UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket No. 50-322-OL-4
LONG ISLAND LIGHTING COMPANY	)	(Low Power)
(Shoreham Nuclear Power Station, Unit 1)	)	

TESTIMONY OF JOHN L. KNOX AND EDWARD B. TOMLINSON

Q. What is your name?

A. (Knox) My name is John L. Knox

Q. What is your position?

A. (Knox) I am a Senior Electrical Engineer (Reactor Systems) in the Power Systems Branch in the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. In this position I perform technical reviews, analyses, and evaluations of reactor plant features pursuant to the construction and operation of reactors.

Q. What are your qualifications?

A. (Knox)

In 1962, I received an Associate of Arts degree in Electrical Power System Technology from Montgomery College. In 1971, I received a Bachelor of Science degree in Electronic Systems Engineering from the University of Maryland. Since 1974, I have taken a number of courses on PWR and BWR system operation, equipment qualification, and reactor safety.

From 1971-1974, I worked for Potomac Electric Power Company in Washington, D. C. I was assigned to the underground power Transmission Engineering Group and my duties included relocation and restoration of underground power and transmission cables due to the subway construction project. (Prior to this, I spent four years in the Air Force working on the F4 aircraft electronic weapons control systems.)

From 1974 to the present, I have worked for the Nuclear Regulatory Commission involved in the technical review of electrical systems (onsite and offsite power, instrumentation and control). Through 1976, I was a member of the Electrical Instrumentation and Control Systems Power Branch. This branch was split in January 1977 into an I&C branch and a power branch. Since this split, I have been a member of the Power Systems Branch. My present responsibilities include review and evaluation of onsite and offsite electric power systems.

Q. What is your name?

A. (Tomlinson) My name is Edward B. Tomlinson

Q. What is your position?

A. (Tomlinson) I am a Mechanical Engineer (Reactor Systems) in the Power Systems Branch in the Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. In this position, I perform technical reviews, analyses, and evaluations of reactor plant features pursuant to the construction and operation of reactors.

Q. What are your qualifications?

A. (Tomlinson) I received a Bachelor of Science Degree in 1960 from the U.S. Merchant Marine Academy. My major field of study was marine engineering. Since then, I have taken courses and/or received instruction in hydraulics, machinery vibration, electronics, and PWR/BWR system operation. I currently hold a marine engineer's license for steam and diesel, any horsepower.

From 1960-1961, I was employed as a marine engineer for the Military Sea Transport Service. In this capacity, I was responsible for operation and/or maintenance of shipboard mechanical and electrical systems.

From 1961-1962, I was employed as a field service engineer for the Scintilla Division of the Bendix Corporation. In this capacity, I was responsible for investigating and reporting on the cause of malfunctions in fuel injection systems and ignition systems for industrial and aviation engines.

From 1963-1968, I was employed as a mechanical engineer for the American Telephone and Telegraph Company. My primary responsibilities included design of mechanical systems for telephone company buildings. These duties included extensive work on standby diesel generator systems and gas turbine generator systems. From 1968-1970, I was employed by International Business Machines Corporation in a similar capacity for military computer facilities.

From 1970-1975, I was employed as a mechanical/marine engineer at Northrop Services, Inc. In this capacity, I was responsible for providing support services to the U.S. Navy on shipboard mechanical/electrical systems associated with new ship construction, including diesel and gas turbine powered main propulsion and auxiliary systems.

From 1975-1977, I was employed as a reactor systems engineer in the Auxiliary and Power Conversion Systems Branch, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. My responsibilities included review and evaluation of reactor auxiliary systems, including diesel generators.

From 1977-1981, I was employed as a general engineer in the Marine Engineer Division, National Ocean Spray, NOAA. I was primarily responsible for maintenance planning and equipment selection for shipboard systems, including diesel powered propulsion and electric generating equipment.

From 1981 to the present, I have worked in the Power Systems Branch, U.S. Nuclear Regulatory Commission. My present responsibilities include review and evaluation of diesel engines and their auxiliary systems associated with onsite power systems. I am also assigned to the TDI Task Group for generic review of TDI diesel engines.

Q. Has LILCO submitted an application for a low power license?

A. (Knox) Yes

Q. Does that application presume that the Transamerica Delaval Industries' diesels onsite would not operate?

A. (Knox) Yes

Q. Are any supplemental sources of power indicated in LILCO's low power application?

A. (Knox) Yes

Q. What are they?

A. (Knox/Tomlinson) A 20 MW peaking unit consisting of a single gas turbine powered generator. A 10 MW peaking unit consisting of four (4) separate diesel generators rated at 2.5 MW, each.

Q. Where are they located?

A. (Knox) They are both located on the Shoreham plant site. The gas turbine is located in the 69 KV switchyard which is approximately 300 feet south of the Shoreham reactor building. The four diesel generators are located next to the southwest corner of the reactor building.

Q. Are these supplemental power sources connected to each other or are they independent of each other?

A. (Knox) They are independent of each other.

Q. Does this independence meet the single failure criterion that would be required for the normal safety related diesel generators located at an operating nuclear power plant?

A. (Knox) Yes

Q. Is it the staff's opinion that these alternative sources would be available after a seismic event?

A. (Knox, Tomlinson) Yes

Q. Why?

A. (Knox, Tomlinson)

(a) The manufacturer has provided assurance that the gas turbine will be structurally sound after a seismic event.

(b) Diesel generators similar to those being used at Shoreham have been used in marine and locomotive applications, and

(c) Operating experience during seismic events has demonstrated the capability of similar equipment to that being used at Shoreham to survive a seismic event and to perform its design function after the seismic event.

(d) LILCO has provided a seismic analysis that the diesel generators and their associated switchgear will survive a seismic event. No Staff review of that analysis has been conducted.

Q. Is it necessary that these alternate power sources be seismically qualified?

A. No. If a seismic event were to occur simultaneous with a loss of offsite AC power, there would be at least thirty days before AC power would be needed at the site. As stated above, the Staff believes the alternate power sources at Shoreham would survive a seismic event. In the event that they failed to survive such an event, repairs could be made or additional sources of AC power could be made available to the site well within the time needed.

Q. Are these supplemental power sources independent of the normal offsite power system at Shoreham?

A. (Knox) Yes

Q. Does this independence meet what would be required for the normal onsite safety related diesel generators located at an operating nuclear power plant?

A. (Knox) Yes

Q. Does the gas turbine unit or the four supplementary diesel generators qualify as an onsite source of AC electric power?

A. (Knox) No

Q. Why not?

A. (Knox) The onsite source of AC electric power for plant operation at 100 percent of rated power is required to supply power to safety loads in a short period of time (approximately 60 seconds) following the limiting design basis event loss of coolant accident. For plant operation at 5 percent of rated power, AC electric power is not required for 55 minutes following the limiting loss of coolant accident. Thus, the gas turbine or the diesel generators need not be qualified to start and supply power to safety loads in a short period of time.

The onsite source of AC electric power for plant operation at 100 percent of rated power is, also, required to supply power to safety loads following design basis events which may cause loss of offsite power such as seismic, hurricane, and tornado events. In order for the onsite sources to supply power as required, they must be qualified for these events. For plant operation at 5 percent of rated power, AC power is not required immediately following these events since steam driven pumps that are AC independent are available for event mitigation. Thus, the gas turbine or the diesel generators need not be qualified to operate in any of these environments.

Q. You have mentioned a gas turbine. Will you please describe it and what power it will produce?

A. (Tomlinson) The 20 MW peaking unit is powered by a gas turbine. This gas turbine is designed for industrial application, but is very similar in design and operation to an aircraft "jet engine." The gas turbine consists of two major sections: i.e., a compressor/combustor section, and a power turbine. In the first section, combustion air under pressure and fuel are combined and burned to produce high pressure gasses. Some of these gasses are used to operate the compressor for pressurizing the combustion air. The remaining gasses are routed to the power turbine where they are expanded and cooled in the process of extracting energy. The power turbine is connected to and drives the ac generator. There is no physical connection between the compressor section and the power turbine. Maximum output of this unit is 20 MW.

Q. How would it start?

A. (Tomlinson) The turbine is started using a staring motor which operates on compressed air. On signal, the starting motor engages the compressor section of the gas turbine and accelerates it until it reaches a speed where combustion begins and the turbine can operate independently. Compressed air for starting is supplied from a receiver located near the gas turbine generator enclosure. A compressor is provided to automatically maintain sufficient pressure in the receiver. Starting controls are powered from a 125V, 150 AH lead acid battery.

Q. What has been the reliability of the gas turbine LILCO intends to use here?

A. (Knox, Tomlinson) In the 1982-1983 time frame, there were 84 start attempts, of which 82 were successful, for a total reliability of 97.6%. In addition, the gas turbine has been refurbished since being relocated to Shoreham, which enhances its reliability.

Q. What fuel does it use?

A. (Tomlinson) The gas turbine operates on #2 fuel oil.

Q. How does that fuel come to the turbine?

A. (Knox, Tomlinson) Fuel for the gas turbine generator is supplied from a 1,000,000 gallon capacity storage tank located in a fenced location at the Shoreham site but not within the same fence as the Shoreham unit. There are two fuel transfer pumps associated with the turbine. One pump is powered from the 125V battery, and the other pump operates on 230V ac. Both pumps take suction from the storage tank and deliver fuel under pressure to the inlet of the gas turbine fuel pump.

Q. How long would the fuel from its storage tank last?

A (Tomlinson) There is adequate storage capacity for 20 days of operation at maximum output of the gas turbine generator (20 MW). A technical specification requirement to maintain a minimum stored volume of fuel for seven days of operation at maximum continuous output of the gas turbine generator (20 MW) will be imposed.

Q. You have also mentioned four supplemental diesels. Please fully describe them. How would they start?

A. (Tomlinson) Each diesel generator consists of an ac generator driven by a 20 cylinder, turbocharged, 2 cycle series 645 diesel engine manufactured by the Electromotive Division of General Motors. Each diesel generator is rated at 2.5 MW. The diesel engines are started by electric motors which are similar in operation to automobile starter motors, but much larger. The starter motors are designed to operate on 112V dc, and there are two starting motors per diesel engine. Power for the starting motors is from a 112V, 420 AH lead acid battery.

Q. Does the operation of one of these diesels depend on the operation of any others?

A. (Tomlinson) No. The diesel generators are capable of operating totally independent of each other.

Q. What has been the reliability of these mobile diesels?

A. (Knox, Tomlinson) For the 1982-1983 time frame, there were 279 start attempts, of which 275 were successful on the first attempt, and one was successful on the second attempt, for a total reliability of 98.6% per diesel. When four versus one diesel generator is considered, the reliability of the four-mobile diesel generators (for the Shoreham application were only one is needed to supply minimum required safety loads) approaches 100 percent.

Q. What is the fuel source for these diesels?

A. (Knox, Tomlinson) Two 9000 gallon fuel tankers are located onsite within the fenced Shoreham unit. One of these fuel tankers is connected to the diesel generators fuel transfer pumps at all times, and provides adequate fuel for nine (9) hours of continuous operation at maximum rated load of the diesel generators (10 MW). The other 9000 gallon tanker is available to be refilled, either at a depot offsite, or from the gas turbine generator fuel storage tank onsite. A technical specification requirement to maintain a minimum stored volume for seven days of operation at maximum continuous output of the four diesel generators (10 MW) in the gas turbine generator fuel storage tank will be imposed. When the fuel supply in one fuel tanker is depleted, the second tanker is connected to the diesel generators to supply fuel while the empty tanker is removed and filled with fuel. Four hours is adequate time to remove, refill, and reposition a 9000 gallon fuel tanker. This represents a worst case condition. In actuality, the plant load will be equal to a less than one half the diesel generators capacity of 10 MW. At these levels, one 9000 gallon tanker can supply fuel to the diesel generators for approximately 16 hours.

Q. Describe how the electrical power from the gas turbine comes into the Shoreham facility and is routed to the safety related loads.

A. (Knox) Power from the turbine generator is routed through an existing step up transformer located in the 69 KV switchyard to the switchyard bus. From this bus power is routed through existing cable located in underground concrete encased conduit, the station service transformer, cable bus duct, 4.16 switchgear (Bus 12), cable routed in raceway, cable routed in concrete encased conduit to the safety related switchgear. From the safety related switchgear power is distributed as required by the safety related onsite distribution system.

Q. Describe how the electric power from the four diesels you mentioned comes into the Shoreham facility and is routed to the safety related loads.

A. (Knox) Power from the diesels is routed through cables around the west side of the reactor building so that they enter the south side of the non-emergency switchgear room. The cables inside the switchgear room are connected through breakers to 4.16 KV switchgear bus 11. From bus 11, power is routed by cables routed in raceways and concrete encased conduit to the safety related switchgear. From the safety related switchgear power is distributed as required by the safety related onsite distribution system.

Q. In regard to this routing, are they independent of each other?

A. (Knox) Yes

Q. Does this independence meet the single failure criterion that would be required for the routing of circuits associated with a normal onsite safety related diesel generator located at an operating nuclear power plant.

A. (Knox) Yes

Q. If LILCO was to lose power to the Shoreham facility from the general power grids, what steps has LILCO said it would take to put the diesels or the gas turbine on line.

A. (Knox) Both the gas turbine and mobile diesel generators would start automatically. The Shoreham operator by procedure would open and close breakers from the control room as required to supply safety loads. If the gas turbine is unavailable, the control room operator would dispatch a field operator to the nonemerency switchgear room to determine the status of the diesel generators and to open and close breakers as required by procedures. The control room operator then by procedure would open and close breakers from the control room as required to supply power to safety loads.

Q. How do you know?

A. (Knox) The procedures or the capability to supply power to safety loads would be demonstrated by operational testing. This testing will be included as part the Shoreham Technical Specifications.

Q. Would these procedures be followed as to the diesels and the turbine sequentially or simultaneously?

A. (Knox) Sequentially. Both the diesels and turbine start simultaneously on loss of voltage signal. If power is available from the gas turbine the procedure for connecting actual loads to the gas turbine can proceed. If power is not available from the gas turbine procedures for reestablishing power from the mobile diesel generators would start.

Q. How long would it take to have the gas turbine into operation and operating cooling equipment within the Shoreham facility conservatively?

A. (Knox) 10 minutes

Q. What are the conservatisms?

A. (Knox) Time for the control room operator to respond by opening and closing switches.

Q. How long would it take to get the gas turbine operating this equipment realistically?

A. (Knox) 5 minutes

Q. How long would it take to get the diesels we have mentioned on line and operating the cooling equipment conservatively?

A. (Knox) 30 minutes

Q. What are the conservatisms?

A. (Knox) Time for control room and field operator to respond by opening and closing switches.

Q. How long would it realistically take?

A. (Knox) 15 minutes

Q. How many of the diesels are needed to operate cooling equipment needed to shutdown the plant.

A. (Knox) One

Q. Is the gas turbine or the diesels we have spoken about normally used for 100 percent power operation at Shoreham?

A. (Knox) No

Q. What are the normal sources of offsite power to Shoreham?

A. (Knox) There are two sources of offsite power. One source is the 69 KV transmission line from the wildwood 69 KV substation through the Shoreham 69 KV switchyard, the RSS transformer to the safety buses. The other source is the 138 KV transmission line from the Shoreham 138 KV switchyard through the NSS transformer to the safety buses.

Q. From how many different corridors does this power enter the plant?

A. (Knox) Two

Q. How many separate entrances to the Shoreham plant do these sources of power use to enter the plant?

A. (Knox) Two

Q. How many common points are there between these transmission corridors?

A. (Knox) None

Q. Where do they cross or meet?

A. (Knox) They do not cross over or meet.

Q. How does this compare to what the NRC normally requires for full power operation of nuclear plants.

A. (Knox) This design exceeds our requirements in that the offsite circuits do not pass through a common switchyard which is allowed by GDC 17.

Q. What conditions does the staff see as necessary to allow low power operation with the gas turbine and the mobile diesel generators we have spoken about?

A. (Knox) The following conditions are necessary:

1. The automatic transfer between the two normal offsite power circuits at Shoreham must be removed or disabled during low power operation.

2. A fire barrier or 50 feet of separation must be provided between the cables associated with the mobile diesel generators and the RSS and NSS transformers.

3. A quality assurance program for the gas turbine, the mobile diesel generator, and their associated circuits commensurate with their importance to safety.

4. The circuits associated with the gas turbine and four-mobile diesel generators located in the nonessential switchgear room

must be protected in accordance with the requirements of Appendix R or a procedure must be available so that power can be reestablished around the switchgear room within 30 days from one of the alternate AC power sources.

Q. Why are these necessary?

A. (Knox)

1. The automatic transfer must be removed in order to assure independence between the two normal offsite circuits as well as between gas turbine and mobile diesel generators and to preclude the common failure of the three sources of power.

2. A fire barrier or 50 feet of separation must be provided to assure that there will not be a common failure between the normal offsite circuit and the circuits associated with the mobile diesel generators and between the circuits associated with the gas turbine and the mobile diesel generators.

3. A quality assurance program is needed to assure that maintenance, testing, and operation of the gas turbine, mobile diesel generators, and their associated circuits is performed in accordance with their design specification, with documentation, to assure their continued reliability.

4. Protection or a procedure for rerouting circuits associated

with the gas turbine and mobile diesel generators located in the nonessential switchgear room is needed in order to assure AC power availability in the event of a design basis fire in that switchgear room.

Q. Do the gas turbine and diesels we have spoken about for low power operations at Shoreham with the imposition of the staff's conditions have a level of reliability that is currently being demonstrated for onsite safety related diesel generator power supplies qualified for full power operation of nuclear plants.

A. (Knox) Yes

Q. What is the basis for your answer?

A. (Knox, Tomlinson) For normal onsite safety related diesel generators, the demonstrated reliability is within 92 to 99%. For the low power application at Shoreham, the staff has considered the combined reliability of the gas turbine generator and the diesel generators. The gas turbine generator has a demonstrated reliability of approximately 97.6%, while the diesel generators, for this application, have demonstrated reliability approaching 100%. The combined reliability, then, also approaches 100%.

Q. What procedures has the NRC analyzed in connection with LILCO's low power application?

A. (Knox) Procedures for connecting power to the safety loads from the gas turbine and the mobile diesel generators.

Q. In your testimony you testified as to various sources of power for Shorenam. Is it credible that with the conditions the staff seeks all these sources of power could be lost so as to prevent restoration of power to run cooling pumps and other emergency equipment within 55 minutes of the loss of power?

A. (Knox) No

Q. Why?

A. (Knox) Because there are three independent sources of AC power. Each source has sufficient capacity, capability, and reliability to assure that structures, systems, and components important to safety perform as intended.

NUREG-0420
Supplement No. 6

Safety Evaluation Report
related to the operation of Shoreham Nuclear Power Station, Unit No. 1

Docket No. 50-322

Long Island Lighting Company

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

JULY 1984

ABSTRACT

Supplement 6 (SSER 6) to the Safety Evaluation Report on Long Island Lighting Company's application for a license to operate the Shoreham Nuclear Power Station, Unit 1, located in Suffolk County, New York, has been prepared by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. This supplement addresses several items that have been reviewed by the staff since the previous supplement was issued.

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1 INTRODUCTION AND GENERAL DISCUSSION

1.1 Introduction

The Nuclear Regulatory Commission's Safety Evaluation Report (SER) (NUREG-0420) on the application by Long Island Lighting Company (LILCO or applicant) to operate the Shoreham Nuclear Power Station was issued by the Nuclear Regulatory Commission staff (NRC staff) on April 10, 1981. Supplement 1 (SSER 1) to the Shoreham SER was issued in September 1981; SSER 2 was issued in February 1982; SSER 3 was issued in February 1983; SSER 4 was issued in September 1983; and SSER 5 was issued in April 1984.

Each of the sections in this SSER 6 is numbered the same as the section of the SER that is being updated. The discussions in this report are supplementary to and not in lieu of the discussions in the SER, except where specifically noted.

Copies of this report are available for public inspection at the Commission's Public Document Room, 1717 H Street, NW, Washington, D.C. 20555 and at the Shoreham-Wading River Public Library, Route 25A, Shoreham, New York 11786. Copies are also available for purchase from the sources indicated on the inside front cover.

The NRC Project Manager assigned to the operating license application for Shoreham is Ralph Caruso. He may be contacted by calling (301) 492-7000 or writing to the following address:

Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

This supplement is a product of the NRC staff. The following NRC staff members and consultants contributed to this report:

- W. Hodges - Section Leader, Reactor Systems Branch
- J. Knox - Senior Electrical Engineer
- T. Quay - Section Leader, Accident Evaluation Branch
- E. Tomlinson - Mechanical Engineer
- J. Clifford - Operational Safety Engineer

1.7 Outstanding Issues

In Section 1.7 of the SER, the NRC staff identified 61 outstanding issues that were not resolved at the time of issuance of the SER. This report discusses subsequent supplementary information that has been received regarding the applicant's March 20, 1984 supplemental motion for that low-power license and the staff's evaluation of that motion. The items identified in Section 1.7 of the SER are listed below with status of each item. If the item is discussed in this supplement, the section where the item is discussed is identified. The this supplement, the section where the item is discussed is identified. The resolution of the remaining outstanding issues will be discussed in future supplements to the SER.

Item	Status	Section
(1) Pool Dynamic Loads	Resolved	
(2) Masonry Walls	Resolved	
(3) Piping Vibration Test Program - Small Bore Piping/Instrumentation Lines	Resolved	
(4) Piping Vibration Test Program - Safety-Related Snubbers	Resolved	
(5) LOCA Loadings on Reactor Vessel Supports and Internals	Resolved	
(6) Downcomer Fatigue Analysis	Resolved	
(7) Piping Functional Capability Criteria	Resolved	
(8) Dynamic Qualification	Partially resolved, awaiting further information	
(9) Environmental Qualification	Partially resolved, awaiting further information	
(10) Seismic and LOCA Loadings	Resolved pending confirmation	
(11) Supplemental ECCS Calculations with NUREG-0630 Model	Resolved with license condition	
(12) ODYN, Generic Letter 81-08	Resolved	
(13) NUREG-0619, Feedwater Nozzle and Control Rod Return Line Cracking Generic Letter 81-11	Resolved	
(14) Jet Pump Holddown Beam	Resolved	
(15) Inservice Testing of Pumps and Valves	Resolved	
(16) Leak Testing of Pressure Isolation Valves	Resolved	
(17) SRV Surveillance Program	Resolved	
(18) NUREG-0313, Revision 1	Resolved	

Item	Status	Section
(19) Preservice Inspection	Resolved	
(20) Appendix G - IV.A.2.a	Resolved	
(21) Appendix G - IV.A.2.c	Resolved	
(22) Appendix G - IV.A.3	Resolved	
(23) Appendix G - IV.B	Resolved	
(24) Appendix H - II.C.3b	Resolved	
(25) RCI[illegible]	Resolved	
(26) Suppression Pool Bypass	Resolved	
(27) Steam Condensation Downcomer Lateral Loads	Resolved	
(28) Steam Condensation Oscillation and Chugging Loads	Resolved	
(29) Quencher Air Clearing Load	Resolved	
(30) Drywell Pressure History	Resolved	
(31) Impact Loads on Grating	Resolved	
(32) Steam Condensation Submerged Drag Loads	Resolved	
(33) Pool Temperature Limit	Resolved	
(34) Quencher Arm and Tie-Down Loads	Resolved	
(35) Containment Isolation	Resolved	
(36) Containment Purge System	Resolved	
(37) Secondary Containment Bypass Leakage	Resolved	
(38) Fracture Prevention of Containment Pressure Boundary	Resolved	
(39) Emergency Procedures	Resolved	
(40) LOCA Analyses	Resolved	
(41) LPCI Diversion	Resolved	

Item	Status	Section
(42) Flow Meter	Resolved	
(43) Loss of Safety Function After Reset	Resolved	
(44) Level Measurement Errors	Resolved	
(45) Fire Protection	Resolved	
(46) IE Bulletin 79-27	Resolved	
(47) Control System Failures	Resolved	
(48) High Energy Line Breaks	Resolved	
(49) DC System Monitoring	Resolved	
(50) Low and/or Degraded Grid Voltage Condition	Resolved	
(51) Fracture Toughness of Steam and Feedwater Line Materials	Resolved	
(52) Management Organization	Resolved	
(53) Emergency Planning	Under review	
(54) Security	Awaiting further information	
(55) Q-List	Resolved	
(56) Financial Qualification	Resolved	
(57) TMI-2 Requirements		
Shift Technical Advisor	Resolved with license condition	
Shift Supervisor Administrative Duties	Resolved	
Shift Manning	Resolved	
Upgrade Operator Training	Resolved	
Training Programs - Operators	Resolved pending confirmation	
Revise Licensing Examinations	Resolved	
Organization and Management	Resolved	

Item	Status	Section
Procedures for Transients and Accidents	Resolved	
Shift Relief and Turnover Procedures	Resolved	
Control Room Access	Resolved	
Dissemination of Operating Experiences	Resolved	
Verify Correct Performance of Operating Activities	Resolved	
Vendor Review of Procedures	Resolved	
Emergency Procedures	Resolved	
Control Room Design Review	Resolved pending confirmation	
Training During Low-Power Testing	Resolved	
Reactor Coolant System Vents	Resolved	
Plant Shielding	Resolved	
Post-Accident Sampling	Resolved with license condition	
Degraded Core Training	Resolved	
Hydrogen Control	Resolved	
Relief and Safety Valves	Resolved pending confirmation	
Valve Position Indication	Resolved	
Dedicated Hydrogen Penetrations	Resolved	
Containment Isolation Dependability	Resolved with license condition	
Accident-Monitoring Instrumentation		
Attachment 1	Resolved with post-implementation review	
Attachment 2	Resolved	
Attachment 3	Resolved	

Item	Status	Section
Attachment 4	Resolved	
Attachment 5	Resolved	
Attachment 6	Resolved	
Inadequate Core Cooling	License condition	
IE Bulletins		
Item 5	Resolved pending confirmation	
Item 10	Resolved pending confirmation	
Item 22	Resolved	
Item 23	Resolved	
Bulletins and Order Task Force		
Item 3	Resolved	
Item 13	Resolved pending confirmation	
Item 16	Resolved	
Item 17	Resolved	
Item 18	Resolved	
Item 21	Resolved	
Item 22	Resolved	
Item 24	Resolved	
Item 25	Resolved	
Item 27	Resolved	
Item 28	Resolved	
Item 30	Resolved	
Item 31	Resolved	
Item 44	Resolved	

Item	Status	Section
Item 45	Resolved	
Item 46	Resolved	
Emergency Preparedness - Short Term	Under review	
Upgrade Emergency Support Facilities	Under review	
Emergency Preparedness - Long Term	Under review	
Primary Coolant Outside Containment	Resolved	
Improved Iodine Monitoring	Resolved	
Control Room Habitability	Resolved pending confirmation	
(58) Reactor Vessel Materials Toughness	Resolved	
(59) Control of Heavy Loads - Generic Letter 81-07	Resolved	
(60) Station Blackout - Generic Letter 81-04	Resolved pending confirmation	
(61) Scram System Piping	Resolved	
(62) Remote Shutdown System	Resolved with license condition	
(63) Design Verification	Under review	
(64) Loose Parts Monitoring System	Resolved	
(65) Low-Power License Motion	Resolved with license condition	1.10, 8.5, 13.5, 15, 23

1.10 Motion for a Low-Power License

On March 20, 1984, the applicant made a supplemental motion (the motion) for a low-power operating license before the Atomic Safety and Licensing Board Panel. The objective of this supplemental motion is to show that pending diesel generator issues need not be resolved to support the issuance of a low-power license. In support of this objective, the applicant has provided design information and analysis to demonstrate that even if one assumes the unavailability of all three onsite diesel generators, with a single design-basis event and the concurrent (normally postulated) loss of offsite power, there is reasonable assurance that an alternate ac power source can be made available in sufficient time to ensure that structures, systems, and components important to safety perform as intended at 5% power.

The staff published its evaluation of the motion in SSER 5, dated April 1984. However, on May 16, 1984, the Commission ruled that the applicant must file an application for an exemption from the applicable requirements of GDC-17. The applicant filed such a request with the Atomic Safety and Licensing Board on May 22, 1984. Additional information was provided to the staff in letters from the applicant dated June 6, 1984 (SNRC-1047) and June 28, 1984 (SNRC-1060).

The evaluations contained in this SSER update those in SSER 5 (when appropriate) and provide the staff's technical basis for granting an exemption from GDC-17.

8 ELECTRIC POWER

8.5 Alternating Current Power System for Low Power Operation

The objective of the staff review in this area is to determine whether the alternate ac power sources meet the intended safety function and review objectives that are defined in the SER for the onsite diesel generator ac power sources. The safety function of the alternate ac power sources (assuming neither the offsite power system nor the onsite diesel generators are functioning) is to provide sufficient capacity and capability to ensure that the structures, systems, and components important to safety perform as intended for low-power operation. Thus, the objective of the review is to determine whether the alternate ac power sources have the required redundancy, meet the single failure criterion, and have the capacity, capability, and reliability to supply power to all required safety loads. It is also the objective of the staff review to determine whether the alternate ac power sources will provide reasonable assurance that ac power will be available in sufficient time after postulated design-basis events.

The applicant has proposed to use two portable "peaking units" as alternate ac power sources. These peaking units are rated at 20 MW and 10 MW, respectively.

The 20-MW unit consists of a single gas-turbine-powered generator. The generator, gas turbine, and all electrical and mechanical controls are contained within a weather-resistant enclosure. The gas turbine is designed for "dead-line" start capability: i.e., the gas turbine is capable of starting, accelerating to rated speed and voltage, and connecting to a power distribution system using only self-contained control systems and power sources, following an appropriate loss of voltage signal. The turbine starts using compressed air to drive an air start motor. Starting air is stored at 400 to 500 psig in pressurized receivers of sufficient capacity to allow three starting attempts without recharging. An automatically controlled air compressor within the enclosure is cycled on and off, as required, to maintain the compressed air supply. The distribution system has a 150-ampere-hour, 125-volt dc battery. A 50-amp battery charger maintains the battery charged at required levels. Power for the air compressor and battery charger comes from an auxiliary transformer that is powered from the associated distribution system (69-kV) during standby, and from the gas turbine generator during operation. Fuel is from an onsite, 1,000,000gallon storage tank. Two fuel pumps deliver fuel under pressure to the gas turbine. One pump is powered from the 125-volt dc battery and starts automatically when the gas turbine starts. The dc pump operates until the gas turbine generator is producing power, when the ac-operated pump starts and the dc pump automatically stops. Power for the ac fuel pump is from the same source used by the air compressor and battery charger.

The 10-MW unit consists of four diesel-engine-powered generators, each rated at 2.5 MW. Each generator--with its associated diesel engine, electrical and mechanical components, and controls--is in an independent, weather-resistant enclosure. Each diesel generator is designed for "dead-line" start capability. Each starts using two 125-volt dc electric starting motors. A single, 420-ampere-hour, 125-volt dc, lead acid battery provides power for the starting motors on all four diesel engines. This battery is in the enclosure of one of the four diesel generator power units. The diesel generators start in sequence, with the start cycle for one ending before the start cycle for another begins. A start cycle lasts 15 seconds. The starting battery has capacity for 7 diesel engine start cvcles. The battery is maintained at full charge by a battery charger. Power for the battery charger is from an auxiliary transformer that is powered from the associated distribution system (4 kV) during standby, and from the diesel generators when they are on line. The diesel generators are designed to automatically synchronize with each other after they reach rated speed and voltage; they are connected to the load as one unit. The controls are designed to allow stable parallel operation of the four diesel generators. Connection to the load will be by manual operation.

The following areas were considered in the staff review of these alternate ac power sources:

Capacity and Capability of 20-MW Gas Turbine

The applicant (by item 20 of the Schiffmacher affidavit, contained in the motion) stated that the 20-MW gas turbine has the ability to carry all plant emergency loads together with some selected plant nonemergency loads. To demonstrate this capacity, the applicant (by item 8 of the Museler affidavit) stated that on a biweekly basis through actual test the 20-MW gas turbine will be loaded to at least 13 MW. The 13-MW test load is slightly greater than the total of all plant loads that can be connected to safety buses, as shown on FSAR Table 8.3.1-1. The 13-MW test load does not, however, consider selected nonemergency loads. The nonemergency load is about 20% of the 20-MW capacity of the gas turbine, or 4 MW, as stated by the applicant (line 7, page 22 of the March 29, 1984 meeting transcript). The staff will require, as part of the Shoreham Technical Specification, that this 4-MW nonemergency load be included in the test load so that the gas turbine will be loaded to 20 MW as part of an operational test prior to plant operation beyond criticality testing, and to 13 MW every 2 weeks. With the imposition of this requirement, the staff concludes that the 20-MW gas turbine has sufficient capacity and is acceptable.

In regard to the capability of the gas turbine to be connected to safety loads, the applicant (pages 18, 19, and 20 of the March 29, 1984 meeting transcript) stated

(1) On loss of voltage on the 69-MW offsite power system bus, the gas turbine automatically starts; breaker number 640, shown on FSAR Figure 8.2.1-1, automatically opens, isolating the 69-kV switchyard from the LILCO offsite grid system, and motor mechanical switches 616 and 617 on FSAR Figure 8.2.1-1 automatically open to strip off load normally connected to the 69-kV switchyard bus.

(2) All loads connected to nonsafety buses 1B and 12 on FSAR Figure 8.2.1-1 are automatically disconnected on loss of voltage except the 4-MW nonemergency load discussed above.

(3) The gas turbine is automatically connected to the 69-kV bus after it attains the correct speed.

(4) All other loads or power supplies that may be connected to (but are not automatically disconnected from) the 69-kV switchyard bus are administratively kept disconnected.

Thus, on loss of the normal 69-kV offsite circuit, a source of power is automatically reestablished in 2 to 3 minutes so that the control room operator need only, by procedure, close breakers 424, 444, or 464 shown on FSAR Figure 8.2.1-1 to resupply power to safety loads (lines 7 to 13, page 26 of the March 29, 1984 meeting transcript). To demonstrate this capability, the applicant (lines 19, 20 and 21, page 24 of the March 29, 1984 meeting transcript) stated that a test would be performed once a month to ensure that the gas turbine will start automatically on loss of grid voltage and isolate from the grid.

As part of the Shoreham Technical Specifications, the staff will require that this monthly test be performed with the following functions verified:

(1) that loads normally connected to the 69-kV and 4.16-kV buses are automatically disconnected

(2) that the gas turbine automatically connects to the 69-kV bus within 2 to 3 minutes

The staff will also require, as part of the Technical Specifications, the periodic verification, once every 12 hours, that loads or power supplies normally disconnected from the 69-kV bus are in fact disconnected.

With respect to the capability to close breakers numbered 424, 444, or 464 so that power can be supplied to actual loads, the applicant (lines 15 through 20, page 25, and lines 1 through 7, page 29 of the March 29, 1984 meeting transcript) indicated that this capability would be demonstrated by operational testing before plant operation in Phases III and IV and will require 5 to 10 minutes for the control room operator to complete. In addition to this operational test, the staff will require that proper operation of the gas turbine be demonstrated by loading it to its design load requirement (which includes safety loads as well as nonsafety loads on 480-V busses 12A, 12B, 12C, and 12D), with verification that voltage and frequency are maintained within required limits. The staff also will require, as part of the Shoreham Technical Specifications, that the capability to connect to actual safety loads also be demonstrated once every 6 months while the unit is shut down. With the imposition of these requirements, the staff concludes that there is sufficient capability to ensure that the gas turbine can be connected to safety loads and can supply power to permit functioning of required safety loads and that it is acceptable.

Capacity and Capability of the Four Mobile Diesel Generators

In regard to the capacity of the four mobile diesel generators, the applicant (lines 7 through 10, page 10 of the March 29, 1984 meeting transcript) stated that one of the four 2.5-MW mobile diesel generators has adequate power to mitigate the worst case accident. To demonstrate this capacity, the applicant, by letter dated April 3, 1984 (SNRC-1033), stated that on a biweekly basis through actual test the four 2.5-MW diesel generators will be loaded to a minimum of 50% of rated load or to at least 1.25 MW per diesel generator. Because this minimum test load of 1.25 MW does not equal the minimum required capacity of 2.5 MW to mitigate the worst case accident, the staff will require, as part of the Shoreham Technical Specifications, that each diesel generator be loaded to 2.5 MW or that all four mobile diesel generators be loaded to 10 MW every 2 weeks. With the imposition of this requirement, the staff concludes that each of the four mobile diesel generators has sufficient capacity and is acceptable.

In regard to the capability of the four mobile diesel generators to be connected to safety loads, the applicant (pages 11 through 18 of the March 29, 1984 meeting transcript) indicated that

(1) On loss of power the diesel generators would automatically start.

(2) A field operator would be dispatched to establish the availability and status of the diesel generators.

(3) The field operator in coordination with the control room operator, by procedure, would manually open disconnect switches to isolate the offsite power grid system from the four mobile diesel generators.

(4) All loads connected to non-safety bus 11 shown on FSAR Figure 8.2.1-1 are automatically disconnected except for nonemergency loads on buses 11A, 11B, 11C, and 11D.

(5) The control room operator, by procedure, will ensure that these nonemergency loads connected to bus 11 are in fact disconnected by manually opening their supply breaker.

(6) The field operator, by procedure, manually closes a breaker so that ac power from the four mobile diesel generators is connected to 4.16-kV bus 11 shown on FSAR Figure 8.2.1-1.

(7) The control room operator, by procedure, closes breakers numbered 415, 435, or 455 shown on FSAR Figure 8.2.1-1 to resupply power to safety loads.

With respect to the capability of the four mobile diesel generators to be connected to safety loads, the applicant (lines 9 through 22, page 31 of the March 29, 1984 meeting transcript) indicated that the capability would be demonstrated as part of operational testing before Phases III and IV and will require 30 minutes for the control room and field operators to complete. As part of this test, the staff will require that the applicant demonstrate proper operation of the four mobile diesel generators by loading each diesel generator to its design load requirements for 1 hour and verifying that voltage and frequency are maintained within required limits. In addition to these preoperational tests, the staff will require, as part of the Shoreham Technical Specifications, that the above described capability to connect the four mobile diesel generators to safety loads be demonstrated once every 6 months while the unit is shut down. With respect to the capability of the diesel generators to automatically start on loss of voltage, the applicant (by item 8e of the Museler affidavit) stated that the generators would be tested (on a biweekly basis) to demonstrate that at least three of the four mobile diesel generators can be manually started and operated at rated speed. As part of this periodic test, the staff will require, as part of the Shoreham Technical Specifications, (1) that the diesel generators be started on a simulated loss of offsite power signal with ac power disconnected from all diesel generator auxiliary equipment (such as ac power to the starting battery through the battery charger) and (2) that each of the four diesel generators can be manually reconnected to their common bus following disconnection for any reason. Also as part of these preoperational and 6-month periodic tests, the staff will require that:

(1) the battery charger be demonstrated capable of recharging the battery to at least 95% of full charge within 8 hours.

(2) a battery service test be performed in accordance with the guidelines of Standard 450-1980 of the Institute of Electrical and Electronics Engineers (IEEE) to a load test profile equal to 7 full 15 second engine start cycles. With the imposition of these requirements, the staff concludes that there is sufficient capability and capacity to ensure that the four mobile diesel generators can be connected to safety loads and can supply power to permit functioning of required safety loads and are acceptable.

Independence and Compliance with the Single Failure Criterion

With regard to electrical independence of the 20-MW gas turbine from the four mobile alternate power supplies and their circuits, the staff was concerned that the electrical cross connections (shown on FSAR Figure 8.2.1-1) between the two alternate sources could cause their common failure. Concerning the interconnections through 4.16-kV buses 1A, 1B, 11, and 12, the applicant (line 25 of page 20, and lines 1 through 7 of page 26 of the March 29, 1984 meeting transcript) stated that breakers numbered 420, 430, 460, and 470 on FSAR Figure 8.2.1-1 are normally open. Regarding the interconnection between 480-V buses 11A and 12A, 11B and 12B, 11C and 12C, and 11D and 12D shown on FSAR Figure 8.2.1-1, the applicant (lines 21 and 23 of page 22 of the transcript) also stated that the breaker interconnecting each of these buses is normally open. As part of the Technical Specifications for Shoreham, the staff will require verification, once every 12 hours, that each of these normally open breakers remains open. As to the remaining interconnections through the 4.16-kV emergency buses numbered 101, 102, and 103, the applicant (lines 13 through 16 of page 36 of the March 29, 1984 meeting transcript) indicated that plant procedures would prevent such interconnection. Procedure directs that one of the two supply breakers to each of these buses normally would be kept open, while the other breaker normally is kept closed. During the March 29, 1984 meeting, the staff (pages 36 through 41 of the transcript) expressed the concern that because these breakers included an automatic transfer capability between the two breakers, some event or single failure could cause failure of both sources of alternate power. To preclude this occurrence, the staff will require that the transfer capability be removed, and the staff will so condition the low-power license. With the imposition of this requirement, the staff considers this item resolved. The Shoreham Technical Specifications will be changed to reflect that testing of this automatic transfer will not be required during low-power operation but will be required for the full-power license.

In regard to the physical independence between the 20-MW gas turbine and the four mobile diesel generators alternate power supplies and their circuits, the applicant (page 82 of the March 29, 1984 meeting transcript) provided a description of the physical separation of these circuits. This description indicated that the gas turbine is located in the 69-kV switchyard, with its circuits entering the switchgear room as shown on FSAR Figures 8.2.1-3A and 8.2.1-8A. These circuits are part of the circuits associated with the reserve station transformer. The four mobile diesel generators are in a physically separate location next to the southwest corner of the reactor building with the circuits entering the same switchgear room shown on FSAR Figure 8.2.1-8A. These circuits enter approximately 40 feet east on the same side of the switchgear room (as those circuits associated with the gas turbine).

On the basis of this description, the staff concludes

(1) The gas turbine and mobile diesel generators are separated by approximately 300 feet.

(2) The four mobile diesel generators are separated from the reserve station service transformer by approximately 150 feet and the control and auxiliary boiler building.

(3) The circuits associated with the gas turbine are routed in underground concrete enclosed raceway approximately 75 feet from the location of the four mobile diesel generators.

(4) The circuits associated with each of the alternate ac sources located in the 69-kV switchgear room shown on FSAR Figure 8.2.1-8A are routed in physically separate cable bus duct, raceway, or switchgear.

(5) The circuits associated with each alternate ac source are routed between the switchgear room and the safety buses in raceways encased in the concrete floor, as shown on FSAR Figure 8.2.1-8B.

The preceding separation provides sufficient independence so that failure of one alternate source will not cause loss of the other source, and is acceptable with the following exception: because the staff is concerned that failure of either the reserve station service transformer or the normal station service transformer as a result of fire may cause failure of the circuits associated with the four mobile diesel generators, the staff will require that these circuits be located no closer than 50 feet from either transformer, or adequate fire barrier separation must be provided. The staff will so condition the low-power license. With the imposition of this requirement, the staff considers this item resolved.

The applicant has not provided any information regarding the quality and design standards to which the alternate ac power supplies and their associated circuits were designed. Because of the importance of these items to the safe operation of the plant during low-power operation, the staff will require they be subject to a quality assurance program commensurate with their importance to safety for 5% rated power operation. This program shall include all pertinent and past history (inspection reports, mill certifications, manufacturer certification, etc.) as available. Current and future documentation shall be all inclusive and be available at the site. With the imposition of this requirement as a condition to the Shoreham low-power license, the staff considers this item resolved.

In regard to protection from natural phenomena and postulated accidents the staff has concluded

(1) Environmental conditions associated with postulated loss-of-coolant or pipe break accidents are confined to the reactor containment or plant

auxiliary building. Thus, the alternate ac power system is sufficiently isolated or removed so that the accident environment will have no effect on the capability of the alternate ac power system to perform its safety function. The staff concludes that there is reasonable assurance that ac power will be available for these environmental conditions, and that it is acceptable in this regard.

(2) For low-power operation, the main turbine generator is not operating. Thus, the only source of missiles that need to be considered would be from outside the plant building and that would be from a tornado. For tornados, the applicant, by letter dated April 3, 1984, stated that the plant would be immediately shut down if the NWS issues a tornado watch for the Shoreham area. The staff will require, as part of the Shoreham Technical Specifications, the immediate shut down of the plant given this condition. With the imposition of this requirement, the staff concludes that more than 30 days will be available before ac power is needed; thus, there is reasonable assurance that ac power will be available and that it is acceptable in this regard.

(3) In regard to hurricanes, the applicant (item 7a of the Museler affidavit) stated that the plant would be immediately shut down if NWS issues a hurricane warning for the Shoreham area. The staff will require, as part of the Shoreham Technical Specifications, the immediate shut down of the plant given this condition. With the imposition of this requirement, the staff concludes that more than 30 days will be available before ac power is needed. Thus, the staff concludes that there is reasonable assurance that ac power will be available and that it is acceptable in this regard.

(4) In regard to a seismic event, the applicant (item 7e of the Museler affidavit) stated that the plant would be immediately shut down if there is an indication of seismic activity of 0.01g on the Shoreham seismic monitors.

In addition, the applicant (item 23 of the Schiffmacher affidavit) provided the manufacturer's assurance that the gas turbine would remain structurally sound during a design-basis seismic event at Shoreham and would be available after the event to perform its design function. As part of the Shoreham Technical Specifications, the staff will require the immediate shut down of the plant if there should be such an indication of seismic activity.

In case of a seismic event, it is the staff's opinion that the alternate ac sources will be available after the event because

(a) A period of 30 days is available before the alternate ac power sources are needed for any mitigating function.

(b) The manufacturer has provided assurance that the gas turbine will be structurally sound after a seismic event.

(c) Diesel generators similar to those being used at Shoreham have been used in marine and locomotive applications.

(d) Operating experience during seismic events has demonstrated the capability of equipment similar to that being used at Shoreham to survive a seismic event and to perform its design function after the seismic event.

The staff, therefore, concludes that there is reasonable assurance that ac power will be available following a seismic event and that it is acceptable in this regard.

(5) Concerning other natural phenomena, the applicant (item 7 of the Museler affidavit and by letter dated April 3, 1984) stated that the plant would be immediately shut down in case of (1) a severe storm watch for the Shoreham area issued by NWS, (2) a prediction by NWS for the Shoreham area of abnormally high tides greater than 5 feet above mean high water within 24 hours, (3) the outage of two of the four LILCO interconnections to Consolidated Edison and to the New England Power Grid, and (4) a low electrical frequency condition that causes an alarm on the LILCO transmission system. The staff will require, as part of the Shoreham Technical Specifications, that the plant be immediately shut down for each of these conditions. With the imposition of this requirement, the staff concludes that more than 30 days will be available before ac power is needed. Thus, there is reasonable assurance that ac power will be available when required and that it is acceptable in this regard.

(6) The applicant has provided no evaluation of a design-basis event fire in the nonsafety switchgear room through which both alternate ac power circuits pass. The staff will, therefore, require--and so condition the low-power license--that these circuits either be protected in accordance with the requirements of Appendix R to 10 CFR 50 or that a procedure be developed so that ac power can be re-established around the switchgear room from one of the alternate ac power sources to the safety loads within 30 days. With the imposition of this requirement, the staff concludes that the design is acceptable.

Thus, for the long term, following these design basis events, there is reasonable assurance that ac power will be available for event mitigation. However, for plant operation at 5 percent of rated power, ac power is not required immediately following these design basis events, since steam driven pumps that are ac independent are available for event mitigation.

Reliability

The gas turbine generator is powered by a Pratt and Whitney gas turbine. This turbine generator is designed so that the power section of the turbine is not connected to the compressor section. In this design, the starting motor does not have to turn the mass of the generator during starting, thereby making starting faster, easier, and more reliable. Operating history for gas turbine generator identical to that used at Shoreham (as presented by the applicant in a letter dated April 11, 1984) shows 2 failures out of 84 start attempts or 97.6% reliability. The staff concludes that this reliability is well within the 92 to 99% reliability currently being demonstrated by typical onsite power system diesel generators located at operating nuclear power plants and is acceptable.

Each of the four mobile diesel generators is powered by 20-cylinder, EMD series 645 turbocharged diesel engines. These engines have widespread application in power generation, marine systems, and locomotives, and miscellaneous other industrial applications. This series of EMD diesel engines has an excellent reputation for inservice reliability in all types of applications. The operating history (pages 7 through 11 of the March 29, 1984 meeting transcript) for the four mobile diesel generators shows that on a per-diesel-generator basis there were 4 failures out of 279 start attempts or 98.6% reliability per diesel. When four diesel generators are considered (rather than one), the reliability of the four mobile diesel generators (for the Shoreham application where only one is needed to supply minimum required safety loads) approaches 100%.

Evaluation Findings

The review of the alternate ac power sources proposed by the applicant for low-power operation at Shoreham covered single-line diagrams, station layout drawings, schematic diagrams, descriptive information and a confirmatory site inspection. The staff concludes that the alternate ac power sources have the required redundancy, meets the single failure criterion, and have the capacity, capability, and reliability to supply power to all required safety loads for low-power operation. The design, thus, provides reasonable assurance that ac power will be available within 55 minutes following a design-basis event LOCA and is acceptable, as described above.

13 CONDUCT OF OPERATIONS

13.5 PLANT PROCEDURES

13.5.1 Procedures for Augmentation of Electrical Power

The staff has reviewed the procedures to be used in providing electric power to the Shoreham Nuclear Power Station emergency buses following a loss of normal off-site power sources. The purpose of the review is to determine whether the existing procedures can be implemented to restore electric power to mitigating equipment (e.g., RHR pumps, containment coolers) in a time period that will allow the plant operator actions necessary to prevent exceeding 10 CFR 50.46 limits.

The following operational procedures were reviewed:

TP 29.015.03 - "Interim Emergency Procedure (5% Power); Restoration of AC Power With Onsite Mobile Generators"
SP 29.015.02 - "Loss of All AC Power Emergency Procedure"

These procedures were reviewed for useability and technical accuracy with the existing electrical distribution systems.

The following briefly describes the expected sequence following a loss of off-site power:

Upon loss of both the Normal and Reserve Station Service Transformers (NSST and RSST), the available TDI diesels are designed to start and close onto the emergency buses automatically. Then the emergency electrical loads are designed to automatically sequence onto the bus. No operator action is necessary other than to monitor these automatic actions.

If the TDIs fail to start or load, the on-site 20 MW gas turbine is to be used to power the emergency buses. The gas turbine automatically starts on a loss of off-site power. The operators verify that power is available from the gas turbine by observing control room indication of power available to the RSST. This is designed to occur within 2-3 minutes following a loss of power. An equipment operator is instructed to then connect the 20 MW gas turbine to the 4 KV bus through a locally operated breaker, and to reset the emergency bus program lockouts. The 4 KV emergency bus loads are designed to then automatically start in sequence.

If the 20 MW gas turbine fails to start or if it cannot be loaded, the temporary (EMD) on-site diesel generators are to be used. The EMDs are designed to start and synchronize together automatically following loss of power to the 4KV-SWG-11 bus. Procedure TP 29.015.03 instructs the control room operators to isolate the 4KV-SWG-11 bus from the NSST and RSST, shed the 4 KV emergency buses (101, 102, and 103) from 4KV-SWG-11 bus, and shed the loads from the 4 KV emergency buses in preparation for reenergizing the 4 KV buses. An equipment operator is to go to the emergency and normal switchgear rooms to remove undervoltage bus program fuses, and to ensure locally operated breakers are lined up in preparation for power restoration. The NSST may then be isolated from the grid if a fault exists in the NSST, and the EMD diesel generators are to be connected to the 4KV-SWG-11 bus. The procedure then instructs the control room operators to energize the emergency buses and emergency bus loads.

The staff observed operational demonstrations of the use of the 20 MW gas turbine and the EMD diesel generators on July 2, 1984. The demonstrations included the simulated loss of AC power with subsequent automatic start of the respective power sources, the operators performing the necessary actions to restore electrical power to the emergency buses, and the operators starting and operating representative emergency bus loads.

The operational aspects of these demonstrations were evaluated by observing the operators perform the necessary actions to restore AC power to the emergency buses using either the 20 MW gas turbine or the EMD diesel generators. The staff evaluated the procedures used, equipment accessibility, lighting conditions, operator familiarity with the required equipment and operations, and operator transit routes used to reach the necessary equipment.

The following changes will be necessary for the staff to find the procedural and operational aspects of the augmented electrical power system at Shoreham acceptable.

1. To enhance visibility of the NSST disconnects during station blackout conditions at night or during adverse weather conditions, emergency lighting must be installed at the NSST to illuminate the disconnects.

2. To prevent possible personnel injury and the resulting time delay on a transit from the control room to the emergency switchgear room, the portion of the I-beam that protrudes into the stairwell leading from behind the control room back panels to the emergency switchgear room must be removed or padded.

3. To enable the operators to readily and accurately access the undervoltage bus program fuses in the emergency switchgear room, the covers for these cabinets must be clearly labeled as containing the undervoltage bus program fuses. In addition, the fuse block for the undervoltage bus program fuses must be clearly identified within the cabinet. These labels must be of sufficient size and contrast to allow rapid recognition of the proper cabinet and fuse block under station blackout conditions.

4. To provide additional assurance that all operators are familiar and proficient with the equipment and procedures to be used, each operating shift must satisfactorily perform TP 85.84042.3, "Supplemental Diesel Generator-EMD-(GM); Electrical Functional Test Procedure."

5. To reduce the possibility of error while implementing the procedures, the following modifications to the listed procedures are necessary.

   a. TP 29.015.03

      1) Place a line, to be used as a placekeeping aid, next to each action step in Section 4.0.

2) Step 4.1 - The list of breakers should be expanded to include 1R22* ACB-102-1.

3) Step 4.3 - All 4 KV loads that need to be in pull-to-lock (PTL), must be listed. The current wording, "This includes ..." implies that loads other than the ones listed need to be placed in PTL.

4) Step 4.4 - As currently worded, the followup action to this step will cause Step 4.5 to be executed regardless of the condition of OCB 1350 and 1360. Step 4.4 should be separated into the two discrete actions being performed (possibly through the use of substeps). The procedure also needs to specify which action step is to follow successful interaction with the system operator to open OCB 1350 and 1360.

b. SP 29.015.02

1) This procedure needs to include or reference the actions that are to be taken to restore power to the emergency buses using the on-site 20 MW gas turbine. This should include a direct reference to the on-site 20 MW gas turbine, to meet the same intent as the reference to the Holtsville gas turbines in Step 3.4.

2) At the appropriate step in this procedure, a reference needs to be made to TP 29.015.03.

The staff will condition the Shoreham license to require the completion of these items prior to fuel load.

With the resolution of these confirmatory items, the staff concludes that there is reasonable assurance that the operators can properly implement the necessary procedures for restoration of AC power to the emergency buses and equipment using the on-site 20 MW Gas Turbine and the EMD diesel generators.

15.0 TRANSIENT AND ACCIDENT ANALYSIS

By letter dated March 21, 1984 (SNRC-1026), the applicant presented a supplemental motion for a low power operating license to the Atomic Safety and Licensing Board panel. Clarifications and additional information were given by the applicant at the March 29, 1984 meeting held in Bethesda, Maryland. The objective of this supplemental motion is to show that the pending diesel generator issues being litigated need not be resolved prior to the granting of a low power license. Pursuant to this objective, the applicant provided design information and analyses to demonstrate that even if one assumes the unavailability of all three onsite diesel generators in conjunction with a design basis event and the concurrent loss of offsite power, there is reasonable assurance that alternate AC power can be made available in sufficient time to assure that structures, systems, and components important to safety perform as intended. As a result of Commission review of the supplemental motion by the applicant it determined that, in the absence of qualified diesel generators, the applicant must request an exemption to GDC-17.

On May 16, 1984, the Commission issued criteria to be satisfied by the applicant if it chose to request an exemption to GDC-17 (CLI-84-8). One criterion was that the applicant should include a discussion of its basis for concluding that, at the power levels for which it seeks authorization to operate, operation would be as safe, under the conditions proposed, as operation would have been with a fully qualified onsite A/C power source. The applicant's motion of Ma[illegible] 1984 and submittal of June 28, 1984 (SNRC-1060), responded to that criterion. The applicant assumed that the criterion is satisfied because at 5% thermal power with enhanced offsite power, the deterministic thermal and radiological success criteria are met given the assumption of no qualified diesels. We have reviewed those submittals and conclude that, for the transients and accidents analyzed in Chapter 15 of the Shoreham FSAR, operation with the enhanced offsite power supply at 5% power is as safe as operation with fully qualified TDI diesels at 5% power. This assessment is based primarily on the fact that: 1) for most transients and accidents, no fuel failures occur whether or not TDI diesels are available and, 2) for those few instances (e.g., fuel handling accident) in which fuel failure can occur, the activity available for release to the environment is negligibly small whether or not TDI diesels are available. Details supporting this conclusion are given in the remainder of this evaluation.

The alternate AC power supplies at the site consist of one 20 MW gas turbine and four 2.5 MW mobile diesel generators. According to the applicant, the gas turbine can restore power to the ECCS pumps within 10 minutes and the mobile diesels can restore power to the ECCS pumps within 30 minutes. During a loss of offsite power and loss of the gas turbine, only one of the four mobile diesels is required to mitigate the most limiting accident (LOCA). Restoration of power to one of the three divisions will ensure power to at least one of the 2 ECCS pumps. A detailed evaluation of electrical systems is given in section 8.3.1 of the SSER.

LILCO requests NRC approval for the following activities at Shoreham.

(a) Phase I: fuel load and precriticality testing

(b) Phase II: cold criticality testing

(c) Phase III: heatup and low power testing to rated pressure/temperature conditions (approximately 1% rated power); and

(d) Phase IV: low power testing (1-5% rated power)

These phases are distinct; each consists of a separate set of operations and testing. Together, they include the full sequence of activities associated with fuel loading and low power testing up to 5% of rated power.

The staff has reviewed all of the events considered in Chapter 15 of the FSAR to determine the effect on public health and safety of operation of the Shoreham plant during all the four phases referred above. The staff has reviewed the applicant's analyses given in LILCO's motion for low power operation. The evaluation was based on the availability of alternate AC power supplies provided by LILCO, with no credit assumed for the TDI diesels. We find LILCO's submittal to be acceptable. A detailed evaluation of the four phases of operation is given below.

Phase I: <u>Fuel Load And Precriticality Testing</u>

This phase of the Shoreham plant operation includes only initial fuel loading and precriticality testing. The reactor will remain at essentially ambient temperature and atmospheric pressure. The reactor will not be taken critical. Any increase in temperature beyond ambient conditions will be due only to external heat sources such as recirculation pump heat. There will be no heat generation in the core.

The review of the FSAR Chapter 15 analysis revealed that of the 38 accident or transient events addressed, 22 of the events could not occur during phase 1 because of the operating conditions of the reactor. These events all involve operational modes or component operations which are not possible during this phase. Because no steam is available, all events which would require pressurized conditions are precluded. Other events are precluded by definition (i.e., control rod removal error during refueling, fuel assembly insertion error during refueling; a fuel insertion error during initial loading would be of no consequence because there is no criticality and because of the absence of decay heat). In addition to the 22 events which cannot occur, there are 5 events for which the component operation evaluated in Chapter 15 could occur, but the phenomena of concern in Chapter 15 could not exist.

All recirculation pump events such as recirculation pump trip and abnormal start up of an idle recirculation pump would be of concern only if they could affect core physics or thermal hydraulic conditions. With no nuclear heat generation in the core, there are no pertinent phenomena to evaluate.

The remaining eleven events addressed in Chapter 15 could possibly occur. For events such as continuous rod withdrawal and a control rod drop accident or a liquid radwaste tank rupture, there could be no radiological consequences because there are no fission products.

In Phase I, fuel loading and precriticality testing, the reactor will not be taken critical. There will be no heat generation in the core. There will be no fission products. Because there will have been no power generation and, consequently, no decay heat, there will be no need for cooling systems to remove decay heat.

Availability of AC power is not a safety concern during Phase I because many of the transients cannot occur and for those that can occur, there can be no radiological consequences regardless of whether or not AC power is available. Therefore, there is no risk to the public health and safety. We find the LILCO discussion of Phase I to be acceptable.

Phase II: Cold Criticality Testing

This phase of operation of the Shoreham plant includes cold criticality testing and very low power testing at essentially ambient temperature and atmospheric pressure. The power level during this phase of testing will be in the range of 0.0001% to 0.001% of rated power.

The review of Chapter 15 for Phase II operation indicates that most of the transients are not possible for the same reasons described in the Phase I evaluation. Because the fission product inventories in the core will be significantly less during Phase II operation than for conditions analyzed in the FSAR and essentially all fission products will be retained in the fuel pellets, the radiological impact for the continuous control rod withdrawal during startup transients and, fuel handling accidents, is insignificant.

Because of the low pressure condition, it is not reasonable to postulate a loss-of-coolant accident during Phases I and II operation. The NRC normally postulates breaks only in high energy lines; for Phases I and II, there are no high energy lines because the reactor system is at atmospheric pressure.

If a loss-of-coolant accident should occur during Phase II testing, LILCO states that there would be time on the order of months available to restore make-up water for core cooling. At the decay heat levels which would exist under these conditions, heat transfer to the environment would remove a significant fraction of the decay heat. Realistic calculations would be expected to show that the temperature never approaches 2200°F. However, even if no heat transfer from the fuel rods and equilibrium fission products are assumed (i.e., infinite operation at .001% power), then a bounding analysis shows that more than 30 days are available to restore cooling prior to exceeding a temperature of 2200°F. Therefore, even assuming the unavailability of onsite power sources, there is a high probability of restoring AC power and preventing fuel failure.

Availability of AC power is not a safety concern during Phase II, because many of the transients cannot occur and for those that can occur, it is very unlikely that fuel failure could occur. Even if it did, there can be no significant radiological consequences due to very low fission product inventory. Therefore, there is no significant risk to the public health and safety.

We have reviewed the LILCO discussion of safety significance of Phase II operation and find it acceptable.

Phases III and IV: <u>Low Power Testing Up to 5% of Rated Power</u>

This phase of operation of the Shoreham plant includes reactor heatup and pressurization. Power level is taken in progressive steps to 1% of rated power. After the required physics tests and other pre-operational tests have been completed, the power level is taken in progressive steps from [illegible] to 5% of rated thermal power. All systems and their support systems, especially the Automatic Depressurization System (ADS), High Pressure Coolant Injection System (HPCI), Reactor Core Isolation Cooling System (RCIC), Core Spray System, Residual Heat Removal System (RHR), and the Remote Shutdown System will be operational during both phases of operation.

The review of the FSAR Chapter 15 analysis shows that of the 38 accident or transient events addressed in Chapter 15, 5 events can not occur during this phase. Generator load rejection and turbine trip with failure of generator breakers to open events are not possible because the generator will not be connected to the grid. Control rod removal error during refueling and fuel assembly insertion error during refueling are precluded by definition. A cask drop accident is precluded by design, hence it is not postulated in the analysis. The remaining 33 events are considered.

For all of the events, operation of the plant up to 5% of rated power will be bounded by the Chapter 15 analysis, most of which predict no fuel failures. For example, the turbine trip event is analyzed with the assumption that the limiting event occurs with the reactor operating at 105% of rated steam flow coupled with failure of the turbine bypass valves to open. Even this limiting event does not result in any fuel failures. The FSAR specifically notes that turbine trips at power levels less than 30% of rated power are bounded by the limiting analysis. Another example is the loss of feedwater heating event. This event is analyzed with the assumption of continuous operation of the feedwater system and the most severe possible loss of feedwater heating, resulting in the injection of colder feedwater. For operation at power levels less than 5%, the impact of lost feedwater heating is minimal because of the low feedwater flow.

For low power testing up to 5% power, the fission product inventory in the core will not exceed 5% of the values assumed in the FSAR. LILCO estimates that the fuel burnup during low power testing will be less than 200 MWD/MTU (Ref: LILCO Letter SNRC-1036 dated April 11, 1984). This low fuel burnup enhances safety in three ways: (a) the amount of decay heat present in the core following shutdown is substantially reduced resulting in reduced cooling system requirements (b) the amount of radioactivity that could be released upon fuel failure is substantially (much more than a factor of 20) reduced, and (c) if additional failures were postulated to occur, the operator will have a longer time to take corrective actions.

For example, on loss of feedwater, the water level in the reactor will decrease at a slower rate than if the event occurred at 100% power. If HPCI or RCIC operate at least once during the first four days to restore normal water level, then no additional make up will be required to prevent core uncovery due to boil-off. Similarly, in the loss of condenser vacuum event, the operator will have more time to identify the decreasing vacuum and to take steps to remedy the situation before automatic actions such as turbine trip, feed pump trip or main steam isolation occur. Another example is the main steam isolation valve closure event. At five percent power, the amount of heat produced upon isolation of the reactor vessel (which is followed by a reactor trip) results in a much slower pressure and temperature increase than would be experienced at 100% power. This gives the operator more time to manually initiate reactor cooling rather than relying on automatic action. In effect, the operator may end the transient before there is any substantial impact on the plant.

Another factor contributing to the enhanced safety during low power testing is the reduction in the required capacity for mitigating systems. Because of the lower levels of decay heat present following operation at 5% power, the demand for core cooling and auxiliary systems is substantially reduced, permitting the operation of fewer systems and components to mitigate any event. It follows that the AC power requirements for event mitigation are substantially reduced for 5% power operation as compared to 100% power operation. (Five minutes after shutdown, about 42 GPM makeup is required to compensate for boil-off; after 8 hours, 12 GPM are required).

Because of the lack of seismic qualification for the enhanced offsite power, each of the anticipated operational occurrences was reviewed for vulnerability to a seismic event. One transient, a stuck open relief valve transient, was identified as a potential concern. The basis of the concern was that a stuck open relief valve would cause the reactor pressure to decrease and would eventually cause the HPCI and RCIC systems to stop operating. If a seismic event caused sufficient damage to the offsite power system, no AC power would be available to provide makeup of water lost through the stuck open relief valve.

In a conference call on July 12, 1984, the applicant stated that no single active failure can cause a safety/relief valve to stick open while operating in the safety mode. Therefore, there is no basis for postulating a stuck open valve for the safety mode of operation. Plant procedures instruct operators to manually start RCIC to control reactor pressure following MSIV closure rather than using a safety/relief valve in the relief mode. Thus, there is no basis for considering a stuck open safety/relief valve in conjunction with a seismic event.

The Standby Gas Treatment System (SGTS) is used to mitigate the consequences of two accidents: the fuel-handling accident and LOCA. The considerations for the LOCA are discussed above.

In a fuel handling accident, those fission products which are in the fuel-cladding gap are subject to release from damaged fuel assemblies, but not the fission products which remain in the fuel itself. At 5% power, not only is the total fuel inventory 20 times smaller than at full power (5% versus 100%), but also the fraction of that inventory that has left the fuel and entered the gap is at least 20 times smaller as well. This reduction of fission products in the fuel-clad gap alone compensates for a loss of the SGTS due to unavailability of the onsite diesels (this system was assumed in the SER to reduce the post-accident release of iodine fission products by a factor of 20). However, the consequences of postulated fuel-handling accidents could also be mitigated by imposing a technical specification restriction on movement of irradiated fuel. Restricting the movement of irradiated fuel for a period of 40 days would more than compensate for the iodine removal capability of the SGTS. The decay allowed for by the forty day period would also produce more than a factor of 20 reduction in radioactive iodine released during a postulated accident.

Containment Isolation

With respect to containment isolation, LILCO, as noted in a letter response dated April 11, 1984 (SNRC-1036), has performed an evaluation of all containment penetrations to assure adequate isolation capability. Based on this effort only two 3/4" diameter valves were found to require prompt closure capability to assure containment integrity. For these two valves, containment integrity was threatened only for the unlikely event of a breach in the Reactor Building Closed Cooling Water RBCLCW system inside the containment coincident with a LOCA. For all other LOCA events, containment integrity was assured for all penetrations including the above mentioned valves. To ensure containment integrity in a timely manner for this limited condition, LILCO has committed to assign an equipment operator to the reactor building whenever the reactor vessel is pressurized during Phases III and IV.

The staff has evaluated the applicant's study of containment integrity for the stated events. With LILCO's commitment to station an assigned person to assure containment integrity for the case of a breach in the RBCLCW system, the staff concurs that containment integrity is assured for all LOCA events.

The applicant has evaluated the response of the primary containment in the unlikely event of Loss of Offsite AC Power, pipe break outside containment and a feedwater line break. For all cases, the applicant found that suppression pool cooling would not be required for about 30 days to limit the pressure and temperature conditions within the containment to below design values. The staff concurs with the applicants evaluation and finds this to be more than sufficient time to provide pool cooling and therefore concludes the containment is not threatened for the above events.

The applicant has also performed a detailed analysis of the drywell temperature response to the total loss of drywell cooling. The analysis was performed for several drywell initial temperatures and relative humidity and the reactor at 100% power and 5% power. The calculated drywell response to these transients indicates that the maximum normal operating limit of 145°F will be exceeded shortly after the total loss of drywell cooling; however, the drywell temperature response is still enveloped by the environmental qualification conditions of safety-related equipment in the primary containment.

We have reviewed the applicant's analyses and agree with the applicant's conclusion that the safety-related equipment would be expected to function under the postulated loss of drywell cooling capability.

LOCA Analysis

Of all the transients and accidents, the Loss Of Coolant Accident (LOCA) is the most limiting one with regard to AC power unavailability. Other transients and accidents are less severe. For small break accidents, RCIC and HPCI systems will be used to mitigate the accident. All components (other than room cooling) required for operation of RCIC and HPCI systems are completely independent of AC power. HPCI and RCIC use steam as the motive power and DC power for initial valve operation and turbine control. Those parts of the RCIC system required for injection are seismically qualified. Modifications to the HPCI system, which should make HPCI capable of withstanding a seismic event, are in progress. The license will require that these modifications be completed prior to entering Phase III testing. No core damage is involved for small breaks because RCIC and/or HPCI will maintain the reactor vessel water level within normal operating limits.

In the worst situation (for large break LOCA) where the vessel pressure decreases rapidly, RCIC and HPCI systems will not be operable. Since AC driven ECCS pumps are assumed to be unavailable, the reactor vessel level decreases rapidly, the reactor trips and MSIV's close. The applicant, in its letter SNRC-1035 dated April 6, 1984, submitted a GE analysis for the scenario described above. GE performed the analysis to determine the time to reach 10 CFR 50.46 limits. Four cases were considered:

(a) The first case uses a core thermal peaking factor of approximately 5. (A peak rod MAPLHGR of 1.34 Kw/ft was used). Using approved 10 CFR 50.46, Appendix K models and assumptions, core uncovery time was calculated for infinite reactor operation at 5% power. This case indicates that 55 minutes are required to reach the peak cladding temperature limit of 2200°F. Even at 55 minutes, no fuel failures were predicted to occur.

(b) This case utilizes a core thermal peaking factor of 3.38 (A peak rod MAPLHGR of 0.91 Kw/ft was used). Using approved Appendix K models and assumptions, core uncovery time was calculated for infinite reactor operation at 5% power. This case indicates that 86 minutes are required to reach the peak cladding temperature limit of 2200°F. No fuel failures were predicted.

(c) This case takes into account a bound on the expected operating history of the core during the startup phase. A core thermal peaking factor of 3.38 corresponding to a peak rod MAPLHGR of 0.91 Kw/ft was used in the analysis. Approved Appendix K models and assumptions were used. This case indicates that 110 minutes are required to reach the peak cladding temperature limit of 2200°F. No fuel failures were predicted.

(d) A more realistic LOCA analysis without the stringent Appendix K criteria was performed. A core thermal peaking factor of 3.38 corresponding to a peak rod MAPLHGR of 0.91 Kw/ft was assumed in the analysis. This case takes into account a bound on the expected operating history of the core during the startup test phase. The results indicate that there would be 3 to 4 hours available prior to reaching the 2200°F limit. No fuel failures were predicted.

It is expected that no more than 30 minutes will be needed to restore power to the ECCS pumps from alternate AC sources. The GE analysis indicates that a time period of 1 to 4 hours will be available for restoring AC power during a LOCA with simultaneous loss of off-site power. We find this acceptable.

Table 8.1 of the Shoreham SER depicts the divisional arrangement of various safety systems. Division I supplies power to core spray pump A and LPCI pump

A, Division II supplies power to core spray pump B and LPCI pump B and Division III supplies power to LPCI pumps C and D. Prompt restoration of power to any one of the three divisions will ensure availability of AC power to at least 2 of the ECCS pumps. One of the four mobile diesels can supply power to one ECCS pump in one division. One out of the six ECCS pumps is sufficient for core cooling and to maintain cladding temperatures within the limits of 10 CFR 50.46. In the March 29, 1984 meeting, the applicant described the use of the procedures and training of operators to perform the procedural actions during a loss of off-site power. Because of the time available and operator training there is a high confidence that alternate AC power sources can restore power to the ECCS pumps within the needed time frame. Further evaluation of operator training and procedures is found in Section 13.5 of this SER.

On the basis of its evaluation, the staff has concluded that there is reasonable assurance that the 10 CF 50.46 criteria will not be violated. Therefore, there is no significant risk to the public health and safety.

23 CONCLUSIONS

The staff has reviewed the applicant's submittals and motions for low-power operation of the Shoreham plant and the request for an exemption from the provisions of GDC-17. We have performed scoping calculations to verify the results presented by the applicant and have considered the effect of loss of all AC power on transients and accidents. For those events that could be postulated to occur, the staff has reasonable assurance that sufficient time exists so that AC power could be made available to those systems required to maintain core cooling prior to release of any radioactive fission products from the fuel. Therefore, there is no fission product release that could be postulated during operation up to 5% of rated power without TDI diesels available. Since operation at power levels up to 5% of rated power with the TDI diesels available also results in no fission product release for the postulated events, we conclude that operation without TDI diesels is as safe as operation with TDI diesels available for power levels up to 5% of rated power. We therefore conclude that the applicant has provided adequate technical justification to support the granting of an exemption from the requirements of GDC-17.