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SHOREHAM NUCLEAR POWER STATION
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Direct Dial Number

May 13, 1983

SNRC-881

Mr. Thomas T. Martin
Division of Engineering &
Technical Programs
U.S. NRC Region I
631 Park Avenue
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NRC INSPECTION NO. 82-04
SHOREHAM NUCLEAR POWER STATION
Docket No. 50-322

Dear Mr. Martin:

In SNRC-743 dated July 28, 1982, LILCO responded to several findings identified in the subject Inspection Report including a subpart of Deviation 322/82-04-02 dealing with the blockage of several Primary Containment Spray Nozzles by ventilation duct work.

Subsequent to that submittal, the Resident Inspector, J. Higgins, and the ASLB requested additional information to the spray blockage issue during litigation of the subject inspection. This additional information is provided in the enclosed "Discussion of Drywell Spray Interference" and Attachments. A copy has already been provided to Mr. J. Higgins for his review and it is our understanding that this written discussion has addressed his outstanding concern relative to this issue and no additional follow-up is required.

J. L. Smith

J. L. Smith
Manager, Special Projects

JLS:bc
Enclosure

cc: J. Higgins
All Parties Listed in Attachment 1

ATTACHMENT 1

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DISCUSSION OF DRYWELL SPRAY INTERFERENCE

For purposes of clarity, the three ASLB requests are set forth below followed by LILCO's response (Tr. 17.530-33 (Brenner, J.)).

1. Define what processes are in place during design, installation, and testing stages which should have alerted LILCO to the interference concern raised by the NRC inspector that some drywell spray nozzles were blocked by ventilation ductwork.

2. Define how the situation came to exist that some drywell spray nozzles were blocked by ventilation ductwork, how it continued to exist, and why it was not identified by LILCO prior to being raised by the NRC inspector.

3. State whether the drywell spray nozzles are safety related or non-safety related.

LILCO Response

The premise for the line of questioning in this ASLB request is that the NRC inspector identified a real concern that had not been properly considered in the design stage and, therefore, went undetected during installation and testing stages. This initial premise is incorrect; this type of interference concern was adequately considered in the design stage and, therefore, did not have to be further addressed during installation and testing stages. However, to be further responsive to the ASLB request, each of the three items is addressed below:

1. The types of processes and procedures that are in place for Shoreham to address the type of interference concerns raised by this request during design, installation, and testing are summarized in Attachment A.

2. The following discussion provides background and describes the situation regarding the blockage of drywell spray nozzles, the recognition and safety impact of this condition, and the fact that it had been adequately addressed during the design stage.

The primary design function of the drywell sprays is to provide drywell atmosphere cooling in post-LOCA scenarios. A secondary function is drywell atmosphere mixing. During the detailed design drawing development and spray nozzle procurement phases, consideration was given to drywell spray header

LILCO Response (Continued)

location, to the number and orientation of spray nozzles, to spray nozzle design, including flow rate, pressure drop, and maximum spray coverage, and to the method employed for evaluation of spray effectiveness. It was recognized at that time that many interferences would exist within the drywell which could affect the spray coverage. These interferences include radial beams, the biological shield wall, pipe whip restraints and support structures, piping and associated support systems, ventilation ductwork, electrical conduit, miscellaneous steel, platforms, grating, and any other surfaces within the drywell. Some of these types of existing and potential interferences were recognized and consideration was given to them in optimizing the spray system design and in developing the calculation for spray effectiveness.

First, interferences were considered in the location, number, orientation, and design of the spray nozzles. Redundant circular type drywell spray headers are located at the outer periphery of the drywell with one located about four feet above the other. The upper spray header is located about forty-seven feet above the drywell floor where the spray water would accumulate. There are a total of two hundred twenty-four individual spray nozzles located on the spray headers with the distance between the nozzles being about two feet. A total of seven spray nozzles have partial spray obstructions due to interferences. Four of these nozzles are in the lower spray header in a section of pipe about six feet long. These are the four nozzles which were blocked by the ventilation ductwork, initiating this NRC I&E concern. The remaining three spray nozzles, two of them in the lower spray header and one in the upper spray header, are obstructed due to interferences with pipe supports. Each spray nozzle is designed to cover an oval area of about twenty feet by fifteen feet at an elevation of five feet below the spray header, providing significant overlapping of sprays and coverage to adjacent nozzle areas. This individual nozzle spray area coverage increases as the spray drops to lower elevations in the drywell. These design criteria for the spray nozzle system were established to ensure a low degree of dependence on the number of spray nozzles, thus assuring that if a blockage of a few spray nozzles in a row occurred, it would not leave any area uncovered or have any overall impact on the performance and effectiveness of the spray system. To address further the overall impact of interferences on the design, the spray nozzles were oriented to pre-engineered angles which optimize the overall cross-sectional area covered by the sprays for cooling and the induced swirling effect for mixing.

LILCO Response (Continued)

Secondly, interferences were considered in the method of evaluating the spray effectiveness within the drywell. In evaluating the spray effectiveness, an overall effective spray fall height of only thirty feet was considered. This overall effective spray fall height is divided into six five-foot sections. Starting from the top and moving downward, each five-foot section was evaluated to determine the plan view cross-sectional area covered by the type of interferences mentioned previously. This calculated area was then subtracted from the initial spray covered area. This process continued for each section, being reduced by the appropriate amount to the next lower section, until a spray fall height of thirty feet existed at which point a zero effective spray covered area was reached. This conservative method assuming gross interferences was used to calculate the spray effectiveness which was then used in other analyses regarding the utilization of drywell sprays.

In conclusion, this second concern is not applicable to Shoreham based on the fact that Shoreham had considered the effects of interferences in the design of the spray nozzle system and had performed the analysis based on the known and predicted obstacles. Further inspection was not deemed necessary due to the insignificant impact of additional interferences on the calculation of spray effectiveness.

The specific LILCO response to the NRC inspector's concern, which initially raised this issue, is provided as Attachment B. This specific response was prepared to show quantitatively the insignificant effect that blockage of spray nozzles had on the FSAR analyses. This was accomplished by using conservative assumptions of reduction in the spray effectiveness and flow rate. However, the more detailed discussion presented above shows that the type of blockage addressed by the concern was considered in the original design, such that this specific concern could have no impact on the overall effectiveness of the spray system or its design basis.

3. The drywell spray nozzles are safety related.

PROCESSES/PROCEDURES THAT ADDRESS INTERFERENCES DURING DESIGN, INSTALLATION, AND TESTING STAGES

The potential for physical interferences (spatial interactions) exists in the construction of plants of the magnitude and complexity of Shoreham. However, through the proper recognition, the processing of documents, and the utilization of appropriate procedures, the potential for interferences is minimized during the design, installation, and testing stages. Each of these stages will be discussed as to its contribution in addressing the interference concern.

A. Design Stage

The most important stage where interferences should be addressed is during design. Addressing potential interference concerns during design is accomplished in three ways:

1. Through Recognition of the Concern

The first step in evolving a design is for the responsible engineer to identify the design basis. Included in this design basis are many unique factors that may be applicable to the specific design and other appropriate information derived from vendor drawings and specifications, flow diagrams, general arrangement drawings, etc. To aid the engineer, corporate technical guidelines and procedures are provided which address both generic and specific concerns. This information is forwarded to a design group who will develop the physical design drawings. The designer utilizes standardized procedures and checklists in the development of the drawings. The checklists include specific checks for clearances and interferences with other disciplines, structures, and components. However, it is the engineer's responsibility to either provide adequate design margin to allow for potential unique interferences in the design basis or to add appropriate notes on the design drawings where specific concerns regarding unique interferences may exist. Many of these potentially unique interferences are addressed by special engineering studies.

2. Through Processing of Design Drawings

The designer develops the drawings based on input from the responsible engineer. These drawings are then reviewed by a checker in the discipline generating the drawing. Upon completion of this review, the drawings are circulated to other design disciplines, where checks for interfaces, clearances, and

A. Design Stage

2. Through Processing of Design Drawings (Continued)

interferences are performed. Once this design review and sign-off is complete, the drawings are forwarded to the engineer who is responsible for the specific design. The responsible engineer, with the aid of procedures, identifies all engineering disciplines that are required to review the drawings. This review provides further checking by the appropriate engineering disciplines as to technical adequacy, correct design input, special requirements, and for potential cross-discipline interfaces and interferences. The drawings are then reviewed and signed by the appropriate Lead Discipline Engineer and certified by a qualified Professional Engineer. The drawings are finally approved by the Project Engineer for release to and use by construction.

3. Through Identification of Potential Interference Concerns in Specifications, Procedures, and Field Verification

Adequate design margin is controlled by allowing construction tolerances and placing dimensional restrictions on the installation where known type potential interferences could exist through controlled field erection and installation specifications and procedures. Also, documented field verification programs (physical walkdowns) are specifically developed to address potential interferences which must be performed after installation is complete and/or during plant testing. Some of these verification programs are further addressed in the following discussion under "Installation and Testing Stages".

B. Installation and Testing Stages

The following physical interference (spatial interaction) types of reviews are performed on equipment under the responsibility of Shoreham Construction and Engineering Department:

1. As part of the "As-Built" piping verification program, thermal piping (QA Categories I and II) is field walked to identify a minimum of 1" clearance to other systems, equipment, and structures. This minimum interference criteria has been established by Engineering personnel to ensure that all items will not, in some manner, restrict the motion of the pipe. Interferences are marked up on piping isometrics during the field walk, then provided to Engineering for their disposition.

2. To ensure that adequate gap exists between piping and associated pipe whip restraints, a program exists to check this gap at cold set conditions during construction

B. Installation and Testing Stages

2. (Continued)

and again as hot conditions during power ascension.

3. The thermal expansion test program is conducted on the main steam, feedwater, Reactor Core Isolation Cooling (RCIC), High Pressure Coolant Injection (HPCI), Residual Heat Removal (RHR), and recirculation piping systems. This instrumented test program, utilizing Linear Variable Differential Transformers (LVDTs), assures that the expansion of this piping corresponds to the calculated values and that the piping returns to its origianl configuration upon cooldown. In addition, all other high-energy piping systems that can be visually inspected are observed to verify that their piping can expand as designed during heatup from ambient conditions and return to their original position within limits during cooldowns.

The purpose of the Pre-operational Test Program is to verify that systems or components meet their intended design criteria to the extent practical. This Program is governed by the FSAR and the Startup Manual.

The LILCO Startup Manual states, in part, from Section 6.5.1:

> "Verification of System Completion...will be done in order to verify that erection or construction of a component, subsystem, or system is complete...and... during the walkdown verification, exceptions that are noted will be entered on Startup Form 7.3, 'Master Punch List'."

During the initial testing phase, after the turnover of the component, subsystem, or system to the LILCO Startup organization, the Startup Manual states, in part, from Section 4.6.1:

> "During the test program it is necessary to assure... incorrect design...are promptly identified and corrected.
>
> There are...mechanisms to identify problems and initiate corrective measures...Engineering and Design Coordination Reports (E&DCRs)."

As mentioned in the above statement, when and if problems are encountered, an E&DCR would be issued requesting Engineering to provide a resolution to the problem condition. With this resolution, the appropriate site documents would be issued to implement the corrections. These E&DCRs could be initiated any time up to the end of the Pre-operational Testing phase.

The Startup Manual also states, in part, in Section 8.4.1:

B. Installation and Testing Stages (Continued)

"The scope of the Pre-operational Test procedure shall include:

1. Integrated system operation will be verified to the extent practicable."

The Pre-operational Test "test results" are then reviewed and approved by the Joint Test Group. The turnover package to the Shoreham Plant Staff is then prepared. After this package is reviewed and approved by the Startup Manager, it is presented to the Shoreham Plant Staff. The system then receives its final "walkdown". Any discrepant items found are placed on the Master Punch List for tracking until they are resolved.

During the Pre-operational and initial Startup Test Program, a Vibration Test Program is conducted on ASME III Code Classes 1, 2, and 3 piping systems. The main steam, recirculation, RHR, core spray, HPCI, RCIC, and feedwater system testing are instrumented and the systems will be subjected to various operational flow modes while simultaneously monitoring and recording coincident motions. This test program is designed to reveal such things as effects of water hammer loads, attached components on the operation of equipment and vibratory responses of the equipment, its supports, or connected equipment to detect and eliminate future potential problems.

Attachment B

CONCERN

A number of drywell spray nozzles are permanently blocked by ventilation duct work, reducing the effectiveness of the containment spray system.

RESPONSE

Although the ventilation duct work reduces the spray flow effectiveness, i.e., the sprayed coverage, the actual spray flow rate is unchanged. A conservative quantification of this reduction would be to assume a reduction in the flow rate equal to the percentage of blocked nozzles. This approach is conservative in that the reduction assumes (1) no spray, (2) no flow, and (3) conservatively estimates the total percentage affected. Any flow spilling into the containment will actually contribute to pressure reduction. The assumed reduction is estimated to be 5 percent.

As stated in SNRC-743, no credit has been taken for the first 30 minutes after a DBA. For the case with steam bypass, spray is then initiated, terminating the pressure increase immediately, as shown in FSAR Fig. 6.2.1.23.

A preliminary analysis assuming no containment spray for 30 minutes and utilizing passive suppression chamber heat sinks has been done. This analysis uses a containment flow rate of approximately 10,000 gpm (two pumps in one spray loop). During the time interval beyond 30 minutes when containment spray is operating, the actual heat removal contribution of the containment sprays was calculated to average 57.5% of the total, with the suppression chamber passive heat sinks contributing the remainder.

The 5 percent reduction is therefore considered to equal a 500 gpm reduction in the approximate 10,000 gpm flow and given that the spray represents only 57.5 percent of the actual heat removal occurring during the spray interval, the total reduction in heat removal is small.

In summary, the reduction in flow has no impact on peak pressure after the DBA as the peak pressure is reached before spray actuation. In the analysis for the environmental qualification program, a double ended rupture of the recirculating line was used for peak pressure calculation with no credit for the spray system. This temperature profile bounds the case with the flow reduction. For steam bypass, in addition to the conservatisms in the assumed bypass area and in the 30 minutes operator response time, the flow reduction is conservative. Spray initiation will immediately terminate the pressure increase and cause a ramp decrease, the rate of decrease reduced slightly by the flow blockage.