

The need to update the FSAR to make it more accurate was emphasized by the Staff's CAT inspection, where the Staff

identified eight deviations. (Findings QA:321-22, 324-29). One deviation is of particular significance because it has such clear QA/QC design control implications. During CAT, the Staff observed that drywell spray nozzles were partially blocked by HVAC duct work, a blockage condition which was not depicted in the FSAR. The Staff noted this as a deviation. Subsequent review disclosed a QA/QC nonconformance: the condition of blockage of the drywell spray (a system classified by LILCO as safety-related) had never been analyzed by LILCO engineering personnel or identified by the LILCO QA organization. (Findings QA:317-20). This constitutes, in our opinion, a clear deviation from the requirements of Appendix B, Criterion 3, which requires control of design interfaces. No satisfactory explanation of this QA/QC discrepancy was provided, including how it could have occurred in the first place under LILCO's QA program.

The Staff testified that it wants a completely up-to-date and accurate FSAR, reviewed by the Staff, prior to fuel load. (Finding QA:299). We agree. We disagree with LILCO's apparent view that much of the information in the FSAR is "descriptive detail," not amounting to a FSAR commitment. (Finding QA: 301). It is not feasible to draw a line between what is a "commitment" and what is other "detail." We thus accept the Staff's position that the FSAR should be maintained as

accurately as possible, and certainly should not be permitted to exhibit such deviations (or violations) as illustrated by the drywell spray problem.

The FSAR, based upon the evidence of record, has not been maintained up-to-date. The SPCR Program, however, appears satisfactory to rectify the situation, so long as it is fully carried out and so long as procedures are implemented to ensure that the FSAR, once made accurate, is maintained in that condition. Accordingly, prior to fuel load, we require: (a) that the SPCR Program be completed by LILCO; and (b) that the Staff complete its review of the SPCR Program as described in its testimony (Finding QA:299), and provide us with its view regarding whether the Shoreham FSAR is then fully accurate. The results of the Staff review should be submitted to the Board and parties for necessary review to ensure that the Shoreham FSAR is, in fact, up-to-date. In addition, we require that LILCO establish procedures to ensure that the FSAR, once brought to an accurate condition through the SPCR Program, will be maintained in that condition in the future. As part of this submission, LILCO must demonstrate that the procedures and other measures which are being implemented will alleviate the past problems which have arisen.

6. LILCO Has Failed to Comply with Electrical Separation Criteria

During the QA/QC hearings, there was discussion concerning LILCO's QA/QC design control program relating to ensuring compliance with electrical separation requirements. This discussion concerned particularly whether the LILCO QA/QC program had been sufficiently attentive to ensure that nonconforming installation of electrical cable, raceway and conduit had not been made or, if made, had been properly noticed, as required by 10 CFR Part 50, Appendix B. (See Finding QA:333).

In the CAT inspection, the I&E inspectors observed that while an E&DCR had established requirements for separation of Class 1E and non-Class 1E electrical cables, the inspectors identified examples of cable installation that did not comply with the separation requirements. This installation thus did not conform to the E&DCR and violated LILCO separation criteria. These nonconforming installations had not been identified by LILCO prior to the CAT inspection. It was not cited as an I&E violation, however, because LILCO felt that there was still ongoing construction in the area and that the final LILCO QA/QC inspection had not taken place. (Findings QA:331-32). The Staff witnesses appeared to agree, however, that this could have been cited as an Appendix B violation. (Findings QA: 335-36).

One purpose of the QA/QC program is to ensure that nonconforming installations do not take place, or are appropriately controlled. (See Findings QA:333, 339; 10 CFR Part 50, Appendix B, Criterion 15). The CAT inspection represents one observation in a line of previous observations where the QA/QC program had not effectively ensured that nonconforming installations did not occur. (Finding QA:330).

For example, in I&E Report 77-05, I&E cited LILCO for a Criterion 16 violation. In that report, it was noted that nonconforming cable installations had been identified by SWEC and deficiency correction orders had been issued. However, notwithstanding these deficiency correction orders, further nonconforming installations had taken place, repeating those that had been previously identified. They were cited as a violation by I&E, notwithstanding the fact that final FQC inspection had not taken place, because in-process inspection had occurred and should have prevented the nonconformance from occurring. (Findings QA: 337-38).

Subsequently, in I&E Report 79-07, a design control problem occurred in the electrical separation area. This problem again constituted a Criterion 16 violation, in that nonconforming raceway installations were in violation of separation criteria. This permitted the subsequent installation of nonconforming cable. Corrective action to prevent repetition had not been taken. (Findings QA: 340-41).

Subsequently, in I&E Report 80-10, the inspector observed that redundant safety-related conduit was installed but it did not meet the separation criteria of the specification. The nonconformance had not been previously documented or tagged and thus constituted a nonconforming installation in violation of Appendix B. (Finding QA: 342).

The nonconformances in the electrical separation area were finally closed out, with certain minor exceptions, in I&E Inspection Report 82-24. (Finding QA:343). Our concern in this regard, however, is that over a period of approximately five years, there were repeated instances where electrical separation difficulties were observed due to nonconforming installation. QA/QC is designed to prevent such nonconforming installation, or if allowed, should clearly identify the nonconformance at the time of the installation. This had not taken place, which indicates a deficiency in the QA/QC program.

The Staff testimony in this regard was that the electrical separation area is an exceedingly difficult one at all plants and that the type and number of electrical separation violations which occurred at Shoreham were probably fairly normal compared to other plants. (Findings QA:344-45). However, it is clear that even at the time of the CAT inspection, the procedures and inspection criteria, that the inspectors were to utilize in the electrical separation area, were still not fully

developed. LILCO was aware of the need for further definition of separation criteria, but they were not yet established. (Findings QA:346, 403).

Under 10 CFR Part 50, Appendix B, timely and complete implementation of Appendix B requirements is required. It appears to this Board that in the electrical separation area, the emphasis was on installing cable and other items, rather than installing them correctly. The evidence does not explain why the separation criteria were not fully defined and established prior to 1982. The evidence also does not explain why cable, raceway and conduit continued to be installed when the design criteria still were not finally determined. In an area as important as electrical separation, the Board would have expected that the QA/QC program implemented by LILCO would have insisted that the defined criteria for electrical separation be fully established well before 1982. In this regard, we note that those criteria were not established until after the CAT inspection, or only six months before the date LILCO, in early 1982, was projecting fuel load. This is unacceptable in terms of the timely implementation of design criteria. Accordingly, in the electrical separation area, we find that LILCO did not implement a QA/QC program in a timely and effective manner.

7. The Staff's Readiness Assessment Team Inspection Confirms That LILCO's QA/QC Program Has Not Been Properly Implemented

(a) Introduction

During January 10-15, 1983, the Staff conducted an unannounced Readiness Assessment Team inspection of the Shoreham plant. This inspection was performed by resident and region-based inspectors and NRC Region I management and was conducted to determine the status of operational readiness of the Shoreham facility. Based on the results of this inspection, the Staff concluded that a number of areas required resolution by LILCO before it can be determined whether Shoreham is ready for an operating license. (Findings QA:423-24).

The Staff identified four Severity Level IV violations during its inspection. In addition, the Staff found plant housekeeping to be unacceptable at the time of its inspection. LILCO was cited for no violations in the housekeeping area primarily because plant housekeeping was already an open violation. However, on January 19, 1983, the Staff issued Confirmatory Action Letter ("CAL") 83-01. In the Staff's view, this provided a mechanism to achieve prompt corrective action from LILCO in the housekeeping area. (Finding QA:427; see Section IV.B.3(a) for further discussion of housekeeping).

(b) LILCO's Overreliance on the Final Inspection Program to Identify Construction Discrepancies

The nature of the violations and other construction discrepancies identified by the Staff during the RAT inspection led the Staff to conclude that additional action is needed in the area of final system inspections. In particular, the Staff expressed concerns about LILCO's overreliance on the final inspection program to identify construction discrepancies. (Finding QA:429). We agree.

The Staff's concerns are understandable in light of the RAT inspection findings. The RAT inspection team took into consideration the inspection status of the items and components reviewed during the inspection and, as a general matter, only those discrepancies that had passed through the Shoreham final inspection program without having been detected were made violations by the Staff. (Finding QA:428). In addition, the Staff was concerned by the fact that FQC final inspections had resulted in a significant number of components being rejected and returned to Construction for additional work. (Finding QA:432). To the Staff, the high rejection rates indicated that construction items are not receiving proper attention prior to being sumitted to FQC for final inspection. Accordingly, the Staff requested assurances from LILCO that components would be "cleaned up" by Construction prior to the time they are turned over to FQC for final inspection. (Finding QA:434).

Because of its concerns about LILCO's overreliance on final inspection, the Staff instructed LILCO in its response to the RAT inspection to give particular attention to how it intended to ensure an effective final inspection program. (Finding QA:429). Unfortunately, LILCO's formal response had not been filed by the time of hearing. In fact, its preliminary response had not been fully reviewed by the Staff. As a result, no evidence regarding the Staff's review of LILCO's response was presented. (Finding QA:430).

Notwithstanding this lack of Staff review, the issue of LILCO's overreliance on the final inspection program to detect construction discrepancies was addressed in the RAT Inspection Report, in LILCO's prefiled testimony, and in cross-examination of LILCO and Staff witnesses. Based on the evidence presented, we conclude that LILCO's final inspection program has not been implemented effectively and that improvements to the program are therefore necessary.

Violations A and D of the RAT Inspection Report are discussed in detail later in this Opinion and thus will only be summarized at this time in the context of our discussion of overreliance on final inspections by LILCO. (See Sections IV.B.7.(c)(i) and (ii). Violations A and D involved completed contruction that had been final inspected and accepted by QC prior to the Staff's inspection. (Findings QA:452, 516). For

example, Violation A(2) resulted from the Staff's inspection of 12 pipe supports that had been final inspected and accepted by FQC. Notwithstanding this final inspection, the Staff identified discrepancies in three of the 12 supports. (Finding QA:465).24/

Even more disturbing were the Staff's inspection results in the area of Shoreham's electrical as-built program. In this important area, the Staff discovered that four of nine cable tray supports inspected did not conform to applicable drawings. (Finding QA:490).25/ These discrepancies were collectively identified by the Staff as Violation A(3). The nine supports inspected by the Staff had been randomly selected from among 350 cable tray supports that had been final inspected and accepted by FQC at the time of the RAT inspection. In addition, the supports had passed through LILCO's CABTRAP program prior to the Staff's inspection. (Finding QA:492).26/

24/ See also Finding QA:135 concerning FQC Audit 33, where final FQC inspection failed to identify inconsistencies between the as-built plant and what was called for in an E&DCR.

25/ The Staff's inspection disclosed discrepancies in Shoreham's electrical as-built program in addition to the discrepancies involving these four cable tray supports. These other discrepancies, however, were not identified as a violation by the Staff because the particular cable tray supports had not been turned over to FQC for final inspection. (Finding QA:514).

26/ The fact that the CABTRAP program did not identify these deficiencies severely lessens any reliance we might other-

(Footnote cont'd next page)

In Violation D, the Staff found further reason for concern about the adequacy of Shoreham's final inspection program. There, the Staff identified a number of discrepancies relating to repair/rework conducted by startup personnel on one of the Shoreham diesel generators. These discrepancies had not been detected by the Shoreham OQA organization, which had final inspected and accepted the repair/rework activity. (Findings QA:516, 521).

We recognize that because of the Staff's concerns regarding the final inspection program, LILCO has agreed to take certain measures to improve the quality and effectiveness of both construction activity and final inspections. These measures, however, are inadequate to accomplish this purpose. (Findings QA:437-38).

First, although LILCO has agreed to a Field Quality Assurance ("FQA") re-inspection of FQC-accepted components, that re-inspection is limited to a five percent sample of components that have been inspected and accepted by FQC since the time of the Staff's RAT inspection. Moreover, re-inspection will not be performed on a statistically valid random sampling basis.

(Footnote cont'd from previous page)

wise have given to this and the other as-built electrical programs described by LILCO. (See LILCO Ex. 21, at 184-87, and further discussion of this violation, infra).

Instead, the re-inspection will be performed on the basis of LILCO's judgment, and, solely on the basis of that judgment, LILCO will determine such questions as whether the sample size should be increased and whether further re-inspection is warranted. (Finding QA:439). As a result, there are no established criteria governing the FQA re-inspection program, and there is no basis to extrapolate from the items sampled to the entire population of FQC-accepted items. See, e.g., Finding QA:716). Moreover, LILCO has indicated that this re-inspection of FQC's inspection program will be for only a two-month period. (Finding QA:440).

Even at the time of the RAT inspection hearing, the FQA re-inspection program had found discrepancies not detected by FQC at the time of its final inspection. This result prompted the Staff to commit to a further review of the FQC final inspection program. (Finding QA:440). That review has not been completed and, on the evidence presented, we cannot find that the FQC final inspection program is functioning adequately. (Finding QA:441). Indeed, we reach the opposite conclusion: the deficiencies identified in the RAT inspection, coupled with the additional discrepencies already identified by FQA, lead us to conclude that the final inspection program cannot be relied upon to ensure that the as-built plant meets design requirements.

Second, we understand that LILCO has performed an analysis of those items rejected by FQC during the period November 1, 1982 through late January, 1983, to determine the reasons for rejection. We conclude, however, that the scope of LILCO's analysis is deficient and does not permit us to determine whether items are receiving proper attention by Construction prior to being submitted for final inspection. (Findings QA:442, 445). That analysis reveals that LILCO has not determined the disposition of all items rejected by FQC. (Finding QA:444). Moreover, the analysis does not provide sufficient data regarding those components rejected by FQC, but then accepted without modification in the field. The fact that a rejected item may later be accepted "as is" does not resolve our concerns about the quality and effectiveness of the QA/QC program -- especially since that program failed to detect the discrepancy before the item was submitted for final inspection. (Finding QA:445).

Third, we are concerned about the workload of FQC inspectors. As noted by the Staff in the RAT inspection report, the workload of the FQC group is significant and may increase as more items are completed and turned over for final inspection. (Finding QA:448). LILCO asserts that the workload of the FQC inspectors is in accord with "industry practice." It also points out that the size of the FQC staff has been

increased. (Findings QA:446, 447). Nevertheless, the workload has not diminished and, LILCO's opinion notwithstanding, we believe that the hours worked by FQC inspectors adversely impact the quality of the FQC inspection program. (Finding QA:449).

Finally, our concerns regarding the final inspection program are exacerbated by the apparent failure of site procedures to control construction activity to final inspected and accepted items. Site QC Procedure 15.4 requires Construction to notify FQC by means of a rework request notice when inspected items are disturbed. Both the Staff (see Violation C(1) of the RAT inspection, discussed infra) and Torrey Pines (see PFR 045, discussed infra) have discovered instances where this notification has not been given, resulting in final inspections being voided without obtaining assurance that there would be re-inspection of Construction's repair/rework activity. (Findings QA:537-38, 677). We find this failure to control construction activity surrounding QC inspected and accepted items to be a matter of significant concern.27/

27/ Our concern in this regard is heightened because in I&E Reports 82-04 and 82-26, the Staff identified instances where construction activity (scaffolding erected or attached to pipe supports) affected or could have affected QC-inspected items. (Findings QA:245-46).

For the foregoing reasons, we endorse the concerns expressed by the Staff regarding LILCO's overreliance on the final inspection program to detect construction deficiencies. Because the measures proposed by LILCO in response to the Staff's concerns are inadequate to ensure the quality and the effectiveness of construction and FQC inspections, LILCO is directed to:

1. Perform a statistically valid random sampling re-inspection of all items and components that have to date been inspected and accepted by FQC;

2. Submit promptly upon completion the results of this re-inspection for review by this Board and the parties;

3. Submit to this Board and the parties additional measures for improving the Shoreham final inspection program to an acceptable level.

(c) The Violations Identified by the Staff

(i) Violation A -- Failure to Provide Adequate Verification of Completed Construction in Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports

LILCO's failure to provide adequate verification of completed construction in the areas of Control Rod Drive ("CRD") piping supports, pipehangers and cable tray supports was identified by the Staff in RAT Violation A. As noted, the three subparts of Violation A involved construction activity that had been final inspected and accepted by QC prior to the RAT inspection. (Finding QA:451-52).

Violation A(1) -- Welds on CRD Piping Supports

Violation A(1) involved welds on CRD hydraulic line supports which were completed with fitup gaps even though the design drawings did not specify a gap requirement, but instead required fillet welds all around both ends of the supports. The installation and welding of the supports had been performed by Reactor Controls Incorporated ("Reactor Controls"). (Finding QA:454).

Problems regarding fitup gaps had been identified by the Staff prior to the RAT inspection. In Inspection Report 79-07, the Staff cited LILCO for welding violations where, like the violation identified in the RAT inspection, welds were completed with fitup gaps even though the gaps had not been specified

either in the design drawing or in the welding technique used in performing the welds. Reactor Controls performed the welding found deficient in both Inspection Report 79-07 and in Violation A(1) of the RAT inspection. (Findings QA:461-62).

We conclude that LILCO should have specified fitup gap requirements on the design drawings in question. Without such specification, design requirements become ambiguous and subject to the interpretation of the welder and the inspector. LILCO should therefore review all applicable design documents for pipe support welds of the type involved in Violation A(1). That review should ensure that Code requirements, including fitup gap requirements, are clearly specified.

Violation A(2) -- Completed Residual Heat Removal System Hangers

As previously noted, Violation A(2) resulted from the Staff's inspection of 12 pipe supports in the residual heat removal ("RHR") system that had been final inspected and accepted by FQC at the time of the Staff's RAT inspection. Of the 12 pipe supports inspected by the Staff, problems were identified with three of the supports. (Finding QA:465).

Two different types of problems were identified by the Staff. One problem involved torquing of the high strength bolts on a pipe support. The bolts were not installed finger tight as required by the design drawing; instead, they were

installed with an indeterminate torque in excess of finger tight. (Finding QA:467).

The second problem involved bearing gaps between lugs and pipe clamps on two pipe supports. The Staff noted that there was not full contact between the lugs welded to piping and the pipe clamps supporting the pipe as required by the "full bearing" (i.e., complete surface contact between the mating surfaces) provision of the applicable E&DCR. For one support, less than three of the four lugs were in full contact with the pipe clamp. For the other support, only three of the four lugs were in full contact with the pipe clamp. Additionally, the requirements of an E&DCR addressing the bearing requirements of a lug, ground to a taper, were not met for one of the supports in that only line contact between the clamp and lug existed. (Finding QA:468).

-- Improper Bolt Torque

There are only two pipe supports at the Shoreham plant that use high strength bolts required to be installed finger tight and both were found during the RAT inspection to have bolts installed with an indeterminate torque in excess of finger tight. (Finding QA:469). However, there are other components at Shoreham which require finger tight torquing of nuts and bolts. Moreover, there are design purposes for requiring finger tight torquing of components. (Findings QA:473, 475).

We conclude that there is no basis in the record to support LILCO's assumption that the original installation of the high strength bolts was correct and that the condition found by the Staff was the result of operational conditions. Therefore, LILCO should intitiate measures to ensure that the design purposes for requiring finger tight torquing of components are attained. (Findings QA:474-75).

-- Bearing Gaps

As noted, the "full bearing" provision of the E&DCR applicable to the two pipe supports inspected by the Staff required complete surface contact between the lugs and pipe clamps on the supports. This E&DCR requirment was not implemented in the as-built plant. Moreover, LILCO's final FQC inspection had not inspected for full bearing of all surfaces of the clamp/lug interface. Thus, LILCO speculated that the particular FQC inspector involved found the bearings acceptable, based on his interpretation of the drawings against which the supports were inspected. (Finding QA:476).

We find that the drawings should have been clear and unambiguous, thereby eliminating the need for interpretation by the FQC inspector. In instances where an FQC inspector has questions, he should go back to Engineering for clarification. Thus, in this particular instance, the FQC inspector, once he did not find the full bearing called for, should have either

gone back to Engineering for clarification, or the item should have been rejected. (Finding QA:476).28/

In its corrective action, LILCO proposes to re-inspect all supports of a "similar configuration" to the two supports found by the Staff not to have full bearing. (Finding QA:481). Pending the results of this re-inspection, we find no basis in the record to support LILCO's conclusion that adequate bearing for Shoreham pipe supports having a lug-to-clamp arrangement has been achieved. (Finding QA:481).

The RAT inspection report identified an additional problem involving the misuse of two different E&DCRs that specified different requirements for bearing between pipe clamps and lugs. In particular, the E&DCR which addressed bearings for GE-supplied supports was noted by the Staff to have been used by LILCO in inspecting SWEC supports. (Finding QA:485). LILCO has disagreed with the Staff's finding in this regard. (LILCO Finding QA:584). However, on the evidence presented, there is insufficient basis to support LILCO's position and we will await further Staff review. (Finding QA:487).

28/ We find this situation somewhat similar to that in EA Audit 34, Observation 020, where engineers installed supports in new locations on the basis of engineering judgment, rather than recalculation. (See Section IV.B.1).

Violation A(3) -- Cable Tray Supports

From a QA/QC perspective, the Staff considers the Shoreham electrical as-built program to be an important program. Thus, the RAT inspection included a review of documentation and installed components associated with that program. (Finding QA:488).

The intent of the Shoreham electrical as-built program is to provide accurate drawings of the installed electrical equipment, to ensure that all installations are properly qualified, to allow for modification of installations as necessary to meet specified requirements and to ensure that QC inspections are performed with updated, correct documentation. The program encompasses cable trays, cable tray supports, conduit, conduit supports, cable tray covers, junction boxes and cable wrapping. (Finding QA:489).

As previously noted, Violation A(3) resulted from the Staff's inspection of nine cable tray supports which had received final QC inspection under Shoreham's electrical as-built program. The nine supports were randomly selected from among the Shoreham cable tray supports that had been final inspected and accepted by FQC as of the time of the RAT inspection. These supports had also passed through LILCO's CABTRAP program prior to their inspection by the Staff. (Findings QA:490, 492). The Staff inspector observed that four of the

supports inspected did not conform to the applicable drawings governing their construction. (Finding QA:490).

Notwithstanding that discrepancies were identified in four of the nine supports inspected, LILCO believes that its CABTRAP program is adequate to verify that Shoreham's cable tray supports conform to the engineering criteria and applicable drawings governing their construction. Moreover, LILCO does not consider the discrepancies identified by the Staff in Violation A(3) to be the kind of discrepancies that raise concerns regarding the adequacy of the cable tray supports or of its CABTRAP program. (Finding QA:493). We do not agree.

Like the Staff, we are surprised that at Shoreham's stage of construction, these kinds of discrepancies exist with respect to the cable tray supports. (Finding QA:509). As noted, of the nine cable tray supports reviewed by the Staff, four of the supports did not conform to their applicable as-built drawings. Although LILCO responded to only three of the four discrepant conditions identified by the Staff in its inspection report, it acknowledged that the discrepancies identified with respect to the fourth support were not materially different from the discrepancies that related to the three other supports cited as a violation by the Staff. (Finding QA:491).

We understand that the Staff's review, once completed, will likely confirm LILCO's belief that the problems involving these supports can be resolved by correcting the applicable as-built drawings. (Finding QA:512). We expect LILCO, however, to initiate corrective action over and beyond the mere correction of the as-built drawings. In fact, given the kind of discrepancies identified during the RAT inspection, a sampling re-inspection by LILCO of all 350 cable tray supports which, at the time of the RAT inspection had been final inspected, is appropriate. Accordingly, LILCO is directed to complete and submit to the Staff acceptable documentation relating to this cable tray support/as-built drawing re-inspection. (Finding QA:512).

We further direct LILCO to institute retraining for all FQC inspectors responsible for inspection in the electrical as-built program. We are aware that, subsequent to the RAT inspection, some retraining of FQC inspectors responsible for inspections in the electrical as-built program was conducted. (Finding QA:513). This training, however, was limited in its scope. For example, the training should be expanded to take into account such matters as the other discrepancies in this area that were identified by the Staff. These discrepancies included incorrectly installed expansion anchor bolts, missing high strength bolting, and unsatisfactory and incomplete welding. (Finding QA:514).

We recognize that these discrepancies were not identified as a violation by the Staff since the cable tray supports involved had not been turned over to FQC for final inspection. (Finding QA:514). Nevertheless, we are concerned about these discrepancies, just as we are concerned about the discrepancies identified by the Staff in Violation A(3). Our concern is underscored by the fact that Shoreham's FQC inspectors use as-built drawings to perform final inspections at the plant. (Finding QA:515).

As previously noted, we are also concerned about the workload of the electrical FQC group. The FQC workload is significant and may increase as more installations are completed and turned over for final inspection. (Finding QA:515). We recognize that the size of the FQC staff has been increased. Nevertheless, we expect the Staff to evaluate further the FQC workload and request it to submit to us an analysis regarding whether that workload is compatible with ensuring that adequate inspections are performed.

(ii) Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification Under Operating QA Jurisdiction

With regard to repair/rework conducted under startup jurisdiction on the "A" diesel generator, the Staff examined one in-process rework to replace the governor servo-booster and one completed rework modification to install turbocharger supports. For this latter completed modification, the Staff reviewed the OQA inspection records and noted that the final documented OQA inspection had failed to identify a variety of nonconforming conditions in the completed turbocharger support installation. (Finding QA:516).

One nonconforming condition involved a tubular support weld which varied from its design drawing in that it failed to wrap around the entire fitup joint. (Finding QA:517). A second nonconforming condition concerned the welding technique used in the rework, which was not qualified for the orientation encountered in the field. (Finding QA:518). The third nonconforming condition involved high strength bolting installations which did not conform to applicable Code requirements in that several bolted joints had their washers missing; in addition, the high strength bolts in these installations had been retorqued, in variance with Code requirements. (Finding QA:519).

Since these three nonconforming conditions had been final inspected and accepted by OQA at the time of the RAT inspection, the Staff determined that there had not been an adequate inspection by OQA. As a result, the Staff cited LILCO for a violation of Criterion 10 of Appendix B. The three nonconforming conditions were collectively identified by the Staff as Violation D. (Finding QA:520).

Even if the failure of the weld to wrap around the entire fitup joint was, as LILCO asserted, merely an oversight by the LILCO startup organization welder, the welding technique used to weld the support was unqualified for the orientation/angle encountered. Moreover, the OQA inspector erred in not detecting the missing weld material. (Finding QA:522). In the case of the missing washers and the retorqued bolts, the installation errors were also compounded by the fact that the errors were missed by OQA inspection. (Finding QA:525). Thus, there were multiple errors involved in each of the discrepancies identified by the Staff in Violation D. (Findings QA:522, 525).

The RAT inspection was not the first instance that LILCO has been cited for violations due to the use of nonqualified welding techniques. Inspection Reports 78-12 and 78-15 had previously identified similar welding violations. In fact, LILCO's use of nonqualified welding techniques had previously

led the Staff to request that LILCO give this matter particular attention. (Finding QA:523).

At a minimum, Violation D raises concerns about the accuracy of the OQA final inspections reviewed during the RAT inspection. (Finding QA:528). On the evidence presented, we must conclude that the discrepancies identified by the Staff in Violation D are of significant concern to our determination about the adequacy of the Shoreham OQA organization. In this regard, we note that there has been a failure on LILCO's part to demonstrate that OQA personnel are qualified to inspect the work assigned to their purview. LILCO also has not demonstrated that the problems identified in Violation D were neither representative of the quality of OQA inspection, nor indicative of an overall program failure. (Finding QA:529). For these reasons, we find that LILCO should re-inspect a representative sampling of OQA final inspections. LILCO is directed to submit for Staff review all documentation relating to this re-inspection and any analysis of the results. (Finding QA:530).

(iii) Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment

During the RAT inspection, the cold set conditions of several spring hangers in primary containment were inspected. From its review, the Staff determined that two hangers had not been adjusted to the design cold set. Nevertheless, the Master

Punch List ("MPL"), used to identify and control outstanding items, indicated that these hangers had been cold set. The Staff also discovered that rework to spring supports already cold set did not result in feedback to require resetting, as evidenced by the fact that items were not returned to the MPL. (Finding QA:531). This failure to control cold set and cold set status of spring hangers resulted in rendering the cold set status of spring hangers in the drywell indeterminate, and was contrary to the requirements of Criterion 14 of Appendix B. This violation was identified by the Staff as Violation B. (Finding QA:531).29/

Although LILCO believed that the two specific pipe supports referenced in Violation B were not different from the required condition, but instead were appropriate and controlled, it nevertheless agreed with the Staff that a more rigorous accounting system for the cold setting of pipe supports was appropriate. Accordingly, LILCO, following the

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29/ The Staff has raised some additional concerns with respect to the Shoreham MPL. Those concerns, as set forth in the RAT inspection report, include the fact that many different site organizations maintain separate lists/programs to keep track of their individual items of responsibility. Until such time as these lists are collated into one master tracking list, it is hard to determine the true extent of the amount of work needed to be completed at the plant. The prioritization of items and management involvement in determination of MPL items which can be delayed until after fuel load are to be reviewed during subsequent NRC inspections. (Finding QA:533).

RAT inspection, established an additional program for tracking the cold setting of pipe supports. (Finding QA:532). That program, however, will not involve the FQC or the FQA organizations. Instead, it is to be conducted by the operating staff and by the construction supervisory staff. Moreover, any rework to the spring supports subsequent to the Shoreham Stress Reconciliation Program will also be performed by these two organizations. (Finding QA:532).

Although the Staff had not completed its review of LILCO's response to Violation B at the time of the RAT inspection hearing, we note that during the inspection the Staff was advised by LILCO that the discrepancies noted with respect to the spring hangers would have been identified, since all hangers were to be re-inspected prior to fuel load. We find this conclusive statement to be a further example of LILCO's overreliance on the final inspection program, and it is entitled to little, if any, weight. (Finding QA:534).

We are concerned about the failure of LILCO's prior inspection program to track adequately the status of cold setting of spring hangers. Pending Staff review of LILCO's new program for tracking the cold setting of pipe supports, we find that we are prevented from concluding that there is no longer a concern that similar failures will not recur when performing the final cold set. In this regard, the Staff is requested to include

within its review consideration of Shoreham's procedures to prioritize punch list items to ensure that the MPL includes all remaining work items, NRC open items, and other commitments and open items. (Finding QA:535).

(iv) Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation

Violation C(1) -- Failure to Control Changes Following Final Inspection Per QC Procedure 15.4

Violation C(1) identified a failure by Construction to notify FQC by means of a rework/request notice prior to commencing work on final FQC accepted items. This failure was contrary to Criterion 5 of Appendix B, which requires activities affecting quality to be accomplished in accordance with documented instructions, procedures and drawings. (Finding QA:536).

Specifically, during inspections of platforms in secondary containment and main steam pipe whip restraints inside primary containment, the Staff identified two examples of failure of site procedures to control rework/repair activity of FQC inspected and accepted items. The first example involved Platform 21 in secondary containment. The Staff's review disclosed that FQC had torqued and accepted the high strength bolts involved in this structure. Later, an E&DCR required rework of this platform, including removal of bolts previously inspected

and accepted by FQC. This construction activity voided the final FQC inspections. However, notification of Construction's action was not given to FQC. This was a specific violation of QC Procedure 15.4, which requires Construction to notify FQC by means of a rework/request notice when QC inspected items are disturbed. (Finding QA:537).30/

The second failure to control rework/repair activity identified by the Staff involved a trolley beam welded to Main Steam Restraint 30. This restraint had been final QC inspected but no rework/request notice had been issued to notify FQC that the design capability of the restraint had been modified and that welds had been made to the restraint. (Finding QA:538).

LILCO acknowledged that QC Procedure 15.4 specifically requires notification to FQC of rework/repair to final inspected items by the filing of a rework/request notice. Moreover, it agreed that in the case of both the rework to Platform 21 and the restraint in primary containment, this

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30/ Altogether, the Staff inspected three platforms in secondary containment. These platforms were selected at random and were inspected to determine whether construction installation requirements had been met. The Staff's inspection disclosed that deficiencies existed with all three platforms. However, only the deficiencies relating to the high strength bolts on Platform 21 were identified as a violation by the Staff; deficiencies involving incorrectly installed expansion anchor bolts on two other platforms were not made a violation by the Staff since final FQC inspection of those platforms had not been completed. (Finding QA:539).

notification was not given. LILCO asserted, however, that in each case, notification was made to FQC through the issuance of the E&DCRs which required Construction to perform the rework/repair activity. (Finding QA:540).

Receipt of an E&DCR does not, however, specifically trigger an inspection by FQC; nor does FQC necessarily re-inspect previously accepted items on the basis of an E&DCR. (Finding QA:542). Thus, it is not the issuance of E&DCRs, but the filing of rework/request notification forms, that informs FQC that previously inspected items have been disturbed and require reinspection. (Finding QA:542). Moreover, in the structural steel area, FQC does not formally notify Construction of the areas where inspections have been performed. Thus, Construction was not aware that FQC had inspected Platform 21 and the restraint in primary containment, and it performed the rework/repair activity without notifying FQC beforehand. (Finding QA:543).

Following the Staff's RAT inspection and the issuance of Violation C(1), LILCO initiated a procedure requiring all structural in-process inspections to be tagged. This tagging procedure, however, will be applied only in the structural steel area. (Finding QA:544).

We are concerned about Construction's failures to notify FQC prior to commencing rework/repair on final inspected and

accepted items in accordance with QC Procedure 15.4. As previously noted, the problem identified during the RAT inspection was not an isolated instance. For example, Torrey Pines also documented a specific violation of QC Procedure 15.4 in its review of the Shoreham plant. (Finding QA:545). (See PFR-045, which involved the disassembly of a pipe support which had been final FQC inspected; Finding QA:677).

Our concern again is not alleviated by LILCO's assumption that its final acceptance inspection of Platform 21, and the restraint in primary containment, would have detected the discrepancies identified by the Staff. (Finding QA:546). In light of the previously expressed concerns about LILCO's final inspection program, this assumption is entitled to little, if any, weight.

The Staff had not completed its review of LILCO's response to Violation C(1) at the time of the hearing. On the evidence presented, we nevertheless conclude that LILCO has not demonstrated adequate procedural controls over rework/repair to final inspected items. While we are encouraged by LILCO's decision to tag inspected items in the structural steel area, we believe that all final inspected items at the plant should be tagged. Accordingly, LILCO is directed to institute acceptable tagging procedures for all final inspected items and to submit these procedures to the Staff for review. (Finding QA:547).

Violations C(2) and C(3) -- Procedure and Document Control Violations

Violation C(2) involved a design change which was issued initially by GE and then was endorsed by LILCO/SWEC on an E&DCR. This design change affected a number of drawings, one of which was drawing 1.61-207. However, the particular E&DCRs involved were not incorporated into the revised drawing. This is similar to the violation in I&E Report 82-26. (Findings QA:147-48, 537); see discussion in Section IV.B.2.).

Violation C(3) was closely related to LILCO's failure to incorporate the E&DCRs into drawing 1.61-207. The Staff's concern was that the responsible test engineer had failed to note that there were outstanding E&DCRs not posted on the revised drawing. This was a specific violation of EAP 6.3, Revision 3, Attachment 6.2. (Finding QA:549).31/

Although its review of LILCO's response to Violations C(2) and (3) was not complete at the time of the hearing, the Staff indicated disagreement with LILCO's response and with LILCO's conclusions that no preventive or corrective action was required. (Finding QA:551). We find that, on the evidence presented, we are prevented from finding that the discrepancies identified by the Staff are not of concern. (Finding QA:552).

31/ These two discrepancies were collectively considered a violation of Criterion 5 of Appendix B, Paragraph 17.1.5.A of the Shoreham FSAR, and Paragraph 5.3.2 of the LILCO Engineering QA Manual. (Finding QA:550).

V. The NRC Staff Inspection Program

In the review of LILCO's compliance with the NRC's QA/QC regulations, a further issue arises regarding the degree to which this Board should give weight to I&E's conclusion that LILCO has complied with the NRC's QA requirements. (See Finding QA:2). We conclude that the I&E program does provide important insights into QA/QC compliance, particularly concerning the specific inspections which are performed, such as the RAT effort. However, for reasons discussed below, we conclude that little weight can be given to the I&E conclusion that LILCO has properly implemented its overall QA/QC program.

The I&E inspection program is not meant to be a comprehensive QA program for the Shoreham plant. Rather, the I&E program is designed as a sampling inspection to assess a licensee's programmatic compliance with QA/QC commitments. The major responsibility for QA/QC compliance rests with the licensee. This limitation of purpose results, at least in part, from the limited Staff resources when compared with those which a utility can devote. (Findings QA:21, 405).

We find that the Staff resources which have been devoted to the Shoreham project do provide important insights in the sense that the Staff has identified certain areas where there have been repetitive problems with QA/QC compliance. Those primarily identified by the Staff were storage, welding and

design control. (Finding QA:363). Certainly, such findings by the Staff are important to our assessment as to whether patterns of QA/QC deficiencies exist at Shoreham.32/

In particular, there have been a large number of storage-related violations identified by the Staff, as discussed earlier in this Opinion. (See Section IV.B.3; Findings QA:199-205, 207-16, 219, 225-27, 231-32, 553-61)). The fact that the Staff has identified similar violations to those identified by LILCO and SWEC confirms, in our opinion, that in that particular area, there certainly was a degree of difficulty in the proper implementation of the QA/QC program. Similarly, in the welding area, the Staff identified 16 violations, primarily occurring during the intensive work period of 1977 through mid-1979. (Findings QA:347-54). These violations are of concern for the additional reason that if not detected by the inspection program, some of the welding violations could

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32/ We do not find that the number of violations at Shoreham constitutes a meaningful measure of QA/QC compliance. The number has averaged about seven per year between 1975 and 1982, when the number jumped to 16. That increase appears, at least in part, to be the result of increased Staff inspection in 1982. (Findings QA:577-80). Furthermore, it also does not appear productive to compare the number of violations at Shoreham with those at other plants. There is too much judgment involved in labeling an item a violation, including things like not writing a violation if an item falls within a prior open violation and the fact that many violations have multiple parts. (Findings QA:232, 578).

have been potential safety concerns. (Finding QA:351). As stated earlier in our discussion of the Staff's RAT inspection, we do not have confidence that the LILCO inspection program has in fact identified all welding problems. Indeed, the RAT inspectors identified new welding deficiencies, some of which were similar to earlier ones identified in I&E Reports. (See Section IV.B.7).

Aside from consideration of specific I&E inspection results, the more difficult question is whether the Staff's conclusion that there are no patterns of QA/QC deficiencies (or none that have not been corrected) at Shoreham should be accepted or accorded substantial weight. We conclude that it cannot be accorded great weight.

First, as discussed earlier in this Opinion and in detail in our SC Contention 7B Opinion, the Staff's I&E program does not inspect for compliance by LILCO with respect to QA/QC implementation for SS&Cs important to safety but not safety-related. Thus, the extent of any Staff opinions on QA/QC implementation can only concern safety-related SS&Cs; other SS&Cs covered by Appendix A, GDC 1, are not covered by any Staff opinion.

Second, the Staff program uses no systematic statistical methodology designed to permit the Staff to extrapolate, on a statistically meaningful basis, the results of its inspections

to other SS&Cs which are not inspected. (Section III.B). Since the Staff only inspects one to five percent of plant items (Finding QA:21), the ability to extrapolate inspection results is essential if any overall conclusion is to be accorded weight. Accordingly, the Staff's conclusions, while possibly correct as far as they go, apply only to those relatively few items which are actually inspected by the Staff.

Third, the QA/QC hearing raised a question as to whether the Staff's limited inspection resources on the Shoreham project have been properly allocated. During the hearing, this Board became aware of the auditing which is performed by SWEC and LILCO at Shoreham. The Staff witnesses, however, were largely unfamiliar with these audit programs. To be sure, the Staff had reviewed some of the audits. However, the Staff had no systematic program for reviewing all or even most of the audits which were performed in connection with Shoreham. (Findings QA:387-88, 398-400).33/ We consider this to be a serious deficiency in the Staff effort, since the audit results from the SWEC and LILCO programs would provide natural areas for further Staff investigation, particularly when those audits identify problems.

33/ The Staff, for instance, had not previously been aware of the conclusions in Field Audits 602 and 654 that preparation, issuance and control of E&DCRs during 1977 was considered unsatisfactory. (Findings QA:91, 109, 152).

Similarly, this Board took interest in the quarterly QA reports to management prepared by the LILCO QA Department. These quarterly reports were designed to highlight significant QA/QC developments during a quarter, and, in addition, to summarize the LILCO Field Audit reports which had been prepared during that period. Even if Staff resources are insufficient to review all the audits performed during a particular time period, certainly the Staff resources would have been sufficient to review the quarterly reports to management, which highlighted areas of particular concern. The Staff witnesses testified, however, while such review might be beneficial, it had not taken place until just before the hearing. (Findings QA:390, 396).

Fourth, the ability of I&E to provide serious judgment on the adequacy of QA/QC implementation is brought into question by the fact that severe QA/QC breakdowns have occurred at other plants but I&E has not been able to identify the problems in advance.34/ (Findings QA:20, 374, 386). The Staff has taken

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34/ A symptom of the problems with the NRC review effort is that at the operating license stage, the Staff provides no comprehensive review in the SER of whether the licensee has implemented its QA/QC PSAR commitments over the entire design and construction period. (Findings QA:357-58). The Systematic Assessment of Licensee Performance ("SALP") program, while somewhat similar to an SER, is more limited in scope (only one year is reviewed at a time) and covers primarily site-related activities. (Findings QA:22, 358, 362, 395). Only two SALP reviews have been conducted for Shoreham -- 1981 and 1982 -- thus leaving the bulk of the

(Footnote cont'd next page)

some positive steps, including the assignment of a resident inspector to Shoreham in 1979, inspections like CAT and RAT in 1982 and 1983, and the SALP process, which evaluated Shoreham in 1981 and 1982. (Finding QA:22). While these additional efforts will likely improve Staff review processes, most of these efforts come well after the primary design and construction of Shoreham. Furthermore, they do not alleviate other deficiencies in the Staff effort, such as failing to assess the QA/QC applied to all SS&Cs important to safety and the failure to use a statistically valid methodology. (Findings QA:22, 355). Thus, it is questionable whether they provide substantial benefit to resolution of the question whether LILCO has adequately implemented its QA/QC program during the entire design and construction of Shoreham.

Finally, the area of greatest concern to this Board in terms of the ability of the Staff witnesses to provide conclusions regarding QA/QC implementation has to do with design control. The Staff witnesses testified that they believed that for the entire design and construction phase, QA/QC had been adequately implemented. Certainly, with respect to construction implementation, the Staff witnesses have been directly

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design/construction period without a systematic review. (Finding QA:361).

involved and, with the caveats stated above, do have some basis to provide views on the adequacy of QA/QC implementation. In the design control area, however, the Staff witnesses, in our opinion, had far less basis to express conclusions.

The Region I inspection efforts with respect to the design process pertain to the design work which was performed onsite. (Finding QA:376). However, only a small amount of the design for the Shoreham facility was performed onsite. The large majority of the design work was performed at SWEC in Boston or at other offsite locations, or by GE at its various offices offsite. (Finding QA:385). To the extent that design work was performed onsite, the I&E review was quite limited. (Findings QA:144, 376, 380, 382, 385).

The primary review of the adequacy of design implementation by GE and SWEC is performed by I&E Region IV. However, the Staff witnesses did not include anyone from Region IV and the witnesses had not reviewed any Region IV I&E reports to determine whether any significant developments by Region IV had been reported. To be sure, Region IV will highlight for other regions when particularly significant QA/QC problems are identified. (Findings QA:377-78, 383). However, there can be many QA/QC problems which do not merit highlighting, but which might nevertheless bear on the issues presented in this proceeding, although the Staff witnesses expressed doubt in this regard. (Finding QA:378).

Mr. Hubbard, testifying for Suffolk County, expressed his opinion, based upon personal experience at GE through 1976, that the Region IV inspection effort had focused primarily on whether there was a QA/QC program at GE. The Region IV effort had not focused on whether that QA/QC program had been adequately implemented by GE. (Findings QA:370-71). As we noted earlier in this Opinion, however, the fact that a program exists is not significant unless there is also evidence that the program has been implemented.

Mr. Hubbard also presented evidence that the NRC Staff itself has acknowledged to the Commission that the inspection program at architect/engineers and at the reactor vendors has never focused adequately on whether there has been proper implementation of the QA/QC programs for design control. Thus, Mr. Harold Denton, in a briefing to the Commissioners on January 29, 1982, stated:

> One of the areas that we never inspected very heavily was at the architect/ engineer's design office. We did a lot of inspection, I think, over the years of the quality construction assuming that the blueprints were correct, and the main gap we had been focusing on in these first two cases (San Onofre and LaSalle) is that gap of whether the drawings themselves properly reflected the design commitment in the application. (Finding QA:368).

VI. Torrey Pines

A. Introduction

Torrey Pines was engaged by LILCO in May of 1982 to conduct a review of the Shoreham safety-related construction program. The review, conducted from May through September, 1982, traced Shoreham's construction from the procurement of materials through final construction and turnover to startup, and included an assessment of Shoreham's QA construction program. Torrey Pines did not, however, assess the adequacy of Shoreham's design. Nor did it address LILCO's proposed operating procedures, including the QA/QC program for operations. (Finding QA:585).

The purpose of Torrey Pines' review was to determine whether the Shoreham construction process converted the design requirements into adequately installed hardware. To accomplish this, Torrey Pines: (1) reviewed selected LILCO and SWEC procedures used in the construction process to determine the adequacy of the basic process (Task A); (2) reviewed a selection of the points where the procedures should have been implemented to determine whether they were, in fact, implemented (Tasks B and E); and (3) inspected installed hardware to determine whether the hardware met the design requirements (Tasks C and D). (Finding QA:586).

In conducting its review of the Shoreham plant, Torrey Pines instructed its walkdown teams and investigators to identify and document perceived differences between observed and required conditions. The Discrepancy Report ("DR") form was used to document such differences between what was being reviewed and what was required. Altogether, 371 DRs were filed by the walkdown teams and document investigators. (Finding QA:587).

All DRs were reviewed and evaluated for validity. Those DRs determined to be valid were then further evaluated and if a potential for safety significance was identified, a Potential Finding Report ("PFR") was prepared. Of the 371 DRs generated, 103 were judged by Torrey Pines to be invalid. From the remaining 268 valid DRs, 120 PFRs were prepared. (Finding QA:588).

All PFRs were also reviewed and evaluated for validity. Valid Potential Findings were classified as either Findings or Observations. If a Potential Finding was a discrepancy that could result in a substantial safety hazard or if there was an indication of a repetitive or generic deviation that could create a substantial safety hazard, the Potential Finding was classified as a Finding. Potential Findings that were valid, but that did not satisfy these criteria, were classified as Observations. Of the 120 total PFRs generated, 69 were judged

invalid by Torrey Pines. From the remaining 51 PFRs, Torrey Pines classified 32 as Observations and 19 as Findings. (Finding QA:589).

The question presented by the Torrey Pines inspection effort is whether that review provides assurance that the installed plant does in fact reflect the requirements of the final design documents. The Torrey Pines effort also might be considered evidence regarding whether the LILCO QA/QC program was properly implemented. (Finding QA:582). For reasons described hereafter, we conclude that the Torrey Pines report does not provide confidence in the quality of the as-built plant or the adequacy of QA/QC implementation by LILCO.

B. Torrey Pines Was Not Independent from LILCO, Nor Did It Operate Under an Acceptable Protocol

Prior to LILCO's retention of Torrey Pines, the County and LILCO had engaged in discussions regarding an independent physical inspection of the Shoreham plant. Had the negotiations between LILCO and the County been successful, the County would have been involved in the selection of the consultant for the Shoreham inspection. It also would have participated in determining the protocol for the inspection. However, when LILCO itself selected and retained Torrey Pines, the County was excluded from these matters and prevented from participating in the inspection to ensure Torrey Pines' independence. (Findings QA:594-95).

In fact, no party other than LILCO had any relationship with Torrey Pines. Further, the protocol for the Torrey Pines project established by LILCO ensured that Torrey Pines interfaced only with LILCO, received information and comments only from LILCO, and reported only to LILCO. Thus, only LILCO had the opportunity to influence Torrey Pines. (Finding QA:596).

The protocol under which Torrey Pines operated was inadequate for other reasons. No party other than LILCO had the opportunity to comment on such matters as the scope of work, acceptance criteria, schedule, and resource allocation of Torrey Pines. LILCO not only had this opportunity, but in some respects it was able to dictate matters to Torrey Pines. For example, Torrey Pines was instructed by LILCO to complete the project before fuel load. This emphasis on scheduling impinged upon resource allocation by Torrey Pines. (Finding QA:600).

For the foregoing reasons, we conclude that Torrey Pines was not acceptably independent from LILCO, nor did it operate under an acceptable protocol. We agree with Suffolk County that all parties to this proceeding, as well as this Board, should have been provided a meaningful role in the Torrey Pines review.

C. The Scope of Torrey Pines' Review Was Not Adequate to Support the Conclusions Reached by Torrey Pines

The subject of Torrey Pines' review was limited to the Shoreham construction process. Thus, the Torrey Pines inspection did not provide a comprehensive design review, physical inspection and QA/QC review adequate to verify that the design and construction of Shoreham have been implemented in accordance with FSAR commitments and regulatory requirements. (Finding QA:603). In fact, because the scope of its inspection was influenced from the outset by LILCO and was improperly limited in important areas, Torrey Pines did not provide an adequate review of even the Shoreham construction process. (Finding QA:604).

At the time of its initial contact with Torrey Pines, LILCO presented its views on the scope of the Shoreham construction review. Those views were given serious consideration by Torrey Pines when it established the scope of the project. Thus, even though it thought it unnecessary, Torrey Pines agreed to LILCO's request to inspect all safety-related large bore pipe supports at Shoreham. Because the construction of these pipe supports was incomplete, Torrey Pines' assessment was conducted against a changing construction baseline, and the ongoing construction and QA/QC activities prevented Torrey Pines from verifying that the supports were constructed in accordance with design requirements. (Finding QA:605).

Irrespective of the question of LILCO's potential influence over Torrey Pines, the approach used by Torrey Pines is subject to criticism. First, that approach relied on the engineering judgment and experience of Torrey Pines and rejected the use of statistically valid sampling techniques. As a result, the general conclusions reached by Torrey Pines are invalid. (Finding QA:607; see further discussion of statistical matters regarding the Torrey Pines review in Section VI.G).

Second, Torrey Pines limited its review to the safety-related features of the plant. Thus, components and equipment important to safety but not safety-related were not included within the review. As a result, the Torrey Pines review can provide no assurance that the QA/QC requirements of GDC 1 of Appendix A to 10 CFR Part 50, have, in fact, been implemented. Moreover, Torrey Pines made no independent determination of the safety-related status of components, systems or items at Shoreham, but instead relied on LILCO to identify the safety-related systems in the plant. (Finding QA:608).

Third, each of the Tasks carried out by Torrey Pines is subject to criticism in its own right. For example, Task A was intended to determine if the safety-related construction QA/QC process used by LILCO and SWEC was adequate. Torrey Pines accomplished this Task by reviewing a sample of the LILCO and SWEC procedures and manuals which defined QA/QC controls

applied to the Shoreham construction efforts, which began in 1973. Certain areas of the Shoreham construction control QA/QC program, however, took place prior to 1973 -- for example, some materials, components and equipment were procured prior to 1973. (Finding QA:609). Moreover, with the exception of 20 LILCO and SWEC procedures and manual revisions which, for the most part, covered the years 1972 to 1976, the procedures reviewed by Torrey Pines were only those procedures in effect at the time of Torrey Pines' review under Task A. Because the 20 earlier procedures and manual revisions reviewed by Torrey Pines represented only a small portion of the procedures and manuals in effect during the period 1969 to the present time, there may have been periods of construction during which none of the procedures reviewed by Torrey Pines were in effect. (Finding QA:610).

Fourth, in limiting its review under Task A to the LILCO and SWEC QA/QC manuals and procedures, Torrey Pines excluded other site contractors with QA/QC programs from its assessment of Shoreham's overall QA/QC program. Site contractors with their own QA/QC programs accounted for approximately 30 percent of the total plant construction work and included Courter and Company, whose E&DCR-related problems already have been discussed. Despite this substantial construction responsibility, Torrey Pines considered it unnecessary to its overall

assessment of Shoreham's QA/QC program to review the QA/QC programs of these site contractors. (Findings QA:610-11). Thus, notwithstanding its exclusion of these contractors, Torrey Pines concluded with respect to Task A that Shoreham's construction control program was satisfactory and that the overall QA/QC program implementation for all site contractors was adequate. (Finding QA:612).

Aside from the questionable validity of its overall conclusions under Task A, Torrey Pines' criteria for deciding when discrepancies should be reported under Task A were applied in a discretionary and judgmental manner. For a DR to have been written under Task A, the deficiency observed was required to be a matter which, in the judgment of the Torrey Pines reviewer, was of some significance to the Shoreham construction control program. Thus, Torrey Pines' conclusions under Task A were based in large part on the discretion and judgment of the Torrey Pines reviewer. (Finding QA:613).

Task B of the Shoreham review is subject to the same kind of criticisms rendered against Task A. Task B was designed to determine whether the construction-related procedures and manuals identified in Task A were properly implemented. The Task was carried out by reviewing portions of selected construction records (document packages) of 45 safety-related components. These 45 components were drawn from a total population of

approximately 100,000 safety-related items and were selected solely on the basis of Torrey Pines' judgment from the list of safety-related components that were visually inspected under the Task C walkdown review. (Finding QA:614).

Torrey Pines, however, did not review the construction records for the 45 safety-related components against the contruction-related procedures and manuals in effect at the time such components were procured and installed. Instead, those construction records were reviewed against the current Shoreham procedures and manuals. Thus, earlier revisions or changes to the current procedures were not within the scope of Torrey Pines' review under Task B. (Finding QA:615).

As in Task A, the Torrey Pines reviewer exercised judgment in determining whether to write a Discrepancy Report under Task B. Moreover, in concluding that the construction procedures and manuals identified in Task A were effectively implemented, Torrey Pines did not attempt to correlate the Task B discrepancies to the particular component document packages reviewed. Instead, Torrey Pines' sole basis for deciding that Shoreham's process was properly implemented was its judgment that the discrepancies in Task B revealed no significant safety concerns.35/ (Findings QA:616-17).

35/ This emphasis by Torrey Pines on determining whether an item was a safety concern makes clear in our Opinion the fact that the review was not primarily to assess the

(Footnote cont'd next page)

Torrey Pines did find that there was a lack of timely incorporation of E&DCRs in Shoreham's design documents. However, no DRs were generated in this regard since Torrey Pines could find no requirement in the Shoreham construction control program for incorporation of E&DCRs in the design drawings. This was a significant oversight by Torrey Pines, since the timely incorporation of E&DCRs in drawings is required by Appendix B of 10 CFR Part 50. (Finding QA:618).

Torrey Pines' review under Task C was also improperly restricted in several respects. In Task C, Torrey Pines visually inspected selected items to determine whether installation and construction complied with design requirements. Conformance was checked by comparing the plant's hardware, as installed, against the applicable design documents during inspection walkdowns. (Finding QA:619).

Torrey Pines chose systems that serve a safety function in plant operation for inspection under Task C. Systems having safety-related functions, but not considered by Torrey Pines to be important to the cold shutdown activities of the plant, were not included under Task C. With respect to safety-related

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Shoreham QA/QC program. As we previously discussed, in the QA/QC area, the primary focus must be on whether QA/QC procedures and requirements are followed, not on whether there is a safety concern. (See Section IV.A.2).

hardware which was not inspected, Torrey Pines assumed that since the construction control program was determined to be adequate with respect to the safety-related hardware inspected, that same program would necessarily ensure the adequacy of all other safety-related hardware in the plant. (Findings QA:620-21).

Thirty-two of the 37 systems selected for walkdown under Task C were identified for Torrey Pines by LILCO at the initial meeting of the two organizations. The five safety-related systems added by Torrey Pines required LILCO's authorization beforehand. This was consistent with Torrey Pines' understanding that major changes in the project scope required LILCO's approval. (Finding QA:622).

Torrey Pines did not know the total population of the various types of items inspected under Task C. Nor did it consider such knowledge to be significant to the conclusions reached from its walkdowns of the Shoreham plant. In fact, even when the total population of a specific type of a component was known, the sample selected for inspection was often very small. For example, of the 72 safety-related NSSS loops and 62 balance-of-plant safety-related control loops, Torrey Pines inspected just one loop from each. Coupled with Torrey Pines' selection of items for inspection on a nonrandom basis, this use of small sample sizes renders invalid the conclusions reached by Torrey Pines. (Finding QA:627).

The major emphasis of Torrey Pines' inspection under Task C was devoted to evaluating Shoreham's mechanical and pipe support areas. These areas constituted about 47 percent and 45 percent, respectively, of the total features checked. They resulted in 49 percent and 17 percent of the Discrepancy Reports generated. In contrast, the electrical walkdowns constituted eight percent of total features checked, but resulted in about 34 percent of the Discrepancy Reports. (Finding QA:628).

Torrey Pines justified this widely differing percentage between the number of items inspected in the electrical and mechanical walkdowns and the number of discrepancies identified, by making adjustments for the electrical component identification difficulties vis-a-vis the simplicity of mechanical pipeline verification. We find that these adjustments were not warranted since the electrical, mechanical and piping features are of similar complexity both with respect to identification and otherwise. Of course, the alleged complexity of electrical features does not explain why the Shoreham QA/QC program failed to reveal and cure deficiencies. (Finding QA:629). Moreover, even after it became clear to Torrey Pines that discrepancies in Shoreham's electrical features occurred with a much higher frequency than in other systems, the scope of the inspections of electrical items was not expanded. (Finding QA:630).

The scope of Torrey Pines' inspection of electrical features was restricted in other ways. With respect to its inspection of Shoreham's electrical cabling systems, Torrey Pines assumed that the design was adequate. Thus, there was inadequate testing of the electrical cabling systems. Moreover, even after Torrey Pines became aware of electrical separation implementation problems in the plant, it did not inspect electrical separation, since LILCO considered that area to be a design issue. (Finding QA:631).36/

Following its Task C review, Torrey Pines concluded that the construction of Shoreham's safety-related mechanical equipment, electrical equipment and pipe supports as satisfactory. This conclusion was based on Torrey Pines' judgment and was made notwithstanding the fact that only portions of the plant's mechanical, electrical and pipe support systems were physically inspected. As discussed infra, the process of extrapolating from a sample to the total population requires the use of statistically-based random sampling methods. Thus, Torrey Pines' judgment sampling prevented the very kind of overall conclusions that were reached under Task C. (Findings QA:632-33).

36/ Given the recurrent electrical separation difficulties experienced by LILCO (see Section IV.B.6), we believe Torrey Pines should have devoted substantially greater Task C effort to electrical disciplines.

Under Subtasks D1 and E1, Torrey Pines reviewed a limited number of piping welds and Certified Material Test Reports ("CMTRs"). This hardware and documentation review should have been broader in scope.37/ A more serious deficiency, however, was Torrey Pines' use of the results obtained to extrapolate to conclusions about the entire plant. (Finding QA:634). Those conclusions have no validity since the sampled populations were not drawn randomly, but were selected on the basis of Torrey Pines' engineering judgment. (Findings QA:636, 638).

Based on the foregoing, we conclude that the scope of Torrey Pines' review of the construction phase was not adequate to support the conclusions of the Final Report. Torrey Pines' review was improperly limited in important areas. In particular, equipment important to safety was not included within the review, the review of electrical equipment was restricted, and the review of Shoreham's QA/QC programs was limited to the QA/QC measures applied to safety-related items and did not include the QA/QC programs of significant Shoreham site contractors. (Finding QA:640).

37/ Torrey Pines found no welding deficiencies in its limited review. (Finding QA:636). The fact that the RAT inspection identified several welding violations from a far more limited effort (see Section IV.B.7) re-inforces our view that the Torrey Pines welding review was far too limited for the conclusions in that area to be entitled to any weight.

We further conclude that Torrey Pines' failure to use statistically valid sampling techniques renders the conclusions reached in the Final Report invalid. Rather than relying on its judgment to the exclusion of statistical techniques, Torrey Pines should have combined statistical methodology with engineering judgment in selecting samples for inspection and in evaluating the significance of inspection findings. In that way, statistically valid data could have been obtained which would have permitted extrapolation of the inspection results to features beyond those structures, components and QA records and documentation reviewed. (Finding QA:641).

D. Torrey Pines' Discrepancy/Finding Process was Deficient

Torrey Pines did not follow its own procedures in conducting the construction review of Shoreham. Those procedures required that "any difference between an observed condition (document or installed hardware) and a required condition" be documented by the preparation of a Discrepancy Report. DRs, however, were often invalidated in a manner inconsistent with this standard. Accordingly, Torrey Pines understated the number of Discrepancy Reports and Potential Findings and possibly the number of Observations and Findings. (Finding QA:643).

Of the 371 DRs generated by Torrey Pines, 103 were found to be invalid. Many of these DRs were improperly invalidated.

(Finding QA:643). For example, DRs were invalidated after Torrey Pines learned that the location and other design requirements of various components were specified on drawings other than those drawings chosen by Torrey Pines for use in its walkdowns. Moreover, even after discovering that the drawings it had chosen were inappropriate, Torrey Pines did not re-inspect the components relating to the invalidated DRs to determine whether installation complied with the requirements of the appropriate drawings. Instead, it simply invalidated the DRs which had noted the discrepancies. (Findings QA:645-46, 648-49).

DRs were also invalidated by Torrey Pines whenever further investigation or walkdowns revealed that discrepant conditions had been resolved. In such instances, Torrey Pines assumed that the discrepant conditions had been resolved as part of Shoreham's "normal construction process." (Finding QA:647).

Quite aside from its improper invalidation of Discrepancy Reports, Torrey Pines improperly limited its review of valid DRs. Thus, although it acknowledged that a failure to implement a QA/QC requirement could constitute a potential safety concern, Torrey Pines did not review the discrepancies to determine whether, on an individual basis, they reflected deficiencies in the Shoreham QA/QC process. Torrey Pines instead limited its review to determining whether the DRs, in the

aggregate, reflected problems with the QA/QC process. On this limited basis, Torrey Pines concluded that there were no trends evidencing such problems. What Torrey Pines failed to realize, however, is that the cumulative effect of similar DRs could have a potential safety impact, or could indicate a repetitive QA/QC program deficiency, which would not have been evident in a single isolated DR. (Finding QA:650).

Moreover in its review, Torrey Pines, once satisfied that a design document, such as an E&DCR, was sufficient to resolve an apparent discrepancy between observed and required conditions, did nothing further to determine whether the discrepant conditions had actually been resolved. This was a serious omission in the Torrey Pines process. (Finding QA:651).

Further, Torrey Pines was neither consistent nor accurate in its determinations of which valid DRs warranted being made Potential Findings. For example, Torrey Pines did not generate PFRs from those valid DRs which related to nonsafety-related material, components or equipment. Accordingly, Torrey Pines excluded items which may have been important to safety but which had not been classified as safety-related by LILCO. (Finding QA:652).

Torrey Pines also did not prepare PFRs from a number of valid DRs which it believed had little or no effect on system

integrity or operation. These discrepancies, however, were not reviewed by Torrey Pines for compliance with the criteria of Appendix B. In Torrey Pines' view, the criteria of Appendix B are only applicable if the equipment or components in question are found to have significance to the plant's safety. (Finding QA:652). Thus, although Torrey Pines acknowledged that entire groups of DRs demonstrated that there were patterns of deficiencies in the Shoreham construction control process, it did not find these discrepancies to be indicative of Appendix B nonconformances, based on its judgment that the discrepancies identified were not of safety significance. (See, e.g., Findings QA:654-56).

Torrey Pines also did not prepare PFRs from a number of valid DRs which it believed indicated no safety problem. Thus, discrepant items that were mistagged or mislabeled did not result in PFRs if the proper equipment was in place. (Finding QA:657). Nor were PFRs prepared from a number of valid DRs which involved documentation discrepancies or failures to follow procedural requirements, since Torrey Pines did not believe these DRs showed a potential to impact safety. (Findings QA:658-59).

Torrey Pines also sometimes made inaccurate determinations concerning a DR's potential safety impact; then, of course, no PFR was written. (Finding QA:660). Of more concern, Torrey

Pines generally made no determination as to whether the Shoreham construction control program accounted for and controlled the discrepant items identified during its review, since its review was limited to safety-significant features. (Finding QA:662). Moreover, even when Torrey Pines did initiate PFRs, it was permitted the flexibility under its program criteria for reducing the number of Findings. For example, although Torrey Pines initiated a number of PFRs when it discovered that temporary pipe supports had not been removed from the piping system, only one, PFR 064, was made a Finding by Torrey Pines. The remaining PFRs were classified as Observations. Torrey Pines justified this difference in classification by making PFR 064 a Finding under the multiple discrepancy criteria. (Findings QA:663-64).

Altogether, Torrey Pines invalidated 69 of the 120 PFRs generated from its review of the Shoreham plant. (Finding QA:665). A significant number of these PFRs were invalidated after the original design organization demonstrated that E&DCRs or repair/rework requests had been issued prior to the walkdowns by Torrey Pines. Torrey Pines also invalidated PFRs on the basis of E&DCRs or repair/rework requests issued <u>after</u> the walkdowns had detected the discrepancies. (Finding QA:666).

Based on the foregoing, we have serious concerns about Torrey Pines' preparation and processing of DRs and PFRs. Moreover, we agree with Suffolk County that the number of Observations and Findings in the Final Report may have been understated. (Finding QA:670). In any event, what is clear from the evidence presented is that Torrey Pines did not adquately evaluate the Shoreham QA/QC construction program. Rather, Torrey Pines emphasized only the safety significance of the material, components and items inspected, and it carried through its evaluation of any identified discrepancy only if it was determined that the discrepancy had the potential to impact the plant's safety. Thus, the Torrey Pines conclusions, at least as they relate to the adequacy of Shoreham's construction QA/QC program, are entitled to little, if any, weight.

E. Torrey Pines' Review Demonstrated That Shoreham's QA/QC Inspection Process Is Inadequate

LILCO's inspection process has been described as producing a "gating effect." The term "gate" is used by LILCO to describe each stage in the inspection process at which functions or attributes must be verified and beyond which material or components may not pass unless requirements have been met. Within each major gate (procurement, receiving, storage, pre-installation, installation, system turnover and test program) there may also be several subgates that require passing before the item may continue to be processed. LILCO contends

that the effect of these multiple "gates" is to provide several chances to detect a nonconforming condition. (Finding QA:672).

Although LILCO indicated that all safety-related equipment or components at the plant is required to pass through each of the seven "gates" of LILCO's inspection process (Finding QA:673), and despite the fact that these "gates" are structured to track the requirements of Appendix B,[38] the Torrey Pines inspection revealed that LILCO's QA/QC inspection process fails to ensure the detection of deficient materials, components or equipment. (Findings QA:674).

Every discrepancy identified by Torrey Pines was generally indicative of a missed QA/QC "gate." (Finding QA:674). Indeed, the County presented numerous examples of Findings and Observations that were not detected by LILCO's "gating" process. (Findings QA:675-85). Torrey Pines, however, did not attempt to determine the number of inspection opportunities missed by LILCO's gating process. Nor did it attempt to identify the failures in the Shoreham QA/QC program implementation

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38/ According to LILCO witness Novarro, the procurement "gate" should ensure compliance with the requirements of Criterion 4, the receiving "gate" should ensure compliance with the requirements of Criterion 7, the storage "gate" should ensure compliance with the requirements of Criterion 13, the pre-installation and installation "gates" should ensure compliance with the requirements of Criterion 10, and the test program "gates" should ensure compliance with the requirements of Criterion 11. (Finding QA:672).

that permitted these discrepancies to occur and remain undetected. (Finding QA:686). Nevertheless, Torrey Pines concluded that the QA program for construction of safety-related equipment and the implementation of the program requirements during plant construction are satisfactory. This conclusion was based on Torrey Pines' view that the errors and deficiencies identified during its review of the Shoreham plant were merely mistakes made by Shoreham personnel in not meeting the requirements of the construction QA/QC program. Such mistakes were not, however, violations of the requirements of Appendix B since, in Torrey Pines' opinion, Appendix B's requirements merely set forth the programmatic requirements of the QA/QC program. (Finding QA:687).

Thus, the purpose of a QA/QC program, under Torrey Pines' view, is to "restrict the significance of errors that are made," so that those defects or errors which do occur "are not of significance with respect to the safety function of the hardware in the plant." Given this view, Torrey Pines' conclusion regarding the adequacy of Shoreham's QA/QC program was necessarily tied to its opinion regarding the safety significance of those construction defects and errors identified during its review of the Shoreham plant. Since Torrey Pines invariably concluded that the defects and errors detected were not significant, it necessarily concluded that the plant

hardware had been constructed correctly and that such hardware would perform its safety function. Thus, the QA/QC program was judged adequate by Torrey Pines. (Finding QA:688).

Based on the foregoing, we find it surprising that, despite finding numerous discrepancies that had not been detected by LILCO's "gating effect," Torrey Pines did not attempt to identify failures in the QA/QC program which permitted these discrepancies to occur and remain undetected. We find that this was a serious deficiency of the Torrey Pines program which supports our determination that the conclusions of the Final Report with respect to the adequacy of Shoreham's QA/QC construction program are entitled to little weight. (Finding QA:690).

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate

Notwithstanding the approval of LILCO's Corrective Action Plans ("CAPs") by Torrey Pines, we find that those CAPs, as prepared by LILCO, do not satisfy the requirements for corrective action of Criterion 16 of Appendix B. (Finding QA:693). None of the CAPs addresses the deficiency or deficiencies in Shoreham's QA/QC program that allowed the Findings identified by Torrey Pines to occur. Moreover, the corrective measures generally address the symptom rather than the underlying or root cause of the inspection Findings. Further,

a number of the CAPs fail to provide for any investigation beyond the immediate discrepant condition to determine where else the condition could exist. The CAPs also fail to include measures to prevent repetition of the discrepancies identified by Torrey Pines. Moreover, they do not require investigation into why the condition had not been detected by Shoreham's QA/QC program. In fact, none of the CAPs even references Shoreham's QA/QC program, nor any QA/QC manuals or procedures. (Finding QA:694).

Despite numerous examples by Suffolk County of these inadequacies in LILCO's CAPs (Findings QA:695-707), Torrey Pines and LILCO believed the CAPs, as written, were acceptable. We cannot agree. Further, we are concerned that no corrective measures were prepared by LILCO in response to the 32 Observations and hundreds of DRs identified by Torrey Pines. Accordingly, LILCO is directed to prepare and submit for our review corrective action measures for the Observations and DRs that were not made Findings by Torrey Pines. (Finding QA:710).

G. Statistically Valid Sampling Techniques Were Not Used by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid

Since it was not feasible to inspect every component or examine every document at Shoreham, Torrey Pines chose to inspect a subcollection of components and documents. This was entirely appropriate. However, instead of availing itself of

widely accepted, probability-based sampling methods and their attendant systematic methodologies for extrapolating from sample to population, Torrey Pines selected items for inspection in a nonrandom, ad hoc manner. We therefore must conclude that, while the Torrey Pines inspection uncovered some useful information, it cannot form the basis for reaching positive general conclusions about Shoreham, including the Shoreham QA/QC program. (Finding QA:711).

In conducting its review of Shoreham, Torrey Pines used its judgment not only to select items for inspection, but also to decide whether the total number of items selected provided a sufficient basis for concluding that Shoreham's construction control process was functioning adequately. Once it determined that the construction control process was satisfactory, Torrey Pines extrapolated to the conclusion that the construction of the entire plant was satisfactory. (Finding QA:713).

Under this judgmental approach, Torrey Pines reasoned that inspecting or examining a greater number of items or components was not important to the conclusions drawn with respect to the Shoreham QA/QC program. This approach also permitted Torrey Pines, based on its review of relatively few items, to extrapolate to the conclusion that the Shoreham QA/QC program had been properly implemented. Finally, this approach provided Torrey Pines a way to minimize the impact of any discrepancies

identified. Through the exercise of its judgment, Torrey Pines could simply decide that such discrepancies were not indicative of a programmatic problem of any kind. (Finding QA:714).

However, Torrey Pines' approach led to results that were neither reliable nor verifiable. There is no valid methodology for extrapolating from a judgment sample to a population. Torrey Pines' process of extrapolating from the limited number of items it sampled to conclusions regarding the entire plant was therefore seriously flawed. (Findings QA:715-16).

The use of random sampling techniques in conducting the Shoreham review would not have prevented Torrey Pines from inspecting items not included in the random samples, and such items could have been included in any general conclusions or judgments regarding Shoreham's construction. However, items inspected, but not drawn from random samples, cannot be used in drawing valid inferences about total populations. Thus, Torrey Pines' process of extrapolating inferences about the total plant population from nonrandom sampling of items was inherently flawed. To extrapolate with any measurable basis for confidence from a sample to a population requires the use of random sampling methods. (Finding QA:718).

Based on the evidence presented, we conclude that statistically valid methods could have been used by Torrey Pines in its inspection of the Shoreham plant. Moreover, such methods

would have been cost-effective. It was Torrey Pines' sampling process that was flawed, and the random selection of samples, rather than selection according to nonrandom and informal kinds of judgment, could have been implemented in a cost-effective way. (Finding QA:720). In fact, Torrey Pines' approach adequately sets forth the foundation for a statistically valid sampling approach by identifying the populations of interest and stratifying those populations into subcollections that could be sampled. By simply using random sampling methodology in place of the judgment samples that were used, Torrey Pines could have rendered conclusions that were justifiable, reliable and verifiable, and which might, in turn, have been of value to this Board. (Finding QA:721).

Moreover, we conclude that neither the diversity nor the complexity of a nuclear power plant precludes the use of statistical methodology. There are well-defined statistical methods for sampling from a heterogeneous or diverse population and obtaining a statistically valid conclusion from such study. Similarly, the complexity of the population does not preclude the use of statistical methodology. Within the context of stratified sampling, it is possible to identify subpopulations that are more complex than others, and to sample those populations more heavily. Nothing precludes this difference in sampling emphasis. (Findings QA:722-23).

On the other hand, whether a statistically valid or a judgment sample methodology is used, sample size has an impact on the validity of conclusions drawn from the sample. In general, the more precision or accuracy desired, the larger the sample size and the sampling plan. (Finding QA:724).

This correlation between the size of the sample and the degree of confidence or precision which can be placed on conclusions or extrapolations drawn from the sample was not considered under the Torrey Pines approach. For example, based on its inspection of only one of 72 NSSS safety-related loops, Torrey Pines extrapolated to the conclusion that all 72 loops were adequate. This conclusion was completely unfounded. Very little confidence can be placed in any extrapolation based on a single sample from a population size of 72. Nevertheless, throughout its review of the Shoreham plant, Torrey Pines relied on small sample sizes to support its overall conclusions regarding the plant's construction. Quite aside from the randomness issue, this approach makes the conclusions of the Torrey Pines report highly unreliable. (Finding QA:725).

Contrary to suggestions by LILCO (LILCO Finding QA:862), the process of random sampling and estimating population characteristics does not depend upon establishing acceptability criteria or other presuppositions. That is, a random sample can be developed and parameters of a population can be

estimated, with scientific rigor, without making judgments as to the significance of the results. The sole aim of the statistical study is to provide reliable information about the character of a population. Once that information is obtained, judgments as to the significance of the results can be made by other disciplines. (Finding QA:726). In other words, the statistical process is an iterative process. The role of the statistician is to obtain scientifically valid information on populations of interest. Thereafter, other disciplines can use this information to reach conclusions concerning the population under study. (Finding QA:727).

In his testimony, Dr. Samaniego concluded that a statistically valid program could be designed that would demonstrate whether Shoreham was constructed in accordance with design requirements. In implementing this statistically-based program, nuclear engineers, quality assurance personnel and other experts would work with the statistician in designing the program and in determining the size and areas of concentration of the program. (Finding QA:728). We have no reason to doubt the correctness of Dr. Samaniego's testimony.

Thus, without random sampling, it is impossible to assess the reliability of, or have confidence in, any extrapolation to a total population. For this reason, the methodology used by Torrey Pines, i.e., nonrandom and ad hoc sampling based on

judgment, was seriously flawed, and the conclusions it reached have no validity. Torrey Pines not only extrapolated within populations, but it extrapolated to the entire Shoreham plant without looking at items from the entire plant. Even under a statistically valid study, inferences can only be drawn from those populations which are actually sampled. (Finding QA:730). Based on the foregoing, we must conclude that the substantive conclusions of the Torrey Pines Report are unjustified.

VII. Conclusion

We have found in the foregoing discussion and in our Findings that there have been pervasive QA/QC deficiencies at Shoreham during the design and construction phase. The Torrey Pines review, for reasons noted above, does not alleviate these concerns. Thus, to overcome these QA/QC deficiencies -- to have confidence in the adequacy of Shoreham's design and construction -- we conclude that there must be a comprehensive design review, construction inspection and QA/QC implementation review.

Mr. Hubbard outlined certain important requirements for such a review. (Findings QA:733-38). We decline to set forth in this Opinion precisely what must be included. We believe instead that the proper next step is for LILCO, in consultation with the County and Staff, to propose the contours of the

review to be undertaken. We do offer, however, the following guidance:

-- The review must be conducted under a protocol which removes any question regarding the independence of the review;

-- The review must cover all SS&Cs important to safety, as we have defined that term in our Contention 7B Opinion;

-- The review must be based upon a statistically valid methodology so that the results may be extrapolated to other SS&Cs which are not specifically reviewed; and

-- The review must be sufficiently comprehensive in the design, construction and QA/QC areas so that all major contractors and all major disciplines are covered by the review.

B. SUFFOLK COUNTY CONTENTION 13(a): -- OPERATING QUALITY ASSURANCE

Suffolk County's Contention 13(a) raises the particular concern that, contrary to Criterion 1 of 10 CFR Part 50, Appendix B, the LILCO Operating Quality Assurance ("OQA") Section does not have organizational freedom and sufficient independence from cost and scheduling as opposed to safety considerations. This concern arises from the fact that the OQA Engineer, who heads the OQA

Section, reports directly to the Plant Manager, who in turn reports to the Vice President, Nuclear; both the Plant Manager and the Vice President, Nuclear, are responsible for the operation of the plant and for cost and scheduling matters. (Findings OQA: 2-4).

The OQA Engineer is responsible for assuring compliance with the QA program at the plant and for developing and implementing OQA procedures. (Finding OQA: 1). The Plant Manager has both functional and administrative authority over the OQA Engineer, and thus may give him directions, as well as evaluate his performance, give him raises, and even fire him. (Findings OQA: 2, 5). We find that this relationship inherently results in subtle pressures upon the OQA Engineer to go along with positions taken by the Plant Manager and to avoid conflicts with him, even if the Plant Manager refrains from a more overt exercise of his powers. Accordingly, we believe that the Plant Manager, by virtue of his complete authority over the OQA Engineer, necessarily influences the OQA Engineer to an extent sufficient to raise a serious issue of whether the OQA Engineer and his Section have adequate independence to meet the requirements of 10 CFR Part 50, Appendix B, Criterion 1.

The inherent problem in the relationship between the Plant Manager and the OQA Engineer is underscored by the fact that a similar relationship between the Manager of the QA Department ("QA

Manager") and his superior was changed in 1973, by having the QA Manager report to the Vice President, Engineering, who has no responsibility for the construction or operation of Shoreham or for cost and scheduling matters. (Finding OQA:7). LILCO witnesses testified that the purpose of the change was to ensure the QA Department's independence from project management which has cost and scheduling responsibilities, and the NRC Staff testified that the reporting chain of the QA Manager to the Vice President, Engineering, is the element which assures that the QA Manager and his department are free from undue influence associated with cost and schedules. (Finding OQA:7). We see no reason why similar considerations should not mandate that the OQA Engineer must report to a superior with no cost and scheduling responsibility.

We are not persuaded that there are sufficient safeguards to ensure the independence from cost and scheduling of the OQA Engineer who reports to the Plant Manager. First, the OQA Engineer is under the total control of the Plant Manager. There are no safeguards to protect the OQA Engineer's special responsibility for safety and quality, and the Plant Manager's authority over the OQA Engineer is identical to his authority over his other subordinates, such as the chief engineer. (Finding OQA:5).

Second, the QA Manager cannot adequately protect the independence of the OQA Engineer and his Section. While the QA Manager is vested with the authority to direct the overall QA

program, he has no functional or administrative authority over the QQA Engineer, and does not even participate in regularly evaluating his performance. (Findings QQA:6, 8). The provision in the QA Manual that if the Plant Manager and the QQA Engineer "differ significantly with regards to a quality matter, they shall refer the matter to the QA Manager for resolution," is at best unrealistic and at worst illusory protection. The QA Manager would not overrule the Plant Manager and resolve the matter, but would merely provide the QQA Engineer with formal access of appeal to the Vice President, Engineering or the Vice President, Nuclear, access which is provided in any case by LILCO policy. (Finding QQA:14). Such appeals could involve delay. In a conflict between the Plant Manager and the QQA Engineer as to whether the plant should be shut down, the Plant Manager would prevail, because the plant cannot be shut down without the involvement of the Plant Manager or his designee. (Finding QQA:14). In any case, we believe that it would take an unusually strong-willed QQA Engineer to appeal a dispute with his boss, the Plant Manager, to higher management. Further, such action, which could jeopardize the position, if not the employment, of the QQA Engineer, would probably only be taken in the most extreme situation.

Third, we disagree with the proposition that there are adequate checks and balances -- audits, inspections, and procedure

reviews and concurrences -- to prevent the Plant Manager from exerting undue influence on OQA Section personnel. (See Finding OQA:16). Audits and inspections could only discover undue influence after the fact; they are not a substitute for institutional requirements, but are rather devices for ensuring compliance with requirements. Moreover, it would be extremely difficult, if not impossible, for audits and inspections to disclose subtle changes in attitude and performance by OQA personnel occasioned by their subordinate relationship to a Plant Manager whose primary concern might be meeting cost and scheduling targets. We do not believe that review and concurrence with OQA procedures by other LILCO organizations would inhibit undue influence by a Plant Manager. Indeed, the Plant Manager has the final say, since he must approve, and hence could veto, OQA procedures. (Finding OQA:17).

The Board accordingly believes that because of the total authority of the Plant Manager over the OQA Section and the lack of adequate safeguards to ensure the independence of the OQA Engineer from cost and schedule when opposed to safety considerations, the organization structure for QA should be changed to provide that the OQA Engineer reports to an official who is free from responsibility for cost and scheduling matters which might conflict with safety considerations.

Such a change in structure would strengthen the QA organization, and need not entail any significant disadvantages for LILCO. Mr. Muller, the current OQA Engineer, testified that the principal advantage in having the OQA Engineer as the direct subordinate of the Plant Manager is the direct access this provides. However, both Mr. Muller and Mr. Gilray of the Staff conceded that it would be feasible to have equivalent access to and communication with the Plant Manager even if the OQA Engineer did not work for the Plant Manager. (Finding OQA:9).

The only disadvantage of the change we are requiring would be, according to Mr. Muller, that the OQA Engineer would be an "outsider." Mr. Gilray's testimony on this point is contradictory; he first said that it would be a disadvantage if the OQA Engineer were "not part of the team," and later stated that it would be unacceptable if QA personnel were part of the team. (Finding OQA:9). In any case, we do not believe that the possible perception of OQA personnel as "outsiders" will adversely affect their ability to perform their inspection, surveillance, audit and other QA functions, any more than such a perception adversely affects the functions of NRC Staff and inspectors and auditors.

We understand and agree with the current position of the Staff, that there is no one rigid organization which is the only acceptable organization for QA at a nuclear power plant. (Finding OQA:

19). However, we believe that in finding the LILCO OQA organization acceptable (Finding OQA:10), the Staff did not perform an adequately rigorous analysis.

Mr. Gilray started with the premise that even though the Plant Manager has overall responsibility for the operation of the plant (which includes cost and scheduling matters), he is nevertheless "sufficiently free from cost and scheduling matters as opposed to safety matters." (Finding OQA:10). This premise is incorrect; the dual responsibilities of the Plant Manager create an inherent potential conflict which raises the issue of the independence of his subordinate, the OQA Engineer. Mr. Gilray testified that the OQA Engineer could report to any organizational position in LILCO, without being subject to undue influence of cost and scheduling matters, except the Chief Engineer, the Technical Support Manager, and the Chief Technical Manager. (Finding OQA:11). We believe this position is entirely too broad and shows an incomplete understanding of Criterion 1 of Appendix B and of the LILCO organization.

According to Mr. Gilray's testimony, it would not be acceptable for the OQA Engineer to report to the Chief Operating Engineer, because he has direct responsibility for the day-to-day operation of the plant on schedule and within cost. (Finding OQA: 11). But Mr. Gilray saw no problem with the OQA Engineer reporting to the Plant Manager, who has overall responsibility for

operating the plant, including ensuring that the Chief Operating Engineer meets scheduling requirements. (Findings OQA:10, 12). We believe those positions are inconsistent and incorrect. The potential for undue influence of cost and scheduling is no less likely to occur from the Chief Operating Engineer than from his supervisor, the Plant Manager. Moreover, Mr. Gilray overlooked the fact that in the absence of the Plant Manager, either the Chief Operating Engineer or the Chief Technical Engineer would assume the Plant Manager's overall responsibility for the plant (Finding OQA:13), and the OQA Engineer would therefore report to positions which Mr. Gilray finds unacceptable.

Our decision regarding the LILCO QA organization does not mean that in no case may operating QA personnel for a nuclear power plant report functionally to onsite plant management. We are aware that both the Staff's standard review plan and published NRC guidance generally permit such a structure. (Findings OQA:15, 18). But in each case there must be a careful analysis to determine whether the organization meets the requirements of Criterion 1 of Appendix B. That analysis must include, inter alia, the extent to which the onsite plant management to which OQA personnel report have responsibility for cost and scheduling matters; the extent to which such management exercises administrative, as well as functional, authority over such personnel; and the existence of organizational and procedural safeguards to ensure that OQA

personnel are sufficiently free of the pressures of cost and scheduling matters. In the present case, our analysis indicates that the OQA Engineer and the OQA Section do not have adequate organizational freedom and sufficient independence from cost and schedule when opposed to safety considerations.

C. SUFFOLK COUNTY CONTENTION 8: ENVIRONMENTAL QUALIFICAION

Suffolk County Contention 8 concerns the adequacy of the Environmental Qualification ("EQ") program at Shoreham. Although several specific inadequacies in the program were alleged by Suffolk County in the text of its contention, the litigation of the issue was focused on the more basic issue of whether the EQ program at Shoreham complies with 10 CFR Part 50, Section 50.49. That regulation, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants," was published in the Federal Register on January 21, 1983, and became effective February 22, 1983. It is, by its terms, applicable to Shoreham. See 10 CFR Part 50, Section 50.49(a).

The Shoreham EQ program was designed to comply with the requirements set forth in NUREG-0588 and NRC Memorandum and Order CLI-80-21. (Finding EQ:5). Similarly, the Staff's safety evaluation report at the time of the hearing on this issue reflected the Staff's review of the Shoreham EQ program for compliance with those requirements. (Findings EQ:5, 9).

Because NUREG-0588 and the Commission Memorandum and Order CLI-80-21 deal only with safety-related electrical equipment, both the Shoreham EQ program and the Staff's review thereof were limited to electrical equipment that had been classified as safety-related at Shoreham. (Findings EQ:4, 6, 9).39/

Unlike NUREG-0588, Section 50.49 applies to electrical equipment important to safety and therefore includes both safety-related and nonsafety-related equipment. The rule defines the scope of its coverage as follows:

> (1) Safety-related electric equipment: This equipment is that relied upon to remain functional during and following design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in a safe shutdown condition, and (iii) the capability to prevent or mitigate the consequences of accidents that could result in potential off-site exposures comparable to the 10 CFR, Part 100 guidelines . . . .
>
> (2) Nonsafety-related electric equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified in subparagraphs (i) through (iii) of paragraph (b)(1) of this Section by the safety-related equipment.
>
> (3) Certain post-accident monitoring equipment [specified as "Category 1 and 2" in Regulatory Guide 1.97, Revision 2].

(Finding EQ:6). 10 CFR Part 50, Appendix A, GDC 4 also

39/ The LILCO EQ program also does include certain equipment required by Regulatory Guide 1.97, Revision 2, that may or may not be safety-related. That equipment is considered separately in Section C below.

requires that equipment important to safety be designed to be compatible with postulated environmental conditions. (Finding EQ:7). Therefore, in order to comply with Section 50.49 and GDC 4, an applicant's EQ program must include not only safety-related equipment, but also that nonsafety-related equipment which is important to safety, and the post-accident monitoring equipment specified in Regulatory Guide 1.97, Revision 2, Categories 1 and 2.

There was no dispute that the Shoreham EQ program does not include any nonsafety-related equipment as defined in paragraph (b)(2) of Section 50.49. (Finding EQ:8). Indeed, the testimony submitted by both LILCO and the Staff on this Contention made clear that only safety-related equipment was considered relevant to the EQ program, prior to the issuance of Section 50.49. Accordingly, we find that any conclusions to be drawn from the LILCO or Staff testimony, or from LILCO or the Staff's proposed Findings of Fact, concerning the adequacy of the Shoreham EQ program must be limited to that program only as it applies to safety-related equipment. (Finding EQ:10).

In the discussion which follows, we address LILCO's compliance with Section 50.49 by separately discussing each category of equipment covered by that regulation.

A. Section 50.49(b)(1) - Safety-Related Equipment.

1. Equipment Included in EQ Program

The LILCO witnesses testified as to how safety-related electrical equipment as Shoreham was identified and analyzed in determining whether it needed to be included in the Shoreham EQ program. The reviews performed for this purpose were designed to identify that equipment previously designated as safety-related (Class 1E) during the initial design process. (Findings EQ:11-13).

Suffolk County contended that much safety-related equipment and several entire safety-related systems were excluded from the Shoreham EQ program without identifiable basis or explanation in the EQ report. (Finding EQ:15). In light of discussion during cross-examination of the treatment of the standby liquid control system ("SLCS") in the Shoreham EQ program, we are unable to conclude, as LILCO urges, that the Shoreham EQ program includes all necessary safety-related equipment.

Only one component of the SLCS is included in the Shoreham EQ program -- the level measurement on the standby liquid control tank. That component is required to be in the EQ program by Regulatory Guide 1.97, Revision 2. (Finding EQ:20). Both the Suffolk County witness and the LILCO witnesses, however, agreed that parts of the SLCS will be exposed to harsh environments during one or more of the design basis accidents.

(Findings EQ:16, 18). Although there was testimony that the SLCS has to be qualified only for normal operating conditions, (Finding EQ:18), we agree with Suffolk County that at least certain components of that system, such as the squib valves, the equipment necessary for those valves to function, and the SLCS pressure indicator, are necessary to mitigate design basis events and therefore fit into category (b)(1) of Section 50.49. There may be other components of the SLCS system which also fit into that category or category (b)(2) of the regulation. (Findings EQ:17, 21).

Apparently, no components in the SLCS other than the tank level indicator are included in the Shoreham EQ program; in our opinion, there has been no satisfactory explanation for the exclusion of other SLCS components that may be subject to a harsh environment and necessary to mitigate design basis events. (Finding EQ:22). Accordingly, we find, based on this example, that LILCO has failed to demonstrate that all necessary safety-related equipment has been included in the Shoreham EQ program.

2. Staff Review

As of June, 1982, when the Staff performed an audit of LILCO's EQ program, approximately 40 percent of the equipment to be included in that program had actually been qualified. (Finding EQ:23). At that time, the Staff identified 81 types of equipment that required either retesting, replacement or

additional qualification analysis. (Finding EQ:24). At the time of the hearing, approximately nine to ten months after the completion of the Staff audit, only about 30 percent of the deficiencies in qualification identified by the Staff had been resolved by LILCO. (Finding EQ:28).

Although the Staff identified the qualification deficiencies as "cause for concern" and requiring "case-by-case evaluation," according to the Staff witnesses the Equipment Qualification Branch intends to do nothing more than accept statements submitted by LILCO as to the resolution of these deficiencies. The Equipment Qualification Branch Staff will not conduct any additional audit or review to determine or verify the adequacy of the resolutions proposed by LILCO. (Findings EQ:26, 27). Thus, a proposed SER supplement intended to close out the qualification deficiencies will not be based upon any independent Staff review or analysis. (Findings EQ:26, 27, 29).40/

In light of the relatively large number of deficiencies identified by the Staff, and the significance apparently attached to them by the Staff at the time of their

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40/ Despite a suggestion that the Office of Inspection and Enforcement might, in the future, be given some review responsibilities with respect to equipment qualification, the Staff witnesses testified that no such I&E review was anticipated prior to the preparation of the referenced SER supplement. (Finding EQ:29).

identification, the Board cannot accept this proposed "resolution" of the matter. We conclude that a Staff finding that the Shoreham EQ program is adequate and in compliance with Section 50.49(b)(1) must be based upon a meaningful Staff review and not merely upon unquestioned acceptance of statements submitted by LILCO. See Finding EQ:62(g).

The Staff's planned treatment of deficiencies identified with respect to justifications for interim operation ("JIOs"), submitted by LILCO for equipment that will not be fully qualified prior to Shoreham operation, is similarly unacceptable. Section 50.49(i) requires submission of JIOs for all such equipment prior to the granting of an operating license. (Finding EQ:30). Following a review of the JIOs submitted by LILCO, the Staff identified several open items that must be addressed by LILCO before the Staff's review can be completed. (Finding EQ:33). The extent of the anticipated Staff review of LILCO's proposed resolution of the JIO deficiencies is not clear.

Moreover, Section 50.49(i) requires that the analyses contained in JIOs must include, where appropriate, consideration of several factors, including whether a failure of equipment under the accident environment resulting from a design basis event would produce misleading information for the operator. According to the Staff witnesses, the Staff has provided

no guidance to applicants concerning this requirement. In addition, the Staff witness was not qualified to identify the criteria used by the Staff in determining that LILCO's JIOs adequately considered the possibility of equipment failures resulting in misleading information for the operator. (Findings EQ:30-31). The Board finds that a Staff conclusion that the JIOs submitted by LILCO are adequate must be based upon a meaningful review of LILCO's proposed resolution of identified deficiencies, as well as a meaningful review, based upon defined criteria, of LILCO's analyses of the effects of potential failures on information provided to operators. (See Finding EQ:62(g)).

B. Section 50.49(b)(2) - Nonsafety-Related Equipment

1. Staff Guidance and Review

As noted above, LILCO's EQ program does not specifically address the nonsafety-related equipment that is important to safety and identified in paragraph (b)(2) of Section 50.49. (Finding EQ:8). Although the Staff testified that it will require LILCO to identify any equipment in category (b)(2) that is not already in its EQ program (as required by Section 50.49(d)), the record indicates that the Staff has provided no guidance to applicants as to how to go about preparing such a list. (Findings EQ:34-41). Indeed, the Staff witnesses testified that the Staff has not developed its own policy on

what will constitute compliance with Section 50.49(b)(2); nor has the Staff developed a "working knowledge" of how to deal with the list of equipment required by the regulation. (Finding EQ:36). It was evident from the Staff's testimony on cross-examination that the Staff has not determined what criteria should be used by an applicant in evaluating its equipment to generate a list of the nonsafety-related equipment identified in Category (b)(2). (Findings EQ:38, 40-41).

The Staff witnesses were also unable to describe how the Staff intends to review the list of category (b)(2) equipment to be submitted by LILCO. (Findings EQ:42, 45). On this point, the Staff again stated that "there has been no formal policy set up at this particular time;" the Staff witnesses were unable to state how or on what basis the Staff intends to assure itself that all equipment falling into category (b)(2) actually appears on the list of equipment to be submitted by LILCO. (Findings EQ:42, 45, 48). The Staff testified that a decision as to what kind of review will be performed will not even be made until after LILCO has submitted its proposed list of category (b)(2) equipment. (Finding EQ:43).

At the time of the hearing, the Staff stated it had no intention of performing a generic review of BWR equipment to determine for itself what equipment should fall into the (b)(2) category. (Finding EQ:44). However, the Staff witnesses and

the Suffolk County witness testified that in order to determine the equipment covered by all of Section 50.49, it would be necessary first to identify that equipment falling into each of the three subpart (b) categories and then to identify which pieces of such equipment are located in a harsh environment. (Findings EQ:39, 59).

We find that the Staff has no basis upon which to review LILCO's compliance with Section 50.49(b)(2). Accordingly, any future Staff finding of compliance by LILCO, prior to the establishment by the Staff of review criteria and necessary guidance for applicants, would be entitled to no weight.

2. LILCO Position

LILCO stated in its testimony that it believes there is no equipment in category (b)(2) at Shoreham. (Finding EQ:50). LILCO's witness, Mr. Kascsak, testified that LILCO believes it will not have to identify any equipment in that category because the Shoreham design process has eliminated all such equipment. (Finding EQ:51). However, LILCO does not intend to perform any studies or analyses beyond those already performed during the design process which have determined that there is no equipment in category (b)(2). (Finding EQ:52).

We are unable to accept LILCO's conclusory statement as evidence of present or future compliance with Section 50.49 (b)(2) sufficient to permit a finding in favor of LILCO on this

Contention. We agree with Suffolk County that even with a systematic design process that attempted to preclude adverse effects of nonsafety-related equipment on safety-related equipment, there can still be no assurance that there would not be such effects once the design has been implemented. (Finding EQ:53). Furthermore, in order to determine what equipment, if any, falls into category (b)(2), both safety-related and nonsafety-related systems must be reviewed, since either type of system could contain nonsafety-related components, the failure of which could prevent satisfactory accomplishment of Part 100 safety functions. (Finding EQ:55). We find that in the absence of such a review, LILCO has no basis on which to conclude that, at Shoreham, there is no equipment in the (b)(2) category. (Finding EQ:54).

We wish to emphasize that we are not finding, at this time, that LILCO's present belief concerning the amount of category (b)(2) equipment at Shoreham will necessarily prove to be erroneous. Our point is that such a conclusion cannot be drawn without there first having been a systematic review of all equipment which potentially could be in that category. Such a review, of both safety-related and nonsafety-related but important-to-safety equipment, has not been performed at Shoreham.41/

41/ LILCO argued in its Proposed Findings (Vol. I, at 160) that because Section 50.49(b)(2) does not mention the pos-

(Footnote cont'd next page)

C. Section 50.49(b)(3) - Regulatory Guide 1.97 Equipment

The Staff's review of LILCO's compliance with Regulatory Guide 1.97, Revision 2, will not be completed prior to fuel load, even though Section 50.49(b)(3) requires the qualification of category 1 and 2 items identified in that Regulatory Guide. (Finding EQ:56). LILCO has indicated, on the record in this proceeding, that it does not intend to install all the equipment recommended in Regulatory Guide 1.97, Revision 2. (Finding EQ:57). Nonetheless, the Staff witnesses were unable to explain on what basis the Staff could determine that LILCO had complied with Section 50.49, including the submission of all necessary JIOs prior to fuel load, if the Staff had not reviewed LILCO's response to Regulatory Guide 1.97, Revision 2.

(Footnote cont'd from previous page)

sibility of equipment failures misleading the operator, such consideration is only applicable to JIOs, and not to a determination of what equipment falls into category (b)(2). LILCO is correct that the words in Section 50.49(i)(5) are not contained in Section 50.49(b)(2); however, the conclusion drawn by LILCO from that fact is incorrect. We find that consideration of whether a failure would produce potentially misleading information is an essential part of identifying equipment important to safety. One way the failure of nonsafety-related equipment could "prevent satisfactory accomplishment of safety functions" (§50.49(b)(2)) is by providing information that would mislead the operator. Thus, a consideration of that possibility is an inherent part of identifying the equipment important to safety that is covered by category (b)(2).

(Finding EQ:58). We find that completion of the Staff's Regulatory Guide 1.97 review is a prerequisite to a determination of Section 50.49 compliance. See Finding EQ:62(c) and (f).

D. Actions Necessary for Compliance with Section 50.49

We believe the logical first step in the process of complying with Section 50.49 is the preparation of a list of all electrical equipment at Shoreham that is important to safety. Following the preparation of such a list, the items on it can be evaluated to determine if they meet the criteria set forth in Section 50.49. If they do, they must be included in the Shoreham EQ program. (Finding EQ:59). The Staff agreed, on cross-examination, that a list of items important to safety would be a helpful tool in conducting a review of an applicant-submitted list of equipment covered by Section 50.49. The Staff further testified that, if available, an all-inclusive list of equipment important to safety that had been approved by the Staff would be used as a checklist in reviewing an applicant's list of Section 50.49(b)(2) equipment. (Finding EQ:60). We find that a list of equipment important to safety at Shoreham should be prepared by LILCO. We also find that a generic list of BWR equipment that is important to safety should be generated by the Staff. In the absence of such lists, we believe there can be no basis for a conclusion by the

Staff, by LILCO or by this Board, that Shoreham's EQ program complies with Section 50.49, particularly in light of LILCO's failure to use an important-to-safety category in its classification of equipment. (Findings EQ:61-62).

E. Conclusion

We find in favor of Suffolk County on SC Contention 8 because there is no basis in the present record for a finding that Shoreham is in compliance with 10 CFR Part 50, Section 50.49. Further, we retain jurisdiction of this matter, and we identify in our detailed Findings several actions which must be taken by LILCO and by the Staff as preconditions for a finding of such compliance. We will not repeat all those actions here, but refer to our Findings EQ:62-64.

Although LILCO urges us to find in its favor on this Contention and to rely on Staff review to assure proper resolution of this open item, we are unable to do so. As a licensing board, we have a duty to make findings on critical issues of health and safety prior to issuance of an operating license. We are not empowered to delegate that obligation to the Staff.42/ As the Commission has stated:

42/ Cleveland Electric Illuminating Company, (Perry Nuclear Power Plant, Units 1 and 2), ALAB-298, 2 NRC 730, 737 (1975). See also, Washington Public Power Supply System (Hanford No. 2 Nuclear Power Plant), ALAB-113, 6 AEC at 251, 252 (1973).

> As a general proposition, issues should be dealt with in the hearings and not left over for later (and possibly more informal) resolution . . . . [T]he mechanism of post-hearing resolution must not be employed to obviate the basic findings prerequisite to an operating license -- including a reasonable assurance that the facility can be operated without endangering the health and safety of the public. 10 CFR §50.57. In short, the "post-hearing" approach should be employed sparingly and only in clear cases. In doubtful cases, the matter should be resolved in an adversary framework prior to issuance of licenses 43/

Although certain minor matters may properly be left to the Staff for post-hearing resolution,44/ such instances are limited to minor procedural deficiencies or issues where on-the-record proceedings would not be helpful for resolution of the issue.45/ In this case, however, the unresolved issue before us is neither minor nor procedural: LILCO admittedly has not yet

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43/ Consolidated Edison Company of New York, (Indian Point Station, Unit No. 2), CLI-74-23, 7 AEC at 947, 951-952. See also, Public Service Company of Indiana, (Marble Hill Generating Station, Units 1 and 2), ALAB-461, 7 NRC 313, 318 (1978) in which Staff Counsel urged that factual determinations related to the issue of an applicant's financial obligations should not be left to the Staff, noting that "delegating open matters to the staff for posthearing resolution is a practice frowned upon by both the Commission and this [Appeal] Board . . . ."

44/ See, e.g., Consolidated Edison, 7 AEC at 951 and note 8.

45/ Southern California Edison Co. (San Onofre Nuclear Generating Station, Units 2 and 3), LBP-82-39, 15 NRC 1163 (1982). For instance in San Onofre, the Board held that the issue of whether a public information booklet should be printed in Spanish as well as English was a minor issue that could be left to the Staff to resolve. Southern California Edison Co., 15 NRC at 1216.

complied with a Commission regulation dealing with equipment qualification, a critical safety issue. The Staff has no idea at present how it will determine or ensure such compliance in the future. Promises or expectations of eventual compliance are not sufficient. We would violate our obligation as a licensing board were we to terminate our consideration of this matter given the present state of the record.

Accordingly, we must retain jurisdiction of this issue pending completion of the actions we identify in our Findings and submission of the results thereof to us and to the parties. Following such submissions, and an opportunity for the parties to be heard thereon, we will again review this issue and make a determination as to whether Shoreham complies with Section 50.49.

FINDINGS OF FACT

A. QUALITY ASSURANCE/QUALITY CONTROL

I. Procedural Matters

QA:1. Suffolk County Contention 12, on which the Shoreham Opponents Coalition was a participant, reads as follows:

> Suffolk County contends that LILCO and the NRC Staff have not adequately demonstrated that the quality assurance program for the design and installation of structures, systems, and components for Shoreham was conducted in a timely manner in compliance with the pertinent portions of 10 CFR 50, Appendix B, Sections I to XVIII, and 10 CFR 50, Appendix A, GDC 1. There has been a pattern of QA/QC breakdowns at Shoreham. This pattern has covered Appendix B Criteria 2, 3, and 5-18. Accordingly, Suffolk County contends that LILCO has failed to comply with 10 CER Part 50, Appendix B, as particularized in Appendix 1 attached hereto.

The detailed Appendix to SC Contention 12 is contained as an attachment to the County's prefiled QA/QC testimony. SC Ex. 89B, at 2-4 through 2-31.

QA:2. Suffolk County Contention 14 reads as follows:

> Suffolk County contends that the NRC Staff's Inspection and Enforcement (I&E) Program has not adequately verified that LILCO's quality assurance program for Shoreham has been implemented in accordance with the requirements of 10 CFR Part 50.34(a), paragraph 7 and 10 CFR Part 50, Appendix B, Sections 1 through XVIII, in that:
>
> (a) The I&E Program has identified only the symptoms of the Shoreham quality deficiencies as

nonconformances, and has not required LILCO to initiate corrective action to resolve the root causes;

(b) The I&E Program's reliance on LILCO for primary inspections at Shoreham with NRC officials serving as auditors is not adequate because the same practice has recently proved to be inadequate in timely identifying quality deficiencies at other nuclear facilities (e.g., Browns Ferry, North Anna, Davis Besse, and Rancho Seco); and

(c) The I&E Program has no baseline criteria against which to measure quantitatively the effectiveness of the Shoreham quality program. In order to draw conclusions from random inspections just such a statistical base is desirable. In addition, the I&E program has no means of determining improvements in, or the effectiveness of, corrections as no comparative measures are used.

QA:3. Suffolk County Contention 15 reads as follows:

> Suffolk County contends that the Shoreham quality assurance/quality control program has involved inadequate review and physical inspection to verify compliance with 10 CFR 50, Appendix B. The inability to verify full compliance with Appendix B is based on inadequacies discovered independently at Diablo Canyon, Zimmer, Midland and South Texas and on statements by NRC Chairman Palladino. Similarly, the random non-systematic approach taken by NRC I&E to verify quality programs is inadequate to provide appropriate assurance of compliance. Also the random checks being conducted by the NRC resident inspector at Shoreham indicate lapses, breakdowns and inconsistencies that do not provide credible public assurance of an operable QA System. For example, see NRC inspections 50-322/79-05, 80-03, 80-06, 80-08, 80-04, and 81-02. Because the NRC reports do not indicate what changes, if any, were made in procedures to correct for

> failures that have occurred, it is not possible to judge the adequacy of corrective actions. Finally, there are no quantitative measures used to assure that NRC, I&E and LILCO audits can be correlated statistically to provide verification of the adequacy of the QA system to detect system or equipment errors or distinguish between random errors and systematic failures.
>
> Therefore, there is no assurance that LILCO has complied with 10 CFR 50.55(e) and 10 CFR 50, Appendix B, Sections XVII and XVIII. Suffolk County contends that NRC, I&E and LILCO cannot provide assurance of compliance without systematically auditing QA documentation against physically inspectable structures and components. This physical audit should be sufficiently detailed to provide statistically valid data to permit projection of the audit results to systems beyond those systems and QA records inspected.

QA:4. Witnesses for LILCO, the NRC Staff and Suffolk County testified on Contentions 12-15. LILCO's prefiled testimony was submitted by Messrs. John F. Alexander, T. Frank Gerecke, Joseph M. Kelly, Arthur R. Muller, William J. Museler and Edward J. Youngling of LILCO; Messrs. T. Tracy Arrington, Frederick B. Baldwin, Robert G. Burns and William F. Eifert of Stone and Webster Engineering Corporation ("SWEC"); and Mr. Donald G. Long of General Electric ("GE"). Alexander et al., LILCO Ex. 21. Mr. Robert A. Kubinak and Mr. Brian McCaffrey also appeared at the Board's request for LILCO on Independent Safety Evaluation Group ("ISEG") matters. See LILCO Ex. 35, Items 3 and 4 (Professional Qualifications -- Robert A. Kubinak, Professional Qualifications -- Brian McCaffrey).

Messrs. Museler, Arrington and Kelly submitted supplemental testimony for the Applicant on the NRC Readiness Assessment Team ("RAT") inspection. LILCO Ex. 21, ff. Tr. 19,757.

QA:5. Prefiled testimony was submitted on behalf of the NRC Staff by Messrs. Robert M. Gallo of the Division of Project and Resident Programs, Region I; John William Gilray of the Quality Assurance Branch, Office of Nuclear Reactor Regulation; James C. Higgins of Region I and Senior Resident Inspector at the Shoreham Nuclear Power Station; Lewis Narrow of the Engineering Programs Branch, Division of Engineering and Technical Programs, Region I; and George W. Rivenbark of the Operating Reactor Branch No. 4, Division of Licensing, Office of Nuclear Reactor Regulation. Staff Ex. 8. Messrs. Gallo, Gilray, Rivenbark, Higgins and Narrow also submitted supplemental testimony updating I&E reports. Gallo et al., ff. Tr. 16,411-A. Mr. Donald L. Caphton of the Engineering Programs Branch, Division of Engineering and Technical Programs, Region I, joined Mr. Gilray in appearing for the NRC Staff on Operational Quality Assurance independence. See Tr. 20,148 (Professional Qualifications -- Donald L. Caphton). Mr. Edward G. Greenman, Projects Branch No. 1, Division of Project and Resident Programs, Region I, joined Mr. Higgins in appearing for the NRC Staff regarding the RAT inspection. See Tr. 19,753 (Professional Qualifications -- Edward G. Greenman).

QA:6. Suffolk County's testimony was filed by Mr. Richard B. Hubbard of MHB Technical Associates. SC Exs. 89A and 89B. LILCO moved to strike portions of the Suffolk County QA/QC testimony, including all those which pertained to QA requirements for structures, systems and components ("SS&Cs") important to safety but not safety-related. The LILCO Motion, the Staff's support thereof and the County's opposition to the Motion are bound into the record following Tr. 10,058. The LILCO Motion was denied prior to the start of the hearing during a conference call and the Board confirmed its ruling at the start of the QA/QC hearing. Tr. 10,059. Mr. Hubbard also filed supplemental testimony on housekeeping. SC Ex. 89D, ff. Tr. 15,362. The Board denied the County an opportunity to submit testimony on the RAT inspection.

QA:7. Testimony was also filed by LILCO and Suffolk County on Torrey Pines Technology's construction verification of Shoreham. Prefiled testimony on behalf of LILCO was submitted by Mr. Joseph P. Novarro of LILCO and Mr. Louis D. Johnson of Torrey Pines Technology. Novarro, ff. Tr. 17,588; Johnson, LILCO Ex. 56. Mr. Johnson also filed supplemental testimony. Johnson, ff. Tr. 18,313. Depositions were taken of Messrs. Novarro and Johnson as well, and were admitted into evidence. Johnson, LILCO Ex. 57; Novarro, LILCO Ex. 58. Prefiled testimony was submitted on behalf of Suffolk County by Mr. Hubbard

and Dr. Francisco J. Samaniego of the University of California, Davis. Hubbard and Samaniego, ff. Tr. 19,068. LILCO unsuccessfully moved to strike Dr. Samaniego's testimony. See Tr. 17,568-80, 19,287-92. Messrs. Hubbard and Samaniego were also deposed regarding the Torrey Pines inspection, and their joint deposition was received into evidence. Hubbard and Samaniego, SC Ex. 112.

QA:8. The Licensing Board encouraged the examination on QA/QC to focus on alleged deficiencies in QA implementation rather than on the description of LILCO's QA program. Tr. 10,259-68 (Brenner, Lanpher).

II. Overview

QA:9. Quality assurance, as that term is utilized in the NRC's regulations, constitutes a process that goes all the way from design through operation. It is a disciplined process which plans a course of action, implements that plan and documents the implementation. It is a process that is controlled by procedures which assure that you assign people to be responsible and that you define what they are going to do, when they are going to do it and how they are going to do it. Tr. 15,948-49 (Hubbard).

QA:10. QA constitutes a management tool by which one assures that the design is correct and the plant is constructed in accordance with that design. SC Ex. 89B, at 3-2. A good QA

program requires strong management support and attention. Chairman Palladino of the Nuclear Regulatory Commission has stated:

> To be effective, a QA program must have the full support and attention of the nuclear industry managers responsible for design and construction. SC Ex. 89B, at 3-2.

QA:11. Mr. William Dircks, the NRC's Executive Director for Operations, has stated:

> The NRC looks to the power plant owners, the utilities themselves, to take the leadership role in assuring the quality of their plants and operations. This requires heavy emphasis and active involvement of top licensee management in QA programs. Careful attention is required in the selection of engineering specifications and QA procedures and practices for each task and their implementation by workers on the job. Most importantly, there must be adequate resources of qualified personnel at management, operating, and staff levels. SC. Ex. 89B, at 3-5.

QA:12. In an article on quality assurance entitled, "Upgrading Quality Assurance Programmatic Guidance for Operating Nuclear Power Plants," Mr. Haass of the NRC Staff stated that the "attitude of the licensee's management toward QA is of the utmost importance to the success or failure of the QA program." Tr. 15,319 (Morris). Mr. Hubbard agreed with that statement. He stated that if the management at the top really believes in quality discipline, one will end up with a more reliable plant. Accordingly, QA does start at the top.

Tr. 15,320 (Hubbard). In Mr. Hubbard's view, LILCO has put QA aside. Tr. 15,320-21 (Hubbard).

QA:13. In the QA/QC context, management attitude concerns whether a licensee's management is dedicated to implementation of its QA/QC program. Such management commitment and attitude is essential if a QA/QC program is to be properly implemented. SC Ex. 89D, at 5.

QA:14. Successful implementation of a QA program is essential to achieving expected levels of safety. SC Ex. 89A, at 45.

QA:15. A QA/QC program which is established by management should reflect a degree of control which can be achieved if the program is properly implemented. It is not consistent with good QA/QC practice to establish QA/QC requirements which cannot be satisfied. This leads to the possibility of repeated failure to achieve an unrealistic goal, which may condition personnel to consider QA/QC program requirements as unimportant. Thus, an important aspect of a good QA/QC program is to set forth achieveable, realistic goals, which have full management support, and to then vigorously enforce those goals. Any deviation from those goals or policies which have been set by management then must be considered to be significant since such deviation reflects a failure of management to fully enforce and implement its policies. SC Ex. 89D, at 6-7.

QA:16. The linchpin in the NRC's defense-in-depth approach to nuclear safety is its emphasis on QA/QC in design, construction and operation of nuclear power facilities. SC Ex. 89A, at 14.

QA:17. A QA/QC program for a nuclear power plant exists first to ensure that the plant is designed and constructed in compliance with prescribed regulations, and second to document this compliance. SC Ex. 89A, at 6. The establishment of a QA/QC program and its proper implementation will not ensure that all errors are eliminated. In a complex facility such as a nuclear power plant, complete elimination of errors is not possible. Thus, QA and QC recognize this fact and establish a control system designed to detect the inevitable errors and therefore to ensure that the facility is in fact designed, constructed and operated in accordance with the required standards. SC Ex. 89A, at 15. Criterion 16 of Appendix B in effect acknowledges the fact that there will be deviations from the requirements of a QA program. Tr. 17,364 (Gallo). QA/QC recognizes this inevitability and therefore imposes a control system which is designed to detect these errors and thus ensure that the facility is designed and constructed to the required standards. SC Ex. 89A, at 15.

QA:18. The NRC's 1980 Annual Report, NUREG-0774, emphasizes the importance of quality assurance in the NRC regulatory format:

> The application of disciplined engineering practices and thorough management and programatic controls to the design, fabrication, construction, and operation of nuclear power plants is essential to the protection of public health and safety and of the environment. QA provides this necessary discipline and control. Through a QA program that meets NRC requirements, all organizations performing work that is ultimately related to the safety of plant operation are required to conduct that work in a preplanned and documented manner; to independently verify the adequacy of completed work; to provide records that will confirm the acceptability of work and manufactured items; and to assure that all individuals involved with the work are properly trained and qualified to carry out their responsibilities. (emphasis supplied) SC Ex. 89A, at 14.

QA:19. Prior to 1970, there was no explicit regulatory requirement for a QA/QC program. Starting in 1970, however, a new approach was developed that required adherence to specific, detailed criteria. The new NRC rules which were adopted in 1970 had one basic purpose: assurance that the design, construction and operation of nuclear plants, such as Shoreham, met high quality standards. This assurance would help to ensure that plants would generate power safely. SC Ex. 89A, at 6, 8.

QA:20. In the past several years, serious QA deficiencies have been reported at a number of plants, raising serious questions about utilities' compliance with NRC requirements and the ability of the NRC licensing review program and inspection

process to provide assurance that QA/QC requirements are, in fact, properly implemented. These included the South Texas project (multiple design flaws, coupled with earlier disclosure of construction problems); SW problems with seismic models; and significant breakdowns at Diablo Canyon and Zimmer. SC Ex. 89A, at 8. See also SC Ex. 89B, at 3-7 through 3-14 (discussion of serious QA breakdowns at Marble Hill, Midland, Zimmer, South Texas and Diablo Canyon). The causes of the QA breakdown at these other plants are diverse but most can be traced to ineffective management control of the QA program. SC Ex. 89B, at 3-14 and 3-15. These deficiencies at other plants are significant for Shoreham and they demonstrate the ineffectiveness of the NRC I&E program in providing verification of compliance by utilities with Appendix B requirements. SC Ex. 89A, at 8.

QA:21. The I&E inspection effort is aimed at assuring that licensees establish and implement effective QA programs which fully satisfy the NRC's regulations. SC Ex. 89B, at 3-2. The NRC looks to the licensees to take the leadership role in assuring the quality of their plants. The resources of the NRC constitute only a small fraction of the resources of a licensee. Thus, the I&E program constitutes an audit and overview of the licensees' program, which covers one to five percent of the inspection activities performed by the licensee and its contractors. SC Ex. 89B, at 3-5 and 3-6.

QA:22. Mr. Dircks acknowledged that there have been deficiencies in the I&E inspection program, such as failure to recognize the breadth and depth of problems and failure to correct the specific causes of cited violations. The Staff has taken steps recently to address these deficiencies. It has:

-- stationed resident inspectors at facilities which should assist in monitoring performance of management QA control;

-- toughened enforcement policy by placing emphasis on dealing with poor regulatory performance in construction areas;

-- instituted team inspections (such as the Construction Assessment Team ("CAT") inspection), which enhance I&E's perspective of licensee's QA program;

-- focused I&E efforts on highest priority matters;

-- established the SALP program;

-- used the NDE van. SC Ex. 89B, at 3-16 through 3-18.

All of these activities have been instituted at Shoreham over the last several years. Tr. 17,250 (Gallo). These measures are not adequate in Mr. Hubbard's opinion. They relate almost entirely to construction activities and thus the deficiencies in the design area are not addressed. Further,

these fixes do not address necessary compliance with GDC 1 for items important to safety but not safety-related and do not address deficiencies for failing to use a statistically valid methodology. Tr. 15,951-52 (Hubbard).

QA:23. Shoreham received its construction permit on April 14, 1973. Appendix B to Part 50 was adopted by the NRC in June of 1970. Accordingly, the QA/QC regulations had been in place for nearly three years when construction activities for safety features at Shoreham were authorized. SC Ex. 89A, at 9.

QA:24. The QA requirements of 10 CFR Part 50, Appendix B, and Part 50, Appendix A, GDC 1, require QA to be applied to virtually all activities associated with the design, construction and operation of SS&Cs which are important to safety. SC Ex. 89A, at 9.

QA:25. The American National Standards Institute ("ANSI") in 1970 established committees to develop explicit guidance for licensees and contractors on how to implement the QA requirements of the NRC. Beginning in 1971 and through much of the 1970s, the ANSI committees issued over a dozen final and draft QA standards pertaining to almost all aspects of plant design and construction. For example, ANSI Standard N45.2.2, pertaining to packaging, shipping, receiving, storage and handling of equipment, was issued in 1973. SC Ex. 89A, at 10-13.

III. Calculations

A. Procedural Requirements

QA:26. The SWEC Engineering Assurance ("EA") program formalizes management policies and practices for ensuring the quality of engineering work. The EA division work includes developing policies and procedures for performing engineering work. LILCO Ex. 21, at 77.

QA:27. Engineering Assurance Procedure ("EAP") 5.3, entitled "Control of Computerized and Manual Calculations," establishes the methods for the preparation, review and storage of calculations. This is part of the SWEC QA program and, as such, is a written procedure which supports implementation of that program. LILCO Ex. 11, at 17.1-31, Table 17.1.2B-2, at 4. In the LILCO FSAR, EAP 5.3 is listed as one of the procedures designed to implement compliance with Criterion 5 of Appendix B. LILCO Ex. 11, Table 17.1.2B-2, at 4, at 17.1-35 and 36. The traceability requirement of EAP 5.3 is part of the SWEC QA program. Tr. 10,492 (Eifert). Under Appendix B, Criterion 5, a licensee must prepare documented instructions, procedures and drawings for activities affecting quality. Once these procedures, instructions and drawings are documented, the licensee is expected to implement that program. Tr. 12,099-100 (Eifert).

QA:28. Audit observations or infraction notices by SWEC indicate a failure to comply with a procedure or control mechanism. They indicate a condition which needs to be improved. Tr. 10,299-300 (Eifert).

QA:29. The SWEC audit program has been organized on a project basis, so that the audits are conducted by discipline. Accordingly, SWEC witnesses took the position that a recurrent problem occurs only if it shows up again in the same group or discipline. Tr. 10,398 (Eifert). It would be unreasonable in their opinion to request engineers in one discipline to take corrective actions for problems that were being encountered in a different discipline. Tr. 10,399 (Eifert). However, there may be specific instances where it is appropriate to look at a trend of problems across organizational lines. Tr. 10,402 (Museler).

QA:30. The basic SWEC procedure for control of design calculations is EAP 5.3. This EAP applies throughout various SWEC disciplines (structural, mechanical, electrical, for instance) and covers preparation and control of manual and computerized calculations. Tr. 10,290, 13,438 (Eifert).

QA:31. Mr. Hubbard believes that the SWEC EA audits are useful in terms of looking at the process, the design process, and particularly for seeing whether the necessary discipline had been imposed. He does not believe they are useful in

finding out whether the actual substance of the design was correct. Tr. 16,143 (Hubbard); Tr. 10,763-64 (Eifert).

QA:32. Positive traceability means that in the future, someone who is not on the project after these calculations have been around for a while could go to the calculation and be able to use it. Without strict traceability requirements, that person, if he did not have explanatory interoffice communications or other such items to help, would find tracing the calculation to be difficult. Accordingly, the strict positive traceability requirement of EAP 5.3 has been imposed. Tr. 10,536-38 (Museler).

QA:33. With respect to the traceability requirement, Judge Carpenter asked questions to determine how adequate traceability could be ensured if the procedure were not complied with and a new employee who was not familiar with the calculations needed to use those calculations. See Tr. 10,503-04. Judge Carpenter further made the point that the fact that SWEC auditing engineers can actually trace the calculations despite lack of input data when they go to audit the calculations does not answer the question for the future. If the calculations have to be used five or ten years in the future and different people are involved and they do not have the interoffice correspondence, etc., which makes tracing more feasible, then there is going to be a real problem. See Tr.

10,536-38. That is the reason that the information is required to be placed on the calculation. Tr. 10,504 (Museler). However, even if the information is not on a particular calculation, an engineer would be able from the subject matter to identify those documents which would constitute the source of information. Tr. 10,504-05 (Museler). The traceability, in the absence of identification of the specific input data, exists because of knowledge of the process, the availability of the documentation, and the constant use of that documentation by all engineers on the project. Tr. 10,508-09 (Eifert). However, SWEC is concerned about the positive traceability observations, especially for future useability. Mr. Eifert emphasized that SWEC has been able to do the tracing, but in some instances it might take as much as ten hours to find the input for a given analysis. Tr. 10,540 (Eifert). Thus there was traceability, but there wasn't positive traceability of the kind that SWEC procedures require. Tr. 10,540-41 (Eifert).

QA:34. Speaking with reference to EA Audit 19 where the source of basic data for calculations was not provided, Mr. Eifert clarified that the reason SWEC requires strict documentation of input data is that if it becomes necessary to revise or change the calculations at a later date, either during construction or operation, persons not familiar with the original calculations may be doing the analyses. If you are going to

have ready traceability, then it is important to have specific reference to the input documents. Tr. 10,463 (Eifert). Thus, the SWEC traceability requirement is primarily included to ensure the future useability of calculations, and not from the standpoint of ensuring the immediate accuracy of individual analyses. Tr. 10,494 (Eifert).

QA:35. Mr. Eifert was nearly certain that EAP 5.3 does not specifically define the term "positive traceability," although it has been used in many audit findings. However, the procedure, in its instructions for preparation of calculations, gives specific details on how preparers are to identify input sources. Tr. 10,573, 10,628-29 (Eifert).

QA:36. Over the years, there have been several changes in the administrative controls for engineering calculations. In approximately 1973, SWEC imposed the requirement that when a calculation references another calculation, it must be identified by number. In 1978, the procedure was revised to provide specific instructions with respect to such things as identification of texts and the need for more than just the author being mentioned. The procedure was then altered again in 1979 to change the format, with the required detail remaining basically the same. Tr. 10,745-46 (Eifert). There was a change in 1975 with respect to properly identifying computer programs, including the specific version and level of the computer

program. In 1979, there was a change in a specific detail with respect to identifying input sources to such things as a page number in the input source document. Tr. 13,917-18 (Eifert).

QA:37. The reason why SWEC management is interested in the traceability of calculations is that some years from now, after the engineers no longer have a close memory of what they utilized, if you go back and look at the calculation to see if some change is important, you will be able to identify what went into the calculation. In addition, by having the traceability of calculations, it provides a product to SWEC clients that they can readily use. This is especially true if the client is going to use its own engineering staff during the operating phase. Tr. 10,763-64 (Eifert).

QA.38. One aspect of the control of design calculations is that input data used in the calculations be clearly defined and the source of the data be traceable. Tr. 10,992 (Eifert). Other aspects of design calculation control are:

-- verification of the design, including checking for accuracy (Tr. 10,291, 10,296 (Eifert));
-- that the calculations need to be available to persons who need to use the calculations in their work (Tr. 10,292 (Eifert));
-- superseded calculations are marked as void or superseded (Tr. 10,295 (Eifert));

-- computer programs used in calculations are qualified (Tr. 10,296 (Eifert)).

QA:39. SWEC EA audits actual check the accuracy of calculations in some instances but not in all cases. The auditor would generally look for evidence of required checking and also, in a number of cases, would actually look at some portions of the calculations. Tr. 10,364-65 (Eifert).

B. Audit Results

1. Ready Traceability

QA:40. In part 1A, LILCO Exhibit 24 lists 26 portions of SWEC or Site Engineering Office audits where "ready traceability" calculation deficiencies were identified. Mr. Eifert described this group of audits as constituting a category of detailed administrative concerns. "The concerns deal with the specific detail, documentation of sources of the input data which Stone & Webster expects our engineers to put in the calculation documentation to ensure that this information is readily available and to make it such that an engineer in the future could readily review and understand that calculation." This is a stringent requirement, which is now contained in EAP 5.3. Tr. 13,323 (Eifert); LILCO Ex. 24, at 1-2. Mr. Eifert believes that the ready traceability audit observations described in LILCO Exhibit 24 are administrative oversights, but they are details that SWEC management wants in the calculations. Tr. 13,353 (Eifert).

QA:41. The ready traceability audit observations noted in part 1A of LILCO Exhibit 24 are described generally by way of example by Mr. Eifert. Mr. Eifert indicated that despite the specific audit findings involved, in all cases that he knew of, the data actually were retrievable, but simply were not in the precise format required by SWEC procedures. Tr. 13,324-34 (Eifert).

QA:42. Mr. Eifert testified that the ready traceability audit observations set forth in LILCO Exhibit 24, Category 1A and 1B, are not significant in terms of the integrity of the plant design. Mr. Eifert describes it as an administrative problem and not a problem with technical adequacy. Tr. 13,334-35 (Eifert). Mr. Eifert explained that the audit process used by SWEC does not only audit the administrative requirements, but also checks specifically to identify that the engineers have used the correct and current input data. This is done in many of the audits. The audit process has not found difficulties with respect to the engineers not using the correct or current data. They have used the correct or current data, but have sometimes failed to document the data's source. Tr. 13,336, 13,348-49 (Eifert). There was one audit observation in which a revision to the source document was made after the calculation had been prepared and before the review had been completed. This indicates that the wrong input data

were used. However, Mr. Eifert believes this would have been caught during the review process. Tr. 13,348-49 (Eifert).

QA:43. The three audit observations at page 2 of LILCO Exhibit 24 (Item 1B, entitled "Computer Program Identification") are three instances where the version and level of the computer program had not been identified as required by EAP 5.3. That procedure requires that the reference in the calculation to the computer program include the program name, version and level. Tr. 13,332-33 (Eifert). This situation involved cases where there was actual traceability, but the level of detail required by the EAP had not in fact been satisfied. Tr. 13,333-34 (Eifert).

QA:44. Mr. Eifert had two explanations for the number of ready traceability audit observations set forth in LILCO Exhibit 24. First, the number of ready traceability audit observations reflects an increasing stringency in the requirements of EAP 5.3. Second, engineers put their primary emphasis on ensuring the technical adequacy of the analysis and have not placed a similar emphasis in ensuring that the detailed administrative documentation is correct. Tr. 10,533, 13,337-38 (Eifert). Mr. Eifert stated that there has been some resistance on the part of engineers to spend a disproportionate amount of their time on administrative details as opposed to engineering. The SWEC EA Division is attempting through

training sessions to show why such administrative details are important. Tr. 10,748-49 (Eifert). Mr. Eifert stated that he has received total management support for these efforts, including participation in training sessions. Tr. 10,749-50 (Eifert).

QA:45. With respect to the ready traceability problem, Mr. Eifert believes that the preventive action and corrective action taken by SWEC has been adequate and effective. The first form of corrective action is to ensure that the lead engineers responsible in these areas take steps to ensure that personnel clearly understand the SWEC ready traceability requirement and the need for implementation of that requirement. Moreover, there has been formal training with respect to calculations. This training first began in 1972. Tr. 13,340-41 (Eifert). In the late 1970s, SWEC structured its training presentation to emphasize to engineers the importance of some of the procedural requirements and why management has established those requirements. The ready traceability problem is an administrative control procedure which engineers by their nature consider to be of secondary importance. Tr. 10,533 (Eifert). Mr. Eifert believes that the audit program has been effective because SWEC is continuing that program. SWEC, however, does not believe that this is an important finding with respect to the integrity of the plant design. Tr. 13,342 (Eifert).

QA:46. Mr. Eifert testified that Criterion 16 has two parts. The first part requires that the audit program identify conditions that need to be corrected and that the correction be achieved. The second part of Criterion 16 specifies that for significant conditions adverse to quality, measures shall assure that the quality condition is determined and that corrective action taken to preclude repetition is instituted. With respect to the ready traceability audit findings, this second part of Criterion 16 does not come into play, in Mr. Eifert's opinion, because these are not significant conditions adverse to quality. Notwithstanding this fact, SWEC has taken preventive measures, such as a training program. Tr. 13,343-44 (Eifert).

QA:47. Mr. Eifert testified that the ready traceability problems do not relate to Appendix B, Criterion 3. Criterion 3, in his opinion, relates only to the establishment of a design control program. The concerns with respect to ready traceability represent, in his opinion, minor implementation problems with the ready traceability requirement, and thus do not relate to Criterion 3 of Appendix B. Tr. 13,345 (Eifert).

QA:48. Mr. Eifert agreed that QA implementation is one of the keys to ensuring that a quality plant is designed and constructed. Tr. 10,500 (Eifert). Mr. Eifert further agreed that implementation of all requirements of the QA program,

including detailed implementation requirements, is important. Tr. 10,500 (Eifert). The different procedural requirements have different levels of importance. Mr. Eifert would agree that traceability of input, positive traceability, is important. Tr. 10,500-01 (Eifert).

QA:49. As of the time of Engineering Assurance Audit 23, which is dated December 1977, Mr. Eifert agreed that there was evidence that the positive traceability problem had recurred. Tr. 10,530 (Eifert). On the opening page of EA Audit 23, it states that "all the disciplines audited for compliance with EAP 5.3 (calculations) exhibited deficiencies in identification of input sources to assure positive retrievability." SC Ex. 51, EA 23, at 1 (emphasis supplied). This indicates that a number of disciplines audited by SWEC had the same basic kind of problem. Tr. 10,552 (Eifert).

2. Other Audit Findings

QA:50. EA Audit 28, Observation 080, Part 1, concerns one calculation that had not been checked prior to the time it was being used. In the followup activity after this audit observation, the auditors determined that four additional calculations existed which were preliminary where results had been used. Tr. 13,918-19 (Eifert).

QA:51. SC Exhibit 52, an October 2, 1979 letter from Mr. Costa of SWEC to Mr. Gerecke of LILCO, states:

> An analysis of audit findings revealed only one condition which would be detrimental to quality if left uncorrected. This condition concerns continuing problems with preparation, review and approval of calculations. Examples of these problems are: calculations not checked (including some required to support the current design); lesser problems with correct indexing; identification of superceded calculations; use of distribution sheets; identification of computer programs used and calculation page markings. SC Ex. 52, at 6.

This statement comes from the report which SWEC annually provides to LILCO concerning the status of the QA program. Tr. 10,706 (Eifert). Suffolk County Exhibit 52 represents a summation of the status of the audit findings with respect to Engineering Assurance for the time period July 1, 1978 - June 30, 1979. Tr. 10,708 (Eifert). The item that is specifically referred to in the quoted material is Audit Observation 080 from EA Audit 28. Tr. 10,706 (Eifert). The reference in the quoted material is to continuing problems of an administrative control type which are not in themselves directly related to any technical inadequacies or deficiencies in design. Tr. 10,709 (Eifert).

QA:52. The five audits listed under category 2 on pages 2 and 3 of LILCO Exhibit 24, involving a total of eight audit observations, all constitute instances where there was actual review of calculations as required by the EAPs, but in each case the review had not been properly documented as required by the procedures. In some cases, the failure in documentation

resulted from failing to initial a page as required by the procedure. In another case, the problem involved the fact that the computer runs had not been summarized as required by the procedure. Tr. 13,356-61 (Eifert). In LILCO's opinion, these eight audit findings fall into a category similar to that of ready traceability, namely an administrative problem rather than a substantive problem with the calculations themselves. Tr. 13,356 (Eifert).

QA:53. In Audit Observation Structural-023 of Engineering Assurance Audit 40, conducted in April, 1982, the following observation was made:

> The action taken by the structural division to prevent recurrence of the conditions described in Audit Observation Structural-015 was not adequate.
>
> Recent audits of Structural Calculations on Shoreham Project and North Anna 3 Project revealed similar conditions as reported in Struc-015. The corrective action taken by the Structural Division was to issue STP 11.5 and implement training programs for their personnel. However, calculations reviewed subsequent to this procedure and training reveal the same problems exist. EA Audit 40, Observation Structural-023.

Audit Observation Structural-023 was issued to advise the Structural Division that their efforts at implementing the corrective action for A.O. Structural-015 were in some cases achieving less than total results. Tr. 10,821 (Eifert).

3. Audit Observation 120

QA:54. Audit Observation 120 of EA Audit 34 was published in November, 1980. Audit Observation 142 in EA Audit 38 was issued in December, 1981 and also pertains to Audit Observation 120. Subsequently, in EA Audit 39, page 2, dated February 24, 1982, this matter is again discussed. In all of these subsequent audits, the auditor stressed his view that adequate and prompt corrective action had not taken place for the problems identified initially in Audit Observation 120. SC Ex. 51, EA 38, Observation 142; EA 39, at 2. Audit Observation 142 was primarily to ensure that LILCO got a proper definition of the Phase 2 effort which related to solving the problems identified in Audit Observation 120. Tr. 10,675 (Eifert). Audit Observation 142 is closed today. Audit Observation 120 required an extension to complete the total corrective action. Tr. 10,675 (Eifert). In order to speed things up, a stop work order was issued and the project immediately submitted the final plan for the Phase 2 effort to engineering management. That Phase 2 plan was accepted and the stop work order was lifted. Tr. 10,675 (Eifert). The Phase 1 effort for Audit Observation 120 involved the work of the Project and Engineering Mechanics Division to fully explore and understand the extent of the conditions reported in Audit Observation 120. Phase 2 constituted implementation of the corrective action

plan which was decided upon as a result of the studies conducted under Phase 1. Tr. 10,676-78 (Eifert). The Phase 2 corrective action plan was adopted and implemented after issuance of EA Audit 39, which was issued in early 1982. Tr. 10,679 (Eifert).

QA:55. In EA Audit 40, Attachment 2, an extension of time was granted until August 31, 1982 to complete the work under Audit Observation 120. SC Ex. 51, EA Audit 40, Attachment 2. That deadline has been extended. Work was scheduled to have been completed by October 15, 1982. It was expected that about 90 to 98 percent of the work was complete at the time of the hearing, but that it would not be totally completed by October 15. The remaining work consisted of putting all records in their final form for final review. Tr. 10,799-800 (Eifert, Museler).

QA:56. The primary cause of the problems observed in Audit Observation 120 was that field changes had been made to pipe support locations and documented on E&DCRs and judgments were made about the need for revising the underlying analysis to support the revised design. The situation was that engineers were making those judgments and it was the judgment of the auditor that the changes might be sufficiently different that an analysis revision was also necessary in making the change. Tr. 10,754-55 (Eifert).

QA:57. Where judgment changes are made in an analysis, the SWEC procedures do not require that the underlying analysis reflect the fact that that judgment change has been made. Tr. 10,757-58 (Eifert).

QA:58. Audit Observation 120 concerns related directly to pipe support design calculations. LILCO's corrective action did not involve review of other disciplines to determine whether there were other problems with the use of unsupported engineering judgment in resolution of potential issues. The pipe support area is not the only area where field changes to design might have to be effected. Mr. Eifert is confident that if problems similar to the Audit Observation 120 problems existed in other disciplines, they would have been identified through the normal audit process. SWEC has not identified problems of this nature in other disciplines. Tr. 10,685-91 (Eifert). The corrective action program for Audit Observation 120 has been applied to pipe supports and has not been applied to other kinds of supports such as cable tray, equipment supports or HVAC supports. The supports for the other equipment are designed by the structural organization, while the engineering mechanics organization designs pipe supports. Those other areas have been audited and problems similar to that in Audit Observation 120 have not been found. Tr. 10,800-01 (Museler, Eifert).

QA:59. Mr. Eifert does not believe that the Audit Observation 120 problem was a long-standing problem. This is because the 1979-81 time frame was when LILCO was installing a large number of pipe supports. The problem was identified in 1980. Thus, he saw no basis to go back and try to find out why the problem was not identified earlier. Tr. 10,700-01 (Eifert).

QA:60. Shoreham has about 11,000 large bore pipe supports and approximately 15,000 small pipe supports. Tr. 10,728, 10,796 (Museler). Mr. Museler does not believe that Shoreham has had to change an unusual number of supports. Tr. 10,730 (Museler). As a result of Audit Observation 120, 1800 pipe support engineering calculations were redone. Tr. 10,773 (Museler). The 1800 pipe supports that were actually reviewed were selected as follows: Sixteen thousand of the pipe supports were small bore pipe supports which are designed under a different method so that the Audit Observation 120 problem was not applicable. Tr. 10,775, 10,796-97 (Museler). Accordingly, the Audit Observation 120 problem is a large bore pipe support problem only, of which there are approximately 10,000. Out of the 1800 calculations which were redone, about one percent fell outside of the acceptable range. Tr. 10,776 (Museler).

QA:61. The LILCO Final Stress Reconciliation Program would be designed to identify problems such as that in EA Audit 34, Observation 120. Tr. 10,751-52 (Museler). The Stress Reconciliation Program covers all safety-related piping systems and pipe supports and a large portion of the nonsafety-related pipe supports and piping systems, the ones that are thermal and the ones that require seismic analysis. Tr. 10,753-54 (Museler).

4. Early Project Audits

QA:62. LILCO does not believe that the early Engineering Assurance Audits, EA Audits 0, 00 and 01 (SC Exs. 48-50), which were performed in 1970, are indicative of design control results during that early period, at least in a manner which can be readily compared to subsequent audits. Rather, LILCO considers these early audits to be pilot audits used primarily to formulate the audit program. Shoreham was one of the first SWEC projects to have such audits. The audits, in Mr. Burns' view, did not reveal any serious deficiencies in the calculations themselves. The audits did reveal omissions in implementation of required activities. In many cases, the auditors were auditing work that was in process, ut not yet complete. For these reasons, LILCO could not correlate the observations and discussions described in these early reports to the observations in subsequent reports. Tr. 10,328-29, 13,321-22 (Eifert); Tr. 10,327 (Burns).

QA:63. The engineering for the Shoreham project was active in 1968-70 and then effectively was shut down when it appeared the construction permit would not be issued until 1973. The engineering effort was later restarted to be prepared for the start of construction. Tr. 10,374 (Museler).

QA:64. SC Exhibit 48 is Shoreham Project Audit O, dating from January, 1970, and represents the first EA audit of Shoreham. Tr. 10,302 (Eifert); SC Ex. 48. In this audit, it is indicated that for some calculations, the documentation of the review and endorsement was not available to the auditors. Tr. 10,318 (Eifert). The conclusion of the audit relating to calculations was as follows:

> The audit of calculations indicated an unacceptable level of conformance to the requirements of review and endorsement. Seven divisions in Engineering and Design, totaling ten technical sections, were audited for a total of 45 calculations in essential areas of Design. Some 405 checks were made and 76 omissions to required procedure detected. An acceptable performance would require no more than 17 omissions. These results predict that the average calculation in the LILCO Project is NOT FULLY OR ADEQUATELY REVIEWED 22 PERCENT OF THE TIME. SC Ex. 48, at 45.

Mr. Eifert had no reason to disagree with the foregoing finding, but testified that he believed it reflected an inattention to administrative controls and was not indicative that the underlying calculations were inadequate. Mr. Eifert stated, however, that inattention to administrative controls was not acceptable. Tr. 10,319-20 (Eifert).

QA:65. SC Exhibit 49 is Shoreham Project Audit 00, dating from April, 1970. SC Ex. 49. This audit reveals problems relating to requirements for review of calculations.

> The audit of calculations indicated an unacceptable level of conformance to the requirements of review. Seven Divisions in Engineering and Design, totaling nine technical disciplines, were audited for a total of 26 calculations in essential areas of engineering and design. Some 224 checks were made and 17-1/2 infractions to required procedure observed. An acceptable performance would require no more than 7 infractions. These results predict that the average calculation in the LILCO Project is NOT FULLY OR ADEQUATELY REVIEWED 7 PERCENT OF THE TIME.

> The most frequent infraction on calculations is the failure to complete a formal review and sign-off by a second engineer. The Project engineer should obtain a list of all unchecked calculations from the Lead engineers and establish a schedule for checking these calculations. SC Ex. 49, at 7.

It turns out that review of the calculations had taken place. Tr. 10,335-36 (Eifert).

QA:66. SC Exhibit 50 is SWEC EA Audit No. 1. This audit, dating from September 1970, indicates a need for attention to the administrative control of calculations. Tr. 10,344-45 (Eifert).

> LILCO Project calculations were determined to be unacceptable with respect to Stone & Webster standards. Of four (4) calculation categories audited only one (1) (Structural Design) was found to be below acceptable standards. Seventeen (17) calculations were given one hundred forty two (142) checks and thirteen (13) infractions noted. These findings indicate that project calculations taken

as a whole are 9 PERCENT UNSATISFACTORY in meeting Stone & Webster requirements. SC Ex. 50, at 7.

IV. E&DCRs

A. General

QA:67. An E&DCR is a means of requesting or authorizing an Engineering Department approval of a change or clarification of a requirement. LILCO Ex. 21, at 3.

QA:68. SWEC EAP 6.3 is entitled "Preparation, Review, Approval, and Control of E&DCRs." This is the basic EAP which controls E&DCRs. Its purpose is to establish a system for documenting and approving changes and additions to specified documents if shop or site work must be performed before the basic document is formally revised and issued. See LILCO Ex. 11, Table 17.1.2B-2, at 6; Tr. 10,851 (Eifert).

QA:69. Concerning E&DCRs, Mr. Eifert agreed that the degree of control which may be established for files and other controlled documents may vary depending upon the circumstances and that this is a matter of judgment. Thus, the LILCO document control programs do reflect what LILCO thought was appropriate. Tr. 13,643, 13,883-84 (Eifert). Furthermore, Mr. Eifert believes that the document control programs, as illustrated by the various procedures in various areas, are programs that can be satisfied if properly implemented. Tr. 13,885 (Eifert).

QA:70. EAP 6.3 is designed to control the E&DCR system and to be in accordance with requirements of Criteria 3, 5 and 6 of Appendix B. EAP 6.3 is the primary procedure with respect to E&DCRs by which LILCO's Appendix B program implements the requirements of Criterion 5 with respect to E&DCRs. EAP 6.3 is supplemented by other procedures which describe more fully how the E&DCR itself is implemented. EAP 6.3 describes the E&DCR system, and is linked to Criterion 3 when one talks about design changes. When one talks about document control, it is linked to Criterion 6. Tr. 13,885-88 (Eifert, Baldwin).

QA:71. Mr. Eifert agrees that some of the E&DCR audit findings cited violations of EAP 6.3. When LILCO identifies implementation difficulties through its own monitoring activities, Mr. Eifert does not consider this implementation difficulty a violation of Appendix B. For example, in the document control area, he would consider it an Appendix B violation if LILCO had not established a document control system. Tr. 13,890-92 (Eifert). Mr. Eifert testified that a single instance of failing to comply with EAP 6.3 would never, in his judgment, be considered a noncompliance with Criterion 5 of 10 CFR Part 50, Appendix B. Tr. 13,899-901 (Eifert).

QA:72. With respect to incorporation of an E&DCR into the master design document, the EAPs have required the project to issue a specific project instruction to describe the specific

criteria for incorporation. EAP 6.3 does contain some minimum criteria. Tr. 10,983 (Museler).

QA:73. EAP 6.3 requires maintenace of the E&DCR change record. Tr. 11,012 (Eifert).

QA:74. Filing, logging and indexing of E&DCRs are part of the administrative control aspects of the design process. Tr. 10,996 (Eifert). Mr. Eifert agrees that some of the administrative aspects of the procedures are descriptions of the way in which SWEC meets the requirements of its Appendix B program. Tr. 10,978-99 (Eifert).

QA:75. The primary purpose of the E&DCR system, as originally set up, was to support construction activities. However, it has flexibility; it is used in other areas as well, including design. Tr. 10,848-50 (Eifert). The general practice is to approve a change via the E&DCR process, including review and final approval, prior to the construction of that portion of the design. There are certain circumstances, however, where the project engineer can permit construction to proceed before finalization of the E&DCR. Tr. 10,850-51 (Eifert).

QA:76. An E&DCR requires an engineering answer, assessment, or decision. Tr. 10,218 (Museler). E&DCRs are "leading" documents; they "authorize a change to a drawing or provide a clarification to a specification in advance of the next reissue

of that drawing or specification. They are control documents and they do carry the force of design control." Tr. 10,220 (Museler). All E&DCRs are subject to the same document control procedures. Tr. 10,225 (Museler).

QA:77. When revisions are made to documents, they are required to be distributed to the same individuals and groups which received the original documents. E&DCRs are also subject to a tracking system. Distribution and tracking mechanisms are considered necessary because E&DCRs are considered controlling engineering documents. Accordingly, it is important to have design control mechanisms for E&DCRs for the same purposes that LILCO controls all design documents. LILCO Ex. 21, at 97; Tr. 10,852 (Eifert).

QA:78. With respect to E&DCRs, required controls include proper distribution, maintenance of the central file, and control of logs of E&DCRs. Tr. 10,854 (Eifert). It is important to maintain E&DCR control logs up to date. The control logs provide a formal control to track the E&DCRs which have been issued as changes to specific engineering documents. Tr. 10,856 (Eifert). The primary function of the master E&DCR log is to assure that E&DCRs are logged against affected documents so there is an accurate reference of what changes have been considered when the prime document (such as a drawing) is utilized. Tr. 10,247 (Museler).

QA:79. With respect to the construction effort, LILCO has multiple methods to ensure proper cognizance of E&DCRs which may affect drawings, specifications or procedures. The first method is to maintain master logs where E&DCRs are written against certain design documents. The second mechanism is through use of a distribution system, whereby any organizations which are issued the original design documents are also issued copies of E&DCRs associated with those documents. The organizations and other recipients of E&DCRs on the site must acknowledge receipt and incorporate those documents in their files. Other requirements include logging the E&DCR number on the drawing until the next revision of the drawing incorporates those E&DCRs. Tr. 10,857-58 (Museler).

QA:80. For procedures and specifications in the construction area, one must write the E&DCR number on the cover page of the specification and then file the specification with that E&DCR. Tr. 10,904 (Museler).

QA:81. When a recipient receives a controlled document, such as an E&DCR, he is required to note the E&DCR against the controlled document in his possession. This involves noting it on a drawing or a series of drawings, or on the specification or procedure. The recipients are also required in the case of specifications and procedures to place the E&DCR in the file or at the location where the specification or procedure is located. Tr. 11,093-94 (Museler).

B. E&DCR Control Problems

QA:82. LILCO has not found instances where the individual who was doing work in the field has not had the proper design document. Tr. 10,859-60 (Museler).

QA:83. Procedures have been in effect for the control of E&DCRs in one form or another since the inception of the project. However, for many of the companies, contractors and many of the SWEC and LILCO personnel on the site in 1976, these procedures were new. A large mechanical effort began in 1976 and grew rapidly through 1977-78. Accordingly, while the E&DCR procedures had been in existence for some time the implementation of the procedures by the various site organizations was, in some respects, a new experience. Various site organizations experienced difficulty in getting people to understand the importance of adhering to those procedures. Tr. 11,034 (Museler).

QA:84. During the 1976-77 time phase, there were problems with the distribution and proper posting of E&DCRs. Tr. 10,862 (Museler). The problems which occurred related to things like signing and dating of E&DCRs, updating the master E&DCR log and also the distribution and posting of E&DCRs to drawings. Tr. 10,863 (Museler). LILCO considered the E&DCR situation at the site at this time to be unacceptable. Tr. 10,859 (Museler). Mr. Kelly testified that there was no indication, however, that

the 1976-77 problems caused any problem with the installation activities going on or the inspection activities. Tr. 10,862 (Kelly).

QA:85. Mr. Museler believes that during the 1976-77 time period, the E&DCR system was operating satisfactorily from the standpoint of ensuring that the final product in the field was implemented in accordance with design documents. At the same time, however, the distribution of E&DCRs and the maintenance of E&DCR logs and posting of E&DCRs in the field was not satisfactory and corrective action was necessary. Tr. 10,865 (Museler).

QA:86. Regarding the E&DCR problems in 1977, LILCO had serious concerns for the efficiency of the construction management process, specifically if there were not a timely updating of the design documents. This could lead to doing unnecessary work. As a result of the 1977 audits, there may have been some rework required. Tr. 10,919-20 (Museler).

QA:87. LILCO witnesses believed that the E&DCR situation during the 1976-77 time frame did not have any adverse impact on the plant. One reason for this conclusion is that the in-process and final inspections performed by various groups did not identify that final installation or in-process installation was being accomplished without utilizing the proper design documents. Tr. 10,901, 10,904-05 (Museler). In

addition, the audits which were done by SWEC and LILCO did not identify any installation problems. Tr. 10,906 (Kelly).

QA;88. LILCO witnesses testified that, in their opinion, the E&DCR deficiencies noted in LILCO and SWEC audits could be broken down into several groups, including ten audits involving 13 audit observations where E&DCRs were not properly logged. See LILCO Ex. 28, at 1; Tr. 13,553-54 (Baldwin). Mr. Baldwin believes these items would not have affected the design or safety of the plant because there was only a remote chance that E&DCRs would not have gone to the proper people and because the inspection processes would have ensured proper implementation. Furthermore, corrective action was taken. Tr. 13, 555-58 (Baldwin). Similar conclusions were expressed regarding some other groupings of E&DCRs described on LILCO Ex. 28. Tr. 13,593-97 (posting problems); 13,606 (clarification examples); 13,608 (missing from files); 13,625-26 (timely distribution and incorporation); 13,636 (miscellaneous items). Mr. Baldwin felt that none of the E&DCR noncompliances constituted an Appendix B violation. Tr. 13,639-43 (Baldwin).

QA:89. In the 1977 Field Audits, the auditors found unsatisfactory attributes in the range of 17-24 percent. These percentages are unacceptable to LILCO. The percentage of inaccuracies typically runs at or below five percent. Tr. 11,105 (Museler). Mr. Museler believes that if the deficiency

rate for E&DCR control runs at or below five percent, this is an acceptable figure. Tr. 11,111-12 (Museler). Mr. Kelly agrees that a five percent mark for E&DCR controls would be acceptable, although that does not mean one would not correct discrepancies if an audit showed less than five percent unacceptable. Tr. 11,112 (Kelly).

QA:90. In early 1980 and again in mid-1981, there were problems with E&DCR control. Although not as severe as those first identified in Field Audit 602, they indicated a need for increased attention. Tr. 11,114 (Museler). These were both instances which involved Courter and Company. There was fairly rapid improvement for each of these instances. Tr. 11,115 (Museler).

1. Field Audits

QA:91. SC Exhibit 55 is LILCO Field Audit 602, dated July 5, 1977. Mr. Kelly approved this audit and Mr. Gerecke received it. See SC Ex. 55, at 1 and 3; Tr. 10,894 (Kelly, Gerecke). Paragraph 3.1 of this audit states:

> Preparation, issuance and control of E&DCRs affecting specifications, procedures, and drawings is considered unsatisfactory. SC Ex. 55, at 1.

Mr. Gerecke concurred with this conclusion. Tr. 10,896 (Gerecke). Mr. Gerecke confirmed that there was a concern about the E&DCR program at this time, but stated that there was no evidence that any of the problems impacted the actual design

or construction in the field. Tr. 10,894-95 (Gerecke). Mr. Kelly does not believe that the findings in Field Audit 602 represented a sudden deterioration in the E&DCR program at the time of this audit but were more indicative of a significant increase in work activity and that this audit demonstrated a need for LILCO to focus much more attention on solving the problem. Tr. 10,898-99 (Kelly). Prior to Field Audit 602, there were previous audit findings identifying specific departures from requirements. There was nothing that indicated, however, in Mr. Kelly's opinion, the degree of problems that were identified in Field Audit 602. Tr. 10,399-900 (Kelly). Certain of the problems in Audit 602 pertained to Courter and Company. Tr. 11,373 (Kelly); 10,976-77, 11,075, 11,374 (Museler).

QA:92. Mr. Arrington disagreed with the conclusion in paragraph 3.1 of Field Audit 602. He believed the overall E&DCR process was acceptable. He agrees that there were areas where there were problems, but stated that these were isolated cases where some contractors were not completely up to speed. Tr. 10,941-43 (Arrington). Mr. Arrington could point to nothing in the Field Audit 602 upon which he based his conclusion that the observations in this audit were isolated cases. He apparently based this view on knowledge of the process in 1977 and the fact that his inspections did not identify

instances where the installed plant differed from the E&DCR. He believed this was more of a posting problem, not an actual problem in the field. Tr. 10,945 (Arrington).

QA:93. LILCO did not consider the E&DCR problem in 1977 to be significant in the context of plant safety. In terms of the overall efficiency of the project, this was considered to be a serious problem. Thus, in terms of safety of the plant, Mr. Museler and Mr. Kelly also disagree with paragraph 3.1 of Field Audit 602. Tr. 10,947-49, 10,951 (Museler, Kelly).

QA:94. Paragraph 4.2 of Field Audit 602 states: "Out of 89 drawings sampled 28.08% of the drawings were missing applicable E&DCRs." SC Ex. 55, at 1; Tr. 11,056 (Kelly). Mr. Baldwin was not surprised by this finding given the particular point in time in the Shoreham project. Tr. 10,959 (Baldwin). For this observation to have had an impact on the installed plant, LILCO states that the same E&DCR would have had to have missed going to the UNICO construction supervision, to the contractor and to the FQC inspection organization. They believed this to be an extremely remote possibility. Tr. 10,912 (Kelly). However, the problem in tracking up-to-date design documents, specifically E&DCRs, could have an impact on the specific design. Tr. 10,926 (Museler).

QA:95. The preparation, issuance and control of E&DCRs is subject to the QA program. Tr. 10,951 (Museler). With respect

to those QA aspects which affected the safety of the plant, Mr. Museler believes the program was effective. With respect to meeting stated procedural requirements, such as the instances outlined in Field Audit 602, the program was not meeting those requirements. Those procedural requirements are part of the QA program. Tr. 10,951-52 (Museler).

QA:96. Criterion 6 of Part 50, Appendix B states in part:

> Measures shall be established to control the issuance of documents, such as instructions, procedures, and drawings, including changes thereto, which describe all activities affecting quality. 10 CFR 50, Appendix B, Criterion 6.

As of July 1977, Mr. Museler believes that LILCO was meeting Criterion 6. Mr. Museler believes that E&DCRs and other documents were reaching the appropriate personnel so that the work was performed properly in the field, although there may have been instances where delay in distribution led to some delay in the work. Tr. 10,953-54 (Museler).

QA:97. Audit Observation 4.1 of Field Audit 602 concerns a sampling of holders of controlled copies of certain specifications. In most instances, specifications were not prefaced by all their pertinent E&DCRs. Out of 700 E&DCRs sampled, 10.57 percent were missing. See SC Ex. 55, at 1. The E&DCRs may not actually have been missing. This observation may mean that the specifications do not have the E&DCRs written on the cover page, but the E&DCRs may have been filed. Tr. 10,955

(Museler). Observation 4.1 of Field Audit 602 is indicative of a situation where a number of E&DCRs were missing from the specification files. Tr. 11,056 (Kelly).

QA:98. Out of 89 drawings sampled in Field Audit 602, 17.97 percent were not the latest applicable revisions. SC Ex. 55, at 2, paragraph 4.3.

QA:99. In Field Audit 602's review of controlled copies of procedures, it was revealed that in most cases the procedures were not prefaced by all of the appropriate E&DCRs. Out of 228 E&DCRs sampled, 18.42 percent were missing. SC Ex. 55, at 2, paragraph 4.4.; Tr. 11,056 (Kelly).

QA:100. During Field Audit 602, a review was made of subcontractor document distribution cards for drawings to ascertain the amount of control that Courter and Company exercised at field locations. Out of 89 drawings sampled, the following discrepancies were noted:

(a) Ten drawings were found in the field, but according to Courter records, they had not been distributed to the field. Mr. Museler does not believe this observation is serious because he assumes that the ten drawings were the proper revisions of the drawings that were in the field. The fact that the Courter drawing log did not reflect the fact that they were in the field does not, in his opinion, have a significant impact on the process.

(b) Seven outdated revisions of drawings were found in the field but Courter's records indicated that these had either been voided or returned.

(c) One drawing was found in a different location than Courter's records specified.

(d) One drawing was found in the field but it had been superceded. SC Ex. 55, at 2, paragraph 4.5.; Tr. 10,960-62 (Museler).

QA:101. As of July, 1977, the Boston SWEC change records for E&DCRs and N&Ds were supposed to be the latest listing of E&DCRs pertaining to specifications. However, out of 175 separate E&DCRs reviewed for five specifications, the Boston list did not list 26.86 percent of the E&DCRs. SC Ex. 55, at 2, paragraph 4.6, Tr. 13,554 (Baldwin). A primary reason for this discrepancy was that a large number of the E&DCRs generated in the field had not been transmitted to Boston in time to be incorporated into the Boston log. One of the corrective actions taken was to have the master log brought up to date and to centralize responsibility for updating the master log. This responsibility was shifted to the field since the majority of E&DCRs were issued in the field. By the beginning of 1979 or in late 1978, the log was about 98-99 percent accurate. Tr. 10,964 (Museler); 13,566 (Baldwin).

QA:102. The corrective action for Field Audit 602 included such things as updating the master log, reviewing and updating the distribution list, updating construction procedures, dedicating certain contractor personnel to document control within the contractor organization, and also instituting various daily pickup procedures to ensure that documents were distributed rapidly. Furthermore, responsibility for the master E&DCR log was centralized in the UNICO construction management organization. Tr. 10,973 (Museler). Training was also undertaken for personnel who were responsible for posting and logging E&DCRs, and a further audit program was maintained in this area. Tr. 10,974 (Museler). Thus, Mr. Museler believed that a very extensive corrective and preventive action program resulted from the observations of Field Audit 602. It did not lead to correction of the situation overnight. Tr. 10,975 (Museler).

QA:103. Mr. Kelly testified that in response to Field Audit 602, a sample of 200 E&DCRs was picked randomly from all disciplines and verified as far as the correctness of the permanent plant installation was concerned. It was found that each item looked at was installed properly. Tr. 11,040-42 (Kelly). The inspection results are marked as Suffolk County Exhibit 60. See Tr. 11,251-54 (Kelly, Museler). The sampling indicated that 163 of the E&DCRs had already been accomplished

in accordance with the requirement of the E&DCRs. Twenty-five E&DCRs had not been implemented because they had not been scheduled by construction for completion by that point in time. Four of the E&DCRs, even though they referenced permanent plant drawings, did not apply to a piece of permanent plant installation. Six of the E&DCRs exhibited one of the deficiencies that have been referenced before. The deficiency was that they has not been incorporated into the specification. This, however, did not affect the permanent plant installation. The result of the audit was that LILCO did not discover any instance where the plant had not been constructed in accordance with the E&DCRs. Tr. 11,255-57 (Museler).

QA:104. Another reason that LILCO does not believe that the E&DCR-related problems affected the as-built plant is that both the in-process and final inspections by the Construction and QA groups have not shown that the plant was not constructed in accordance with the E&DCRs. Tr. 11,396, 13,559-60 (Museler). The sampling of 100-200 E&DCRs discussed in SC Ex. 60 is one basis for this view, but Mr. Museler appears to rely more on the overall process that checks whether the document logging discrepancies impacts the final product. Tr. 11,397 (Museler).

QA:105. LILCO has suggested that the E&DCR Implementation Verification Program is an additional reason to have

confidence that E&DCRs are in fact incorporated in the as-built plant. LILCO Ex. 21, at 179-81.

QA:106. In Field Audit 654, dated November 16, 1977, paragraph 4.2, states that the Weekly E&DCR Summary, the official list of E&DCRs, did not reference all of the E&DCRs which are applicable to five specifications, three procedures, and 85 drawings reviewed during the audit. Out of a total of 372 outstanding E&DCRs, 27 E&DCRs (7.26 percent) were found to be missing from the Weekly Summary. SC Ex. 57, ff. Tr. 11,122, at 2. The Weekly Summary, which was audited in Field Audit 654, was instituted as a consequence of Field Audit 602. Mr. Kelly thinks that the 7.2 percent problem was indicative of a good record given the short time that the weekly summary had been in effect. Tr. 11,057-58 (Kelly). The purpose of the weekly summary was to provide a more advanced warning of E&DCRs to all personnel who hold controlled documents. This was needed because the master E&DCR log is published just monthly or bi-monthly. Tr. 11,059 (Museler).

QA:107. Observation 4.3 of Field Audit 654 identifies further problems with the Weekly E&DCR Summary, including the fact that the summary was not complete as of November 1977 in identifying those E&DCRs which had been superceded or incorporated in applicable revisions of affected documents. The audit also indicates that four E&DCRs were inaccurately listed

against certain specifications and drawings. SC Ex. 57, ff. Tr. 11,122, at 2; Tr. 11,064 (Kelly).

QA:108. Observation 4.6 of Field Audit 654 reflects that a review of five specifications and three procedures revealed that most copies were not prefaced by all their pertinent E&DCRs. Out of 853 E&DCRs sampled, 209 (24.5 percent) were missing from those documents. It is noted that with respect to Courter & Company, ten specifications or procedures were reviewed involving 180 applicable E&DCRs. Seventy-one or 39.4 percent of the E&DCRs related to the Courter specifications or procedures were missing. SC Ex. 57, ff. Tr. 11,122, at 3. The documents were not actually missing but, rather, had not been posted against the specification as required. Tr. 11,369-70, 11,385-86 (Museler). Mr. Kelly states that this is an example of where Courter and Company had more documents than it really needed and as part of the corrective and preventive action, it returned 22 specifications which were duplicate copies. Tr. 11,065 (Kelly).

QA:109. In paragraph 3.1 of SC Exhibit 57, Field Audit 654, the auditor concluded that the preparation, issuance and control of E&DCRs affecting specifications, procedures and drawings remained unsatisfactory, and that a significant number of shortcomings in the handling of E&DCRs still existed as of November 16, 1977. SC Ex. 57, ff. Tr. 11,122, at 1. This

audit report was approved by Mr. Kelly and sent to Mr. Gerecke. SC Ex. 57, ff. Tr. 11,122, at 1, 5. During this time period, corrective and preventive action was being taken but it was not meeting standards that LILCO thought should be met. The magnitude of the undertaking was such that it took approximately until the end of 1978 for the action to become fully effective. Tr. 11,075 (Museler).

QA:110. Mr. Museler agrees that in paragraph 4.6 of Field Audit 654, the auditor reported that procedural requirements related to specifications and procedures were not being adhered to. Tr. 11,097 (Museler). The E&DCRs had not been prefaced with the right numbers. Tr. 13,592 (Baldwin).

QA:111. In paragraph 4.7 of Field Audit 654, the auditors sampled 88 drawings in the field. Twenty-five were noted as missing E&DCRs and eight were not the latest revisions per document control in the contractor's records. These figures revealed that a total of 37.5 percent of the drawings reviewed in the audit were incorrect per the latest available information. With respect to Courter and Company, 54 drawings were reviewed which had 110 applicable E&DCRs. Thirty-four E&DCRs were missing and 18 drawings did not have E&DCRs posted. In addition, five drawings were the wrong revision. In total for Courter, out of 54 drawings reviewed, 42.6 percent had problems. SC Ex. 57, ff. Tr. 11,122, at 3. Mr. Museler agrees

that the procedural requirements were not being adhered to with respect to the items noted in paragraph 4.7 of Field Audit 654. Tr. 11,097 (Museler). This problem involved having E&DCRs not being posted against the affected drawing. Tr. 11,099 (Museler). While the E&DCRs were not being posted against the drawing, the E&DCRs were, in fact, being used in the field to construct the plant. Tr. 11,100 (Museler).

QA:112. The master log is one of the control documents for the design process. Tr. 11,295 (Museler). The auditor in Field Audit 654 found that the master log had not been sent to Boston as required. SC Ex. 57, at 2, paragraph 4.4; Tr. 11,294 (Museler). Thus, between July 29, 1977 and December, 1977, the Boston office received copies of individual E&DCRs, but did not receive the master log during that period. Tr. 11,295 (Museler).

QA:113. Field Audit 718, paragraph 4.3, dated March 13, 1978, identified discrepancies pertaining to four specifications and one weld procedure scheduled for audit. Out of 259 E&DCRs reviewed, 35, or 13.5 percent, were found to be missing. In addition, E&DCRs were not being properly filed with the proper welding procedure technique sheets. With respect to Courter and Company, the findings were that seven specifications and/or procedures were reviewed involving a total of 103 outstanding E&DCRs. Twenty-three E&DCRs were missing,

constituting 22.3 percent. In addition, the wrong revision of the document was identified three times. SC Ex. 58, ff. Tr. 11,138, at 2; Tr. 13,608 (Baldwin). Mr. Kelly confirms that 13.5 percent of E&DCRs were not referenced on the specifications or procedures that were looked at during the audit. Mr. Kelly does not find this to be a satisfactory situation. Tr. 11,123 (Kelly).

QA:114. In Field Audit 718, paragraph 4.4, 71 drawings were selected for audit. Out of a total of 185 drawings reviewed in various areas, 38 did not have the proper notations of E&DCRs and six were not the proper revisions for the site document control. Courter and Company was responsible for 30 of the 44 found to be in error. All areas except for Courter and Company had shown improvement in the control of E&DCRs affecting drawings. Field Audit 718, ff. Tr. 11,138, at 3. With respect to Courter and Company, 53 drawings were reviewed that had a total of 369 outstanding E&DCRs. One hundred E&DCRs were missing and 26 drawings did not have the E&DCRs noted thereon. In addition, four drawings were the wrong revision. Accordingly, of the 53 Courter drawings which were reviewed, 56.6 percent had errors. SC Ex. 58, ff. Tr. 11,138, at 3. Even though progress was noted in other areas, for Comstock/Jackson, 6.25 percent of the drawings were in error and 10.1 percent of the UNICO drawings were in error. SC Ex. 58, ff. Tr. 11,138, at 3; see Tr. 11,125-26 (Kelly).

QA:115. LILCO Field Audit 842, dated November 16, 1978, reflects the review of nine separate copies of two specifications. Six hundred seventy-four outstanding E&DCRs were noted. Seventy-six E&DCRs, or 11.3 percent, were missing from the specifications. For Courter and Company, five specifications were reviewed involving a total of 354 E&DCRs. Fifty-three E&DCRS, or 14.9 percent, were missing. SC Ex. 59, ff. Tr. 11,138, at 1. By the time Field Audit 842 was issued, LILCO had advised its contractors of the need to ensure that copies of controlled documents in their possession were maintained up-to-date and complete. Tr. 11,130 (Museler). With respect to this audit, the notation that E&DCRs were missing means that they were not in the specification file or they were not listed on the specification or both deficiencies were present. Mr. Museler agrees that this audit indicates that 11.3 percent of the specifications included in the audit did not meet the requirements of LILCO's procedures. Tr. 11,131-32 (Museler). The audit also indicates that UNICO piping and instrumentation, which is a separate holder of the specifications, had one specification audited and 17.5 percent of the E&DCRs was missing. See SC Ex. 59, ff. Tr. 11,138, at 1.

QA:116. In Field Audit 842, the auditor reviewed 32 separate drawings which involved 115 outstanding E&DCRs. Twelve of the drawings were found to be missing 19 E&DCRs, or 16.5

percent. With respect to Courter, 15 drawings were reviewed involving a total of 71 E&DCRs. Ten E&DCRs were missing, involving six documents. A total of 14.1 percent of the Courter E&DCRs was missing. For Comstock/Jackson, 20 percent of the E&DCRs were missing. SC Ex. 59, ff. Tr. 11,138, at 2. Mr. Museler testified that the 19 E&DCRs listed as "missing" had not been posted or written on the individual copies of the drawings. It is not a requirement for E&DCRs to be attached or filed with the drawings. Tr. 11,133 (Museler). Accordingly, this audit finding pertaining to drawings indicates that 19 E&DCRs were not properly recorded on the drawings. This constitutes a deviation from the procedural requirements affecting the control of E&DCRs. It does not indicate that the E&DCRs were not distributed or were not in the appropriate files. Tr. 11,133-34 (Museler).

QA:117. Mr. Kelly disagrees that Courter and Company had E&DCR-related problems between November, 1977 and June, 1981. Tr. 11,366 (Kelly). Mr. Kelly also would not agree that in Field Audit 654, dated November, 1977, E&DCR problems related to Courter were identified. He does say that there were some problems with some Courter documents. Tr. 11,366 (Kelly).

QA:118. With respect to Courter and Company, the E&DCR problems were identified in 1977 and Mr. Museler believed that they had reached a satisfactory status by early 19[illegible]. One

audit in 1981 gave some cause for further concern. Tr. 11,373-74 (Museler).

QA:119. The August 20, 1979 Quarterly Report to Management, a part of SC Exhibit 63, states that in Field Audit 970, dated June, 1979, the control of E&DCRs at the site, which had been identified as unsatisfactory in earlier audit reports, was now considered generally satisfactory, except that Courter and Company control of E&DCRs affecting specifications still was only 91 percent effective. See SC Ex. 63. Mr. Gerecke stated that he believes that the Courter program was effective, but only 91 percent effective. Tr. 11,375 (Gerecke). As of August, 1979, LILCO considered the Courter control of E&DCRs affecting specifications as unsatisfactory from a management or QA standpoint. It was not unsatisfactory in LILCO's opinion, in the sense of the impact that this lack of control had on the integrity of the design or the safety of the plant. Tr. 11,377 (Gerecke). Mr. Kelly stated that in Field Audit 970, which was reported upon in the August, 1979 report, only a few specifications were actually looked at, and accordingly, the 91 percent effective number may be misleading. Tr. 11,377-78 (Kelly).

QA:120. The LILCO quarterly reports to management do not discuss all audits that have taken place during the previous quarter. Rather, a report generally only discusses those audit findings that are of such significance so as to warrant

management attention. Tr. 11,378 (Gerecke). In August, 1979, the E&DCR problem had been reported in several consecutive quarterly reports to management. Since this E&DCR problem was not totally closed, it was felt appropriate to note the continuing status of the problem. Tr. 11,378-79 (Gerecke). The quarterly reports were given to upper management because they contain data that the QA Department feels management should know. Mr. Museler thinks the important aspect of the August 20, 1979 report is that, in the judgment of the QA Department, the problem was being addressed and satisfactorily solved. Thus, it was a problem that they wanted management to know about, but Mr. Museler thinks it is important to know that the problem was under control. Tr. 11,379-80 (Museler).

QA:121. The LILCO quarterly reports to management are information-type/overview reports to keep management apprised of the overall status of the audit program. Tr. 11,426 (Gerecke). At the end of each quarter, the division managers initially look at all the audits that have been performed and make a recommendation to the QA Department manager of those audit findings that should be brought to management's attention. Mr. Gerecke then reviews them and will discuss them as necessary and then a final report to management will be prepared. Tr. 11,426-27 (Gerecke).

QA:122. Courter and Company had its own QA personnel starting in January, 1978. Accordingly, SWEC reviewed Courter's work on a surveillance inspection and in-process inspection basis. SWEC did a 100 percent documentation review of all E&DCRs, drawings and specifications to which the work was intended to comply. Tr. 11,399-400 (Arrington).

QA:123. Courter first began work on the Shoreham project in early 1975. The bulk of its work began in late 1975 and early 1976 and has continued uninterrupted to the present. Tr. 11,428-29 (Museler).

QA:124. On January 1, 1978, Courter assumed the first line QA responsibilities and Code responsibilities for the direction of the ASME piping on the site. Prior to that time, the overall responsibility had always been with SWEC. Subsequent to this date, the installation Code responsibility was Courter's and the final overall Code responsibility remained with SWEC. Thus, there was a change in the first line QA and installation Code responsibilities as of January 1, 1978. Tr. 11,429-30 (Museler). It appears that no consideration was given to not having Courter take over the first line QA responsibilities in view of the E&DCR problems which had been identified in 19[illegible]. Tr. 11,430 (Museler). While there was a concern with E[illegible] LILCO had satisfied itself that there was no problem with the actual installation. Tr. 11,430-32

(Museler). The ASME qualification process included a look at the Courter E&DCR program; the program was found to be satisfactory. Tr. 11,436 (Arrington).

QA:125. As a result of Field Audit 602, LILCO management discussed E&DCR problems with the president of Courter and Company. Courter took prompt action, although it was not effective in the short term. Tr. 10,976-77 (Museler).

2. SWEC Audits of E&DCRs

QA:126. In EA Audit 19, Item 2.B.5, dated December, 1976, it is reported that one of the responsible engineers did not maintain a file of E&DCRs which applied to specifications under his control. SC Ex. 51, Attachment 19. The E&DCRs were not in the required specification file, but the E&DCR change record of the master log was current for that particular specification at that particular time. Tr. 10,999 (Eifert). The requirement to have the E&DCR filed with the specification was an independent requirement separate from maintenance of the change record or change log. Tr. 10,999-11,000 (Eifert).

QA:127. EA Audit 21, Observation 011, Item 1, dated May 20, 1977, identifies a need to revise project procedures to provide for maintaining a change record for E&DCRs which affected manufacturer's drawings. Tr. 11,005 (Eifert); SC Ex. 51, Attachment 21.

QA:128. In EA Audit 22, Observation 017, Item 2, dated August 19, 1977, the auditor noted that some specification changes affected by E&DCRs were not listed in the change records against the affected documents. SC Ex. 51, Attachment 22. The auditor selected 25 specification changes in E&DCRs to determine if they were listed on the change record and identified that four out of the 25 had not been identified in this mid-1977 audit. Tr. 11,006 (Eifert). This was one of the audit observations which ultimately led to maintenance of the change record being transferred to the site. Tr. 11,007 (Eifert).

QA:129. EA Audit 23, Observation 041, Item 2, dated December 28, 1977, indicates that seven of 43 drawing and specification changes in E&DCRs were found to be incorrectly listed or not listed in the change record against the affected document. See SC Ex. 51, Attachment 23; Tr. 11,023 (Eifert). As corrective action, the project reviewed the current practice to update the then existing change records. As preventive action, the project advised the EA Division that they were developing a revised mechanism for tracking E&DCRs through the site engineering office. Tr. 11,024 (Eifert).

QA:130. In FQC Audit 19, Observation D.1, dating from August, 1976, 15 specifications and 15 drawings were checked to determine whether associated E&DCRs were either listed on or

attached to the affected documents. It was determined that four E&DCRs were missing or not listed on the applicable document and that two specification E&DCRs were misfiled. All of these discrepancies were found in the turbine trailer, except one which was missing from the reactor trailer files. SC Ex. 56, Attachment 19. Mr. Baldwin agrees that this observation involves four E&DCRs which were missing or were not listed on the applicable document. Tr. 11,026 (Baldwin). This was a posting problem; with one exception, the E&DCRs were found and filed in the work area. Tr. 13,591-92 (Baldwin).

QA:131. FQC Audit 25, Observation D.2, dating from April, 1978, notes that out of a sample of approximately 200 drawing record cards, some document record cards were not up-to-date and listed E&DCRs that had been incorporated in the latest revisions of numerous drawings. Further, some document record cards were not up-to-date in that they did not, in all cases, reference the applicable E&DCRs which were outstanding. SC Ex. 56, Attachment 25. The document record cards are utilized by contractors to record the E&DCR distribution which is made. Tr. 11,049 (Museler). This audit observation indicates that there were some inaccuracies in document record cards, but it does not indicate that the E&DCRs were not at the right locations. Tr. 11,051, 13,537-38 (Baldwin). This observation also indicates that the document record cards were not up-to-date.

Tr. 11,051 (Baldwin). Mr. Museler agrees that the audit observation is correct. He does not believe, however, that it is significant in terms of the E&DCR process in the instance where the record cards did not reflect that E&DCRs had already been incorporated in the revised document. Tr. 11,052, 11,054 (Museler). Mr. Museler agrees that the second part of the observation, where the document record cards failed to reference applicable E&DCRs which were outstanding, is not without meaning. Tr. 11,054 (Museler).

QA:132. In EA Audit 23, Observation 041, dated December 28, 1977, the auditor found that one specification had 12 outstanding E&DCRs that were approved prior to issuance of Addendum 2 of the specification. All the outstanding E&DCRs, at the time of the amendment, had not been inc orated as required by procedures. SC Ex. 51, Attachment 23. Earlier that year, the project had revised incorporation guidelines. A guideline was included that indicated that the outstanding E&DCRs to be incorporated should be incorporated at the time of a specification addendum. Prior to that time, the existing guidance was not specific regarding when E&DCRs should be incorporated. This audit observation indicated a revision or an addendum to a specification without incorporating all the E&DCRs outstanding at that point in time. In response to this situation, the project took action to ensure that all people

were aware of the revised project requirement for incorporation of E&DCRs and that they were implementing that requirement. Tr. 11,140-41 (Eifert).

QA:133. New guidelines to track the incorporation of E&DCRs were established in the spring of 1982. Tr. 11,143 (Eifert). Prior to this new tracking device, the master E&DCR log was utilized as a means of tracking outstanding E&DCRs. Tr. 11,144 (Museler). Increasing frequency of issuance of E&DCRs in the later years of the Shoreham project has made it difficult to revise and update various documents. The process of updating a drawing or specification is a more lengthy process than just issuing an E&DCR. Tr. 11,147-48 (Museler).

QA:134. Prior to EA Audit 23, specifications were to be revised when more than ten E&DCRs were outstanding or every 12 months if more than three E&DCRs had been issued. They also were to be revised at the completion of work. However, with the large number of E&DCRs being issued, it was determined not to be practical or desirable to continue that guideline. Tr. 11,148-49 (Eifert).

QA:135. FQC Audit 33, Observations B3 and F1, dated March 31, 1980, constitutes a situation where an E&DCR had an error in it. The E&DCR then was to be incorporated into a revision of a drawing. It was not incorporated correctly into the drawing revision, resulting in the welding detail on a pipe hanger

differing from the condition which was required by the E&DCR. It turned out that the actual as-welded condition was correct, but that was due to the fact that the E&DCR, in the first place, had an error in it. The final FQC inspection had taken place, and the inspector had failed to identify the inconsistency between the as-built condition and what was called for by the E&DCR. The error which was missed by the inspector was subsequently picked up by the auditor. Tr. 11,171-76, 13,633 (Arrington, Baldwin, Museler).

QA:136. In FQC Audit 23, dated September 5, 1977, the auditor found that over 25 percent of the E&DCRs which were reviewed during the audit did not comply with the procedural requirement of either being listed on or attached to the affected document. Of the 144 E&DCRs which were examined, 38 had not been listed on or attached to the affected document. The auditor felt that the distribution and control of E&DCRs at the job site was suspect. SC Ex. 56, Attachment 23, at 2, paragraph 3.1.1.A and Item D.2. This audit occurred in the autumn of 1977, and Mr. Baldwin had no reason to disagree with the auditor's remarks. Tr. 11,272-73 (Baldwin). Part of the problem was also that some of the E&DCRs were not being correctly distributed. It appears that this situation involved both procedures and specifications. Tr. 11,276 (Arrington).

QA:137. In EA Audit 23, dated December 28, 1977, it is noted that seven of 40 sampled E&DCRs which revise other E&DCRs did not contain a cross reference to the revised E&DCR. SC Ex. 51, Attachment 23, Observation 041, Item 8.

QA:138. In FQC Audit 33, dated March 31, 1980, it is noted that a review of the FQC structural steel inspection revealed that many E&DCRs had not been noted on the affected drawings. The E&DCRs were present in the file folders. SC Ex. 56, Attachment 33, B.1. Thus, the E&DCRs were not posted on the drawing. Tr. 11,282 (Baldwin). It was a requirement at that point in time, in March, 1980, that the E&DCR number actually be noted on the affected drawing. Tr. 11,282 (Baldwin).

QA:139. In reference to FQC Audit 23, the LILCO witnesses agreed that the timely distribution of documents is important to the document control process. SC Ex. 56, FQC Audit 23, at 2; Tr. 11,285-86 (Baldwin). Contrary to procedural requirements, some E&DCRs are not being distributed. Instead, a weekly summary is issued to all holders of controlled documents. Also, FQC Audit 23 revealed that E&DCRs are not always being listed nor are copies attached to affected documents. Of the 144 E&DCRs examined, 38 had not been so handled. SC Ex. 56, FQC Audit 23.

QA:140. In EA Audit 15, dated November, 1975, the auditor reported that the project was not distributing E&DCR change

records on a weekly basis or with the minimum distribution required by EAP 6.3. SC Ex. 51, Attachment 15. The project was distributing documents, or the change record, on a monthly basis, rather than on a weekly basis. Subsequently, the requirement was changed so that the distribution of change records could be made on a monthly basis. Tr. 11,289-90 (Eifert); Tr. 13,625-26 (Baldwin). However, prior to the change in procedure, the EAP required a weekly distribution; this requirement was not being met. Tr. 11,290 (Eifert).

QA:141. Mr. Arrington agreed that in FQC Audit 38, dated June, 1981, there were some Courter problems with logging of E&DCRs. Tr. 11,366 (Arrington). In FQC Audit 38, dating from May and June, 1981, the E&DCRs were in file cabinets in boxes in the area where they were supposed to be. However, they were not filed in accordance with the procedural requirements. Tr. 11,367 (Baldwin).

3. I&E Reports Concerning E&DCRs

QA:142. In SC Ex. 106, I&E Report 76-06, dated June 22, 1976, the auditor noted that in Field Audit 322, dated November 6, 1975, LILCO had identified that the constructor was not filing E&DCRs with the applicable specifications and procedures as was required by site procedures. A followup audit was then performed by the licensee and documented in Field Audit 399, dated April 27, 1976. The same problem was again identified.

The failure of the constructor to effect corrective action was contrary to the requirement that nonconformances be identified and corrective action be taken to preclude repetition. This item was cited as being contrary to Criterion 16 of Appendix B. SC Ex. 106, Appendix A; Tr. 16,755 (Narrow). This item subsequently was closed out in I&E Inspection Report 76-12. I&E subsequently noted no violations concerning control of E&DCRs in 1977. SC Ex. 89B, Attachment 5; See Tr. 16,756 (Narrow). The Staff witnesses do not recall ever reviewing Field Audit 602 or 654. The same is true with respect to Field Audit 708. Tr. 16,757-58 (Higgins).

QA:143. In I&E Report 76-06, I&E cited LILCO for failure to initiate proper corrective action for an E&DCR problem. This was identified through I&E review of certain LILCO field audits. However, the subject of E&DCRs was closed out in I&E Report 76-12 and was never again cited as a violation by I&E during the 1977-1979 period. Given Mr. Hubbard's review of the large E&DCR problems which occurred in the 1977 time frame, he is concerned that I&E did not subsequently revisit this subject matter. Tr. 16,143-44 (Hubbard). Mr. Hubbard concluded that although the Staff initially identified the problem, they closed out the corrective action prematurely. Tr. 16,157 (Hubbard).

QA:144. Mr. Narrow, as NRC inspector, routinely reviewed E&DCRs. Tr. 16,309 (Narrow). During all of his years at Shoreham, however, Mr. Narrow has looked at approximately 100-200 E&DCRs. He regularly reviewed E&DCRs although the number of E&DCRs considered was small. Tr. 16,304 (Narrow). Mr. Narrow's inspection of E&DCRs was primarily to see that the engineering decisions that were made had been reviewed and approved by someone in engineering. Mr. Narrow did not review engineering calculations or the input that went into the E&DCRs. However, he reviewed the results of the calculations to determine whether they appeared to be acceptable. This was just a matter of engineering judgment. Similarly, Mr. Narrow's review of E&DCRs in general would have been a judgmental review instead of a close technical review. Tr. 16,310-11 (Narrow).

QA:145. In the CAT inspection, the inspector noted that the E&DCR system was being used for documenting interpretation of design requirements and site project technical communications. This practice led to a large number of E&DCRs. In addition, many E&DCRs themselves had been revised, modified or augmented. Finally, some E&DCRs were classified as generic and thus were comprehensive primary design documents used over a long period of time. The E&DCR system was primarily intended to be a change control system. Its scope had been expanded, however, so that it became a cumbersome system. SC Ex. 89B, at

4-41. Clear, concise and timely dissemination of technical and design information is essential for effective and error-free execution of engineered construction. The E&DCR system, as implemented at Shoreham, lacked timely drawing revision and thus did not provide for such clear, concise and timely dissemination. The NRC Staff considered this a weak area in the licensee's management control program. SC Ex. 89B, at 4-41, 4-42.

QA:146. The Staff witnesses believe that the E&DCR concerns described in the CAT inspection were primarily a matter for engineering resolution. However, they agree that it is an area that QA/QC should consider. Tr. 16,374-76 (Higgins).

QA:147. In I&E Inspection Report 82-26, Suffolk County Exhibit 91, the Staff cited LILCO for a violation of Criterion 6. This was a violation because a revision to the drawings issued in 1981 indicated that a particular E&DCR had been incorporated when, in fact, the wiring changes of the E&DCR were not incorporated into the drawings. The Shoreham FSAR, 10 CFR Part 50, Appendix B, Criterion 6 and the LILCO Engineering QA Manual all require that measures be established to control the issuance of drawings, including the prompt incorporation of changes and a review for adequacy before release. SC Ex. 91, Appendix A.

QA:148. Mr. Higgins indicated that the 82-26 problem was not directly related to the weaknesses in E&DCRs identified in the CAT inspection. Tr. 16,376-77 (Higgins). The situation in 82-26 was an instance where LILCO did not incorporate an E&DCR when it thought it had, while the weakness in the CAT inspection relates to the large backlog of E&DCRs that were not being promptly incorporated. Tr. 16,378 (Higgins). The matters, however, are not totally unrelated items. The CAT inspection expressed concern that the program for timely incorporation of E&DCRs was not as good as it should have been. The timely incorporation of E&DCRs is important because, without incorporation, use of a drawing is made more difficult; also, errors in the revision of the drawing are more likely since a large number of E&DCRs eventually has to be incorporated. In 82-26, the reason for the error apparently was an oversight; the error was not due to the fact that there was a large number of E&DCRs outstanding against the drawing. Tr. 16,379-80 (Higgins). The concern in 82-26 was that, even though the index indicated that the E&DCR was incorporated, someone using the drawing might think it was accurate and rely upon it. In fact, however, the drawing would not be accurate because it did not include the E&DCR. Tr. 16,380 (Higgins). The concern in the CAT inspection was also that the failure to have prompt incorporation of E&DCRs might lead to errors as well. Tr. 16,380-81 (Higgins).

QA:149. The violation cited in I&E Inspection Report 82-26 relates to the proper control of design documents. The Staff does not consider this a design control problem. Mr. Higgins agrees, however, that the 82-26 deficiency relates to the adequacy of the design document. Tr. 16,381-84 (Higgins). Mr. Higgins considers items to be design control problems only if there were hardware problems in terms of improper design or lack of accordance with the design basis. Tr. 16,384-85 (Higgins).

QA:150. In I&E Inspection Report 82-26, there was also a problem with the master E&DCR log. When a revision to a drawing is made, and E&DCRs against the drawing are incorporated, that would be indicated on the drawing and in the index or master E&DCR log. The master E&DCR log in this instance showed that it had been incorporated when, in fact, it had not been. Tr. 16,390-91 (Higgins). The master E&DCR log, dated August 27, 1982, indicated that the E&DCR had been incorporated into Revision C of the particular drawings in question. SC Ex. 91, at 9.

QA:151. From I&E's standpoint, there were no recurrent violations at Shoreham in the E&DCR area. LILCO may have had more than one finding in LILCO's internal audits in this area, but I&E is of the opinion that LILCO's program was addressing that, and therefore I&E did not find additional violations of a

recurrent nature. However, Mr. Higgins is not in a position to make a judgment on whether LILCO's corrective actions concerning control of E&DCRs were adequately prompt. Tr. 16,762-63 (Higgins).

QA:152. Mr. Narrow had not been aware during the 1977 time frame that LILCO had found or reached the conclusion that the preparation, issuance and control of E&DCRs effecting specifications, procedures and drawings was considered unsatisfactory. Tr. 16,766 (Narrow).

QA:153. Mr. Higgins and Mr. Narrow testified that they were not previously aware of the conclusions relating to E&DCR control contained in LILCO Field Audits 602 and 654. If they had been aware in the 1977 time frame, the violation of 76-06 which had been closed ... 76-12 would not have been re-opened because they would have had the opinion that LILCO was effectively following up on the audit findings which had been identified. Tr. 16,771 (Higgins, Narrow).

QA:154. In I&E Inspection Report 76-06, the Staff also identified a design control violation: there were four E&DCRs which had been issued concerning safety-related items which had not been reviewed by the quality assurance organization as required by LILCO procedure. Staff Ex. 8, at 24; SC Ex. 106, Appendix A, at 2; Tr. 16,913 (Narrow).

QA:155. In I&E Report 80-14, vent lines and valves had been installed without a specific authorizing E&DCR. There was a generic E&DCR, but not a specific one, which had been issued covering the particular activity. Accordingly, a necessary process of the design change, the issuance of the E&DCR, had not taken place. Staff Ex. 8, at 24; Tr. 16,914 (Higgins). There had been no prior QA approval of the particular installations of vent and drain lines, which was why the violation was written. Tr. 16,917-18 (Higgins).

QA:156. In I&E Inspection Report 81-22, Suffolk County Exhibit 104, page 7, the inspector noted that E&DCRs and drawing updates were not being distributed in a controlled manner to the startup engineers who were responsible for implementing design changes and for incorporating those changes into the testing program. The inspector also noted that the procedures that were in place did not fully detail methods to ensure and document that each design change, issued after startup jurisdiction took over, is incorporated into the plant and into the test program. Particular areas which were noted are as follows:

> [D]ocumentation of actions for an E&DCR issued when a drawing change does not result; documentation of action for E&DCRs and drawing changes for other than electrical drawings; actions to be taken and resulting documentation when changes occur after the preoperational test has been released for performance.

LILCO did not have a system set up whereby the startup engineer would have to signify receipt for an E&DCR or provide any type of record that he had gotten it and taken the required actions. LILCO had some distribution controls, but Mr. Higgins did not feel they were adequate, particularly in view of other problems which he had identified. Tr. 16,977-78 (Higgins); SC Ex. 104, at 7. Mr. Higgins thought that there needed to be improvements in the controlled distribution of E&DCRs. Tr. 16,979 (Higgins).

C. E&DCR Verification

QA:157. The E&DCR implementation verification program was started in July, 1976. LILCO Ex. 21, at 179. The purpose of the program was to provide additional assurance that all E&DCRs were properly implemented. Tr. 11,438 (Museler). There was no particular event which caused the program to be started at that time. However, Mr. Museler recalls that this was about the time that the startup organization was beginning to get geared up, and SWEC encountered an E&DCR implementation problem on another project. That problem caused some heightened concern. Tr. 11,438-39 (Museler).

QA:158. Through October 4, 1982, there have been 69,946 E&DCRs on the Shoreham project. For particular years, the numbers have been as follows: 1976, 3322; 1977, 4812; 1978, 6518; 1979, 9373; 1980, 11,433; 1981, 11,260; and 1982, as of

the time of hearing, 8423. Tr. 11,010 (Kelly). See also Tr. 10,861 (Museler). There are three phases in the E&DCR verification program: the period prior to July 15, 1976, which is Phase 1; Phase 2, which is from July, 1976 through August 5, 1977; and Phase 3 which is the rest. In Phase 1, up to July 15, 1976, a total of 4331 E&DCRs had been issued, of which 1445 required verification. Thirteen hundred sixty-six (1366) had already been verified, leaving 79 more to be verified. In Phase 2, July 15, 1976, through August 5, 1977, a total of 5832 E&DCRs was issued. Nineteen hundred sixty-one (1961) required verification, and 1956 had been verified as of October 2. During Phase 3, the time period August 5, 1977, to October 4, 1982, 59,783 E&DCRs had been issued, of which 4480 required verification and 3720 had been verified. Thus a total of 69,946 E&DCRs had been issued with 7886 requiring verification. Tr. 12,030-32 (Arrington); LILCO Ex. 22, ff. Tr. 12,033.

QA:159. Not all of the 69,946 E&DCRs required physical work, but a large number did. Tr. 13,563 (Museler).

QA:160. The E&DCR verification program was not part of the Appendix B QA program. The E&DCR verification program is administered by the UNICO construction organization. The inspections are performed by UNICO personnel. In some cases, QA personnel will perform inspections. The QA personnel are involved only with those items that involve nondestructive testing. Tr. 11,440-41 (Museler).

QA:161. All E&DCRs that affect startup or operation of the plant, or that require nondestructive testing, are included in the program. Mechanical, electrical and piping changes that affect the function of a system must also be verified under the program. LILCO Ex. 21, at 180. The verification of a pipe support would not be covered by the E&DCR verification program. However, a change in the mechanical logic of the system or a change in the piping, for instance the addition of a bypass path around a pump or the addition of a valve, would directly affect the functioning of the system and would be included in the program. Tr. 11,441-42 (Museler).

V. Storage/Housekeeping

A. General

QA:162. Appendix B, Criterion 13 sets forth the basic requirements which LILCO must meet for storage, receiving and handling of materials and equipment during the construction phase. The Criterion 13 requirements related to receiving, storage and handling are given further definition in ANSI Standard N45.2.2, which was issued in 1972. Tr. 11,463-64 (Museler, Kelly, Long). With minor exceptions, LILCO is committed in the FSAR to comply with these ANSI standard requirements. Tr. 11,464-65 (Kelly); LILCO Ex. 11, FSAR, Appendix 3B.

QA:163. In the Shoreham FSAR, LILCO commits to compliance with ANSI N45.2.2-1972, which pertains to receiving, storing

and handling of safety-related components. In I&E Report 79-16, the Staff cited LILCO for a violation because, contrary to the requirements of this ANSI standard, LILCO failed to take actions to ensure compliance with the ANSI standard. The Staff found that the LILCO commitment in the FSAR to this ANSI standard implemented LILCO's program for compliance with Appendix B, Criterion 2. Accordingly, when LILCO failed to comply with this ANSI standard, it similarly failed to comply with the Appendix B requirement and the violation was cited. Staff Ex. 8, Attachment 2.a; Tr. 16,435-36 (Higgins).

QA:164. ANSI N45.2.2 states in part:

> Levels and methods of storage necessary are defined to minimize the possibility of damage or lowering of quality due to corrosion, contamination, deterioration or physical damage from the time an item is stored upon receipt until the time the item is removed from storage and placed in its final location. ANSI N45.2.2, at 10-11.

Such protection is the basic purpose for LILCO's storage program under the ANSI standard. To the extent practicable, LILCO attempts to assure that cleanliness and good housekeeping practices are enforced at all times. Tr. 11,469-70 (Kelly).

QA:165. The LILCO witnesses agreed that the purpose of covering items as specified in the ANSI standard is to provide drainage and to assure air circulation to minimize condensation. In addition, certain coverings are intended to prevent dirt from getting into the equipment. Tr. 11,470-71 (Museler).

QA:166. The primary purpose of caps for pipes and other materials is to protect the ends of the pipes which are prepared for welding. They also prevent debris and water from entering the pipe. Tr. 11,471 (Museler). If an end cap is not provided and the pipe is banged against a hard surface, the end preparation of the pipe would have to be reworked. The requirement for end caps also provides some protection against corrosion and other kinds of damage besides banging. Tr. 11,471-72 (Museler).

QA:167. An end cap is something that is on a piece of pipe, conduit or tubing. Caps are also found on the female entrances to instruments and motors. The term "covers" is sometimes used interchangeably with the term "end caps." Usually, however, covers refer to a tarpaulin or poly which is placed over an entire piece of equipment. An end cap is normally closed to protect the end of something while a cover would be for the entire piece of equipment or material. Some end caps are for the purpose of protecting machined ends of pipes or conduit. Other caps, for example caps on open instrumentation tubing, are primarily to keep dirt from entering the tube. Caps also might prevent water from entering a tube. Tr. 11,710-12 (Museler). Covers and caps are part of the total storage program to protect equipment. Tr. 11,712 (Museler). This is part of the total 10 CFR Part 50, Appendix B program to comply with Criterion 13. Tr. 11,713-14 (Museler).

QA:168. ANSI N45.2.2, at page 12, specifies that "[w]ritten records shall be prepared that will include such pertinent information as storage location, inspection results, protection, and personnel access." LILCO has a program to comply with this storage record requirement. The storage history cards are part of this program to comply. The purpose of the storage history card is to document necessary preventive maintenance and inspection activities that need to take place for an item. They also provide for component identification, the component's location for preventive maintenance and the times when inspection activities are to be performed. Tr. 11,472-73 (Kelly). In addition to specifying inspections and possible preventive maintenance, the storage history cards may also specify other requirements. Such requirements may specify whether local heat has to be applied or whether covers have to be over the equipment. The LILCO procedures require the storage history cards, at least those in the central file, to be maintained accurately and completely. Tr. 11,492 (Museler). The storage history cards are used by LILCO to ensure that storage and preventive maintenance requirements are implemented. The storage history cards are one part of LILCO's overall program for compliance with Appendix B, Criterion 13. Tr. 11,494-95 (Museler).

QA:169. Meggering is a resistance check of various electrical parts, generally of a motor. Dunnage, generally wood, is what you set equipment or components on, and is for the purpose of keeping equipment or components off the ground or off the floor. Tr. 11,504 (Museler).

QA:170. During the construction of Shoreham, there were in excess of 2500 storage history cards. Between 1500 and 1800 of these cards are now active. Probably in excess of 500 of these cards are on components that require some type of preventive maintenance within a month's period of time. Such preventive maintenance might be a meggering check, oil check or rotation of equipment. Tr. 11,514 (Baldwin).

QA:171. There are four storage levels, A-D. Level A has the most stringent requirements and Level D generally has the least stringent requirements. The Categories A-D utilized by LILCO are the same categories as those specified in ANSI Standard N45.2.2. Tr. 11,489-90 (Museler). Level B storage requires covered, heated storage above 40 degrees. Tr. 11,519-20 (Museler). ANSI Standard N45.2.2, for Level D storage, requires that the storage area be well drained. Tr. 11,608 (Long). Storage Levels A and B require indoor storage. Storage Level C requires protection against weather, including rain, and is also indoor storage which need not be heated. Level C storage, however, can also be outdoors if the equipment

is protected against rain by a building or by putting a waterproof covering around it. Level D storage need not be indoors or in a weather-protected area. Tr. 11,654 (Museler). Section 6.1.2(3) of ANSI N45.2.2 states: "Level C items shall be stored indoors or equivalent with all provisions and requirements as set forth in Level B items, except that heat and temperature control is not required." Tr. 11,655. Storage Levels A and B require heated storage. Maximum and minimum temperatures are specified, with the minimum temperature in Level B storage being 40 degrees. Tr. 11,834-35 (Kelly, Arrington).

QA:172. LILCO has procedures to ensure that potential deterioration due to water or moisture is prevented, or is minimized to the extent possible. QC-17.1, entitled "Storage of Equipment and Material," is a QA procedure in this regard. There are also site procedures covering this subject. Tr. 11,602 (Museler). These site procedures, together with the QA procedures, are LILCO's means of meeting Appendix B, Criterion 13 in terms of protecting against potential weather damage or deterioration. Tr. 11,602-03 (Museler). QC Procedure 17.1 is the implementing procedure for storage of material and equipment that meets the requirements of ANSI N45.2.2. Tr. 11,741 (Arrington).

QA:173. Dunnage is defined as storing something off the ground. Tr. 11,504, 11,616 (Museler). ANSI N45.2.2, in Section 6.1.2(4), states: "Items shall be stored on cribbing or equivalent to allow for air circulation and to avoid trapping of water." Tr. 11,622 (Museler).

QA:174. In the CAT inspection, the I&E inspectors identified a number of vent valves that had not been plugged or capped to prevent dirt or dust from entering the valves that were mounted on certain instrument panels. SC Ex. 89B, at 4-19; SC Ex. 89A, at 22; Tr. 16,138 (Hubbard). LILCO has committed in Appendix 3B of the FSAR to meet Regulatory Guide 1.38 requirements, which references ANSI Standard N45.2.2, a standard dealing with storage handling and receiving. That ANSI standard provides that items in storage shall have all covers, caps, plugs or other closures intact. The standard further states that any covers removed for internal access at anytime for any reason shall be immediately replaced and resealed after completion of the purpose of the removal. Tr. 16,139 (Hubbard).

QA:175. The purpose of having a tarpaulin is generally to keep water off the equipment. While tarpaulins are not completely waterproof, the purpose of such covers is to help prevent damage due to deterioration. Tr. 11,643-44 (Museler).

QA:176. With respect to the entire storage discussion, LILCO witnesses attached no significance to the number of audit findings. They do not believe that this is an excessive number in light of the large number of components in the plant and the length of time over which the construction process proceeded. Secondly, in their opinion, the findings do not indicate an adverse effect on the actual hardware involved, with the few exceptions which were noted. Tr. 13,772 (Museler).

QA:177. With respect to the entire storage category, the LILCO witnesses are of the opinion that those findings neither constitute nor indicate any violation of any Appendix B criteria. With respect to Criterion 13, the witnesses stated that the necessary measures required by Criterion 13 have been established and are in place. Furthermore, there is an extensive inspection, surveillance and audit program to ensure that it is implemented. With respect to Criterion 16, related to corrective action, the necessary measures have been established and the program is functional. With respect to significant conditions adverse to quality, weather conditions have been significant, but necessary investigations have been performed. With respect to Criterion 18, a comprehensive system of audits to verify compliance has been established. Tr. 13,774-76 (Kelly).

B. LILCO/SWEC Audit Findings

QA:178. LILCO agrees that there are eight audit findings where inspections did not occur in a timely manner or the preventive maintenance activities had not taken place. These are: FA 376, Finding 4.8; FA 601, Finding 4.4; FA 1016, Findings 4.1 and 4.3; FA 1213, Findings 4.1 and 4.2; and FA 1425, Finding 4.1. They all fall into a similar category of timely inspections or maintenance activities not being performed. Tr. 11,543 (Museler). While the inspections did not occur on the correct schedule, in each instance, when the inspections were subsequently performed after the audits, the equipment was found to be satisfactory. Tr. 11,503-04 (Museler).

QA:179. FQC Audit 13, Finding D.5, Field Audit 226, Findings 4.4 and 4.14, FQC Audit 23, Finding D.7, and FQC 40, Observation 1.4, Subpart 4, all relate to the same subject matter of drainage situations that needed correction. Tr. 11,611 (Kelly).

QA:180. With respect to Field Audit 444, Finding 4.2, Mr. Arrington believes that the ANSI standard is talking about equipment, and not materials such as structural steel. Rebar and structural steel shapes are constantly subjected to weather conditions, although it is not allowable to store them in mud. Tr. 11,619-20, 11,623 (Arrington). ANSI N45.2.2 specifies that structural items and reinforcing steel are included as Level D items. Tr. 11,627 (Arrington).

QA:181. The LILCO witnesses agreed that Field Audit 340, Finding 4.3, FQC Audit 23, Finding D.5.2, and FA Audit 444, Finding 4.1, all relate to the category of dunnage. They do not agree that Field Audit 444, Finding 4.2, falls into the dunnage category. Tr. 11,632 (Museler).

QA:182. The following audits were received into evidence in the so-called dunnage category: FA 371, Findings 4.2, 4.3 and 4.4; FA 444, Finding 4.1; FA 340, Finding 4.3; FQC Audit 23, Finding D.5.2; FA 803, Finding 4.2; FA 1183, Findings 4.1, 4.2 and 4.3. FA 444, Finding 4.2, was moved into evidence but not as part of the dunnage group. Tr. 11,634 (Lanpher).

QA:183. Field Audit 444, Item 4.2, reported corrosion. Tr. 13,930 (Museler).

QA:184. In FQC 15, Finding D.7, it was determined that five gate valves were left without protective end caps that were required by procedure. Mr. Arrington stated that there was no damage as a result of the caps' absence. Mr. Arrington stated that damage checks are done by visual inspection, and will detect debris or damage to the end preparations. In addition, material that is in storage receives testing during the construction phase and the operational phase. Those tests will also indicate whether there was any damage. Mr. Arrington believes that these processes will pick up any

damage. Tr. 11,734-37 (Arrington). Mr. Museler confirmed that in storage observations, the condition observed might have an effect that is not immediately visually apparent. When this is the case, and it does not occur often, it is referred to engineering for evaluation and some pieces of equipment have had to be returned to manufactuers for checkout or for refurbishing. Mr. Arrington later clarified that it is not always readily apparent just by visual inspection whether there is or is not damage. Tr. 11,737-39 (Museler, Arrington). End caps are important in relation to potential damage or deterioration to the component itself. When an end cap is identified to the SWEC QA organization as not being in place, checks are made to see whether or not there was any damage. Tr. 11,770-71 (Arrington).

QA:185. In most instances, end caps for items are furnished by the manufacturer. Tr. 11,742 (Museler). End caps are taken off frequently, sometimes by test personnel to perform measurements for end preparations. It is not uncommon that end caps are not put back immediately because there may be additional information that is needed. Also, workmen often do not like to put them back immediately if they know they are going to have to return to that same area again. Thus, in Mr. Arrington's opinion, there is usually a reason why the end caps are off. However, workers do not take time to document if the

end caps are left off or what the reason is for not putting back the end caps. Tr. 11,742-45 (Kelly, Arrington). The principal cause for leaving end caps off of valves and pieces of pipe is inattention on the part of craft personnel who are handling these pieces of equipment. Tr. 11,798 (Museler).

QA:186. The Suffolk County examination documented the following audits involving failure to have end caps: FQC Audit 15, Finding D.7; Field Audit 601, Findings 4.1, 4.2 and 4.3; Field Audit 1180, Finding 4.3; and Field Audit 1234, Finding 4.1. In addition, the LILCO witnesses agreed that the following additional audits also involved the lack of end caps: Field Audit 470, Finding 4.9; FQC Audit 23, Finding D.5.3; Field Audit 656, Finding 4.2; Field Audit 721, Findings 4.1 and 4.2; Field Audit 803, Findings 4.3 and 4.4; Field Audit 934, Findings 4.2 and 4.3; Field Audit 980, Findings 4.2 and 4.3; Field Audit 1026, Finding 4.1 and 4.2; FQC Audit 33, page 2 in Finding D.4; Field Audit 1086, Finding 4.2; and FQC Audit 34, Finding N.2. Tr. 11,751-53 (Museler). At a number of times during the project, QA personnel indicated that greater attention was needed with respect to end caps. Tr. 11,798-99 (Museler).

QA:187. Audits FQC 20, Finding D.4, FA 425, Finding 4.4, FA 470, Finding 4.3, FQC 24, Finding D. 5, FA 740, Findings 4.1 and 4.2, FA 1086, Finding 4.1, and FA 1313, Finding 4.2, all relate in one degree or another to actual damage being observed

during the storage program audits. Tr. 11,815-24 (Arrington, Museler, Kelly).

QA:188. During the time period of May, 1980 through December, 1981, Mr. Gerecke advised management in each quarterly QA report that there were problems related to environmental protection for installed or stored equipment. Tr. 11,878-79 (Gerecke). Thus, the Quarterly QA Reports for Management for May, 1980, July, 1980, November, 1980, February, 1981, August, 1981, and December, 1981, all identify problems related to environmental protection of installed equipment. The first five reports refer to installed equipment and the last one refers to stored equipment. See SC Ex. 63. Mr. Gerecke confirms that each of these reports contain information about Field Audits which have identified areas where adequate protection has not been provided to equipment either stored in place or otherwise. They also almost always identify instances from previous audits that now have been corrected. Tr. 11,872-73, 13,828 (Gerecke). Mr. Gerecke cannot recall whether he received any questions back from management on these particular findings related to environmental protection. Tr. 13,829-30 (Gerecke).

QA:189. At the time of the May, 1980 Quarterly Report, LILCO did consider that this item regarding environmental protection of installed equipment was an item of sufficient significance which should be called to management's attention.

Subsequent reports were primarily to update management on the status and the significance or lack of significance of the findings in subsequent audits. Tr. 11,873-74 (Gerecke).

QA:190. A Quarterly QA Report to Management is a summary report to advise management of what is happening in the audit area. Tr. 13,833 (Kelly). When audit report findings are significant or have the potential of turning into a significant situation, LILCO does not wait for quarterly reports in order to inform management. Rather, it is done right away. An example of this was in Field Audit 602 concerning E&DCRs. The vice president was invited to the exit conference and took action that he felt was necessary to get the audit management moving. Tr. 13,830, 13,840 (Gerecke).

QA:191. Mr. Museler did not hear from upper management relating to the environmental protection problems reported in the quarterly reports in 1980 and 1981. He believes this was the case because management understood this was not a problem that required their attention. During earlier years, Mr. Museler did hear from management on the E&DCR issue quite frequently in terms of getting that matter turned around. Tr. 13,844 (Museler).

QA:192. In the quarterly QA reports to management, Mr. Gerecke normally brings one or more field audits to management's attention. There are approximately 45 field audits

every quarter. Because a field audit is singled out in a quarterly report does not imply that it necessarily has great significance. Tr. 13,861-63 (Gerecke). However, the Board notes that the Quarterly Report of May 30, 1980, which is part of SC Exhibit 63, contains the following statement: "No other audit findings are of such significance as to warrant management attention at this time." By this, Mr. Gerecke meant to call to management's attention that no field audit had been singled out, so that they would be aware of the situation. Tr. 13,863-64 (Gerecke).

QA:193. Concerning the storage history card problems reported in the field audits and FQC audits, LILCO testified that corrective action had been taken. Such corrective action included completion of the storage history cards, performance of investigations of suspected damage and performing tests. Tr. 13,737-38 (Museler).

QA:194. With respect to the audit observations concerning failure to protect against weather, LILCO testified that corrective action was taken in all cases. The corrective actions consisted of such things as replacement of a poly cover, placement of an item on dunnage, replacement of an end cap and similar actions. In the opinion of LILCO witnesses, these actions do not represent anything that is significantly adverse to quality because, in no case, to their knowledge, did any

damage occur. Tr. 13,742-43 (Kelly). By lack of damage, Mr. Kelly means that nothing different had to be done in the way of repair or other actions that would have been done anyway. Thus, with respect to Field Audit 444, Finding 4.4, where there was severe corrosion on structural steel, damage was not considered to occur because sand blasting would have taken place in any case. Tr. 13,745 (Kelly).

QA:195. With respect to the audit observations concerning end caps and covering, LILCO testified that corrective action was taken in every case. This action would have involved replacing the end caps or the covers and, where damaged, the item would have been discarded or repaired. Tr. 13,747-48 (Kelly).

QA:196. With respect to Field Audit 601, Findings 4.1, 4.2 and 4.3, Mr. Kelly stated that there was a total of five valves which did not have end caps. Mr. Kelly pointed out that there would have been QA inspections and cleanliness inspections at a later time. Accordingly, in Mr. Kelly's opinion, anything that might have occurred due to the lack of an end cap would have been discovered and rectified at a later time. Tr. 13,748-49 (Kelly).

QA:197. The purpose of end caps is to provide for cleanliness and, to the extent possible, to protect the end preparations for welded-in components. Mr. Museler testified

that the mere absence of an end cap, in itself, has no significance and causes no additional rework. No matter whether the end cap is on or off, the item in the end preparation is cleaned, polished and otherwise prepared. Further, cleanliness checks are made whether or not the caps are there. Tr. 13,750-52 (Kelly).

QA:198. With respect to the audit findings concerning a failure to provide proper environmental protection (like heaters), LILCO testified that corrective action was taken in each case. Such corrective action typically would be to re-energize heaters. Tr. 13,766-67 (Kelly).

C. I&E Storage Inspections

QA:199. The I&E inspectors in the CAT inspection, when inspecting instrumentation, controls and electrical power areas, identified a number of vent valves that had not been plugged or capped to prevent dirt and dust from entering the valves on two panels. In addition, certain identification tags were missing from the instrument line at instrument panels. SC Ex. 89B, at 4-19. This constitutes a violation of ANSI N45.2.2, paragraph 6.4.2(1). Mr. Higgins does not know why it was not cited as a violation. Tr. 16,533-34 (Higgins). Mr. Higgins states that this situation does not meet the ANSI standard to which LILCO had committed. Mr. Higgins believes that this was a case where it was decided that the observations

were not significant enough to merit citation as a violation. Tr. 16,535-36 (Higgins). Mr. Higgins agrees that this situation could literally have been cited as a violation. Tr. 16,536-37 (Higgins). Mr. Higgins agrees that the item at page 4-19 of the CAT inspection is similar to the item in I&E Inspection Report 79-16. Mr. Higgins does not agree that this situation was one where no effective corrective action had been taken. Tr. 16,537-38 (Higgins).

QA:200. In the CAT inspection, the I&E inspector observed that several electrical jumpers used in control room panels had been removed from the terminal block and were not tagged. The free terminals were not protected against possible shortage. SC Ex. 89B, at 4-20.

QA:201. The CAT inspectors noted that electrical components had not been completely sealed to prevent moisture entry. The final cable run to components was often by means of a metal conduit, but the conduit was not sealed where the electrical cable entered it. Because it was not sealed, the opening provided a moisture entry path to the component. SC Ex. 89B, at 4-23.

QA:202. The LILCO witnesses cite NRC I&E Inspection Report 79-16, at page 6, as evidence that the inspector had noted that LILCO appeared to have a very effective program for maintaining temporary heat on motors and generators. The LILCO

witnesses also consider the inspector's notation as additional evidence that LILCO placed emphasis on trying to keep its storage program complet ; effective. Tr. 13,767-68 (Kelly). The LILCO witnesses do not believe the findings concerning heaters, etc., constitute conditions significantly adverse to quality, basically because no damage was sustained by the equipment. Further, where there was a possibility of a potential impact on quality, additional evaluations were made to ensure that the necessary quality was achieved. Tr. 13,769-71 (Kelly, Museler).

QA:203. ANSI N45.2.2-1972, in paragraph 6.4.2(1), states in part that: "Items in storage shall have all covers, caps, plugs or other closures intact ... Covers removed for internal access at any time for any reason shall be immediately replaced and resealed after completion of the purpose for removal." Staff Ex. 8, Attachment 2.a. LILCO had committed to this ANSI standard. Tr. 16,533 (Higgins). In I&E Report 79-16, dated January 19, 1980, the Staff discovered instances where caps and covers had been removed and not been immediately replaced. Because LILCO had not complied with its commitment to the ANSI standard, the Staff determined it was a violation of Criterion 2. Tr. 16,533 (Higgins).

QA:204. In I&E Report 81-14, dated September 14, 1981, LILCO is cited for a violation which involved leads in a panel

which had been lifted with no documentation in the log. This was a violation because LILCO had procedures that required this documentation. Moreover, the lifting had not been tagged as required. In I&E's opinion, LILCO was not complying with those procedures. Tr. 16,540 (Higgins); SC Ex. 97, Appendix A. Subsequently, in I&E Inspection Report 82-13, dated July 14, 1982, the same general problem, as identified in 81-14, recurred. Indeed, in the cover letter to Inspection Report 82-13, it is noted that the inadequately lifted lead and jumper control were similar to items identified during Inspections 81-14 and 81-20. Tr. 16,541 (Higgins); SC Ex. 98, cover and Appendix A, Violation C; SC Ex. 99, at 4. Mr. Higgins agrees that Inspection Report 81-20 constituted another situation where the Staff had a concern with discrepancies identified initially as a violation and then, upon followup, additional problems of the same kind as those in 81-20 were found. Accordingly, the violation was held open and an additional violation was not written. Then, in 82-13, the Staff found additional problems and felt it was necessary to escalate the attention given to it. Accordingly, it was put in a cover letter and the violation was cited. Subsequent to 82-13, LILCO gave additional attention and corrected the problem. Tr. 16,541-43 (Higgins). The reason that the discrepancies noted in 81-20 were not written up as a violation was because there already was a violation

from 81-14 which was being held open. Tr. 16,543 (Higgins). The violation was being held open because I&E had a concern that the corrective action which was taken was not fully adequate. Tr. 16,544 (Higgins).

QA:205. In the CAT inspection, SC Ex. 89B, at 4-20, the Staff identified an instance where several electric jumpers had been removed from a terminal block, but were not tagged. Mr. Higgins agrees that this is similar to the problem which originally was identified in Inspection Report 81-14. Mr. Higgins does not know why this was not cited as a violation. Tr. 16,545-46 (Higgins). Mr. Higgins agrees that this constitutes a violation of Appendix B. Tr. 16,546 (Higgins). Mr. Higgins would agree that in this instance, along with the citation for a violation in 82-13, the jumper and lead problem did constitute a recurrent item. Tr. 16,547 (Gallo).

QA:206. The purpose of lifted lead and tag program is that the necessary testing and maintenance can be accomplished in a controlled manner. Tr. 16,550 (Higgins).

QA:207. In I&E Report 76-07, SC Ex. 100, LILCO is cited for a violation of Criterion 13. The 480 volt switchgear and the associated transformer were not maintained in a clean condition as required by the electrical installation specification. At the time of the inspection, the cover installed for protection of the equipment was torn and was too small to

completely cover the equipment, resulting in deposits of dust and debris on the relay contacts and transformer windings. SC Ex. 100, Appendix A. The failure to comply with the requirements of the specification constituted a violation of Appendix B. Tr. 16,564-66 (Narrow).

QA:208. In I&E Report 82-15, dated August 30, 1982, SC Ex. 101, at 6, the I&E inspectors identified corrosion in various areas of this suppression pool. Tr. 16,613 (Higgins). The concern of Mr. Higgins in citing this matter was the potential deterioration resulting from the corrosion. Mr. Higgins did not know whether this was a serious concern or not, and awaited LILCO's response to this item. Tr. 16,618-19 (Higgins).

QA:209. In I&E Report 74-05, one of the violations which was identified was that the environment which was observed for the pressure vessel deviated from that which had been specified. Subsequently, the requirements were changed but, for purposes of the violation notice, it was at least in part for failure to maintain the necessary environmental conditions, i.e., the established pressure. Tr. 16,778 (Narrow). The primary purpose of the environmental condition specification was to have an inert atmosphere within the pressure vessel to minimize the amount of oxygen and moisture. That objective was achieved, although the auditor correctly noted that the

pressure could not be maintained at the specified level unless the flow is increased above the maximum. Tr. 17,378 (Narrow).

QA:210. In I&E Report 75-05, the Staff noted that records of dew point and outside temperature were not being maintained. Staff Ex. 8, at 15. This finding, as that in 74-05, involved the reactor pressure vessel. The nature of the problem was that dew point with the nitrogen blanket within the pressure vessel was not maintained within the limits specified by the storage procedure. Tr. 16,779-80 (Narrow). Thus, this citation involved a problem in maintaining temperature control. Tr. 16,781 (Narrow). Mr. Narrow believes that this citation was primarily a matter of maintaining the proper environmental records and not primarily a matter of maintaining proper environmental conditions. However, in one case, the dew point was not maintained. Tr. 16,781-82 (Narrow).

QA:211. In I&E Report 79-16, one item of violation cited by the Staff states that space heaters for two panels were found to be de-energized. Space heaters are provided in order to control environmental conditions. Tr. 16,785-86 (Higgins); Staff Ex. 8, Attachment 2.a.

QA:212. In I&E Inspection Report 74-02, Violation No. 2, cadwelds were in the process of being installed but weather protection had not been provided for the cadweld sleeves. Accordingly, they exhibited rust inside the sleeves. Tr. 16,789-91 (Narrow).

QA:213. I&E Report 76-01 reported corrosion on threads of pipe hangers in storage. Staff Ex. 8, at 15.

QA:214. In I&E Report 76-12, LILCO was cited for a violation because there was molten iron splatter on the refueling cavity liner. Staff Ex. 8, at 15. This was an instance where thermal cutting was taking place without sufficient care to avoid potential damage to some other items. This violation is similar to the details set forth in the CAT inspection, at page 34, where the inspector observed that grinding was being conducted next to the RHR pump and dust was settling around the unprotected RHR pumpshaft. In each instance, an activity was being carried out without sufficient care for the effects of that activity on other items. Tr. 16,800-03 (Higgins). The Staff witnesses thought these were different items because they involved different types of cutting processes and protection of different kinds of items. Second, grinding is different than thermal cutting and the components that are being protected are different. Tr. 16,804 (Higgins). Mr. Gallo agrees that the situation identified in the CAT inspection with grit and dust getting into the RHR pumpshaft would be an item of concern. Tr. 16,805 (Gallo).

QA:215. I&E Report 79-16 covers diverse storage-related problems, including: failure to keep Category 1 components stored in a clean condition; problems with dust, dirt, grease,

trash and broken glass around Category 1 components; equipment openings not being covered; and de-energized space heaters. The majority of these problems involved failure to provide required protection or covering of installed equipment. Tr. 16,828 (Higgins).

QA:216. Mr. Higgins agrees that I&E Reports 76-07, 76-09, 78-16, 79-06 and 79-16 all involve the protection or covering of installed equipment. Tr. 16,829 (Higgins). Programmatic deficiencies were noted in Inspection 79-16, which led LILCO to institute programmatic changes thereafter. The Staff thought these changes were effective and closed out the violation. Staff Ex. 8, at 17-18 and Attachment 2.

QA:217. Mr. Higgins would agree that in the period May 30, 1980 through December, 1981, there were repeated instances of failure to provide adequate environmental protection to installed equipment. Tr. 16,832 (Higgins).

QA:218. Mr. Higgins, after review of the Quarterly Reports to Management relating to environmental protection of installed equipment, still believes that the corrective action after I&E Report 79-16 was effective. Tr. 16,837-40. Mr. Higgins thinks that LILCO's storage program for installed equipment was adequate during the time period of May, 1980 through December, 1981. However, he believes that they could have expended greater effort and had a more effective program.

Tr. 16,853 (Higgins). Mr. Higgins would have liked to have seen LILCO do more. However, he thinks LILCO's effort was adequate from a regulatory and QA standpoint. Tr. 16,855 (Higgins).

QA:219. Mr. Higgins agrees that I&E Report 79-16 and the CAT inspection are similar in that both involve dirt-producing activities. One was cited as a housekeeping violation and one was cited as an equipment storage problem. Mr. Higgins also agrees that the two findings are similar to I&E Report 82-27. Tr. 16,859-60 (Higgins).

QA:220. Mr. Higgins believes that the findings concerning equipment storage relating to such things as missing pipe caps and covers are similar in nature to the types of storage findings that would be found at other construction sites. Mr. Narrow thinks that the question of protection of equipment in storage has been overemphasized given the large number of items to be stored for the long period of time that they were stored. He would have been surprised if some nonconformances had not been identified. Tr. 17,320 (Narrow).

D. Housekeeping

QA:221. LILCO has procedures and requirements to keep storage areas clean and free from debris. One of the implementing procedures is QC 17.1. LILCO's housekeeping procedures cover not only storage areas, but all areas of the construction

site. These procedures are designed to minimize the accumulation of material not directly related to the building of the plant. To the extent that these procedures cover portions of the plant or portions of the storage areas relating to safety-related equipment, they are part of the implementation of Appendix B requirements. Tr. 11,924-26 (Kelly, Arrington, Museler).

QA:222. ANSI N45.2.2, in Section 6.2, states that cleanliness and good housekeeping practices shall be enforced at all times. Mr. Kelly stated that LILCO does enforce such practices at all times. Tr. 11,928-9 (Kelly). Section 6.2.2 of ANSI N45.2.2 specifies that storage areas shall be cleaned as required to avoid the accumulation of trash, discarded packaging materials and other detrimental soil. Tr. 11,931-32 (Kelly). The LILCO witnesses believe that it is acceptable for normal accumulation of construction material to be present in the storage area when construction activities are taking place. Tr. 11,932-33 (Museler).

QA:223. The overall control of housekeeping can be tied to the defense-in-depth concept. One lessens the probability that things might work improperly if these regulations are adhered to since it is desirable to avoid exposure to potential causes of equipment degradation. Tr. 16,861-62 (Higgins).

QA:224. LILCO Field QA conducted 230 audits that address storage areas as far as housekeeping (trash and debris) was concerned. During those audits, 580 storage areas were inspected. Of those areas, 23 revealed departures from requirements. That represents a 3.97 percent rate of departure, which LILCO's witnesses believe indicates the program's success. Tr. 12,029-30, 12,036 (Kelly).

QA:225. In I&E Inspection Report 82-04, the 1982 CAT inspection, LILCO was cited for violation of 10 CFR Part 50, Appendix B, Criterion 5. The violations stemmed from "lack of management control for housekeeping, cleanliness and fire protection." SC Ex. 89B, at 4-44; see SC Ex. 89D, at 4-5. The specific violation involved LILCO's failure to keep certain work areas sufficiently clean and orderly so that the construction activity could proceed in an efficient manner. Construction Site Instruction 13.1 directed:

> Work areas shall be kept sufficiently clean and orderly so that construction activity can proceed in an efficient manner . . . excess material shall not be allowed to accumulate and create conditions that will adversely affect quality . . . Equipment and instructions for the protection from the prevention of damage by fire shall be provided . . . .

The NRC Staff found that this CSI had not been satisfied because of certain housekeeping deficiencies. Because this CSI

had not been satisfied and because this was part of LILCO's program to implement its compliance with Criterion 5 of Appendix B, the NRC Staff cited LILCO for a violation. See SC Ex. 89B, at 4-4; Tr. 16,437 (Higgins).

QA:226. In Violation No. 4 of the CAT inspection, the I&E inspector identified a deviation from Criterion 5 of Appendix B. The I&E inspectors found:

(1) On February 12 and again on February 24, fire hazards were identified in the fuel oil transfer rooms. These hazards included fuel leaking from pumps; fuel oil in drip trays, welds and buckets; combustible fumes in rooms where pumps were running; and room vents which were taped closed. In addition, on February 25, 1982, welding was taking place without fire extinguishers present. No fire watch was designated nor had previously identified fire hazards been eliminated.

(2) On February 12 and again on February 24, fire hazards were identified in the emergency diesel generator room. These included fuel oil overflowing from plastic hoses, fuel oil in open buckets, and fuel oil on the floor and foundations. On February 25, welding was observed on two of the diesels with fuel still under the engine generators.

(3) On February 24, both rooms of the screen well pump house were observed to have excess material and were extremely dirty. The material blocked access to the electrical panels and hindered work. SC Ex. 89B, at 4-4, 4-5.

The I&E inspectors stated that it was "of particular concern" that there were "many observed instances of dirt, grit and debris in, on and around electrical boxes, cabling, and operating shafts and stems of motor operated valves." SC Ex. 89B, at 4-44. The I&E inspector noted that the examples of housekeeping, cleanliness and fire prevention deficiencies were judged a violation stemming from lack of management control. As a result of the inspection, LILCO committed to assign a ten-person cleanup crew to the plant buildings, beginning March 1, 1982. SC Ex. 89B, at 4-44; Tr. 13,811-13 (Museler).

QA:227. During the CAT inspection, the housekeeping deficiencies were initially identified early in the inspection. This was on February 11 or 12, 1982, and the Staff concerns in this regard were communicated to LILCO at or about that time. In this instance, the same problems were then re-identified on February 25, 1982. Some things had been cleaned up, but the inspector went back and found similar problems and, in some instances, almost exactly the same problems. Mr. Higgins would not have expected to have found the same problems in late February which had been identified initially on February 11 and 12. Tr. 16,486-90 (Higgins).

QA:228. Subsequent to the CAT inspection, in a memorandum dated March 8, 1982, signed by Mr. Museler and Mr. Youngling, LILCO specified corrective action measures to be taken by LILCO

to confirm or reconfirm efforts to maintain acceptable levels of cleanliness at Shoreham. This memorandum was marked as LILCO Exhibit 54 and is bound into the record following transcript page 17,303. Tr. 17,301-02 (Higgins).

QA:229. LILCO Exhibit 54 indicates that strict compliance with housekeeping and cleanliness instructions is mandatory and that violations will subject persons to disciplinary actions up to and including termination. Mr. Higgins would agree that these strong words indicate a strong attitude towards such cleanliness requirements. Tr. 17,304 (Higgins). Mr. Higgins, however, was unaware of any disciplinary action against any employees in violation of housekeeping or cleanliness requirements. Tr. 17,304 (Higgins).

QA:230. Although LILCO Exhibit 54 relating to housekeeping and cleanliness was, in the Staff's opinion, a strong statement of corrective action by LILCO, as indicated by Inspection 82-27, LILCO subsequently had similar housekeeping problems. Tr. 17,462-63 (Higgins).

QA:231. I&E Report 82-27 is dated November 22, 1982. At page 5, under the heading, "Plant Tours," the following information was observed:

> Inspection of battery and emergency switchgear rooms revealed many unacceptable items such as wood, rags, paper, metal, poly bottles, drop cords, welding lead, air hose, a damaged ammeter on a battery charger which had been damaged since May 1982, a 24 VDC battery cell which has been

> jumpered out with a damaged connector since July 1982, and all three battery doors unlocked and propped open . . . .
>
> The reactor building and containment were very dirty with debris, hardware, wood, rags, paper and dirt on components, piping, and in electrical trays.
>
> It was noticed that a concerted effort was being made in the containment drywell, but is not evident in the reactor building. In screenwell room A, a ladder was against the electrical cabinet and no fire extinguisher is present in the room. In screenwell room B, a large workbench is up against the electrical cabinet also. SC Ex. 93, at 5.

QA:232. The items that were identified in Inspection Report 82-27 were similar to those that were found in the CAT inspection. They were not cited as a new violation in 82-27 because there was still an open item in the CAT inspection. Tr. 16,442-44 (Higgins).

QA:233. After the Staff had reviewed proposed corrective action to the housekeeping deficiencies in the CAT inspection as described in LILCO's July 28, 1982 letter (SC Ex. 70), the Staff was not completely satisfied with the adequacy of those corrective actions. Accordingly, during the week of September 5, there were discussions regarding the need for further actions. Subsequently, in Inspection Report 82-27, conducted subsequent to the September 5 meeting, the inspector identified conditions that he felt should have been better. Tr. 16,444-49 (Higgins).

QA:234. Mr. Higgins agrees that the findings in I&E Inspection Report 82-27 are basically the same situation as that identified in Violation No. 4 of the CAT inspection. Tr. 16,449-50 (Higgins). The observations in I&E Report 82-27 were approximately eight months after the CAT inspection. These were not the same instances of litter and debris, but rather, they were additional instances of the same type of problem. Mr. Higgins would agree that as of October, 1982, there were still problems with housekeeping and cleanliness and with inadequacy of fire protection. Tr. 16,450-52 (Higgins). It indicates continuing problems in housekeeping and cleanliness. Tr. 16,452 (Higgins).

QA:235. By the time the CAT inspectors left the site in February, 1982, the specific housekeeping/cleanliness deficiencies had been cleaned up. These deficiencies involved the battery and switchgear rooms. There is nothing special about these rooms that would make them logical candidates to be more dirty than other places. Indeed, the NRC Staff believes that these are areas that the Staff expects to see cleaner than other areas. Tr. 16,456-57 (Higgins). The CAT observations related to cleanliness and housekeeping were made because the Staff felt that LILCO had erred on the side of allowing too much trash to accumulate. Tr. 16,458 (Higgins).

QA:236. Mr. Higgins agrees that the CAT inspection and I&E Report 82-27 constitute two observations eight months apart which do not show much improvement at a time when it could be expected that improvement would take place as construction activities decreased. Tr. 16,462 (Higgins).

QA:237. LILCO's attitude with respect to the cleanliness and housekeeping issues is that they will clean up as they go along with a "big push" at the conclusion. They did not completely ignore this situation. When it was brought up by the NRC Staff, LILCO ultimately said that the plant was still in the construction mode, and that there is a lot of dirt-generating activity and that it would not be productive or cost effective to be doing as much cleanup as the Staff wanted. Accordingly, the Staff testified that this has been an area where the Staff has differed with LILCO management. Tr. 16,463-64 (Higgins).

QA:238. The Staff witnesses believe that there is some assurance that the housekeeping and similar deficiencies have not really resulted in conditions adverse to quality because of subsequent checks. These checks include such things as final inspections, pre-operational tests, etc. Mr. Higgins believes that the inspections, tests and flushes that are done are adequate to cover any deficiencies that might have resulted from the storage deficiencies that have been identified. Tr. 16,467-70 (Higgins).

QA:239. Mr. Narrow cannot give specific details, but he recalls that there have been times when some equipment required major repair because of deterioration due to exposure to the elements, possibly during storage. Tr. 16,472 (Narrow). Mr. Higgins recalls an air conditioning system filtration electrical control box that was so corroded due to improper storage that it needed to be replaced completely. Tr. 16,472 (Higgins).

QA:240. The litter and debris deficiencies noted in the CAT inspection and in I&E Inspection Report 82-27 had the potential to cause problems. Because of this potential, the Staff sought to have them remove all possible causes of problems. The Staff does not like to depend on subsequent checks (such as pre-op tests) to insure quality. Tr. 16,474 (Higgins). The Licensing Board agrees that subsequent tests and checks should not be relied upon to insure quality because it necessarily lessens the margin of safety and reduces the ability to rely upon the defense-in-depth concept inherent in nuclear reactor regulation.

QA:241. Testifying on December 15, 1982, Mr. Higgins said that the amount of dirt and the disorderly nature of the Shoreham facility is somewhat greater than the Staff would have expected. Mr. Higgins characterized the cleanliness situation as "over the border." Tr. 16,475 (Higgins).

QA:242. After the meeting of the I&E Staff with LILCO management on the week of September 5, 1982, LILCO management committed to doing the work to eliminate the problem. The Staff thought it was noteworthy that subsequently, in Inspection Report 82-27, the same types of problems did turn up. Tr. 16,476 (Higgins).

QA:243. LILCO Ex. 33, a November 4, 1982 letter from the NRC Staff to LILCO, which is further followup on the CAT inspection. This letter grew out of the meetings held the week of September 5, 1982. With respect to the housekeeping/cleanliness violation in the CAT inspection, the Staff had not been entirely satisfied with the responses contained in SC Ex. 7 (the LILCO formal response to the CAT inspection) and the Staff felt it was necessary to elicit additional commitments. The additional commitments included one in which senior LILCO management would perform periodic walkthroughs in various areas to identify housekeeping deficiencies. Tr. 16,480-482 (Higgins). In addition, electrical trays were being inspected for quality control, cleanliness and freedom from debris. This was an additional commitment in LILCO Ex. 33, which had resulted from the September 5 meeting. Tr. 16,484 (Higgins).

QA:244. In I&E Inspection Report 79-16, the inspector noted that on tours conducted between October 3 and October 11, 1979, that many category 1 components were not maintained with

adequate cleanness. Discrepancies noted included accumulations of dust, dirt, grease, trash and broken glass. Some of the effected components were the standby liquid control pumps and motors, the HCPI pump and turbine, the RCIC pump and turbine and the battery room. Staff Ex. 8, Attachment 2.b, at 5-6. Mr. Higgins agrees that, at least to some extent, this is similar to the finding in Violation 4 of the CAT inspection. Tr. 16,493 (Higgins). In response to the 79-16 finding, LILCO cleaned up the particular discrepancies and also rewrote their QC instruction, which specified that cleanliness checks needed to be made. Given this corrective action, Mr. Higgins would still not expect that the corrective action for 79-16 would ensure cleanness in areas identified in the CAT inspection. Tr. 16,495-96 (Higgins).

QA:245. The third violation in the CAT inspection was a pipe hanger which was found to be displaced from its accepted tolerance. The cause of this was that carpenters had attached scaffolding to the pipe hanger, an act which is prohibited by site requirements. The pipe hanger was within the vendor's design tolerance, but was outside LILCO's design tolerance and thus was cited by the NRC. This item was corrected while the inspection was still ongoing. When the scaffolding was moved, the pipe hanger returned to its proper position. Tr. 13,806-07 (Museler). This occurrence of improper mounting of scaffolding

to a pipe hanger occurred after final FQC inspection. Tr. 13,810 (Museler). This was a valid observation on the part of the NRC inspector. Tr. 13,810 (Museler).

QA:246. Violation No. 3 in the CAT inspection involved the scaffolding being attached to a pipe support. SC Ex. 89B at 4-4. In I&E Inspection Report 82-26, SC Ex. 91, at 4, it is noted that the inspector on September 21, 1982, noted that scaffolding was hung from several pipe supports and restraints. In one case, it was hung from a pipe which was just next to its containment penetration. Tr. 16,518 (Higgins); SC Ex. 91, at 4. This is somewhat different from the situation in the CAT inspection because the pipe supports and restraints which were being used by the scaffolding in Report 82-26 were much more substantial and were not the type that could be moved by the scaffolding. Mr. Higgins was concerned, however, that this was contrary to a licensing memorandum that had been put out to personnel stating that permanent plant components must not be used in any manner to support scaffolding. Thus, the main difference from the CAT inspection was that, in CAT, the support had actually gone beyond its permitted tolerance while, in 82-26, no damage was noted. The fact that scaffolding was being attached to permanent plant components, as noted in Report 82-26, was contrary to the internal LILCO memorandum to its personnel which Mr. Higgins believes should have been

adhered to. Tr. 16,519-20; SC Ex. 91 at 4. Mr. Higgins, after reviewing the situation in 82-26, concluded that the earlier corrective action was not sufficient. Tr. 16,521 (Higgins).

QA:247. Dirt has the potential to cause damage, depending on the kind of component which is affected. The damage which is caused by housekeeping deficiencies is not always easily recognizable. For instance, premature aging is not always easy to detect, even assuming that proper inspections and tests are carried out. To avoid this potential damage, it is important that housekeeping and cleanliness requirements be followed. SC Ex. 89D, at 3.

QA:248. The Licensing Board specifically asked Mr. Hubbard to answer questions regarding why the housekeeping deficiencies discussed by Suffolk County in cross-examination of the LILCO witness panel are significant from a QA/QC point of view. See Tr. 11,969-70. As a result, Mr. Hubbard submitted supplemental direct testimony in response to this Board question. See SC Ex. 89D.

QA:249. Mr. Hubbard believes audit findings relating to litter and debris are significant in the analysis of the adequacy of the implementation of LILCO's QA/QC program. First, there is the potential for damage resulting from litter and debris. Each housekeeping deficiency is not likely to cause significant damage and, indeed, some deficiencies (such as

loose paper) would likely never cause a problem. However, the same measures which need to be implemented to control loose paper also prohibit excess dirt in the storage area. If violated in that regard, the dirt can enter into components and equipment and cause deterioration, some of which may be very difficult to recognize. In this regard, Mr. Hubbard pointed out that premature aging of a component is not always readily observable, even assuming that proper inspections and tests are conducted. SC Ex. 89D, at 2-3.

QA:250. Mr. Hubbard also found that the housekeeping deficiencies were significant because they constitute violation of regulatory provisions. The NRC's regulations, 10 CFR Part 50, Appendix B, create a standard which must be followed. If it is not followed, a violation exists which should be considered significant, because it may indicate a disregard for Appendix B requirements. SC Ex. 89D, at 3.

QA:251. Criterion 2 of Appendix B states:

> Activities affecting quality shall be accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment; suitable environmental conditions for accomplishing the activity, such as adequate cleanness . . . .

Criterion 13 of Appendix B, dealing with storage, echoes these requirements by specifying that a licensee must establish measures for "cleaning and preservation of material and

equipment in accordance with work and inspection instructions to prevent damage or deterioration." SC Ex. 89D, at 4.

QA:252. ANSI N45.2.2-1972 states:

> Cleanliness and good housekeeping practices shall be enforced at all times in the storage areas. The storage areas shall be cleaned as required to avoid the accumulation of trash, discarded packaging materials and other detrimental soil.

ANSI N45.2.2 also provides:

> The use or storage of food, drinks, and salt tablet dispensers in any storage areas shall not be permitted. SC Ex. 89D, at 4.

QA:253. The housekeeping/storage related deficiencies at Shoreham are indicative of management failure to ensure full implementation of the Shoreham QA/QC program. It is recognized that under Appendix B, the degree of QA/QC controls may vary, depending upon the need for such controls. This is emphasized by Criterion 2 of Appendix B. However, the QA/QC program, once established, should also reflect the degree of control which can be achieved with proper implementation. It would make no sense to establish a program which is unfeasible to implement, since it may lead to personnel believing that full and complete implementation of QA/QC measures is not important. Accordingly, an extremely important aspect of a good QA/QC program is the prescription of a set of clear and understandable rules and vigorous enforcement of those rules. Once such a program is established, any deviation must be considered significant since

it reflects a deviation from the defined program. SC Ex. 89D, at 6-7.

QA:254. The LILCO witnesses testified on several occasions that, in their opinion, particular housekeeping/ storage deficiencies were not significant because they had not resulted in damage to otherwise affected systems, structures or components. Mr. Hubbard did not agree with this conclusion. Mr. Hubbard believes these deficiencies are significant chiefly because they reflect a lack of discipline in, and management attention to, the QA/QC program. That program required that storage areas be maintained in a clean manner. The large number of QA/QC deficiencies indicates that this program is not fully implemented. The fact that LILCO QA/QC management (as reflected by the LILCO witnesses) finds repeated litter and housekeeping deficiencies to be acceptable, or at least not a significant concern, represents a lack of attention to the necessary discipline and detail which are essential to a successful program. SC Ex. 89D, at 7-8.

QA:255. The LILCO witnesses agreed that Field Audit 470, Finding 4.1, Field Audit 740, Finding 4.1, Field Audit 1275, Finding 4.1, and Field Audit 1325, Findings 3.2 and 4.1 involved auditors' observations that the requirements of LILCO's housekeeping procedures were not being met. The LILCO witnesses believed that the requirements of LILCO's procedures were being

met, except in the case of Audit Finding 4.1 of Field Audit 470. Tr. 11,947-49 (Museler). Mr. Museler stated that in addition to the first five findings, there are additional similar findings: Field Audit 226, Finding 4.3; Field Audit 444, Finding 4.1; Field Audit 803, Finding 4.4; and FQC Audit 40, Finding 1.3, paragraph A, subpart 5. Mr. Museler would characterize these audit observations as ones where the auditor noted an accumulation of trash or other foreign material in storage areas. Tr. 11,953-54 (Museler).

QA:256. Mr. Museler believes that Field Audit 470, Finding 4.5, where trash and debris were found in contact with equipment in storage, is in a different class of housekeeping finding than the others. The program's objectives are not to keep warehouses clean, but to keep equipment clean. This finding, then, is more important than others since trash or debris has been in contact with equipment and could adversely affect the equipment. Tr. 11,955-56 (Museler).

QA:257. Field Audit 721, Item 4.1, and Field Audit 1086, Item 4.2, are similar observations of instances where trash had accumulated. In one case, trash had accumulated in large bore pipes, and, in another case, in two air filters. These observations address situations where the site procedures had resulted in an unsatisfactory condition, although it did not result in any damage. This is similar to Audit Observation 4.1

of Field Audit 740 where damage did result. So these three Audit Observations, together with Field Audit 470, Finding 4.5, do constitute trash accumulating unsatisfactorily on, or near, equipment. This is a deviation from required procedures. Tr. 11,960-61 (Museler).

QA:258. LILCO identified seven audit findings in the storage/housekeeping area where, in its opinion, damage was sustained: FA 425, Finding 4.4; FA 470, Finding 4.3; FQC 24, Finding D.5; FA 740, Findings 4.1 and 4.2; FA 1086, Finding 4.1; and FQC 20, Finding D.4. See Tr. 13,752-53 (Kelly); LILCO Ex. 31, ff. Tr. 13,234, at 6-7. Mr. Kelly testified that this damage would not have been prevented if the missing caps or covers had been present. Rather, this damage was due to other causes. Tr. 13,752-53 (Kelly). The damage in these cases was caused by things that happened during the construction process, and it is not reasonable to expect that there will not be some such damage. Tr. 13,754 (Museler). The damage was not reported promptly because when a craftsman accidentally damages something, he may be quite reluctant to report it. Tr. 13,755 (Museler).

E. LILCO Storage Surveillances

QA:259. LILCO has storage-related surveillance programs for mechanical, electrical and instrumentation equipment. These programs are described in LILCO's Prefiled QA/QC

Testimony. Tr. 10,840 (Kelly); LILCO Ex. 21, at 175-76. These surveillances are hardware-oriented and constitute a supplement to the regular storage program of inspections and audits. Tr. 10,841-42 (Kelly).

QA:260. Beginning in 1976, LILCO QA management decided to review the major safety-related activities at Shoreham more frequently than just as provided in the audit program. Accordingly, LILCO instituted a formal surveillance program related to welding, mechanical, electrical and instrumentation disciplines. A sample LILCO surveillance report form is Attachment 42 to the LILCO Prefiled Testimony. There were about 725 welding and mechanical surveillances, and over 450 electrical and instrumentation surveillances. As a result, more than 9,000 attributes were verified, with the program identifying about 160 unsatisfactory items. LILCO Ex. 21, at 175-76. Thus, about 1.77 percent of all attributes were found unsatisfactory. Tr. 12,457 (Kelly).

QA:261. The LILCO witness testified that in the storage area, the vast majority of the attributes verified during surveillances has been determined to be acceptable. Tr. 10,844 (Kelly). However, environmental protection is the area in which attributes needing verification occur most frequently. This basically relates to equipment which has polyethylene covers on it or other coverings that would protect it from

construction activities. Tr. 10,846-47 (Kelly). Mr. Kelly testified that the number of unsatisfactory surveillances in that category is small in comparison to the total number of reviews which are done. Such a number of unsatisfactory surveillances is expected given the amount of construction activity at the site. Tr. 10,845-46 (Kelly).

QA:262. In addition to storage of electrical, mechanical and instrumentational items, the LILCO surveillance program also covers electrical cable installation, electrical terminations, welding material control, welding performance, pressure testing, welding procedures and welder qualification. Approximately 9,500 attributes were looked at, with 160 unsatisfactory conditions identified. In the storage area relating to electrical, mechanical and instrumentation items, 2,500 attributes, were looked at. Of the 2,500 storage attributes, 108 unsatisfactory items were found. Fifty-two unsatisfactory items were identified and verified in verifying the other 7,000 attributes. Tr. 13,773-74 (Kelly).

QA:263. Some of the surveillance categories are instrumentation in short term storage, mechanical equipment in short term storage and electrical equipment in short term storage. Tr. 12,458 (Kelly). SC Exhibit 73 is a summation of the surveillance reports concerning instrumentation in short term storage, mechanical equipment in short term storage and

QA:264. In SC Exhibit 73, the environmental protection category relates mostly to whether items were properly covered. Tr. 12,463 (Kelly). For all of the years covered, 1978-82, 6.67 percent of the instances in which the environmental protection category was considered for the instrumentation area, the situation was deemed unsatisfactory. Tr. 12,463 (Kelly); SC Ex. 73, at 1-2. During the time period 1976-82, 7.2 percent of the instances in which the enviromental protection category was considered for mechanical equipment storage, the situation was found to be unsatisfactory. Tr. 12,464 (Kelly); SC Ex. 73, at 4-6. Electrical equipment in short term storage was evaluated during the years 1977-82. The environmental protection category's attributes were found to be unsatisfactory in 14.4 percent of the cases. Tr. 12,464 (Kelly); SC Ex. 73, at. 7-9. Mr. Kelly adds that this does not imply that there is any damage or detriment to the equipment. Tr. 12,464-65 (Kelly). The rate for unsatisfactory surveillances for the environmental protection category was 9.85 percent for all years, for all storage surveillances. Mr. Kelly does not believe that this is significant. Tr. 12,465 (Kelly).

QA:265. In the instrumentational surveillance class, there is a category for openings capped. A similar category

does not appear for the electrical and mechanical inspections. The openings capped category was evaluated for all years of instrumentation in short term storage. In 12.64 to 13.79 percent of the cases in which this attribute was examined, the attribute was deemed unsatisfactory. Tr. 12,465-66; SC Ex. 73, at 3.

QA:266. With respect to all storage surveillances, combining electrical, mechanical and instrumentation, the following results were achieved:

Category	Percentage of Attributes Unsatisfactory
Environmental Protection	9.85
Storage History Card	6.04
Dunnage	15.21
Internal Heaters	11.90
Visible Damage	4.71
Tubing Free From Damage	9.23
Identification	2.99
Openings Cap	12.64
Other	0.50
Total	4.33

SC Ex. 73, at 12-13.

VI. Manuals Not Up-To-Date

QA:267. Activities affecting quality must be prescribed by documented instructions, procedures, or drawings. The documents that are used to construct the plant, or to maintain the plant, and the related procedures, documents and drawings, all should be followed. In addition, documents which affect

the quality of the plant must be reviewed for accuracy. Tr. 11,978 (Museler).

QA:268. LILCO's requirements are that the latest revision of documents be used for work and that the final inspections and procedures developed for the plant must use the latest information. LILCO's program to comply with Appendix B requires utilization of the latest applicable revision, if that latest revision affects or is applicable to safety-related portions of the plant. Tr. 11,997-98 (Museler).

QA:269. The project manual is a specific set of procedures, instructions and memoranda unique to the Shoreham project that are issued and controlled by SWEC project engineering teams. Tr. 11,999-12,000 (Eifert).

QA:270. In I&E Report 79-05, the Staff cited LILCO for violation of Appendix B, Criterion 5, because certain engineering quality assurance procedures had not been updated for more than one year. This failure to update change notices within one year constituted a violation of EAP 5.1, which states in part:

> The Quality Program Division Manager shall annually have effective EQAPs . . . reviewed, corrected, and updated as indicated by the review. Staff Ex. 8, Attachment 1.a.

The LILCO FSAR stated that the Engineering Quality Assurance Program would provide for the control of documents including

quality assurance manuals, procedures and instructions. Staff Ex. 8, Attachment 1.a. The Staff determined that the LILCO program which required the updating of EQAPs was a program which was designed to implement LILCO's compliance with Appendix B, Criterion 5. Tr. 16,434 (Gallo). Thus, LILCO's failure to follow its own internal procedures consituted a violation of Appendix B, Criterion 5. Tr. 16,432 (Gallo).

QA:271. I&E Report 79-05, dated May 4, 1979, involved LILCO's failure to have six quality assurance procedures up-to-date. That constituted a violation of LILCO's internal procedures which required that the quality assurance procedures be updated at least annually. Mr. Higgins said it would be fair to state that LILCO's failure to follow its own internal procedures constituted a violation of Appendix B, Criterion 5. Tr. 16,432 (Higgins); 16,435-36 (Gallo); Staff Ex. 8, Attachment 1.a.

QA:272. In Report 79-05, the licensee failed to update Engineering QA procedures annually as required by his own internal procedures. Staff Ex. 8, at 10-11. The Engineering QA procedures are manual procedures. In this instance, a controlled manual had not been kept up-to-date. The Staff testimony stated that there had been no recurrence of the failure to keep this manual up-to-date. Tr. 16,726-27 (Higgins); Staff Ex. 8, Attachment 1.b. Mr. Higgins agreed that if LILCO's

audit program had identified similar failures to keep EQAP manuals up to date, then such a hypothetical failure would be similar to the one cited. Tr. 16,728 (Higgins).

QA:273. With respect to problems with the Startup Manual, the initial violation (I&E Report 81-13, SC Ex. 94) was written in the summer of 1981. Mr. Higgins went back to follow up on it in early 1982 and saw that LILCO was in the process of correcting matters, but that there was still some correction going on. Accordingly, the violation remained open. Several months later in 1982, Mr. Higgins went back and found that there were still problems with the Startup Manual, and, therefore, a second violation was written and was highlighted to management's attention in the cover letter of the inspection report. At that point, LILCO did implement effective corrective actions to eliminate the problem. Tr. 16,501-02 (Higgins).

QA:274. In I&E Report 81-13, it was determined that Startup Manual number 43, which was located in the control room and used by persons in the control room, was not adequately controlled. That Manual was not updated to include one revision and four instructions. Furthermore, the controlled manual's distribution list incorrectly assigned that copy of the Manual to a different recipient. SC Ex. 94, Appendix A, at 1-2, 4-5. It is I&E's view that if a controlled document is

required to be maintained up-to-date, and if LILCO does not maintain that document up-to-date, this constitutes a failure to comply with Appendix B, Criterion 6. Tr. 16,505-06 (Higgins).

QA:275. In I&E Report 81-13, I&E audited only a single control copy of the Startup Manual. Subsequently, LILCO reviewed other copies of the Startup Manual. It was determined that 42 of 59 manuals that were looked at had deficiencies. These manuals were subsequently updated. It was found, therefore, that the failure to maintain the Startup Manual up-to-date was a widespread problem. SC Ex. 95, item 2.a; Tr. 16,507-08 (Higgins).

QA:276. In I&E Report 82-02, the resident inspector reviewed the status of the Startup Manual. On January 18, 1982, the inspector noted that the control room and OQA copies of the Startup Manual had not been updated to include revision 15, and that records showed that only seven of 44 controlled copies had been updated. SC Ex. 95, item 2A; Tr. 16,509-10 (Higgins). Mr. Higgins would agree that as of January 18, 1982, the prior corrective actions instituted after Report 81-13 had not been completely effective. Tr. 16,510 (Higgins). I&E Report 81-13 is dated October 8, 1981 and refers to a routine safety inspection performed on August 11 through 14, 1981. SC Ex. 94, cover page. The situation which existed in I&E

report 82-02 would have been cited as a violation except that the previous violation from 81-13 was still open. Tr. 16,510-11 (Higgins).

QA:277. In I&E Report 82-08, dated May 27, 1982, concerning an inspection between March 30 and May 10, 1982, the I&E inspector identified a repeat violation in terms of failure to adequately control the Startup Manual. This was a situation where the corrective action instituted by LILCO subsequent to I&E Report 81-13 had not been effective. Tr. 16,512-13 (Higgins); SC Ex. 96, Appendix A and cover. The I&E inspector found that portions of the Startup Manual which was audited were not entirely up-to-date. SC Ex. 96, Appendix A. The Startup Manual problems were closed out in I&E Report 82-23. To Mr. Higgins' knowledge, the problems resulted in no adverse effects on the conduct of the startup program. Tr. 17,305 (Higgins).

QA:278. Mr. Higgins agrees that in EA Audit 19, Item 2.b.1, three of five EA procedure manuals were audited and did not contain all of the current procedures. Tr. 16,729 (Higgins).

QA:279. Mr. Higgins would agree that FQC Audit 14, Finding A.1, is similar to I&E Report 79-05 in the sense that both audits involve an instance where a manual of the QA organization was not kept up-to-date. Tr. 16,738-39 (Higgins).

QA:280. The LILCO witnesses discussed audit observations where manual holders were not keeping their manuals up-to-date. Mr. Eifert believes that these instances have an extremely remote possibility of having any impact on quality. Tr. 13,512 (Eifert). Many of these situations developed when people received revised instructions and put them in their manuals without picking out or marking as void the earlier revision. Tr. 13,513 (Eifert).

QA:281. The LILCO Job Only manual is a unique manual that was developed for pipe stress and support engineering work at the Shoreham plant. The audit observations related to that manual reflect difficulties in getting the manual started and indicate a lack of concern with the adequacy of the pipe stress engineering or support work. Tr. 13,514 (Eifert).

QA:282. One reason that Mr. Eifert was not concerned with manuals not being up-to-date is that the manual itself is not a work check list. There are other means that SWEC uses to assure that people are doing work that they are supposed to be doing. The most important such means is the supervisor himself. Mr. Eifert does not believe that these audit observations related to keeping manuals up-to-date had any effect on the design or integrity of the plant. Tr. 13,518-19 (Eifert).

QA:283. With respect to manuals not being kept up-to-date, Criterion 6 is relevant. LILCO had established appropriate measures for document control. The findings all relate to instances where implementation difficulties had occurred. Mr. Eifert does not believe that there was any violation of Criterion 6. Tr. 13,531 (Eifert).

QA:284. It is agreed that EA Audit 19, Finding 2.B.2; EA Audit 22, Finding 021(2); EA Audit 23, Finding 037; and EA Audit 27, Finding 078 all constitute similar findings relating to failure to maintain an up-to-date manual. Tr. 12,038-39 (Eifert).

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QA/QC AND EQ SUPPLEMENT TO SUFFOLK COUNTY'S PROPOSED OPINION, FINDINGS OF FACT, AND CONCLUSIONS OF LAW IN THE FORM OF A PARTIAL INITIAL DECISION

April 7, 1983

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VOLUME TWO OF TWO

SUMMARY TABLE OF CONTENTS

Page No.

PRELIMINARY STATEMENT 1

OPINION 1

A. SUFFOLK COUNTY CONTENTIONS 12, 14 AND 15: QUALITY ASSURANCE/QUALITY CONTROL DURING THE DESIGN AND CONSTRUCTION OF SHOREHAM 1

B. SUFFOLK COUNTY CONTENTION 13(a): OPERATING QUALITY ASSURANCE 148

C. SUFFOLK COUNTY CONTENTION 8: ENVIRONMENTAL QUALIFICATION 156

FINDINGS OF FACT 180

A. QUALITY ASSURANCE/QUALITY CONTROL 180

B. OPERATING QUALITY ASSURANCE 504

C. ENVIRONMENTAL QUALIFICATION 511

APPENDICES

Volume One

Detailed
Table of Contents

Page No.

PRELIMINARY STATEMENT..... 1

OPINION..... 1

A. SUFFOLK COUNTY CONTENTIONS 12, 14 AND 15: QUALITY ASSURANCE/QUALITY CONTROL DURING THE DESIGN AND CONSTRUCTION OF SHOREHAM..... 1

I. Summary of Opinion..... 1

II. The NRC's Quality Assurance Requirements..... 12

III. Deficiencies in Scope of the LILCO QA/QC Program..... 18

A. The LILCO QA Program Fails to Cover Nonsafety-Related SS&Cs Which Are Important to Safety..... 18

B. LILCO's Audit Program Fails to Comply With 10 CFR Part 50, Appendix B, Criterion 18..... 21

IV. The Evidence Documents a Pattern of LILCO Failures to Comply With the NRC's QA/QC Requirements..... 28

A. Preliminary Considerations..... 28

1. The Definition of a QA/QC Violation or Deficiency..... 28

2. The Need to Link QA/QC Deficiencies to a Safety Defect..... 33

B. The Evidence Documents LILCO's Failure to Implement Its QA/QC Program in Accordance with 10 CFR Part 50, Appendix B.....39

1. LILCO Has Failed to Adhere to Procedural Requirements for Control of Manual and Computerized Calculations..... 40

2. LILCO Has Failed to Control Engineering and Design Change Reports..... 48

3. LILCO Has Failed to Implement Programs For Storage and Housekeeping in Accordance with 10 CFR Part 50, Appendix B..... 59

(a) Storage Deficiencies..... 60

(b) Housekeeping Deficiencies..... 66

4. LILCO has Not Maintained Manuals Up-to-Date..... 71

5. LILCO Has Not Maintained the FSAR Up-to-Date and Accurate..... 73

6. Lilco Has Failed to Comply with Electrical Separation Criteria..... 78

7. The Staff's Readiness Assessment Team Inspection Further Confirms That LILCO's QA/QC Program Has Not Been Properly Implemented..... 82

(a) Introduction..... 82

(b) LILCO's Overreliance on the Final Inspection Program to Identify Construction Discrepancies..... 83

(c) The Violations Identified by the Staff..... 91

(i) Violation A -- Failure to Provide Adequate Verification of Completed Construction in Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports..... 91

Violation A(1) -- Welds on CRD Piping Supports..... 91

Violation A(2) -- Completed Residual Heat Removal System Hangers..... 92

-- Improper Bolt Torque..... 93

-- Bearing Gaps..... 94

Violation A(3) -- Cable Tray Supports..... 96

(ii) Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification Under Operational QA Jurisdiction..... 100

(iii) Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment..... 102

(iv) Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation..... 105

Violation C(1) -- Failure to Control Changes Following Final Inspection Per QC Procedure 15.4..... 105

Violations C(2) and C(3) -- Procedure and Document Control Violations..... 109

V. The NRC Staff Inspection Program..... 110

VI. Torrey Pines..... 118

A. Introduction..... 118

B. Torrey Pines Was Not Independent from LILCO, Nor Did It Operate Under an Acceptable Protocol..... 120

C. The Scope of Torrey Pines' Review Was Not Adequate to Support the Conclusions Reached by Torrey Pines..... 121

D. Torrey Pines' Discrepancy/Finding Process was Deficient..... 132

E. Torrey Pines' Review Demonstrated That Shoreham's QA/QC Inspection Process Is Inadequate..... 137

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate..... 140

G. Statistically Valid Sampling Techniques Were Not Used by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid..... 141

VII. Conclusion..... 147

B. SUFFOLK COUNTY CONTENTION 13(a): OPERATING QUALITY ASSURANCE..... 148

C. SUFFOLK COUNTY CONTENTION 8: ENVIRONMENTAL QUALIFICATION.....156

A. Section 50.49(b)(1) - Safety-Related Equipment..... 159

1. Equipment Included in EQ Program..... 159

2. Staff Review..... 160

B. Section 50.49(b)(2) - Nonsafety-Related Equipment..... 163

1. Staff Guidance and Review..... 163

2. LILCO Position..... 165

C. Section 50.49(b)(3) - Regulatory Guide 1.97 Equipment..... 167

D. Actions Necessary For Compliance with Section 50.49..... 168

E. Conclusion.. 169

FINDINGS OF FACT

A. QUALITY ASSURANCE/QUALITY CONTROL.....180

I. Procedural Matters.....180

II. Overview.....185

III. Calculations.....193

A. Procedural Requirements.....193

B. Audit Results.....199

1. Ready Traceability.....199

2. Other Audit Findings.....204

3. Audit Observation 120.....207

4. Early Project Audits.....211

IV. E&DCRs.....214

A. General.....214

B. E&DCR Control Problems.....219

1. Field Audits.....222

2. SWEC Audits of E&DCRs.....240

3. I&E Reports Concerning E&DCRs.....247

C. E&DCR Verification.....255

V. Storage/Housekeeping.....257

A. General.....257
B. LILCO/SWEC Audit Findings.....265
C. I&E Storage Inspections.....273
D. Housekeeping.....282
E. LILCO Storage Surveillances.....300
VI. Manuals Not Up-To-Date.....304

Volume Two

VII. FSAR Control.....312
A. General.....312
B. SWEC Audit Findings.....314
C. Staff FSAR Concerns.....315
VIII. Electrical Separation.....329
IX. Welding.....337
X. NRC Review and I&E Program.....340
A. General.....340
B. CAT Inspection.....343
C. NRC Design Review.....345
D. Staff Review of LILCO and SWEC Audits.....353
E. Statistics.....358
F. RAT Inspection.....363
1. Introduction.....363
2. LILCO's Overreliance on the QA/QC Final Inspection Program to Identify Construction Deficiencies.....367

3. Violation A -- Failure to Provide Adequate Verification of Completed Construction in the Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports.....376

(a) Violation A(1) -- Welds on CRD Piping Supports.....377

(b) Violation A(2) -- Completed Residual Heat Removal System Hangers.....381

(i) Bolt Torque on Pipe Support E11-PSA-109.....382

(ii) Bearing Gaps between Lugs and Pipe Clamps.....386

(c) Violation A(3) -- Cable Tray Supports.....391

(i) Support RB100B.....393

(ii) Support RB208A.....395

(iii) Support RB131.....396

(iv) Conclusion.....399

4. Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification under Operational QA Jurisdiction.....402

(a) Failure to Perform Weld as Required and Use of Nonqualified Welding Technique.....403

(b) Inadequate High Strength Bolting Installations.....404

(c) Conclusions.....406

5. Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment.....407

6. Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation.....410

(a) Violation C(1) -- Failure to Control Changes Following Following Final Inspection Per QC Procedure 15.4.....410

(b) Violations C(2) and C(3) -- Procedure and Document Control Violations..... 415

7. Unacceptable Plant Housekeeping.....416

G. Important to Safety.....419

H. Number of I&E Violations.....424

XI. Torrey Pines.....427

A. Introduction.....428

B. Torrey Pines Was Not Independent from LILCO, Nor Did It Operate Under an Acceptable Protocol.....431

C. The Scope of Torrey Pines' Review Was Not Adequate To Support the Conclusions Reached by Torrey Pines.....436

D. Torrey Pines' Discrepancy/Finding Process Was Deficient.....456

E. Torrey Pines' Review Demonstrated that Shoreham's QA/QC Inspection Process Is Inadequate.....472

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate.....481

G. Statistically Valid Sampling Techniques Were Not Utilized by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid.....491

XII. Remedy.....502

B. OPERATING QUALITY ASSURANCE.....504

C. ENVIRONMENTAL QUALIFICATION.....511

A. Compliance with Section 50.49(b)(1).....516

1. Identification of Safety-Related Equipment in the Shoreham EQ Program.....516

2. Status of Qualification of Safety-Related Equipment and Staff Review.....520

3. Justifications for Interim Operation and Staff Review.....522

B. Compliance with Section 50.49(b)(2).....524

1. No Criteria or Guidance for Compliance Provided by Staff.....524

2. Future Staff Review Undefined.....526

3. Shoreham Category (b)(2) Equipment.....528

C. Compliance with Section 50.49(b)(3).....530

D. Actions Necessary for a Finding of Compliance With Section 50.49.....530

Appendix 1: SWEC Audit Observations Concerning Calculations Particularly Concerning Compliance with EAP 5.3 "Control of Computerized and Manual Calculations"

Appendix 2: Courter E&DCR Deficiencies

Appendix 3: Storage and Housekeeping, Index to Categories

Appendix 4: Failure to Keep Manuals Up-to-Date

VII. FSAR Control

A. General

QA:285. The FSAR contains LILCO's commitments regarding regulatory requirements and also contains a significant amount of descriptive material in addition to those commitments. As design changes are effected during the construction phase, LILCO has a requirement to keep the FSAR current as to regulatory commitments. LILCO has a program to keep the FSAR current and that program concerns not only physical updating of the overall FSAR, but also includes other mechanisms to assure that the information in the FSAR is made available to the Staff on a timely basis. For instance, there is a question-and-answer process which relates directly to the FSAR. Tr. 12,318-20 (Museler).

QA:286. Both SWEC and LILCO have specific procedures (SWEC procedures are called project procedures) by which changes that are involved in the design process, after submittal of the FSAR, are identified and tracked for inclusion in the FSAR. Tr. 12,323-25 (Eifert, Museler).

QA:287. The decisions as to whether the FSAR needs revision and whether the FSAR has in fact been properly updated are audited during SWEC EA audits of the E&DCR process. Tr. 10,240 (Eifert). The engineering organization of SWEC is responsible

for determining if an FSAR change is required by an E&DCR. This decision is supposed to be made at the time the solution for the E&DCR is provided. Tr. 10,245-46 (Museler, Eifert).

QA:288. Mr. Hubbard considers the FSAR to be part of the design control process. He notes that at pages 96-98 of LILCO's prefiled testimony, there is a description of the control of design changes in reference to the E&DCR form. It is noted in that testimony that the change control mechanisms are designed to ensure that the proposed changes are evaluated for possible impact on the commitments in the FSAR. EAP 6.3 also concerns this same area. Accordingly, LILCO itself has included FSAR changes in their description of the overall design change control process. Tr. 16,049-50 (Hubbard).

QA:289. The FSAR is not the detailed design document from which plant features are actually installed, but it does set forth design criteria and commitments. The FSAR thus acts as an interface with more detailed design documents. The FSAR describes the design commitments which should be reflected in the detailed design documents. The Staff inspects the detailed design documents with the FSAR. Mr. Higgins agrees that it is fair to state that the FSAR is closely tied to control of the design process. Tr. 17,417-19 (Higgins). See also Tr. 17,343-44 (Gallo).

B. SWEC Audit Findings

QA:290. In EA Audit 27, Audit Observation 072, Nos. 1 and 6, there are two instances documented where calculations did not agree with FSAR values. In one instance, the observation indicates that a calculation provided for stresses to be increased by one-third for seismic loading. The FSAR did not permit such an increase. In the other instance, the calculations used a particular earthquake value whereas the FSAR specified that a different earthquake be used for the values. As a result, in the first instance, the calculation was redone to agree with the FSAR. In the second instance, it was determined that the FSAR needed to be amended and such an amendment was initiated. Tr. 10,583-85 (Eifert); SC Ex. 51, EA 27, Observation 072. The subsequent rework of the calculations was to identify that the proper allowable stress had been, in fact, used. Thus, the rework was an administrative change to make sure that there was no misunderstanding with respect to the loading mechanism which was used in the analysis. Tr. 13,402 (Eifert). With respect to the item where the FSAR was changed, it was not a technical change. It was more like a clarification. Tr. 13,404 (Eifert).

QA:291. In EA Audit 40, at 2, it is noted that loading combinations listed in the FSAR had not been updated to reflect those used in the calculations. Item 3 of Audit Observation

154 of EA Audit 40 revealed that the FSAR had not been revised to reflect loading combinations used in the calculations. SC Ex. 51, EA Audit 40.

QA:292. In EA Audit 33, Observation 114, the auditor was concerned that E&DCRs had not been checked off to indicate that a change in the FSAR was required when, in fact, the E&DCR did have an effect on the FSAR. This was noted on the first page of the audit, indicating that this was one of the more significant items in the audit report. This situation was not in compliance with the requirements of SWEC procedures and, as a result, SWEC took action to ensure that such E&DCR items were tracked. Tr. 12,330-33 (Eifert).

C. Staff FSAR Concerns

QA:293. Prior to November, 1981, there had been a number of findings and inspection reports that identified discrepancies between the as-built plant and the FSAR design descriptions. There are two reasons why the Staff was concerned about this. First, in the Staff's review of the adequacy of the design, the Staff was concerned that they might not be reviewing the plant that was actually being built. Second, during future operations, it is important that the Staff have a reliable document that represents the as-built plant. This is particularly useful in emergency situations. Tr. 16,982-83 (Higgins). The Staff believes that the FSAR, at

least to the extent of the detail that goes into it, should be an accurate description of the design. Tr. 16,984 (Gallo). The Staff was not able to clearly identify one particular cause for the FSAR discrepancy difficulties. Most of the discrepancies that the Staff identified were fairly fine, detailed types of problems. Some were larger, however, and accordingly the Staff believed that a full review was needed to make sure that all of the fine detailed discrepancies were identified and corrected in the FSAR. Tr. 16,986-87 (Higgins).

QA:294. The Shoreham Plant Configuration Review Program ("SPCR") was instituted in response to a request by the Staff. This was not a mild request. Region I would not have been able to recommend a license if LILCO had not done something to update the FSAR and make it accurate. Tr. 17,062 (Gallo, Higgins).

QA:295. The NRC witnesses confirm that the reason they wanted the FSAR updated was to ensure that NRR in fact reviewed the as-built plant. Considerations for the future were prompted by the TMI accident, which showed the need for an up-to-date FSAR for NRC Staff use in the event of an emergency. Tr. 17,130-31 (Gallo).

QA:296. The deviations cited by the NRC Staff from FSAR commitment in the I&E inspection were not significant enough to affect the NRR review of the plant and its design basis or the implementation of that design basis. Tr. 17,135 (Higgins).

QA:297. The Staff made a strong request of LILCO to carry out activities to bring the FSAR up to an adequate level of accuracy. What LILCO had been doing prior to that time was not adequate in the Staff's opinion. Tr. 17,373 (Higgins). The primary purpose of the SPCR program was to make the FSAR accurate, not to confirm the implementations of the design, although there is some overlap. Tr. 17,373-74 (Higgins).

QA:298. Mr. Higgins has performed some walkdowns of systems. These walkdowns were similar to the CAT walkdown, but were not as detailed. In general, he found that the systems were constructed in accordance with the detailed design documents. He also found that the necessary detail in the FSAR was not completely achieved. Tr. 17,383-84 (Higgins). The walkdowns conducted by Mr. Higgins resulted in his discovering many minor differences between details in the FSAR and the as-built plant. There were about five to ten differences per system. This would be a fairly small percentage of the details of all systems contained in the FSAR. Tr. 17,478-79 (Higgins).

QA:299. The NRC Staff intends to review the results of the SPCR Program. This review will include discussions with LILCO personnel, review of the systems that are included in the program, review of the type of procedures and QA review that the program is receiving, review of the configuration discrepancy reports and review of the resolutions. There also will be

a final review of the actual physical comparison between the system that has gone through the program and the actual as-built plant. This final review will involve another walkdown. These steps by the Staff have not taken place, but are expected to take place before fuel load. Tr. 17,416-17 (Higgins).

QA:300. Mr. Higgins does not agree that there are numerous descriptive details in the FSAR which do not constitute legally binding commitments on LILCO. Tr. 17,496 (Higgins).

QA:301. When LILCO speaks of a FSAR commitment, the reference is to some feature of the plant, or of its operation, which must meet a specific regulatory requirement or design basis. LILCO believes there are three levels of detail in the FSAR: commitments; significant details which do not constitute a commitment but which are of sufficient importance that if any changes are made in those details, the NRC Staff should be informed of those changes on a fairly rapid basis; and descriptive detail, which may be useful in the Staff review of the FSAR. Tr. 13,293-95, 13,296 (Museler).

QA:302. The SPCR Program is being used by LILCO to bring the descriptive detail in the FSAR to the level of accuracy which the NRC requests. Tr. 13,302-03 (Museler).

QA:303. The LILCO witnesses disagree with the statement in Appendix B of the 1982 CAT inspection that the findings of deviations in that I&E Report constitute violations of FSAR commitments. Tr. 13,308 (Museler). The SPCR Program was not undertaken at the specific request of the NRC Staff. However, the Staff strongly urged LILCO to review and update the FSAR for the types of concerns that were later identified in the CAT inspection, Appendix B. Tr. 13,313-14 (Museler). Indeed, in meetings during the previous two years, the Staff had indicated that LILCO should be doing more to incorporate details, such as those in Appendix B to the CAT inspection, into the FSAR. The Staff didn't indicate exactly what should be done to accomplish this task, but expressed the concern to LILCO management. As a result, LILCO management decided to embark on the SPCR Program to satisfy the NRC Staff concerns and to ensure that, if future changes were made in the FSAR requirements related to updating, LILCO would be in a good position to comply immediately with those regulations. Tr. 12,365-66 (Museler).

QA:304. The SPCR Program involves walkdowns of safety-related systems, as well as portions of nonsafety-related systems which have safety-related components in them. Tr. 13,688-89 (Museler).

QA:305. LILCO Exhibit 29 constitutes a summary of the types of problems which have been identified in the SPCR

Program. Tr. 13,690 (Museler). All of the findings contained in the SPCR reports which are contained in Suffolk County Exhibit 71, fall into LILCO's third category of FSAR problems; that category consists of deficiencies in descriptive detail. Tr. 13,690-91 (Museler). There have not been any changes in hardware in the plant as a result of these findings. Mr. Museler also believes that there will be no hardware changes as a result of these findings. Tr. 13,691 (Museler). In addition, Mr. Museler does not believe that any of the SPCR observations affect or degrade the safety of the plant or the capabilities of the plant as described in the Shoreham FSAR. In the opinion of Mr. Museler, the observations also do not affect the Staff's safety review. Tr. 13,691-92 (Museler).

QA:306. In its review of the Shoreham application, the NRC Staff uses the FSAR as a measure of LILCO's commitments and to obtain certain important descriptive information. The Staff also uses LILCO's other detailed design documents, particularly for the electrical area. Tr. 13,728 (Museler).

QA:307. LILCO decided to perform the SPCR in the latter half of 1981. Tr. 12,358 (Museler).

QA:308. Attachment 28 to the LILCO Prefiled Testimony, Project Procedure P-309, entitled "Plant Configuration Review," guides the implementation of the SPCR Program. Tr. 12,366-67 (Museler).

QA:309. Suffolk County Exhibit 71 is entitled "Shoreham Plant Configuration Reports," and contains seven reports, one for each of the following systems: reactor water recirculation, control rod drive hydraulic control, standby liquid control, core spray system, MSIV leakage control system, high pressure coolant injection and reactor core isolation cooling. See SC Exhibit 71. The overall purpose of the SPCR is to determine whether FSAR commitments for any system description which might bear on the conclusions of safety analysis are accurate. The purpose also is to identify any differences between the as-built plant and the informational detail in the FSAR. Tr. 12,374-75 (Museler).

QA:310. Tab 1 of Suffolk County Exhibit 71, concerning the reactor water recirculation system, indicates that the reviewers identified nine potential discrepancies between the as-built plant and the FSAR. Tr. 12,374 (Museler). Tab 1 states that the results of this review indicate that conformance "does not exist until engineering resolution is provided." SC Ex. 71, Tab 1, at 1. Mr. Museler confirms that the results of the review for the reactor water recirculation system indicate that conformance between the as-built plant and the FSAR did not exist until engineering resolution was provided. Tr. 12,375 (Museler).

QA:311. Tab 2 of Suffolk County Exhibit 71 is the Plant Configuration Report for the control rod drive hydraulic control system. The report indicates that the reviewers identified 13 potential discrepancies between the as-built plant and the FSAR. The report concluded that conformance between the as-built plant and that the FSAR did not exist until engineering resolution was provided. Tr. 12,375-76 (Museler); SC Ex. 71, Tab 2.

QA:312. Tabs 3-7 of Suffolk County Exhibit 71 are the Plant Configuration Reports for the standby liquid control system, the core spray system, the MSIV leakage control system, the high pressure coolant injection system and the reactor core isolation cooling system. All of these reports indicate that conformance did not exist between the as-built plant and the FSAR until engineering resolution was provided. Mr. Museler does not believe that any of these constitute deviations from an FSAR commitment, but they do contain a number of observations indicating that the as-built plant differs from some of the detailed information contained in the FSAR. Tr. 12,377-78 (Museler); SC Ex. 71, Tabs 3-7.

QA:313. Suffolk County Exhibit 71 indicates that with respect to the standby liquid control system, nine configuration discrepancy reports were issued. The MSIV leakage control system had eight discrepancy reports. The HPCI system had nine

discrepancy reports. The reactor core isolation cooling system had 12 discrepancy reports. Tr. 12,379 (Museler).

QA:314. As of February, 1982, the RHR system which was the focus of the CAT inspection was "construction complete." It had been turned over to the LILCO startup organization, but there was a punchlist of items yet to be completed. It was in the checkout and the initial operation ("C&IO") phase but it had not completed its preoperational tests. Tr. 12,360 (Museler). In selecting the RHR system for inspection in the CAT inspection, the Staff wanted to pick an important safety system, one that was essentially done in terms of construction, so that a meaningful inspection of the as-built configuration could be performed. That was the meaning of "completed" in the CAT inspection. Tr. 16,989 (Higgins).

QA:315. In Mr. Museler's opinion, the Notice of Deviation items in the CAT inspection are similar to the discrepancies in descriptive detail which Mr. Museler had described previously in the SPCR reports. Tr. 13,819 (Museler).

QA:316. The Staff feels that all informational detail in the FSAR should be complete and correct. Any deviation between the as-built plant and the FSAR which is identified and which is not already included in a scheduled change to the FSAR would be considered by the Staff to be a deviation from an FSAR commitment. Tr. 16,990-91 (Higgins).

QA:317. In the CAT inspection, the second deviation noted in Appendix B concerned drywell spray nozzles that are permanently blocked by ventilation duct work. It is noted in the inspection report that this reduces the effectiveness of the containment spray system. SC Ex. 89B, at 4-6. Mr. Hubbard is interested in whether this interference had been looked at as part of the design review process. Tr. 15,560-61 (Hubbard). The ventilation duct work ran up the side of the drywell very close to the drywell spray header and thereby passed in front of it. Thus, the spray coming out of the nozzles would spray the duct work, thereby preventing the nozzles from performing their spray and condensation functions in the manner for which they were intended. The spray would come out but it would immediately hit the duct work. The spray effect, for which the nozzles had been designed, could not be achieved by the nozzles in front of the duct work. Tr. 17,021-22 (Higgins). This was considered one of the more significant discrepancies which were identified in Appendix B of the CAT inspection. Tr. 17,022 (Higgins). Subsequently, this discrepancy was resolved by analysis. Tr. 17,022 (Higgins). Mr. Higgins does not believe that the blockage by duct work which was identified in CAT had been analyzed in the design documents of LILCO prior to the CAT team's identification of the problem. Tr. 17,023 (Higgins). The drywell spray nozzles are safety-related. To the best of

Mr. Higgins' knowledge, LILCO QA reviews had not identified this problem prior to the CAT inspection. Mr. Higgins feels that someone in the LILCO organization should have identified it. Tr. 17,023-24 (Higgins). Even if the ventilation systems were not safety-related, they affected the performance of a safety-related system. Tr. 17,025 (Higgins). With respect to the drywell spray blockage matter, it appears that LILCO had not even identified the situation before the CAT inspection. Tr. 17,057 (Higgins).

QA:318. The Teledyne core spray analysis was performed as a result of the request made by the NRC Staff at a March 15, 1982 meeting with LILCO. The Staff did not, however, require the study to be performed. Tr. 17,049-50 (Gallo).

QA:319. The NRR resolution of the drywell spray problem was that it was not a safety concern because the drywell spray did not need to be considered a safety-related system. Tr. 17,355-57 (Higgins). In Staff Exhibit 10, the Staff resolution states:

> The inspection team noted that some (approximately 5%) drywell spray nozzles were physically blocked by installed ventilation duct work. However, the drywell sprays in the Shoreham design were not considered in the Staff's review of mitigation systems for LOCAs or any design events. Therefore, the 5 percent reduction presents no safety concerns for the Shoreham plant. Staff Ex. 10, ff. Tr. 17,358, at 2.

Apparently, the Staff resolution is that even though the drywell spray nozzles may be classified as safety-related, they do not perform a safety-related function. Mr. Higgins would, however, consider these to fall into the category of important to safety. Tr. 17,361-62 (Higgins). The Staff resolution makes no reference to any concern about possible QA/QC problems resulting from the apparent failure of LILCO QA to have previously identified this matter.

QA:320. At the time of the CAT inspection, the drywell spray nozzle and the HVAC system were fully installed, at least in that area of the facility. Tr. 17,429 (Higgins). Mr. Higgins would agree that the drywell spray matter indicates some problem with interference with the two systems. The design process should deal with such interferences, or interfaces. To the best of Mr. Higgins' knowledge, however, this problem had not been noted in the design process, the installation process or LILCO inspection process. Tr. 17,433-34 (Higgins). The drywell spray nozzles were allegedly designed, installed and inspected to full Appendix B requirements. It is only subsequent to such inspection, that Mr. Higgins has determined, through NRR review, that Appendix B perhaps would not have to be applied. Tr. 17,436-37 (Higgins).

QA:321. In Appendix B to the CAT inspection, the Staff identified eight deviations from the Shoreham FSAR, some of

which had multiple parts. The Staff further noted that similar discrepancies had been noted previously. SC Ex. 89B, at 4-1, 4-6, 4-7.

QA:322. In Appendix B, "Notice of Deviation," to the NRC's CAT inspection, the NRC Staff stated that "it appears that several of your [LILCO's] activities were not conducted in accordance with the Final Safety Analysis Report (FSAR) commitments." See SC Ex. 89B, at 4-6. Mr. Museler stated that all deviations noted in that CAT portion were deviations from the informational detail in the FSAR. They were not deviations from any FSAR commitments. Thus, LILCO disagreed that what the NRC Staff noted was a deviation from any FSAR commitment. Tr. 12,336 (Museler).

QA:323. Suffolk County Exhibit 70, a July 28, 1982 letter from Mr. Pollock of LILCO to Mr. Thomas Martin, the NRC Staff Region I, (SNRC-743), constitutes LILCO's written response to the CAT inspection. Tr. 12,337 (Museler); see SC Ex. 70.

QA:324. The first finding of Appendix B to the CAT inspection concerns the fact that a standard cabinet was installed with a certain kind of bolt while the FSAR required a different installation. SC Ex. 89B, at 4-6. Mr. Museler believes that this was a difference only regarding informational detail, not a violation of a FSAR commitment. Mr. Museler he would term the FSAR commitment to be that the

cabinets are installed for seismic conditions. In fact, however, the as-built plant differed from the descriptive information from the FSAR. He does not believe that these details constituted an FSAR commitment. Tr. 12,339-42 (Museler).

QA:325. With respect to the Appendix B Notice of Deviation in the CAT Inspection, Mr. Museler confirmed that a number of other items set forth in Appendix B also reflected differences between the as-built plant and the FSAR. Tr. 12,343-48 (Museler).

QA:326. In Item 5 of Appendix B, Notice of Deviation to the CAT Inspection, the NRC identified that the trip set points for drywell pressure and LPCI low pressure were contrary to those specified in the FSAR. SC Ex. 89B, at 4-6. Mr. Museler agreed that this is an instance where the FSAR differed from the as-built condition. Tr. 12,345 (Museler).

QA:327. Mr. Museler agrees that five of the six conditions noted, in the Notice of Deviation from the CAT inspection, are contrary to two RHR piping and instrument drawings in the FSAR. Tr. 12,345-48 (Museler). However, two of the five conditions, the four relief valves not going to controlled radwaste and the relief valve that was not a thermal relief valve, were termed semantic differences between the NRC and LILCO. Tr. 12,345-46 (Museler).

QA:328. In Item 7 of the Notice of Deviation from the CAT inspection, there are two conditions that the NRC feels are contrary to the FSAR. Mr. Museler agreed that there is a difference between the as-built construction and the FSAR concerning the safety relief valve on a steam supply. Mr. Museler said there is a typographical error in the FSAR. It should say HPCI steam supply, rather than RCIC steam supply. The other condition was termed a semantic difference. Mr. Museler says this was simply a matter of interpreting the words that describe where a safety relief valve is located. Tr. 12,356-57 (Museler).

QA:329. In the case of Item 8, the NRC noted that there are additional valves located in the containment that are not described in the FSAR. Mr. Museler said that the FSAR at page 7.3-25 was meant to indicate the functional parts of the RHR system. LILCO is going to clarify the text so that it more clearly states their understanding. 12,357-58 (Museler).

VIII. Electrical Separation

QA:330. Separation difficulties at Shoreham dated back to 1978, according to the CAT inspection. SC Ex. 89B, at 4-22.

QA:331. In Appendix C to the CAT inspection, the NRC inspectors observed that an E&DCR had established requirements for separation of Class 1E and non-Class 1E electrical cables in transmit between raceways. The inspectors identified four

examples that did not comply with the requirements of the E&DCR. SC Ex. 89B, at 4-8. These constituted apparent violations of the LILCO separation criteria between non-Class 1E cable and Class 1E cable. The inspector noted that the separation in cables from tray to conduit was not addressed specifically in the FSAR nor in the specification. The inspector noted that the required one-inch horizontal and one-foot vertical separation criteria were not being maintained. SC Ex. 89B, at 4-21.

QA:332. In CAT, the E&DCR had become part of the specification. Cable installations described by that specification were required to comply with the specification as it had been supplemented by the E&DCR. The Staff identified four instances in the CAT inspection where there was lack of compliance with the separation criteria specified in that E&DCR. Tr. 16,572-73 (Higgins). The Staff did not cite this as a violation because LILCO maintained that additional work remained to be done to ensure that the cables met all separation requirements. This was a situation where the Staff felt that the work was being done in the wrong time frame and constituted a weakness, especially in light of past problems. Separation area concerns should have been better defined by that point in time. Tr. 16,573-74 (Higgins). These items had not yet received their final QA/QC inspections. LILCO felt that separation area

problems were part of an area of ongoing construction. Thus, the Staff did not write it up as a violation, but did feel that it merited additional attention. Tr. 16,575 (Higgins). Mr. Higgins agreed, however, that there were several violations of the LILCO separation criteria. Tr. 16,576-77 (Higgins). Mr. Higgins also agreed that there were nonconforming installations. All of these nonconforming installations had not been identified by LILCO prior to the CAT irspection. The Staff, however, does not generally cite items as violations until the completion of the installation and the final QA/QC inspection has taken place. Tr. 16,578-79 (Higgins).

QA:333. Mr. Narrow would agree that normally, when a licensee is installing nonconforming cables, they ought to be tagged or noted in some way at the time of the installation. In this case, however, LILCO was implementing a program which was going to examine all of that cable by means of a special 100 percent inspection. Tr. 16,581 (Narrow).

QA:334. With respect to the electrical separation matter, Mr. Higgins agreed that it was not clear to which criteria QA was supposed to inspect cables and raceways. Tr. 16,589 (Higgins). Mr. Higgins could not answer how this situation complied with Criterion 5 of Appendix B relating to the requirement that activities affecting quality shall be prescribed by documented instructions, procedures or drawings. Tr. 16,590

(Higgins). It appears to the NRC Staff that the final engineering criteria and design criteria for electrical separation were not even resolved until April 1, 1982. Tr. 16,592 (Gallo).

QA:335. During the electrical separation discussion regarding CAT, Judge Carpenter observed that it was difficult for him to see why this is not an absolute violation of Appendix B. Tr. 16,601 (Carpenter).

QA:336. Referring to the electrical separation matters in the CAT inspection, Mr. Higgins agreed that if the specification was not complied with and the installation was not in compliance with the specification, an Appendix B violation would occur. Tr. 16,607 (Higgins). Mr. Gallo would agree that it is a violation, so long as the specification was one that affected quality. Tr. 16,609 (Gallo).

QA:337. In I&E Report 77-05, dated April 7, 1977, SC Ex. 105, Appendix A and page a, LILCO was cited for a violation in an instance where field routed safety-related cable did not meet the separation criteria of the specification. One of the concerns of I&E was that corrective actions instituted by LILCO did not preclude repetition of installation of cables which violated the separation criteria. During the inspection, I&E identified safety-related cable installations which did not meet that criteria. Tr. 16,713-4 (Narrow, Higgins).

QA:338. In I&E Inspection Report 77-05, it is reported that SWEC had issued a deficiency correction order in November, 1976 to correct instances where field-routed, safety-related cable was installed within switch gear enclosures but which did not meet separation criteria of the specification. The corrective action specified and taken by SWEC personnel did not include actions to preclude repetition of the nonconformance. As a result, on March 2, 1977, the inspector identified safety-related cable installations in switchgear enclosures which did not meet specified separation criteria. These nonconformances were repetitions of those previously identified by SWEC in November, 1976. SC Ex. 105, Appendix A. This violation was noted against Criterion 16. Tr. 16,720 (Higgins, Narrow). LILCO had argued that the installation was not fully complete and had not been inspected by FQC. However, in-process inspection had taken place and therefore should have prevented the nonconformance from occurring. Tr. 16,721 (Narrow).

QA:339. Mr. Gallo would agree that under Appendix B, the installers are expected to follow instructions of construction specification. QA/QC is there as a means of verification. Tr. 16,725 (Gallo).

QA:340. The violation in I&E Report 79-07 may be described as follows:

> Contrary to Criterion 16, 10 CFR 50 Appendix B, as of May 25, 1979 S&W specification SH1-159 and associated change EDCR-F19039 permit installation of raceway which do not conform to the minimum separation criteria, and permit subsequent installation of cables in the nonconforming raceways. Documentation of each nonconformance is provided by Specification SH1-159, and future disposition of the condition is controlled by the E&DCR control system. However, corrective action to prevent repetition has not been taken and additional nonconforming installations are being made. SC Ex. 89B, at 5-57.

QA:341. Mr. Higgins testified that the electrical separation problems reflected in I&E Report 79-07 constituted a design control problem because there were continuing problems throughout the several years that Mr. Narrow and Mr. Higgins have been involved with the project. The Staff witnesses did not include I&E Report 77-05 as another design control problem in the electrical separation area discussed in their prefiled testimony. See Staff Ex. 8, at 24-25. During cross-examination, they testified that I&E Report 77-05 is closely tied between design control and QA/QC corrective actions and that there are elements of both in the report. Tr. 16,928-29 (Higgins). There were QA aspects in the sense that quality control corrective actions should have precluded the nonconforming installations. There were also design aspects because they should have provided proper instructions so that safety- and nonsafety-related cables were installed in the proper way. Tr. 16,930 (Higgins).

QA:342. In I&E Report 80-10, dated August 12, 1980, the inspector observed that redundant safety-related conduit was installed which did not meet the separation criteria of the specification. Also, the nonconformance had not been previously documented or tagged. Tr. 16,933-34; SC Ex. 108, Appendix A, Violation B. This constituted an installation in a nonconforming manner. Tr. 16,934 (Narrow). This constitutes another of the electrical separation problems. Tr. 16,935 (Higgins).

QA:343. The Staff witnesses testified that, in their opinion, the QA/QC problems in the electrical separation area ended with I&E Inspection Report 82-24, SC Ex. 109, which closed out certain other violations which had been previously discussed. Tr. 16,936-37 (Higgins). However, in I&E Inspection Report 82-24 the inspectors identified a nonconformance with the electrical separation requirements. There were two examples where wrapped cable did not meet the one-inch minimum separation distance from cable tray. This was not written up as a violation because LILCO was able to produce evidence that the cables had been acceptable when installed, but that subsequent activities had knocked them out of alignment. Further, since this was part of the overall electrical separation area, I&E did not write it as a violation because it had to do with the overall final program that was still taking place. Additional steps were to be taken in the electrical separation

area. Tr. 16,966-67 (Higgins). Mr. Higgins did not consider this to be a serious matter. Tr. 16,968 (Higgins). This item's movement out of position to a new position, after the QC inspection had taken place, did cause some concern. The movement violated separation criteria. Tr. 16,968 (Higgins). Mr. Higgins informed LILCO representatives that he did not believe LILCO could maintain the one-inch separation criterion which had been specified. Maintenace of the one-inch separation criterion is part of the concern in I&E Report 82-24. Tr. 16,973 (Higgins).

QA:344. Mr. Gallo testified that the electrical separation problem is one which I&E finds at essentially all construction sites, but that Shoreham seems to have a greater problem than the average site. Tr. 16,969-70 (Gallo).

QA:345. Mr. Narrow testified that, in his opinion, the type and number of violations in the electrical separation area is probably fairly normal for a plant of Shoreham's type. Tr. 17,161 (Narrow). Mr. Higgins believes that the problems in electrical separation area are more in the technical area than in the QA/QC area. Tr. 17,162 (Higgins).

QA:346. At the time of the CAT inspection, the QA procedures and inspection criteria that the inspectors were to utilize were not yet developed because of changing final QC criteria. LILCO was aware of the need for more definition of

these criteria but had not yet established them. Tr. 17,238-39 (Higgins).

IX. Welding

QA:347. Mr. Hubbard was not satisfied with the LILCO explanation that as the number of welders on the job increased, the number of nonconformances followed. If a good QA program had been implemented, the increase in work would have been anticipated and necessary training and QA imposed so that the rate of nonconformances should have declined as work increased. Tr. 16,112 (Hubbard).

QA:348. As of May, 1982, the Staff had inspected welding during 38 inspections and two investigations. Sixteen violations were reported. Violations were reported in 15 of the inspections or investigations. Thus, over 35 percent of the instances in which I&E considered welding, a violation was reported. Tr. 16,864-65 (Narrow); Staff Ex. 8, at 19-21. During those 38 inspections and two investigations, the Staff looked at a large number of welds. Tr. 16,866 (Narrow). In most inspections, three to 15 welds would be inspected, which involved looking at a number of attributes, such as cleanliness, weld preparation, weld cleanup, operation of welding equipment, nondestructive examination and visual inspection in-process welding. Thus, ten or 12 various operations might be considered. Tr. 16,868 (Narrow).

QA:349. The number of welding inspections at Shoreham per year are as follows: 1974, 3; 1975, 5; 1976, 6; 1977, 8 or 9; 1978, 10 or 8; 1979, 5 or 6; 1980, 2; 1981, no inspections. Welding also would be evaluated during nonspecific inspections such as an inspector's tour of the facility. Tr. 16,869-70 (Narrow).

QA:350. There was an increase in the number of welding violations in early 1978 that continued into July of 1979. In July, 1979, I&E asked LILCO to review its welding activities. Tr. 16,872 (Narrow).

QA:351. Mr. Narrow and the other Staff witnesses were asked by Judge Carpenter whether any of the 16 I&E violations in the welding area would have been considered to produce an unacceptable weld, if the violation had not been discovered. Mr. Gallo testified that there were four particular items that the Staff would have questioned. First, Inspection Report 76-11 dealt with an undersized structural steel weld. The Staff could not determine whether it was likely that any future inspection of LILCO's program would have identified this problem. From the information available to the I&E witnesses, they could not tell whether this weld would have led to a nonacceptable situation. Second, Inspection Report 77-17 involved a problem with the nonconforming contour of a transition at a field weld. As a result of this observation, all welds

were inspected by LILCO and 82 of 408 welds were found to be unacceptable. Mr. Gallo cannot identify any inspection that would have identified this particular problem. The problem might have been exposed by a final walkdown or the preservice inspection. An item from Inspection Report 78-15 involved skewed angle joints. The I&E witnesses did not appear to think it was likely that this would have been identified in some further inspection, but that is difficult to tell. Finally, in I&E Inspection Report 78-16, there were welding defects identified in the reactor building polar crane. The polar crane had what Mr. Gallo would call rejectable defects. Mr. Gallo could identify nothing in the licensee program which would have identified this type of defect. Tr. 16,939-48 (Gallo, Narrow, Higgins).

QA:352. The Staff witnesses testified in their prefiled testimony that no unacceptable welds exist at Shoreham. Staff Ex. 8, at 24. After cross-examination, it appeared clear that the thrust of the Staff testimony in this regard is their belief that, based upon NRC inspections and the LILCO program of inspections, it is improbable that an unacceptable weld will escape detection. Tr. 16,951 (Gallo). However, as discussed in the context of the RAT inspection findings, we do not share this confidence in the LILCO inspection process, particularly since in the RAT inspection, the Staff, with its limited

resources, identified several unacceptable welds that had been overlooked by FQC final inspection. (See Findings QA:454-62, 517-18, 522-23).

QA:353. I&E Inspection Report 79-12 is the report that closes out the welding violation reported in 78-15. It is reported that several welds had to be removed and repaired according to new procedures. Tr. 16,952-53 (Gallo).

QA:354. With respect to the polar crane problems reported in Report 78-16, after the inspection report was issued, LILCO inspected additional welds in the polar crane area and found ten percent of those that they considered had rejectable defects. Tr. 16,953 (Gallo).

QA:355. The Staff testimony concerning welding matters was limited only to safety-related items. Tr. 16,954 (Gallo).

QA:356. As work on the project increased, Mr. Hubbard would have expected defects, on a per person basis, to go down as the number of welders increased. The rate of problems would be expected to decrease as new welders were trained by experienced welders. Tr. 16,142 (Hubbard).

X. NRC Review and I&E Program

A. General

QA:357. The Staff's SER for Shoreham is devoid of any analysis or conclusions concerning whether LILCO has complied with the QA requirements of 10 CFR Part 50, Appendix B, GDC 1

or the PSAR commitments during design and construction. Accordingly, there has been no NRR review of Shoreham's implementation of the foregoing commitments. Rather, the Shoreham SER only addresses LILCO's compliance with the proposed operating QA program. SC Ex. 89A, at 12.

QA:358. Mr. Hubbard testified that in the SER, the NRC did not review the implementation of the LILCO design and construction program. I&E has looked at selected aspects, but no one has done a complete comprehensive review to see what the QA program has effectively implemented in accordance with PSAR requirements. Tr. 15,446 (Hubbard). Mr. Hubbard agreed that the SALP program does constitute a kind of overall review of what I&E has been doing over the course of time. Mr. Hubbard, however, has serious concerns about the adequacy of the SALP review. SALP documents what I&E has looked at during the past year. However, SALP does not have anything like baseline criteria with which one plant can be compared to another. Thus, the SALP review is fairly subjective. Tr. 15,449 (Hubbard). Furthermore, the SALP review only looks at one aspect of site activities. The SALP does not address much of the work of the architect/engineer or GE. Tr. 15,450 (Hubbard).

QA:359. In Mr. Hubbard's opinion, the NRC I&E program does provide some information on where potential problem areas may appear. However, the I&E program does not provide

sufficient information to allow for a conclusion that a QA/QC program has, in fact, been effectively implemented. Tr. 15,969 (Hubbard).

QA:360. The Staff witnesses concluded that NRC inspections at Shoreham during the 1973-82 period showed no pattern of QA/QC breakdowns. Staff Ex. 8, at 4-5. This conclusion is based upon the entire I&E effort, not just the Appendix A portion relating to violations. Tr. 16,314 (Higgins). In addition, this conclusion is based on other reviews done by the Region I office. Those reviews include the SALP report, as well as the input of the project manager from NRR. Tr. 16,315 (Gallo).

QA:361. There have been two SALP reports prepared for Shoreham, 1981 and 1982. Prior to 1981, there was no formalized SALP process. Tr. 16,315-16 (Gallo).

QA:362. The SALP report for a particular year takes into account the inspection reports and the information in those reports for the previous 12 months. It also takes into account the subjective judgments by inspectors and supervisors, as well as the reports from the licensees, such as construction deficiency reports. Tr. 16,316-17 (Gallo).

QA:363. The primary areas of concern identified in the I&E inspections of Shoreham as requiring management attention have been storage, welding and design control. Staff Ex. 8, at 12.

B. CAT Inspection

QA:364. The purpose of the NRC Staff's CAT inspection in February, 1982 was to compare the completed construction and physical installation at Shoreham with regulatory commitments and engineering and design documents. The CAT inspection did not attempt to systematically verify that the design documents were consistent with the design criteria. The CAT inspection involved approximately 373 hours onsite and 73 hours in the office by three region-based inspectors. SC Ex. 89A, at 17-18; SC Ex. 89B, at 4-13. The CAT inspection involved physical inspection of the residual heat removal system. The inspection compared the as-built installation flow diagrams, logic diagrams, construction diagrams and other design and engineering information against the plant's as-built condition. SC Ex. 89A, at 18.

QA:365. In the CAT inspection, the NRC Staff identified a large number of items which it highlighted in the inspection report. These items included violations of Appendix B criteria, deviations from FSAR commitments, observations regarding weaknesses and other observations about nonconformances and discrepancies which were observed by the CAT inspectors. Mr. Hubbard testified that CAT identified 43 problems which he termed to be QA/QC "breakdowns." SC Ex. 89A, at 19-41. There was considerable discussion during Mr.

Hubbard's examination concerning what he meant by the term "breakdown." He did not utilize that term in the same sense that the Staff uses the term in its enforcement policy, i.e., a level 2 severity violation. Rather, Mr. Hubbard used the term more generically to indicate problems with either the implementation or the establishment of the proper QA/QC measures. These measures would ensure proper design, construction and installation of systems, structures and components. Thus, the word "breakdown" means a failure to meet a requirement. Tr. 15,398-99 (Hubbard). For example, if someone does not follow a particular step in a procedure and is cited in an audit for said nonperformance, that would constitute a breakdown. Tr. 15,404 (Hubbard). Every audit finding or surveillance finding would be a breakdown as Mr. Hubbard uses the word. Tr. 15,405 (Hubbard).

QA:366. Breakdowns, as used in Mr. Hubbard's testimony, have varying degrees of significance. Tr. 15,413 (Hubbard).

QA:367. Mr. Hubbard believes that the CAT inspection is important because it provides a sample of the plant that has already had normal inspections, audits, surveillances and I&E review. In a sense, that sample of plant operation has passed through many gates. Nevertheless, many items passed through undetected. Tr. 15,451-52 (Hubbard). The QA/QC deficiencies noted in the CAT inspection are significant because they also

went undetected by LILCO and the NRC Staff for a number of years. The RHR system was virtually completed at the time of the inspection. However, these defects were not discovered by LILCO or the Staff until years after the work had been performed and even then were discovered only during a special audit. If the proper QA/QC program had been established and implemented prior to this time, many of these deficiencies should have been detected earlier. SC Ex. 89A, at 43-44.

C. NRC Design Review

QA:368. The Staff's I&E program has emphasized construction more than design. This is consistent with statements made by Mr. DeYoung, the Director of the Office of Inspection and Enforcement. Tr. 15,833 (Hubbard). In those remarks, he stated:

> One of the areas that we never inspected very heavily is the architect engineer's design office. We did a lot of inspection, I think, over the years of the quality construction assuming that the blue prints were correct, and the main gap we have been focusing on in these first two cases (San Onofre and LaSalle) is that gap of whether the drawings themselves properly reflected the design commitment in the application. Tr. 15,833 (Hubbard); SC Ex. 89A, at 60.

QA:369. The NRC has reviewed the topical reports of SWEC and GE relating to the quality assurance programs of LILCO's organizations, including the design aspects of quality assurance. However, as noted by the NRC's Mr. DeYoung, the review

of those topical reports is different from a review that concentrates on the implementation of the program as defined in those topical reports. Tr. 15,834-35 (Hubbard).

QA:370. The licensee contract/vendor inspection program is a NRC Staff program in which the design control process and its implementation are reviewed. This involves the Staff going to SWEC maybe four times a year for maybe three to four days. Mr. Hubbard's experience while at GE was that this program was intended primarily to see if there were procedures in place. This was not a detailed review of implementation, but rather a review of whether there was a program in place for design control. Tr. 15,835 (Hubbard).

QA:371. Mr. Hubbard has not been involved in any LCVIP inspections since 1976. However, he has reviewed a GAO report which discusses that and has also reviewed I&E reports relating to inspections by I&E Region IV of SWEC. This review shows a consistent pattern of visiting about four times a year. Tr. 15,836 (Hubbard).

QA:372. NRR does not look a great deal at calculations nor the criteria used to develop the final design. Tr. 15,838 (Hubbard).

QA:373. The problems with the I&E program for inspection of vendors and architect engineers are really two-fold. First, they do not inspect frequently enough; and second, they

primarily look at implementation procedures, rather than the actual calculations or implementation. Tr. 15,839 (Hubbard). Mr. Hubbard testified also that Mr. Volmer and Mr. Denton share his opinion that there is not sufficient emphasis in the I&E program on the actual implementation of the design process. Tr. 15,841 (Hubbard); SC Ex. 89A, at 60-61.

QA:374. In Mr. Hubbard's opinion, the NRC's I&E program does not identify quality problems at a timely fashion at a number of sites, such as Diablo, Midland, South Texas, and Zimmer. Since that same program has been applied at Shoreham, it is difficult to have confidence in the conclusions reached by the Staff. Tr. 15,929-30 (Hubbard).

QA:375. On March 15, 1982, Mr. Denton met with LILCO representatives. At that meeting, Mr. Museler and Mr. Pollock described the design and construction program which LILCO had implemented. Mr. Denton expressed the view that everybody had a QA program and he was not particularly interested in that. He was, however, particularly interested in implementation in the design area and where design changes had occurred late in the project, like the Mark II matters or the seismic redesign at Diablo. Tr. 15,933-35 (Hubbard).

QA:376. During the 1975-78 period, Mr. Gallo participated in two inspections at Shoreham. Those were the only inspections that he ever performed at Shoreham. Tr. 16,281 (Gallo).

The focus of Mr. Higgins' responsibilities as Resident Inspector has been on pre-operational and operational phases of the I&E program. He has inspected some construction activities. The first inspections which Mr. Higgins performed on Shoreham were in 1979. Tr. 16,282-83 (Higgins). Mr. Narrow was involved in the details of I&E's construction inspection program. That program includes a limited amount of design inspection which is performed onsite, but does not include any offsite design inspection. Mr. Narrow has not performed any inspections at SWEC offices or at GE. He has conducted inspection activities at the Hicksville offices of LILCO. Tr. 16,286-87 (Narrow). Messrs. Higgins and Gallo have never performed any kind of inspections or QA investigations offsite at Stone and Webster or at GE. Tr. 16,301 (Higgins, Gallo).

QA:377. I&E Region IV does inspections of GE and SWEC. In the course of their inspections, they review audits performed, for example, by SWEC's Boston office. Thus, Mr. Higgins believes that the Engineering Assurance audits, which are part of SC Ex. 51, would have been reviewed on a sampling basis by I&E Region IV. Tr. 16,322-23 (Higgins). Region IV apparently reviews Engineering Assurance audits at least four times a year. In 1981, they reviewed three and, in 1982, they reviewed two of the Engineering Assurance reports. Tr. 16,323 (Narrow).

QA:378. I&E Region I receives what is called a "White Book," that provides a periodic summary of Region IV findings. Region I management people review that book and if there is some specific or significant problem, Region I would probably identify it with respect to the particular plants within its region. Mr. Gallo has reviewed the White Book, but did not review it for the purpose of preparing the Staff's testimony. Tr. 16,347-48 (Gallo). Region IV also has procedures so that significant deficiencies are made available to the particular dockets and to the regions. Thus, Mr. Higgins does not believe there are any significant items "lurking" in Region IV reports of which Region I is not aware. Tr. 16,349 (Higgins).

QA:379. In the CAT inspection, I&E identified a weakness in the control of E&DCRs primarily related to the large number of outstanding E&DCRs. This was also noted in the 1982 SALP report. Region I provides Region IV with a copy of the SALP report, but Region I, to the best of the knowledge of the Staff witnesses, did not tell Region IV what was happening with respect to E&DCRs, even though E&DCRs at the site also might affect processes going on at SWEC in Boston. Tr. 16,361-63 (Higgins).

QA:380. When Region I finds a significant problem which is outside of its area of expertise, it will ask Region IV to conduct an inspection or investigation. This has occurred in

the past. Tr. 16,363-64 (Gallo). The NRC witnesses are not sure, in the case of the CAT inspection E&DCR weakness, if it was a conscious decision on the part of I&E not to communicate this information directly to Region IV. Tr. 16,365 (Gallo, Higgins). Region I design review activities include a review of E&DCRs, some work in system design, particularly comparing the as-built plant with the FSAR, and some review of Site Engineering Office activities. I&E also gets into the design area somewhat in the area of pre-operational test procedures, particularly from the point of view of trying to understand the acceptance criteria. Tr. 16,367-68 (Higgins).

QA:381. In the Staff's prefiled testimony, the Staff states that its inspections included design review and control. This testimony relates specifically to the design review performed by Region I inspectors at the site. Staff Ex. 8, at 7; Tr. 16,424 (Higgins).

QA:382. Mr. Higgins' design review activities with respect to Shoreham are essentially of two types. First, he would choose a system from the FSAR, review the FSAR design documents and commitments, and then tour the plant to look at the system hardware. Second, if particular problems came up, such as had been identified in inspections, bulletins, circulars or in a pre-operational test, he also would become involved in design activities. Tr. 17,084-85 (Higgins).

QA:383. There is a mechanism by which Region I finds out if Region IV has discovered anything significant in its review of GE and SWEC which relates to the Shoreham design or design control process. Tr. 17,091 (Gallo). In the one year that Mr. Gallo had held his present supervisor position, he could only recall one generic problem that had come to his attention from Region IV which affected the Shoreham project. Tr. 17,092 (Gallo). To Mr. Gallo's knowledge, Region IV has not found it necessary to notify Region I of any specific problem found at SWEC or GE. Tr. 17,093 (Gallo).

QA:384. LILCO Exhibit 53 constitutes a list of questions posed by NRR concerning the design review for Shoreham performed by the NRC Staff. Tr. 17,295-97 (Higgins); LILCO Ex. 53, ff. Tr. 17,297. Referring to the statements in Mr. Hubbard's prefiled testimony concerning the failure of the NRC to adequately review the implementation of the design processes, the Staff testified that in the last few years, Region IV has done many more QA program reviews and has tried to take a concentrated look at the implementation of the engineering, rather than just at the engineering program and the changes to it. Tr. 17,299 (Gallo). Mr. Gallo understands that Region IV's activities in the distant past were primarily programmatic type inspections. Tr. 17,300 (Gallo). LILCO Exhibit 53 indicates the kind of detailed design review and engineering

review that NRR has done with respect to Shoreham. Tr. 17,300-01 (Gallo).

QA:385. Mr. Higgins testified that there had been significant engineering activities conducted at the Site Engineering Office by SWEC. Tr. 17,084 (Higgins). He agrees, however, that the vast majority of the engineering design work for Shoreham was conducted offsite. Tr. 17,419-20 (Higgins). Mr. Higgins did not regularly audit or inspect the Site Engineering Office. Rather, his involvement with that office involved particular questions that came up in the course of other activities. Tr. 17,420 (Higgins). Mr. Narrow's involvement with the Site Engineering Office is similar to that of Mr. Higgins. Tr. 17,421 (Narrow).

QA:386. The recently discovered QA/QC breakdowns at plants such as Diablo Canyon, Zimmer, South Texas, Midland and Marble Hill confirm that the I&E program has some severe and systemmatic deficiencies, which have precluded I&E from discovering serious flaws at other plants. SC Ex. 89A, at 54. The deficiencies in the I&E program have been studied in a 1976 Sandia report, a 1978 GAO report, and in the QA portion of the Kemeny Commission Report. These reports are all discussed in prefiled testimony of Mr. Hubbard. SC Ex. 89A, at 55-59. In addition, the Board finds that the NRC Staff has conducted virtually no in-depth review of the implementation of the design

process by nuclear reactor vendors and architect engineers. This point has been made clear by Mr. William Dircks, the NRC's Executive Director of Operation, in a letter to NRC Chairman Palladino in early 1982. SC Ex. 89A, at 60-62.

D. Staff Review of LILCO and SWEC Audits

QA:387. For purposes of preparation of testimony in this proceeding, the NRC Staff did not review any of the SWEC engineering assurance audits. Tr. 16,317 (Higgins). Similarly, no FQC or LILCO audits were reviewed for purposes of preparation of the testimony, although FQC and LILCO audits are looked at during the NRC inspection program. Tr. 16,317 (Narrow). However, during the NRC inspection effort, I&E does not review all of the FQC audits. In addition, only some of the field audits are reviewed by I&E. Tr. 16,318 (Narrow, Higgins).

QA:388. Subsequent to the preparation of the Staff's testimony, Mr. Gallo testified that the Staff panel had reviewed the testimony and looked at the audits which were discussed. In addition, they looked at the exhibits which accompanied the transcripts. Tr. 16,320-21 (Gallo). Subsequently, however, Mr. Gallo and Mr. Narrow both stated that they have not looked at SC Ex. 51 which contains Engineering Assurance Audits 2-40. Mr. Higgins stated that he has had occasion to look at only very few of those during the course of the inspection program. From September to December of 1982, Mr. Gallo had looked at a

selected number of these. Tr. 16,322 (Gallo). Subsequently, when asked about specific engineering assurance audits, the Staff witnesses were unable to provide answers to the questions. Tr. 16,323-25 (Narrow, Higgins, Gallo).

QA:389. In preparation of the Staff testimony, the Staff panel did not review any of the Region IV audits of SWEC. Subsequent to preparing the testimony, Mr. Gallo has looked at a microfiche listing of the inspection reports that are in the docket files. Thus, it is fair to state, that the Staff testimony provides no opinion regarding any of the audit findings of Region IV either relating to SWEC or to GE. Tr. 16,325-26 (Gallo, Higgins).

QA:390. With respect to LILCO quarterly reports to management, Mr. Narrow recalls reading one of them at one time. Mr. Higgins has not reviewed any. Tr. 16,326 (Narrow, Higgins). Mr. Gallo had reviewed SC Exhibit 63, which is a compilation of quarterly reports to management, during the last several weeks prior to his taking the stand. Tr. 16,331-32 (Gallo).

QA:391. At page 4 of the Staff prefiled testimony, the Staff finds that there is no pattern of QA/QC breakdowns at Shoreham. Staff Ex. 8, at 4. As used in the Staff testimony, the term "breakdown" is synonomous with the Level 2 Severity QA/QC violation, as defined in Appendix C to 10 CFR Part 50.

When the testimony was prepared, the Staff did not definitively link it to a specific severity level, but they did consider what would constitute a QA/QC breakdown. The Level 2 Severity discussion in the Staff's enforcement policy is roughly the same as what the Staff testimony means in terms of QA/QC breakdown. Tr. 16,332-36 (Gallo, Higgins).

QA:392. Even if there were not a pattern of Level 2 QA/QC breakdowns at Shoreham, the Staff could have serious reservations or concerns about the adequacy of a QA/QC program. Tr. 16,342 (Higgins).

QA:393. It is I&E policy that if the licensee identifies a problem or deficiency in its own program that is not a Severity Level 1 or 2 problem, and takes adequate corrective action, it is not cited as a violation. Tr. 16,344 (Gallo).

QA:394. Even in instances where I&E might not cite an item as a violation, there may be a need in I&E's view for improvement of the QA/QC with respect to the particular item. Tr. 16,345 (Higgins). Examples of that would be the four observations in the CAT inspection. Tr. 16,345-46 (Higgins).

QA:395. Region IV was not directly involved in the SALP dated June 22, 1982. However, Region IV input has been used in other SALP appraisals. Mr. Gallo is not sure whether there was any Region IV input in the 1981 SALP for Shoreham. Tr. 16,347 (Gallo).

QA:396. Mr. Narrow agrees that it is conceivable that it might be worthwhile for I&E to review the LILCO quarterly reports to management, particularly since they are summaries of the underlying audit findings. However, I&E had not reviewed the quarterly reports until just before the hearing. Tr. 16,354-55 (Narrow, Gallo).

QA:397. In the NRC SALP report for 1982, SC Exhibit 92, Enclosure 2, at 7, the Staff uses the term "programmatic breakdown." The Staff was not intending, however, to use it in the sense of a Severity Level 2 violation as set forth in the Staff enforcement policy. See SC Ex. 92; Tr. 16,421-23 (Higgins).

QA:398. Mr. Narrow does not review the FQC audits done by the Boston SWEC office on a regular basis. Tr. 16,735 (Narrow).

QA:399. As a general matter, the Staff witnesses were not in a position to answer questions regarding the details of EA or FQC audits. There may have been a few of those audits with which they are familiar, but they were not familiar with most. Tr. 16,736-37 (Narrow).

QA:400. In preparation of the Staff testimony, the Staff witnesses did not review any specific EA audits or FQC audits. Tr. 16,743 (Higgins). Subsequent to that testimony, they did review some of the audits and found nothing that would cause concern or that would change the conclusions in their

testimony. Tr. 16,745 (Higgins). However, these witnesses have no knowledge of the matters contained in those audit reports other than the cold words of the audit. Tr. 16,746 (Higgins).

QA:401. LILCO Exhibit 52, excerpts from I&E Report 79-04, constitutes an instance where the inspector in the course of an inspection used LILCO surveillance reports and field audits. Tr. 17,182 (Narrow).

QA:402. The NRC Staff witnesses testified that the six recommendations set forth in Attachment 5 to Mr. Hubbard's prefiled testimony have been implemented for Shoreham. Tr. 17,243-51 (Gallo).

QA:403. In the SALP review process, a Category 3 rating means that both NRC and licensee attention should be increased because of weaknesses that have been identified. In the 1982 SALP at Shoreham, design and engineering were rated in Category 3. Tr. 17,422 (Gallo). During the 1982 SALP period which covered March 1, 1981 through February 28, 1982, the NRC found that there was a weakness with respect to timely incorporation of E&DCRs. Further, the Staff still had problems with final resolution of electrical separation items. Tr. 17,423-24 (Higgins). In the CAT inspection, I&E found discrepancies in the area of electrical separation of safety-related and nonsafety-related cables in transition or in free air. The

Staff believes that LILCO's program did not adequately address this particular electrical separation issue. Tr. 17,425 (Higgins). Indeed, when the Staff looked at the entire electrical separation area, the Staff was very concerned that there was a long way to go. Tr. 17,426 (Higgins).

E. Statistics

QA:404. The NRC's I&E program should provide some verification that SS&Cs are designed, manufactured, installed and operated in strict accordance with applicable QA/QC requirements. SC Ex. 89A, at 45.

QA:405. The Staff has not evaluated the Shoreham QA program against any objective baseline criteria to measure how it quantitatively evaluates the effectiveness of the Shoreham QA program. Rather, it relies upon subjective qualitative judgment to measure the program effectiveness. SC Ex. 89A, at 51.

QA:406. The NRC Staff's I&E program with respect to Shoreham has inspected only a small sampling of items at the plant. Because of the limited amount of effort devoted by I&E and the lack of a statistical basis in the I&E program, the NRC Staff is not in a position to conclude with any degree of assurance that LILCO has successfully implemented its QA program. SC Ex. 89A, at 52.

QA:407. Mr. Hubbard's concludes, based upon the CAT inspection and the I&E reports, that there is substantial doubt

concerning the actual quality achieved in the design and construction of Shoreham. That is why he recommended that an independent design review and physical inspection be undertaken. Tr. 15,775 (Hubbard).

QA:408. An experienced person can make subjective judgments on the effectiveness of the QA program at a nuclear plant without the use of objective baseline criteria. However, these judgments will not necessarily be reliable. Tr. 15,795 (Hubbard). The lack of reliability might be a result of such things as inadequate data, inadequate consideration of all aspects of the program or perhaps some unrealized sampling bias. Tr. 15,795-96 (Hubbard).

QA:409. The NRC Staff's expenditure of 7,000-10,000 manhours on the Shoreham project does not allow for extrapolation from the I&E data to the population of plant attributes as a whole. Tr. 15,797 (Hubbard).

QA:410. In attempting to develop objective baseline criteria, it is necessary to exercise a substantial amount of judgment. Decisions will include what is to be considered. Tr. 15,798-99 (Hubbard).

QA:411. Proper objective baseline criteria have been used in certain circumstances. For instance, at Marble Hill, the NRC specified a statistical sampling program that was to have been established to develop a certain degree of confidence in

the previous concrete inspection. At Diablo Canyon, the independent design review program also involved the use of statistics. Further, in assessing the E&DCR problem at Shoreham in 1976-77, statistical techniques again were used. Tr. 15,800-01. These examples indicate that a statistical program could be developed for a nuclear power plant. Tr. 15,802 (Hubbard).

QA:412. It is Mr. Hubbard's opinion that the I&E effort has been too limited to reach an informed conclusion regarding the adequacy of the implementation of QA at Shoreham. This is tied to the fact that statistical techniques had not been used. Tr. 15,812-13 (Hubbard).

QA:413. Mr. Hubbard's basic problem with the I&E program is not that it has devoted only between 7,000-12,000 hours to the Shoreham project. He is more concerned that the I&E program focuses almost entirely on safety-related activities. Accordingly, the scope of the program is too narrow. Second, the I&E program is not based on random sampling. The program does not use statistical methodologies for extrapolation. The program might have been adequate, even with the number of hours that had been spent, if the scope of the program were broadened and statistical methodologies were utilized. Tr. 15,950-51 (Hubbard).

QA:414. This failure to use statistically valid sampling techniques is also reflected in other aspects of Shoreham's QA/QC program. According to Mr. Eifert, the LILCO audit program does not audit 100 percent of Shoreham's QA items and records. Tr. 12,406, 12,408 (Eifert). Instead, that program audits a sample of items to develop conclusions about the overall effectiveness of Shoreham's QA/QC program. Tr. 12,408-09 (Eifert). However, statistically-based sampling techniques are not used in LILCO's audit program. Tr. 12,437 (Eifert).

QA:415. In LILCO's view, statistical sampling techniques are not appropriate with respect to an audit program, Tr. 12,413 (Eifert), and, under its auditing methods, audit findings or observations are based on judgment sampling techniques. Thereafter, based on these specific observations, LILCO makes inferences regarding the total population, including that portion of the population that is not subject to the specific audit findings or observations. Tr. 12,443-45 (Eifert).

QA:416. As previously noted, extrapolations which are reliable and verifiable require the use of statistical techniques. Tr. 15,918 (Hubbard). Thus, an audit program that selects samples on the basis of judgment and then extrapolates the results to the population being audited has no validity. It is not the conclusions regarding the areas specifically audited which are invalid, but the process of extrapolation to the total population. Tr. 15,913, 15,914-15 (Hubbard).

QA:417. Criterion 18 of Appendix B requires implementation of an audit program to verify compliance with the QA/QC program as well as determination of the effectiveness of that program. Tr. 12,410 (Eifert). Whatever is accomplished by that audit program must provide a basis for concluding that all aspects of the QA program have been effective as implemented. Tr. 12,411 (Eifert). Thus, Criterion 18 can be interpreted to require the use of statistical methodology in performing audits. SC Ex. 112, at 52; Tr. 15,944-45, 15,996 (Hubbard).

QA:418. Moreover, the areas of statistics and engineering judgment should complement each other in an audit program. Statistics should be used primarily in the selection of samples to be audited. Tr. 15,943-44 (Hubbard). In this way, the process of extrapolating from the sampled population to the total population has validity. Tr. 15,990 (Hubbard).

QA:419. The Staff agrees with LILCO that it is not necessary to choose an audit or inspection sample using statistical methodology. Moreover, the Staff, like LILCO, believes that the use of such statistical methodology is not required in order to extrapolate to the total population. Tr. 17,258-59 (Gallo). Thus, although I&E does not perform 100 percent inspections, Tr. 17,045 (Gallo), it also does not use statistical methods for selecting samples for audit or inspection. Tr. 17,263 (Higgins).

QA:420. In some areas, however, the Staff does use statistical techniques. Mr. Higgins testified that data gathering during the leak rate test is an example of this use of statistics. However, statistical methodology is not used in selecting inspection samples. Tr. 17,280-81 (Higgins). Thus, even in major inspection reports, such as the Shoreham CAT inspection, the items inspected are not selected on the basis of random sampling techniques. Tr. 17,270 (Higgins).

QA:421. LILCO and SWEC do use statistical techniques as part of Shoreham's QA/QC inspection process. SC Ex. 112, at 43; Tr. 12,428 (Eifert). However, primary reliance is placed on the judgment of the inspector. As noted, statistically-based sampling techniques are not used to any extent in Shoreham's audit program. Tr. 12,437 (Eifert). Presumably, this failure to use statistical sampling is not attributed to the diversity of items at the Shoreham plant, since Mr. Burns, on behalf of LILCO, acknowledged that, through stratification sampling, diverse populations can be subdivided to obtain relatively homogeneous subpopulations that can then be analyzed. Tr. 12,452 (Burns).

F. RAT Inspection

1. Introduction

QA:422. Direct testimony regarding the NRC Staff's Readiness Assessment Team inspection of Shoreham, Inspection

Report No. 50-322/83-02 (the "RAT inspection"), was filed by LILCO. See Supplemental Testimony of Messrs. Museler, Arrington and Kelly Concerning I&E Inspection Report No. 50-322/83-02, ff. Tr. 19,757. The NRC Staff presented witnesses for examination by the Board and the parties. However, the Staff did not file any direct testimony regarding the RAT inspection; nor did it conduct any cross-examination of the joint LILCO-Staff witness panel. Suffolk County was precluded from filing direct testimony, but conducted cross-examination of the joint panel. The hearing was held on February 22 and 23, 1983.

QA:423. The RAT inspection was a special unannounced team inspection of the Shoreham plant conducted on January 10-15, 1983 by resident and region-based inspectors and NRC Region I management. Staff Ex. 13, cover letter, at 1; Tr. 19,758 (Greenman). Staff witness Greenman was the team leader on the inspection and the inspection report was prepared under his supervision. Tr. 19,749 (Greenman).

QA:424. The RAT inspection was conducted to determine the status of operational readiness of the Shoreham facility in a variety of areas, including construction, preoperational testing, operations, plant operational staffing, organizational interfaces, housekeeping, physical condition of plant and licensee action on previous inspection findings. Tr. 19,758

(Greenman); Staff Ex. 13, Inspection Summary. The inspection involved 465 inspector hours onsite by eight NRC inspectors, the NRR Project Manager, and NRC management. Staff Ex. 13, Inspection Summary. Following this inspection, the Staff concluded that a number of areas required resolution by LILCO before it could be determined whether Shoreham is ready for an operating license. Tr. 19,767-68 (Greenman); Staff Ex. 13, cover letter, at 1.

QA:425. From its review of the plant's status, Master Punch List ("MPL") items, preoperational test status, program and procedural development, final quality control inspection, and existing resources, the Staff also determined that Shoreham will not be ready for fuel load for a period of at least five to six months from the time of the inspection. Staff Ex. 13, at 1. LILCO has indicated that, prior to fuel load, it intends to resolve those areas identified as requiring resolution prior to a recommendation by Region I regarding Shoreham's readiness for an operating license. Tr. 19,768 (Greenman).

QA:426. The RAT inspection's findings were discussed with LILCO during the inspection. In addition, the results of the inspection were discussed with LILCO's management at a meeting on January 25, 1983. Staff Ex. 13, cover letter, at 1.

QA:427. Based on its inspection, the Staff identified four Severity Level IV violations. In addition, the Staff found

plant housekeeping to be unacceptable at the time of its inspection. LILCO was cited for no violations in this regard, primarily because inadequate plant housekeeping was already an open violation. Tr. 20,007 (Greenman). Moreover, the issuance of Confirmatory Action Letter ("CAL") 83-01 to LILCO on January 19, 1983, Staff Ex. 12, provided a mechanism for the Staff to achieve corrective action by LILCO in this area. Tr. 20,007 (Greenman).

QA:428. The RAT inspection team took into consideration the inspection status of the items and components reviewed during the inspection; thus, the inspection report pointed out whether identified discrepancies had been final inspected and accepted by Shoreham's QA/QC program. Tr. 19,772 (Greenman). Those discrepancies that had passed through the QA/QC program without having been detected were given more emphasis by the Staff than were other discrepancies identified during the inspection. Tr. 19,774 (Higgins). In fact, LILCO was generally not cited for violations by the Staff unless the discrepancies identified had been subjected to final inspection by LILCO before the Staff's RAT inspection. Tr. 19,772-73 (Higgins).

QA:429. In addition to the four violations and the plant housekeeping discrepancies identified, the Staff concluded from its inspection of Shoreham's construction areas that additional action by LILCO is needed in the area of final system

inspections. Staff Ex. 13, at 1. In particular, the Staff expressed concerns about LILCO's overreliance on the final inspection program to identify construction discrepancies. Staff Ex. 13, cover letter, at 2; Tr. 19,783 (Greenman). LILCO was therefore instructed to give particular attention in its response to the Staff's inspection report explaining how it intended to ensure an effective final inspection program. Staff Ex. 13, cover letter, at 2.

QA:430. However, LILCO's response to the RAT inspection report, SNRC-843, dated February 19, 1983, had not been reviewed by Staff witness Greenman at the time of the RAT inspection hearing. Tr. 19,761 (Greenman). Moreover, Mr. Higgins had not completed his review of the response. Tr. 19,761 (Higgins). Nor had the response been reviewed by the RAT inspection team members. Tr. 19,762 (Higgins). Thus, no evidence was presented by the Staff regarding its review of LILCO's response. Tr. 19,762 (Higgins).

2. LILCO's Overreliance on the QA/QC Final Inspection Program to Identify Construction Deficiencies

QA:431. As noted, the Staff's inspection of Shoreham's construction areas indicated that additional licensee attention is needed in the area of final system inspections. See Finding QA:429, supra.

QA:432. The Staff's concerns relate, in part, to the RAT inspection findings and the fact that construction

discrepancies were identified even though the items or components had been final inspected and accepted by the Shoreham QA/QC program. Tr. 19,784 (Greenman). The Staff is also concerned, however, by the fact that FQC final inspections have resulted in a significant number of components being returned to Construction for additional work because nonconforming components have been submitted for final inspection. Staff Ex. 13, at 1; Tr. 19,773-74 (Higgins).

QA:433. Based on information provided by LILCO, the Staff determined that, since September 1, 1982, rejection rates by FQC of items turned over for final inspection are as follows: large bore pipe supports, 30 percent; small bore pipe supports, 64 percent; cable tray supports, 42 percent; conduit, 10 percent; cable wrapping, 12 percent; and junction boxes, 34 percent. Staff Ex. 13, at 1.

QA:434. These high rejection rates demonstrate that construction items are not receiving proper attention prior to being submitted to FQC for final inspection, and that LILCO is placing too much reliance on its final inspection program to detect and correct construction deficiencies. Tr. 19,784 (Greenman). The Staff believes this deficiency should be corrected by shifting the workload from FQC back to Construction. Therefore, the Staff requested assurances from LILCO that items would be "cleaned up" by Construction prior to the

time they are turned over to FQC for final inspection. Tr. 19,797-98 (Greenman).

QA:435. While LILCO agreed with the Staff that the high rejection rate by FQC of items turned over for final inspection is an item of concern, LILCO also believes that a large number of items returned by FQC were totally unrelated to the quality of the installed hardware. Thus, LILCO testified that many of the rejected items were the result of the detailed review and inspection of the final product and documentation provided by Shoreham's QA/QC program. LILCO reasoned that a high rejection rate is not unusual given this level of detail. Furthermore, LILCO submitted that most of the rejected items are minor and inconsequential in nature. Museler et al., ff. Tr. 19,757, at 25. In this regard, Mr. Museler testified that typical examples of the type of item rejected by FQC were Shoreham's cable tray cover holddowns. LILCO Ex. 65, ff. Tr. 20,072; Tr. 20,098-99 (Museler). These items had been rejected by FQC simply because Construction had tapered the edges without obtaining approval from Engineering for this modification. Tr. 19,789-90 (Museler). Mr. Higgins, however, disagreed with Mr. Museler's testimony and did not think that LILCO Exhibit 65 exemplified the type of item rejected by FQC. Tr. 20,094-95 (Higgins).

QA:436. LILCO also testified that many of the reasons for rejection by FQC have no bearing on even this detailed level of review. For example, according to LILCO, inspection packages are rejected if any FQC inspectors cannot obtain access to an area or component to perform his inspection. Museler et al., ff. Tr. 19,757, at 25. While Mr. Museler testified that a large number of the items rejected were rejected because they were inaccessible, he was unable to provide evidence regarding the percentage of items rejected for this reason. Tr. 19,787, 19,792 (Museler).

QA:437. The Staff had concerns regarding the status and the quality of items coming from Construction to FQC for final inspection. Therefore, LILCO has agreed to initiate certain measures to improve the quality and effectiveness of both construction activity and FQC inspections. Staff Ex. 13, at 1; Museler et al., ff. Tr. 19,757, at 25. These measures include: emphasis by construction managers to "clean up" items on components submitted to FQC for final inspection; traceability of work to responsible construction personnel; analysis of results of FQC inspections requiring rejection of components; trending of past and future FQC documented findings to ascertain whether remedial actions are appropriate; FQA re-inspection of a sample of FQC accepted components; and evaluation of the hours worked by FQC inspectors to determine whether undue pressure is placed on FQC by an unacceptable use of overtime. Staff Ex. 13, at 1.

QA:438. The Board finds that the measures initiated by LILCO in response to the Staff's concerns are inadequate to ensure the quality and effectiveness of construction and FQC inspections.

QA:439. For example, the FQA re-inspection measure, as proposed by LILCO, is limited to a re-inspection of a five percent sample of FQC accepted components. Tr. 19,774-75 (Greenman). That re-inspection, moreover, will not include re-inspection of items that were final inspected and accepted by FQC prior to the Staff's RAT inspection. Tr. 19,781-82 (Museler). Nor will the re-inspection be performed on a statistically valid random sampling basis. Tr. 19,775 (Higgins). Rather, the re-inspection will be performed on the basis of LILCO's judgment -- and LILCO will use its judgment to determine whether the sample size should be increased and whether further re-inspection is warranted. Tr. 20,033 (Museler). As a result, there are no fixed criteria for when further re-inspection should be performed. Tr. 19,777-78 (Higgins); Tr. 20,032 (Museler).

QA:440. Moreover, LILCO contemplates that the FQA re-inspection program will be conducted for only a two month period, i.e., through the end of March, 1983. Museler et al., ff. Tr. 19,757, at 27-28. At the time of the RAT inspection hearing, this re-inspection program had identified three

discrepancies not detected by FQC at the time of its final inspection. LILCO nevertheless concluded that these results demonstrated the adequacy of the FQC final inspection program. Museler et al., ff. Tr. 19,757, at 27-28. The Staff, however, took no such comfort from these re-inspection results. In fact, the additional discrepancies identified by FQA led the Staff to decide that it will evaluate further the FQC final inspection program. Tr. 19,779 (Higgins). That evaluation will be conducted by Mr. Higgins, as the senior resident inspector for Shoreham, and by Region I. Tr. 19,778 (Greenman).

QA:441. The Board endorses the desirability of a comprehensive evaluation of the FQC final inspection program and believes that such an evaluation can be adequately performed through the FQA re-inspection program described by the LILCO witnesses. The Board is mindful, however, that for the results of FQA's re-inspection to be meaningful, the Staff must be actively involved in the evaluation of the re-inspection results. Moreover, for the Board to reach a reasoned decision, it must be provided more data regarding the adequacy and effectiveness of the FQC final inspection program. Absent such data, the Board cannot find that Shoreham's FQC final inspection program is functioning adequately.

QA:442. Based on LILCO's own analysis of FQC's rejection of components during the period from November 1, 1982 through

late January, 1983, the Board shares the Staff's concern that items are not receiving proper attention prior to their submission to FQC for final inspection.

QA:443. According to LILCO, that analysis has thus far shown that five percent of the N&Ds issued by FQC have required modifications to hardware in the field. Museler et al., ff. Tr. 19,757, at 26. Moreover, the percentage of DCOs issued by FQC requiring rework to installed hardware is larger. For example, small bore pipe support DCOs for the period January 22, 1983 through February 8, 1983 resulted in an average rework rate of nine percent. Museler et al., ff. Tr. 19,757, at 26; SC Ex. 116A, ff. Tr. 20,004.

QA:444. However, the above percentages did not include items for which FQC had not made a determination as to whether rework would be required. Of the N&Ds issued by FQC and subjected to analysis by LILCO at the time of the RAT inspection hearing, a determination had not been made with respect to 13 percent of the items rejected by FQC. SC Ex. 116B, ff. Tr. 20,004. An even higher percentage of the rejected small bore pipe support DCOs remained to be dispositioned by FQC. SC Ex. 116A, ff. Tr. 20,004. Thus, it is possible that the percentage of components requiring hardware modifications could be significantly larger than the percentages presented by LILCO. Tr. 20,001-02 (Kelly).

QA:445. The Board has considered LILCO's analysis of FQC's rejection of nonconforming components and finds this analysis to be seriously deficient in its scope. Notwithstanding LILCO's belief that this analysis reveals that a relatively low percentage of rejected items actually requires hardware modifications in the field, the Board cannot so find. Data regarding the disposition of all items rejected by FQC, including those items for which FQC had not made a determination as of the time of the RAT inspection hearing, is required before the Board can reach an informed decision. Moreover, there should be an analysis by LILCO and the Staff of those components rejected by FQC but then accepted without modification in the field. The fact that a rejected item may later be accepted "as is" still raises questions concerning the quality and effectiveness of the QA/QC process that failed to detect the discrepancy before submission to FQC for final inspection. Thus, on the evidence presented, the Board cannot find that FQC's return of components to Construction for additional work is not a matter of significant concern.

QA:446. With regard to LILCO's evaluation of the hours worked by FQC inspectors to determine whether undue pressure is placed on FQC by an unacceptable use of overtime, the LILCO witnesses testified that the FQC inspection staff has been increased by 50 percent since late November/early December, 1982.

Ten of these additional inspectors were hired following the RAT inspection. Tr. 20,036-37 (Arrington).

QA:447. Despite this increase in the FQC staff, the average inspector still works approximately 60 hours per week. Staff Ex. 13, at 14. The LILCO witnesses testified that this level of overtime is not excessive and is consistent with industry practice. Museler et al., ff. Tr. 19,757, at 28; Tr. 20,065-67 (Arrington). In fact, LILCO witness Arrington asserted that it is no different for an inspector to work ten to 12 hour days than it is for a construction laborer to work the same schedule. Tr. 20,067 (Arrington).

QA:448. The Staff, however, expressed concern about whether comprehensive and detailed inspections can be performed under the workload presently expected of FQC's inspectors. Staff Ex. 13, at 14. Thus, the Staff disagreed with LILCO's assessment of the hours worked by those inspectors. The Staff considers 60 hours per week to be an excessive workload. Tr. 20,093 (Greenman).

QA:449. The Board is also concerned that the present workload of FQC's inspectors has an adverse impact upon the quality of the FQC inspection program. LILCO's "evaluation" of the hours worked by FQC inspectors amounts to little more than management's opinion that the overtime level is consistent with industry practice. The Board finds that LILCO's conclusion in this regard is entitled to little, if any, weight.

3. Violation A -- Failure to Provide Adequate Verification of Completed Construction in the Areas of Control Rod Drive Piping Supports, Pipehangers and Cable Tray Supports

QA:450. Criterion 10 of Appendix B and Section 17.1.10A of the Shoreham FSAR require inspections to be pe formed to verify conformance of completed construction activities to documented instructions, procedures and drawings. Furthermore, Criterion 5 of Appendix B and Section 17.1.5A of the Shoreham FSAR require activities affecting quality to be accomplished in accordance with documented instructions, procedures and drawings. Staff Ex. 13, Appendix A, at 1.

QA:451. Contrary to the above requirements, as of January 13, 1983, LILCO failed to provide adequate verification of completed construction in the areas of Control Rod Drive ("CRD") piping supports, pipehangers and cable tray supports. Staff Ex. 13, Inspection Summary. As a result, the Staff cited LILCO for a Severity Level IV violation. This violation was identified as Violation A. Staff Ex. 13, Appendix A, at 1.

QA:452. All three subparts of Violation A involved completed construction activity that was not in conformance with drawing requirements. Nevertheless, the construction had been final inspected and accepted by QC prior to the RAT inspection. Staff Ex. 13, Appendix A, at 1.

QA:453. The Board finds that this failure of QC to identify and correct discrepancies between completed construction

activity and drawing requirements is further evidence of LILCO's overreliance on the final inspection program. This overreliance raises concerns as to the quality and effectiveness of the QA/QC program that must be resolved.

(a) Violation A(1) -- Welds on CRD Piping Supports

QA:454. Violation A(1) involved welds on CRD hydraulic line supports which were completed with fitup gaps even though the design drawings did not specify a gap requirement, but instead required 3/16-inch fillet welds all around both ends of the supports. Staff Ex. 13, at 14; Museler et al., ff. Tr. 19,757, at 2-3. The installation and welding of the CRD supports was performed by Reactor Controls Incorporated ("Reactor Controls"). Staff Ex. 13, at 14.

QA:455. At the time of the RAT inspection, neither Reactor Controls nor LILCO had measured the fillet welds to determine the actual weld size. Nevertheless, the Staff did not make a 100 percent inspection of the welds in the CRD system; instead, a sampling inspection was performed. Tr. 19,816 (Greenman). Moreover, although the Staff examined dozens of welds in the CRD system, it took fillet weld measurements of only one weld on one typical support with a fitup gap. Its measurements of that weld resulted in Violation A(1). Tr. 19,817 (Higgins).

QA:456. Six additional areas indicative of further unacceptable weld conditions were noted by the Staff during the RAT inspection. The Staff, however, took no measurements of these other welds. Tr. 19,816 (Greenman).

QA:457. The Staff's measurements of the one fillet weld revealed that the weld did not meet design drawing requirements. Staff Ex. 13, at 15; Tr. 19,804-05 (Higgins). This discrepancy had not been identified by Reactor Controls or LILCO prior to the RAT inspection, even though the welds in question had been final inspected and accepted by Reactor Controls. Tr. 19,806 (Higgins); Staff Ex. 13, at 15.

QA:458. Even though the welds were performed and inspected to drawings that did not specify fitup gaps, LILCO testified that the welder and the Reactor Controls inspector believed that such gaps were allowable. Museler et al., ff. Tr. 19,757, at 3. Thus, LILCO asserted that the welding discrepancy identified by the Staff was caused by a lack of specificity with respect to the gap requirement. Museler et al., ff. Tr. 19,757, at 3. Any lack of specificity, however, was with respect to the LILCO drawings. Tr. 19,812 (Higgins). The ASME III Code requirements for the fillet welds address fitup gaps, and the Staff's measurements of the one fillet weld determined that, with the fitup gap, the weld size did not meet design drawing requirements. Staff Ex. 13, at 15.

QA:459. The Staff's limited review of LILCO's response to violation A(1) prevented the Staff from expressing an opinion regarding LILCO's explanation as to the cause of the welding discrepancy. Tr. 19,819 (Higgins). The Staff, however, did acknowledge that the particular weld procedure involved did not specify that the weld be measured. Tr. 19,819 (Greenman). In addition, the Staff noted that design drawings should unambiguously specify whether fitup gaps are allowable. Tr. 19,819-20 (Greenman). The Board fully agrees.

QA:460. Nor was the Staff prepared to give an opinion regarding the adequacy of the corrective action proposed by LILCO. Tr. 19,820 (Greenman). That corrective action consists of a 100 percent re-inspection of all Reactor Controls pipe support welds of the type noted in Violation A(1). Museler et al., ff. Tr. 19,757, at 3; Tr. 19,816 (Greenman). In addition, LILCO has agreed to modify the applicable design drawings to remove any ambiguity regarding fitup gaps. Museler et al., ff. Tr. 19,757, at 3. These corrective action measures had not been completed at the time of the RAT inspection hearing. Tr. 19,816-17 (Greenman).

QA:461. The Staff considered it significant that it had previously brought problems regarding fitup gaps to LILCO's attention. In Inspection Report 79-07, the Staff had identified a violation regarding welds with fitup gaps up to 3/16 of an

inch. Tr. 19,807-08 (Higgins). Like the welding violations identified in the RAT inspection, these fitup gaps had not been specified either in the design drawing or in the welding technique used in performing the welds. Tr. 19,812 (Higgins). Because of the similarities between Inspection Report 79-07 and the welding discrepancy identified during the RAT inspection, the Staff indicated that, as part of its review of LILCO's response to the RAT inspection findings, its welding experts will compare the welding violations in Inspection Report 79-07 to the discrepancy identified in violation A(1). Tr. 19,808 (Higgins); Tr. 19,812-13 (Higgins).

QA:462. Moreover, Reactor Controls performed the welding found to be deficient in both Inspection Report 79-07 and in Violation A(1) of the RAT inspection. Tr. 19,813 (Higgins). This factor will also be taken into consideration in the Staff's review of LILCO's response to the RAT inspection findings. Tr. 19,813-14 (Higgins).

QA:463. The Board finds that LILCO should have specified fitup gap requirements on the design drawings in question. Without such specification, design requirements become ambiguous and subject to the interpretation of both the welder and the QC inspector. For this reason, LILCO should review all applicable design documents for pipe support welds of the type involved in violation A(1). That review should ensure that

ASME Code requirements, including fitup gap requirements, are specified unambiguously.

QA:464. Furthermore, until such time as the Staff completes its review of the LILCO response and performs an evaluation of the similar welding violations identified in Inspection Report 79-07 and during the RAT inspection, the Board finds that there is no basis in the record for determining the adequacy of LILCO's proposed corrective action measures to Violation A(1).

(b) Violation A(2) -- Completed Residual Heat Removal System Hangers

QA:465. Violation A(2) resulted from the Staff's inspection of 12 pipe supports in the Residual Heat Removal ("RHR") system. These pipe supports had been final inspected and accepted by FQC at the time of the Staff's RAT inspection. Tr. 19,821-22 (Higgins). Problems were identified in three of the pipe supports inspected by the Staff. Tr. 19,822 (Higgins).

QA:466. The 12 pipe supports inspected during the RAT inspection were selected on the basis of the Staff inspector's individual judgment. Although there was some degree of randomness involved in the selection, the pipe supports were not selected using statistically valid sampling techniques. Tr. 19,822 (Higgins).

QA:467. Violation A(2) involved two different types of problems. One problem involved torquing of the high strength

bolts on support E11-PSA-109. The bolts were not installed finger tight as required by the design drawing; instead, they were installed with an indeterminate torque in excess of finger tight. Staff Ex. 13, at 15; Tr. 19,821 (Higgins).

QA:468. The second problem involved bearing gaps between lugs and pipe clamps on pipe supports E11-PSSH-173 and E11-PSSH-184. Staff Ex. 13, at 15-16. The Staff noted that there was not full contact between the lugs welded to piping and the pipe clamps supporting the pipe as required by the "full bearing" (i.e., complete surface contact between the mating surfaces) provision of E&DCR 1748S. Museler et al., ff. Tr. 19,757, at 5-6; Staff Ex. 13, at 15-16. For support E11-PSSH-173, less than three of the four lugs were in full contact with the pipe clamp. For support E11-PSSH-184, only three of the four lugs were in full contact with the pipe clamp. Staff Ex. 13, at 15-16. Additionally, the requirements of an E&DCR addressing the bearing requirements of a lug ground to a taper were not met for support E11-PSSH-173 in that only line contact between the clamp and lug existed. Staff Ex. 13, at 15; Tr. 19,821-22 (Higgins).

(i) Bolt Torque on Pipe Support E11-PSA-109

QA:469. According to Mr. Museler, there are only two pipe supports at the Shoreham plant that use high strength bolts required to be installed finger tight. Tr. 19,825 (Museler).

Both of these supports were found during the RAT inspection to have bolts installed with an indeterminate torque in excess of finger tight. Staff Ex. 13, at 15, 17. Pipe support E11-PSA-109 was specifically made part of Violation A(2). Staff Ex. 13, at 15. Pipe support E11-PSA-055 was not made a violation by the Staff because the support had not been final FQC accepted. Nevertheless, the Staff's inspection of that support disclosed that high strength bolts had not been used where required and that the bolts were tightened in excess of finger tight. Staff Ex. 13, at 17.

QA:470. Although LILCO testified that support E11-PSA-055 was in process at the time of the Staff's inspection, and that temporary bolts had been installed to hold the support in position until the high strength bolts were installed, the RAT inspection report noted that the pipe support had been turned over to FQC for final inspection. Staff Ex. 13, at 17; Tr. 19,826 (Museler). Mr. Museler disagreed with the inspection report in this regard, but acknowledged that if the support had indeed been turned over to FQC for final inspection, then that would be a matter of some concern. Tr. 19,827-28 (Museler). Mr. Museler acknowledged, however, that on occasion items are turned over to FQC for final inspection even though the items are not construction complete. Tr. 19,828 (Museler).

QA:471. The LILCO witnesses also disagreed with the Staff's assessment that the bolts on support E11-PSA-109 had been improperly installed. Instead, they asserted that the bolts had been properly installed and that there was, in fact, no nonconforming condition in the field at the time of the Staff's inspection. Museler et al., ff. 19,757, at 4. LILCO reasoned that the nuts and bolts had been installed for some time and that the difficulty in removing the bolts could be attributed to oxidation of the mating surfaces. Museler et al., ff. Tr. 19,757, at 4. The Staff found this explanation plausible, and indicated that it will evaluate that explanation in reviewing LILCO's response to the RAT inspection findings. Tr. 19,832 (Greenman).

QA:472. Despite its testimony regarding the correctness of the original installation, following the RAT inspection LILCO requested Engineering to review this condition and to evaluate the consequences of overtightening the high strength nuts and bolts. Museler et al., ff. Tr. 19,757, at 5. According to Mr. Museler, this Engineering review determined that for the effectiveness of the pipe support to have been reduced, nuts/bolts would have to have been tightened significantly beyond the finger tight torque required by the design drawing. Tr. 19,834-35 (Museler).

QA:473. With respect to the pervasiveness of the identified overtorquing of high strength bolts, the Staff was unable to provide information regarding the number of such bolts inspected during the RAT inspection. Nor was the Staff able to identify the number of bolts found by its inspection to be torqued in excess of the finger tight requirement. Tr. 19,823 (Higgins). LILCO testified that the Staff's inspection had found only two bolts on support E11-PSA-109 not able to be loosened by hand even though the applicable design drawing called for finger tight installation. Tr. 19,823-24 (Museler); Museler et al., ff. Tr. 19,757, at 3. However, as LILCO acknowledged, there are other components or equipment at Shoreham -- for example, equipment mountings -- where finger tight torquing of nuts and bolts is required by design drawings. Tr. 19,836-37 (Museler).

QA:474. The Board finds that there is nothing in the record to support LILCO's assumption that the original installation of the high strength bolts was correct. Thus, despite the results of the engineering evaluation performed by LILCO, the Board finds, on the evidence presented, that the Staff's inspection findings raise questions about the adequacy of Shoreham's final inspection process. The Board is concerned about the lack of Staff review in this regard.

QA:475. In addition, the Board notes that there are design purposes for requiring finger tight torquing of components. Tr. 19,834 (Arrington). The Board finds, however, that, LILCO's proposed corrective action fails to initiate measures to ensure that these design purposes are attained. This must be corrected.

(ii) Bearing Gaps between Lugs and Pipe Clamps

QA:476. As noted, the "full bearing" provision of E&DCR 1748S, the applicable design drawing, required complete surface contact between the mating surfaces between the lugs and pipe clamps on supports E11-PSSH-173 and 184. Staff Ex. 13, at 15-16; Tr. 19,846-47 (Museler). LILCO's final FQC inspection, however, did not inspect for full bearing of all surfaces of the clamp/lug interface. Museler et al., ff. Tr. 19,757, at 6. Instead, LILCO speculated that the particular FQC inspector involved found the bearings acceptable based on his interpretation of the drawings against which the supports were inspected. Tr. 19,841-42 (Museler); Museler et al., ff. Tr. 19,757, at 6. However, as noted by Staff witness Higgins, the drawings should have been clear and unambiguous, thereby eliminating the need for interpretation by the FQC inspector. Tr. 19,840 (Higgins). Moreover, in instances where an FQC inspector has questions, he should go back to Engineering for clarification. Thus, in this particular instance, the FQC inspector, once he did not find

the full bearing called for, should have either gone back to Engineering for clarification, or the item should have been rejected. Tr. 19,840-41 (Higgins).

QA:477. LILCO agreed with the Staff's analysis in this regard. Thus, the LILCO witnesses acknowledged that the applicable design drawing called for full bearing, and not just point contact or positive bearing, and that the FQC inspector should therefore have requested clarification from Engineering rather than passing or accepting the bearing gaps on the pipe supports. Tr. 19,843 (Arrington); Tr. 19,846-47 (Museler).

QA:478. Nevertheless, LILCO asserted that because of the angled surface on the clamps of these supports, full bearing was not possible without specific machining operations. Furthermore, LILCO noted that Engineering had reviewed the condition and determined that full bearing was neither required nor necessary. Thus, LILCO concluded that the FQC inspector's interpretation of the drawings, although technically contrary to the full bearing requirement of E&DCR 1748S, was in accord with the actual Engineering requirement for the pipe support configuration. Museler et al., ff. Tr. 19,757, at 6.

QA:479. Staff witness Greenman disagreed with this analysis, and testified that the violation, as written, was justified, since full bearing between the lugs and pipe clamps was specifically required by the design requirements. Tr.

19,831-32 (Greenman). With respect to whether the subsequent evaluation by Engineering was adequate to determine that full bearing is not required, the Staff had not yet reviewed that aspect of LILCO's response. Tr. 19,832 (Greenman).

QA:480. The Board agrees that the full bearing requirement of E&DCR 1748S specifically required complete surface contact between the lugs and pipe clamps. Thus, FQC's acceptance of the pipe supports was contrary to the requirements of Criterion 10 of Appendix B since the supports did not meet design requirements. As with the improperly torqued high strength bolts, the Board takes no comfort from subsequent Engineering evaluations that determine, after the fact, that a discrepant condition is acceptable "as is." Such evaluations do not remove concerns about the final inspection process that allowed these discrepancies to go undetected.

QA:481. With respect to LILCO's re-inspection of all supports of a "similar configuration" to supports E11-PSSH-173 and 184, it is the Staff's understanding that there are 25 pipe supports in secondary containment and 13 pipe supports in the primary containment that utilize the particular clamp/lug arrangement identified as a problem during the RAT inspection. Tr. 19,848 (Higgins). Pending the results of this re-inspection effort, the Board finds there is nothing in the record to support LILCO's conclusion that adequate bearing for

Shoreham pipe supports having a lug to clamp arrangement has been achieved.

QA:482. With respect to FQC's interpretation of drawings, LILCO witness Arrington testified that in performing an inspection, there is a need to deal with additions to the base design drawing, such as E&DCRs. Tr. 20,040 (Arrington). According to Mr. Arrington, interpretation is required in determining which of these additional documents apply to the item or component being inspected. Tr. 20,040 (Arrington).

QA:483. However, if an inspector has a question about a document he is using in his inspection, he is not supposed to interpret the document. Questions of interpretation are to be brought to the attention of either the inspector's supervisor or, more appropriately, to Engineering. Tr. 20,040-41 (Arrington). Similarly, rather than interpreting installation requirements that may not be clear, Construction is supposed to request clarifications from Engineering. Tr. 20,041 (Museler).

QA:484. The Board agrees that it is the responsibility of Engineering, and not the QA/QC inspector, to interpret design requirements. The Board finds that LILCO should periodically remind its inspection staff of this, and notes that the discrepancy detected by the Staff and involving the bearing gaps of pipe supports E11-PSSH-173 and 184 might have been detected by the Shoreham final inspection process if this practice had been earlier adopted by LILCO.

QA:485. The RAT inspection report identified an additional problem involving the misuse of two different E&DCRs that specified different requirements for bearing between pipe clamps and lugs. In particular, E&DCR 33350C, which addressed bearings for GE-supplied supports, was noted by the Staff to have been used by LILCO in inspecting SWEC supports. The requirements of E&DCR 1748S, however, should have been used for SWEC supports at the Shoreham plant. Staff Ex. 13, at 16; Tr. 19,829-30 (Higgins).

QA:486. LILCO disagreed with the Staff's finding. LILCO testified that SWEC pipe supports have been installed and inspected to the appropriate document (E&DCR 1748S), and that GE supports have been installed and inspected to their appropriate document (E&DCR 33350C). Tr. 19,830 (Museler); Museler et al., ff. Tr. 19,757, at 7.

QA:487. In light of LILCO's additional information, the Staff intends to re-examine its inspection findings so that it can determine whether the inspection of these pipe supports was in fact carried out, as stated by LILCO. Tr. 19,830 (Higgins); Tr. 19,847 (Higgins). Pending this Staff review, the Board finds that there is insufficient information in the record to support LILCO's position.

(c) Violation A(3) -- Cable Tray Supports

QA:488. From a QA/QC perspective, the Staff considers the Shoreham electrical as-built program to be an important program. Tr. 19,849 (Higgins). Thus, the RAT inspection included a review of documentation and installed components associated with that program. Staff Ex. 13, at 13.

QA:489. The intent of the Shoreham electrical as-built program is to provide accurate drawings of the installed electrical equipment, to ensure that all installations are properly qualified, to allow for modification of installations as necessary to meet specified requirements and to ensure that QC inspections are performed with updated, correct documentation. Staff Ex. 13, at 12-13. The program encompasses cable trays, cable tray supports, conduit, conduit supports, cable tray covers, junction boxes and cable wrapping. Staff Ex. 13, at 13.

QA:490. Violation A(3) resulted from the Staff's inspection of nine cable tray supports which had received final QC inspection under Shoreham's electrical as-built program. Tr. 19,855 (Higgins). The Staff inspector observed from his review that four of the supports inspected did not conform to the applicable drawings governing their construction. Tr. 19,850 (Higgins); Staff Ex. 13, at 13.

QA:491. LILCO responded to only three of the four discrepant conditions identified by the Staff in its inspection; nevertheless, LILCO acknowledged that the discrepancies identified with respect to support RB215B were not materially different from the discrepancies that related to the three other supports cited as violations by the Staff. Tr. 19,850-51 (Museler).

QA:492. The nine cable tray supports that were inspected by the Staff were randomly selected from among the 350 cable tray supports that had been final inspected and accepted by FQC as of the time of the RAT inspection. Tr. 19,855, 19,856 (Higgins); Staff Ex. 13, at 13. These supports had also passed through LILCO's CABTRAP program prior to their inspection by the Staff. Tr. 19,855 (Higgins).

QA:493. Despite the fact that discrepancies were identified in four of the nine supports inspected, LILCO believes that its CABTRAP program is nevertheless adequate to verify that Shoreham's cable tray supports conform to the engineering criteria and applicable drawings governing their construction. Tr. 19,860-61 (Museler). Moreover, LILCO did not consider the discrepancies identified by the Staff in Violation A(3) to be the kind of discrepancies that raise concerns regarding the adequacy of the cable tray supports or of LILCO's CABTRAP program. Tr. 19,860 (Museler). In LILCO's opinion, of the three

cable tray supports included within Violation A(3), two were properly installed and the third represented a minor difference in installation that was later verified to be acceptable as built. Thus, in no case did any of the three supports require any rework. Tr. 19,859 (Museler).

(i) Support RB100B

QA:494. The Staff noted that the drawings for cable tray support RB100B indicated that the third horizontal brace of the support supported only one cable tray; however, the actual installation supported two trays. The support also had a lateral brace extending from the east vertical strut to the center of the ceiling brace, which was not shown on the drawings. Staff Ex. 13, at 14.

QA:495. Altnough LILCO informed the Staff at the time of the RAT inspection that support RB100B had been analyzed for two tray loading on the third horizontal brace and that the drawing error was therefore an oversight, the Staff was not advised why the support contained the extra brace. Staff Ex. 13, at 14. Nor did LILCO's Supplemental Testimony address the question of this extra brace. Tr. 19,858 (Higgins). In fact, at the hearing, LILCO's witnesses took issue with the Staff's conclusion that support RB100B contained an extra brace. Tr. 19,868 (Museler); Tr. 19,869-70 (Arrington).

QA:496. In general, the problems identified by the Staff with respect to cable tray support RB100B concerned modifications to the support that were not picked up by the draftsman in preparing the as-built drawing. Tr. 19,863 (Higgins). According to Mr. Museler, the discrepancy resulted from the failure of the draftsman to transcribe correctly the notes made from the walkdown of this support. Tr. 19,867 (Museler). However described, there were drafting errors in the preparation of the as-built drawing.

QA:497. At some point, changes or modifications made in drafting as-built drawings must be reviewed to ensure the accuracy of the drawings. Tr. 19,864 (Higgins). Without such a review, there is a significant loophole in the as-built program. Tr. 19,864 (Higgins). Mr. Museler agreed with the Staff's assessment in this regard, and acknowledged that the reviewer of the as-built drawing for support RB100B had not detected the drafting error. Thus, there were two mistakes made with respect to the support. Tr. 19,867-68 (Museler).

QA:498. According to Mr. Museler, there is no QA/QC review of changes or modifications made in drafting as-built drawings to ensure the accuracy of the drawings. However, SWEC's EA program is responsible for ensuring the accuracy of Shoreham's electrical as-built drawings. Tr. 19,865-66 (Museler).

QA:499. LILCO concluded that, other than revising the as-built drawing for support RB100B to reflect the second tray, no further preventive or corrective action is required, since the constructed support is in accordance with the design, and there is no reason to believe that the identified discrepancies were other than "isolated human error." Museler et al., ff., Tr. 19,757, at 8. The Staff was unable to respond to this conclusion since its review was not complete. Tr. 19,870 (Higgins); Tr. 19,858 (Greenman). That review, according to the Staff, will address the issue of whether Shoreham's as-built electrical program ensures the production of fully accurate drawings. Tr. 19,870-71 (Higgins).

(ii) Support RB208A

QA:500. The Staff also identified discrepancies with respect to cable tray support RB208A. There, the diagonal lateral brace of the support was installed to the opposite corners of the vertical braces as indicated on the drawings. Staff Ex. 13, at 13. The discrepancy probably occurred because the FQC inspector looked at the brace the wrong way, i.e., the orientation of the drawing was noted to be looking west when it was looking east. Tr. 19,873-74 (Greenman); Staff Ex. 13, at 13.

QA:501. The diagonal lateral brace of support RB208A was installed subsequent to the issuance of the as-built drawing. In fact, the brace was installed pursuant to an E&DCR that was

issued as a result of a walkdown with the as-built drawing. Tr. 19,879 (Arrington). However, the orientation of the reference points listed on the E&DCR were in error. Tr. 19,874-75 (Arrington).

QA:502. According to Mr. Arrington, the as-built drawing and the applicable E&DCR were used by FQC in performing its inspection of support RB208A. Although the reference points on the as-built drawing were exactly opposite those that were drawn on the E&DCR, the FQC inspector did not detect this conflict between the two documents. Tr. 19,878-79 (Arrington).

QA:503. LILCO's corrective action with respect to the discrepancy identified in support RB208A included the revision of the as-built drawing, and a field check of 12 additional cable tray supports having an east/west orientation and their associated as-built drawings. This field check identified one other discrepancy. Museler et al., ff. Tr. 19,757, at 9; Tr. 19,875 (Museler).

(iii) Support RB131

QA:504. The Staff also identified discrepancies with respect to support RB131. There, the diagonal lateral brace of the support located on the west side of the support was required to be located within one foot of the bottom of the brace. Its actual connection point, however, was approximately two feet above the brace's lower end. Staff Ex. 13, at 13.

QA:505. According to LILCO, the brace involved in support RB131 was originally installed in the correct location. However, FQC later determined that the correct hardware had not been installed and issued a Deficiency Correction Order ("DCO"). Tr. 19,883 (Higgins). Following installation of the corrective hardware, the FQC inspector did not re-inspect to ensure that the hardware had been installed in the location required. Museler et al., ff. Tr. 19,757, at 10. According to Mr. Museler, under these circumstances, re-inspection of the location was not required, since the only purpose of the re-inspection was to ensure compliance with the DCO and only the particular nonconformance noted in the DCO. Tr. 19,888 (Museler).

QA:506. Nevertheless, because the installation of the corrective hardware required movement of the brace's termination point to the new location, an E&DCR should have been requested prior to installing the corrective hardware. According to Mr. Museler, issuance of the E&DCR would have ensured FQC's re-inspection of the installed hardware, including re-inspection to verify that the new location was as called for in the E&DCR. Tr. 19,888-89 (Museler). Thus, the failure by FQC to notify Engineering and request an E&DCR was a violation of the Shoreham QC program. Moreover, this was not an isolated event. Thus, Mr. Museler acknowledged that there have been

other instances where final inspected components have been modified after final QC acceptance without obtaining the appropriate Engineering approval beforehand. Tr. 19,890 (Museler).

QA:507. LILCO's believes that the only discrepancy identified with respect to support RB131 was FQC's failure to notify and obtain authorization from Engineering to install the corrected hardware in a new location, Tr. 19,889 (Museler). However, the Staff testified that the discrepancy also occurred because Construction, after notification by FQC, did more than just change the hardware; in addition, the location of the brace was moved. That was not part of the DCO, therefore the work performed was not in accordance with the DCO. Tr. 19,886 (Higgins).

QA:508. As a result of the discrepancy in support RB131, LILCO performed an engineering verification to determine that the as-built condition of the support was acceptable. In addition, the as-built drawing was revised. Museler et al., ff. Tr. 19,757, at 10. This engineering evaluation was performed after the RAT inspection as a result of the discrepancy detected by the Staff. Tr. 19,894 (Museler). However, as noted, there had been no engineering approval for removal of the hardware on the brace of support RB131 until after the RAT inspection. Tr. 19,894 (Museler).

(iv) Conclusion

QA:509. With respect to Violation A(3), Mr. Greenman expressed surprise that there were the kind of discrepancies identified by the Staff with respect to the cable tray supports at Shoreham's stage of construction. Tr. 19,896 (Greenman).

QA:510. The Board shares the Staff's concerns, and finds that, based on the results of the Staff's inspection in the area of Shoreham's electrical as-built program, there is no assurance that FQC inspections are being performed with updated, correct drawings.

QA:511. As noted, four of the nine cable tray supports reviewed by the Staff did not conform to the applicable as-built drawings. Tr. 19,863 (Higgins); Staff Ex. 13, at 13.

QA:512. Moreover, according to Mr. Higgins, the Staff's review, once completed, will likely confirm that the problems involving these supports can be resolved by correcting the applicable as-built drawings. The Staff, however, expects LILCO to initiate corrective action over and beyond the mere correction of these as-built drawings. Tr. 19,863 (Higgins). In the Staff's opinion, given the kind of discrepancies identified during the RAT inspection, a sampling re-inspection by LILCO of all 350 cable tray supports which, at the time of the RAT inspection had been finally inspected, would be appropriate. Tr. 19,901-02 (Greenman). The Board agrees. Accordingly, the

Board will retain jurisdiction of this matter, and LILCO is directed to complete and submit to the Staff acceptable documentation relating to this cable tray support/as-built drawing re-inspection.

QA:513. We further find that LILCO must institute retraining for all FQC inspectors responsible for inspection in the electrical as-built program, and that an appropriate review of this retraining must be performed by the Staff. We are aware that subsequent to the RAT inspection, some retraining of FQC inspectors responsible for inspections in the electrical as-built program was conducted. Tr. 19,880-81 (Arrington); Museler et al., ff. Tr. 19,757, at 9. This training, however, was limited in its scope; it involved only about eight FQC inspectors and lasted only about 45 minutes. Tr. 19,881 (Arrington). In fact, according to Mr. Arrington, this training really consisted of nothing more than a review of the RAT inspection violations regarding the cable tray supports. Tr. 19,881 (Arrington).

QA:514. The Staff's inspection, however, identified discrepancies in the electrical as-built program in addition to the nonconformance of the four supports to their applicable drawings. Discrepancies involving incorrectly installed expansion anchor bolts, missing high strength bolting, unsatisfactory welding and incomplete welding were also

identified. Staff Ex. 13, at 13. These discrepancies were not identified as a violation by the Staff because the cable tray supports involved had not been turned over to FQC for final inspection. Staff Ex. 13, at 13. Nevertheless, the Board is concerned about these discrepancies, and finds that the scope of the FQC retraining should encompass matters in addition to the problems found to exist in the as-built drawings.

QA:515. Our finding that the discrepancies identified by the Staff in Violation A(3) are significant is underscored by the fact that Shoreham's FQC inspectors use as-built drawings to perform final inspections at the plant. Tr. 19,862 (Higgins). We are also concerned about the workload of the electrical FQC group. As noted by the Staff, the workload of that group is significant and may increase as more installations are completed and turned over for final inspection. Staff Ex. 13, at 14. We recognize that the size of the FQC staff has been increased, Tr. 19,898-99 (Greenman); nevertheless, the Staff should evaluate further the FQC workload and submit to the Board its analysis of whether that workload is acceptable to ensure that adequate inspections are performed.

4. Violation D -- Failure to Provide Adequate Verification of Completed Rework for Diesel Generator Modification under Operational QA Jurisdiction

QA:516. With regard to repair/rework conducted under startup jurisdiction on the "A" diesel generator, the Staff examined one in-process rework to replace the governor servo-booster and one completed rework modification to install turbocharger supports. Staff Ex. 13, at 23. For this latter completed modification, the Staff reviewed the OQA inspection records and noted that the final documented OQA inspection had failed to identify a variety of nonconforming conditions in the completed turbocharger support installation. Staff Ex. 13, at 23-24.

QA:517. One nonconforming condition involved a tubular support weld which varied from its design drawing in that it failed to wrap around the entire fitup joint. Museler et al., ff. Tr. 19,757, at 16; Staff Ex. 13, at 24.

QA:518. A second nonconforming condition concerned the welding technique used in the rework which was not qualified for the orientation encountered in the field. Museler et al., ff. Tr. 19,757, at 16; Staff Ex. 13, at 24.

QA:519. The third nonconforming condition involved high strength bolting installations which did not conform to applicable AISC Code requirements in that several bolted joints had their washers missing; in addition, the ASTM A490 high strength

bolts in these installations had been retorqued, in variance with Code requirements. Museler et al., ff. Tr. 19,757, at 17; Staff Ex. 13, at 24; Tr. 19,907 (Higgins).

QA:520. Since these three nonconforming conditions had been final inspected and accepted by OQA at the time of the RAT inspection, Tr. 19,907 (Higgins), the Staff determined that there had not been an adequate inspection by OQA. As a result, the Staff found there was a violation of Criterion 10 of Appendix B. Staff Ex. 13, at 24; Tr. 19,914 (Higgins). The three nonconforming conditions were collectively identified by the Staff as Violation D.

QA:521. Although the Shoreham OQA organization is delegated responsibility to perform inspection of repair/rework items, Tr. 19,910 (Higgins), the construction work involved in Violation D was performed by the LILCO startup organization. Tr. 19,909 (Museler).

(a) Failure to Perform Weld as Required and Use of Nonqualified Welding Technique

QA:522. According to the LILCO witnesses, the failure of the weld to wrap around the entire fitup joint was an oversight by the LILCO startup organization welder who thought he had completed the weld. Museler et al., ff. Tr. 19,757, at 18. However, the welding technique used to weld the support was unqualified for the orientation/angle encountered. Staff Ex. 13, at 24. In addition, the OQA inspector also erred in not

detecting the missing weld material. Museler et al., ff. Tr. 19,757, at 17; Tr. 19,929 (Museler). Thus, there were two separate errors involved in this welding discrepancy. Tr. 19,929 (Museler).

QA:523. Moreover, the RAT inspection was not the first instance in which LILCO had been cited for violations due to the use of nonqualified welding techniques. As noted by Staff witness Higgins, Inspection Reports 78-12 and 78-15 had also identified welding violations similar to the welding violation under Violation D of the RAT inspection report. Tr. 19,911-12 (Higgins). In fact, LILCO's use of nonqualified welding techniques had previously led the Staff to request that LILCO give this matter particular attention. Staff Ex. 8, at 22. Thus, much like Violation A(1), where the Staff intends to review LILCO's response in light of Inspection Report 79-07, the Staff also intends to review LILCO's response to Violation D in light of the welding violations identified in Inspection Reports 78-12 and 78-15. Tr. 19,922 (Higgins).

(b) Inadequate High Strength Bolting Installations

QA:524. According to Mr. Higgins, the startup support personnel who failed to install the washers and who retorqued the A490 high strength bolts were not familiar with the applicable Code requirements for the bolts. Tr. 19,930-31 (Higgins).

QA:525. Nevertheless, as with the welding discrepancies, in the case of the missing washers and the retorqued bolts, the installation errors were compounded by the fact that those errors were missed by OQA inspection. Tr. 19,931 (Higgins).

QA:526. Following the RAT inspection, the Staff was concerned that construction work under the jurisdiction of OQA may not get as rigorous inspection as that done by FQC because of the nature of the work relative to knowledge of construction codes, drawing details, weld criteria and overall good standard installation practices. Staff Ex. 13, at 24. Those concerns had not been resolved at the time of the RAT inspection hearing. Tr. 19,934 (Higgins).

QA:527. Notwithstanding the Staff's expressed concerns, the corrective and preventive action proposed by LILCO with respect to the missing washers and improperly torqued bolts was to install new bolts and washers in the turbocharger support. In addition, by additional training, startup personnel and OQA inspectors were to be informed of installation requirements relating to high strength bolts. Museler et al., ff. Tr. 19,757, at 19-20. This additional training had been provided to the OQA inspectors, but not to startup personnel, as of the time of the RAT inspection hearing. Tr. 19,932-33 (Museler). This training, however, consisted of no more than 45 minutes of instruction regarding bolt torquing and the use of high

strength bolting material. Tr. 19,933 (Museler). The Board finds that such limited training was entirely insufficient.

(c) Conclusions

QA:528. In the Staff's opinion, Violation D raises concerns about the accuracy of the OQA final inspections reviewed during the RAT inspection. Tr. 19,919 (Greenman). However, because it had not completed its review of LILCO's response to Violation D, the Staff was unwilling to draw any conclusions with respect to the overall adequacy of the OQA inspection program. Tr. 19,919, 19,924, 19,929-30 (Greenman). Nor was the Staff willing to comment on whether a re-inspection of a sampling of OQA final inspections would be an appropriate corrective action by LILCO. Tr. 19,920-21 (Greenman).

QA:529. The Board finds that the incomplete nature of the Staff's assessment prevents the Board from finding that construction work under the jurisdiction of OQA is not of concern. Indeed, we find the discrepancies identified by the Staff in Violation D to be of significant concern to our determination of the adequacy of the OQA organization. In this regard, we note that there has been a failure on LILCO's part to demonstrate that OQA personnel are qualified to inspect the work assigned to their purview. Nor has LILCO demonstrated that the problems identified in Violation D were neither representative of the quality of OQA inspection, nor indicative of an overall program failure.

QA:530. For these reasons, the Board finds that LILCO should re-inspect a representative sampling of OQA final inspections. LILCO is directed to submit for Staff review all documentation relating to this re-inspection and any analysis of the results.

5. Violation B -- Failure to Track Adequately the Cold Set Status of Safety-Related Spring Hangers Inside Primary Containment

QA:531. During the RAT inspection, the cold set conditions of several spring hangers in primary containment were inspected. The Staff inspector determined from his review that hangers E11-PSSH-181 and 187 had not been adjusted to the design cold set. Nevertheless, the Master Punch List ("MPL"), used to identify and control outstanding items, indicated that these hangers had been cold set. Staff Ex. 13, at 16. The Staff inspector also discovered that rework to spring supports already cold set did not result in feedback to require resetting, as evidenced by the fact that items were not returned to the MPL. Staff Ex. 13, at 16; Tr. 19,937-38 (Higgins). This failure to control cold set and cold set status of spring hangers resulted in rendering the cold set status of spring hangers in the drywell indeterminate and was contrary to the requirements of Criterion 14 of Appendix B. This violation was identified by the Staff as Violation B. Staff Ex. 13, at 16; Tr. 19,940-41 (Higgins).

QA:532. Although LILCO believed that the two specific pipe supports referenced in Violation B were not different from the required condition, but instead were appropriate and controlled, it nevertheless agreed with the Staff that a more rigorous accounting system for the cold setting of pipe supports was appropriate. Museler et al., ff. Tr. 19,757, at 11-12. Accordingly, following the RAT inspection, LILCO established an additional program for tracking the cold setting of pipe supports. That program, however, will not involve the FQC or the FQA organizations. Tr. 19,942 (Museler). Instead, it is to be conducted by the operating staff and the construction supervisory staff. Tr. 19,942 (Museler). Moreover, any rework to the spring supports subsequent to the Shoreham stress reconciliation program will also be performed by these two organizations. Tr. 19,944 (Museler).

QA:533. As noted, Violation B raised concerns with the Staff about the accuracy of Shoreham's MPL in the area of spring hangers. Tr. 19,946 (Higgins). The Staff, however, noted additional concerns with respect to the Shoreham MPL. Tr. 19,947 (Higgins). Those concerns, as set forth in the RAT inspection report, include the fact that many different site organizations maintain separate lists/programs to keep track of their individual items of responsibility. Until such time as these lists are correlated into one master tracking list, it is

hard to determine the true extent of the amount of work needed to be completed at the plant. Staff Ex. 13, at 34. The prioritization of items and management involvement in determination of MPL items which can be delayed until after fuel load is to be reviewed during subsequent NRC inspections. Staff Ex. 13, at 34.

QA:534. Although the Staff had not completed its review of LILCO's response to Violation B as of the RAT inspection hearing, the Board notes that, during the inspection, the Staff was advised by LILCO that the discrepancies noted with respect to the spring hangers would have been identified since all hangers were to be re-inspected prior to fuel load. Staff Ex. 13, at 17; Museler et al., ff. Tr. 19,757, at 12. The Board finds this concluding statement to be a further example of LILCO's overreliance on the final inspection program and, as such, it is entitled to little, if any, weight.

QA:535. The Board is concerned about the failure of LILCO's prior inspection program to track adequately the status of cold setting of spring hangers. Pending Staff review of LILCO's new program for tracking the cold setting of pipe supports, the Board finds that it is prevented from concluding that there is no longer a concern that similar failures will not recur when performing the final cold set. In this regard, the Staff is directed to complete its review and to submit its

findings to the Board. That review should include consideration of Shoreham's procedures to prioritize punch list items to ensure that the MPL includes all remaining work items, NRC open items and other commitments and open items.

6. Violation C -- Failure to Follow Procedures in the Areas of QC Notification, Engineering Assurance Documentation and Test Procedure Discrepancy Notation

(a) Violation C(1) -- Failure to Control Changes Following Final Inspection Per QC Procedure 15.4

QA:536. Violation C(1) identified a failure by Construction to notify FQC by means of a Repair/Request Notice prior to commencing work on final FQC accepted items. Staff Ex. 13, at 18. This failure was contrary to the requirements of Criterion 5 of Appendix B and Section 17.15A of the Shoreham FSAR which require activities affecting quality to be accomplished in accordance with documented instructions, procedures and drawings. Staff Ex. 13, Appendix A, at 2.

QA:537. Specifically, during inspections of platforms in secondary containment and main steam pipe whip restraints inside primary containment, the Staff identified two examples of the failure of site procedures to control rework/repair activity of FQC inspected and accepted items. The first example involved Platform 21 in secondary containment. The Staff's review disclosed that FQC had torqued and accepted the high strength bolts involved in this structure. Thereafter, an

E&DCR required rework of this platform, including removal of bolts previously inspected and accepted by FQC. This construction activity voided the final FQC inspections. However, notification of Construction's action was not given to FQC. This was a specific violation of QC Procedure 15.4, which requires Construction to notify FQC by means of a Rework/Request Notice when QC inspected items are disturbed. Staff Ex. 13, at 17; Tr. 19,955 (Higgins); Tr. 19,958 (Arrington).

QA:538. The second failure to control rework/repair activity identified by the Staff involved a trolley beam welded to Main Steam Restraint 30. This restraint had been final QC inspected but no Rework/Request Notice had been issued to notify FQC that the design capability of the restraint had been modified and that welds had been made to the restraint. Staff Ex. 13, at 17.

QA:539. Altogether, during the RAT inspection the Staff inspected three platforms in secondary containment. These platforms were selected at random and were inspected to determine whether construction installation requirements had been met. Staff Ex. 13, at 18; Tr. 19,961 (Greenman). The Staff's inspection disclosed that deficiencies existed with all three platforms. Staff Ex. 13, at 18; Tr. 19,956 (Greenman). However, only the deficiencies relating to the high strength bolts on Platform 21 were identified as a violation by the Staff;

deficiencies involving incorrectly installed expansion anchor bolts on two other platforms were not made a violation by the Staff since final FQC inspection of those platforms had not been completed. Staff Ex. 13, at 18.

QA:540. LILCO acknowledged that QC Procedure 15.4 specifically requires notification to FQC of repair/rework to final inspected items by the filing of a Rework/Request Notice. Tr. 19,958 (Arrington). Moreover, LILCO agreed that in the case of both the rework to Platform 21 and the restraint in primary containment, this notification was not given as required by QC Procedure 15.4. Museler et al., ff. Tr. 19,757, at 14. LILCO asserted, however, that in each case, notification was made to FQC through the issuance of the E&DCRs which required Construction to perform the repair/rework activity. Museler et al., ff. Tr. 19,757, at 14.

QA:541. According to the LILCO witnesses, FQC is notified through the issuance of E&DCRs that work has been performed to final inspected items. Upon receipt of such E&DCRs, FQC is required to hold open any items which previously had been final inspected. Tr. 19,957 (Museler). Mr. Arrington indicated that FQC is on the distribution list for all document control items and is required to review all E&DCRs and changes to drawings during the construction phase. Tr. 19,958 (Arrington).

QA:542. Nevertheless, receipt of an E&DCR does not specifically trigger an inspection by FQC, Tr. 19,959-60 (Arrington); nor does FQC necessarily re-inspect previously accepted items on the basis of an E&DCR. Tr. 19,959 (Arrington). Instead, an E&DCR becomes part of the inspection package for the component in question. When called to do final inspection, FQC is instructed to perform the inspection in accordance with the inspection package, including any applicable E&DCRs. Tr. 19,959 (Arrington). Thus, it is not the issuance of E&DCRs, but the filing of repair/rework notification forms, that informs FQC that previously inspected items have been disturbed and require re-inspection. Tr. 19,958 (Arrington).

QA:543. Moreover, in the structural steel area, FQC does not, and has not in the past, formally notified Construction of the areas where inspections have been performed. Tr. 19,963 (Arrington); Museler et al., ff. Tr. 19,757, at 14. Since Construction was not aware that FQC had inspected Platform 21 and the restraint in primary containment, it performed the repair/rework activity without notifying FQC beforehand. Tr. 19,959 (Arrington); Museler et al., ff. Tr. 19,757, at 14.

QA:544. Following the Staff's RAT inspection and the issuance of Violation C(1), LILCO initiated a procedure requiring all structural in-process inspections to be tagged. Tr. 19,970 (Museler). However, this tagging procedure will be applied

only in the structural steel area. Tr. 19,970 (Museler); Tr. 19,972 (Arrington).

QA:545. The Board is concerned about Construction's failures to notify FQC prior to commencing repair/rework on final inspected and accepted items in accordance with QC Procedure 15.4. The problem identified during the RAT inspection was not an isolated instance. Torrey Pines also documented a specific violation of QC Procedure 15.4 in its review of the Shoreham plant. See PFR-045, which involved the disassembly of a pipe support which had been final FQC inspected. Tr. 19,956 (Higgins); LILCO Ex. 59, Volume III, Book 1.

QA:546. Our concern is not alleviated by LILCO's assumption that its final acceptance inspection of Platform 21 and the restraint in primary containment would have detected the discrepancies identified by the Staff. Museler et al., ff. Tr. 19,757, at 14-15; Staff Ex. 13, at 17-18. In light of the concerns we have previously expressed about LILCO's final inspection program, this assumption is entitled to little, if any, weight.

QA:547. The Board also notes that the Staff had not completed its review of LILCO's response to Violation C(1) at the time of the RAT inspection hearing. Tr. 19,960 (Greenman). On the evidence presented, the Board finds that LILCO has not demonstrated adequate procedural controls over repair/rework to

final inspected items. While we are encouraged by LILCO's decision to tag inspected items in the structural steel area, we believe that all final inspected items at the plant should be tagged. Accordingly, LILCO is directed to institute acceptable tagging procedures for all final inspected items and to submit these procedures to the Staff for its review.

(b) Violations C(2) and C(3) -- Procedure and Document Control Violations

QA:548. Violation C(2) involved a design change which was issued initially by GE and then was endorsed by LILCO/SWEC on an E&DCR. This design change affected a number of drawings, one of which was drawing 1.61-207. However, the particular E&DCRs involved were not incorporated into the revised drawing. Tr. 19,972-73 (Higgins).

QA:549. Violation C(3) was closely related to LILCO's failure to incorporate the E&DCRs into drawing 1.61-207. The Staff's concern was that the responsible test engineer had failed to note that there were outstanding E&DCRs not posted on the revised drawing. This was a specific violation of EA Procedure 6.3, Revision 3, Attachment 6.2. Staff Ex. 13, at 22; Museler et al., ff. Tr. 19,757, at 15.

QA:550. These two discrepancies were collectively considered a violation of Criterion 5 of Appendix B, Paragraph 17.1.5.A of the Shoreham FSAR, and Paragraph 5.3.2 of the LILCO Engineering QA Manual. Staff Ex. 13, at 23.

QA:551. Although its review of LILCO's response to Violations C(2) and (3) was not complete at the time of the RAT inspection hearing, the Staff indicated disagreement with LILCO's response and with LILCO's conclusions that no preventive or corrective action was required. Tr. 19,973, 19,976, 19,985, 19,986-87 (Higgins).

QA:552. On the basis of the evidence presented, the Board is unable to find that the discrepancies identified by the Staff are not of concern.

7. Unacceptable Plant Housekeeping

QA:553. For some time, at least as far back as the time of the CAT inspection, the Staff has noted its views that plant housekeeping at Shoreham is deficient and should be improved. Tr. 20,052-53 (Brenner); Tr. 20,008 (Greenman). However, up until the time of the RAT inspection, LILCO's management had been unwilling to accept the Staff's views in this regard. Tr. 20,053 (Higgins).

QA:554. Thus, at the time of the RAT inspection, the Staff determined that plant housekeeping at Shoreham was still not acceptable. Tr. 20,005 (Greenman); Staff Ex. 13, at 2, 5-7. During that inspection, discrepancies were identified in overall controls and physical plant conditions. This was indicated by freestanding water, problems with corrosion, accumulated trash and litter, debris in cable trays and on top of

equipment and an "overall prevalent attitude among site personnel of inattention to housekeeping." Staff Ex. 13, at 2.

QA:555. All of the Staff inspectors involved in the RAT inspection believed there was a prevalent attitude among site personnel of inattention to housekeeping. Tr. 20,005-06 (Greenman). There were two aspects to the Staff's conclusion in this regard. One was an observation of unclean areas; the other was management's overall attitude, reflected by management's decision to postpone final cleanup of the plant. Tr. 20,044 (Greenman).

QA:556. In LILCO's view, it is more efficient to postpone final cleanup until the remaining construction activity at Shoreham is closer to completion. Museler et al., ff. Tr. 19,757, at 21. The Staff, however, has consistently disagreed with this view. As noted by Mr. Greenman, there is no basis in the regulations for postponing final cleanup until construction activity is completed. Tr. 20,009-10 (Greenman).

QA:557. Moreover, in the Staff's view, the Shoreham plant was essentially completed and constructed at the time of the RAT inspection. Thus, the Staff inspectors expected the plant to be much further along with respect to cleanliness, Tr. 20,045 (Greenman). and believed that the Shoreham situation was completely different from what the Staff generally encounters at other plants. Tr. 20,046 (Greenman). This judgment was not

influenced by Shoreham's proposed fuel load date. Tr. 20,045 (Greenman).

QA:558. The Staff found during the RAT inspection that even in those areas where LILCO had established cleanliness zones, LILCO was not adhering to the housekeeping requirements applicable to those particular areas. Tr. 20,044 (Greenman). Thus, the Staff disagreed with LILCO's testimony that the Staff believed that the cleanliness levels in the upper elevations of the primary containment and the radwaste building were appropriate for areas where construction was essentially completed. Tr. 20,054 (Greenman). Contrary to this testimony, housekeeping problems were identified by the Staff during its inspection, even in those areas which had been essentially completed from a construction standpoint. Tr. 20,054 (Greenman).

QA:559. One of the purposes of plant housekeeping is the preservation of material and equipment to prevent damage or deterioration as reflected in Criterion 13 of Appendix B. Tr. 20,006 (Greenman). Thus, the Staff witnesses agreed that if LILCO permits inadequate housekeeping to continue, it is possible that the safe startup and operation of the plant would be adversely affected. Tr. 20,046 (Greenman); Tr. 20,082 (Higgins). That is why there are regulations governing the housekeeping area. Tr. 20,082 (Higgins).

QA:560. The Staff also agreed that the discrepancies that had been identified in the area of plant housekeeping could be construed to be contrary to the requirements of Criterion 2 of Appendix B. Tr. 20,007 (Greenman). Moreover, in the Staff's view, LILCO's housekeeping efforts failed to comply with ANSI Standard N45.2.3 concerning housekeeping during the construction phase of nuclear power plants. Tr. 20,012 (Greenman). LILCO had comitted to this ANSI Standard in the Shoreham FSAR. Tr. 20,011 (Greenman).

QA:561. Based on the foregoing, the Staff, following the RAT inspection, issued Conformatory Action Letter 83-01. This letter was issued to obtain prompt and effective corrective action in Shoreham's housekeeping. Tr. 20,009 (Greenman); Staff Ex. 12, ff. Tr. 19,747. In the Staff's view, assuming LILCO's programs to clean up the plant stay on track, there is no need for any additional corrective or remedial action by LILCO. Tr. 20,055-56 (Greenman).

G. Important to Safety

QA:562. Mr. Hubbard testified that LILCO should identify which components or structures have been covered by the QA program. This identification should list both the components or structures which are "safety-related" and those which are "important to safety." Tr. 15,444 (Hubbard).

QA:563. There has been a debate within NRR, dating back to at least 1975, relating to the proper interpretation of the term "important to safety." There has also been a debate regarding the application of QA to all items falling within GDC 1. Tr. 15,348 (Hubbard).

QA:564. Mr. Hubbard has reviewed the LILCO QA manuals for design and construction operation. He has also reviewed Section 17.2 of the FSAR. His judgment is that the QA manuals and the FSAR both focus on compliance with Appendix B requirements for safety-related items. The QA manuals and the FSAR do not describe a systematic program for items important to safety. Tr. 15,950 (Hubbard). In addition to finding that there was no systematic program for SS&Cs important to safety defined in the QA manuals for the FSAR of LILCO, Mr. Hubbard has also looked at the quality assurance procedures and, in general, each of those apply only to safety-related SS&Cs. Tr. 15,996-97 (Hubbard).

QA:565. When Mr. Hubbard was employed by General Electric, the manual programs which Mr. Hubbard developed related generally to QA for safety-related SS&Cs. There was no systematic program at GE for items that were nonsafety-related. Mr. Hubbard would not characterize the GE program during the time he was employed there as a graded QA program. Rather, a judgment would be made as to whether something was

safety-related or whether it wasn't. If the object in question was not safety-related, then certain things did not apply. Accordingly, the QA program was not graded in the sense that they had nine useable categories or increments. Tr. 15,999-16,000 (Hubbard).

QA:566. Mr. Hubbard was not familiar with any LILCO construction site inspection program for nonsafety-related SS&Cs. No such program is described in the LILCO QA Manual. In response to questions as to whether it is possible that there was another program for nonsafety-related items, Mr. Hubbard testified that if there was such a systematic program, he had not seen that program's manual or any implementing procedures. Tr. 16,005 (Hubbard).

QA:567. Mr. Hubbard was asked whether he could provide specific examples of QA deficiencies which, if undetected during construction, preoperation or startup, could contribute to an increment of risk during operation. In response to this question, Mr. Hubbard testified that it is difficult to predict with any certainty which of the breakdowns in discipline eventually are going to cause problems that might result in an accident. The regulations state that there must be discipline. Discipline should be uniformly applied because it is impossible to predict where problems will occur. Tr. 16,037-38 (Hubbard).

QA:568. Mr. Hubbard agrees that LILCO has some QA requirements for nonsafety-related equipment, components and structures. In attempting to ascertain what LILCO's program is, he looked for a description in the FSAR and couldn't find it. Except for caveats such as those in the fire protection area, there was no systematic program described in the QA Manual and statement of QA policy. Mr. Hubbard then looked at the QA procedures to see if they discuss both safety-related and important-to-safety. He found no systematic program there. Accordingly, Mr. Hubbard was unable to find documentation of a single systematic program which starts from top management and filters all the way down. There is no commitment made in the FSAR to have such a systematic program. Tr. 16,080-81 (Hubbard).

QA:569. In 1976, GE did not have a systematic program for QA on nonsafety-related items in theprogram managed by Mr. Hubbard. Mr. Hubbard does not know whether GE has such a program today. Tr. 16,096-97 (Hubbard).

QA:570. Referring to I&E Inspection Report 82-29, Judge Brenner raised questions relating to E&DCR matters. Mr. Higgins stated that the same E&DCR system is used for both safety-related and nonsafety-related items, but that the degree of attention to changes is quite a bit different if it is a nonsafety-related system. Tr. 16,393-95 (Higgins).

QA:571. The E&DCR problem noted in 82-29, at the bottom of page 6 of that report, falls into a similar category of the violation noted in the I&E Inspection Report 82-26, namely control of the design documents. The difference is that Appendix B does not apply to the item in inspection report 82-29 since it is not safety-related. If the E&DCR problem noted in 82-29 had been a safety-related item, it would have been cited as a violation. Tr. 16,396, 16,957 (Higgins).

QA:572. In the construction program, I&E does not write citations against nonsafety-related systems. Tr. 16,396-97 (Gallo).

QA:573. Prior to pre-operational testing the I&E Inspection Program is directed towards safety-related items, with a couple of minor exceptions, such as fire protection. During the pre-operational testing and operations, the program does take into account some nonsafety-related items. Tr. 16,956 (Gallo).

QA:574. In I&E Report 79-16, the inspectors noted cleanliness discrepancies on Category 2 and 3 equipment, including the control rod drive pumps and the condensate booster pumps. Staff Ex. 8, Attachment 2.B.; Tr. 16,958 (Higgins). These items would fall within the category of important-to-safety but not safety-related. These discrepancies were not cited as violations against Appendix B because they were not

safety-related. They also were not cited as a violations against GDC 1. Mr. Higgins stated that GDC 1 does not say that the control rod drive pumps and the condensate booster pumps must be kept clean. Tr. 16,958-59 (Higgins). Mr. Higgins has never cited a violation against GDC 1, conducted an inspection using GDC 1 or prepared a check list or other guide on how to interpret the QA requirements of GDC 1. Tr. 16,961 (Higgins).

H. Number of I&E Violations

QA:575. Information regarding LILCO's I&E violations vs. those at other plants is set forth on page 41 of the LILCO prefiled testimony. This comes from the tabular summary of information set forth in SC Exhibit 72, which was prepared by Mr. Gerecke. Tr. 12,394, 12,396 (Gerecke); LILCO Ex. 21, at 41. Most of the numbers of noncompliances by various utilities came from printouts from the NRC. There were several gaps in the information, which Mr. Gerecke filled in by calling the QA manager of the involved utility. Tr. 12,396 (Gerecke).

QA:576. The nonconformances listed in Suffolk County Exhibit 72 include only I&E violations. They do not include items such as deviations. The period covered in the document begins in 1975, although there was no particular reason for picking that year. Mr. Gerecke does not recall the number of noncompliances that were cited by the NRC for Shoreham in 1974, although he recalls that it was more than in 1975 or 1976. Tr.

12,397-99 (Gerecke). The evidence indicates that the number of violations in 1974 was 15 or 16. SC Ex. 89B, at 5-1. Mr. Gerecke also did not know how many noncompliances had been cited before that time in 1982. Tr. 12,399 (Gerecke).

QA:577. SC Ex. 72 indicates that for the years 1975-81, Shoreham averaged 7.3 noncompliances per year. Mr. Gerecke would not be surprised if the number of noncompliances in 1982 was higher than that average. Tr. 12,399 (Gerecke).

QA:578. In comparing the number of noncompliances at Shoreham with the number at other plants, Mr. Gerecke did not review the noncompliances with various plants to see what they entailed. Thus, he did not determine whether there were multiple items listed under a particular noncompliance. Tr. 12,399-400 (Gerecke). I&E violations may, in fact, have many different subparts. For instance, I&E Inspection Report 79-16 cites LILCO for a single violation when in fact, five problems were cited by the Staff in that report. Inspections were performed by personnel who were not qualified to the ANSI standard. No mechanism exists to update the equipment storage history cards at the time the equipment changes location. Periodic cleanliness checks were not specified. Caps, covers and plugs had been removed and had not been replaced. Space heaters on two panels were found to be de-energized. Staff Ex. 8, Attachment 2.a. In this instance, multiple remedial actions

were required in order to resolve this notice of violation. Tr. 16,707-08 (Higgins).

QA:579. As of December 15, 1982, I&E had cited LILCO for 16 violations in 1982. This was a larger number than in previous years. The larger number of violations was one of the reasons the Staff asked for a management meeting with LILCO. The meeting was held on August 25. The Staff was concerned that perhaps this larger number was indicative of an upward trend. Tr. 16,669 (Higgins).

QA:580. Mr. Gallo finds that in the last one or two years before plant operation, the number of violations tends to increase. This is because there are a number of new activities that start to occur, e.g. pre-operational testing, and there are additional inspections. Nevertheless, the Staff was concerned about the increase in violations but was not able to determine a specific cause. Tr. 16,671-72 (Gallo, Higgins). There were more inspections in 1982 than in 1981. There was a total of 23 in 1981 and, up to the time of the testimony, there were 29 in 1982 with about 7 more inspections reports for 1982 in the process. Tr. 16,673 (Gallo).

QA:581. From 1974 through February, 1982, the NRC reported 71 violations or deviations at Shoreham. Of this number, 69 were violations. There have been 40 violations of Criterion 5; 7 violations of Criterion 9; and 7 violations of

Criterion 16 pertaining to corrective action. SC Ex. 89B, at 5-1. From April, 1973 through June 1, 1982, I&E Region I issued 73 violations to Shoreham. Staff Ex. 8, at 4.

XI. Torrey Pines

QA:582. The primary focus of the Torrey Pines inspection program was to verify that the Shoreham plant has been built in accordance with the design documents. The program was to assess whether the control programs for the construction process and the design change process have been properly implemented. The Torrey Pines program took as a given the design documents. The Teledyne program, on the other hand, is checking the engineering that goes into the design process. For example, it will verify whether all the inputs that go into the stress analyses are correct. Tr. 12,534-36 (Museler).

QA:583. Mr. Hubbard testified that with respect to the construction review proposed in May 1982 between LILCO and Suffolk County, there were minor differences of opinion regarding what should be considered. In the design area where LILCO had hired Teledyne to look at one mechanical system, there was a major difference of opinion regarding which areas to select for review. The County believed that an electrical system should be looked at as well as an air system, and that it would also be good to look at a GE designed piping system as well as one designed by SWEC. Tr. 15,316 (Hubbard).

A. Introduction

QA:584. Direct testimony regarding Torrey Pines Technology's inspection of the Shoreham plant was filed by LILCO and by Suffolk County. See Testimony of Joseph P. Novarro on behalf of the Long Island Lighting Company, ff. Tr. 17,588; Testimony of Louis D. Johnson of Torrey Pines Technology ("Torrey Pines" or "TPT") on behalf of the Long Island Lighting Company (LILCO Ex. 56); Supplemental Testimony of Louis D. Johnson on behalf of the Long Island Lighting Company, ff. Tr. 18,313; Testimony of Richard B. Hubbard and Dr. Francisco J. Samaniego on behalf of Suffolk County, ff. Tr. 19,068. The NRC Staff filed no testimony and presented no witnesses regarding the Torrey Pines inspection. Nor did the NRC Staff conduct any cross-examination of the LILCO or the Suffolk County witnesses.

QA:585. Torrey Pines was engaged by LILCO to conduct a review of the Shoreham safety-related construction program. The review, conducted May through September 1982, traced Shoreham's construction from the procurement of materials through final construction and turnover to startup, and included an assessment of Shoreham's quality assurance construction program. LILCO Ex. 59, Volume II, at 1-1 and 1-5. Torrey Pines did not, however, assess the adequacy of Shoreham's design. Nor did it address LILCO's proposed operating procedures, including the QA/QC program for operations. Hubbard and Samaniego, ff. Tr. 19,068, at 7; Tr. 17,681-83 (Johnson).

QA:586. The purpose of Torrey Pines' review was to determine whether the Shoreham construction process converted the design requirements into adequately installed hardware. To accomplish this, Torrey Pines: (1) reviewed selected LILCO and SWEC procedures used in the construction process to determine the adequacy of the basic process (Task A); (2) reviewed a selection of the points where the procedures should have been implemented to determine whether they were, in fact, implemented (Tasks B and E); and (3) inspected installed hardware to determine whether the hardware met the design requirements (Tasks C and D). These five Tasks (Tasks A through E) required over 26,000 manhours. Including the processing of Potential Finding Reports (Task F) and project management (Task G), the entire Torrey Pines project totalled over 33,000 manhours. The results of Torrey Pines' review were reported in a three-volume report issued on November 1, 1982. LILCO Ex. 59, Volume II, at 1-5 and 1-6.

QA:587. Torrey Pines' engineers and technicians reviewed more than 11,000 documents, inspected more than 6,000 components and structures, and checked about 150,000 documentation and hardware particulars (individual points or details). LILCO Ex. 56, Attachment 2, at 1-1; Tr. 18,316-17 (Novarro). In reviewing this documentation and hardware, walkdown teams and investigators were instructed by Torrey Pines to identify and

document perceived differences between observed and required conditions. The Discrepancy Report ("DR") form was used to document such differences between what was being reviewed and what was required. Altogether, 371 DRs were filed by the walkdown teams and document investigators. LILCO Ex. 59, Volume II, at 1-7; LILCO Ex. 56, Attachment 2, at 4-2.

QA:588. All DRs were reviewed and evaluated for validity (i.e., to assess whether there was an actual difference between the observed and required conditions). Those DRs determined to be valid were then further evaluated and if a potential for safety significance was identified, a Potential Finding Report ("PFR") was prepared. Of the 371 DRs generated, 103 were judged by Torrey Pines to be invalid. From the remaining 268 valid DRs, 120 PFRs were prepared. LILCO Ex. 59, Volume II, at 1-7 and 1-9; LILCO Ex. 56, Attachment 2, at 4-2.

QA:589. PFRs were reviewed by Torrey Pines and then by the original design organizations (LILCO, SWEC or GE). PFRs were classified as invalid if, after the above-described review, the PFR's initiator and the task leader agreed that the Potential Finding was not a potential safety concern or that the basis for the Potential Finding was inaccurate or incomplete. Valid Potential Findings were classified as either Findings or Observations. If a Potential Finding was a discrepancy that could result in a substantial safety hazard or if

there was an indication of a repetitive or generic deviation that could create a substantial safety hazard, the Potential Finding was classified as a Finding. Potential Findings that were valid, but that did not satisfy these criteria, were classified as Observations. LILCO Ex. 59, Volume II, at 1-11, 1-13. Of the total of 120 PFRs generated, 69 were judged invalid by Torrey Pines. Of the remaining 51 PFRs, Torrey Pines classified 32 as Observations and 19 as Findings. LILCO Ex. 56, Attachment 2, at 4-2.

B. Torrey Pines Was Not Independent from LILCO, Nor Did it Operate Under an Acceptable Protocol

QA:590. Despite Torrey Pines' limited experience in either the design or construction of BWRs, LILCO contacted no organizations with BWR experience before it decided to retain Torrey Pines. LILCO Ex. 58, at 96.

QA:591. Moreover, there were no bidding procedures in LILCO's selection of the Torrey Pines organization. LILCO Ex. 58, at 96. Instead, LILCO accepted Torrey Pines' proposal for the project and contracted the work on the basis of time and materials. The estimated cost to LILCO was $2.3 million. LILCO Ex. 58, at 103-04.

QA:592. Torrey Pines was aware of the significance of LILCO's business. Prior to the Shoreham project, revenues from LILCO had accounted for less than one percent of the annual revenues of GA Technology, the parent company of Torrey Pines.

LILCO Ex. 59, Volume II, at 1-6. The Shoreham project, how , accounted for as much as 20 percent of Torrey Pines' revenues for 1982. LILCO Ex. 57, at 127. As a result, even during the time of Torrey Pines' review of Shoreham, there were business contacts by Torrey Pines' marketing manager with LILCO. Tr. 17,653-54, 18,889-91 (Johnson).

QA:593. At the time Torrey Pines was retained by LILCO, LILCO requested verification that none of the personnel assigned to the Shoreham project had previously been employed either by LILCO on any project, or by SWEC on the Shoreham project. LILCO Ex. 58, at 124. Although Torrey Pines satisfied itself that none of its personnel had any financial interest (for example, equity ownership) in LILCO, it did not determine whether the personnel assigned to the Shoreham review had any financial interest in SWEC, GE or other Shoreham site contractors. Tr. 17,643-45 (Johnson). Nor was it determined whether its personnel had ever provided consulting or advisory services to LILCO, SWEC or GE. LILCO Ex. 57, at 142.

QA:594. LILCO witness Novarro testified that LILCO had retained Torrey Pines solely to allay the concerns of Suffolk County officials and to assure the public that the Shoreham plant had been constructed in accordance with design requirements and satisfactory construction practices. Tr. 18,953-55 (Novarro); LILCO Ex. 58, at 84; Novarro, ff. Tr. 17,588, at

4-5. He also testified that LILCO's sole reason for hiring Torrey Pines was because LILCO had made a commitment to the County to do so during the course of the settlement negotiations regarding an independent physical inspection of the plant. Tr. 18,953-54 (Novarro). Those negotiations, however, were conducted in May of 1982, almost a full month after LILCO first contacted Torrey Pines. LILCO Ex. 58, at 82-83, 86.

QA:595. Had the negotiations between LILCO and the County resulted in a settlement, the County would have been involved in the selection of the consultant for the Shoreham inspection project. The County also would have participated in determining the protocol for the inspection. However, when LILCO itself selected and retained Torrey Pines, the County was excluded from these matters and was prevented from participating in the inspection to ensure Torrey Pines' independence. Hubbard and Sameniego, ff. Tr. 19,068, at 5.

QA:596. In fact, no party other than LILCO had any relationship with Torrey Pines. SC Ex. 112, at 104; Hubbard and Samaniego, ff. Tr. 19,068, at 6; Tr. 16,093 (Hubbard). Further, the protocol for the Torrey Pines project established by LILCO ensured that Torrey Pines interfaced only with LILCO, received information and comments only from LILCO and reported only to LILCO. Thus, only LILCO had the opportunity to influence Torrey Pines. Hubbard and Samaniego, ff. Tr. 19,068, at 6; Tr. 16,094-95, 19,174-76 (Hubbard); SC Ex. 112, at 138-39.

QA:597. Under the protocol established by LILCO, Torrey Pines received information from, and reported to, a limited group of site personnel appointed by LILCO's management. This group, comprised of representatives from, SWEC, GE and the respective Shoreham Startup, QA, Construction and Site Engineering organizations, was responsible for all matters regarding the Torrey Pines project. LILCO Ex. 58, at 20-22. Other LILCO subcontractors were not represented on this group. LILCO Ex. 58, at 46-47.

QA:598. As LILCO's liaison to Torrey Pines, any member of this group could perform such perfunctory tasks as providing data to Torrey Pines or assisting Torrey Pines in gaining access to different areas of the plant. More important matters, however, generally required handling by Mr. Novarro, who was given overall responsibility for the Torrey Pines project. Thus, Mr. Novarro personally reviewed and approved every LILCO (or other original design organization) response to Torrey Pines' Potential Findings. Moreover, these responses were prepared by site personnel selected by Mr. Novarro. LILCO Ex. 58, at 26-36.

QA:599. Of course, over the course of its review of the Shoreham plant, Torrey Pines' engineers and technicians had frequent contact with site personnel other than the group of individuals designated by LILCO. LILCO Ex. 58, at 43, 45.

This contact provided additional opportunities for LILCO or its contractors to influence the conduct and the results of the Torrey Pines review. For example, Torrey Pines and LILCO discussed, among other things, the discrepancies identified by Torrey Pines. Tr. 17,663-68, 17,670-75 (Johnson). Once a Discrepancy Report was completed, a copy was given to LILCO for its review. LILCO Ex. 57, at 122.

QA:600. The protocol under which Torrey Pines operated was inadequate for other reasons. No party to these proceedings, other than LILCO, had the opportunity to review or comment on such matters as Torrey Pines' scope of work, acceptance criteria, schedule and resource allocation. Hubbard and Samaniego, ff. Tr. 19,068, at 6; Tr. 16,092-93 (Hubbard). LILCO not only had this opportunity, but, in some respects, it was able to dictate matters to Torrey Pines. For example, at the time Torrey Pines was retained for the Shoreham project, it was instructed by LILCO to complete the project before fuel load, which was then scheduled for September of 1982. LILCO Ex. 57, at 48; LILCO Ex. 58, at 65. This LILCO-imposed scheduling requirement impinged upon resource allocation by Torrey Pines. LILCO Ex. 57, at 68, 162.

QA:601. Other problems with Torrey Pines' protocol may have been disclosed if access to the documents underlying Torrey Pines' Final Report, and not contained in the Report,

had been provided to Suffolk County. Examples of some of the underlying documents not contained in the Torrey Pines Final Report are procedures and inspection checklists. Hubbard and Samaniego, ff. Tr. 19,068, at 6.

QA:602. The Board finds that Torrey Pines was not acceptably independent from LILCO, nor did it operate under an acceptable protocol. The Board agrees with Suffolk County that all parties to this proceeding, as well as the Board, should have been provided a meaningful role in the Torrey Pines review. Because no party other than LILCO had any relationship with Torrey Pines, the Board is concerned about the credibility of Torrey Pines' review and inspection. The Board finds that Torrey Pines' conclusions regarding the Shoreham QA/QC program are entitled to little, if any, weight.

C. The Scope of Torrey Pines' Review Was Not Adequate To Support the Conclusions Reached by Torrey Pines

QA:603. The Torrey Pines inspection did not include a comprehensive design review, physical inspection, and QA/QC review adequate to verify that the design and construction of Shoreham have been implemented in accordance with FSAR commitments and regulatory requirements. Hubbard and Samaniego, ff. Tr. 19,068, at 6-7. As previously noted, the subject of Torrey Pines' review was limited to the Shoreham construction process. See Finding QA:586, supra. The adequacy of Shoreham's design and of LILCO's operating procedures was not addressed by Torrey Pines. LILCO Ex. 59, Volume II, at 1-1, 1-5.

QA:604. In fact, because the scope of Torrey Pines' inspection was improperly limited in important areas and was influenced from the outset by LILCO. Therefore, Torrey Pines did not provide an adequate review of the Shoreham construction process. Hubbard and Samaniego, ff. Tr. 19,068, at 7.

QA:605. At the time of its initial contact with Torrey Pines, LILCO presented its views on the scope of the Shoreham construction review. Those views were given serious consideration by Torrey Pines when it established the scope of the project. LILCO Ex. 58, at 106-07, 112-13. Thus, Torrey Pines agreed to LILCO's request to inspect all safety-related large-bore pipe supports at Shoreham even though Torrey Pines thought that such an inspection was unnecessary. LILCO Ex. 57, at 93; LILCO Ex. 58, at 115. LILCO, however, did not inform Torrey Pines that the construction of these pipe supports was incomplete. LILCO Ex. 57, at 99. As a result, Torrey Pines' assessment of the large bore supports was conducted against a changing construction baseline. Also, the ongoing construction and QA/QC activities prevented TPT from verifying that the supports were constructed in accordance with design requirements. Hubbard and Samaniego, ff. Tr. 19,068, at 11.

QA:606. Mr. Johnson, the Shoreham project manager for Torrey Pines, explained that Torrey Pines' approach to the project focused on the construction control process, (i.e.,

primarily the QA program requirements) at Shoreham. By reviewing the construction control process, Torrey Pines sought to determine whether LILCO had effectively implemented the requirements of the QA program in the construction phase. Thereafter, hardware was inspected in order to verify that the process, in fact, produced hardware that complied with design requirements. Based on this limited inspection of some of the plant's hardware, Torrey Pines then extrapolated and made judgments regarding the adequacy of all the plant's hardware produced by the construction control process. LILCO Ex., 57, at 49-50, 76-77. According to Mr. Johnson, this "process-oriented" approach differed from the approach to the project proposed by LILCO. Basically, however, the two approaches differed only by Torrey Pines' addition of Tasks A and B and by its expansion of the scope and level of detail of some of Task C. LILCO Ex. 57, at 78, 86-87, 92.

QA:607. Irrespective of the question of LILCO's influence over Torrey Pines, the approach used by Torrey Pines is subject to criticism. First, that approach relied on the engineering judgment and experience of Torrey Pines and rejected the use of statistically valid sampling techniques. As a result, the general conclusions reached by Torrey Pines are invalid. See Findings QA:711-32, infra.

QA:608. Second, Torrey Pines limited its review to safety-related (i.e., LILCO QA Category 1) features; thus, components and equipment "important to safety" were not included within the review. Tr. 17,696-97, 17,702 (Johnson). As a result, the Torrey Pines review can provide no assurance that the QA/QC requirements of GDC 1 of Appendix A to 10 CFR Part 50 have, in fact, been implemented. Hubbard and Samaniego, ff. Tr. 19,068, at 7-8. In fact, Torrey Pines made no independent determination of the safety-related status of components, systems or items at Shoreham, but instead relied on LILCO to identify the safety-related systems in the plant. Tr. 17,697 (Johnson).

QA:609. Third, each of the Tasks carried out by Torrey Pines is subject to criticism under the approach used by Torrey Pines. For example, Task A was intended to determine if the safety-related construction QA/QC process used by LILCO and SWEC was adequate, and was accomplished by reviewing a sample of the LILCO and SWEC procedures and manuals which defined QA/QC controls applied to the Shoreham construction efforts, which began in 1973. LILCO Ex. 59, Volume II, at 2-1; Tr. 17,690-91 (Johnson). Certain areas of the Shoreham construction control QA/QC program, however, took place prior to 1973 -- for example, material, components and equipment were procured prior to 1973. Tr. 17,685 (Johnson); Tr. 17,686

(Novarro). Although Torrey Pines did review some pre-1973 documentation in connection with Task B, that review was limited in scope and the documentation was compared against the requirements of the Shoreham PSAR that was in existence in 1973. Torrey Pines chose to review only a sampling of LILCO or SWEC procedures and manuals which were in existence before 1973. Tr. 17,691-92, 17,695-96, 17,926-27 (Johnson). Nevertheless, in Torrey Pines' view, its Task A review constituted a 100 percent inspection effort. LILCO Ex. 57, at 98.

QA:610. Torrey Pines reviewed some 606 procedures under Task A, including 20 LILCO and SWEC procedures and manual revisions which, for the most part, covered the years 1972 to 1976. LILCO Ex. 59, Volume II, at 2-14; Tr. 17,956 (Johnson). Although the County was unable to solicit information regarding when the procedures became effective, Tr. 17,957, 17,964 (Johnson), it was determined that, with the exception of the 20 procedures and manual revisions, the procedures reviewed by Torrey Pines were only those procedures in effect at the time of Torrey Pines' review under Task A. Moreover, unlike the current construction control program procedures and manuals, which were reviewed in their entirety by Torrey Pines, the 20 earlier procedures and manual revisions reviewed by Torrey Pines represented only a small portion of the procedures and manuals in effect during the period 1969 to the present time.

Tr. 17,970, 17,977, 17,984 (Johnson). Thus, there may have been periods of construction during which none of the procedures reviewed by Torrey Pines were in effect. Tr. 17,968-69 (Johnson).

QA:611. Fourth, Torrey Pines limited its review under Task A to the LILCO and SWEC QA/QC manuals and procedures. Torrey Pines excluded other site contractors with QA/QC programs from its assessment of Shoreham's overall QA/QC program. Hubbard and Samaniego, ff. Tr. 19,068, at 11. Aside from SWEC, site contractors with their own QA/QC programs during Shoreham's construction included: Courter and Company, the piping and mechanical contractor; NISCO, which performed work on the primary shield wall; Reactor Controls, which worked on the control rod drive installations; and Nuclear Energy Services, the preservice/in-service inspection contractor. Tr. 17,930-34 (Novarro). These contractors accounted for approximately 30 percent of the total plant construction work. Tr. 17,944-45 (Novarro).

QA:612. Despite the substantial construction responsibility of these site contractors, Torrey Pines did not consider it necessary to its overall assessment of Shoreham's QA/QC program to review their QA/QC programs. Tr. 17,928, 18,895 (Johnson); LILCO Ex. 57, at 231, 235. Thus, notwithstanding its exclusion of these contractors, Torrey Pines concluded with respect to

Task A that Shoreham's construction control program was satisfactory. LILCO Ex. 59, Volume II, at 2-14; Tr. 17,938 (Johnson). Further, despite having limited its review to the LILCO and SWEC QA/QC programs, Torrey Pines concluded that the overall QA/QC program implementation for all site contractors was adequate. These conclusions were based, in part, on Torrey Pines' assumption that site contractors having their own QA/QC programs would structure those programs to comply with the SWEC QA/QC program. Tr. 17,939-42, 17,951-54 (Johnson). Torrey Pines also thought that its review disclosed some "evidence" that the QA/QC programs of these other site contractors were adequately implemented. Tr. 18,896 (Johnson). This "evidence", however, consisted of nothing more than Torrey Pines' review, under Task B, of a few procedures in Courter's QA program, Tr. 18,978-79 (Johnson), and its equally limited review, under Task D1, of a small number of procedures used by Nuclear Energy Services in conducting the preservice inspection of some welds. Tr. 18,981 (Johnson). There was no specific "evidence" with respect to the QA programs of Reactor Controls or NISCO. Tr. 18,980 (Johnson).

QA:613. Aside from the questionable validity of its overall conclusions under Task A, Torrey Pines' criteria for deciding when discrepancies should be reported under Task A were applied in a discretionary manner. Those criteria

required errors, omissions, conflicts or lack of clarity in procedures or manuals to be documented in Discrepancy Reports. In applying these criteria, Torrey Pines determined that there were no discrepancies in any of the 606 procedures and manuals reviewed. Tr. 17,993-94 (Johnson); LILCO Ex. 59, Volume II, at 2-12. However, for a DR to have been written under Task A, it was required that the observed deficiency be a matter which, in the judgment of the Torrey Pines reviewer, was of some significance to the Shoreham construction control program. Tr. 18,001 (Johnson). Thus, Torrey Pines' conclusions regarding the Shoreham construction QA/QC control program under Task A were based, in large part, on the discretion and judgment of the Torrey Pines reviewer. Tr. 18,002 (Johnson).

QA:614. As structured by Torrey Pines, Task B of the Shoreham review is subject to the same kind of criticism rendered against Task A. Task B was designed to determine whether the construction-related procedures and manuals identified in Task A were properly implemented. The Task was carried out by reviewing portions of selected construction records (document packages) of 45 safety-related components. Tr. 18,023-24 (Novarro); Tr. 18,049 (Johnson). These 45 components were drawn from a total population of approximately 100,000 safety-related items, Tr. 18,026, 18,054 (Novarro), and were selected solely on the basis of Torrey Pines' judgment from the

list of safety-related components that were physically inspected under the Task C walkdown review. Tr. 18,024-25 (Novarro); Tr.18,008-09, 18,049 (Johnson), LILCO Ex. 59, Volume II, at 3-1, 3-4.

QA:615. Torrey Pines did not review the construction records for the 45 safety-related components against the construction-related procedures and manuals in effect at the time such components were procured and installed. Instead, those construction records were reviewed against the current Shoreham procedures and manuals. LILCO Ex. 59, Volume II, at 3-1; Tr. 18,014-15, 18,017 (Johnson). Thus, earlier revisions or changes to the current procedures -- for example, between the time a selected component was first procured and installed and the time the procedure was subsequently revised so as to become "current" for purposes of Torrey Pines' review -- were not within the scope of Torrey Pines' review under Task B. Tr. 18,016 (Johnson).

QA:616. A total of 1,150 documents, involving an estimated 31,000 particulars, or requirements, were examined in Task B. LILCO Ex. 59, Volume II, at 3-4; Tr. 18,026, 18,028, 18,038 (Johnson). As in Task A, the Torrey Pines reviewer exercised judgment in determining whether to write a Discrepancy Report. Tr. 18,029-30 (Johnson). From the 25 DRs initiated as a result of Task B, seven PFRs were prepared by Torrey Pines. One PFR

was classified as a Finding, one as an Observation, and five were determined to be invalid. LILCO Ex. 59, Volume II, at 3-7. Although Torrey Pines reasoned that Task A's procedures and manuals had been satisfactorily implemented, and that this conclusion was supported by its determination that there was but a single Finding as a result of the Task B review, this same kind of extrapolation was not performed with respect to the remainder of the discrepancies identified under Task B. Tr. 18,062-63 (Johnson).

QA:617. In concluding that the construction procedures and manuals identified in Task A were effectively implemented, LILCO Ex. 59, Volume II, at 3-8, Torrey Pines did not attempt to correlate the Task B discrepancies to the particular component document packages that had been reviewed. Instead, Torrey Pines' sole basis for deciding that the Shoreham QA process was properly implemented was its judgment that the discrepancies in Task B revealed no significant safety concerns. Tr. 18,041, 18,045, 18,060-61 (Johnson).

QA:618. Torrey Pines did find, however, that there was a lack of timely incorporation of E&DCRs into Shoreham's design documents. Nevertheless, Torrey Pines did not generate any DRs in this regard since it could find no requirement in the Shoreham construction control program for incorporation of E&DCRs in the design drawings. Tr. 18,038 (Johnson). This was

a significant omission by Torrey Pines, since the timely incorporation of E&DCRs in design drawings is required by 10 CFR Part 50, Appendix B. Tr. 18,038-39 (Johnson).

QA:619. As noted, the scopes of Tasks A and B were inadequate to support the conclusions reached by Torrey Pines; and, Torrey Pines' review under Task C was also improperly restricted in several important areas. In Task C, Torrey Pines visually inspected selected items to determine whether installation and construction complied with design requirements. Conformance was checked by visually comparing the plant's hardware, as installed, against the applicable design documents during inspection walkdowns. In performing these visual inspections and walkdowns, approximately 6000 different pieces of equipment and structures were checked. LILCO Ex. 59, Volume II, at 4-1 and 4-2.

QA:620. Torrey Pines chose systems that serve a safety function in plant operation for inspection under Task C. LILCO Ex. 59, Volume II, at 4-1. In deciding which safety-related systems and components to review, Torrey Pines first selected what it believed were the predominant, or most likely, paths to cold shutdown. LILCO Ex. 57, at 111. That selection, in Torrey Pines' opinion, identified the more significant elements in the plant's safety-related hardware. It was these elements which were inspected in the Task C walkdowns. Tr. 18,910-11 (Johnson).

QA:621. Systems having safety-related functions, but not considered by Torrey Pines to be important to the cold shutdown activities of the plant, were not included for inspection under Task C. LILCO Ex. 59, Volume II, Table 4.2-1, at 4-5; Tr. 18,084-85 (Novarro); Tr. 18,095 (Johnson). According to Mr. Novarro, however, at least one of the excluded systems, the condensate and feedwater system, is used to get to cold shutdown. Tr. 18,096-97 (Novarro). In addition, other systems with safety-related portions were excluded from the scope of the Task C walkdowns. Tr. 18,102-03, 18,144A-53 (Johnson). Torrey Pines assumed that since the construction control program had been adequate with respect to the safety-related hardware inspected, that same program would necessarily ensure the adequacy of all other safety-related hardware in the plant including that safety-related hardware that was not inspected. Tr. 18,910-11 (Johnson).

QA:622. Thirty-two of the 37 systems selected for walkdowns under Task C were identified for Torrey Pines by LILCO at the initial meeting between the two organizations. Tr. 18,094 (Johnson). Moreover, the five safety-related systems added by Torrey Pines required LILCO's authorization beforehand. LILCO Ex. 58, at 113. This was consistent with Torrey Pines' understanding that major changes in the project's scope required LILCO's approval. LILCO Ex. 58, at 116-17, 118.

QA:623. At the time it made its selection of the items inspected under Task C, Torrey Pines had reviewed no I&E inspection reports for Shoreham. Moreover, it never reviewed any of those reports, even though it acknowledged that such reports might have been relevant to the scope of the Task C walkdowns. Tr. 18,115-16 (Johnson). Also, LILCO did not inform Torrey Pines of problems identified by the Staff in its various inspections of the Shoreham plant. Tr. 18,112-13 (Johnson, Novarro).

QA:624. Specific features of the 37 systems were selected for walkdown using different levels of detail. Features walked down at Level 3 were subjected to the most detailed review. Most features were reviewed at Level 1. LILCO Ex. 59, Volume II, at 4-4.

QA:625. The Level 1 walkdown was a visual inspection during which installed components were compared to their appropriate flow diagrams. Tr. 18,106 (Johnson). The flow diagrams were used by Torrey Pines for the sake of efficiency. Tr. 18,107 (Johnson).

QA:626. Task C was divided into the pipe support, electrical and mechanical areas. The number of manhours expended under Task C was estimated to be fairly evenly divided among these three areas. Tr. 18,173 (Johnson). Walkdown package preparation may have accounted for as much as half of the total time expended on Task C. Tr. 18,175 (Johnson).

QA:627. Torrey Pines did not know the total population of the various types of items inspected under Task C. Nor did it consider such knowledge to be significant to the conclusions reached from its walkdown of the Shoreham plant. Tr. 18,159-60 (Johnson). Thus, with respect to Task C's mechanical walkdown, Torrey Pines inspected a total of four flow elements at walkdown Levels 2 and 3. LILCO Ex. 59, Volume II, Table E-2, at 4E-4; Tr. 18,196 (Johnson). Based on this limited inspection, Torrey Pines concluded that the installation or construction of all other flow elements in the plant was satisfactory, even though neither the total number of flow elements in the plant nor the number of different types of flow elements in the plant was known to Torrey Pines. Tr. 18,196-98 (Johnson). Moreover, even when the total population of a specific type of component was known, the sample selected for inspection was often very small. For example, of 72 safety-related NSSS loops, and 62 balance-of-plant safety-related control loops, Torrey Pines inspected just one loop from each. LILCO Ex. 59, Volume II, at 4-193; Tr. 18,176 (Johnson). Coupled with Torrey Pines' selection of items for inspection on a nonrandom (i.e., judgmental) basis, this use of small sample sizes renders invalid the conclusions reached by Torrey Pines. Tr. 19,221-22 (Samaniego).

QA:628. The major emphasis of Torrey Pines' inspection under Task C was devoted to evaluating Shoreham's mechanical and pipe support areas. These areas constituted about 47 percent and 45 percent, respectively, of the total features checked and resulted in 49 percent and 17 percent of the Discrepancy Reports generated. In contrast, the electrical walkdown, constituting 8 percent of total features checked, resulted in about 34 percent of the Discrepancy Reports. LILCO Ex. 59, Volume II, at 7-25; Hubbard and Samaniego, ff. Tr. 19,068, at 9. The number of components or features inspected by Torrey Pines was based solely on its judgment as to the number of items required to be examined to provide a sufficient basis for its conclusions about the Shoreham construction QA/QC control program. Tr. 18,164-65, 18,170 (Johnson).

QA:629. Torrey Pines justified the widely differing percentages between the number of items inspected in the electrical and mechanical walkdowns and the number of discrepancies identified by making adjustments for the electrical component identification difficulties vis-a-vis the simplicity of mechanical pipeline verification. LILCO Ex. 59, Volume II, at 7-25 and 7-26. These adjustments were not warranted since the electrical, mechanical and piping features are of similar complexity, both with respect to identification and otherwise. SC Ex. 112, at 169-70. Moreover, the alleged complexity of electrical

features did not explain why the Shoreham QA/QC program failed to reveal and cure deficiencies. Hubbard and Samaniego, ff. Tr. 19,068, at 10.

QA:630. LILCO was fully aware that, in the County's view, the scope of Torrey Pines' electrical review was too narrow. LILCO Ex. 58, at 151. Nevertheless, even after it became clear to Torrey Pines that discrepancies in Shoreham's electrical features occurred with a much higher frequency than in other systems, the scope of the inspections of electrical items was not expanded. Hubbard and Samaniego, ff. Tr. 19,068, at 10.

QA:631. The scope of Torrey Pines' inspection of electrical features was restricted in other ways. With respect to its inspection of Shoreham's electrical cabling systems, Torrey Pines assumed that the design was adequate. Thus, although it verified that the electrical signal went from the source to the termination point in the installed cabling, there was no sneak testing performed, i.e., Torrey Pines did not test the electrical circuits to determine whether the signal went to any point other than the design termination point. Nor was any test performed to verify the magnitude of the voltage and amperage. Tr. 18,155-57 (Johnson). Moreover, even after it became aware of electrical separation implementation problems in the plant, Torrey Pines did not inspect electrical separation, since LILCO considered that area to be a design issue. Tr. 18,119-20 (Johnson); Tr. 18,120 (Novarro).

QA:632. Following its Task C review, Torrey Pines concluded that the construction of Shoreham's safety-related mechanical equipment and pipelines was satisfactory. LILCO Ex. 59, Volume II, at 4-195. This conclusion was based on Torrey Pines' judgment, Tr. 18,195-96 (Johnson), and was made notwithstanding the fact that only portions of the plant's mechanical systems were physically inspected. Tr. 18,183 (Johnson). However, the process of extrapolating from a sample to the total population requires the use of statistically valid random sampling methods. Thus, Torrey Pines' judgment sampling prevented the very kind of overall conclusion reached under Task C. Tr. 19,231 (Samaniego).

QA:633. Torrey Pines' conclusions regarding the adequacy of the construction of Shoreham's safety-related electrical equipment and pipe supports were based on Torrey Pines' judgment. Tr. 18,204-07 (Johnson); LILCO Ex. 59, Volume II, at 4-198. Thus, these conclusions were also invalid, Tr. 19,231 (Samaniego), even though, unlike the conclusions regarding the mechanical and electrical walkdowns (which were based on a small sample of equipment and components), the conclusions regarding the pipe support walkdowns were based on a significant sampling of the pipe support systems. Tr. 18,206-07 (Johnson). In fact, at LILCO's request, Torrey Pines inspected all safety-related large bore pipe supports at the plant. Tr.

18,213 (Johnson). Torrey Pines found a number of supports to be incorrect, incomplete and in various stages of rework at the time of its review. Nevertheless, it assumed that LILCO's construction control program would ensure proper completion of the supports, and concluded that the construction of Shoreham's pipe supports was satisfactory. LILCO Ex. 59, Volume II, at 4-197; Tr. 18,207-08 (Johnson).

QA:634. Under Subtasks D1 and E1, Torrey Pines reviewed a limited number of piping welds and Certified Material Test Reports ("CMTRs"). This review of Shoreham's hardware and documentation should have been broader in scope. A more serious deficiency, however, was Torrey Pines' use of the results obtained to extrapolate to conclusions about the entire plant. Tr. 19,127 (Samaniego).

QA:635. In Subtask D1 Torrey Pines examined a sample of 75 ASME large bore piping welds covered by the Shoreham Preservice Inspection ("PSI") program. LILCO Ex. 59, Volume II, at 5-1. In selecting these 75 welds for testing, Torrey Pines did not know the number of other safety-related welds in the plant. Tr. 18,224 (Johnson). Further, the Subtask D1 inspection was limited to accessible welds covered by the PSI program even though a "large number" of safety-related welds are not covered by that program, Tr. 18,225 (Johnson), or are inaccessible. LILCO Ex. 59, Volume II, at 5-1.

QA:636. Although Torrey Pines concluded that the large-bore piping welds examined were satisfactory, that conclusion was limited to the particular welds tested under Subtask D1. Nevertheless, Torrey Pines relied on the results of Subtask D1 to extrapolate to the conclusion that other welds in the plant are satisfactory. Tr. 18,225 (Johnson). That conclusion has no validity since the sampled population was not drawn randomly, but was selected on the basis of Torrey Pines' engineering judgment. Tr. 19,101-02, 19,104 (Samaniego).

QA:637. In Subtask E1, Torrey Pines reviewed selected CMTRs for ASME piping materials to determine whether the documentation for the materials complied with specification requirements. LILCO Ex. 59, Volume II, at 6-1. The CMTRs reviewed were selected on the basis of Torrey Pines' judgment upon the 37 systems inspected under Task C. Tr. 18,237-38 (Johnson).

QA:638. Although Torrey Pines concluded that the safety-related piping systems materials test data were satisfactorily documented and conformed to ASME III Code requirements, LILCO Ex. 59, Volume II, at 6-5, that conclusion was limited to the particular CMTRs reviewed under Subtask E1. However, as with its Subtask D1 conclusions, Torrey Pines extrapolated from the particular CMTRs reviewed to conclude that other piping materials data in the plant are satisfactory. Tr.

18,238-39 (Johnson). Again, Torrey Pines' flawed methodology renders this conclusion invalid. Tr. 19,125 (Samaniego).

QA:639. Based on the foregoing, the Board finds that the Torrey Pines review did not provide a comprehensive design review, physical inspection and QA/QC review to verify that the design and construction of Shoreham have been implemented in accordance with regulatory requirements and FSAR commitments. The Torrey Pines review was limited to the Shoreham construction phase. Thus, the adequacy of Shoreham's design and of LILCO's proposed operating procedures were not addressed by Torrey Pines.

QA:640. Moreover, the Board finds that the scope of Torrey Pines' review of the construction phase was not adequate to support the conclusions of the Final Report. Torrey Pines' review was improperly limited in at least three important areas: equipment "important to safety" was not included within the review; the review of electrical equipment was restricted; and the review of Shoreham's QA/QC programs was limited to the QA/QC measures applied to safety-related items and did not include the QA/QC programs of Shoreham site contractors.

QA:641. The Board further finds that Torrey Pines' failure to use statistically valid sampling techniques renders the conclusions reached in the Final Report invalid. Rather than relying on its judgment to the exclusion of statistical

techniques, Torrey Pines should have combined statistical methodology with engineering judgment in selecting samples for inspection and in evaluating the significance of inspection findings. In that way, statistically valid data could have been obtained that would have permitted extrapolation of the inspection results to features beyond those structures, components and QA records and documentation reviewed.

D. Torrey Pines' Discrepancy/Finding Process Was Deficient

QA:642. In conducting its review of the Shoreham plant, Torrey Pines grouped multiple discrepancies within individual Discrepancy Reports. Tr. 18,324-25 (Johnson); Johnson, ff. Tr. 18,313, at 2, 4. Torrey Pines sometimes also grouped more than one DR within a single PFR. Johnson, ff. Tr. 18,313, at 5-6. This consolidation of DRs and PFRs reduced the number of discrepancies identified by Torrey Pines.

QA:643. Moreover, Torrey Pines did not follow its own procedures in conducting the construction review of Shoreham. Those procedures required that "any difference between an observed condition (document or installed hardware) and a required condition" be documented by the preparation of a Discrepancy Report. LILCO Ex. 59, Volume I, at 4-1; Tr. 18,353 (Johnson). Thus, a discrepancy's potential for impact on plant safety was not to be considered in evaluating the validity of DRs. Tr. 18,257, 18,259 (Johnson). DRs, however, were often

invalidated in a manner inconsistent with this standard. Accordingly, Torrey Pines understated the number of DRs and Potential Findings, and possibly the number of Observations and Findings. Hubbard and Samaniego, ff. Tr. 19,068, at 12-13, 16.

QA:644. Of the 371 DRs generated by Torrey Pines, 103 were found by Torrey Pines to be invalid. LILCO Ex. 59, Volume II, at 7-11. Many of these DRs were improperly invalidated. Hubbard and Samaniego, ff. Tr. 19,068, at 13. In fact, in some instances, DRs were invalidated for reasons that also applied to DRs that remained valid. Tr. 18,404-07 (Johnson).

QA:645. At least 19 DRs (DRs 009, 010, 011, 012, 013, 015, 016, 022, 023, 024, 026, 027, 034, 048, 068, 069, 070, 082, and 153) involving principally branch line and drain line sequence were invalidated after-the-fact by Torrey Pines. LILCO Ex. 59, Volume III, Book 2. Torrey Pines initially prepared these DRs after comparing the installed features against Shoreham's flow diagrams. Tr. 18,354 (Johnson). According to Mr. Johnson, the DRs were invalidated after Torrey Pines learned that the location and other design requirements of various components, including branch lines, drain lines, vents, valves, duct configurations and flanges, are specified on Shoreham's isometric drawings and not on the Shoreham flow diagrams -- the drawings that were chosen by Torrey Pines for use in its walkdowns. Tr. 18,357-58, 18,360, 18,370-73

(Johnson). Even after discovering that the design requirements are contained on the isometric drawings, and not the flow diagrams, Torrey Pines did not re-inspect the components relating to the invalidated DRs to determine whether installation complied with the requirements of the isometric drawings. Tr. 18,359-60, 18,361-62, 18,363-64 (Johnson). Instead, it simply invalidated the DRs which had noted the discrepancies based on the flow diagrams. In doing so, Torrey Pines reasoned that there were no discrepancies between the flow diagrams and the installed equipment, since Shoreham's flow diagrams by definition do not specify design requirements. Tr. 18,362, 18,363 (Johnson).

QA:646. Similarly, DR 025 and DRs 042 and 047 were invalidated by Torrey Pines because it had used flow diagrams in its walkdowns. Under the Shoreham system, there are no dimensions on flow diagrams, and the location of items cannot be specified. Tr. 18,382 (Johnson). Therefore, Torrey Pines was precluded from determining whether observed and required conditions were different, since the flow diagrams do not specify design requirements. Tr. 18,378-80 (Johnson); Johnson, ff. Tr. 18,313, at 9, 12-13.

QA:647. DRs 186, 248 and 273 were invalidated by Torrey Pines after further investigation or walkdowns revealed that the discrepant conditions had been resolved. Tr. 18,387

(Johnson); Johnson, ff. Tr. 18,313, at 11. In such instances, Torrey Pines assumed that the discrepant conditions had been resolved as part of Shoreham's "normal construction process." Tr. 18,384 (Johnson).

QA:648. DRs 245, 287, 324, 328, 354 and 356 involved secondary pipe supports. Much like the discrepancies involving branch and drain lines (see Finding QA:645, supra), these discrepancies were invalidated after Torrey Pines learned that the documents it had selected for use in its walkdowns -- Shoreham's piping isometric drawings -- did not specify the design requirements for the inspected items. LILCO Ex. 59, Volume III, Book 2; Johnson, ff. Tr. 18,313, at 11-12. Thus, even though secondary supports were found at locations other than those specified on Shoreham's isometric drawings, the reported discrepancies were invalidated since Torrey Pines could not verify the accuracy of the support locations from the drawings used in the walkdowns. Tr. 18,399-400, 18,401 (Johnson).

QA:649. Under the Shoreham system, locations for secondary pipe supports are specified in a series of E&DCRs. Tr. 18,401-02 (Johnson). Thus, to verify secondary support locations, the reviewer must search through Shoreham's design drawings until the pertinent E&DCRs are located. Tr. 18,402 (Johnson). Torrey Pines, however, did not make such a search.

Instead, after learning that the piping isometric drawings were inappropriate documents for checking secondary support locations, Torrey Pines simply invalidated many of the DRs involving secondary supports which had been prepared. Johnson, ff. Tr. 18,313, at 12. However, since, by definition, a missing support could not have met design requirements, those DRs documenting missing secondary supports, with the exception of DR 328, were left valid. Tr. 18,400 (Johnson). And, during the hearings Mr. Johnson acknowledged that DR 328 had been improperly invalidated by Torrey Pines. Tr. 18,401 (Johnson).

QA:650. Quite aside from its improper invalidation of Discrepancy Reports, Torrey Pines improperly limited its review of valid DRs. Thus, although it acknowledged that a failure to implement a QA/QC requirement could constitute a potential safety concern, Tr. 18,409 (Johnson), Torrey Pines did not review the discrepancies to determine whether, on an individual basis, they reflected deficiencies in the Shoreham QA/QC process. Tr. 18,410, 18,413 (Johnson). Instead, Torrey Pines limited its review, in the context of the QA/QC process, to determining whether the DRs, in the aggregate, reflected problems with the QA/QC process. On this limited basis, it concluded that there were no trends indicating such problems. Tr. 18,411-12 (Johnson). However, what Torrey Pines failed to realize is that the cumulative effect of similar DRs could have

a potential safety impact, or could indicate a repetitive QA/QC program deficiency, which would not have been evident in a single isolated DR. Hubbard and Samaniego, ff. Tr. 19,068, at 14; SC Ex. 112, at 198-200.

QA:651. Moreover, in its review, Torrey Pines, once satisfied that a design document, such as an E&DCR, was sufficient to resolve an apparent discrepancy between observed and required conditions, did nothing further to determine whether the discrepant conditions had actually been resolved. Tr. 18,342-43 (Johnson). This was a serious omission in the Torrey Pines process.

QA:652. Further, Torrey Pines was neither consistent nor accurate in its determinations of which valid DRs warranted being made Potential Findings. Hubbard and Samaniego, ff. Tr. 19,068, at 14. For example, Torrey Pines did not generate Potential Finding Reports from those valid DRs which related to non-Category 1, (i.e. nonsafety-related) material, components or equipment. DRs 112, 124, 130, 137, 139, 249, 259, 264, 268, 292 and 331 are examples. LILCO Ex. 59, Volume III, Book 2. Accordingly, Torrey Pines wholly excluded those items which may have been important to safety, but which had not been classified as Category 1. Hubbard and Samaniego, ff. Tr. 19,068, at 14; Tr. 17,698-99, 17,701-02 (Johnson); LILCO Ex. 59, Volume II, Table C-1, at 4C-1.

QA:653. Torrey Pines also did not prepare PFRs from a number of valid DRs which it believed had little or no effect on system integrity or operation. Johnson, ff. Tr. 18,313, at 13-14. DRs 144, 145, 160, 169, 208, 217, 227, 231, 233, 235, 237, 242, 246, 256, 261, 272, 280, 285, 286, 288, 330, 348, 349, 353, 357, 360 and 370 are examples. LILCO Ex. 59, Volume III, Book 2. These discrepancies, however, were not reviewed by Torrey Pines for compliance with the criteria of 10 CFR Part 50, Appendix B. See, e.g., Tr. 18,414, 18,418 (Johnson). In Torrey Pines' view, the criteria of Appendix B would only be applicable if the equipment or components in question were found to be of significance to the plant's safety. Tr. 18,418, 18,420, 18,425, 18,428 (Johnson). LILCO followed this same interpretation of Appendix B. Tr. 18,431 (Novarro).

QA:654. Fifteen of the above DRs, including DRs 145, 285, 286, 330, 348 and 349, were prepared by Torrey Pines because pipe support locations differed from the locations specified by the applicable design drawings. LILCO Ex. 59, Volume III, Book 2; Tr. 18,417, 18,421-23 (Johnson). Torrey Pines acknowledged that these DRs demonstrated that there was a pattern of the Shoreham construction control process failing to locate pipe supports in their specified locations. Tr. 18,423 (Johnson). However, based on its judgment that the misplaced pipe supports were not of safety significance, Torrey Pines did not find

these discrepancies to be indicative of a repetitive QA/QC deficiency under Criterion 5 or 10 of Appendix B. Tr. 18,425, 18,426-28 (Johnson). This judgment was made notwithstanding the fact that the pipe supports in question were safety-related supports. Tr. 18,427 (Johnson).

QA:655. Five other valid DRs (DRs 233, 235, 236, 237 and 246), not made PFRs by Torrey Pines because there was little or no effect on system integrity or operation, involved instrumentation supports not shown in the design drawings. LILCO Ex. 59, Volume III, Book 2; Tr. 18,436-37 (Johnson). Torrey Pines acknowledged that these discrepancies demonstrated that instrumentation supports were being attached to large pipe supports without regard to whether the attached supports were specified on the design drawings. Tr. 18,440 (Johnson). However, it did not find this pattern to be in violation of either Criterion 5 or 10 of Appendix B. Again, this conclusion was based on Torrey Pines' interpretation of Appendix B and its judgment that the extra instrumentation supports were not of safety significance. Tr. 18,440-41 (Johnson).

QA:656. Four other valid DRs (DRs 217, 231, 242 and 256), not made PFRs by Torrey Pines because there was little or no effect on system integrity or operation, involved additional supports not specified on the design drawings. LILCO Ex. 59, Volume III, Book 2; Tr. 18,450-51 (Johnson). These DRs were

prepared because Torrey Pines, at the time of its walkdown, could not identify any design documents showing the additional supports. Tr. 18,452 (Johnson). Torrey Pines speculated that this may have been explained by the ongoing pipe support reconciliation program, i.e., that the design drawings may have been in process at the time of the walkdowns. Tr. 18,452 (Johnson). However, there was no evidence that this was, in fact, the case. Tr. 18,454 (Johnson). Torrey Pines did not review these DRs against the requirements of Criteria 5 and 10 of Appendix B. Tr. 18,453-54 (Johnson).

QA:657. Torrey Pines did not prepare PFRs from a number of valid DRs which it believed indicated no safety problem. Certain of these discrepant items (DRs 081, 298, 306, 314, 316, 327, 334, 341, 344, 366, 369 and 371) were mistagged or mislabeled, but because proper equipment was in place, PFRs were not generated. LILCO Ex. 59, Volume III, Book 2; Johnson ff. Tr. 18,313, at 15; Tr. 18,455 (Johnson). These discrepancies demonstrated that LILCO's measures for identification and control of materials and components were inadequate. Nevertheless, Torrey Pines did not consider the discrepancies to be in violation of Criterion 8 of Appendix B. Tr. 18,455-56 (Johnson). Suffolk County was precluded from asking questions regarding the last three DRs of this group, which, in the County's view, demonstrated violations of Criterion 14 of Appendix B. Tr. 14,463 (Brenner).

QA:658. Torrey Pines also did not prepare PFRs from a number of valid DRs which involved documentation discrepancies, since it did not believe these DRs showed a potential to impact safety. Johnson, ff. Tr. 18,313, at 15-16. DRs 120, 127, 174 and 281 are examples. LILCO Ex. 59, Volume III, Book 2. These DRs revealed failures to comply with stated instructions or procedures of the Shoreham QA/QC program. Nevertheless, Torrey Pines did not consider the discrepancies to be in noncompliance with Criterion 5 of Appendix B. Tr. 18,466, 18,468-69 (Johnson).

QA:659. Similarly, Torrey Pines did not prepare PFRs from a number of valid DRs which involved failures to follow procedural requirements, since it believed no safety concern was evidenced by these discrepancies. Johnson, ff. Tr. 18,313, at 16. DRs 175, 180, 181, 183, 191, 230, 367 and 368 are examples. LILCO Ex. 59, Volume III, Book 2; Tr. 18,469-70 (Johnson). Although it determined that procedural requirements had not been followed, Torrey Pines did not consider such noncompliance to be indicative of a violation of Criterion 5 of Appendix B. Tr. 18,470 (Johnson). In fact, although DR 230 was generated because Torrey Pines could not verify whether a torquing device had been properly calibrated, as required by LILCO's QA manual, Torrey Pines, even assuming improper calibration of the device, did not consider the discrepancy to

be in violation of Criterion 5. Nor did it consider the discrepancy to be in violation of Criterion 12, which requires that measures be established to assure that tools, gauges, instruments and other measuring and testing devices are calibrated. In Torrey Pines' view, LILCO's torquing procedure met the requirements of Criterion 12, and a failure to follow that procedure, while a discrepancy from the program requirements, was not considered an Appendix B violation. Tr. 18,477-78 (Johnson).

QA:660. In addition, Torrey Pines sometimes made inaccurate determinations concerning a DR's potential safety impact and therefore no PFR was written. For example, DR 123 examined LILCO's QA Audit Program and concluded that the program was deficient in not following LILCO QA Procedure No. 18.2, regarding corrective action for violations reported by audits. In its inspection, Torrey Pines discovered that a failure to follow Procedure 18.2 had led to the same violation over four consecutive audits. Nevertheless, this DR was not made a PFR because Torrey Pines concluded that there was no potential safety impact. LILCO Ex. 59, Volume III, Book 2, DR 123. However, the failure to initiate prompt corrective action in response to a repetitive audit finding could have a safety impact. In addition, this failure was contrary to the requirements of Criteria 16 and 18 of Appendix B to 10 CFR Part 50. Hubbard and Samaniego, ff. Tr. 19,068, at 14-15.

QA:661. Another example was Torrey Pines' questionable decision to find that DR 281 was "no longer a safety item" and therefore did not warrant being made a PFR. DR 281 disclosed that GE and SWEC differed in their views regarding whether certain equipment should be classified as safety-related. GE had listed a number of items as Category 1 classification, while SWEC had listed the same items as Category 2. LILCO Ex. 59, Volume III, Book 2, Attachment 3 to DR 281. This difference resulted in certain equipment being classified as safety-related (Category 1) during receipt inspection, but nonsafety-related (Category 2) during installation. Hubbard and Samaniego, ff. Tr. 19,068, at 15.

QA:662. Torrey Pines did not prepare PFRs for a number of valid DRs which involved missing secondary pipe supports, since it believed no safety concerns were raised by these missing supports. Johnson, ff. Tr. 18,313, at 16-17. DRs 193, 244, 312, 328, 351, 352 and 361 are examples. LILCO Ex. 59, Volume III, Book 2; Tr. 18,501-02, 18,955 (Johnson). Nor did Torrey Pines consider these discrepancies to be indicative of problems in the implementation of Shoreham's QA/QC program, since construction on the Shoreham pipe supports was not complete at the time of its review, and since the Final Stress Reconciliation Program, which included the secondary supports for the Shoreham piping systems, was ongoing at the time of Torrey Pines'

review. Tr. 18,502 (Johnson); Tr. 18,503-04 (Johnson, Novarro). In fact, in Torrey Pines' view, even if the missing supports were never installed, there would be no safety concerns with respect to the integrity of the primary lines. Tr. 18,507, 18,956 (Johnson). These secondary supports, however, are classified as safety-related by LILCO and do impact on the integrity of the vent or drain lines they support. Tr. 18,956-57 (Johnson). Even so, Torrey Pines made no determination as to whether the Shoreham construction control program accounted for and controlled these secondary supports, since its review was limited to safety-significant features. Tr. 18,958 (Johnson). Instead, Torrey Pines simply concluded that these secondary supports would be installed correctly based upon its opinion that other secondary supports had been correctly installed. Tr. 18,989 (Johnson).

QA:663. Torrey Pines did initiate PFRs when it discovered that temporary pipe supports had not been removed from the piping systems. There was no specific written procedure requiring the identification and removal of such supports, Tr. 18,512-14 (Johnson), and, in contrast to the missing secondary supports, Torrey Pines determined that these temporary supports could affect the structural integrity of the major piping systems at Shoreham. Tr. 18,516-17 (Johnson). However, of the ten PFRs generated (PFRs 063, 064, 085, 091, 099, 100, 106,

108, 109 and 115), only one, PFR 064, was made a Finding by Torrey Pines. The remaining PFRs, with the exception of PFR 100, were classified as Observations. LILCO Ex. 59, Volume III, Books 1 and 2; Tr. 18,511-12 (Johnson). PFR 100 was invalidated by Torrey Pines even though there was no evidence that the support was not removed by LILCO in response to the Potential Finding Report. Tr. 18,523-24 (Johnson).

QA:664. Torrey Pines justified this difference in classification by pointing out that PFR 064 was made a Finding under the multiple discrepancy criteria. Johnson, ff. Tr. 18,313, at 18. Nevertheless, the result was to reduce the number of Findings. Tr. 18,512 (Johnson). Moreover, there was never any evidence provided to Torrey Pines that these temporary supports were, in fact, being removed by LILCO or its contractors. Tr. 18,514 (Johnson).

QA:665. Torrey Pines invalidated 69 of the 120 PFRs generated from its review of the Shoreham plant. LILCO Ex. 59, Volume II, at 7-33.

QA:666. A significant number of these PFRs were invalidated after the original design organization demonstrated that E&DCRs or Repair/Rework Requests ("RRRs") had been issued prior to the walkdowns by Torrey Pines. PFRs 001, 002, 003, 012, 015, 017, 018, 019, 035, 036, 038, 041, 044, 051, 056, 061, 079, 080, 082, 089, 093, 095, 098, 101, 104, 112 and 116 fall

within this category. LILCO Ex. 59, Volume III, Books 1 and 2; Tr. 18,525-26 (Johnson). Torrey Pines had been unaware of these E&DCRs and RRRs at the time of its walkdowns, and had therefore concluded that the discrepant conditions had gone undetected by LILCO. Upon production of this documentation, however, Torrey Pines thought the additional information provided evidence that the discrepant conditions identified had not in fact existed, or had been detected for correction in the normal course of construction. Johnson, ff. Tr. 18,313, at 17. However, Torrey Pines also invalidated PFRs on the basis of E&DCRs or RRRs issued after the walkdowns had detected discrepant conditions. LILCO Ex. 59, Volume III, Book 1, PFRs 016, 065; Tr. 18,552-53 (Johnson).

QA:667. Torrey Pines concluded that, because it was involved in an in-process construction process, its unawareness of these E&DCRs and RRRs was to be expected. Tr. 18,526-27 (Johnson). Although there was no Shoreham procedure requiring components or equipment subject to rework or repair to be tagged, Tr. 18,527 (Johnson), Torrey Pines did not consider such tagging to be required by Criterion 14 of Appendix B, which requires that measures be established to indicate the operating status of components. Tr. 18,530 (Johnson). In Torrey Pines' view, under Criterion 14 only the specific equipment which controls the components being repaired or reworked

must be tagged; the components being repaired/reworked need not be tagged. Tr. 18,535 (Johnson).

QA:668. PFR 008 was invalidated by Torrey Pines because the discrepancy detected was resolved between the time of the walkdown and the time the PFR was reviewed by the original design organization. Again, Torrey Pines assumed that the discrepancy was corrected by LILCO as part of the normal construction process. Tr. 18,538-39 (Johnson).

QA:669. Similarly, a number of PFRs were invalidated between the time of the walkdowns and the time the PFRs were prepared by Torrey Pines. PFRs 041, 042, 043, 067, 101 and 107 are examples. LILCO Ex. 59, Volume III, Books 1 and 2; Tr. 18,547 (Johnson).

QA:670. Based on the foregoing, the Board has serious concerns about Torrey Pines' preparation and processing of Discrepancy Reports and Potential Finding Reports. Although the Final Report required that "any difference between an observed condition (document or installed hardware) and a required condition" be documented, the Board finds that DRs were often invalidated in a manner inconsistent with this standard. This improper invalidation of DRs likely resulted in fewer Observations and Findings.

QA:671. The Board further finds that Torrey Pines was neither consistent nor accurate in its determination of which

valid DRs should be PFRs. As a result, the number of Observations and Findings in the Final Report may have been understated.

E. Torrey Pines' Review Demonstrated that Shoreham's QA/QC Inspection Process Is Inadequate

QA:672. LILCO's inspection process has been described as producing a "gating effect." The term "gate" is used by LILCO to describe each stage in the inspection process at which functions or attributes must be verified and beyond which material or components may not pass unless requirements have been met. Within each major gate (procurement, receiving, storage, pre-installation, installation, system turnover, and test program) there may also be several subgates that require passing before the item may continue to be processed. LILCO contends that the effect of these multiple gates is to provide several chances to detect a nonconformance. LILCO Ex. 21, at 22.

QA:673. According to Mr. Novarro, all safety-related equipment or components at the plant are required to pass through each of the seven "gates" of LILCO's inspection process. Tr. 18,571A (Novarro). Indeed, in LILCO's prefiled QA/QC testimony LILCO stressed the fact that its numerous gates provided assurance that the plant in fact has been properly constructed. See LILCO Ex. 21, at 22. Moreover, these "gates" are structured to track the requirements of Appendix B. Thus,

the procurement "gate" should ensure compliance with the requirements of Criterion 4, the receiving "gate" should ensure compliance with the requirements of Criterion 7, the storage "gate" should ensure compliance with the requirements of Criterion 13, the pre-installation and installation "gates" should ensure compliance with the requirements of Criterion 10, and the test program "gate" should ensure compliance with the requirements of Criterion 11. Tr. 18,572-75 (Novarro).

QA:674. Notwithstanding this "gating effect," the Torrey Pines inspection revealed that LILCO's inspection process fails to ensure the detection of deficient materials, components or equipment. Hubbard and Samaniego, ff. Tr. 19,068, at 16-17. As a result, LILCO places heavy reliance on its final inspection program to detect construction discrepancies. See, e.g., Novarro, ff. Tr. 17,588, at 13, 14, 16, 17; Staff Ex. 13, cover letter, at 2. Nevertheless, Torrey Pines identified a number of deficiencies that were first detected by Torrey Pines despite prior opportunities for LILCO to have detected the same deficiencies. In fact, every discrepancy identified by Torrey Pines was generally indicative of a missed QA/QC "gate." SC Ex. 112, at 200. Included in these deficiencies were those deficiencies that were classified as Findings by Torrey Pines. Hubbard and Samaniego, ff. Tr. 19,068, at 16-17.

QA:675. For example, in PFR 004 (incorrect piping boss material certification), Torrey Pines found that a 6,000 pound boss had been installed on a line when the material certification provided by the manufacturer specified a 3,000 pound boss. LILCO Ex. 59, Volume III, Book 1. Two other identical discrepancies were also noted. LILCO Ex. 59, Volume III, Book 1, Attachments to PFR 004; Tr. 18,582 (Johnson). These discrepancies were not detected by LILCO's "gating process," although detection should have occurred at the procurement, receiving, pre-installation, and/or installation stages. Hubbard and Samaniego, ff. Tr. 19,068, at 17. In addition, the nonconforming material certifications should have been detected at the time LILCO turned over the pipe bosses for Level B Release. Tr. 18,580-81 (Novarro).

QA:676. In PFR 011 (reversed radiation monitor cables), Torrey Pines determined that the locations of two radiation monitor cables were reversed during installation. LILCO Ex. 59, Volume III, Book 1; Novarro, ff. Tr. 17,588 at 13; Tr. 18,598 (Novarro). In addition, the identification tags for the cables were reversed. LILCO Ex. 59, Volume III, Book 1. Although LILCO contended that these discrepancies probably would have been detected during the FQC Acceptance inspection or during the system checkout, Novarro, ff. Tr. 17,588, at 13, the same discrepancies were not detected at the installation stage of LILCO's "gating process." Tr. 18,601 (Novarro).

QA:677. In PFR 032 (missing pipe support welds), Torrey Pines discovered that four pipe support welds on a 16-inch pipe were not welded. LILCO Ex. 59, Volume III, Book 1; Novarro, ff. Tr. 17,588, at 13; Tr. 18,603 (Novarro). LILCO considered this discrepancy to be an isolated event, and therefore not in violation of Criterion 10 of Appendix B. Tr. 18,606-07 (Novarro). Nevertheless, it was acknowledged that the missing welds had been overlooked by FQC at the time of its final inspection. Tr. 18,604-06 (Novarro); LILCO Ex. 59, Volume III, Book 2.

QA:678. In PFR 045 (undocumented pipe support removal), Torrey Pines discovered that subsequent to turnover to startup, a pipe support had been removed and that the removal had not been documented so as to ensure the support's re-installation. This was in violation of QC Procedure 15.4, which requires the initiation of a repair/rework request when final inspected items are subsequently modified. LILCO Ex. 59, Volume III, Books 1 and 2; Novarro, ff. Tr. 17,588, at 14; Tr. 18,609-10 (Novarro). LILCO considered this discrepancy to be an isolated event, and therefore concluded that there was no violation of Criterion 5 of Appendix B. Tr. 18,610 (Novarro). However, in its recent Readiness Assessment Team inspection of the Shoreham plant, the Staff also discovered examples of repair/rework activity to QC inspected and accepted items without notification

to FQC. This failure to notify FQC was a specific violation of QC Procedure 15.4 and was determined by the Staff to be a violation of Criterion 5 of Appendix B. Staff Ex. 13, at 17-18.

QA:679. In PFR 048 (pump motor certification), Torrey Pines determined that various field inspections had not been performed for the recirculation pump motor. Specifically, there had been no pre-installation verification, no foundation inspection, no initial installation inspection, no final installation check and no cleanliness check. LILCO Ex. 59, Volume III, Book 1.

QA:680. In PFR 114 (HVAC duct debris), Torrey Pines noted that Shoreham QA/QC procedures require "inspection of all ducting at completion of construction to prevent the fouling/clogging of ducts by foreign material." LILCO Ex. 59, Volume III, Book 2, PFR 114, at 5. Despite these procedures, Torrey Pines found "garbage, consisting of fiberglass cloth and insulating material" to be blocking "approximately 25% of the duct flow area." LILCO Ex. 59, Volume III, Book 2, PFR 114, at 5. This discrepancy had gone undetected until Torrey Pines' inspection, even though there had been at least one opportunity for detection of the debris before that time -- at the installation inspection, which had been performed. Tr. 18,630-31 (Novarro).

QA:681. In PFR 120 (improper solenoid valve installation), Torrey Pines detected the improper installation orientation of a solenoid valve. The installation had previously been "accepted by inspection and documented on Final Installation..." LILCO Ex. 59, Volume III, Book 2, PFR 120, at 5. In addition to this failure of the final inspection "gate" to detect the incorrect valve orientation, the discrepant condition also escaped detection at the procurement, receipt inspection, and installation inspection stages of the LILCO "gating process." Tr. 18,645-46 (Novarro).

QA:682. LILCO's "gating process" also failed to detect a number of deficiencies that were classified as Observations by Torrey Pines. Hubbard and Samaniego, ff. Tr. 19,068, at 18-19.

QA:683. In PFR 022 (installed solenoid valve different from that which was required), Torrey Pines noted that the valve supplied was different from the valve that was ordered and that this difference should have been identified at the time of procurement by the SWEC PQA shop inspector. LILCO Ex. 59, Volume III, Book 1, PFR 022, Attachment 4, at 1 of 1; Tr. 18,653 (Novarro); Hubbard and Samaniego, ff. Tr. 19,068, at 18-19.

QA:684. In PFR 074, Torrey Pines noted that an incorrect flow transmitter had been installed. LILCO Ex. 59, Volume III, Book 1. Although Torrey Pines determined that the installed

transmitter was acceptable, the documentation describing the equipment was inaccurate in that the instrument data sheet described the transmitter as having a stainless steel body rather than a nickel-plated carbon steel body. This discrepancy should have been detected at the procurement and installation inspection stages of the LILCO "gating process." Tr. 18,662-63 (Novarro). Even though the flow transmitter had been turned over for testing at the time of Torrey Pines' review, the discrepant condition went unnoticed until detected by Torrey Pines. Tr. 18,663 (Novarro).

QA:685. In PFR 092, Torrey Pines discovered that four temperature elements had been installed in locations which differed from the design drawings. LILCO Ex. 59, Volume III, Book 2. Moreover, even after the improper locations were noticed during inspection, the corrective E&DCR that was initiated left the temperature elements in their incorrect locations, and the condition was not remedied until Torrey Pines discovered the problem. Hubbard and Samaniego, ff. Tr. 19,068, at 19; LILCO Ex. 59, Volume III, Book 2.

QA:686. Despite finding numerous discrepancies that had not been detected by LILCO's "gating process," Torrey Pines did not attempt to determine the number of inspection opportunities missed by this "gating process." Tr. 18,666-67 (Johnson). It also did not attempt to identify the failures in the Shoreham

QA/QC program implementation that permitted these discrepancies to occur and remain undetected. Hubbard and Samaniego, ff. Tr. 19,068, at 17; SC Ex. 112, at 202-03.

QA:687. Nevertheless, Torrey Pines concluded that "the QA program for construction of safety-related equipment" and "the implementation of the program requirements during plant construction" are "satisfactory." LILCO Ex. 59, Volume II, at 1-1. This conclusion was based on Torrey Pines' view that the errors and deficiencies identified during its review of the Shoreham plant were merely mistakes made by Shoreham personnel in not meeting the requirements of the construction QA/QC program. Such mistakes were not, however, violations of the requirements of Appendix B since, in Torrey Pines' opinion, Appendix B's requirements merely set forth the programmatic requirements of the QA/QC program. Tr. 18,923 (Johnson).

QA:688. Correspondingly, the purpose of a QA/QC program under Torrey Pines' view, is "to restrict the significance of errors that are made" so that those defects or errors which do occur "are not of significance with respect to the safety function of the hardware in the plant." Tr. 18,920-21 (Johnson). Given this view, Torrey Pines' conclusions regarding the adequacy of Shoreham's QA/QC program were necessarily tied to its opinion regarding the safety significance of those construction defects and errors identified during its

review of the Shoreham plant. And since Torrey Pines invariably concluded that the defects and errors detected were not significant, it necessarily concluded that the plant hardware had been constructed correctly and that such hardware would perform its safety function. Tr. 18,921 (Johnson). Thus, the QA/QC program was judged adequate by Torrey Pines. LILCO Ex. 59, Volume II, at 1-1.

QA:689. Based on the foregoing, the Board finds that LILCO's "gating effect" fails to ensure the detection of deficient materials, components or equipment.

QA:690. The Board finds it surprising that, despite finding numerous discrepancies that had not been detected by LILCO's "gating effect," Torrey Pines did not attempt to identify failures in the QA/QC program which permitted these discrepancies to occur and remain undetected. The Board finds that this was a serious deficiency of the Torrey Pines inspection program, and that the conclusions of the Final Report with respect to the adequacy of Shoreham's QA/QC construction program are entitled to little, if any, weight.

F. The Corrective and Preventive Actions Proposed by LILCO in Response to the Torrey Pines Findings Were Inadequate

QA:691. Following its processing of the Potential Findings generated from the Shoreham review, Torrey Pines sent all Observations and Findings to LILCO for resolution. LILCO Ex. 59, Volume II, at 1-13. Thereafter, LILCO prepared Corrective Action Plans ("CAPs") for each of the 19 Findings, except that seven similar pipe support Findings were grouped into one CAP. However, no CAPS were prepared in response to the 32 Observations or the hundreds of DRs written by Torrey Pines. Hubbard and Samaniego, ff. Tr. 19,068, at 20; SC Ex. 112, at 218-19.

QA:692. LILCO's CAPs were either written or reviewed and approved by Mr. Novarro. LILCO Ex. 58, at 78. Thereafter, the CAPs were reviewed by Torrey Pines, which accepted the corrective measures proposed without changes or modifications of any kind. LILCO Ex. 58, at 81; Tr. 18,884-85 (Johnson).

QA:693. Notwithstanding this approval by Torrey Pines, the CAPs did not satisfy the requirements for corrective action of Criterion 16 of Appendix B. Hubbard and Samaniego, ff. Tr. 19,068, at 21. Moreover, none of the CAPs addressed the deficiency or deficiencies in the Shoreham QA/QC program that allowed the Findings identified by Torrey Pines to occur. This was not surprising to Torrey Pines since, in its view, there

were no deficiencies in Shoreham's QA/QC program. Rather, Torrey Pines believed that the discrepancies identified during the Shoreham review were nothing more than mistakes made in not meeting the requirements of the QA/QC program, i.e., human errors. Tr. 18,638 (Johnson). These human errors were viewed as isolated instances and Torrey Pines did not think that these errors were indicative of weaknesses in Shoreham's QA/QC program. Tr. 18,886 (Johnson).

QA:694. While Mr. Novarro claimed that each CAP identified the underlying cause of its respective inspection Finding, Tr. 18,728 (Novarro), the corrective measures generally addressed the symptom, rather than the underlying cause, of the inspection Findings. Further, a number of the CAPs failed to provide for any investigation beyond the immediate discrepant condition to determine the cause, the underlying reason for the cause and where else the condition could exist. The CAPs also failed to include measures to prevent repetition of the discrepancies identified by Torrey Pines. Moreover, they did not require investigation into why the condition had not been detected by Shoreham's QA/QC program. Hubbard and Samaniego, ff. Tr. 19,068, at 21. In fact, none of the CAPs even referenced the Shoreham QA/QC program, nor any QA/QC manuals or procedures. Tr. 18,639 (Johnson, Novarro). LILCO Ex. 59, Volume III, Book 2.

QA:695. CAP 1 was prepared in response to PFR 004 (the incorrect piping boss material certification). Tr. 18,728-29 (Novarro). Unlike the later CAPs, which were prepared solely by LILCO, CAP 1 was prepared by Torrey Pines and LILCO. Tr. 18,732 (Novarro). LILCO believed the discrepant condition noted in the finding was caused when the fabricator of the pipe spools incorrectly placed a pressure rating certification for a 3,000 pound boss into the data package for the 6,000 pound boss that was shipped and installed at the plant. Tr. 18,730, 18,733 (Novarro); LILCO Ex. 59, Volume III, Book 2, Attachments to CAP 1. Torrey Pines, however, acknowledged that the discrepancy was also caused by the failure of SWEC PQA to discover the improper material certification at the time the data package was inspected. Tr. 18,735-36 (Johnson). Moreover, this was not an isolated discrepancy. Of the nine 1-1/2 inch piping bosses reviewed by Torrey Pines, three had incorrect material certifications. Tr. 18,752-53 (Johnson); LILCO Ex. 59, Volume III, Book 2, Attachments to CAP 1.

QA:696. Although LILCO believed that CAP 1 included measures to prevent repetition of the kind of discrepancy identified by Torrey Pines in PFR 004, the corrective action was limited to an investigation of similar piping bosses installed at the plant. Tr. 18,736-38 (Novarro). LILCO conceded, however, that there were two missed inspection opportunities with

respect to the incorrect material certifications -- the SWEC inspection at the vendor's plant and the test program inspection, after the construction was completed. Tr. 18,741-42, 18,743-44 (Novarro). Notwithstanding these missed inspections, the CAP did not include steps to remind QA/QC inspectors of the need to check documentation against the relevant components or materials received and installed at the plant. Tr. 18,744-45 (Novarro).

QA:697. CAP 2 was prepared in response to PFR 009 (HVAC ducting configuration). Neither the CAP itself nor the corresponding PFR specifically identified the cause of this discrepancy. In fact, the CAP consisted of nothing more than LILCO's agreement, through the means of an E&DCR, to update the flow diagram to reflect the as-built condition of the installed ducting configuration. Tr. 18,754 (Novarro). The PFR did note that, at the time of Torrey Pines' review, there was no requirement to modify flow diagrams to reflect as-built conditions. However, there was no explanation in the PFR as to why there was no such requirement. Tr. 18,755-56 (Novarro); LILCO Ex. 59, Volume III, Book 1, Attachment 6 to PFR 009.

QA:698. In fact, substantial changes in as-built conditions were required by a SWEC procedure to be reflected on the flow diagrams. Tr. 18,759-60 (Johnson); Tr. 18,761 (Novarro). Despite this procedure and the fact that it was not

followed with respect to PFR 009, LILCO did not go back to review other ducting configurations in the plant against their appropriate flow diagrams. Tr. 18,761-62 (Novarro). Moreover, requiring only significant changes in as-built conditions to be reflected on the flow diagrams overlooks the fact that flow diagrams are used by the Shoreham operating staff. Tr. 18,767-68 (Novarro). This is contrary to previous testimony submitted by LILCO. That testimony stated that the configuration of the plant, prior to fuel load, would be accurately reflected by the flow diagrams. LILCO Ex. 21, at 127-28; Tr. 18,770, 18,772 (Novarro).

QA:699. Notwithstanding LILCO's previous testimony regarding the accuracy of the plant's flow diagrams, the SWEC procedure restricting the updating of flow diagrams to significant changes was not re-examined by LILCO following Torrey Pines' identification of the discrepancy in PFR 009. Tr. 18,781 (Novarro). Nor did LILCO re-inspect other flow diagrams to determine whether they had been properly updated as required by this procedure. Tr. 18,788 (Novarro).

QA:700. CAP 4 was prepared in response to PFR 032, which involved missing pipe support welds. Novarro, ff. Tr. 17,588, at 9. LILCO believed the cause of this discrepancy was FQC and Construction personnel either did not understand, or overlooked, an engineering change to the design drawing. The

change required fillet welds all around the pipe support. Tr. 18,835-36 (Novarro). The CAP, however, included no measures to prevent repetition of the kind of discrepancy identified by Torrey Pines in PFR 032. Thus, even though LILCO has no special procedure for informing FQC or Construction of changes to design drawings, Tr. 18,842-43 (Novarro), and even though, in PFR 032, Torrey Pines documented FQC's failure to inspect the pipe support welds against the requirements of the revised drawing, Tr. 18,840-41 (Johnson), LILCO thought it unnecessary to implement any measures to ensure that changes to design drawings are specifically made known to FQC at the time of final inspection. Moreover, it is not clear that PFR 032 was an isolated discrepancy. Although LILCO's inspection of similar welds on similar box-type supports revealed no other discrepancies of the type discovered by Torrey Pines, Tr. 18,831 (Novarro), Torrey Pines initially concluded that this discrepancy was generic. Torrey Pines also concluded that the nature of the discrepancy suggested that numerous similar discrepancies could exist at the plant. Tr. 18,829-30 (Johnson); LILCO Ex. 59, Volume III, Book 1, Attachments to PFR 032.

QA:701. CAP 5 was prepared in response to PFR 045, which disclosed that Construction had temporarily removed part of a large-bore pipe support without following the appropriate

procedure, QC Procedure 15.4. Thus, there was neither a record of the temporary removal nor a request to replace the pipe support. LILCO Ex. 59, Volume III, Book 1, Attachments to PFR 045. As its corrective action, LILCO merely issued a verbal reminder to the offending organization. This preventive action was insufficient. LILCO should have taken a stronger stand by reminding, in writing, each organization of the seriousness of this type of oversight or omission. Hubbard and Samaniego, ff. Tr. 19,068, at 22.

QA:702. In PFR 048, problems were identified in certifying that the recirculation pump motors met the quality classification assigned. These motors had been classified as QA Category 1, then reclassified as Category 2 and then parts of the motors were again reclassified as Category 1. CAP 6 presented steps to resolve the certifying process problem. However, the CAP also described prior problems that were detected while these motors were in QA Category 1 storage. Those problems included "mildew on the insulation, rust on bearings, evidence of rodent occupation, large pieces of loose insulating varnish, steel cuttings, free water and high humidity." LILCO Ex. 59, Volume III, Book 1, PFR 048, Attachment 3, at 3 of 5. These problems indicated a lapse in storage procedures that should have been addressed in the CAP. Hubbard and Samaniego, ff. Tr. 19,068, at 23-24.

QA:703. CAP 11 was prepared in response to PFR 114, which documented debris in the HVAC distribution system to the control room. Novarro, ff. Tr. 17,588, at 10; Hubbard and Samaniego, ff. Tr. 19,068, at 24. The CAP did not identify the cause of the discrepancy, but merely stated that the debris was probably overlooked in the final inspection of the duct system after construction was completed. LILCO Ex. 59, Volume III, Book 2, CAP 11. Nor did the CAP include any measures to prevent repetition of this kind of discrepancy. Tr. 18,848 (Novarro). Thus, even after detection of the HVAC debris by Torrey Pines, LILCO did not re-inspect other HVAC ducts for debris. Nor did it review its procedures for inspecting the plant's HVAC ducting systems. Rather, LILCO assumed that the debris discovered by Torrey Pines was an isolated case and that its inspection procedures, as written, were adequate to detect debris in the plant's HVAC systems. Tr. 18,848-49 (Novarro).

QA:704. Moreover, even though Torrey Pines did inspect other HVAC ducting systems during its review, there was no physical examination of those ducting systems for which construction was completed and had been closed at the time of Torrey Pines' review. Tr. 18,850-51 (Johnson). Accordingly, neither CAP 11 nor Torrey Pines' actions after discovery of the debris adequately addressed the potential generic problems of contamination found in a completed, inspected and closed system. Hubbard and Samaniego, ff. Tr. 19,068, at 24-25.

QA:705. At a minimum, CAP 11 should have required LILCO to determine how Shoreham's QA/QC inspections missed the debris and whether similar inspections had missed debris, or other forms of contamination, in other closed systems. Hubbard and Samaniego, ff. Tr. 19,068, at 24-25. LILCO, however, has not addressed these issues and, instead, intends to continue to rely on flow rates as evidence of lack of debris in closed systems, Tr. 18,851 (Novarro), even though flow rates may not indicate the presence of debris. Moreover, LILCO has not demonstrated that its corrective action will include measures to assure cleanliness in other closed systems. Hubbard and Samaniego, ff. Tr. 19,068, at 25.

QA:706. CAP 13 was prepared in response to PFR 120, which documented three deficient conditions in the installation of a solenoid-operated valve ("SOV"). These conditions were as follows: the SOV was not replaced, as required by an E&DCR, with a SOV that was environmentally qualified; the SOV was not oriented according to the manufacturer's instructions at installation; and this improper installation had been accepted by QA/QC inspection. LILCO Ex. 59, Volume III, Book 2, Attachments to PFR 120; Hubbard and Samaniego, ff. Tr. 19,068, at 25.

QA:707. Although CAP 13 acknowledged that an error was made in the SOV's installation, Tr. 18,852 (Novarro), there was no determination by LILCO of what caused the breakdown in QA/QC

inspection that permitted acceptance of the valve's installation, even though such installation did not conform to the manufacturer's instructions. Tr. 18,857-58 (Novarro). Nor did the CAP include any measures to prevent repetition of the kind of discrepancy identified by Torrey Pines in PFR 120. LILCO did make a limited inspection of similar solenoid valves. Tr. 18,861 (Novarro). LILCO, however, took no steps to ensure that its FQC and Construction personnel comply with manufacturer instructions in installing equipment and components at the plant. Tr. 18,862-63 (Novarro). Instead, LILCO merely assumed that the identified discrepancy was an isolated case of the QA/QC program failing to detect an improper installation of a solenoid valve. Tr. 18,863 (Novarro). Further, based solely on telephonic assurance from the manufacturer, LILCO intends to install new, environmentally-qualified valves to a relaxed orientation standard, even though, at the time of hearing, it had not been confirmed whether this relaxed installation orientation standard has been environmentally-qualified or tested. Hubbard and Samaniego, ff. Tr. 19,068, at 26; LILCO Ex. 59, Volume III, Book 2, CAP 13.

QA:708. Based on its review of LILCO's corrective measures, Torrey Pines concluded that LILCO had reasonably identified the cause of the discrepancies which had resulted in the inspection Findings. Tr. 18,885 (Johnson). The cause

identified in each case was human error, and, in Torrey Pines' view, such errors were not indicative of any systematic weakness in Shoreham's QA/QC program. Tr. 18,886 (Johnson).

QA:709. The Board finds nothing in the record to support this conclusion. None of the corrective action measures address the deficiencies in the QA/QC program that allowed the inspection Findings to occur. Nor do the measures adequately address the underlying cause of the Findings. Further, measures to prevent repetition of the kinds of discrepancies identified by Torrey Pines are not set forth in the corrective action measures. Accordingly, the Board finds that the corrective measures proposed by LILCO do not satisfy the requirements of Criterion 16 of Appendix B.

QA:710. The Board is also concerned that no corrective measures were prepared by LILCO in response to the 32 Observations and hundreds of DRs identified by Torrey Pines. Accordingly, the Board will retain jurisdiction of this matter and LILCO is directed to prepare and submit for Staff review corrective action measures for the Observations and DRs that were not made Findings by Torrey Pines.

G. Statistically Valid Sampling Techniques Were Not Utilized by Torrey Pines and Its Conclusions Regarding the Shoreham Plant Are Therefore Not Valid

QA:711. Since it was not feasible to inspect every component or examine every document at Shoreham, Torrey Pines chose

to inspect a subcollection of components and documents. This was entirely appropriate. However, Torrey Pines did not avail itself of widely accepted, probability-based sampling methods and attendant systematic methodologies for extrapolating from sample to population. Instead, Torrey Pines selected items for inspection in a nonrandom, ad hoc manner. Hubbard and Samaniego, ff. Tr. 19,068, at 27-28; SC Ex. 112, at 9. While such an inspection can uncover useful information, it cannot form the basis for reaching general conclusions about Shoreham. Hubbard and Samaniego, ff. Tr. 19,068, at 28.

QA:712. The precise program plan used by Torrey Pines in its review of Shoreham had not been used before by Torrey Pines. Tr. 18,242 (Johnson). As noted, there were no statistical methodologies involved in this program plan. Tr. 18,243, 18,250 (Johnson). Instead, Torrey Pines' approach used the experience and judgment of its engineers to select a cross-section of items to be sampled. This approach likely introduced biases into the sampling process. Thus, this judgmental sampling process did not provide a vehicle for developing a general profile of the sampled population. Hubbard and Samaniego, ff. Tr. 19,068, at 28-29.

QA:713. In conducting its review of Shoreham, Torrey Pines used its judgment to select items for inspection and also to decide whether the total number of items selected provided a

sufficient basis for the conclusion that Shoreham's construction control process was functioning adequately. Once Torrey Pines determined that the construction control process was satisfactory, it extrapolated to the conclusion that the construction of the entire plant was satisfactory. Tr. 18,217-18 (Johnson). Under this approach, Torrey Pines believed that inspection of the entire Shoreham plant would have disclosed additional discrepancies of the same level of significance found under its judgmental sampling technique. Tr. 18,219-20 (Johnson).

QA:714. Torrey Pines reasoned that under its judgment approach, inspecting or examining a greater number of items or components was not important to the conclusions drawn with respect to the Shoreham construction control, or QA/QC, program. Tr. 18,232-34 (Johnson). Moreover, this approach permitted Torrey Pines, based on its review of relatively few items, to extrapolate to a conclusion that the Shoreham QA/QC program was properly implemented. This same approach also provided Torrey Pines a way to minimize the impact of any discrepancies identified by exercising its "judgment" to find that such discrepancies were not indicative of a programmatic problem of any kind. See Tr. 18,235-36 (Johnson).

QA:715. A sample formed on the basis of judgment carries a high risk of being statistically biased. Torrey Pines' use

of judgment sampling therefore led to results that were neither reliable nor verifiable. SC Ex. 112, at 72. This outcome would have been avoided if Torrey Pines would have substituted scientifically valid random sampling techniques for the judgment, or nonrandom, sampling techniques that were used. Tr. 19,218 (Samaniego).

QA:716. Without application of random sampling methods, it was not possible for Torrey Pines to draw valid inferences from the samples inspected. Tr. 19,132 (Samaniego); SC Ex. 112, at 72. There is no valid methodology for extrapolating from a judgment sample to a population. Therefore, Torrey Pines' process of extrapolating from a limited number of sampled items to conclusions regarding the entire plant was seriously flawed. Hubbard and Samaniego, ff. Tr. 19,068, at 29.

QA:717. A sample formed on the basis of judgment carries a high risk of being statistically biased. The direction of the bias is often unpredictable, and the magnitude of the bias can be substantial. Hubbard and Samaniego, ff. Tr. 19,068, at 29. By using statistically valid random sampling techniques, however, biases may be eliminated or controlled. Tr. 19,072 (Samaniego). In addition, such techniques make possible probability and confidence statements regarding the populations being sampled. Such techniques also introduce a measure of control and precision to inferences which can be drawn regarding such populations. Tr. 19,073 (Samaniego).

QA:718. The use of random sampling techniques in conducting the Shoreham review would not have prevented Torrey Pines from inspecting items not included in the random samples, and such items could have been included in any general conclusions or judgments regarding Shoreham's construction. However, under any statistically valid methodology, items inspected, but not drawn from random samples, cannot be used in drawing inferences about total populations. To make valid inferences about a population from a sample, the sample must be drawn randomly. Thus, Torrey Pines' process of extrapolating inferences about the total plant population from a nonrandom sampling of items was inherently flawed. Tr. 19,101-02, 19,104 (Samaniego). To extrapolate from a sample to a population requires the use of random sampling methods. See Tr. 19,231 (Samaniego).

QA:719. Torrey Pines did not use a valid scientific methodology for ensuring the absence of bias. That fact makes any valid statistical interpretation of the inspection results of the Shoreham plant an impossibility. Tr. 19,104-05 (Samaniego). Thus, the conclusions concerning the general characteristics of the plant, as set forth in the Torrey Pines Report, are not valid. Further, even if Torrey Pines used a conservative approach in selecting components for inspection, such conservatism would not have cured the conclusions of the biases inherent in Torrey Pines' use of engineering judgment in

selecting the components that were inspected. Tr. 19,108-09 (Samaniego).

QA:720. Statistically valid methods could have been used by Torrey Pines in its inspection of the Shoreham plant. Tr. 19,112 (Samaniego). Moreover, such methods would have been cost-effective. SC Ex. 112, at 69, 70. It was Torrey Pines' sampling process that was flawed. The random selection of samples, rather than selection according to nonrandom and informal kinds of judgments, could have been implemented in a cost-effective way. Tr. 19,113 (Samaniego).

QA:721. Torrey Pines' approach adequately set forth the foundation for a statistically valid sampling approach by identifying the populations of interest and stratifying those populations into subcollections that could be sampled. Tr. 19,114-15 (Samaniego). In fact, Torrey Pines sampled from those populations. Thus, by simply using random sampling methodology in place of the judgment samples that were used, Torrey Pines could have rendered conclusions that were justifiable, reliable and verifiable. Tr. 19,232, 19,248-49 (Samaniego).

QA:722. Moreover, neither the diversity nor the complexity of a nuclear power plant precludes the use of statistical methodology. There are well-defined statistical methods for sampling from a heterogeneous, or diverse, population to obtain statistically valid conclusions from such a study. Tr.

19,117-18 (Samaniego). With a diverse or heterogeneous population, the population can be divided into strata, or subpopulations, that have a higher degree of homogeneity. Information can then be gathered about such subpopulations. For example, by random sampling, statistically valid and precise information about the characteristics of a subpopulation can be obtained. That information can then be combined with information obtained from other subpopulations in order to obtain an overall measure of the heterogeneous population. Tr. 19,116-17 (Samaniego). Thus, a basis for extrapolation from a sample within a given subpopulation to the entire population is provided by stratified random samples. Tr. 19,217 (Samaniego). The diversity of the population presents no particular difficulties to the extrapolation process. Tr. 19,217-18 (Samaniego).

QA:723. Similarly, the complexity of a population does not preclude the use of statistical methodology. Within the context of stratified sampling, it is possible to identify subpopulations that are more complex than others, and to sample these subpopulations more heavily. Nothing precludes this difference in sampling emphasis. Tr. 19,117-18 (Samaniego).

QA:724. On the other hand, whether a statistically valid or a judgment sample methodology is used, sample size has an impact on the validity of conclusions drawn from the sample.

In general, the sample size must be increased as a greater degree of precision or accuracy is desired. Tr. 19,219-20 (Samaniego).

QA:725. This correlation between the size of the sample and the degree of confidence, or precision, which can be placed on conclusions or extrapolations drawn from the sample was not considered under the Torrey Pines approach. For example, based on its inspection of only one of 72 NSSS safety-related loops, Torrey Pines extrapolated to the conclusion that all 72 loops were adequate. LILCO Ex. 59, Volume II, at 4-193; Tr. 19,221-22 (Samaniego). This conclusion was completely unfounded. Very little confidence can be placed in any extrapolation based on a single sample from a population size of 72. Nevertheless, Torrey Pines relied on small sample sizes to support its overall conclusions regarding the plant's construction. LILCO Ex. 57, at 187. Quite aside from the randomness issue, this approach made the conclusions of the Torrey Pines Report highly unreliable. Tr. 19,222 (Samaniego).

QA:726. Torrey Pines acknowledged that, under certain circumstances, statistical sampling inspection techniques are appropriate. However, it thought that such techniques require that acceptance criteria be established beforehand. Tr. 18,947-48 (Johnson). The process of random sampling and estimating population characteristics does not, however, depend

upon acceptability criteria or other presuppositions. A random sample can be developed and parameters of a population can be estimated with scientific rigor without making judgments as to the significance of the results. The sole aim of the statistical study is to provide reliable information about the character of a population. Once that information is obtained, judgments as to the significance of the results can be made by other disciplines. Tr. 19,214-15 (Samaniego).

QA:727. In other words, the statistical process is an iterative process. For example, the design of a statistical study benefits from an engineer's judgment and experience. The engineer must decide what populations are of interest and which questions are worth asking. Thereafter, once the study is complete, the engineer may identify followup areas based upon the data which has been obtained. Hubbard and Samaniego, ff. Tr. 19,068, at 30. In short, the role of the statistician is to obtain scientifically valid information on populations of interest. Thereafter, other disciplines can use this information to reach conclusions concerning the population under study. Tr. 19,119 (Samaniego).

QA:728. Dr. Samaniego concluded that a statistically valid program could be designed that would demonstrate whether Shoreham was constructed in accordance with design requirements. Hubbard and Samaniego, ff. Tr. 19,068, at 30. In

implementing this statistically-based program, nuclear engineers, quality assurance personnel and other experts would work with the statistician to design the program and to determine the size of the program and areas of concentration. SC Ex. 112, at 46-47.

QA:729. Nor would such a program require inspection of virtually every item in the plant. Statistical methods are applicable whenever the entire population cannot be sampled. Accordingly, it would be neither necessary nor desirable to inspect the plant's entire population. Tr. 19,142 (Samaniego). The validity of a statistical study depends on the extent to which the sample taken is representative of the population. Even under random sampling techniques, any inferences must be restricted to the sampled population. Tr. 19,215 (Samaniego). However, if random samples are drawn, and the sizes of the samples are large enough to ensure the desired precision in estimating population parameters, questions concerning the general characteristics of Shoreham can be definitely resolved. Hubbard, and Samaniego, ff. Tr. 19,068, at 30.

QA:730. On the other hand, without random sampling, it is impossible to assess the reliability of, or have confidence in, any extrapolation to a total population. Tr. 19,125 (Samaniego). Thus, the methodology used by Torrey Pines, i.e., nonrandom and ad hoc sampling based on judgment, was seriously

flawed, and the conclusions it reached have no scientific validity. Tr. 19,127 (Samaniego). Torrey Pines did more than extrapolate within populations. It also extrapolated to the entire Shoreham plant without looking at items from the entire plant. As noted, even under a statistically valid study, inferences can only be drawn from those populations which are actually sampled. Tr. 19,127 (Hubbard). Therefore, it must be concluded that the substantive conclusions of the Torrey Pines Report are unjustified. Hubbard and Samaniego, ff. Tr. 19,168, at 29.

QA:731. A statistically valid program would have had a different sampling approach from the one used by Torrey Pines. A statistically valid program to determine whether Shoreham was constructed in accordance with design requirements would have used randomly chosen samples representative of the population from which they were drawn. Population characteristics could then have been estimated, and any error from such estimates could have been bound in a mathematically and logically rigorous manner. The unbiased and representative character of random samples would have justified the process of extrapolation from sample to population. Engineering judgment and experience do not provide such justification. Random samples also would have permitted Torrey Pines to determine whether Shoreham was properly constructed. Hubbard and Samaniego, ff. Tr. 19,068, at 29.

QA:732. Based on the foregoing, the Board agrees with Dr. Samaniego that in order to make statistically valid inferences about the general character of the Shoreham plant, it is necessary for the sample of items selected for review to be representative of the entire plant. The Board further agrees that the Torrey Pines study is deficient in this crucial area. Instead of using probability-based sampling methods and their attendant systematic methodologies for extrapolation from sample to population, Torrey Pines selected items for inspection in a nonrandon, ad hoc manner. The Board finds that such an inspection cannot form the basis for reaching general conclusions. The conclusions of the Final Report are therefore entitled to little, if any, weight.

XII. Remedy

QA:733. The County's witness on quality assurance matters testified that LILCO should not be permitted to operate the Shoreham facility until a complete design and construction review is conducted. Such a review is essential to: (1) determine the extent of QA/QC breakdowns; (2) identify the causes of these breakdowns; (3) demonstrate remedial actions, such as alterations of the facility design and construction, to eliminate and correct the errors which exist; and (4) thus provide factual evidence regarding whether the plant is properly designed and built so that it can be operated safely. SC Ex. 89A, at 64.

QA:734. A Shoreham design and construction review must document the actual quality of installed structures, systems and components. The only effective means to demonstrate such quality is to have a comprehensive design verificatioin as well as a physical inspection of electrical and mechanical systems. SC Ex. 89A, at 83.

QA:735. Mr. Hubbard wants an independent design review and physical inspection because there is uncertainty about how well the QA program was implemented during design and construction. He suggests performing design reviews of, at least, three systems, possibly four. Those systems are HVAC, electrical and piping systems. Also, a comprehensive construction inspection might be desirable. This would also compensate for the deficiencies in the I&E program. Tr. 16,078 (Hubbard).

QA:736. Mr. Hubbard felt that the attachment to his testimony described the Teledyne plan as written by LILCO. He felt that it was a "pretty good way of going about it." His major questions concerned the fact that it only looked at one mechanical system, rather than at an additional electrical system and an air system. In addition, Mr. Hubbard would have ensured that it would have included both GE and SWEC. Tr. 16,118 (Teledyne).

QA:737. The scope of safety features which are included in the remedial program should be sufficient to enable an

independent consulting firm to assess the overall adequacy of the Shoreham design, construction and installation. SC Ex. 89A, at 84-85.

QA:738. Mr. Hubbard outlined the scope of a design control and a design verification program. That program should address the procedures, controls and practices governing the development, actual transmittal and use of design information within each of its major design contractor organizations. LILCO has proposed a design review for one mechanical system, the SWEC-designed core spray system. That design review is being performed by Teledyne. Mr. Hubbard testified that LILCO should supplement the core spray review with a similar independent evaluation of design of at least one additional mechanical system. Such a system might be the reactor recirculation system. Mr. Hubbard also recommended an independent evaluation of two electrical systems, the GE-designed reactor protection system and either the SWEC-designed emergency diesel generators or the HVAC system. SC Ex. 89A, at 86-88.

B. OPERATING QUALITY ASSURANCE

Suffolk County Contention 13(a) reads in relevant part as follows:

> Suffolk County contends that the QA program description for the operation of Shoreham, as provided in the FSAR, does not comply with 10 CFR 50.34(b)(6)(ii) and 10 CFR 50, Appendix B, Sections I to XVIII, with regard to:

(a) Failure to address, at a minimum, each of the criteria in Appendix B in sufficient detail to enable an independent reviewer to determine whether and how all the requirements of Appendix B will be satisfied . . . .

Suffolk County's particular concern with respect to Contention 13(a) is that the organization of LILCO for quality assurance, contrary to Criterion 1 of 10 CFR 50, Appendix B, does not provide for the Operating Quality Assurance Section to have organizational freedom and sufficient independence from cost and schedule when opposed to safety considerations. See Tr. 15,987 (Hubbard).

OQA:1. The Operating Quality Assurance ("OQA") Engineer is responsible for assuring compliance with LILCO quality assurance ("QA") program requirements at the station, including supervision of the OQA Section, and developing and implementing OQA procedures. LILCO Ex. 21, Attachment 4, Section 1.2.22; LILCO Ex. 11, at 17.2-3.

OQA:2. The OQA Engineer reports directly to the Shoreham Plant Manager, who has both administrative and functional authority over the OQA Engineer. LILCO Ex. 21, Attachment 4, Section 1.2.22, Exhibits 1.1, 1.2; Tr. 12,782 (Youngling); LILCO Ex. 11, at 17.2-3.

OQA:3. The Plant Manager has responsibility for the operation of the plant, as well as for assuring compliance with LILCO QA program requirements at the station. LILCO Ex. 21,

Attachment 4, Section 1.2.7; LILCO Ex. 11, at 17.2-2 to 17.2-3. His responsibilities include cost and scheduling matters. Tr. 12,790 (Muller); Tr. 20,167 (Gilray).

OQA:4. The Plant Manager reports directly to the Vice President, Nuclear, who, inter alia, has overall responsibility for the safe and reliable operation of the plant. LILCO Ex. 21, Attachment 4, Section 1.2.2, 1.2.7, Exhibit 1.2. The Vice President, Nuclear, has responsibility for cost and scheduling matters for Shoreham. Tr. 12,737 (Muller).

OQA:5. The functional authority of the Plant Manager includes the right to direct the functions of the OQA Engineer; the administrative authority which the Plant Manager exercises over the OQA Engineer includes evaluation of his performance, the right to fire, and giving raises. See Tr. 12,779-81 (Muller, Youngling). The Plant Manager's authority over the OQA Engineer is no different than his authority over his other subordinates as shown on the LILCO QA organization chart, such as the chief engineer. Tr. 12,788-89 (Muller).

OQA:6. The Manager, QA Department ("QA Manager"), is located offsite, has the authority to develop and direct the overall QA program for Shoreham, and reports to the Vice President, Engineering. LILCO Ex. 21, Attachment 4, Section 1.2.19; LILCO Ex. 11, at 17.2-1 to 17.2.2.

OQA:7. The Vice President, Engineering, who is responsible, inter alia, for establishing QA policies during the operation of Shoreham, and for assuring implementation of the QA program, has no responsibility for the construction or operation of Shoreham, or for cost and scheduling matters for the plant which might conflict with safety considerations. Tr. 20,163 (Gilray). See LILCO Ex. 11, at 17.2-1; LILCO Ex. 21, at 5-6, Attachment 4, Section 1.2.3. Originally the QA Manager reported to the Nuclear Projects Manager, but in 1973 a change was made requiring the QA Manager to report to the Vice President, Engineering, in order to ensure that the QA Department is independent from project management which has cost and scheduling responsibility. LILCO Ex. 21, at 5. According to the NRC Staff, having the QA Manager report to the Vice President, Engineering, is the element which assures that the QA Manager and personnel in his department are free from undue influence associated with cost and schedules. Staff Ex. 8, Attachment 3, at 1; Tr. 20,162-63 (Gilray).

OQA:8. The QA Manager has no functional or administrative authority over the OQA Engineer. LILCO Ex. 21, Attachment 4, Sections 1.1, 1.2; LILCO Ex. 11, Figure 17.2.1-1. The QA Manager would not fill out the performance evaluation form for the OQA Engineer unless requested to do so by the Plant Manager. Tr. 12,799-800 (Muller).

OQA:9. According to LILCO, the principal advantage in having the OQA Engineer as the direct subordinate of the Plant Manager is the direct access this provides. Tr. 14,844 (Muller). If the OQA Engineer did not work for the Plant Manager, it would nevertheless be feasible to have an equivalent level of access and communication between them. Tr. 14,845-46 (Muller); Tr. 14,872-73 (Muller); Tr. 20,190 (Gilray). However, LILCO believes the disadvantage of not having the OQA Engineer work for the Plant Manager, is that the OQA Engineer would then be an "outsider." Tr. 14,873 (Muller). Similarly, Mr. Gilray testified that the disadvantage would be that station personnel would feel that the OQA Section personnel were "not part of the team." Tr. 20,190-91 (Gilray). However, Mr. Gilray's testimony is contradictory because later he testified that he did not believe that QA personnel should be "part of the team." Tr. 20,191 (Gilray).

OQA:10. According to Mr. Gilray, it is acceptable to the NRC for the OQA Engineer to report directly to the Plant Manager, even though the latter has overall responsibility for the operation of the plant. Tr. 20,172 (Gilray). Mr. Gilray testified that the Plant Manager "is sufficiently free from cost and scheduling matters as opposed to safety matters." Tr. 20,181-82 (Gilray).

OQA:11. According to Mr. Gilray, the OQA Engineer and the QA Manager could report to any organizational position in LILCO without undue influence of cost and scheduling matters, except the Chief Operating Engineer, because he has direct responsibility for the day-to-day operation of the plant on schedule and within cost, Tr. 20,173 (Gilray), the Technical Support Manager, and the Chief Technical Engineer. Tr. 20,204 (Gilray).

OQA:12. The Chief Operating Engineer reports to the Plant Manager, whose responsibilities include ensuring that the Chief Operating Engineer meets scheduling requirements for the plant. Tr. 20,173-74 (Gilray).

OQA:13. In the absence of the Plant Manager, either the Chief Operating Engineer or the Chief Technical Engineer assumes the Plant Manager's overall responsibility for the Shoreham plant. LILCO Ex. 21, Attachment 50, at 3.

OQA:14. If the Plant Manager and the OQA Engineer "differ significantly with regards to a quality matter, they shall refer the matter to the QA Manager for resolution." LILCO Ex. 21, Attachment 4, Section 1.2.22. This does not mean that the QA Manager could overrule the Plant Manager, but only that the OQA Engineer would be provided formal access to appeal to the Vice President, Engineering or the Vice President, Nuclear. Tr. 12,796-97 (Muller). In any case, LILCO policy would allow

the OQA Engineer to take a dispute with the Plant Manager to either Vice President. Tr. 12,793-94 (Muller). If there were a conflict between the OQA Engineer and the Plant Manager as to whether the plant must be shut down because of a violation, Mr. Muller first testified that the OQA Engineer could issue a stop work order to include plant shut down. Tr. 14,852, 14,877 (Muller). Mr. Muller later testified that the OQA Engineer does not have authority to shut down the plant; that would require the involvement of the Plant Manager or his designee. Tr. 14,878-80, 14,887-88; 14,887-88; 14,893-94 (Muller).

OQA:15. WASH-1284, which was originally published guidance for establishing the QA organization, is no longer operable. The NRC Standard Review Plan permits the organization structure used by LILCO. Tr. 20,220-21 (Gilray).

OQA:16. Mr. Gilray testified that the risk of the Plant Manager exerting undue influence on QA personnel under him is precluded by "checks and balances," including the LILCO Review of Operations Committee, the LILCO Nuclear Review Board, ISEG, the QA Manager, INPO, the NRC resident inspectors and various NRC inspections. Tr. 20,176-77 (Gilray). He denied that all of the foregoing operated only after the fact, and cited as prospective elements which could avoid future undue influence the review and concurrence procedures, including those of ISEG and ROC. He did not know if ISEG does anything with respect to OQA procedures. Tr. 20,178-80 (Gilray).

OQA:17. OQA procedures and instructions are prepared by the OQA Section, reviewed by the OQA Engineer and the QA Manager, and must be approved by the Plant Manager. LILCO Ex. 21, Attachment 4, Appendix D, at 1.

OQA:18. The current NRC guidance concerning QA organization is ANSI Standard 18.7-1976, applicable through Regulatory Guide 1.33, Revision 2. Tr. 14,837-38 (Muller). Paragraph 3.4.2 of ANSI Standard 18.7-1976 states that:

> Depending on the organizational structure, the individual or organizational unit may report functionally to onsite plant management or an offsite organization (see also 3.2). Reporting to onsite plant management is preferable since such an arrangement usually results in improved communications in identifying problems and initiating corrective action. (emphasis added).

OQA:19. The current position of the NRC Staff is that there is no one rigid organization which is the only acceptable organization for a plant QA organization. Tr. 20,222-23 (Gilray).

C. ENVIRONMENTAL QUALIFICATION

EQ:1. Suffolk County Contention 8 reads as follows:

> Suffolk County contends that the TMI-2 accident demonstrated that the severity of the environment in which equipment important to safety must operate was underestimated and that equipment previously deemed to be environmentally qualified had failed. Shoreham's safety-related equipment has not been demonstrated to be capable of maintaining functional operability under all service conditions throughout its installed life, and during the time in which it is actually required to operate, thereby violating 10 CFR 50, Appendix A, GDC 1, 2, 4 and 23 and 10 CFR 50, Appendix B, Sections II, III and XI.

Deficiencies in the qualification of Shoreham's safety-related equipment must be eliminated before operation can be authorized.

(a) The limited test conditions posed in the Shoreham environmental qualification program are not sufficiently conservative;

(b) Equipment has been qualified by grandfathering to older, less stringent standards;

(c) The list of emergency equipment to be environmentally qualified is inadequate;

(d) There has been an inadequate demonstration that all safety-related equipment has been properly qualified to meet aging and other life requirements; and

(e) There is insufficient information to evaluate the overall adequacy of Shoreham's satisfaction of environmental qualification requirements for safety-related equipment.

Pursuant to an agreement of the parties dated January 21, 1983, paragraphs (a) and (b) of the Contention were withdrawn. Agreement with Respect to Partial Resolution of Suffolk County Contention 8/SOC Contention 19(h) -- Environmental Qualification, and Resolution of SOC Contention 19(i) -- Seismic Qualification, ff. Tr. 19,299, at 1.

EQ:2. Prefiled direct testimony was submitted on SC Contention 8 by Suffolk County, LILCO and the NRC Staff. See Direct Testimony of Gregory C. Minor on Behalf of Suffolk County Regarding SC Contention 8 and SOC Contention 19(h) -- Environmental Qualification, ff. Tr. 19,665; Testimony of Robert M. Kascsak, Joan F. Etzweiler, James F. Gleason, Robert J. Najuch, William R. Shosho and Newell K. Woodward for the Long Island

Lighting Company on SC Contention 8/SOC Contention 19(h) -- Environmental Qualification, ff. Tr. 19,305; NRC Staff Testimony of James E. Kennedy and Vincent S. Noonan on Environmental Qualification, ff. Tr. 19,311. The issue was tried on January 26, 27 and 31, 1983.

EQ:3. Suffolk County's witness, Mr. Minor, identified two basic concerns regarding the environmental qualification of equipment at Shoreham. They are:

1. There is inadequate documentation of how LILCO determined what safety-related electrical equipment would be included in its environmental qualification ("EQ") program. Therefore, there is no assurance that all safety-related equipment required to be qualified by 10 CFR Part 50, Appendix A, General Design Criterion ("GDC") 4 and 10 CFR Part 50, Section 50.49(b)(1), has been qualified.

2. There is no evidence that the Shoreham EQ program includes all nonsafety-related electrical equipment the failure of which could mislead the operator or prevent satisfactory accomplishment of 10 CFR Part 100 safety functions by safety-related equipment, as required by Section 50.49(b)(2). Without documentation that LILCO has reviewed nonsafety-related electrical equipment to determine if it is within the definitions set forth in Sections 50.49(b)(2) and 50.49(i), and without justification for the exclusion from the EQ program of any such

equipment, there can be no assurance that all necessary equipment has been included in the EQ program or that the program meets the requirements of GDC 4 and Section 50.49. Minor, ff. Tr. 19,665, at 3.

EQ:4. LILCO witnesses testified that the Shoreham EQ program provides assurance that all safety-related electrical equipment located in potentially harsh environments will maintain functional operability as required to mitigate consequences of a postulated accident and to bring the plant to safe shutdown afterwards, and that the program meets applicable regulatory requirements. Kascsak et al., ff. Tr. 19,305, at 5-6 (emphasis added).

EQ:5. The Shoreham EQ program was designed to satisfy the requirements set forth in NUREG-0588 and NRC Memorandum and Order CLI-80-21. Kascsak et al., ff. Tr. 19,305, at 6,7. Similarly, the Staff's Safety Evaluation Report prepared in November 1982 ("November SER"), reflects the Staff's review of LILCO's EQ program with respect to compliance with NUREG-0588. Tr. 19,385 (Kennedy); Kennedy and Noonan, ff. Tr. 19,311, Attachment 3.

EQ:6. NUREG-0588 deals only with safety-related electrical equipment. Tr. 19,385 (Kennedy). On the other hand, 10 CFR Part 50, Section 50.49 covers electrical equipment important to safety, including both safety-related and nonsafety-related equipment defined as follows:

(1) Safety-related electric equipment: This equipment is that relied upon to remain functional during and following design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in a safe shutdown condition, and (iii) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 C.F.R. Part 100 guidelines. . . .

(2) Nonsafety-related electric equipment whose failure under postulated environmental conditions could prevent satisfactory accomplishment of safety functions specified in subparagraphs (i) through (iii) of paragraph (b)(1) of this section by the safety-related equipment.

(3) Certain post-accident monitoring equipment [specified as "Category 1 and 2" in Regulatory Guide 1.97, Revision 2].

Board Ex. 3, ff. Tr. 19,553, at 2733, 2731.

EQ:7. Similarly, GDC 4 requires that equipment important to safety be designed to be compatible with the environmental conditions postulated to exist. Kennedy and Noonan, ff. Tr. 19,311, at 2-3; Tr. 19,392 (Noonan).

EQ:8. The nonsafety-related equipment identified in paragraph (b)(2) of Section 50.49 has not been specifically addressed in the Shoreham EQ program. Kennedy and Noonan, ff. Tr. 19,311, at 4; Tr. 19,507 (Kennedy).

EQ:9. Up to the time of the hearing on this Contention, all Staff review performed by the Equipment Qualification Branch Staff was limited to safety-related equipment. Tr. 19,392 (Noonan). The Staff's conclusions contained in the SER

address only safety-related electrical equipment; they do not address the broader category of electrical equipment important to safety. Tr. 19,391 (Kennedy).

EQ:10. The Board finds that any conclusions to be drawn from the LILCO and Staff testimony on the adequacy of the Shoreham EQ program must be limited to safety-related equipment, and cannot be applied to the nonsafety-related equipment that is important to safety and within the scope of GDC 4 and Section 50.49. See Kascsak et al., ff. Tr. 19,305, at 22.

A. Compliance with Section 50.49(b)(1)

1. Identification of Safety-Related Equipment in the Shoreham EQ Program

EQ:11. According to the LILCO witnesses, safety-related electrical equipment in existence at Shoreham was identified by LILCO through a review of applicable project documents, including: flow diagrams, specifications, electrical one-line diagrams, logic diagrams, elementary drawings, instrument loop diagrams and general arrangement drawings. Kascsak et al., ff. Tr. 19,305, at 8. This review identified equipment that had been previously designated as safety-related (Class 1E) during the design process. Tr. 19,376, 19,595 (Najuch); Kascsak et al., ff. Tr. 19,305, at 8.

EQ:12. Of the previously designated "safety-related" equipment, only the equipment that either "must perform its

required safety function(s) in the environment dictated by the zones in which the equipment is located," (LILCO's operability code "A") or "does not have an active safety function during the postulated accident conditions, but is connected to Class 1E power systems and has a potential to fail in a manner detrimental to plant safety or accident mitigation" (LILCO's operability code "B"), is included in the Shoreham EQ program. Kascsak et al., ff. Tr. 19,305, at 9.

EQ:13. A "confirmatory" review of the Shoreham Emergency Procedures, still in progress, will result in a list of only safety-related electrical equipment that is relied upon by an operator in any of the six emergency procedures reviewed. Tr. 19,601 (Woodward); Kascsak et al., ff. Tr. 19,305, at 11. LILCO does not expect the review to result in any additions to the Shoreham EQ program. Tr. 19,602 (Kascsak).

EQ:14. The list of equipment included in the Shoreham EQ program is in the Environmental Qualification Status Report ("EQSR"), which is Appendix F of the Environmental Qualification Report for Class 1E Equipment ("EQR"). Kascsak et al., ff. Tr. 19,305, at 9; Minor, ff. Tr. 19,665, at 4.

EQ:15. Much safety-related equipment and several entire systems, were excluded from the Shoreham EQ program. However, neither the basis for such exclusion, nor an identification of the specific safety-related components which were actually

excluded, can be gleaned from the EQ Report or the EQSR. The inscrutability of these documents makes it impossible to determine how or on what basis LILCO excluded some safety-related equipment from the EQ program. Minor, ff. Tr. 19,665, at 4.

EQ:16. For example, Suffolk County's witness testified that the Standby Liquid Control System ("SLCS") includes safety-related electrical equipment in a harsh environment. That electrical equipment, which would fall within LILCO's operability codes A or B, has not been, but should be, included in the Shoreham EQ program. Tr. 19,670-71 (Minor); see also Minor, ff. Tr. 16,665, at 4.

EQ:17. Mr. Minor testified that certain SLCS equipment is relied upon to ensure the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the 10 CFR Part 100 guidelines, and therefore, falls into the category of equipment identified in Section 50.49(b)(1)(iii). Specifically, Mr. Minor testified that an ATWS event that is not mitigated very early would produce a harsh environment similar to that produced by some LOCA events. Tr. 19,671-72 (Minor).

EQ:18. Although the Staff witness Mr. Kennedy testified that in his opinion the SLCS has to be qualified only for normal operating conditions, not for a harsh environment, Tr. 19,647 (Kennedy), the LILCO witnesses agreed with Mr. Minor

that parts of the SLCS will be exposed to harsh environments during one or more of the design basis accidents. Tr. 19,646 (Kascsak).

EQ:19. In performing its EQ review of Shoreham, the Staff did not review components in the SLCS, but did review the operability code assigned by LILCO to the SLCS. According to Staff witness Kennedy, LILCO assigned operability code "C" to most SLCS components -- that is, they were identified as equipment that is exposed to harsh environments but which does not need to function and whose failure would not prevent the accomplishment of safety functions. Tr. 19,646-47 (Noonan).

EQ:20. Only one component of the SLCS, identified as System 1-C-41 in the EQSR, is in the Shoreham EQ program. That component is the level measurement on the standby liquid control tank. The component is required to be in the EQ program by Regulatory Guide 1.97. Tr. 19,696, 19,699 (Minor).

EQ:21. In Mr. Minor's opinion, at a minimum, the squib valves and the other parts of the SLCS necessary for the squib valves to function should be included in the EQ program. In addition, he testified that the SLCS pressure indicator should also be included since it is the means by which an operator determines that there is flow from the SLCS into the pressure vessel. Tr. 19,697 (Minor). These components are not in the Shoreham EQ program although they are within the scope of

Section 50.49. Mr. Minor testified, and the Board agrees, that regardless of whether they are classified as safety-related or nonsafety-related, they are important, necessary to perform a safety function and their failure could mislead the operator. Tr. 19,698 (Minor).

EQ:22. The Board concludes that all necessary components of the SLCS have not been included in the Shoreham EQ program. Based on the example of the SLCS, we conclude, further, that LILCO has failed to demonstrate that all necessary safety-related equipment has been included in the Shoreham EQ program. The Board finds the example of the SLCS persuasive evidence of the need for identification and analysis of all electrical equipment important to safety in the Shoreham plant before it can be determined that all necessary equipment at Shoreham has been properly qualified. See Findings 8:60-63 below.

2. Status of Qualification of Safety-Related Equipment and Staff Review

EQ:23. The NRC Staff performed audits of LILCO's qualification documentation and installed electrical equipment on April 26-30 and June 2-3, 1982. At the time the audits were performed, approximately 40 percent of the equipment in the Shoreham EQSR was qualified. Kennedy and Noonan, ff. Tr. 19,311, Attachment 3, at 1-3; Tr. 19,396 (Kennedy).

EQ:24. In Appendix B to the November SER, the Staff identified 81 types of equipment that required additional

qualification information or corrective action. Most of these required either retesting or replacement; some had to undergo additional analysis. Kennedy and Noonan, ff. Tr. 19,311, Attachment 3, at 1-4, 1-10, and Appendix B; Tr. 19,458-60 (Kennedy).

EQ:25. Several of the dates listed in Appendix B as goals for completion of the necessary corrective actions had passed by the time of the hearing in January, 1983. Kennedy and Noonan, ff. Tr. 19,311, Attachment 3, Appendix B; Tr. 19,464 (Kennedy). The Staff witnesses were unable to state whether the identified corrective actions had in fact been performed by the dates stated in Appendix B. Tr. 19,462-63 (Kennedy).

EQ:26. The Staff has stated that the deficiencies identified in Appendix B of the November 1982 SER "are cause for concern and require further case-by-case evaluation." Kennedy and Noonan, ff. Tr. 19,311, Attachment 3, Appendix B, at 1-11. Despite this statement, the Equipment Qualification Branch will not take part in any additional Staff audits of Shoreham equipment. Tr. 19,463 (Noonan).

EQ:27. The Staff will require LILCO to submit a statement addressing the resolution of each deficiency identified in Appendix B of the November SER. Tr. 19,471 (Noonan). However, the Equipment Qualification Branch Staff's "case-by-case evaluation" of the Appendix B deficiencies will be limited to an

acceptance of the LILCO statement as to the resolution of each deficiency. Tr. 19,472, 19,476-77 (Noonan). The Equipment Qualification Branch Staff will not review any retesting conducted by LILCO, or any replacement equipment, prior to issuing an SER supplement certifying that the deficiencies have been corrected. Tr. 19,475-76 (Noonan).

EQ:28. According to LILCO's witnesses, as of January 31, 1983, approximately nine to ten months after the Staff's audit, about 30 percent of the items listed in Appendix B to the November SER had been resolved by LILCO. Tr. 19,556, 19,558-59 (Kascsak).

EQ:29. Although there have been internal Staff discussions between NRR and the Office of Inspection and Enforcement concerning the responsibilities of I&E in the future with respect to equipment qualification, Tr. 19,463-64, 19,476, 19,477-78 (Noonan), the Staff witnesses did not anticipate that I&E personnel would perform any inspections of environmental qualification equipment retesting or replacement between January and June, 1983. Tr. 19,477 (Noonan).

3. Justifications for Interim Operation and Staff Review

EQ:30. Section 50.49(i) requires that prior to the granting of an operating license, applicants must submit to the Staff an analysis to ensure that the plant can be safely

operated prior to completion of the equipment qualification required by the regulation. Board Ex. 3, ff. Tr. 19,553, at 2734. Such analysis is referred to as a "justification for interim operation" ("JIO") with respect to a particular component. The analyses contained in JIOs must include, where appropriate, consideration of several factors, including whether a failure of equipment under the accident environment resulting from a design basis event would produce misleading information for the operator. Board Ex. 3, ff. Tr. 19,553, at 2734. See §50.49(i)(5). The Staff has provided no guidance to applicants, other than that stated in Section 50.49(i)(5), concerning how to identify types of failures that could result in misleading information. Tr. 19,615 (Kennedy).

EQ:31. The Staff members on the witness panel did not review the portion of LILCO's JIOs that deal with the operator being misled. Mr. Kennedy testified that he was not qualified to state what criteria the Staff used in determining that LILCO's JIOs adequately addressed the possibility of equipment failures' resulting in misleading information for the operator. Tr. 19,615 (Kennedy).

EQ:32. The items identified in Appendix B of the November SER are deficiencies in qualification documentation. They are not related to the additional deficiencies identified in the December 29, 1982 SER Supplement ("December SER"), which are deficiencies in JIOs. Tr. 19,469 (Kennedy).

EQ:33. The December SER identified several JIO-related outstanding items that must be adequately addressed by LILCO before the Staff's review can be completed. Kennedy and Noonan, ff. Tr. 19,311, Attachment 4, at cover letter and 3-2.

B. Compliance with Section 50.49(b)(2)

EQ:34. The Staff testified that it will require LILCO to identify any equipment that falls into category (b)(2) that is not already in its EQ program. Kennedy and Noonan, ff. Tr. 19,311, at 4; Tr. 19,572 (Noonan). Such identification is required under Section 50.49(d). Tr. 19,507-08 (Kennedy). LILCO will be required to submit to the Staff the list of equipment which it is required to prepare under Section 50.49(d). Tr. 19,517-18 (Kennedy).

EQ:35. The Staff expects LILCO to submit the identification of equipment that falls within Category (b)(2) by the latter part of March or the beginning of April, so the Staff can review it prior to its preparation of a mid-June SER Supplement. Tr. 19,508, 19,572 (Noonan).

1. No Criteria or Guidance for Compliance Provided by Staff

EQ:36. At the time of the hearing, the Staff witnesses testified that they did not yet have "a firm policy" on what will constitute compliance with Section 50.49(b)(2). Tr. 19,510 (Kennedy). Mr. Noonan stated "We do not have a working

knowledge yet of dealing with that particular list of equipment because the rule is just now being started to be implemented." Tr. 19,510, 19,574 (Noonan). Mr. Kennedy testified that the Staff "may have a few general ideas of what types of equipment might fall into" category (b)(2). Tr. 19,510 (Kennedy).

EQ:37. Other than what is contained in Section 50.49 itself, the Staff has not provided any guidance to applicants on how to prepare the list required by Section 50.49(d). Tr. 19,520 (Noonan).

EQ:38. Staff witness Noonan testified that he was not qualified to state whether an applicant's review of equipment to identify that within category (b)(2) of Section 50.49 should include consideration of (1) equipment whose failure initiates a transient that requires measures to terminate other than those associated with normal operations, or (2) equipment that serves as a potential backup for cooling or energy for equipment falling in Section 50.49(b)(1). Tr. 19,616-18 (Noonan).

EQ:39. The Staff testified that in order to determine the electrical components that are covered by Section 50.49, it would be necessary to identify the important-to-safety equipment that falls into each of the three subpart (b) categories -- safety-related, nonsafety-related and post-accident monitoring -- and then identify which pieces of such equipment are in a harsh environment. Tr. 19,513-14 (Kennedy).

EQ:40. The Staff witnesses were not aware of any list of that electrical equipment important to safety that is covered by Section 50.49. Tr. 19,514 (Kennedy).

EQ:41. Furthermore, the Staff testified that criteria by which an analysis would be performed to generate a list of nonsafety-related equipment that could adversely affect safety-related equipment is not written down anywhere. Tr. 19,575 (Noonan).

2. Future Staff Review Undefined

EQ:42. The Staff witnesses were unable to state what review would be performed of the list of category (b)(2) equipment to be submitted by LILCO. Tr. 19,510-11, 19,518-19, 19,529 (Noonan). Staff witnesses were also unable to state how the Staff would assure itself that all equipment falling into category (b)(2) actually appears on the list of equipment to be submitted by LILCO. Tr. 19,519 (Noonan). Mr. Noonan stated "There has been no formal policy set up at this particular time." Tr. 19,519 (Noonan).

EQ:43. After LILCO submits a list of category (b)(2) equipment, the Staff will then make a decision as to what kind of review will be performed. How many items are on the list submitted by LILCO will be a factor in the Staff's decision. Tr. 19,510-11 (Noonan). Staff member Rossi, who was not on the witness panel for this contention, will be responsible for

reviewing the list of category (b)(2) equipment to be submitted by LILCO. Tr. 19,573, 19,576 (Noonan).

EQ:44. At the time of the hearing, the Staff did not intend to perform a generic review of BWR equipment to determine what equipment would fall into the (b)(2) category. Tr. 19,576 (Noonan).

EQ:45. Based on discussions among some Staff members, the Staff has a general opinion that the list of items in category (b)(2) should be very small or nonexistent. Tr. 19,510 (Noonan). However, Mr. Noonan testified that he was "having some difficulty . . . with the Staff in deciding just how we determined that it is small." Tr. 19,530 (Noonan). Although Staff members have discussed the possibility of LILCO's list containing no equipment, the Staff has not yet developed a position on how such a "list" would be handled. Tr. 19,576 (Noonan).

EQ:46. Although the Staff testified as to its belief that Section 50.49(b)(2) is "largely accounted for" by compliance with Regulatory Guide 1.75, Revision 1, "Physical Independence of Electric Systems," there are still open items in the Staff's review of such compliance at Shoreham. Kennedy and Noonan, ff. Tr. 19,311 at 4; Tr. 19,560 (Kennedy).

EQ:47. Mr. Kennedy testified that there could be nonsafety-related equipment, not covered by Regulatory Guide

1.75, whose failure could have an impact on the accomplishment of safety functions. Tr. 19,571 (Kennedy).

EQ:48. The Staff witnesses could not say whether the Staff's review of compliance with Section 50.49(b)(2) would include an applicant's consideration of whether an environmentally-caused control system failure of nonsafety-related equipment, covered by Regulatory Guide 1.75, could affect a safety function. Tr. 19,572 (Kennedy); Tr. 19,575 (Noonan).

EQ:49. The Staff testified that equipment in category (b)(2) "may be so plant-specific that it could be very difficult to review." Tr. 19,510 (Kennedy).

3. Shoreham Category (b)(2) Equipment

EQ:50. LILCO believes there is no equipment in category (b)(2) at Shoreham. Tr. 19,529 (Kascsak).

EQ:51. Mr. Kascsak testified that LILCO believes it will not have to identify any equipment in category (b)(2) due to the Shoreham design process, how equipment has been identified within the plant, and LILCO's preclusion of interactions between safety and nonsafety systems as a matter of design practices. Tr. 19,650 (Kascsak).

EQ:52. However, to determine that there is no equipment in category (b)(2) LILCO does not intend to perform any additional studies or analyses beyond those already performed during the design process. Tr. 19,651-52 (Kascsak).

EQ:53. Suffolk County's witness testified that even with a systematic design process that attempted to preclude adverse effects of nonsafety-related equipment on safety-related equipment there can still be no assurance that there would not be such effects. Mr. Minor explained that the design process is not self-contained; if it is not properly implemented, reviewed, and field-verified under actual conditions, even the best design may not achieve what was intended. In addition, the potential adverse effects which must be considered in environmental qualification include a wide variety of factors, including human factors. Even if a design attempts to preclude adverse effects, an evaluation of the design, after it has been implemented, is necessary to determine if an operator could be misled. Accordingly, Mr. Minor disagreed with the LILCO witnesses' statement that the Shoreham design means there will be no equipment in category (b)(2). Tr. 19,667-68 (Minor).

EQ:54. Mr. Minor provided examples of systems, apparently not reviewed for inclusion in the Shoreham EQ program, that in his opinion should be reviewed to determine if they contain nonsafety-related components that fall within category (b)(2). The examples include the offgas system, the emergency lighting system, the emergency communications equipment system, the feedwater system, the condensate system, and the remote shutdown panel. Tr. 19,684-85, (Minor). He stated that these

entire systems may not necesssarily need to be included in the EQ program; without a review of them, however, it is impossible to determine that they contain no components that should be included. Tr. 19,708 (Minor). The Board agrees that a review of such systems against the criteria set forth in Section 50.49 must be performed before such a determination can be made. However, LILCO has apparently made such a determination based solely on the fact that the systems are not safety-related. Tr. 19,708-09 (Minor).

EQ:55. Mr. Minor also testified that to identify equipment that falls into category (b)(2), both safety-related and nonsafety-related systems must be reviewed, because either type system could contain nonsafety-related components the failure of which could prevent satisfactory accomplishment of Part 100 safety functions. Tr. 19,707-08 (Minor).

C. Compliance with Section 50.49(b)(3)

EQ:56. The Staff's review of LILCO's compliance with Regulatory Guide 1.97, Revision 2 will not be completed prior to fuel load. Tr. 19,510, 19,522 (Kennedy). As noted above, Section 50.49(b)(3) requires qualification of category 1 and 2 items contained in that Guide. Board Ex. 3, ff. Tr. 19,553, at 2731.

EQ:57. LILCO has indicated that it does not intend to install all the equipment recommended in Regulatory Guide 1.97, Revision 2. Rigert, ff. Tr. 9455, at 4.

EQ:58. The Board finds that before the Staff can determine that an adequate number of JIOs has been submitted by an Applicant as required by Section 50.49(i), the Staff must have identified the total list of equipment that belongs in the EQ program, including the Regulatory Guide 1.97 items. The Staff witnesses were unable to state how the Staff could determine that LILCO had complied with Section 50.49 when the Staff had not performed a review of the LILCO response to Regulatory Guide 1.97. Tr. 19,523-25 (Kennedy).

D. Actions Necessary for a Finding of Compliance With Section 50.49

EQ:59. Mr. Minor testified that the first step to be taken by an applicant in the process of complying with Section 50.49 is to prepare a list of all electrical equipment important to safety located in the plant. Then, the items on that list should be evaluated to determine if they meet the criteria set forth in Section 50.49. If they do, they must be included in the EQ program. Mr. Minor also testified that the Staff must provide more guidance as to how Section 50.49 is to be implement. Minor, ff. Tr. 19,665, at 6; Tr. 19,709 (Minor). The Board agrees.

EQ:60. Staff witness Mr. Noonan agreed that a list of nuclear plant items important to safety, that had been reviewed and approved by the Staff, would be a helpful tool in conducting a review of LILCO-submitted lists of equipment

covered by Section 50.49. Tr. 19,580 (Noonan). He further testified that, if available, the Staff would use as a check-list in reviewing a list of equipment covered by Section 50.49(b)(2), an all-inclusive list of equipment important to safety that had been approved by the Staff. Tr. 19,584 (Noonan).

EQ:61. The Board finds that such a list of equipment important to safety is necessary both to determine and to assure compliance with Section 50.49. In the absence of such a list, there can be no basis for a conclusion, whether by the Staff, by LILCO or by this Board, that Shoreham complies with that Section, particularly in light of LILCO's failure to use an "important to safety" category in its classification of equipment. See Findings B-4 through B-7, LILCO's Proposed Opinion, Findings of Fact and Conclusions of Law in the Form of a Partial Initial Decision, dated January 17, 1983.

EQ:62. On the present record, the Board concludes that there is no basis for a finding that Shoreham is in compliance with 10 CFR Part 50, Section 50.49. The Board therefore finds in favor of Suffolk County on SC Contention 8. In addition, the Board will retain jurisdiction of this matter and orders the following:

a. LILCO will prepare and submit to the Staff a list of electrical equipment important to safety that is located in the Shoreham plant.

b. LILCO will identify and submit to the Staff those items on the list described in (a) that it believes fall within the scope of Section 50.49 and will include in its EQ program all such items not already so included.

c. LILCO will submit to the Staff a list showing all category 1 and 2 items in Regulatory Guide 1.97, Revision 2, and all equipment to be installed at Shoreham in response to those Regulatory Guide items. The submittal will also identify (i) the EQ status of the Regulatory Guide 1.97 equipment already installed or to be installed, and (ii) the Regulatory Guide 1.97 equipment that LILCO does not intend to install.

d. The Staff will prepare a generic list of BWR equipment important to safety to be used as a checklist against which to review the LILCO list described in (a), and will perform and document such a review.

e. The Staff will review the LILCO list described in (b) against the criteria set forth in Section 50.49, and will document such review.

f. The Staff will review the submittal described in (c) and, prior to making a determination as to compliance with Section 50.49, the Staff will determine if Shoreham has complied with Regulatory Guide 1.97, Revision 2.

g. The Staff will perform an audit or review of the actions taken by LILCO to resolve the deficiencies identified in the November and December SERs.

EQ:63. The Board recognizes that actual qualification of all equipment covered by Section 50.49 need not be complete until the first refueling outage. However, the regulation does require, prior to the issuance of an operating license, submission of JIOs for all equipment to be qualified. §50.49(i). In order to comply with that provision, the Board finds that the actions identified in (a) through (g) above must be completed prior to fuel load.

EQ:64. Upon completion of the items set forth above, the submission of the results to the Board and the parties, and an opportunity for the parties to submit testimony and be heard thereon, the Board will again review this matter and will make a determination as to whether Shoreham complies with 10 CFR Part 50, Section 50.49.

APPENDIX 1

SWEC AUDIT OBSERVATIONS CONCERNING CALCULATIONS, PARTICULARLY CONCERNING COMPLIANCE WITH EAP 5.3 "CONTROL OF COMPUTERIZED AND MANUAL CALCULATIONS"

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 4 2/73	Mechanical Calculations, p.1	Mechanical calculations judged to be unsatisfactory for reasons that include calculation not checked or dated.	Some pages of calculation not initialed and dated. Tr. 13,357 (Eifert). Represents an administrative problem with documentation of review. Tr. 13,356 (Eifert). LILCO places this observation in category of "Inadequate Documentation of Review." LILCO Ex. 24, at 2.
		Numerous nuclear and electrical calculations performed during 1969-71 period lacked references to sources of input data.	Situation violated SWEC procedure but actual traceability still possible. Tr. 10,360-61, 10,363, 13,334 (Eifert). LILCO categorizes this finding as an instance where ready traceability not provided. LILCO Ex. 24, at 1; Tr. 13,322-35 (Eifert). This constitutes a detailed administrative concern, dealing with the specific detail which SWEC expects engineers to put in the calculation documentation to ensure the information is readily available and to make sure an engineer in the future could readily review and understand the calculation. Tr. 13,323 (Eifert).
EA 5, 5/73	p. 1, bottom & top of p. 2	Follows up on EA 4, nuclear and electrical calculations, and notes that there are many old calculations from 1969-71 that do not meet EAP 5.3 requirements. One of the most serious deficiencies is failure to identify or reference sources of input data.	Same kinds of deficiencies as noted in EA 4. Tr. 10,377 (Eifert). LILCO places this observation in its "Ready Traceability" category. LILCO Ex. 24, at 2.

*All audits part of Suffolk County Ex. 51 unless otherwise noted.

Appendix 1

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 7, 10/73	p. 2, item (c) and statistical summary re nuclear calculations and power mechanical calculations.	Noncomformances to EAP 5.3 identified, including failures to properly identify input data sources in two disciplines.	LILCO places observation in "Ready Traceability" category. LILCO Ex. 24, at 1. Source of input data not clearly documented but does not indicate that design data cannot be traced. Tr. 10,384 (Eifert). Represents departure from EAP 5.3 requirement. Tr. 10,386 (Baldwin). Called administrative and not directly related to safety. Tr. 10,387 (Baldwin).
EA 9, 5/74	p. 2, Structural Steel, and Building Service.	Preventive action required because similar deviations from EAP 5.3 requirements were identified on each calculation audited. Problems included checkers and preparers failing to sign and date calculations.	This audit followed shortly after change in procedure and indicates preparers and reviewers were not meeting new procedural requirement. Tr. 10,389 (Eifert). Calculation had been reviewed and met old requirement. Tr. 10,389-90 (Eifert). Reflects lack of attention to administrative detail re change in SWEC practice. Tr. 10,390 (Eifert). LILCO places this observation in its "Inadequate Documentation of Review" group. LILCO Ex. 24, p. 2; Tr. 13,359 (Eifert).
EA 10, 7/74	Item C, pp. 1-2, pipe stress, electrical and vessels calculations	Recurring EAP 5.3 deviations requiring preventive action. Problems include failure of preparers and checkers to sign calculations and indexing problems.	Failure to sign calculations reflects situation where new requirement (signed vs. initials or printed name) had apparently not been met. Tr. 10,395, 13,360 (Eifert). These are administrative problems. Tr. 10,396 (Eifert). The necessary review had occurred but was not documented as required. Tr. 13,360 (Eifert). LILCO Ex. 24, at 2. These were grouped by LILCO as instances of "Inadequate Documentation of Review" or "Indexing/Filing" problems. The potential for an impact on quality from this sort of problem was characterized by LILCO witnesses as "extremely remote." Tr. 13,411-12 (Eifert); LILCO Ex. 24, at 2 and 3.

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 14, 8/75	p. 2, item c	Recurring EAP 5.3 deviations requiring preventive action. Problems include:	
		(a) Sources of some input values in all environmental/hydrothermal calculations not identified as required by EAP 5.3	(a) Each calculation in environmental/hydrothermal area exhibited some input data identification problem. Tr. 10,421-22, 10,423 (Eifert). LILCO places this problem in "Ready Traceability" category. LILCO Ex. 24, at 2.
		(b) Computer runs have not been summarized as required by EAP 5.3, nor is there evidence that data have been reviewed as required by EAP 5.3.	(b) LILCO witnesses confirm summary has not been prepared but are confident that review had been conducted. Tr. 13,361 (Eifert). LILCO places this problem in "Inadequate Documentation of Review" category. LILCO Ex. 24, at 3.
		(c) Environment/aquatic calculations have not all been checked.	(c) This is more than an administrative problem and there is more than a remote possibility of impact on the quality of design. Tr. 13,383, 13,385 (Eifert). One calculation was not reviewed and the calculations had not been indexed. Tr. 13,385 (Eifert). These calculations not used in plant design but rather are for ecological impact and thus would not impact plant design. Id. LILCO places this in its "Miscellaneous Important Concerns" category. LILCO Ex. 24, at 3.
EA 16, 1/76	p. 2, item 2.B. 2.a	Numerous Engineering Mechanical calculations prepared in 1973 and 1974 have not been checked and filed in Division Job books.	Auditor was expressing view that work in this area should be progressing in a more timely manner. Tr. 13,428 (Eifert). LILCO places this item in its "Timeliness" category. LILCO Ex. 24, at 4.

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 17, 5/76	2.B.1.b (audit not in evidence)		This is an example where the off project Engineering Mechanics, Structural Mechanics Group, had not been transmitting all their calculations to the project file, contrary to SWEC procedural requirements. Tr. 13,417 (Eifert). This constitutes an indexing/filing problem re structural mechanics calculations which reflects an implementation problem re EAP 5.3. Tr. 10,441-42; 13,417-18 (Eifert); LILCO Ex. 24, at 3. LILCO places this item in its "Indexing/Filing" category Id.
EA 19, 12/76	p. 3, 2.b.6 (audit not in evidence)		Source of basic data for calculations was not provided, contrary to procedural requirements. Tr. 10,456-58 (Eifert). Example of a problem of identifying source document. Tr. 10,461-62 (Eifert). LILCO places this item in its "Ready Traceability" category LILCO Ex. 24, at 1.
EA 20, 2/77	A.O. 001	25 Project Facilities calculations, some dating from 1970, are marked "preliminary" and have been indexed and filed in separate binder. Haven't been checked, although it is intended they will be checked.	Auditor felt more progress should have been made but these preliminary calculations had not been used. Tr. 13,428-29 (Eifert). LILCO places this item in its "Timeliness" category. LILCO Ex. 24, at 4.
	A.O. 002	Electrical calculations "numerous calculations have sources of input that are not adequately identified to ensure positive traceability."	The SWEC witness believes audit observation probably reflects the actual condition. Tr. 10,469 (Eifert). This is a problem of identification of sources of input. Tr. 10,470 (Eifert). This is a violation of EAP 5.3 Tr. 10,475 (Eifert). LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1.

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
	A.O. 007	Some hydraulic calculations do not positi[illegible]dentify the sources of input data an[illegible]ome of the required calculations have not been completed.	LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 2.
EA 21, 5/77	A.O. 014, Nos. 6 & 9	Project Nuclear Calculations. (a) Many sources of input not positively identified by calculation #. (b) Some required calculations have not been completed.	Item (a) constitutes violation of EAP 5.3. Detailed administrative control not implemented. Tr. 10,490 (Eifert). LILCO places this item in "Ready Traceability" category. LILCO Ex. 24, at 1
	A.O. 016, No. 2	Input sources for many project mechanical calculations are not identified adequately.	Engineer had used interoffice memos to identify sources. Tr. 10,491 (Eifert). LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1.
EA 22, 8/77	A.O. 018, Nos. 2 & 3	Concerning Hydraulic Analysis Calculations: (a) Calculations use data from other calculations but do not identify the calculations from which data were taken; (b) Computer programs used in some calculations not identified.	LILCO places both items in "Ready Traceability" category. LILCO Ex. 24, at 2. (b) Upgrading SWEC procedures required input data for calculations to be more fully identified than what was found. Tr. 10,524 (Eifert). LILCO witness says that EA audit 25, obs 58, No. 1, is another example of this type of problem. Tr. 10,525 (Eifert).

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 23, 12/77	A.O. 030, Nos. 1 & 2	Facilities Design Calculations: (a) Positive traceability required by EAP 5.3 not provided by use of interoffice correspondence as source of input data where engineering document having data is not referenced. (b) Computer summaries do not identify sources of input values required by EAP 5.3.	LILCO places both items in "Ready Traceability" category. LILCO Ex. 24, at 2. (a) the auditor did not find the expected positive traceability. Tr. 10,528 (Eifert)
	A.O. 031, Nos. 1 & 3	Steel design calculations: (a) Interoffice correspondence and verbal instructions referenced as sources of input on all of calculations audited, without noting the engineering document from which it came as required by EAP 5.3. (b) Since 5/3/77, calculations must reference computer program by version and level. Calculations prepared since 5/3/77 do not comply with this EAP 5.3 requirement.	LILCO places both items in its "Ready Traceability" category. LILCO Ex. 24, at 2. (a) Another example (like A.O. 030, #1) where positive traceability is not specifically provided. Tr. 10,529 (Eifert).
	A.O. 032, No. 1	Concrete design calculations have interoffice correspondence and peoples' names as sources of input on all calculations audit, instead of appropriate engineering documents. Does not provide the positive traceability required by EAP 5.3.	LILCO places this item in "Ready Traceability" category. LILCO Ex. 24, p. 2. The auditor confirmed that the correct input data had been used. Tr. 10,535-36 (Eifert)
	A.O. 034 No. 3	EMD mechanical calculations. Audit of 8 calculations showed several discrepancies in sources of input data, including instance where input reference for 1 of values was totally missing on 3 calculations. Interoffice correspondence was used as data source on 3 calculations making retrievability difficult.	LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1. Actual traceability could be accomplished. Tr. 10,532 (Eifert). Traceability would not be very difficult, but it would be easier if the specific document was referenced. Tr. 10,548 (Eifert).

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 24, 3/78	A.O. 050, No. 3	Pipe stress calculations do not specify documented sources of values; traceability required by EAP 5.3 not provided.	LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1. The Auditor noted that traceability was not provided as required by EAP 5.3. Tr. 10,561 (Eifert)
EA 26, 9/78	A.O. 067, Nos. 3 & 6	Pipe support design calculations: (a) Lack of proper communication between SWEC Boston personnel and Site personnel and Site Engineering Office personnel. Since there was no cross reference of pipe support drawings to calculations, could not determine the latest calculation for a given support.	(a) Administration control between two offices. It is important that the two offices understand exactly what the latest design document is. Tr. 10,565-66 (Eifert). The files were not being kept up to date in Boston. Tr. 10,566 (Eifert). Site Engineering Office had responsibility for work but duplicates not in place in Boston. Tr. 10,568 (Eifert). LILCO places this item in "Indexing/Filing" category. LILCO Ex. 24, at 3.
		(b) In many cases calculations do not reference the source of the calculation equations methods used.	(b) There was actual traceability but there was a problem with documentation. Tr. 10,576 (Eifert). LILCO places this item in "Ready Traceability" category. LILCO Ex. 24, at 1
EA 27, 12/78	A.O. 072, Nos. 2, 4, 5	Structural steel design calculations. Three calculations did not identify source of data/values used in calculations.	For 2 of the calculations Nos. 2 & 4, the problem was not identification of the source document, but a need to justify the assumption used in the calculation. Tr. 10,586-88 (Eifert). One of the calculations was reworked but no change resulted. Tr. 13,400-01 (Eifert). The requirement to justify assumptions used in a calculation is similar in purpose to the need to identify the source of data, namely to ensure that subsequent users of the calculations can follow them. Tr. 10,588-89 (Eifert). LILCO places these items in "Ready Traceability" category. LILCO Ex. 24, at 2.

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 28, 4/79	A.O. 079, Nos. 1 & 2	Pipe Stress Design Calculations:	
		(a) Calculation index form required by EAP 5.3 has not been used and so no evidence that project has implemented requirement to identify and track calculations that need confirmation at later date.	(a) LILCO places (a) in its "Indexing/ Filing" category. LILCO Ex. 24, at 3. The index form in EAP 5.3 has been made the standard form for all disciplines. Tr. 10,590 (Eifert). The calculation index was not being marked to indicate confirmation was required. The calculations were being properly marked but the index was not. Tr. 13,416-17 (Eifert). An index was being kept but not in accordance with the new required form. Tr. 10,595 (Eifert).
		(b) References to sources of input are inadequate to ensure traceability. Notes that a similar condition had been noted in EA 24, A.O. 050, No. 3, indicating inadequate project preventive action.	(b) The problem consisted on nonspecific identification of the source documents. Tr. 10,593 (Eifert). LILCO places this item in "Ready Traceability" category. LILCO Ex. 24, at 1
	A.O. 080, No. 1	Audit of Structural Mechanical calculations. Review indicated that 18 calculations prepared prior to 1979 had not been checked at the time of the audit. The results of one calculation had been used to determine "G" values in a specification. This violated EAP 5.3.	The results of an unchecked calculation should not be used. There is a procedure for use of input from preliminary analysis work. The use of an unchecked calculation is not a significant problem if it is properly controlled. Tr. 10,596-600 (Eifert). Four other calculations which had not been checked were also used. Tr. 13,389-90 (Eifert). LILCO puts these items in its "Misc. Important Concerns" category. LILCO Ex. 24, at 3. Mr. Eifert does not believe these deficiencies would have adversely affected the design. Tr. 13,390-91 (Eifert).

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
EA 30, 10/79	A.O. 101, Nos. 1 & 3	Power Nuclear Calculations:	
		(a) Seven of 13 Nuclear calculations have been changed since they were completed (signed by preparer and reviewer). No documentation re when changes were made or by whom or that changes were reviewed or reasons for change not recorded.	(a) The calculations had in fact been reviewed but documentation did not reflect it. Tr. 13,368. LILCO places this item in its "Inadequate Documentation of Review" category. LILCO Ex. 24, at 3, top.
		(b) Two of 13 calculations reference a computer program without reference to version and level as required by EAP 5.3. Also, the specific version and level that had been used had not been qualified.	(b) The use of an unqualified computer program is considered a serious matter. Tr. 10,606-07 (Eifert). This situation was limited to two programs. Tr. 13,391-93 (Eifert). LILCO places this item in its "Miscellaneous Important Concerns" category. LILCO Ex. 24, at 3. This is the only instance where EA audits on Shoreham project have identified the use of an unqualified computer program. Tr. 13,393 (Eifert)
EA 31, 2/80	A.O. 107, Nos. 1 & 2	Mechanical Calculations:	
		(a) Not all references are traceable as required by EAP 5.3.	(a) LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1. LILCO witness agrees that not all references in the calculation are traceable as required by EAP 5.3. Tr. 10,608 (Eifert).
		(b) Unapproved input from an incomplete calculation was used in a calculation. Neither the index nor the calculation was marked to indicate need for confirmation.	(b) This violates the calculation control procedure. This is considered "very important," and LILCO places this item in its "Miscellaneous Important Concerns" category. Tr. 10,608-09, 13,394 (Eifert); LILCO Ex. 24, at 3. No actual problems were identified with the calculations. Tr. 13,394 (Eifert). During corrective action, LILCO found other

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
			similar problems and thus could not consider it to be an isolated case. Thus, LILCO needed to review all calculations prepared in same time frame. Tr. 10,609 (Eifert).
EA 34, 11/80	A.O. 119, p. 2, No. 2 (bottom)	Calculation for Station Service Loading, dating from March 1980, provides data without identifying source of information or whether confirmation is required. Fails to meet requirements of EAP 5.3. Calculation also failed to incorporate latest input data.	The information was traceable to vendor documentation but the ready traceability with specific identification of the source document was not provided. Tr. 10,630-31 (Eifert). With respect to the observation re latest input data not being used, Mr. Eifert thinks this may have been a situation where data had not been distributed at time calculation prepared. Tr. 10,631-33 (Eifert). LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1.
	A.O. 120 Nos. 2 & 4	Pipe Support Design Calculations:	
		(a) Subcalculations used information from vendor catalogs which were not identified. The sources of various formulae used were not identified. Traceability not maintained. Auditor questioned how reviewer could determine correctness of input when information sources not identified.	(a) Traceability did exist, but ready traceability was not provided. The proper formulae were being used. This is example of administrative concern which engineers consider to be secondary. Tr. 10,634-35 (Eifert). LILCO places this item in its "Ready Traceability" category. LILCO Ex. 24, at 1.
		(b) The STRUDL computer models used for some calculations did not agree dimensionally with the BZ drawings (i.e., detailed design drawings). Thus, calculations not representative of supports.	(b) Auditors identified discrepancies between STRUDL model used in pipe support finite element analyses and the actual configuration of the pipe supports. This item started a large re-evaluation of pipe supports. Tr. 10,637-38 (Eifert, Museler). This was a significant concern, requiring review of about 1800 pipe supports to ensure that they met design margins; about 1 percent required modification. Tr. 10,639,

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
			10,684 (Museler). The primary cause of the discrepancies was where pipe supports needed to be adjusted during installation and this was done on the basis of judgment. Tr. 10,640-41 (Eifert); Tr. 10,634-44 (Museler). The Auditor was concerned that these changes were beyond what could be accepted by judgment. Tr. 10,641 (Eifert). It was confirmed by this observation that this exercise of judgment in a number of cases should have been backed up by a calculation. Tr. 10,645 (Museler). This is a very important audit observation. Tr. 10,646 (Eifert). The judgment had been made that the new installation position was only a minor change that did not need new calculation to ensure that design margins are achieved. The audit showed some errors in judgment and, indeed, a few cases where design margins were not achieved. Tr. 10,663-64, 10,666 (Museler); Tr. 10,754-55 (Eifert).
EA 36, 6/81	A.O. 131 (audit not in evidence)		Ready traceability requirements for documentation were not met. Tr. 10,801-02 (Eifert). LILCO places this item in the "Ready Traceability" category of LILCO Ex. 24, at 1.
SEO 11, 4/81 (SC Ex. 53)	A.O. 129, Nos. 1, 4 & 5	SEO Pipe Support Calculations: (a) the version and level of the STRUDL II computer program was not identified in two calculations.	Items a-c are placed in LILCO's "Ready Traceability" category. LILCO Ex. 24, at 1, 2.

Audit*/Date	Portion of Audit	Summary of Audit Finding	Additional Data
		(b) Specific references for information used in pipe support calculations were not identified, such as sources of formulae and sources of allowable loads.	(b) This item contains examples where ready traceability is not provided as required by engineering assurance procedures, but there is traceability. Tr. 10,721-23 (Eifert).
		(c) Programs used in this design of pipe supports not specifically identified; thus, traceability to program version and level not provided. Auditor notes that "there is evidence that calculations are not controlled in a satisfactory manner."	
EA 40, 6/82	A.O. 023, 154, and p. 2 of audit	(a) Steel and Concrete calculations show recurrent problems including sources of input and formulae not identified.	(a) Similar documentation problems were recurring. Tr. 10,813 (Eifert).
		(b) All calculations within 2 of 7 job books did not give source of formulae and thus did not provide traceability of input.	(b) This audit shows examples of lack of ready traceability which is required. Tr. 10,832-33 (Eifert). LILCO places this item in the "Ready Traceability" and "SAR Related" categories. LILCO Ex. 24, at 2-3.

APPENDIX 2

COURTER E&DCR DEFICIENCIES

S.C. Ex. No.	Document/ Audit No./Date	Page/Finding	Description and Additional Data
57	FA 654,11/77	4.6	Auditor reviewed 8 specifications and 2 procedures as to which there were 180 applicable E&DCRs. 71 of those E&DCRs were listed in audit as missing, meaning that 39.4% of the Courter-related E&DCRs were listed as missing. FA 654, finding 4.6; Tr. 11,092 (Kelly). LILCO witness clarified that E&DCRs were not actually missing, but had not been posted against specification as required. Tr. 11,369-70, 11,385-6 (Museler). Improvement in this area began in late 1977 but did not reach satisfactory status until 1979. Tr. 11,373-74 (Museler).
		4.7	54 Courter-held drawings were reviewed, as to which there were 110 applicable E&DCRs. 34 E&DCRs were listed by auditor as missing; 18 drawings had missing E&DCRs; and 5 drawings had the wrong revisions. This meant that 42.6% of the Courter drawings had problems. FA 654, finding 4.7. LILCO witness clarified that E&DCRs not actually missing but rather had not been posted as required. Tr. 11,385 (Museler).
58	FA 718, 3/78	3.1	Audit indicates that there has been an improvement in the site E&DCR program with the exception of that part of the program controlled by Courter. FA 718, finding 3.1.
		4.3	Auditor reviewed 7 specifications and procedures held by Courter, as to which there were 103 outstanding E&DCRs. 23 E&DCRs (22.3%) were listed as missing, and 3 drawings had the wrong revisions. FA 718, finding 4.3. LILCO witness says that in this observation the E&DCRs were missing, unlike FA 654, finding 4.6, where they had not been prefaced properly. Tr. 11,385 (Museler).

COURTER E&DCR DEFICIENCIES

S.C. Ex. No.	Document/ Audit No./Date	Page/Finding	Description and Additional Data
		4.4	Auditor examined E&DCRs affecting drawings. Courter was responsible for 30 of the 44 drawings found to be in error. With respect to Courter, 53 drawings were reviewed as to which 369 E&DCRs were still outstanding. 100 E&DCRs were listed as missing, which affected 26 drawings and 4 drawings had the wrong revisions. All together, 56.6% of the Courter drawings had errors. FA 718, finding 4.4. LILCO witnesses clarified that E&DCRs were not actually missing, but, rather, this was a logging problem. Tr. 11,386 (Museler).
63	QA Quarterly Report, 5/78	p. 1, ¶ 3	Referring to Field Audits 718 and 654, the report to management notes that E&DCR deficiencies have improved, except in the area controlled by Courter. Quarterly Report 5/4/78, at 1.
56	FQC 26, 6/78	L.3	Courter-related E&DCR deficiencies are noted. Document Control does not report E&DCR numbers affecting a document on the applicable site document distribution card as required by QA procedures. Further, from a sample of 10 E&DCRs, it was noted that 4 of the applicable control drawings did not include the E&DCR number as required by procedures. In the turbine area, E&DCRs listed on the drawings did not correspond to the master E&DCR log. Finally, contrary to requirements, E&DCRs which have been incorporated into the drawing are still being noted on the revised drawing. FQC 26, finding L,3. LILCO witness says that this is an instance where E&DCR numbers were not maintained, but this is different from other logging problems because this pertains to an office area. Tr. 11,387 (Arrington.)
63	QA Quarterly Report, 8/78	p. 1, last ¶	The Quarterly Report to management notes the need to continue to monitor Courter in the area of E&DCR control. It notes that Courter appears to be responsive in this area. Quarterly Report 8/31/78, at 1-2.

COURTER E&DCR DEFICIENCIES

S.C. Ex. No.	Document/ Audit No./Date	Page/Finding	Description and Additional Data
63	QA Quarterly Report, 11/78	p. 1, ¶ 3	No audits have been conducted during the preceding 3 months concerning the Courter E&DCR compliance matter. Even though routine surveillance has reported substantial improvement, LILCO field audits are scheduled for the fourth quarter. Quarterly Report 11/03/78, at 1.
59	FA 842, 11/78	4.1	Audit reviewed 5 Courter-held specifications as to which there were 354 applicable E&DCRs. 53 or 14.9% of the E&DCRs were missing. FA 842, finding 4.1. These E&DCRs were not filed with the specifications as procedurally required. Tr. 11,389-90 (Museler). In addition, the audit reviewed drawings held by Courter. Fifteen drawings were reviewed as to which there were 71 outstanding E&DCRs. Ten E&DCRs were missing which affected 6 documents. Accordingly, 14.1% of the E&DCRs which Courter should have been holding were listed as missing. FA 842, finding 4.1. These E&DCRs were not actually missing; a logging problem. Tr. 11,390 (Museler). Drawing problem similar to that in FA 654. Tr. 11,390-91 (Museler).
63	QA Quarterly Report, 1/79	p. 1, ¶ 2	Referring to Field Audit 842, the report to management notes that the concern relative to Courter control of E&DCRs has not been resolved. It goes on to note that the posting by Courter of design change documents was found to be only 85-90% effective. Quarterly Report 1/21/79, at 1.
63	QA Quarterly Report, 4/79	P. 1, ¶ 3	Referring to Field Audit 905 conducted during February 1979, it notes that the Courter problems related to E&DCRs remain unresolved. Maintenance of E&DCR documents by Courter showed an effective rate of approximately 92%. Quarterly Report, 4/16/79 at 1.

COURTER E&DCR DEFICIENCIES

S.C. Ex. No.	Document/ Audit No./Date	Page/Finding	Description and Additional Data
63	QA Quarterly Report, 8/79	p. 1, last ¶	Referring to Field Audit 970, the Quarterly Report notes that E&DCRs seem generally satisfactory except for the Courter & Company control of E&DCRs affecting specifications, where it is only 91% effective. Quarterly Report 8/20/79,at 1. LILCO witnesses clarify that there were still Courter E&DCR problems from an administrative standpoint, and QA wanted management to know about it. Tr. 11,379-81 (Museler, Kelly). However, this lack of control would not, in their opinion, have any impact on the integrity of the plant. Tr. 11,377 (Gerecke).
56	FQC 34, 6/80	N. 1 A,B,C,	Contrary to requirements of its QA procedures, in the turbine, welding, yard, reactor and SQA areas, Courter was not logging in E&DCRs that pertain to specifications. Only those that affected drawings were being logged. See Tr. 11,391-11392 (Arrington), FQC 34, N.1.A. The Courter QAPs require the holders of control documents to maintain the area document control log and file copies of the E&DCRs in front of the specifications which are affected. It was noted that the ADCL did not list an E&DCR and the affected specifications did not have the E&DCRs posted with them. FQC 34, N.1.B. The QAPS require control documents to be updated with E&DCR information using a weekly E&DCR summary and a daily E&DCR distribution. Courter was updating its logs using the weekly summary. That summary is considered by SWEC to be only 85-90% complete and should only be used as a double check to ensure daily posting of E&DCRs. FQC 34, N.1.C.

COURTER E&DCR DEFICIENCIES

S.C. Ex. No.	Document/ Audit No./Date	Page/Finding	Description and Additional Data
56	FQC 35, 9/80	Attachment 2, Observation 2.4	Courter has failed to perform satisfactory corrective action for the violations noted in Observation N.1 of FQC Audit 34 because E&DCRs are not being logged and posted in required manner. FQC 35, Attach.2, Obs. 2.4. LILCO witnesses confirm this was a recurrent logging problem. Tr. 11,403-04 (Arrington). E&DCRs were being posted on a weekly basis instead of the required daily basis. Tr. 11,403 (Arrington).
56	FQC 38, 6/81	p. 2, Item B at top & Attachment 1, Observation 1.2	E&DCRs are not always properly logged and filed in accordance with Courter procedural requirements. The problems include that E&DCRs applicable to specification SH 1-343 were being filed in file cabinets, boxes and in the general file along with other E&DCRs, rather than in front of the particular specification as required by Courter procedures. Further, the Courter instrumentation group was not properly maintaining the document log book in that certain E&DCRs were not logged as required. The auditor noted that the individuals contacted were not totally knowledgeable about the QA requirements about logging of E&DCRs. FQC 38, at 2,Item B and Obs. 1.2. LILCO witness says that some clerical personnel were not aware of the redundant E&DCR logging requirements. Tr. 11,394-95 (Museler). The E&DCRs were in the area but they were not filed in accordance with requirements. Tr. 11,367 (Baldwin).

APPENDIX 3

STORAGE AND HOUSEKEEPING

Index to Categories

1. Missing Storage History Cards.

Audit	Date	Finding
FQC 13	3/75	D.4
FQC 21	4/77	D.11

2. Storage History Card Contains Error.

Audit	Date	Finding
FQC 13	3/75	D.7
FA 238	3/75	4.3
FQC 15	8/75	D.8
FA 443	10/76	4.4
FQC 21	4/77	D.17
FA 1016	10/79	4.2
FA 1086	3/80	4.4

3. Storage History Card Requirements Not Met (for example, inspection/ maintenance not performed on schedule).

Audit	Date	Finding
FA 376	3/76	4.8
FA 470	10/76	4.5
FQC 21	4/77	D.17
FA 601	6/77	4.4
FQC 24	12/77	B.4
FA 679	12/77	4.2
FA 699	2/78	4.1
FA 721	3/78	4.3
FA 934	4/79	4.1
FA 980	8/79	4.1
FA 1016	10/79	4.1 & 4.3
FA 1086	3/80	4.1
FA 1213	1/81	4.1 & 4.2

Note: Field Audits part of Suffolk County, Ex. 66; FQC Audits part of Suffolk County Ex. 56

Audit	Date	Finding
FA 1301	6/81	4.1
FA 1313	8/81	4.1 & 4.2
FA 1425	2/82	4.1

4. Problems with Protective Coverings and Tarpaulins.

Audit	Date	Finding
FQC 13	3/75	D.8
FA 371	2/76	4.1
FA 444	9/76	4.4
FA 443	10/76	4.4
FA 470	10/76	4.5
FQC 21	4/77	D.7 & D.16
FQC 23	9/77	D.5(1)
FA 648	10/77	4.3
FQC 27	9/78	D.7
FA 934	4/79	4.1
FA 980	8/79	4.1
FA 1016	10/79	4.3
FA 1086	3/80	4.1
Q.R.	7/22/80	p.2
FA 1183	10/80	4.2
FQC 36	12/80	1.3
FA 1275	5/81	4.2
FA 1301	6/81	4.1
FA 1313	8/81	4.1 & 4.2
Q.R.	8/31/81	p. 2
Q.R.	12/3/81	p. 1

5. Dunnage Problems

Audit	Date	Finding
FA 340	11/75	4.3
FA 371	2/76	4.2 - 4.4

Audit	Date	Finding
FA 444	9/76	4.1
FQC 23	9/77	D.5(2) & D.7
FA 656	11/77	4.2
FA 803	8/78	4.2 & 4.4
FA 1183	10/80	4.1 - 4.3

6. End Cap Problems.

Audit	Date	Finding
FA 238	3/75	4.9
FQC 15	8/75	D.7
FQC 17	3/76	D.4
FA 425	7/76	4.1
FA 470	10/76	4.9
FA 601	6/77	4.1 - 4.3
FQC 23	9/77	D.5(3), p. 2 of 3
FA 656	11/77	4.2
FA 721	3/78	4.1 & 4.2
FA 803	8/78	4.1, 4.3, 4.4
FA 934	4/79	4.2 & 4.3
FA 980	8/79	4.2 & 4.3
FA 1026	10/79	4.1 & 4.2
FQC 33	3/80	D.4, p. 2 of 3
FA 1086	3/80	4.2
FQC 34	6/80	K.3, N.2, N.2.A
Q.R.	7/22/80	p. 2
FQC 35	9/80	2.3, p. 2 of 3
FA 1180	10/80	4.3
FA 1183	10/80	4.2
FA 1234	1/81	4.1

7. Problems with Leaking Roofs.

Audit	Date	Finding
FA 376	3/76	4.4

Audit	Date	Finding
FA 425	7/76	4.3
FA 470	10/76	4.2
FQC 23	9/77	D.6
FQC 24	12/77	K.7

8. Problems with Poor Drainage and Puddling.

Audit	Date	Finding
FQC 13	3/75	D.5
FA 226	3/75	4.4 & 4.14
FQC 23	9/77	D.7
FQC 40	12/81	1.3.A(4) part 4

9. Problems with Housekeeping (i.e. Trash and Debris).

Audit	Date	Finding
FA 226	3/75	4.3
FA 425	7/76	4.2
FA 444	9/76	4.1
FA 470	10/76	4.1, 4.5
FQC 20	1/77	D.5
FQC 21	4/77	D.13A
FQC 23	9/77	K.5
FA 721	3/78	4.1
FA 740	4/78	4.1
FA 803	8/78	4.4
FA 1086	3/80	4.2
FQC 34	6/80	N.2.C
FA 1275	5/81	4.1
FA 1325	8/81	3.2. & 4.1
FQC 40	12/81	13(A)(5)

10. Inadequate Environmental Protection (heaters not energized, etc.)

Audit	Date	Finding
FA 226	3/75	4.1
FA 340	11/75	4.1

Audit	Date	Finding
FA 376	3/76	4.3
FQC 21	4/77	D.14(B.9), D.15, D.16
FA 648	10/77	4.3
FA 679	12/77	4.2
FA 699	2/78	4.1
FA 721	3/78	4.3
FA 803	8/78	4.1
FA 1016	10/79	4.3
Q.R.	5/80	p. 1
FQC 34	6/80	K.3
Q.R.	7/22/80	p. 2
Q.R.	11/13/80	p. 1
Q.R.	2/17/81	p. 1
Q.R.	8/13/81	p. 1

11. Damage Noted

Audit	Date	Finding
FA 425	7/76	4.4
FA 444	9/76	4.2
FA 470	10/76	4.3
FQC 20	1/77	D.4
FQC 24	12/77	D.5
FA 740	4/78	4.1 & 4.2
FA 1086	3/80	4.1
FA 1313	8/81	4.2

SUMMARY OF STORAGE AUDIT OBSERVATIONS

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FQC 13 3/75	D.4	1	Some NSS equipment in one warehouse did not have "Equipment History Storage Cards" as required by QC procedure 17.1.	The Storage History Card was not attached to the equipment. Tr. 10,587-88 (Arrington).
	D.5	8	Storage area D-9 not well-drained. This violates QC 17.1. The roadways in the area are higher than the storage areas, thus prohibiting drainage and permitting the forming of pools of water under the material.	LILCO witness confirms finding. Notes that audit identifies no damage and drainage pipes were installed as corrective action. Tr. 11,604 (Baldwin).
	D.7	2	Some cards don't indicate what maintenance checks are required, although some checks are being done.	LILCO witnesses agree storage card was in error. Tr. 11,577, 11,585 (Museler). Corrective action involved review of all Storage History Cards. Tr. 13,738 (Kelly).
	D.8	4	Check valves not covered as required. Last 3 monthly construction department checks show same problem with same valves.	LILCO witnesses agree this is instance where a required cover was not in place. No damage noted but same problem noted in 3 monthly checks in a row. Tr. 11,716 (Arrington). This finding is related to inadequate or defective coverings. Tr. 11,726 (Museler).
FA 226 3/75	4.1	10	Two motor generator sets are in an unheated instead of a heated indoor storage area as procedurally required.	Mr. Kelly agrees with the finding. Tr. 11,849 (Kelly). Cannot be sure if local heat was applied before or after audit. Tr. 11,850 (Museler).
	4.3	9	Garbage and food were found in a storage area, the Reactor Shroud Enclosure. This is a violation of QC 17.1.	Auditor found trash accumulation. Tr. 11,953-54 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 226, cont'd	4.4	8	Storage Level D3 has poor drainage and puddling in violation of QC 17.1.	LILCO witness confirms an area of poor drainage. Tr. 11,607 (Museler).
	4.14	8	Some Storage Level C areas do not drain properly because the yard does not have stone spread throughout the enclosure. Equipment is exposed to unnecessary dampness.	Additional draining needed. Tr. 11,605 (Kelly).
FA 238 3/75	4.3	2	The Storage History Card meggering schedule for the windings of the Reactor Core Spray Pump violates SWEC specifications for electrical installation; also special handwritten QC instructions.	The Storage History Card needed to be updated; maintenance was correct but card did not reflect the actual (correct) maintenance being performed. Tr. 11,505 (Museler, Kelly), 13,739 (Kelly). LILCO witness says the Storage History Card contained an error. Tr. 11,568 (Museler).
	4.9	6	Motor leads are exposed to moisture and possible damage in violation of specification Sh-159.	The leads were not taped in accordance with specification requirements. Tr. 11,665 (Museler). This is analogue to need for end caps. Id.
FQC 15 8/75	D.7	6	Five 10" gate valves without protective end caps required by procedure QC 17.1.	End caps not on because no craft personnel available during the strike. No damage observed. Tr. 11,734-36 (Arrington). End caps were required. Tr. 11,740 (Arrington).
	D.8	2	Storage card listed equipment in one location (Bay J) while it really was in Bay E.	Card needed to be updated to reflect exact location. Tr. 11,506-08 (Baldwin). Equipment apparently had been moved but card did not reflect new location. Tr. 11,509 (Arrington); 11,567 (Baldwin). Item called insignificant because equipment was stored at right level and all inspections took place. Tr. 13,739-40 (Kelly). LILCO witness says the Storage History Card contained an error. Tr. 11,568 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 340 11/75	4.1	10	Control Rod Drive Pump Motors did not have their space heaters energized for 8 days while in storage. This is in violation of Specification 159 and FQC procedure QC 17.1.	Space heaters were required to be energized (i.e., turned on). Tr. 11,836 (Kelly). LILCO agrees heaters not on as required. Tr, 11,845 (Museler).
	4.3	5	Steel plates (7) were found lying on the ground in violation of ANSI N45.2.2.	The LILCO witnesses do not dispute the facts but do not believe it violates the ANSI. Tr. 11,616-17 (Museler). The auditor did believe the ANSI was violated. Tr. 11,618 (Museler).
FA 371 2/76	4.1	4	A torn tarpaulin on a refueling platform funneled water on equipment in violation of ANSI N45.2.2.	Auditors discovered torn tarpaulin. Tr. 11,640 (Arrington). This was a departure from the LILCO/SWEC procedure. Tr. 11,637 (Kelly). Mr. Kelly disagreed this violates the ANSI. Id.
	4.2	5	A bundle of stainless steel piping was lying in a puddle in violation of QC 17.1.	Relates to dunnage. Tr. 11,632-33 (Museler).
	4.3	5	Steel angle and plate stock materials had ponded water trapped in some of them. Also, unidentified bars were welded to others. This is a violation of ANSI N45.2.2.	Relates to dunnage. Tr. 11,632-33 (Museler).
	4.4	5	Steel stock material was lying on the ground. This violates ANSI N45.2.2.	Relates to dunnage. Tr. 11,632-33 (Museler).
FQC 17 3/76	D.4	6	Seven valves and 3 heat exchanges lack required protective covers.	End caps missing. Tr. 11,756-58 (Arrington and Kelly). Witnesses do not know specific reason(s) for caps being off. Tr. 11,797 (Arrington).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 376 3/76	4.3	10	Contrary to QC 17.1, "Leanto" area's heaters were not fully operational. Lack of heat has continued uncorrected throughout winter. This condition has been noted in two previous audits.	Heaters were operational but could not be turned on because of a problem with construction power availability. Tr. 11,837, 11,841 (Museler). The situation was a problem from November 1975 to February or April 1976. Tr. 11,840 (Kelly). Heaters not energized. Tr. 11,845 (Museler).
	4.4	7	Contrary to QC 17.1, the roof still leaks in one of the warehouses.	In violation of QC 17.1, the roof was leaking. There had been an attempt to fix the problem but it was not effective. Tr. 11,655-56 (Kelly, Museler).
	4.8	3	Storage History Card for a Control Panel indicates items have been in storage for almost a year, with five items requiring quarterly inspections, but only one inspection took place, on the day the Storage History Card was prepared.	LILCO witnesses agreed this Finding is instance where an inspection or maintenance did not occur on the required schedule. Tr. 11,503, 11,515 (Museler).
FA 425 7/76	4.1	6	Contrary to FQC procedure QC 17.1, and ANSI N45.2.2, 9 pieces of unidentified equipment are stored outdoors, uncovered, with torn or missing opening seals.	Not a problem with covering but with end caps. Tr. 11,649, 11,651-52 (Museler).
	4.2	9	Contrary to QC 17.1 and ANSI N45.2.2, accumulations of trash and evidence of food/drink consumption were found in storage areas.	Accumulations of trash and evidence of food in storage areas. Tr. 11,954 (Museler).
	4.3	7	Storage area roof leaks badly onto stored cardboard crates and cartons. Violates QC 17.1 and ANSI N45.2.2.	Mr. Kelly has no reason to disagree. Tr. 11,656 (Kelly).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 425 (cont'd)	4.4	11	Contrary to FQC procedure QC 17.1, stored cardboard cartons are stacked so high that the bottom ones are crushed.	Boxes crushed; audit does not indicate damage to contents. Tr. 11,819 (Kelly).
FA 444 9/76	4.1	5, 9	A storage area had an accumulation of trash and cartons, a pile of structural steel in a rain puddle with no dunnage, and several stock stainless steel angles in contact with a carbon steel embedment. Auditor states it violates ANSI N45.2.2. This is a repeat problem from earlier audit.	The storage of the structural steel violates LILCO's requirements. Tr. 11,618 (Kelly). The auditor noted accumulation of trash in storage areas. Tr. 11,953-54 (Museler).
	4.2 (not in evidence)	11	[Pipe hanger material had water ponded in structural steel shapes. Two turnbuckles had rust on their threads and machined swivel ball joints. Audit states it violates ANSI N45.2.2.] Not in evidence.	LILCO witnesses disagree with auditor's conclusion that ANSI is violated. Tr. 11,620-28 (Museler, Arrington).
	4.4	4	A painted structural steel assembly of the refueling platform was severely corroded, contrary to construction site instruction 4.6.	Cause of corrosion not clear. Tr. 11,666-67 (Museler). The item involved was sand blasted and primed, as is the policy for all structural steel. This item is termed insignificant. Tr. 13,745 (Kelly).
FA 443 10/76	4.4	2, 4	The Storage History Cards for the Hydraulic Control Units for the Control Rod Drive: (a) were not updated to reflect store-in-place status; and (b) units were not recovered with water barrier wrapping after work shift.	Unit had been moved and so card did not reflect actual storage location. Card needed to be updated. Tr. 11,515 (Kelly); 11,567 (Museler). LILCO witness says the Storage History Card contained an error. Tr. 11,568 (Museler). This finding also involves problem with adequate covering not provided. Tr. 11,650-51 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 470 10/76	4.1	9	Accumulations of trash and evidence of food/drink consumption were still found in storage areas. Repeats an earlier violation in FA 425, Finding 4.2. Audit notes it violates QC 17.1 and ANSI N45.2.2.	Witnesses do not consider this an ANSI violation. They believe goal of ANSI is to maintain equipment in suitable condition and trash did not affect equipment. Tr. 11,927-8 (Kelly). An extension was being constructed and the activities led to accumulation of material. Tr. 11,929 (Museler). Same area had trash as in FA 425, Finding 4.2. Tr. 11,931 (Kelly).
	4.2	7	A storage roof leaks badly onto stored cardboard crates and cartons. This item is contrary to FQC procedure QC 17.1 and ANSI N45.2.2. The condition has gotten worse since FA 425, Finding 4.3.	Relates to and concerns same leaking roof as in FA 425, Finding 4.3. Tr. 11,657 (Kelly); 11,661 (Baldwin).
	4.3	11	Stored cardboard cartons are still stacked so high that the bottom ones are crushed. This repeats an earlier violation.	This was damage to the boxes but witnesses do not know if contents damaged. Tr. 11,820 (Kelly).
	4.5	3, 4, 9	Contrary to ANSI N45.2.2 and the Storage History Card, a box containing a refueling platform assembly hoist had an accumulation of trash, including old dessicant bags and an open can of unidentified liquid in its open crate. Also, there was no "poly" cover and one instrument was rusting.	Museler agrees with auditor that condition was unacceptable since in direct contact with equipment. This is similar to FA 740, Finding 4.1. Tr. 11,955-56 (Museler).
	4.9	6	A core spray header pipe was lying on the floor with its end cap missing.	There was a lack of end caps. Tr. 11,753 (Museler).
FQC 20 1/77	D.4	11	Electrical cable protruding from concrete for grounding purposes not protected, violating Specification.	One cable was damaged. Tr. 11,815-17 (Arrington).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FQC 20 (cont'd)	D.5	9	Trash and litter allowed to accumulate, thus violating CSI 13.1.	Accumulation in reactor building work area. Tr. 11,961-63 (Museler).
FQC 21 4/77	D.7	4	Expansion bolts lacked temporary protective covers required by Specification.	This is a protective covering type problem. Tr. 11,726 (Museler). Covers had been removed for work reasons; not clear how long covers had been off. Tr. 11,803-04 (Arrington).
	D.11	1	Four of 12 pieces of Category I equipment didn't have Storage History Cards, in violation of CSI 4.6.	Subsequent review showed two panels did not have cards. Tr. 11,590 (Arrington). As to other two panels, cards had been filled out but apparently not in the area. Tr. 11,592 (Arrington).
	D.13A	9	Trash accumulation in storage areas, violating QC 17.1.	Auditor found trash accumulation. Tr. 11,956 (Museler).
	D.14 (B.9)	10	Humidity in storage area at 70%, rather than maximum of 60% provided by procedure QC 17.1.	Problem had already been recognized and was being worked on. Tr. 11,862-64 (Baldwin).
	D.15	10	Certain items didn't have strip heater energized as required, and also the protective enclosure was torn and condensation noted. These items were in violation of FQC procedure QC 17.1.	Requirement for strip heaters was probably for humidity control. Auditor noted condensation. Tr. 11,844-45 (Arrington). Heaters not energized. Tr. 11,845 (Museler).
	D.16	4, 10	Spring heaters being stored under conditions contrary to procedure QC 17.1, since building has no roof and protective plastic blown away.	Supposed to be Level C rather than Level D. Violates procedure but the repair of the roof upgraded the area to Level C. Tr. 11,865 (Arrington).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FQC 21 (cont'd)	D.17	2, 3	Pump motors and pump stored in wrong type of area, Level C rather than Level B, as required by QC 17.1. Failure to correct from earlier inspection.	Stored properly in Level C; Storage History Card in error in requiring Level B. Tr. 11,866-67 (Arrington). Witnesses do not know why placed in Level C when card (albeit unnecessarily) specified Level B. Tr. 11,871 (Museler). The card should have been followed. Tr. 11,871-72 (Museler).
FA 601 6/77	4.1	6	Two valve bodies were found with no visible identification and no end caps applied to them as required by QC 17.1.	Witnesses agree required end caps not provided. No indication of damage. Tr. 11,741 (Kelly).
	4.2	6	Valves were found without end caps applied to them.	Witnesses agree required end caps not provided. No indication of damage. Tr. 11,741 (Kelly).
	4.3	6	A valve was found with no end cap applied to it as required by QC 17.1.	Witnesses agree required end caps not provided. No indication of damage. Tr. 11,741 (Kelly).
	4.4	3	Numerous meters had missed inspections required by the Storage History Card.	LILCO witnesses agreed this is instanced where an inspection(s) or maintenance did not occur on the required schedule. Tr. 11,503, 11,515 (Museler).
FQC 23 9/77	D.5(1)	4	Contrary to QC 17.1, tarpaulin and griffolin were torn from boxes. A puddle on the griffolin leaked onto four MOV's which had to be given reject tags.	Auditors discovered torn tarpaulin. Tr. 11,640 (Arrington). Similar to FA 371, Finding 4.1. Tr. 11,639 (Kelly). Reject tags had to be issued until testing proved them acceptable. Tr. 11,645-6 (Arrington).
	D.5(2)	5	Turbine laggings and casings were not stored on dunnage, showed signs of rust, and contained water.	The audit indicates that item was not stored on dunnage and contained water. Tr. 11,630 (Baldwin).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FQC 23 (cont'd)	D.5(3) p. 2 of 3	6	Heavy walled pipe lacked end caps; many unresolved storage problems noted in the last 12 months.	Lack of end caps. Tr. 11,753 (Museler).
	D.6	7	Roof covering Level B warehouse torn, resulting in crates of thermal sleeves becoming wet, conflicts with ANSI N45.2.2.	Arrington agrees violates procedure and ANSI. Tr. 11,659 (Arrington).
	D.7	5, 8	Eight cable reels in deep puddle of water or not on dunnage.	LILCO witness agrees that this item indicates a problem with draining or puddling of water. Tr. 11,607 (Arrington).
	K.5	9	D.13 of FQC Audit 21 not fixed.	Auditor found trash accumulation. Tr. 11,956 (Museler).
FA 648 10/77	4.3	4, 10	In violation of CSI 4.6, the poly cover on a MDV was torn, allowing water to come into contact with equipment. Also, the lamp providing local heat was not on. The bulb needed to be replaced.	Another example of a ripped tarpaulin. Tr. 11,642 (Museler). Appropriate heat not applied. Tr. 11,847 (Museler).
FA 656 11/77	4.2	5, 6	Miscellaneous pieces of piping were found off dunnage and missing end caps. Several pieces of Category I piping and sections of structural steel were also found off dunnage. This is in violation of CSI 4.6.	Lack of end caps. Tr. 11,753 (Museler).
FQC 24 12/77	B.4 (not in evidence)	3	[Audit of 4 cards re electrical equipment didn't reflect FQC checks for 8 months. QC Instruction 17.1 requires quarterly inspections.] Not in evidence.	LILCO witnesses agreed this is instance where inspection or maintenance did not occur on the required schedule. Tr. 11,503, 11,515 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FQC 24 (cont'd)	D.5	11	Damage to level control switch.	Cause of damage not determined. Tr. 11,820-21 (Arrington). A better cover would not have prevented damage. Tr. 13,753 (Kelly).
	K.7	7	D.6 of FQC Audit 23 not fixed. The roof in warehouse B7 still leaked. Repeated efforts to repair the leak were unsuccessful. The equipment has been provided with protective covering.	There was great difficulty repairing roof and protective covering where provided. Tr. 11,659 (Baldwin). Same leaking roof as in FQC 23. Tr. 11,661 (Baldwin).
FA 679 12/77	4.2	3, 10	A pump was found not to have local heat applied in an unheated structure as required by the Storage History Card and CSI 4.6.	Characterized as difference of interpretation. Pumps stored in reactor building which did not then have permanent heating. Auditor felt it should have had local heat as required by storage card. Reactor building had temporary heat. As a result, the local heaters were turned on. Trl. 11,518-19 (Museler). The auditor believed local heat was needed but Mr. Museler disagreed. Tr. 11,543-44 (Museler).
FA 699 2/78	4.1	3, 10	Contrary to CSI 4.6, the refueling platform, main hoist motor, and monorail hoist motor do not have local heat applied. The motors are also stored in an area different from the area required by the Storage History Card.	LILCO witnesses do not believe storage card in error. Tr. 11,577 (Museler). Storage card was correct but equipment stored in wrong location. Thus, implementation of card was not correct. This falls into prior group. Tr. 11,581 (Museler). Heat was not on as required. Tr. 11,848 (Museler). No damage. Tr. 13,740 (Kelly).
FA 721 3/78	4.1	6, 9	Fourteen piping spool pieces were found missing end caps, lacking identification and also were cluttered with debris.	Lack of end caps. Tr. 11,753 (Museler). The auditor correctly noted trash. This situation unsatisfactory but no damage occurred. Tr. 11,960-61 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 721 (cont'd)	4.2	6	A motor operated butterfly valve was found with an end cap punctured. A second motor operated butterfly valve was missing both end caps and mud had accumulated on the valve butterfly plate.	Lack of end caps. Tr. 11,753 (Museler).
	4.3	3, 10	The 25-horsepower motor attached to the hydrogen recombiner did not have the internal heater operating as required by the Storage History Card.	Motor off when should have been operating. Tr. 11,847 (Museler).
FA 740 4/78	4.1	9, 11	A control room air conditioning system unit had severe peeling of the protective coating on the unit's inside surfaces. Also, one of the threaded pipes at the base of the unit is missing its screw-on cover and a length of 1/2" conduit has been broken away from a fitting near the top of the filter. Also, several other lengths of conduit are bent due to debris and ductwork being piled on top of the unit.	Audit does not indicate peeling due to covering problem. Tr. 11,821 (Kelly). Agrees that conduit bent due to debris. Tr. 11,934 (Museler). This situation violated LILCO's procedures. Tr. 11,934-35 (Museler).
	4.2	11	The electrical terminations and inside surfaces of an electrical panel box were extensively corroded. This is a violation of CSI 4.6.	Audit does not indicate corrosion due to covering problem. Tr. 11,821 (Kelly). This item was in its final location and would not be covered. Tr. 13,765 (Museler).
FA 803 8/78	4.1	6, 10	One motor operated valve and three air operated valves were being stored outdoors, not in a heated building as required. Also, two of the AOVs were missing end caps.	Valves had exceeded time allowed in nonheated storage. Tr. 11,855 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 803 (cont'd)	4.2	5	Numerous bundles of reinforcing bars were not on dunnage and were in contact with the ground. This item violates ANSI N45.2.2.	In dunnage category. Tr. 11,632 (Museler).
	4.3	6	Numerous pieces of stock pipe were found with split, broken, or missing end caps. This is a violation of ANSI N45.2.2.	Lack of end caps. Tr. 11,753 (Museler).
	4.4	5, 6, 9	Various temporary laydown areas had excessive litter and/or piping was off dunnage and missing end caps.	Lack of end caps. Tr. 11,753 (Museler). Auditor found trash accumulation. Tr. 11,956 (Museler).
FQC 27 9/78	D.7	4	Stored in place equipment lacks covers and other protection.	Equipment was in process of being installed and so covering not necessary. Apparently work not actually being performed when auditor viewed. Tr. 11,718-22 (Museler, Arrington).
FA 934 4/79	4.1	3, 4	A panel did not have the "poly" cover required by the Storage History Card.	LILCO confirms finding. Tr. 11,523-24 (Kelly), Tr. 11,718-19 (Museler). Not uncommon for this kind of event to result from someone not putting cover back at end of shift. Tr. 11,524 (Kelly). This is example where storage card requirements not being fully implemented. Tr, 11,524, 11,544 (Kelly, Museler).
	4.2	6	A panel had several unplugged openings on the stainless steel lines.	Lack of end caps. Tr. 11,753 (Museler).
	4.3	6	Nine individually mounted instruments have unplugged openings. This is a generic problem.	Lack of end caps. Tr. 11,753 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 980 8/79	4.1	3, 4	None of 4 panels reviewed was covered with "poly," as required by storage cards. This is a generic problem with these panels that has been noted on 3 previous instrumentation storage audits and has not yet been corrected.	LILCO states this was a problem of working on panels and not recovering every time work stops. Final solution was to replace poly with wooden boxes for protection. Tr. 11,525 (Museler). Mr. Kelly approved this audit finding. Tr. 11,527 (Kelly). At least 4 audits identified this problem. Tr. 11,528 (Kelly). Panels not properly covered. Tr. 11,806 (Kelly). Mr. Kelly disagrees that this was instance where proper corrective action not taken. Tr. 11,808 (Kelly). He agrees, however, the problem did recur. Tr. 11,809 (Kelly). Mr. Museler agrees this is instance where storage cards required cover but they were not on when panels inspected. Tr. 11,544 (Museler).
	4.2	6	Two pieces of equipment had conduit openings uncapped, contrary to CSI 4.6.	Lack of end caps. Tr. 11,753 (Museler).
	4.3	6	Contrary to CSI 4.6, four valves had conduit openings uncapped.	Lack of end caps. Tr. 11,753 (Museler).
FA 1016 10/79	4.1	3	The motors from 3 motor operated valves (MOVs) were removed from storage and installed without meggering being performed as required by the Storage History Cards.	LILCO witnesses agreed this is instanced where an inspection or maintenance did not occur on the required schedule. Tr. 11,515 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 1016 (cont'd)	4.2	2	Storage History Cards for 2 bearings indicate that they were not lubricated within a year's time. Inconsistency of fan pre-lubrication (lack of necessity for storage lubrication) with Storage History Card requirements should require change in Storage History Card requirements so only turnover lubrication requirement is in effect.	Storage card incorrect in calling for an unnecessary lubrication. Tr. 11,597 (Kelly). The Storage History Card erroneously required lubrication, so there was no damage in missing it. This finding is termed "insignificant." Tr. 13,741 (Kelly).
	4.3	3, 4, 10	The strip heater(s) on 2 components require periodic inspection(s). These were never performed; neither are the strip heaters installed in the components. Also, two components had no "poly" covering.	LILCO witnesses agreed this is an instance where inspection or maintenance did not occur on required schedule. Tr. 11,503, 11,515 (Museler). This finding does not relate to storage cards but the failure to perform the inspection at the frequency called for on the card. Tr. 11,516 (Museler).
FA 1026 10/79	4.1	6	Contrary to CSI 4.6, a component had an uncovered conduit opening.	Lack of end caps. Tr. 11,753 (Museler).
	4.2	6	Contrary to CSI 4.6, 5 components had uncovered conduit and tubing openings.	Lack of end caps. Tr. 11,753 (Museler).
FQC 33 3/80	p. 2 of 3 D.4	6	Due to lack of or damage to required covers, many instrumentation assemblies vulnerable to damage. Also lack of caps on tubing.	Lack of end caps. Tr. 11,753 (Museler).
FA 1086 3/80	4.1	3, 4, 11	A component was not covered with "poly" as required by storage card. The unit had apparently been damaged and an air filter and a gauge were missing.	Witnesses agree covering required by storage card not on. Air filter and gauge were missing, but not result of damage. Tr. 11,823 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 1086 (cont'd)	4.2	6, 9	Two filters are being used for storage of such items as a welder's helmet, piping, tubing, rain coats, and various debris. Several conduits on top of the units had their openings uncapped and there was an accumulation of debris behind one filter. Also, the filters are not properly identified.	Lack of end caps. Tr. 11,753 (Museler). Finding confirmed; no damage but situation unsatisfactory. Tr. 11,960-61 (Museler).
	4.4	2	The Storage History Card for 44 components do not indicate that they are safety-related.	LILCO witnesses agree storage card in error. Tr. 11,578, 11,585-86 (Museler).
Quarterly Report to Management ("Q.R."), 5/80	p. 1	10	FA 1063, 1070 and 1086 identify failures to provide adequate environmental protection for installed equipment.	This was an item, given its significance relative to the total number of findings, that was brought to management's attention. Tr. 11,874 (Gerecke).
FQC 34 6/80	K.3	6, 10	Some of Observation D.4 of FQC Audit 33 not corrected. Re-audit disclosed 4 panels with unprotected valve openings and tubing without end caps. Two panels contained unenergized heaters.	End caps missing from instrument panels. This had been noted in earlier audit. Tr. 11,810-11 (Arrington).
	N.2	6	Numerous lengths of piping not protected, including lack of protective end coverings.	Lack of end caps. Tr. 11,753 (Museler).
	N.2.A.	6	Plastic covering ripped, exposing pipe to elements.	Not a covering problem but an end cap problem. Tr. 11,649-50 (Arrington).
	N.2.C.	9	Housekeeping deficient; accumulations of debris and dirt need cleanup.	The observation notes dirt and debris in Level B instrumentation warehouse. Tr. 11,960 (Arrington).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
Q.R. 7/22/80	p. 2	4, 6, 10	FA 1098, 4/80, identifies additional instances where there is lack of environmental protection for installed equipment, including failure to cover and cap.	Mr. Gerecke confirms finding. Tr. 11,875 (Gerecke).
FQC 35 9/80	p. 2 of 3, 2.3	6	Open ends of tubing identified as deficient in FQC Audits 33 and 34 still not properly protected.	Other examples of end cap problem found. Open ends of tubing and valves not afforded proper protection. Tr. 11,812-13 (Arrington).
FA 1180 10/80	4.3	6	An uncapped opening remains uncapped. LILCO QA feels this is a failure to take prompt corrective action.	Opening on safety related instrumentation had remained uncapped since earlier audit in August 1980. No apparent damage. Tr. 11,748-49 (Kelly).
FA 1183 10/80	4.1	5	Steel shapes not on dunnage and scrap material not in designated HOLD/REJECT area and have remained in their conditions for 2 months because the corrective action has not been taken.	In dunnage category. Tr. 11,632 (Museler).
	4.2	4, 5, 6	Several containers of conduit collars do not have protective covers (the "poly" is severely weathered). Several pieces of conduit and several conduit elbows did not have end caps and were not on dunnage.	In dunnage category. Tr. 11,632 (Museler).
	4.3	5	Several pieces of angle steel and "I" beam material were not on dunnage.	In dunnage category. Tr. 11,632 (Museler).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
Q.R. 11/13/80	p. 1	10	FA 1133 and 1142 identify two failures to provide adequate environmental protection for installed equipment.	Management advised at 2 additional audits identifying failures to provide environmental protection for installed equipment. Tr. 11,876 (Gerecke).
FQC 36 12/80	1.3	4	Cable not properly stored in accordance with Specification 159. Some of these were previously noted unsatisfactory by FQC.	LILCO witnesses agree protective covering not in place. Tr. 11,650 (Arrington); 11,650 (Museler).
FA 1213 1/81	4.1	3	The Storage History Card of a motor operated valve did not record the performance of a megger test contrary to SWEC Construction Site Instructions and Specifications.	LILCO witnesses do not believe this involved an inaccurate card. Tr. 11,577 (Museler). Storage card apparently correct but meggering test not done correctly. Tr. 11,582-83 (Museler). LILCO witnesses agree this is an instance where inspection(s) did not occur on required schedule. Tr. 11,503, 11,515 (Museler).
	4.2	3	No documented required quarterly maintenance checks had been performed on a panel in almost a year.	LILCO witnesses agree this is an instance where inspection(s) did not occur on required schedule. Tr. 11,503, 11,515 (Museler).
FA 1234 1/81	4.1	6	An instrument had an uncapped conduit opening in violation of ANSI N45.2.2.	Mr. Kelly approved this audit. Tr. 11,751 (Kelly).
Q.R. 2/17/81	p. 1	10	FA 1180 and 1204 identify further failures to provide adequate environmental protection for installed equipment.	Gerecke confirms report to management. Tr. 11,876-78 (Gerecke).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 1275	4.1	9	A pipe storage area was found to have excessive litter and debris. Continuation of a violation in Audit 1237.	No indication of any damage. Tr. 11,935 (Kelly). Involved paper blowing into storage area. Tr. 11,936 (Museler). Auditor believed situation should not have existed. Tr. 11,940 (Kelly).
	4.2	4	A skid of fuel storage racks was found without its protective cover intact. GE specifications require that all equipment be covered for protection from weather.	LILCO witnesses concur this is a covering not in place problem. Tr. 11,649-50 (Museler).
FA 1301 6/81	4.1	3, 4	Equipment was not covered with "poly" as required by storage card.	Witnesses agree that storage card requirement for this safety-related equipment was not being met when auditor came. No damage noted. Tr. 11,716-17 (Kelly).
FA 1313 8/81	4.1	3, 4	Two components were not covered with "poly" as required by Storage History Cards.	Witnesses agree this is instance where required cover not in place when audit conducted. Tr. 11,718-19 (Museler).
	4.2	3, 4, 11	A component was not covered with "poly" as required by Storage History Card and the electrical box was damaged.	Cover not provided. Tr. 11,818 (Museler). Damage not related to cover being missing. Box was physically broken off, something cover could not have prevented. Tr. 11,818-19 (Museler).
FA 1325 8/81	3.2	9	A storage area continued to have excessive litter and debris. Violation remains from Audit 1275. Response appears to be ineffective.	Auditor did not believe prior corrective action had been effective. Tr. 11,945 (Kelly).

AUDIT	AUDIT PAGE/ FINDING	CATEGORY	DESCRIPTION OF AUDIT RESULTS	ADDITIONAL DATA
FA 1325 (cont'd)	4.1	9	A storage area continued to have excessive litter and debris. Violation remains from Audit 1275. It was verified that a wooden floor has been installed but it appears that the area is not cleaned regularly.	Auditor did not believe prior corrective action had been effective. Tr. 11,945 (Kelly).
Q.R. 8/31/81	p. 2	4, 10	FA 1275, 1297 and 1301 identify further instances of improper environmental protection of installed equipment, including failure to provide adequate covers and improper use of internal heaters.	Gerecke confirms report to management. Tr. 11,876-78 (Gerecke).
FQC 40 12/81	1.3.A(4) part 4	8	A cable storage area required upgrading to correct large puddles of water. These puddles indicate a need for proper drainage.	Area needed upgrading to provide drainage. Tr. 11,606 (Arrington).
	13(A)(5)	9	Numerous pieces of debris such as discarded plastic covers, cardboard and rotted wood were evident in a cable storage area.	Trash accumulation. Tr. 11,953-54 (Museler).
Q.R. 12/3/81	p. 1	4	FA 1313 identified 3 additional instances where stored-in-place equipment not adequately covered.	Gerecke confirms report to management. Tr. 11,876-78 (Gerecke).
FA 1425 2/82	4.1	3	A piece of equipment requiring a quarterly storage inspection was not inspected in almost a year and a half.	LILCO witnesses agree this is an instance where inspection(s) did not occur on required schedule. Tr. 11,503, 11,515 (Museler).

APPENDIX 4

Failure to Keep Manuals Up-to-Date

Audit/Date	Audit Page/Finding	Description of Audit Results	Additional Data
FQC 14 6/75	A.1	Of five manuals sampled, two FQC manuals and one NDT need updating.	Four FQC manuals need updating. While these were "information only" copies, they were required to be kept up-to-date. Constitutes a deviation from the requirement. Tr. 12,002-04 (Arrington).
	B.2	Of 28 manuals reviewed for random procedures, six FQC manuals, two ASME manuals, one engineering assurance manual, and one procurement quality control manual were not up-to-date. Also, one ASME manual was unassigned. Overall 24 manuals of 45 sampled were out-of-date.	LILCO witnesses agree manuals were not up-to-date. Tr. 12,042 (Arrington).
	D.2	Of nine manuals held by construction personnel, eight were found not to be up-to-date. Seven were FQC manuals and one was an ASME manual.	LILCO witnesses agree manuals were not up-to-date. Tr. 12,042 (Arrington)
	D.3	FQC manual in the account section did not contain all the issued procedures, nor had the index been kept up-to-date with additional procedures added to the manual.	LILCO witnesses agree manuals were not up-to-date. Tr. 12,042 (Arrington).
FQC 16 12/75	B.2.A-E	Review of 24 FQC procedures manuals being maintained by FQC indicated the following: A. Three FQC procedures manuals contained QCIs that should have been in the appropriate QCI manual. B. Six manuals still contained cancelled or out-of-date procedures. C. Four manuals contained out-of-date Tables of Contents. D. Five manuals were missing documents E. Two manuals contained improperly filed documents.	Part B.2.E not an up-dating problem; procedure present but reversed in order in the manual. Tr. 12,043 (Arrington). Items A-D were manuals that were not kept up-to-date. Tr. 12,043-44 (Arrington)

Audit/Date	Audit Page/Finding	Description of Audit Results	Additional Data
	D.4.A-C	Review of 19 FQC procedure manuals being maintained by construction personnel indicated the following: A. Three manuals contained cancelled documents. B. Tables of Contents in five manuals were out-of-dat . C. Six manuals had documents missing.	Part D.4.D not an updating problem but a situation where manual not assigned to an individual. Parts A-C are updating problems. Tr. 12,043-44 (Arrington).
FQC 18 5/76	B.1	Contrary to QAD-5.13, six QCIs have been issued since the last Table of Contents was prepared, however an updated Table of Contents has not been prepared.	LILCO witnesses agree manual not up-to-date. Tr. 12,042 (Arrington).
EA 18 8/76	p. 2, No. 4	Some manuals have outdated material that is not marked as superseded. Some manuals missing addenda to procedure and general instructions.	LILCO witnesses agree this is instance where manual not up-to-date. Tr. 12,044, 12,038-39 (Eifert).
EA 19 12/76	2.B.2	3 of 5 EAP manuals did not contain all current procedures.	LILCO witnesses confirm this is an instance where manual was not kept up-to-date. Tr. 11,999 (Eifert).
EA 22 8/77	021(2)	2. Most project manuals are not being kept up-to-date. This deficiency has been identified in prior audits.	LILCO witness confirms there are some deficiencies in methods of keeping specific project manuals up-to-date. Tr. 12,000, 12,038-39 (Eifert).
EA 23 12/77	037	An audit of project engineering assurance manuals revealed that approximately 40% of the manuals were deficient. The manuals did not contain up-to-date material or out-of-date material had not been removed, or both.	LILCO witness confirms about 40% of EA manuals audited not up-to-date or contain out-of-date materials. Tr. 12,000-01 12,038-39 (Eifert). Typical of this type of problem is a person, who does not use this manual often, receiving an updated procedure and filing it or noting on index that change was warranted. Tr.12,001 (Eifert).

Audit/Date	Audit Page/Finding	Description of Audit Results	Additional Data
EA 27 10/79	078	Of eight engineering assurance procedure manuals reviewed, five did not contain current material and/or out-of-date material had not been removed. Similar deficiencies were reported in Audit 23, #037.	Similar to EA 23, A.O. 037. Corrective action was to see who really needed these manuals. Tr. 12,002, 12,038-39. (Eifert)
EA 30 10/79	104(4)	Two of four project manuals were missing procedures and one other manual did not have three or more of the last transmittals.	LILCO witness agrees this is a manual that is not being kept up-to-date. Tr. 12,004 (Eifert).
EA 38 12/81	141	The following conditions reduce the level of confidence that project personnel are able to perform their tasks as intended by the Project Engineer. 1. The Tables of Contents for sections (tabs) of the project manual are not officially updated and re-issued frequently enough to keep pace with the changes in project instructions. Numerous pen and ink changes are required of the assigned manual holders. The adequacy of the entries varies from manual to manual. 2. Project instructions contained out-of-date information.	Concerns maintenance of project manual, not EAP manual. Tr. 12,047 (Eifert). However, problem was that manual was not up-to-date. Tr. 12,048 (Eifert).

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

DOCKETED USNRC
'83 APR 12 A10:33
OFFICE OF SECRETARY DOCKETING & SERVICE BRANCH

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

CERTIFICATE OF SERVICE

I certify that copies of Suffolk County's QA/QC and EQ Supplement to Suffolk County's Proposed Opinion, Findings of Fact, and Conclusions of Law in the Form of a Partial Initial Decision were served upon the following by mail, unless otherwise indicated, on April 7, 1983.

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