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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Reactor Building Polar Crane Auxiliary Hoist
NUREG-0612 Reconciliation
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Ref: (1) LILCO Letter dated January 6, 1983, SNRC-817, to Harold R. Denton from J.L. Smith; subject: Submittal of the Phase II Report SER Issue No. 59; "Control of Heavy Loads."

(2) LIPA Telephone Memorandum dated May 27, 1993, between R. Nimitz, W. Pasciak, and S. Schoenwiesner; subject: Heavy Load Lifts under CAL 1-93-006: "Y" Crane and SFSP Floor Plates.

Ladies and Gentlemen:

The attached report (Attachment I) is a study LIPA performed as a result of Reference (2). This report is a reconciliation study which explains the extent to which the auxiliary hoist of the Shoreham Reactor Building Polar Crane meets the NUREG-0612 qualification requirements. It also identifies the compensatory measures taken by LIPA to enable, upon NRC approval, the use of the auxiliary hoist for handling heavy loads in the vicinity of and over those portions of the Spent Fuel Storage Pool (SFSP) which do not contain fuel.

This reconciliation study evaluated the Reactor Building Polar Crane auxiliary hoist for compliance with NUREG-0612 and has identified the following: 1) sufficient design features exist to make the likelihood of a load drop extremely small for all loads intended to be carried; 2) suitable alternatives or design measures exist to ensure compliance with the specific guidelines of NUREG-0612, Sections 5.1.1, 5.1.4(i), and 5.1.6; 3) specific compensatory measures have been taken to satisfy guidelines addressed in Appendix C of NUREG-0612. Consequently, this study justifies the elimination of the restriction contained in the cover letter of Reference (1), in that the use of the auxiliary hoist is no longer "limited by procedural requirements designed to limit damage due to a postulated load drop."

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The study concludes that the Reactor Building Polar Crane auxiliary hoist can be used to handle heavy loads in the vicinity of, and over those portions of the SFSP which do not contain fuel. Therefore, the study's conclusion supersedes the following statement on page 3 of reference (1): "the auxiliary hoist will not be used to handle heavy loads in the vicinity of the Spent Fuel Pool."

The following actions have been performed to increase auxiliary hoist reliability: a) An inspection in March 1993 resulted in additional maintenance and replacement of certain parts and; b) a new wire rope was installed on the auxiliary reeving system in April 1993.

Based on the attached evaluation, the Polar Crane auxiliary hoist meets the intent of "single failure proof" capability and its use in the vicinity of the SFSP should no longer be limited by a postulated load drop.

Should you have any questions or require additional information, please do not hesitate to contact my office.

Very truly yours,

A. J. Bortz
Resident Manager

DYF/kc
Attachment

cc: L. Bell
C. L. Pittiglio
T. T. Martin
R. Nimitz
N. Wagner

REACTOR BUILDING
POLAR CRANE AUXILIARY HOIST
NUREG 0612 RECONCILIATION

INTRODUCTION

LIPA has performed a reconciliation that concludes that the Reactor Building Polar Crane auxiliary hoist can be used to handle heavy loads in the vicinity of and over those portions of the Spent Fuel Storage Pool which do not contain fuel. This conclusion is based on the auxiliary hoist satisfying the guidelines of Sections 5.1.1, 5.1.4 (1), 5.1.6 and Appendix C of NUREG-0612, except for the absence of a load limiting device to detect load hang-up or binding.

In certain cases, compensatory measures such as the derating of the auxiliary hoist from 30 tons to 15 tons have been utilized to satisfy the applicable guidelines as addressed in Appendix C of NUREG-0612.

In addition to satisfying the guidelines of NUREG-0612 as delineated in this evaluation, it should be noted that the following actions have also been performed to assure increased Polar Crane auxiliary hoist reliability.

a) Additional maintenance and replacement of certain parts were performed as a result of a crane inspection performed by a qualified crane inspector in March 1993.

b) New wire rope was installed on the auxiliary reeving system in April 1993.

The evaluation of the Polar Crane auxiliary hoist, including the specific compensatory measures to satisfy the guidelines of NUREG-0612, are summarized below.

NUREG - 0612 SECTION 5.1.1 GUIDELINES

LIPA will comply with the general guidelines of NUREG-0612 Section 5.1.1 as described below when conducting heavy load lifts in the vicinity of the Spent Fuel Storage Pool (SFSP) using the Polar Crane main and auxiliary hoists.

1. SAFE LOAD PATHS

NUREG - 0612, SECTION 5.1.1 (1) GUIDELINE:

"Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor pressure vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should

follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact. These load paths should be defined in procedures, shown on equipment layout drawings, and clearly marked on the floor in the area where the load is to be handled. Deviations from defined load paths should require written alternative procedures approved by the plant safety review committee."

SNPS STATUS:

Safe load paths are procedurally required for every heavy load handling operation to be conducted on the refuel floor (RB elevation 175'9"). Load paths are required to be approved by Engineering and the Site Review Committee (SRC) and are clearly defined in Station Procedure, SP35X001.01, "Handling of Heavy Loads with the Reactor Building Polar Crane" prior to implementation. To the extent practical, load paths will follow structural members and although not shown on equipment layout drawings will be clearly marked on the floor (e.g. temporary use of pylons or tape).

2. LOAD HANDLING PROCEDURES

NUREG - 0612, SECTION 5.1.1 (2) GUIDELINE:

"Procedures should be developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. At a minimum, procedures should cover handling of those loads listed in Table 3-1 of NUREG 0612. These procedures should include: identification of required equipment; inspections and acceptance criteria required before movement of load; the steps and proper sequence to be followed in handling the load; defining the safe load path; and other special precautions."

SNPS STATUS:

Station Procedure, SP35X001.01, has been developed to address heavy load handling operations on the refuel floor using the Polar Crane. In addition, other station procedures have been developed to handle specific components on the refuel floor, e.g. the IF-300 Cask. The procedures include: identification of required equipment, load handling steps and sequences, safe load paths, specific load handling operations and special precautions.

The load handling procedures referred to above include prerequisite steps calling for the performance or verification of prior performance of appropriate inspections prior to movement of the defined loads. Such inspections are performed in accordance with other procedures governing the frequency and conduct of inspection, testing and maintenance on cranes, hoists, slings and special lifting devices. These inspection procedures include appropriate acceptance criteria.

3. CRANE OPERATOR TRAINING

NUREG - 0612, SECTION 5.1.1 (3)GUIDELINE:

"Crane operators should be trained, qualified and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976, "Overhead and Gantry Cranes."

SNPS STATUS:

Station Procedures, SP35X001.01, "Handling of Heavy Loads with Reactor Building Polar Crane" and SP32X002.01, "Reactor Building Crane - Operation and Preventive Maintenance" require personnel operating the Polar Crane to be qualified in accordance with ANSI B30.2-1976. All crane operators are given hands-on training to ensure complete understanding of the operation and safety features of the crane.

4. SPECIAL LIFTING DEVICES

NUREG - 0612, SECTION 5.1.1 (4) GUIDELINE:

"Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, 'Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials.' This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used.* This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device."

SNPS STATUS:

All special lifting devices used in conjunction with the Reactor Building Polar Crane are designed to satisfy the guidelines of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials." Also, the stress design factor for these devices is based on the combined maximum static and dynamic loads that could be imparted on the lifting device during handling. The lifting devices associated with handling heavy loads with the Reactor Building Polar Crane satisfy the single-failure-proof guidelines of NUREG 0612, Sections 5.1.4 (1) and 5.1.6 (1) (a). Lifting devices for critical loads will comply with section 6 of ANSI N14.6.

Additionally, Engineering evaluates the design of all lifting devices (original plant and new plant lifting devices) to verify compliance with NUREG 0612 prior to their use.

"* For the purpose of selecting the proper sling, loads imposed by the SSE need not be included in the dynamic loads imposed on the sling or lifting device."

5. LIFTING DEVICES (NOT SPECIALLY DESIGNED)

NUREG - 0612, SECTION 5.1.1 (5) GUIDELINE:

"Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9-1971, "Slings." However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the "static load" which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used."

SNPS STATUS:

Lifting devices used in conjunction with the Reactor Building Polar Crane are in accordance with ANSI B30.9-1971 "Slings". SP31X023.01, "Slings and Hoist: Inspections and Identification" addresses sling inspections. Engineering evaluates sling capacity and rigging arrangement for heavy loads to include a dynamic load factor in accordance with CMAA-70 in combination with the static load. Sling selection is in accordance with NUREG-0612 Sections 5.1.4 (1) and 5.1.6 (1)(b) in order to satisfy the single-failure-proof guidelines. Although slings are not restricted to use on only certain cranes, the slings are clearly coded to reflect lifting capacity.

6. CRANE - INSPECTION, TESTING AND MAINTENANCE

NUREG - 0612, SECTION 5.1.1 (6) GUIDELINE:

"The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, "Overhead and Gantry Cranes," with the exception that tests and inspections should be performed prior to use where it is not practical to meet the frequencies of ANSI B30.2 for periodic inspection and test, or where frequency of crane use is less than the specified inspection and test frequency (e.g., the Polar Crane inside a PWR containment may only be used every 12 to 18 months during refueling operations, and is generally not accessible during power operation. ANSI B30.2, however, calls for certain inspections to be performed daily or monthly. For such cranes having limited usage, the inspections, tests, and maintenance should be performed prior to their use.)"

SNPS STATUS:

Crane inspection, testing and maintenance procedures are in accordance with ANSI B30.2-1976. Reactor Building Polar Crane inspections and functional testing are performed in accordance with the following procedures:

SP32X002.01, "Reactor Building Crane - Operation and Preventive Maintenance"

Prior to commencing the Decommissioning of this plant, this procedure was revised to provide for the increased frequency of Preventive Maintenance, during periods of "heavy use". Since it was anticipated that the Polar Crane would be used much more frequently during decommissioning operations than at a normal operating plant, the frequencies changed from Annual to semi-Annual, and from Quarterly to Monthly.

The semi-Annual Inspection requires the detailed inspection of structural components, hoist motors, brakes, rotating components, cables and functional checks of all electrical contacts, control functions and mechanical trip functions.

The procedure specifies monthly and shift inspection requirements. Only those limit switches applicable to a given lift are tested at the beginning of each shift. Hence the lower travel limit switches (activated near the 8' elevation) are only tested prior to lifts anticipated to extend below the 40' elevation floor plugs.

SP34X001.01, "Reactor Building Crane Hoist, Sling and Cable Operability Test"

Provides instruction for inspection and operability testing of the Polar Crane to comply with Defueled Technical Specification 3/4.5.3.

In addition, steps in these procedures ensure that the appropriate inspections, tests and maintenance are performed prior to lifting a heavy load, if the crane has not been used within the specified period.

7. <u>CRANE - DESIGN</u>

NUREG - 0612. SECTION 5.1.1 (7) GUIDELINE:

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, "Overhead and Gantry Cranes" and of CMAA-70, "Specifications for Electric Overhead Travelling Cranes." An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

SNPS STATUS:

The Shoreham Nuclear Power Station Reactor Building Polar Crane is a Class A1 (Standby Service) crane manufactured by the Whiting Corporation. The Polar Crane is a top running type, double girder electric overhead traveling crane. It operates on a circular runway located above the Refuel Floor of the Reactor Building. It consists of a nominal 125 ton main hoist and a 30 ton auxiliary hoist.

The auxiliary hoist is a conventional hoist, designed to the requirements of CMAA-70 and meets the requirements of ANSI B30.2-1976. All the auxiliary hoist components are mounted on the same trolley and bridge frame as the main hoist which is a 125 ton rated hoist previously demonstrated to satisfy the guidelines of NUREG 0612. The polar crane structure is more than sufficient to support the safe operation of the auxiliary hoist.

RELIABILITY OF THE POLAR CRANE AUXILIARY HOIST

The reliability of a crane and its associated lifting fixtures represent one of the key elements in demonstrating their acceptability for use over areas such as a Spent Fuel Storage Pool. NUREG-0612 emphasizes crane design as one of the most important aspects in determining whether or not a crane is sufficiently reliable to be used in such areas. Where no analyses have been performed to demonstrate acceptable load drop consequences, the alternative of providing a "single failure-proof" crane is recommended to minimize the potential for load drops. "Single failure-proof" status may be achieved by providing a combination of increased factors of safety, incorporation of special safety features and capabilities, and through redundancy or duality in certain components.

The SNPS Polar Crane auxiliary hoist uses a combination of these elements. For instance, the reliability of the auxiliary hoisting system has been significantly increased from the original design by administratively limiting the allowable load which can be handled by the hoist to 15 tons. This represents an increase of the design factors of safety to twice that of the original 30-ton design rated load.

Recommended reliability measures for cranes used to handle heavy loads in the vicinity of BWR fuel pools are provided in NUREG-0612 Sections 5.1.4, 5.1.6 and Appendix C. In particular, the guidelines of NUREG-0612 Appendix C provide a method for implementation of the guidelines of the report "Single Failure-Proof Cranes For Nuclear Power Plants" (NUREG-0554) to existing cranes. As acknowledged in NUREG-0612, certain components are allowed not to have a redundant counterpart if a sufficient design safety factor is used. The discussion below provides a description of the design of the SNPS Polar Crane auxiliary hoist in comparison to the guidelines of NUREG-0612 Appendix C and NUREG-0554.

NUREG - 0612, APPENDIX C (NUREG - 0554) GUIDELINES

1. ALLOWABLE STRESS LIMITS

NUREG - 0612, APPENDIX C GUIDELINE:

"The allowable stress limits should be identified and be conservative enough to prevent permanent deformation of the individual structural members when exposed to maximum load lifts."

SNPS STATUS:

The crane including the auxiliary hoist was designed in accordance with CMAA Specification No. 70 (1971). All the auxiliary hoist components are mounted on the same trolley and bridge frame as the main hoist which is a 125 ton rated hoist which satisfies the guidelines of NUREG 0612. Permanent deformation of the trolley and bridge frame due to auxiliary hoist loads would therefore not be considered credible.

In addition by reducing the rated load of the auxiliary hoist from 30 to 15 tons, the design factors of the auxiliary hoist have been significantly increased beyond the original design.

2. MINIMUM OPERATING TEMPERATURE

NUREG - 0612, APPENDIX C GUIDELINE:

"The minimum operation temperature of the crane should be determined from the toughness properties of the structural materials that are stressed by the lifting of the load."

SNPS STATUS:

The crane is maintained in the Reactor Building and is not subject to severe pressure and temperature changes. Therefore, no minimum operating temperature has been specified.

3. SEISMIC

NUREG - 0612, APPENDIX C GUIDELINE:

"The crane should be capable of stopping and holding the load during a seismic event equal to a Safe Shutdown Earthquake (SSE) applicable to the facility."

SNPS STATUS:

The Polar Crane is classified as Seismic Category I and is capable of maintaining structural integrity under seismic loading with the rated load (125 ton) suspended from the main hook. The auxiliary hoist mechanism is installed on the same bridge and trolley frame as the main hoist. In addition, all components of the auxiliary hook hoisting mechanism have been analyzed and found capable of maintaining structural integrity, while operating in the vicinity of the Refuel Floor, when subjected to a Design Basis Earthquake (DBE) seismic event with the current rated 15 ton load suspended from the auxiliary hook.

4. **AUTOMATIC CONTROLS AND LIMITING DEVICES:**

NUREG - 0612, APPENDIX C GUIDELINE:

"Automatic controls and limiting devices should be designed so that a component or system malfunction will not prevent the crane from stopping and holding the load safely."

SNPS STATUS:

The crane controls are designed to prevent uncontrolled crane movement in the event of failure. The brake shoe solenoids of the bridge, trolley and each hoist are designed as fail-safe and set the brake upon loss of power. The auxiliary hoist has dual solenoid brakes installed on the motor shaft, one at the drive motor shaft and the other at the gear train shaft. This provides additional safety assurance should a motor coupling fail. During an active malfunction of the control system, the fail-safe feature of the brakes may be utilized by isolating all power to the crane. Control of the mainline breaker is provided in both control units (radio and pendant). This provides the crane operator with an immediately available emergency switch which is capable of stopping the crane at any time. Weekly functional tests and monthly inspections of the hoist holding brakes are performed.

5. **WIRE ROPE REEVING SYSTEM DESIGN**

NUREG - 0612, APPENDIX C GUIDELINE:

"Design of the wire rope reeving system should include dual wire ropes."

SNPS STATUS:

The auxiliary hoist has a single four part wire rope reeving system. The rope reeving system was originally designed in accordance with CMAA 70. The reeving system consists of a 4 - part system of 7/8 inch extra improved plow steel crane rope, 6X37 class, independent wire rope core, having a breaking strength of not less than 39.8 tons. The hoisting cables provide a design factor of 8.7:1 considering the reduced rated load of 15 tons and the dynamic load factor compared to the nominal breaking strength of the rope. Additionally, the wire rope was recently replaced (April, 1993) on the reeving system of the auxiliary hoist to enhance the reliability of the hoisting system.

COMPENSATORY ACTION

By reducing the rated load of auxiliary hoist from 30 to 15 tons, the design factors of the auxiliary hoist components have been increased to approximately twice that of the original design.

6. SENSING DEVICES

NUREG - 0612, APPENDIX C GUIDELINE:

"Sensing devices should be included in the hoisting system to detect such items as overspeed, overload, and overtravel and cause the hoisting action to stop when limits are exceeded."

SNPS STATUS:

The auxiliary hoist is provided with redundant hoist holding brakes, redundant upper travel limit switches (each on separate circuits) and two centrifugal limit switches. A summary of the sensing devices is as follows:

PROTECTION CONTROL	PROTECTION DEVICE	INSTALLED LOCATION
Overspeed	(2) Lowering overspeed switches (each with slow and fast mode limits)	End of motor brake shaft
Overtravel	(1) Upper and lower screw type limit switch	End of drum shaft
	(1) Upper block type limit switch	Switch unit mounted on trolley bridge Paddle linkage mounted on auxiliary load block
Overload	None	N/A

COMPENSATORY ACTION:

If the auxiliary hoist is used for critical lifts where the load has the potential of binding or hanging up, appropriate compensatory measures, (for example the use of a dynamometer and/or additional observers), will be utilized on a case-by-case basis in lieu of the automatic function associated with the use of a load cell. This will assure that binding or load hangup will not produce an overstress or slack cable condition of the auxiliary hoisting system. If appropriate compensatory measures can not be implemented, the main hoist will be used for the critical lift. Station Procedures require that an assessment be made of the potential for a critical load to bind or hang up during lifts.

7. TWO BLOCKING

NUREG - 0612, APPENDIX C GUIDELINE:

"The reeving system should be designed against the destructive effects of 'two-blocking'."

SNPS STATUS:

The auxiliary hoist is equipped with two independent upper travel-limit switches which will prevent "two-blocking."

8. HOISTING DRUM

NUREG - 0612, APPENDIX C GUIDELINE:

"The hoisting drum should be protected against dropping should its shaft or bearings fail."

SNPS STATUS:

The physical configuration of the crane is such that failure of the shaft or bearings will not cause the drum to drop from the crane bridge.

9. SAFETY DEVICES

NUREG - 0612, APPENDIX C GUIDELINE:

"Safety devices such as limit switches provided to reduce the likelihood of malfunction should be in addition to those normally provided for control of maloperation or operator error."

SNPS STATUS:

The auxiliary hoist has two independent upper limit switches to prevent "two-blocking." The hoist motor has overload protection and is equipped with thermal detectors to detect motor overload. The detectors sound an audible alarm on high motor temperature and

have a high set point which will automatically interrupt power to the hoist motor and set the brakes to prevent permanent motor damage. There are no areas over the Refuel Floor that warrant restrictions (except over fuel) on crane travel. Refer to the discussion of sensing devices in item 6 above for identification of all auxiliary hoist limit switches.

10. **COLD PROOF TEST**

NUREG - 0612, APPENDIX C GUIDELINE:

The crane system should be given a cold proof test if material toughness properties are not known.

SNPS STATUS:

A proof test was performed after erection.

SUMMARY -

The above information addresses crane reliability in terms of design. However, inspections, maintenance and testing also affect a crane's reliability. As noted earlier, semiannual monthly and shiftly inspections are performed in accordance with existing procedures, for various components and functions associated with the auxiliary hoist. In addition, within seven days prior to any heavy load lift over the Spent Fuel Storage Pool racks and at least once per seven days during such movement, a surveillance test of both Polar Crane hoists is performed to assure the operability of the crane and its protective features are in accordance with SNPS Technical Specification requirements. These programmatic measures provide an ongoing basis for assurance of the reliability of the Polar Crane auxiliary hoist.

Also, in April 1993, the wire rope of the auxiliary hoist reeving system was completely replaced. The entire crane has been reviewed by a qualified crane inspector to ensure its reliability for the upcoming fuel transfer activities.

Lastly, one of the considerations identified in NUREG-0612 Appendix C which justifies the use of increased component safety factors in lieu of component redundancy is the degree to which a component is subject to wear or degradation. For the SNPS Polar Crane auxiliary hoist, the combination of crane design, decreased load rating, and recent extensive maintenance and inspection provide a firm baseline for establishing the adequacy and sound condition of the crane. Considering the limited extent to which the auxiliary hoist will be used with fuel still remaining in the Spent Fuel Storage Pool and the established maintenance, inspection and testing programs, there is a significant basis for confidence that the crane's sound condition and significant safety factors will not be degraded during its use in the vicinity of the SFSP while the SFSP contains fuel.