LONG ISLAND LIGHTING COMPANY
SHOREHAM NUCLEAR POWER STATION
P.O. BOX 618, NORTH COUNTRY ROAD • WADING RIVER, N.Y. 11792

June 28, 1982 SNRC-721

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Loose Parts Monitoring System
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Dear Mr. Denton:

Enclosed please find sixty (60) copies of a description of Shoreham's Loose Parts Monitoring System (LPMS). This description (Attachment 1) includes information relative to the compliance of the Shoreham LPMS with Regulatory Guide 1.133 Rev. 1 and will serve as the basis for a future FSAR amendment covering this item.

In addition, Long Island Lighting Company commits to provide to the NRC a more complete program description following the outline included as Attachment 2. This will include information accumulated from LPMS operation and experience and will be submitted after fuel load.

This information is being provided in fulfillment of agreements reached at a 6/8/82 meeting between LILCO and the NRC staff. Should you have any questions, please contact this office.

Very truly yours,

J. L. Smith

J. L. Smith
Manager, Special Projects
Shoreham Nuclear Power Station

RWG:mp

cc: J. Higgins
All parties

B001

8207010086 820628
PDR ADOCK 05000322
A PDR

FC-8935

ATTACHMENT 1

SHOREHAM NUCLEAR POWER STATION - UNIT 1

LOOSE PART MONITORING SYSTEM

DESCRIPTION

The Shoreham loose part monitoring system is an acoustic detection, analog processing, and annunciation system providing real time detection of metallic impact noises in the primary coolant system. The system consists of four sensors and a control room cabinet with facilities for monitoring, recording, and alarming any of the four sensor channels. Two of the sensors are located at the reactor feedwater inlets, 45 degrees and 225 degrees azimuth and the other two sensors are located on reactor control rod drive housings, 160 degrees and 340 degrees azimuth.

The loose part monitoring system is designed and installed, and will be operated, in accordance with the recommendations of Regulatory Guide 1.133, Rev. 1, with the exception that cabling associated with the two sensors at the same natural collection region is not physically separated (i.e. separated by distance or barrier) between the sensors themselves and a point in the plant that is always accessible for maintenance during full-power operation. Instead, this cabling shares a common conduit within the drywell, which is inaccessible during full-power operation.

This manner of installation was noted during NRC Inspection No. 82-02, conducted by the NRC resident inspector at Shoreham between January 1 and January 31, 1982, and subsequently evaluated and found acceptable by LILCO as stated in our letter SNRC-677, dated March 11, 1982, to the NRC Region I office. The installation was determined by LILCO to not affect the functional recommendations of Regulatory Guide 1.133, Rev. 1 for the following reasons:

The loose part monitoring system is not, nor is it required to be, a safety-related system. As such, Class IE separation criteria do not apply to the design and installation of this system. Regulatory Guide 1.133, Paragraph C.1.c, recommends physical separation of the two sensors at each natural collection region from the sensor itself to a point in the plant that is always accessible for maintenance during full power operation. As the purpose of having two sensors is to provide "broad coverage" of the collection region, these two sensors are not redundant.

The functional reason for separation is not explicit in the Regulatory Guide; however, it is stated that "it is desirable that the loose part detection system be designed to function following all seismic events that do not require plant shutdown." It

appears, therefore, that the purpose of separation for this system is to protect nonaccessible components of at least one of the two channels serving the same natural collection region from mechanical damage precipitated by an operating basis earthquake. In this regard the following is noted:

a. The loose part monitoring system is designed in accordance with R.G. 1.133 to operate to Operating Basis Earthquake (OBE) criteria. As such, the existing cabling in primary containment, which is installed to Design Basis Earthquake (DBE) levels plus Mark II hydrodynamic load criteria, is qualified significantly beyond the qualification of the loose part monitoring system.

b. Although the existing cables are in the same penetration, the penetration is qualified to safety grade standards and exceeds loose part monitoring system requirements.

c. Within the biological shield, separation is maintained up to a common junction box located at the biological shield penetration. From this junction box a common cable is run through conduit and trays to the primary containment penetration, all of which are designed and supported to withstand DBE. The conduit and cable tray provide mechanical protection to the cabling within the primary containment. Structures and equipment within the primary containment are also designed and installed to DBE levels plus Mark II hydrodynamic load criteria; therefore, any seismic event of sufficient magnitude to damage common channel cables or the penetration would exceed the design basis of the loose part monitoring system as recommended by Regulatory Guide 1.133.

Although separation for fire protection does not appear to be intended by the regulatory guide, it is further noted that Shoreham's inerted containment will prevent the outbreak of fire. Also, the cable will carry only low energy signals (50Vmax AC and DC), for which the voltage and current handling capacity of the safety grade cabling will far exceed even the short circuit output of the loose part monitoring system electronics.

Separation for the purpose of minimizing electrical interference which could lead to spurious alarms also does not appear to be intended by Regulatory Guide 1.133, since the regulatory guide only recommends separation between channels monitoring the same natural collection region and then only within inaccessible areas. Electrical interference, if it were the concern of this section of the regulatory guide, would be no more likely to occur between channels monitoring the same natural collection region than between channels monitoring different natural collection regions.

Also, electrical interference would be no more likely to occur in inaccessible areas than in accessible areas.

In any event, electrical interference, whether it be between two channels of the loose part monitoring system or between a loose part monitoring channel and an instrumentation channel from another system, is prevented by use of twisted-shielded-pair cabling, the shield of which is grounded at a single point within the system. Also, it is the practice at Shoreham to route all instrumentation cabling separate from higher voltage cables such as for power and control circuits. Therefore, electrical interference will not be increased by the lack of separation between channels within the drywell at Shoreham.

Accordingly, the intent, as well as the functional requirements, of Regulatory Guide 1.133 as pertains to separation were met by the current design and installation.

Further detail on the Shoreham Loose Part Monitoring System, following the outline shown in section C.4. of the Regulatory Guide 1.133, is provided as follows:

a. The LPMS consists of four piezoelectric accelerometers, each with a charge converter pre-amplifier, to detect any loose part in the vicinity of a natural loose part collection area, and a control room instrumentation cabinet with equipment for monitoring, recording, and alarming any of the four channels. Two of the sensors are located on the reactor feedwater inlet nozzles at 45 degrees and 225 degrees azimuth, to detect any loose part which might enter the reactor through the feedwater inlets and lodge in the feedwater sparger. Two of the sensors are located on control rod drive (CRD) housings at 160 degrees and 340 degrees azimuth to detect any loose part trapped below the core plate assembly. Each of the accelerometers is connected via its threaded mounting stud to a stainless steel block, which is in turn attached by metal straps to the inlet nozzle or CRD housing.

b. The signal from the accelerometer and charge-converter is successively input to a filter amplifier module and an impact detector module in the control room. Each of the four impact detector modules provides input to a single control module, which provides the following functions:

   1. Determines whether alert rate criterion is met, and accordingly initiates alarm or resets system;

b. 2. Determines which channel reached the alert level first, as an initial, though unverified, indication of general loose part location;

3. Initiates tape recording (if alarm state is reached);

4. Provides alarm inhibit when so indicated by the "deliberate plant maneuver" module.

Each of the channel signals can be routed through an audio monitor module so that the operator can listen to the impact noises.

When initiated, the "Racal" four channel FM tape recorder simultaneously records the signals from all four channels. The tape can be subsequently replayed through the audio monitor or external signal processing equipment, and can also be removed and transported off-site for processing, using more advanced techniques.

A separate hand-held, spring-loaded calibration impact device, which is itself laboratory-calibrated in units of foot-pounds per impact, is used to generate impacts on the external surface of the RPV during LPM channel calibrations.

c. It is anticipated that extraneous noise will be produced by the following during operation:

1. Hydraulic flow
2. Vibration
3. Mechanical actuations (e.g. valves, control rods)
4. Boiling water noise
5. Electro-magnetic interference (EMI)

Specific system features, which are discussed in section e., below, are expected to provide reliable discrimination between true loose part impacts and the extraneous noise sources listed above.

d. Precautions taken to ensure acquisition of quality data include the following:

1. Installation of sensors as close as practical to the RPV itself;

2. Use of strap-mounting instead of magnetic mounting, for better acoustic coupling. (Note: Direct attachment of the sensors to the RPV by means of the threaded stud was prohibited due to structural stress-point considerations);

d. 3. Use of single-point channel grounding to avoid ground loops;

4. Use of coaxial and twisted-shielded pair cable for signal transmission between the sensors and the control room cabinet;

5. Use of signal processing techniques to distinguish a true loose part from normal background noise, as described in Section e. below.

e. The Shoreham LPMS contains several features to distinguish true loose part impacts from background noise, thereby minimizing the spurious alarm rate. First, electronic filters are used to eliminate signal frequency ranges in which excessive noise-to-signal ratios occur, thereby giving preference to frequency ranges in which metallic part impact frequencies would more likely be concentrated. Next, short-term signals that would be characteristic of metallic impacts are electronically separated from longer-term signals that would be characteristic of such background noise sources as hydraulic flow. Using a sensitivity factor that can be manually adjusted, a "threshold voltage" is electronically set above the average voltage of the background noise. Only if the short-term signal exceeds this threshold voltage is an "alert" generated. As the background noise level continually changes with changes in reactor operating conditions, the "threshold voltage" constantly adapts to the current background noise level.

The generation of a single alert need not cause an alarm, however. Another user-adjustable feature of the Shoreham system requires a preset number of alerts to be generated within a preset time period -- typically four alerts within five seconds -- before an alarm is heard by the operator. This feature can be used to minimize spurious alarms caused, for example, by stray electrical "spikes" that might affect only one or two channels. A true loose part is likely to "rattle," generating a succession of impacts within a very short time period. The rattle would satisfy the alert-rate criterion and cause a bona fide alarm.

One other feature of the Shoreham LPM System that can be used to minimize spurious alarms is the Deliberate Plant Maneuver Detector (DPMD). Spurious alarms can be generated by mechanical actions such as control rod movements and valve operations which can closely resemble loose part impacts. By providing an appropriate logic signal from the actuating control circuitry of the control rod or valve to the

e. DPMD, the alarm function can be temporarily inhibited. Removal of the logic signal at the conclusion of the control action restores the LPM system to its fully functional state.

LILCO has intentionally not utilized the DPMD in its initial installation of the Shoreham LPMS because it is impossible to predict with confidence the frequency and source of mechanically-induced spurious alarms absent operational experience with the LPMS and the reactor vessel. As LILCO accumulates testing and operating experience with the LPMS, the usage of the DPMD will be determined and implemented.

The response of each channel to calibrated impacts applied externally to the RPV will be determined prior to fuel load. This will include correlation of the signal voltage amplitude with the impact energy applied. The background noise level voltage amplitude will be established during power operation of the reactor after fuel load, and a determination will be made at that time as to whether the sensitivity recommendation of Reg. Guide 1.133 can be met for the Shoreham reactor. If not, an alert level will be established which achieves satisfactory trade-off between sensitivity and spurious alarm frequency.

f. A technical specification for the Shoreham Loose Part Monitoring System, which will meet the recommendation of Reg. Guide 1.133, will be provided.

g. The following sources of supplemental data and assistance will be available for diagnostic and confirmatory purposes following the detection of a suspected loose part:

1. Baseline impact signal and background noise frequency spectrums;

2. Core and plant process parameters, (e.g. core delta pressure, jet pump flow, neutron flux, offgas activity);

3. On-site and off-site diagnostic assistance by the LPMS vendor.

h. The following procedures will be provided:

1. Pre-operational Test Procedure (PT.622.001)
2. Startup Test Procedure (STP-814)
3. Channel Calibration Procedure (SP 44.662.01)
4. System Functional Check Procedure (SP 44.662.02)
5. LPMS Operating Procedure (SP 23.662.01)
6. LPMS Alarm Response Procedure (Later)

In addition, both a channel check, performed every 24 hours in accordance with section C.3.a. (2)(b) of R.G. 1.133, Rev. 1, and an audio check, performed every 7 days in accordance with section C.3.a.(2)(c), will be included in the Operational Surveillances Procedure (SP 22.008.01).

i. General procedures for minimizing radiation exposure to station personnel during such activities as maintenance, calibration, and diagnostic activities are described in Chapter 12 of the Shoreham FSAR.

j. Supervisory, engineering, and technician personnel from both the operating and technical support sections of the Shoreham Plant Staff will be trained in the operation, maintenance, and calibration of the LPM system. This will include both an on-site training session conducted by the LPMS vendor before fuel load and vendor-assisted "hands-on" training conducted as part of the Startup Test Program.

k. LPMS components installed within the primary containment, including accelerometers, charge converters, conduit and cabling will be designed and installed to function following all seismic events up to and including the Operating Basis Earthquake. Also, the LPMS will be designed and installed to provide both audio and visual alarm capability within the main control room following the Operating Basis Earthquake.

ATTACHMENT 2

SAMPLE TABLE OF CONTENTS

LOOSE PART DETECTION PROGRAM DESCRIPTION

I. System Description

A. Scale piping diagram showing LPM sensor locations.
B. Sensor specifications (type, manufacturer, sensitivity, temperature rating, etc.).
C. Sensor mounting details (drawing and procedure).
D. Preamplifier or line driver (type, manufacturer, location and specifications).
E. Functional description of LPMS.
   1. Theory of operation, detection logic, alarm display.
   2. Data recorder specifications (No. of channels, length of recording, frequency range, and conditions under which recording is initiated).

II. Operational Procedures

A. System Calibration Procedures
   1. Initial and subsequent calibrations
   2. Functional check, as defined in R.G. 1.133
   3. Channel check, as defined in R.G. 1.133

B. Plant Operator Instructions for Use of LPMS
   1. Procedures for routine operation
   2. Procedures to be used following indication of a loose part
      a. Method to confirm existence of loose part
      b. Method to diagnose a loose part (size and location)

III. Licensee Experience with LPMS

A. False alarms (frequency of occurrence and sources)
B. Loose parts detected by LPMS
C. Loose parts not detected by LPMS
D. System availability; causes for downtime

IV. Evaluation for Conformance to R.G. 1.133

A. Loose Part Detection Program
   1. Description of deviations
   2. Description of program modifications
   3. Justification for remaining deviations

B. Loose Part Detection System
   1. Description of deviations
   2. Description of needed modifications to the equipment or installation
   3. Cost/benefit evaluation of considered modifications (cost in dollars and occupational exposure)
   4. Plans for upgrade or backfit