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VARGA,S.A. Operating Reactors Branch 1

SUBJECT: Forwards Part II response to request for addl info re NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," per Generic Ltr 81-07.Rept also addresses Generic Ltr 83-42 re single failure proof cranes.

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CP&L
Carolina Power & Light Company

SERIAL: NLS-85-032

JAN 30 1985

Director of Nuclear Reactor Regulation
Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
United States Nuclear Regulatory Commission
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
CONTROL OF HEAVY LOADS

Dear Mr. Varga:

BACKGROUND

Carolina Power & Light Company (CP&L) was requested by Generic Letter No. 81-07 dated December 22, 1980 to review the controls for handling heavy loads at the H. B. Robinson Steam Electric Plant Unit No. 2 (HBR2) in accordance with NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants". Documentation of the results of CP&L's review and the resulting changes and modifications, if any, was requested to be submitted in two parts. Carolina Power & Light submitted the Part I report by letter dated August 12, 1981. The report attached to this letter is Part II of CP&L's response.

DETAILS

The Part II report addresses Sections 2.2, 2.3, and 2.4 of NRC's December 22, 1980 request for information. In addition, Generic Letter 83-42 concerning single-failure proof cranes is addressed in the report. Five copies of CP&L's Part II report are enclosed for your use.

Lifting equipment identified during the review process as not meeting the guidelines have been upgraded and/or modified consistent with the guidelines of NUREG-0612. The Part II report was written prior to completion of the HBR2 Steam Generator Repair Outage (SGRO); as a result, some sections discuss items which were to be done during the SGRO. The SGRO was recently concluded, and these items were completed. Specifically, the new sling assembly for the Removable Roof Hatch (page 16) has been placed in use and compliance of the Polar Crane to the appropriate H. B. Robinson Maintenance Procedure (page 26) has been accomplished.

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411 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

CONCLUSION

It should be recognized that the attached report describes heavy load handling systems and lifting apparatus at HBR2 as they currently exist. Modifications may be made in the future, but changes will consider the guidance of NUREG-0612. The Company considers the load handling sytems and lifting apparatus at HBR2 to meet the intent of the NUREG-0612 guidance.

If you have any further questions on this subject, please contact Mr. Sherwood Zimmerman at (919) 836-6242.

Yours very truly,

Original Signed By

A. B. CUTTER

A. B. Cutter - Vice President
Nuclear Engineering & Licensing

ONH/crs (1970NH)

Enclosure

cc: Mr. J. P. O'Reilly (NRC-RII)
Mr. G. Requa (NRC)
Mr. H. Krug (NRC-HBR)

Docket No. 50-261
License No. DPR-23

CONTROL OF HEAVY LOADS

NUREG-0612

PART II

RESPONSE TO NRC REQUEST

for

ADDITIONAL INFORMATION

CAROLINA POWER AND LIGHT COMPANY

H. B. ROBINSON UNIT 2

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 22, 1980

TO ALL LICENSEES OF OPERATING PLANTS AND
APPLICANTS FOR OPERATING LICENSES AND
HOLDERS OF CONSTRUCTION PERMITS*

Gentlemen:

Subject: Control of Heavy Loads

In January 1978, the NRC published NUREG-0410 entitled, "NRC Program for the Resolution of Generic Issues Related to Nuclear Power Plants - Report to Congress." As part of this program, the Task Action Plan for Unresolved Safety Issue Task No. A-36, "Control of Heavy Loads Near Spent Fuel," was issued.

We have completed our review of load handling operations at nuclear power plants. A report describing the results of this review has been issued as NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants - Resolution of TAP A-36." This report contains several recommendations to be implemented by all licensees and applicants to ensure the safe handling of heavy loads.

The purpose of this letter is to request that you review your controls for the handling of heavy loads to determine the extent to which the guidelines of Enclosure 1 are presently satisfied at your facility, and to identify the changes and modifications that would be required in order to fully satisfy these guidelines.

To expedite your compliance with this request, we have enclosed the following:

NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" (Enclosure 1).

Staff Position - Interim Actions for Control of Heavy Loads (Enclosure 2).

Request for Additional Information on Control of Heavy Loads (Enclosure 3).

*With the exception of licensees for Indian Point 2 and 3, Zion 1 and 2 and Three Mile Island 1 (These were previously sent a letter)

You are requested to implement the interim actions described in Enclosure 2 as soon as possible but no later than 90 days from the date of this letter.

In order to enable the NRC to determine whether operating licenses should be modified (10 CFR 50.54(f)), operating reactor licensees are requested to provide the following:

1. Submit a report documenting the results of your review and the required changes and modifications. This report should include the information identified in Sections 2.1 through 2.4 of Enclosure 3, on how the guidelines of NUREG-0612 will be satisfied. This report should be submitted in two parts according to the following schedule:

   - Submit the Section 2.1 information within six months from the date of this letter.

   - Submit the Sections 2.2, 2.3 and 2.4 information within nine months.

2. Furnish confirmation within six months that implementation of those changes and modifications you find are necessary will commence as soon as possible without waiting on staff review, so that all such changes, beyond the above interim actions, will be completed within two years of submittal of Section 2.4 for the above report.

3. Furnish justification within six months for any changes or modifications that would be required to fully satisfy the guidelines of Enclosure 1 which you believe are not necessary.

The criteria in NUREG-0612 are also applicable to applicants for operating licenses. Such applicants are expected to provide the information requested by item 1 above and to meet the same schedule of implementation as indicated in 2 above. Any item for which the implementation date is prior to the expected date of issuance of an operating license will be considered to be a prerequisite to obtaining that license.

For any date that cannot be met, furnish a proposed revised date, justification for the delay, and any planned compensating safety actions during the interim.

This request for information was approved by GAO under a blanket clearance number R0072 which expires November 30, 1983. Comments on burden and duplication may be directed to the U.S. General Accounting Office, Regulatory Reports Review, Room 5106, 441 G Street, N.W., Washington, D.C. 20548.

Sincerely,

Darrell G. Eisenhut, Director
Division of Licensing

Enclosures:
1. NUREG-0612
2. Staff Position
3. Request for Additional Information

cc: w/o Enclosure (1)
Service List

CONTROL OF HEAVY LOADS

SUMMARY

This report is Part II of CP&L's response to the NRC request for information dated December 22, 1980, concerning NUREG-0612 "Control of Heavy Loads at Nuclear Power Plants". Part I was previously submitted to the NRC via CP&L letter number NO-81-1336, dated August 12, 1981.

The Part II report addresses Sections 2.2, 2.3 and 2.4 of the above referenced request for information and is structured such that each question is stated in "Quotations" and followed by a response to the question. Tables and attachments are included as appendices to assist in substantiating the results of the review.

Table 3-1 of our Part I report has been revised to correct several errors in equipment weights and to reflect changes in lifting equipment sizing. These changes resulted from our detailed review of each crane/load combination and our attempt to satisfy the requirements of NUREG-0612.

Lifting equipment identified during our review process which did not meet the requirements of NUREG-0612 is identified in appropriate response sections. Equipment not meeting requirements has been or is in the process of being upgraded and/or modified to provide complete compliance with NUREG-0612 or to provide partial compliance supplemented by suitable alternatives or additional design features.

SUMMARY (cont'd)

This report reflects the results of a comprehensive review of the load handling systems and procedures associated with H. B. Robinson Unit 2. Carolina Power & Light Company considers the load handling systems and lifting apparatus discussed herein to be in compliance with or meet the intent of NUREG-0612. Suitable alternatives have been provided where exceptions were taken to the requirements of NUREG-0612.

CONTROL OF HEAVY LOADS

2.2 SPECIFIC REQUIREMENTS FOR OVERHEAD HANDLING SYSTEMS OPERATING IN THE VICINITY OF FUEL STORAGE POOLS:

"NUREG 0612, Section 5.1.2, provides guidelines concerning the design and operation of load-handling systems in the vicinity of stored, spent fuel. Information provided in response to this section should demonstrate that adequate measures have been taken to ensure that in this area, either the likelihood of a load drop which might damage spent fuel is extremely small, or that the estimated consequences of such a drop will not exceed the limits set by the evaluation criteria of NUREG 0612, Section 5.1, Criteria I thru III."

CONTROL OF HEAVY LOADS

Request 2.2.1:

"Identify by name, type, capacity and equipment designator, any cranes physically capable (i.e. ignoring interlocks, movable mechanical stops or operating procedures) of carrying loads which could, if dropped, land or fall into the spent fuel pool."

Response to 2.2.1:

Crane	Serial No.	Manufacturer	Type	Capacity
1. Spent Fuel Cask Handling Crane	S/N 10698	Whiting	Overhead Bridge	125 tons
2. Spent Fuel Pool Moveable Bridge	S/N 727/78	Dwight-Foote	Bridge	1.0 tons
3. New Fuel Element Monorail & Hoist	None	P&H	Monorail	1 ton

CONTROL OF HEAVY LOADS

Request 2.2.2:

"Justify the exclusion of any cranes in this area from the above category by verifying that they are incapable of carrying heavy loads or are permanently prevented from movement of the hook centerline closer than 15 feet to the pool boundary, or by providing a suitable analysis demonstrating that for any failure mode, no heavy load can fall into the fuel storage pool."

Response to 2.2.2:

Crane	Serial No.	Manufacturer	Type	Capacity
Spent Fuel Pool Moveable Bridge	S/N 727/68	Dwight-Foote	Bridge	1.0 tons
New Fuel Element Monorail Hoist	None	P&H	Monorail	1 ton

Spent Fuel Pool Movable Bridge - This crane has been excluded from the above category since it does not carry heavy loads. The load combinations used with this crane consist of handling tools and new or spent fuel elements which do not constitute a heavy load.

Response to 2.2.2: (cont'd)

New Fuel Element Monorail Hoist - This crane handles only new fuel elements and therefore does not carry heavy loads as defined in paragraph 1.2, page 1-2 of NUREG-0612.

Request 2.2.3:

"Identify any cranes listed in 2.2.1 above, which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e. complete compliance with NUREG 0612, Section 5.1.6 or partial compliance supplemented by suitable alternative or additional design features). For each crane so evaluated, provide the load-handling system (i.e. crane-load-combination) information specified in Attachment 1."

Response to 2.2.3:

The "Spent Fuel Cask Handling Crane" identified in paragraph 2.2.1 above is of single-failure-proof design and has been designed in accordance with the requirements of NUREG-0554, ANSI B30.2 and CMAA Spec. 70. Detailed information regarding the Cask Handling Crane design was transmitted to the NRC via CP&L Letter No. NG-74-1246, dated October 17, 1974.

CP&L has verified, as discussed in our respone to Item 1 of 2.3.3 that a single failure in the electric power/control system will not result in a load drop.

The five (5) items requested in Attachment 1, "Single-Failure Proof Handling Systems" of the 12-22-80 letter are addressed below.

Question 1 - "Provide the name of the manufacturer and the design-rated load (DRL). If the maximum critical load (MCL) as defined in NUREG-0554 is not the same as the DRL, provide this capacity."

Response to 2.2.3: (cont'd)

Answer - Paragraph 2.2.1 provided the manufacturer and DRL. The MCL is the 70-ton spent fuel cask plus the weight of the redundant lifting yoke.

Question 2 - "Provide a detailed evaluation of the overhead handling system with respect to the features of design, fabrication, inspection, testing, and operation as delineated in NUREG-0554 and supplemented by the identified alternatives specified in NUREG-0612, Appendix C. This evaluation must include a point-by-point comparison for each section of NUREG-0554. If the alternatives of NUREG-0612, Appendix C, are used for certain applications in lieu of complying with the recommendations of NUREG-0554, this should be explicitly stated. If an alternative to any of those contained in NUREG-0554 or NUREG-0612, Appendix C, is proposed, details must be provided on the proposed alternative to demonstrate its equivalency.

Answer - The Spent Fuel Cask Handling Crane is Single-Failure Proof. Detail information regarding the single-failure proof design characteristics of this crane were submitted to the NRC via the correspondence identified in Paragraph 1 of CP&L's response to 2.2.3. This correspondence indicates the crane to be in compliance with NUREG-0554 and NUREG-0612.

Section 3.2 of NUREG-0554 states that auxiliary hoisting systems employed to lift or assist in handling critical loads should be single-failure proof. The auxiliary hoist is not single-failure

Response to 2.2.3: (cont'd)

proof; however, CP&L considers the auxiliary hoist to have sufficient safety features to adequately guard against a load drop. The hoist is equipped with an upper limit switch to prevent two-blocking. Whiting Corporation has verbally confirmed that the reeving system provides a design safety factor of approximately 6.3:1. Therefore, the heaviest load handled in the vicinity of spent fuel (Table 3-1) provides an increased safety factor of approximately 10.

Question 3 - "With respect to the seismic analysis employed to demonstrate that the overhead handling system can retain the load during a seismic event equal to a safe shutdown earthquake, provide a description of the method of analysis, the assumptions used, and the mathematical model evaluated in the analysis. The description of assumptions should include the basis for selection of trolley and load position."

Answer - The original crane design did not require retention of the load during a seismic event equal to an SSE. The design criteria is as follows:

(1) Design, fabrication, material, and erection are in accordance with AISC Manual of Steel Construction 1963 Edition.

(2) The basic wind loading is 30 psf.

(3) Seismic loadings are five percent of the dead load.

Response to 2.2.3: (cont'd)

(4) Dead load is the dead weight of the crane.

(5) Horizontal forces are as follows:

(a) Lateral Live Load - 10 percent (Lift Load + Weight of Trolley)

(b) Longitudinal Live Load - 10 percent (Dead Load + Lift Load)

(6) The vertical impact load is 15 percent of the lift load.

The probability of a seismic event equal to an SSE occurring during handling of the Spent Fuel Cask is extremely remote. Therefore, a load drop during an SSE is considered not to be credible.

Question 4 - "Provide an evaluation of the lifting devices for each single-failure proof handling system with respect to the guidelines of NUREG-612, Section 5.1.6."

Answer - Redundant Cask Lifting Yoke is designed to interface between the General Electric IF-300 irradiated fuel shipping cask and th Whiting crane redundant hook arrangement. A detailed technical description can be found in the General Electric Company's IF-300 "Irradiated Fuel Shipping Cask Redundant Lifting Yoke Technical Description", dated October 1978, Revision 2. The lifting rig is designed to meet the requirements of ANSI N14.6.

Fuel Gate Lifting Slings - Currently two 5/8"-diameter 6 x 19 IWRC slings are used to handle the fuel gate. The recalculated weight of the fuel gate is 2,459 lbs.

Response to 2.2.3: (cont'd)

The slings provide a safety factor of greater than 20 based on a 60° leg angle, which meets the guidelines of NUREG-0612, Section 5.1.6. Therefore, a load drop due to sling failure is not considered credible.

Removable Siding - The removable siding (weight 2,300 lbs.) is handled by a 3/4" two-leg spreader assembly and two additional 3/4" x 3' long slings. The safety factor for this standard lifting apparatus is approximately 40. Therefore, a load drop due to sling failure is not considered credible.

Removable Roof Hatch - The removable roof hatch (weight 6,552 lbs.) is handled by 3/4" two-leg spreader assembly which attaches to two eyebolts on the roof hatch. The following procedure is followed for rolling back the roof hatch.

1. Lift roof hatch on wheel end approximately four through six inches (maximum) and set roll back wheels. The five-ton S.F. Crane Auxiliary hook is used.
2. After wheels are set in place, the load is released and the crane is connected to the lifting loop at the opposite end of the roof hatch.
3. The end of roof hatch is lifted four through six inches (maximum) and rolled back by traveling with the bridge until hatch is fully open.
4. The hatch end is then set down and the crane is unhooked.

Response to 2.2.3: (cont'd)

The safety factor for this standard lifting apparatus exceeds 10. Therefore, a load drop due to sling failure is not considered credible.

Note: See reply to Question 5 for changes to sling arrangement.

Cask Washdown Roof Hatch - The removable roof hatch (weight approximately 6,600 lbs.) is handled by a 3/4"-diameter four-leg sling assembly. This assembly provides a safety factor in excess of 10. Therefore, a load drop due to failure of the sling assembly is not considered credible.

Response to 2.2.3: (cont'd)

Question 5 - "Provide an evaluation of the interfacing lift points with respect to the guidelines of NUREG-0612, Section 5.1.6."

Answer - Spent Fuel Cask has redundant attachment points in accordance with the requirements of ANSI N14.6.

Spent Fuel Pool Gate - Calculations of lifting lug design confirms a minimum safety factor of 14 based on yield strength of lug material and weld.

Removable Siding - The siding interfacing lift points consist of 2 lug assemblies each with a 1-1/2" pin diameter. The lifting lugs are welded to the structural frame of the siding. This arrangement provides a safety factor of 10 or greater based on ultimate strength.

Removable Roof Hatch - this roof hatch has two (2) 1" diameter eyebolts which screw into the hatch structural frame for setting the wheels. Evaluation of these interfacing lift points indicated that the eyebolts were being over stressed due to the angular load being applied to them (approx. 35-40°). Therefore, a new 3/4" diameter longer 2 leg sling assembly will be provided prior to the next handling of the hatch. The new arrangement will provide at least a 60° angle which will result in a safety factor of 6 or 7. CP&L considers this adequate since the hatch is not actually lifted free of the roof (one end always remains resting on roof).

Response to 2.2.3: (cont'd)

Cask Washdown Roof Hatch - This roof hatch has four (4) 1" diameter eyebolts which screw into the hatch structural frame. The new sling assembly will provide at least a 60° angle to maintain a safety factor of 6 - 7. CP&L considers this to be adequate for this hatch since there is a four point lifting arrangement. Failure of one lift point will not result in a load drop. Should a failure occur the hatch would immediately be set down and not moved until repairs have been completed and accepted.

CONTROL OF HEAVY LOADS

Request 2.2.4:

"For Cranes identified in 2.2.1 above, not categorized according to 2.2.3, demonstrate that the criteria of NUREG-0612, Section 5.1, are satisfied. Compliance with Criterion IV will be demonstrated in response to Section 2.4 of this request. With respect to Criteria I through III, provide a discussion of your evaluation of crane operation in the spent fuel area and your determination of compliance. This response should include the following information for each crane:

a. Which alternatives (e.g., 2, 3, or 4) from those identified in NUREG-0612, Section 5.1.2, have been selected.

b. If Alternative 2 or 3 is selected, discuss the crane motion limitation imposed by electrical interlocks or mechanical stops and indicate the circumstances, if any, under which these protective devices may be bypassed or removed. Discuss any administrative procedures invoked to ensure proper authorization of bypass or removal, and provide any related or proposed technical specification (operational and surveillance) provided to ensure the operability of such electrical interlocks or mechanical stops.

c. Where reliance is placed on crane operational limitations with respect to the time of the storage of certain quantities of spent fuel at specific post-irradiation decay times, provide present and/or proposed technical specifications and discuss administrative or physical controls provided to ensure that these assumptions remain valid.

Request 2.2.4: (cont'd)

d. Where reliance is placed on the physical location of specific fuel modules at certain post-irradiation decay times, provide present and/or proposed technical specifications and discuss administrative or physical controls provided to ensure that these assumptions remain valid.

e. Analyses performed to demonstrate compliance with Criteria I through III should conform to the guidelines of NUREG-0612, Appendix A. Justify any exception taken to these guidelines, and provide the specific information requested in Attachment 2, 3, or 4, as appropriate, for each analysis performed."

Response to 2.2.4:

The cranes identified in 2.2-1 have either been excluded in 2.2-2 since they do not carry heavy loads or have been evaluated in 2.2-3 above as having sufficient design features to make the likelihood of a load drop extremely small for all loads handled.

In addition to meeting the criteria of Section 5.1.2(1) the Cask Handling Crane is also equipped with electrical interlocks that restrict movement of the crane and administrative controls to prevent movement of the crane load block over spent fuel. The following interlocks, limits and administrative controls provide additional protection for guarding against load handling accidents.

Response to 2.2.4: (cont'd)

Limit switches have been provided to limit the horizontal movement of the trolley and of the bridge. The switches have been located so that movement of the loaded crane over the spent fuel pool is prevented. Limit switches also are provided to prevent overloads and critical elevations of the block assembly.

When passing heavy loads into or out of the spent fuel pool enclosure the load or load carrying members are kept from contacting the enclosure by placing the crane in "Restricted Path" mode. When in this mode, the following restrictions are placed on the operation of the overhead crane:

a. An operator is required to be in the cab of the crane at all times.

b. A limit switch keeps the centerline of the load from moving beyond the centerline of the cask sitdown area.

c. Limit switches restrict bridge and trolley movement.

d. A special limit switch system on the reeving equalizer assembly warns the operator if unequal rope stretch or unbalanced condition occurs in the assembly.

e. A limit switch will open the hoist motor circuit if the cable becomes slack from overhoisting.

f. An overload limit device incorporated into the design of the main hoist interrupts power to the main hoist motor if the load exceeds rated capacity.

2.3 SPECIFIC REQUIREMENTS OF OVERHEAD HANDLING SYSTEMS OPERATING IN THE CONTAINMENT

"NUREG-0612, Section 5.1.3 provides guidelines concerning the design and operation of load-handling systems in the vicinity of the reactor core. Information provided in response to this section should be sufficient to demonstrate that adequate measures have been taken to ensure that in this area, either the likelihood of a load drop which might damage spent fuel is extremely small, or that the estimated consequences of such a drop will not exceed the limits set by the evaluation criteria of NUREG-0612, Section 5.1, Criteria I through III."

CONTROL OF HEAVY LOADS

Request 2.3.1:

"Identify by name, type, capacity, and equipment designator, any cranes physically capable (i.e., taking no credit for any interlocks or operating procedures) of carrying heavy loads over the reactor vessel."

Response to 2.3.1:

Crane	Serial No.	Manufacturer	Type	Capacity
Polar Crane	9701	Whiting	Polar Gantry	155 tons
Manipulator Crane	B34939	Stearns-Roger	Bridge	1.5 tons

CONTROL OF HEAVY LOADS

Request 2.3.2:

"Justify the exclusion of any cranes in this area from the above category by verifying that they are incapable of carrying heavy loads, or are permanently prevented from the movement of any load either directly over the reactor vessel or to such a location where in the event of any load-handling system failure, the load may land in or on the reactor vessel."

Response to 2.3.2:

The manipulator crane has been excluded from the above category since no heavy loads are handled by this crane. A heavy load being defined in accordance with paragraph 2 of Section 1.1 "Background", page 1-1, NUREG-0612.

CONTROL OF HEAVY LOADS

Request 2.3.3:

"Identify any cranes listed in 2.3-1 above, which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e., complete compliance with NUREG-0612, Section 5.1.6, or partial compliance supplemented by suitable alternative or additional design features). For each crane so evaluated, provide the load-handling-system (i.e., crane-load-combination) information specified in Attachment 1."

Response to 2.3.3:

Items 1 through 5 below provide answers to load handling system information specified in Attachment 1 of the December 22, 1980, NRC request for information.

Item 1 - "Provide the name of the manufacturer and the design rated load (DRL). If the maximum critical load (MCL) as defined in NUREG-0554 is not the same as the DRL provide this capacity."

Answer -

1. Crane: Containment Polar Crane

   Number: Serial No. 9701

   Manufacturer: Whiting

   Type: Polar Gantry

   DRL: 155 tons

   MCL: 139 tons

Response to 2.3.3: (cont'd)

The Containment Polar Crane has been evaluated to ascertain the extent of conformance with current governing codes and standards. Tables 1-Identification of Crane Codes and Standards, 2A-General Crane Information, and 2B-Comparable Design Adequacy, were provided to the NRC with CP&L's response to the draft T.E.R. for our Part I submittal. (Refer to CP&L letter from Mr. S. R. Zimmerman to Mr. S. A. Varga dated December 15, 1982.) The above referenced tables have also been included in this report under Appendix I to allow for easier reference. Table 2B indicates that the Polar Crane meets or exceeds the current requirements of CMAA-70 and Chapter 2-1 of ANSI B30.2.

In addition, a number of permanent modifications to the Polar Crane structural, mechanical and electrical components were completed in December of 1983. These modifications were necessary to achieve a temporary upgrade to support replacement of the steam generator lower assemblies. The crane as a result of the modifications will be temporarily upgraded during the steam generator replacement outage from its current DRL of 155 tons to 210 tons. The modifications identified during Whiting's Rerating Analysis include:

- Replacement of "turnbolts" in leg connections.
- Additional welds added to all four truck trunnions.
- Addition of reinforcement plates at each leg-to-sill connection.
- Addition of welds to four (4) short stiffeners in both main load girders "A" and "B", addition of welds to the #1 and #2 trolley load girders.

Response to 2.3.3: (cont'd)

- Installation of new brakes on both the main hoist motor and main hoist.
- Replacement of the drum pinion gear and shaft.
- Replacement of turn bolts in the drum bearing support and pinion bearing support.
- Installation of a 10 hp micro-drive motor system and associated equipment with a key lockout switch to prohibit using the existing 40 hp motor and the 10 hp micro-drive simultaneously. The Polar Crane nameplate rating will remain at 155 tons.

The modifications performed to support the steam generator replacement project result in greater design safety margins of load bearing structural and mechanical components and better operating performance during normal plant operation and maintenance.

The modified polar crane was load tested to 210 tons (Whiting Corp. supports the use of a 100% load test). Prior to returning the crane to its normal plant service, full compliance with H. B. Robinson maintenance procedure MMM-009 will be documented. Reload test of the crane after steam generator replacement is not considered necessary since all of the modifications will remain in place. The completed modifications to the crane satisfy the original design life and loading requirements.

Response to 2.3.3: (cont'd)

Periodic inspection and maintenance is required (essentially as was required before modification) to assure satisfactory crane performance during its life. Design standards incorporate not only stress allowables but minimum time allowables for wear considerations. This latter category is reflected in items such as wheel and bearing contact pressures. The H. B. Robinson polar crane normally operates at less than one-half of its DRL and thus wear to date due to a small number of heavy lifts is not significant, nor a calculable factor for the crane evaluation.

To determine if new seismic analyses were required due to the crane modifications, weights were calculated for the structural steel. The calculations includes plates, angles, channel and bars which indicated a weight increase of approximately 3752 pounds. When the weight of the micro-drive system (600 lbs.) is added, the total increase in the crane weight is about 4350 pounds. This is approximately a 1% increase in the weight of the crane (identified in FSAR Table 3.8.1-1). This increase in weight is insignificant to the previous crane or containment analyses and, thus, there was no need to perform additional seismic anlaysis.

Response to 2.3.3: (cont'd)

To further assist in review of the crane adequacy, a summary of the modifications is provided in Appendix II and IIA of this report. Appendix II identifies the modification accomplished under Plant Mod. M-694. The chart identifies overstress areas as calculated for the 210 ton lift, justification for modification or acceptability to remain as is, modification and/or work performed and a statement whether the item meets CMAA-70, 1975 code for 155 ton DRL and the 210 ton temporary upgrade. Appendix IIA identifies other modifications made to the Polar Crane.

The NRC letter dated December 19, 1983, advised CP&L of the potential for a load drop due to a single failure of the electric power/control system. Therefore, CP&L requested verification from the crane manufacturer (Whiting Corp.) that a single electric failure as discussed in your above referenced letter would not result in a load drop. Whiting has confirmed in writing that "any single failure within the electrical installations associated with the subject equipment" (Polar Crane and Cask Handling Crane) "will not result in a loss of proper and sustained support of a hoist load."

Response to 2.3.3: (cont'd)

Item 2 - "Provide a detailed evaluation of the overhead handling system with respect to the features of design, fabrication, inspection, testing, and operation as delineated in NUREG-0554 and supplemented by the identified alternatives specified in NUREG-0612, Appendix C. This evaluation must include a point by point comparison for each section of NUREG-0554. If the alternatives of NUREG-0612, Appendix C are used for certain applications in lieu of complying with the recommendations of NUREG-0554, this should be explicitly stated. If an alternative to any of those contained in NUREG-0554 or NUREG-0612, Appendix C is proposed, details must be provided on the proposed alternative to demonstrate its equivalency."

Answer -

The following evaluation provides a "point-by-point" comparison of the polar crane design and modifications to the requirements delineated in NUREG-0554. In cases where design features do not conform to those of NUREG-0554, alternatives are presented along with an explanation to demonstrate equivalency and/or adequacy. CP&L considers the overall design features sufficient to make the likelihood of a load drop to be extremely small.

Appendix III provides a comparison summary of the discussions provided below.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 2.1 - Construction & Operating Periods

The Polar Crane was used during construction to install the NSSS Components and for general construction lifts. The NSSS vessel lifts exceeded the DRL of Polar Crane. The manufacturer was consulted during the planning of these lifts and concurred with the procedures used. The crane was reinspected prior to turnover for plant operations use. The crane has been used during plant operation and maintenance for over 13 years. No major defects or indications of excessive wear have been discovered during the annual inspections.

NUREG-0554 - Section 2.2 - Maximum Critical Load

Requirement: The Design Rated Load (DRL) should be at least 15% greater than the Maximum Critical Load (MCL).

Actual: The DRL of 155 tons is 11.5% greater than the 139 ton MCL. However, the Whiting design review and the modifications identified in Appendix II indicate a very conservative polar crane design when rated at the 155 ton DRL. Therefore, although the DRL is not permanently changed, the conservative design provides suitable alternatives for compliance with this requirement.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 2.3 - Operation Environment

Requirement: Operating environment including minimum and maximum pressure, maximum rate of pressure increase, temperature, humidity and emergency corrosive or hazardous conditions should be specified as well as proper venting and drainage requirements to avoid collapse and standing water.

Actual: The original design specification did not specifically define the operating environment. Review of the design indicates that the environmental conditions were considered and that the crane complies with the requirements of this section.

Environmental Conditions - the crane will be exposed to 20 mR/HR over a 40 year life. The ambient temperature inside the containment is a minimum of 50°F and a maximum of 120°F with the ambient pressure having a controlled range of -1.0 psig to +1.0 psig. Plant modification #89 provided 136 ventilation holes in boxed sections of polar crane to allow for rapid pressure changes.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 2.4 - Material Properties

Requirement: Material testing for brittle fracture per ASTM E-208 (drop weight test or ASTM A-370 Charpy). Minimum operation temperatures on drop weight test should be obtained from paragraph NC2300 of Section III ASME Code or for Charpy test from paragraph ND2300 of Section III of the ASME Code

or

Cold proof load tested.

Actual: The polar crane meets the requirements of this section as discussed below.

The polar crane was load tested to approximately 210 tons after modifications were completed. Minimum ambient temperature during the outage and testing period was at or below the minimum ambient temperature of the containment building experienced during normal Polar Crane operation. This load test satisfies the cold proof load test alternate requirement of NUREG-0554, Section 2.4.

In addition, Brittle Fracture tendency is reduced to an acceptable level during normal crane operating periods (plant shutdown and fuel in R.V.). Minimum ambient temperature during normal crane operating periods is $50^{o}F$ which is well above the NDTT of the crane material.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 2.5 - Seismic Design

Requirement: Cranes should be designed to retain load during an SSE and remain on their respective runway with wheels prevented from leaving the tracks during the seismic event. Design should also be in accordance with regulatory position 2 of Reg. Guide 1.29, Seismic Design Classification.

Actual: "The original Ebasco Specification No. WELC-5379-54" Reactor Building Crane, Rev. 1, dated March 17, 1967, indicates that the polar crane was designed for the following seismic loads.

(a) Horizontal load equal to 25 percent of dead load of crane and trolley acting simultaneously with:

(b) Vertical load equal to 7 percent of dead load of crane and trolley.

(c) Horizontal load equal to 50 percent of dead load of crane and trolley, acting simultaneously with:

(d) Vertical load equal to 15 percent of dead load of crane and trolley.

Conditions (a) and (b) are design earthquake loads applicable to the design of the crane member and parts. Conditions (c) and (d) are hypothetical earthquake loads applicable to the stability of

Response to 2.3.3: (cont'd)

the crane as a whole, and the integrity of the components.

The Specification states that:
"All structural and mechanical parts of the crane shall be designed to resist dead, live, and seismic loads and the forces produced by impact, thrust, and rated breakdown torque of motors".

The polar crane is equipped with anti-overturn lugs. The probability of the crane experiencing an SSE during handling of a heavy load is considered extremely remote and therefore a load drop due to an SSE is not considered credible.

NUREG-0554 - Section 2.6 - Lamellar Tearing

Requirement: NDE of all weld joints whose failure could result in the drop of a critical load.

Actual: Information regarding extent of original NDE is not available. Welding modifications, to facilitate temporary upgrading of the crane whose failure could result in a load drop, were nondestructively examined in accordance with approved procedures. Periodic inspections during the 12 years of operating life have not indicated any weld joint failure.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 2.7 - Structural Fatigue

Requirement: Construction usage should be added to expected cyclic loading for permanent plant operation when performing fatigue evaluation. A fatigue evaluation should be considered for critical load-bearing structures and components of the crane handling system.

Actual: The Polar Crane design is considered to have met the requirements of CMAA Specification 70 and, therefore, the intent of the above requirement. Construction usage when added to cyclic loading for permanent plant operation would not significantly effect the fatigue evaluation due to the extremely low use factor this crane experiences.

NUREG-0554 - Section 2.8 - Welding Procedures

Requirement: Post weld heat treatment of welds identified in Section 2.6 shall be in accordance with Subarticle 3.9 of AWS D1.1, Structural Welding Code.

Actual: Whiting Corporation, the crane manufacturer, confirmed that AWS D14.1 (Specification for Welding, Industrial, and Mill Cranes) was used by Whiting for the polar crane as has been the case historically for all their cranes. The current crane modification welding was performed to AWS D1.1-1983 in accordance with approved

Response to 2.3.3: (cont'd)

plant welding procedures. Modification welding to AWS D1.1 was also approved by the crane manufacturer.

NUREG-0554 - Section 3.2 - Auxiliary System

Requirement: Auxiliary hoisting systems employed to lift or assist in handling critical load should be single-failure proof.

Actual: The auxiliary hoist is not single-failure proof; however, CP&L considers the auxiliary hoist to have sufficient safety features to adequately guard against a load drop. The auxiliary hoist is equipped with an upper limit switch to prevent two-blocking. The loads identified in Table 3-1 of CP&L's Part I Report do not exceed 50 percent of the auxiliary hoists rated capacity and, therefore, provide an increased safety factor of 10 or greater. The preventive maintenance program and inspection requirements performed by the plant will identify any deterioration of the lifting equipment and allow for corrective action and repair prior to component failure.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 3.3 - Control Systems

Requirement: Provide fail safe controls and limiting devices such that when disorders due to inadvertant operator action, component malfunction or disarrangement of subsystem control functions occur singly or in combination during load handling disorders will not prevent the handling system from stopping and holding the load.

Actual: The polar crane is controlled from the operators cab or by means of pushbutton pendant station. All buttons or levers are spring loaded to return to off switches so that positive operator action is required to initiate and sustain any crane motion. Both stations are equipped with a start-stop button which can be used during an emergency to stop the crane should it become necessary. The crane is equipped with anti-two blocking limits switches, trolley travel limit switches and limit switches to prevent collision with the manipulator crane. Therefore, the polar crane complies with this requirement.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 3.4 - Emergency Repairs

Requirement: Means should be provided for repairing, adjusting or replacing the failed component(s) of subsystem(s) when failure of an active component or subsystem has occurred and the load is supported and retained in the safe (temporary) position with the handling system immobile or a means provided for safely transferring the immobilized hoisting system with its load to a safe laydown area that has been designed to accept the load while repairs are being made.

Actual: Polar crane design complies with this requirement. Depending on failure, repairs can be made in place while load is safely suspended or load may be manually transferred to a safe laydown area that will accept the load while repairs are being made.

NUREG-0554 - Section 4.1 - Reeving System

Requirement: 1. A dual reeving system each providing separate load balance on the head and load blocks through a configuration of ropes and rope equalizers.

2. Rope sizing should include effects of impact loads, acceleration and emergency stops. Maximum load (including static and inertia forces) on each

Response to 2.3.3: (cont'd)

individual wire rope in the dual reeving system with the MCL attached should not exceed 10% of manufacturers published breaking strength.

3. Maximum fleet angle from drum to lead sheave in the load block or between individual sheaves should not exceed (3-1/2°) at any one point during hoisting except that for the last lm (3 ft) of maximum lift elevation the fleet angle may increase slightly. Use of reverse bends should be limited.

4. Pitch diameter of running sheaves should be selected in accordance with CMAA Specification 70.

Actual:

1. The polar crane is not equipped with a dual reeving system. The reeving system consists of a single drum with a single rope reeved to 16 parts through upper and lower sheaves.

2. Ropes have been sized to include affects of impact loads, acceleration and emergency stops. The main hoist rope was replaced during recent polar crane modifications. The new wire rope consists of 16 parts of 1-1/4" Improved Plow Steel 6 X 37 IWRC which has a breaking strength of 69.4 tons. The MCL (R.V. Head & Lift Platform) is 139 tons plus 5 tons for the weight of the load block

Response to 2.3.3: (cont'd)

which provides a safety factor of 7.71. The safety factor for DRL plus weight of the load block is 6.94. These increased safety factors are considered adequate additional protection for reducing load drop potential.

3. The reeving is designed such that the fleet angle relative to the drum and sheaves does not exceed 5° during any operating condition. Reverse bends have been kept to a minimum to reduce rope fatigue.

4. The polar crane has been designed in accordance with CMAA Specification 70. Pitch diameter of all sheaves is at least 24 times the rope diameter.

NUREG-0554 - Section 4.2 - Drum Support

Requirement: Load hoisting drum should be provided with structural and mechanical safety devices to limit the drop of the drum and thereby prevent it from disengaging from its holding brake system if the drum shaft bearings were to fail or fracture.

Actual: The polar crane is not equipped with a device to limit the drop of the drum should the drum shaft bearings fail or fracture; however, during Whiting's

Response to 2.3.3: (cont'd)

polar crane rerating analysis the drum bearing support pedestals and bolts were evaluated. As a result the pedestal bolts have been replaced with higher strength bolts so that stresses will not exceed allowable limits during the 210 ton lifts. When the crane is returned to the original 155 ton DRL, the drum bearing supports will be stressed to less than 70% of allowable when handling the MCL (R.V. Head).

NUREG-0554 - Section 4.3 - Head and Load Blocks

Requirements: 1. Head and load blocks should be designed to maintain vertical load balance about the center of lift from load block through head block and have a dual reeving system.

2. Load block assembly should be provided with two load-attaching points such that each attachment point will be able to support a load of three (3) times the load (static and dynamic) being handled without permanent deformation of load block assembly.

3. The individual component parts of the vertical hoisting system, which include the head block, rope, reeving system, load block and dual attaching devices, should each be designed to support a static load of 200% of the MCL.

Response to 2.3.3: (cont'd)

4. Load blocks should be N.D. Examined by surface and volumetric techniques, documented and recorded.

Actual:

1. The 16 part reeving configuration maintains a vertical load balance through the center of lift from load block through the head block.

2. The load block is not designed for two (2) load attachment points per the above requirement. The main hook is designed for a minimum safety factor of 5 based on DRL, however, during Whiting's rerate analysis it was confirmed that allowable stress for the 210 ton lifts would not be exceeded on the hook. This indicates the safety factor for material strength of the hook exceeds 7.29 based on the MCL.

3. The polar crane DRL is 155 tons. The MCL is 144 tons or approximately 11% less than the DRL. The crane is not in compliance with this requirement. However, the additional design margins, discussed previously, are considered an adequate alternative to this requirement.

4. Crane hooks are nondestructively examined in accordance with ANSI B30.10-1975. This inspection is performed in accordance with an established written procedure.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 4.4 - Hoisting Speed

Requirement: Maximum hoisting speed for critical load should be limited to that given in the slow column on Figure 70-6 of CMAA Specification 70.

Actual: Figure 70-6 of CMAA Specification 70 only shows hook speeds for cranes up to 150 ton capacity. However, the 155 ton capacity main hoist is considered to meet the requirements of this section since the maximum hoist speed does not exceed 2.75 per minute which is below the slow speed requirement for a 150 ton crane.

NUREG-0554 - Section 4.5 - Design Against Two Blocking

Requirement: 1. Provide means within the reeving system located on the head or load block combinations to absorb or control the kinetic energy of rotating machinery during two blocking or

2. Provide two (2) independent travel limit devices of different design and activated by separate mechanical means. The protective control system for load handling should consist of load cell system in the drive train, current sensing devices, or mechanical load-limiting devices.

Response to 2.3.3: (cont'd)

Actual: The polar crane is equipped with dual limit switches which are independent and of different design to prevent two-blocking. The hoist drum contains a geared limit switch for upper and lower hoist limit and the hoist cable is equipped with a weighted block type limit switch for upper hoist limit. The latter being actuated by means of the load block contacting a lever arm which activates the electric/mechanical limit switch.

NUREG-0554 - Section 4.6 - Lifting Devices

Requirement: Lifting devices such as lift beam yokes, trunion type hooks, slings, toggles and clevises should be conservatively designed with dual or auxiliary device combinations. Each device should be selected to support a load of three (3) times the load (static and dynamic) being handled without permanent deformation.

Actual: Special Lifting devices associated with the polar crane are not redundant except for the ISI tool/handling tool. Our reply to the Part I T.E.R provided a comparison of the special lifting devices to ANSI N14.6 (see Table 3 of our response to Mr. S. A. Varga from Mr. S. R. Zimmerman dated December 15, 1982).

Response to 2.3.3: (cont'd)

Each of the polar crane associated lifting devices are briefly discussed below with respect to their design ratings.

Reactor Vessel Head Lifting Rig - The weakest link of this device has a safety factor of 4.20 based on minimum yield. The safety factors of all other components of this device have safety factors greater than 5 based on minimum yield.

Internals Lifting Rig - The safety factors of this device, when handling the lower internals, meet the minimum yield safety factor of 3, however, since during lower internals handling operations there will be no spent fuel in the containment, no hazard to spent fuel exists.

Therefore, handling of the upper internals constitutes the only potential for a load drop which could affect spent fuel or equipment required for safe shutdown. The safety factors of the lifting device during handling of the upper internals exceed 8.2 based on minimum yield strength.

Reactor Coolant Pump Motor Sling Assembly - This lifting device has a minimum safety factor of 6 based on ultimate strength for components whose failure could result in a load drop.

Response to 2.3.3: (cont'd)

ISI Tool/Handling Tool - This device conforms to the requirements of ANSI N14.6 and has a minimum safety factor of 10.24 based on ultimate tensile strength and 6.65 based on yield strength of the material used.

Standard Lifting Devices - Such as slings, hooks, and shackles whenever possible are used in redundant configurations. Safety factors are based on ultimate strength. Each of the dual load paths generally have a safety factor of five based on ultimate strength or in cases where redundancy is not possible a safety factor of 10 or greater. Personnel training and approved procedures emphasize that a minimum safety factor of 10 shall be achieved in configuring the lifting rigs for the loads discussed below.

The lifting devices, as discussed below, are examples of acceptable rigs used to provide adequate factors of safety and reasonable assurance that spent fuel and/or safety related

Response to 2.3.3: (cont'd)

Standard Lifting Devices (cont'd)

equipment will not be damaged due to failure of a lifting device. Frequent inspections, infrequent use, and moderate environmental storage conditions provide additional assurance regarding integrity of the lifting devices.

Stud Tensioner - A typical lifting arrangement for the stud tensioner consists of two 3/4" diameter shoulder eyebolts and two 3/8" diameter 6 x 19 IWRC slings. The shoulder eyebolts, when used in this configuration, have a safe working load of at least 2,000 lbs. each for a combined safety factor of approximately 10. The slings also provide a safety factor of greater than 10. This lifting arrangement meets the requirements of NUREG-0612.

Stud Rack - The lifting device for the stud rack consists of a four-leg 5/8"-diameter sling assembly and four 8.5-ton screw pin anchor shackles. The safety factor for this configuration exceeds 10. Therefore, this device meets the requirements of NUREG-0612.

Hatch Covers

Head Storage - A typical lifting device for the head storage covers consists of a 2-1/4" diameter four-leg sling assembly and four 13-1/2-ton

Response to 2.3.3: (cont'd)

Standard Lifting Devices (cont'd)

capacity shackles. All of the nine-pie shaped blocks can use this arrangement which provides a safety factor of 10 or greater.

The above lifting device meets the intent of or exceeds the requirements of NUREG-0612.

Pump Bay Covers - A typical lifting device for the pump bay hatch covers consists of a 2" diameter four-leg sling and four 13-1/2-ton shackles. The safety factor of the shackles for this configuration is greater than seven (based on use of 13-1/2-ton shackles with six S.F.). The sling safety factor is greater than 10. Should a failure of one lifting leg occur, a load drop would not occur. The above lifting device is considered to satisfy NUREG-0612.

Pressurizer Cover - A typical lifting device for the pressurizer cover consists of a 2-1/4" diameter, four-leg sling assembly, and four 25-ton capacity shackles which attach to the lifting leg oval links rated at 39,900 lbs. each. The safety factors for each of the lifting device components exceeds 10, therefore, this device meets the requirements of NUREG-0612.

Response to 2.3.3: (cont'd)

Standard Lifting Devices (cont'd)

R.V. Missile Shield - A typical lifting device for the missile shield consists of a 2-1/4" diameter four-leg sling assembly and four five-ton capacity screw pin anchor shackles. The safety factor for the sling arrangement is greater than 9 and greater than 10 for the shackles.

Seal Table Cover - A typical lifting device for the seal table cover consists of a 2-1/4" diameter four-leg sling assembly and four 13-1/2-ton capacity shackles which attach to the lifting pad shackles. The safety factors for each of the lifting device components exceeds 10, therefore, this device meets the requirements of NUREG-0612.

R.V. Missile Shield Frame - A typical lifting device for the missile shield frame consists of a four-leg or two-leg 2-1/4" diameter sling assembly depending on the position of the shield frame. During handling in the horizontal position, a four-leg 2-1/4" diameter sling assembly is used with four 13-1/2-ton shackles.

Response to 2.3.3: (cont'd)

Standard Lifting Devices (cont'd)

The slings are connected to the frame by means of a choker-hitch arrangement. The safety factors for components of this arrangement are 10 or greater. During upending and placement into storage, the frame is handled with a 2-1/4" diameter two-leg sling assembly and two 25-ton shackles. The slings are connected to the frame by shackles to a lifting lug arrangement. The minimum safety factor of the components in this arrangement is greater than 12 for the shackles. This lifting device meets the requirements of NUREG-0612.

Air Recirculating Fan Motor - A typical lifting device for the Recirculating Fan Motor consists of two 7/8 eyebolts and two 1/2" diameter 6 x 19 slings. The safety factors for this arrangement meet the requirements of NUREG-0612.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 4.7 - Wire Rope Protection

Requirement: If side loads cannot be avoided, the reeving system should be equipped with a guard that would keep the wire rope properly located in the grooves of the drums.

Actual: Although side loads are not expected to occur the devices are equipped with guards to assist in keeping ropes in place.

NUREG-0554 - Section 4.8 - Machinery Alignment

Requirement: Where gear trains are interposed between the holding brakes and the hoisting drum, these gear trains should be single failure-proof and should be of dual design.

Actual: The polar crane is equipped with a single drive train which is comprised of a standard drive motor and gearing for normal lifts and a micro drive system for heavy lifts. The micro drive is part of the modification to upgrade the polar crane for replacement of the steam generators. The addition of the micro drive system enables the crane to meet the requirements of CMAA Specification 70 for the 210 ton replacement lift. The main hoist gearing meets the design requirements of CMAA Specification 70

Response to 2.3.3: (cont'd)

for the 210 ton steam generator replacement lifts. Therefore, assuming that these requirements are met but not exceeded, the HBR Polar Crane has an increased "Safety Margin" of 135.4% for the design rated load (DRL) of 155 ton and 145.8% for the maximum Critical Load (MCL) which is 144 tons. CP&L considers the above additional safety margins to be an adequate alternative to the requirements of Section 4.8 of of NUREG-0554.

NUREG-0554 - Section 4.9 - Hoist Braking System

Requirement: 1. Each hoist brake should have a minimum capacity of 125% of the torque developed during the hoisting operation.

2. Minimum hoisting braking system should include one power control braking system and two (2) holding brakes.

3. Holding brake system should be single failure-proof.

4. Manual operation of hoisting brakes during emergency conditions should be included in the crane design.

Actual: 1 & 2. The H. B. Robinson Unit 2 Polar Crane is equipped with two (2) mechanical holding brakes and

Response to 2.3.3: (cont'd)

a control braking system which is incorporated into the "W" Thyristor Control which controls the main hoist motor.

The holding brakes were recently replaced as part of modification package M694. The following provides a brief description of the holding brakes.

- 12" Main Hoist Holding Brake - located on the main hoist motor was replaced with a Whiting 13 "SESA" (Solenoid Enclosed Self Adjusting) brake. This brake develops 172% of the required H.P. rating for the 210 ton load or approximately 230% of the required H.P. rating for the 155 ton DRL.
- 23" Main Hoist Holding Brake - located on the intermediate pinion shaft was replaced with a new 23" brake which provides a wider shoe. This brake develops 124% of the required H.P. rating for the 210 ton load or approximately 168% of the required H.P. rating for the 155 ton DRL.

3. The braking system for the Polar Crane is not single failure proof, however, the additional design margins of the holding brakes discussed above and the additional design margins associated with the gear train (gear train meets requirements of CMAA-70 for 210 ton lift) provide an adequate alternative to the single failure proof requirements of NUREG-0554 Section 4.9-3.

Response to 2.3.3: (cont'd)

4. The load may be manually lowered during an emergency.

NUREG-0554 - Section 5 - Bridge and Trolley

5.1 Braking Capacity

Requirement: 1. The maximum torque capability of the driving motor and gear reducer for trolley and bridge motion should not exceed the capability of the gear train and brakes to stop the trolley or bridge from maximum speed with the DRL attached.

2. Brakes should be mechanically tripped to the "on" or "holding" position in the event of a malfunction in the power supply or an overspeed condition.

3. Opposite-drive wheels on bridge or trolley that support bridge or trolley on their runways should be matched and have identical diameters.

4. Trolley and Bridge speeds should be limited per Specification CMAA #70.

Actual: The braking capacity and system meets or exceeds the requirements of CMAA Specification 70 and complies with the above requirements.

Response to 2.3.3: (cont'd)

5.2 - Safety Stops

Requirement: 1. Limiting devices should be provided to control or prevent overtravel and overspeed of the trolley and bridge. Buffers for bridge and trolley travel should be at the end of the rails.

2. Safety devices such as limit type switches should be provided for malfunction and inadvertent operator action or failure and should be in addition to and separate from the limiting means or control devices.

Actual: The trolley is equipped with a limit switch which stops the trolley as it begins travel onto the cantilever section. The operator must consciously press a limit switch bypass button in order to proceed onto the cantilever section. A warning light with identifying name plate is provided to alert operator when trolley has traveled to within 9" of rail stops.

The polar crane is capable of 360° rotation and as such does not need a travel limit. However, limit switches have been installed to prevent collision between the polar crane and manipulator crane.

Response to 2.3.3: (cont'd)

NUREG-0554 - Section 6 - Drivers and Controls

6.1 Driver Section

Requirement: Maximum torque capability of electric motor drive for hoisting should not exceed the rating or capability of components required to hoist the MCL at maximum design speed.

Actual: The electric motors were selected in accordance with the requirements established in CMAA Specification 70 and meet the intent of the requirements in this section.

6.2 Driver Control Systems

Requirement: If crane is used to lift spent fuel assemblies, the control system should be adaptable to include interlocks that will prevent trolley and bridge movements while the load is being hoisted free of the reactor vessel or storage rack.

Actual: Polar crane does not handle spent fuel elements.

6.3 Malfunction Protection

Requirement: 1. Means should be provided in the motor control circuits to sense and respond to such items as excessive electric current, excessive motor temperature, overspeed, overload and overtravel.

Response to 2.3.3: (cont'd)

2. Controls should be provided to absorb kinetic energy of the rotating machinery and stop the hoisting movement reliably and safely if one rope or one of the dual systems should fail or if overloading or an overspeed condition should occur.

Actual: Review of the Polar Crane Motor Control design confirms that the above requirements have been designed into the control circuitry.

6.4 Slow Speed Drives

Requirement: If jogging or plugging is to be used, the control circuit should include features to prevent abrupt change in motion. Drift point in the electric power system when provided for bridge or trolley movement should be provided for only the lowest operating speeds.

Actual: The bridge and trolley are equipped with 5 speed step control. The step controls provide for even movement of the load. It should be noted, however, that only proper operator training will eliminate abrupt changes in motion which cause load swings, therefore, CP&L has placed considerable emphasis on proper training of crane operators.

Response to 2.3.3: (cont'd)

6.5 Safety Devices

Requirement: Safety devices such as limit type switches provided for malfunction, inadvertent operator action or failure should be in addition to and separate from the limiting means on control devices provided for operator.

Actual: Limit switches as discussed previously are separate from normal control functions provided for operation.

6.6 Control Stations

Requirement: 1. Complete operating control system and provision for emergency control should be located in a cab on the bridge.

2. Additional operator control stations should have control similar to the main station.

3. Electrical interlock should be provided to permit only one control station to be operable at any one time.

Response to 2.3.3: (cont'd)

Actual: The polar crane is equipped with both a bridge mounted cab and pendant control. Each station is equipped with similar controls and are interlocked to allow use of only one station at a time.

NUREG-0554 - Section 7 - Installation Instructions

7.1 General

Requirement: Installation instructions should be provided by the manufacturers.

Actual: Complete installation instructions were provided by the manufacturer as well as technical representation provided to assist in crane erection and checkout.

7.2 Construction and Operating Periods

Requirement:

1. Construction and operation requirements should be defined separately.

2. At end of construction period, the crane should be modified as needed for performance requirements of the Nuclear Power Plant operating service.

3. After construction use, the crane should be thoroughly inspected by NDE and load tested for the operating phase.

4. NDE extent and acceptance criteria should be defined in the design specification.

Response to 2.3.3: (cont'd)

5. If allowable stress limits are to be exceeded during construction, added inspection supplementing that described in Section 2.6 of NUREG-0554 should be specified and developed.

6. During and after installation of the crane, the proper assembly of electrical and structural components should be verified.

7. Integrity of control, operating and safety systems should be verified.

Actual:

1. Construction and operating requirements were defined separately.

2. At the end of construction the polar crane design was reviewed by the manufacturer to assure it met the performance requirements of the Nuclear Power Plant operating service.

3. The polar crane was thoroughly inspected and refurbished to restore the crane to its original new condition.

4. NDE extent and criteria were not defined in the specification for removal from construction phase to plant operation phase.

Response to 2.3.3: (cont'd)

5. The polar crane was thoroughly inspected after the construction use period to assure overstress did not have detrimental effect on the crane.

6. Proper assembly of electrical, structural and mechanical components was verified.

7. Integrity of control and operating and safety system were verified during crane checkout and load test.

NUREG-0554 - Section 8 - Testing and Preventive Maintenance

8.1 General

Requirement: 1. Make complete check of all crane's mechanical and electrical systems.

2. Maintain records of checking and testing.

8.2 Static and Dynamic Load Test

Requirement: 1. Perform static and dynamic load test.

Actual: 8.1 & 8.2 The polar crane was thoroughly inspected and checked out prior to testing and the records are maintained on site in the Q.A. file. A static and dynamic load test of the crane's DRL was performed in accordance with ANSI B30.2. The polar crane was dynamically re-load tested upon completion of Plant Mod. M694. This load test was in accordance with the requirements of ANSI B30.2.

Response to 2.3.3: (cont'd)

8.3 Two-Block Test

Requirement: 1. When equipped with an energy-controlling device between the load and head block, the complete hoisting machinery should be allowed to two-block. The test should be conducted at slow speed without load.

2. Crane should be tested for load hangup.

Actual: The polar crane upper point limit switches were checked out to verify proper functioning during crane check and load test. Since the crane is not equipped with an energy controlling device the crane was not allowed to actually "two-block". These limits are also checked frequently to verify proper functioning.

8.4 Operational Tests

Requirement: Operational test should be performed to verify proper functioning of limit switches and ability to perform as designed.

Actual: Operational tests and inspections are performed in accordance with ANSI B30.2.

Response to 2.3.3: (cont'd)

8.5 Maintenance

Requirement: Performance of maintenance and marking of MCL rating.

Actual: The polar crane as well as all other cranes are subject to a periodic inspection and maintenance program as outlined in this report. The maintenance and testing program is considered an extremely important part of safe load handling. The DRL is marked on the crane. CP&L considers this crane to be in like-new condition and not to have suffered any degradation due to use and exposure. The DRL will continue to be marked on the crane.

NUREG-0554 - Section 9 - Operating Manual

Requirement: Manufacturer provide operating manual.

Actual: Whiting provided a crane manual which provides information for checking, testing, operating and maintaining the polar crane.

NUREG-0554 - Section 10 - Quality Assurance

Requirement: Establish a Quality Assurance Program for design, fabrication, installation, testing and operation.

Actual: CP&L is in compliance with this requirement.

Response to 2.3.3: (cont'd)

Item 3 - "With respect to the seismic analysis employed to demonstrate that the overhead handling system can retain the load during a seismic event equal to a safe shutdown earthquake, provide a description of the method of analysis, the assumptions used, and the mathematical model evaluated in the analysis. The description of assumptions should include the basis for selection of trolley and load position."

Answer -

The containment crane was analyzed as a single mass coupled to the multi-mass model of the reactor containment inner structure which serves as its support. The first five mode shapes and the associated periods of vibration were computed utilizing stiffness matrix techniques. The response of each mode of vibration was computed utilizing the methods of modal analysis for the operational response spectra 0.1g and 0.2g design response spectra. Design values of total response were obtained by combining the individual model contributions on a root-mean square basis. The model used in design is shown in Figures 3.7.2-5 and 3.7.2-6.

Response to 2.3.3: (cont'd)

An examination of the mode shapes reveals that the first mode of vibration represents (almost entirely) the vibration of the crane structure above the operating floor. The second and higher modes are primarily the rocking and translational vibration of the reactor containment inner structure with very minor contribution of the crane structure.

Both the trolley and the crane columns are provided with positive stop devices to prevent motion when the crane is not in operation. In addition, rail anchorages are provided to prevent the crane from leaving the rails if uplift should occur. The crane is always in the parked and locked condition when the reactor is in operation.

The original Ebasco Specification No. WELC-5379-54, "Reactor Building Crane", Rev. 1: March 17, 1967, indicates that the polar crane was designed for the following seismic loads:

"a. Horizontal load equal to 25 percent of dead load of crane and trolley acting simultaneously with:

b. Vertical load equal to 7 percent of dead load of crane and trolley.

c. Horizontal load equal to 50 percent of dead load of crane and trolley, acting simultaneously with:

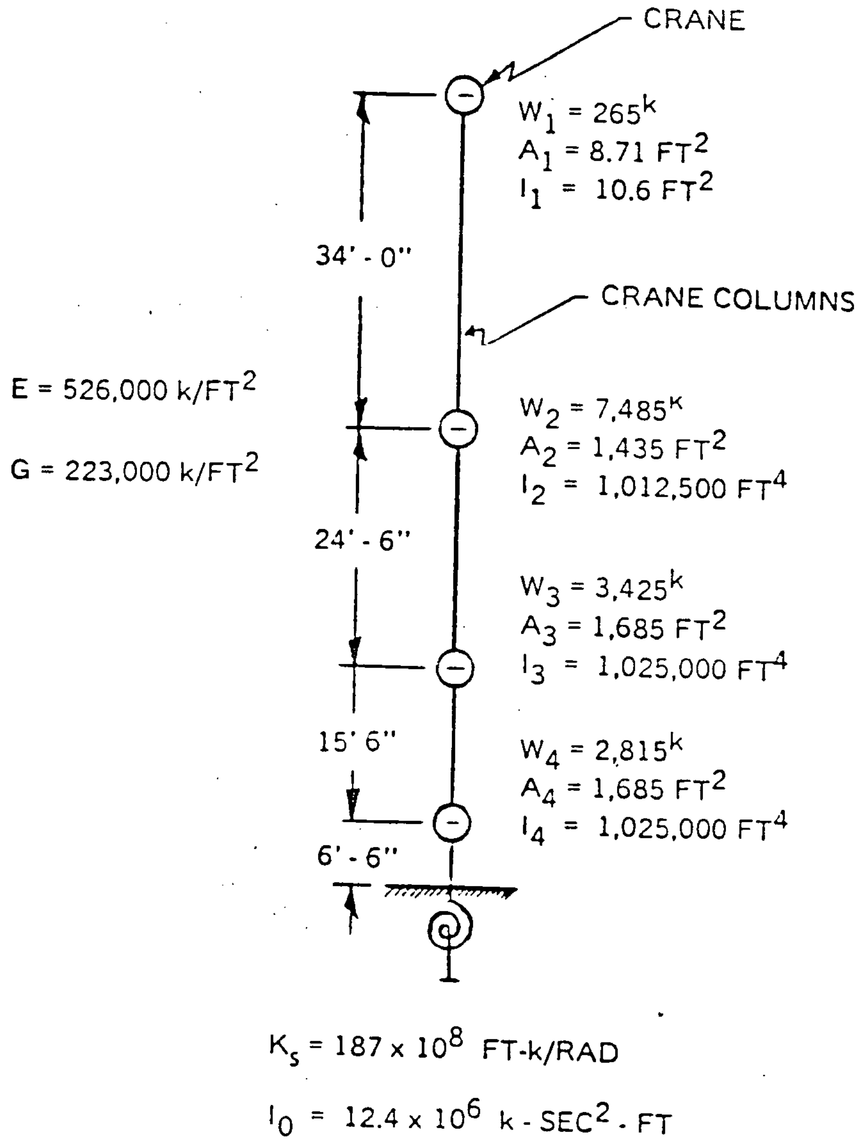
d. Vertical load equal to 15 percent of dead load of crane and trolley.

Response to 2.3.3: (cont'd)

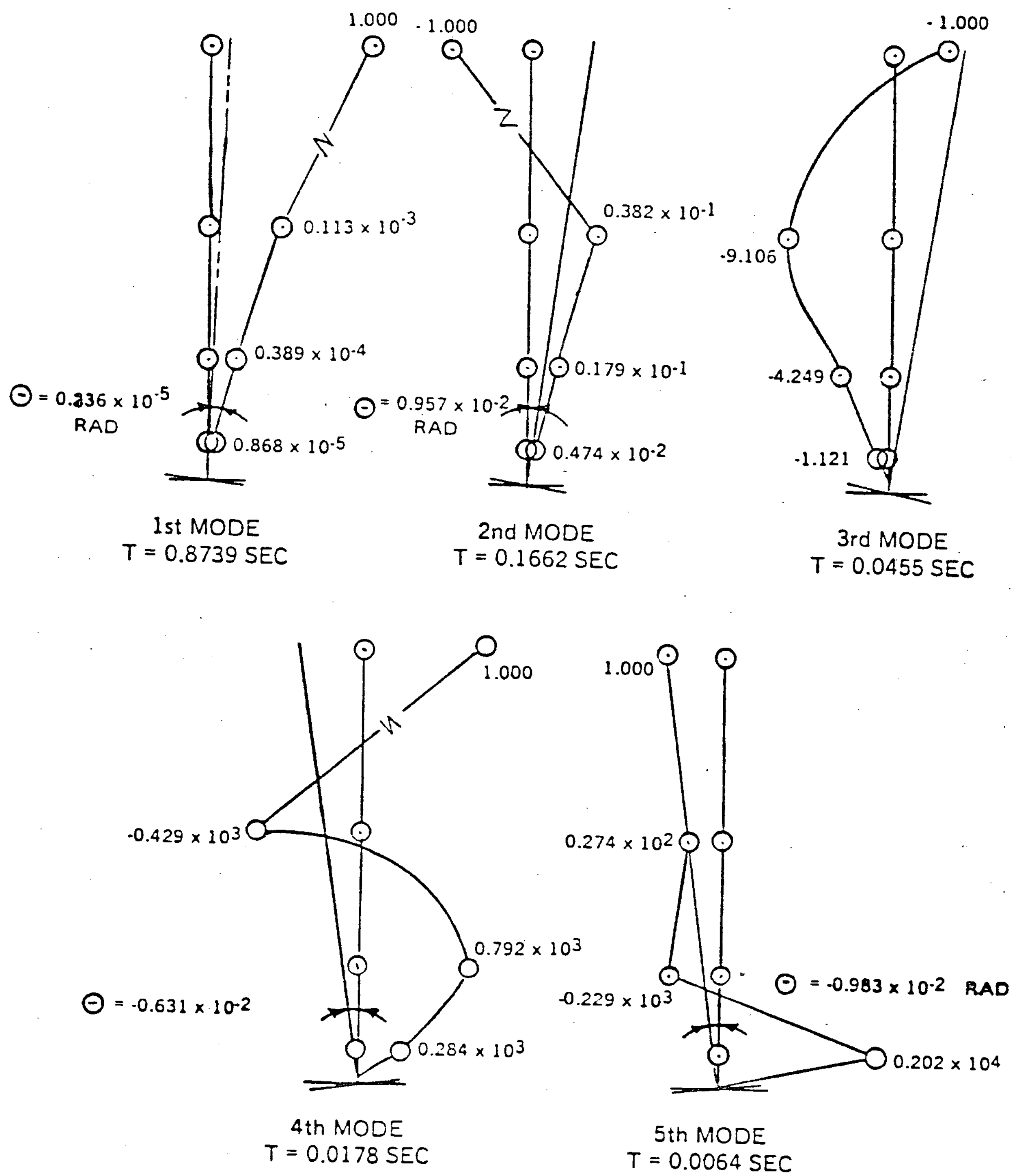
Conditions (a) and (b) are design earthquake loads applicable to the design of the crane member and parts. Conditions (c) and (d) are hypothetical earthquake loads applicable to the stability of the crane as a whole, and the integrity of the components.

All structural and mechanical parts of the crane shall be designed to resist dead, live and seismic loads and the forces produced by impact, thrust, and the rated breakdown torque of motors."

CP&L considers the seismic design of the polar crane to be adequate.



H. B. ROBINSON UNIT 2 Carolina Power & Light Company UPDATED FINAL SAFETY ANALYSIS REPORT	MATHEMATICAL MODEL OF CRANE AND STRUCTURES	FIGURE 3.7.2 - 5



H. B. ROBINSON UNIT 2 Carolina Power & Light Company UPDATED FINAL SAFETY ANALYSIS REPORT	MODE SHAPES AND PERIODS OF VIBRATION OF CRANE AND STRUCTURES	FIGURE 3.7.2 - 6

Response to 2.3.3: (cont'd)

Item 4 - "Provide an evaluation of the lifting devices for each single-failure-proof handling system with respect to the guidelines of NUREG-0612, Section 5.1.6."

Answer -

Evaluation of special and standard lifting devices associated with the polar crane was previously provided in Section 4.6 of the "Point by Point" comparison of the polar crane to NUREG-0554. All standard lifting devices used to handle heavy loads in the containment will provide increased safety factors in accordance with the requirements of Section 5.1.6 of NUREG-0612, except for those exceptions identified in Section 4.6 of the Point by Point Comparison of the Polar Crane to NUREG-0554.

Response to 2.3.3: (cont'd)

Item 5 - "Provide an evaluation of the interfacing lift points with respect to the guidelines of NUREG-0612, Section 5.1.6."

Answer -

Reactor Vessel Head - The reactor and reactor vessel head were designed and built in accordance to ASME Section III - 1965 of the Boiler and Pressure Vessel Code. Information regarding the design safety factor for the head lifting lugs is not readily available due to the age of this plant. However, discussions with the vessel supplier "Westinghouse" indicate that a safety factor of 6 based on ultimate strength was probably used. Although the safety factor or lack of redundancy does not conform to the requirements of NUREG-0612 Section 5.1.6, CP&L does not consider it necessary or prudent to modify the head lifting lugs. Inspection of the lifting lugs has not revealed any deterioration and/or flaws, during the plants 13 year operating history. CP&L will continue to perform inspections in accordance to the procedure outlined in our respone to F.R.C. recommendation 2.1.5C of the Part I T.E.R.

Reactor Internals - The interfacing lift points for the upper and lower internals consist of a structural frame mechanism which fits into an integral part of the upper or lower internals assembly. Since the mechanism and arrangement was designed to handle the heavier lower internal assembly and maintain a

Response to 2.3.3: (cont'd)

minimum yield safety factor of three, the safety factor would increase to approximately 8.2 based on minimum yield strength when handling the upper internals. This was arrived at by comparing the weight differences between the two assemblies.

Reactor Coolant Pump Motor - The Reactor Coolant Pump Motor lifting slots (there are three) are an integral part of the motor casing. Information regarding the design safety factor for the lifting slots is not readily available due to the age of this plant. However, since the lifting slots are cut into the motor frame and the motor lifting sling attaches to provide a vertical pull, the capacity of the lifting slots can be based on the strength of material for the motor frame. Review indicates that the safety factor relative to the attachment point is in excess of 10 based on material ultimate strength. CP&L considers the lifting slots to be adequately designed to provide reasonable assurance that a failure will not occur. Inspections during the 13 years of plant operation have not revealed any deterioration and/or flaws. CP&L will continue to perform inspections in accordance with the procedure outlined in our response to the F.R.C. recommendation 2.1.5C of the Part I T.E.R.

ISI Tool/Handling Tool - The ISI tool attaches to the polar crane hook via a dual arrangement. The safety factor of the hook when handling this tool is greater than 10. Therefore, this lifting arrangement conforms to the requirements of NUREG-0612 Section 5.1.6.

Response to 2.3.3: (cont'd)

Stud Tensioner - The interfacing lift points for the stud tensioner consist of two 3/4" diameter shoulder eyebolts each having a capacity of 6000 lbs. for a straight vertical pull. Any angular pull associated with the normal two sling rigging arrangement would not reduce the eyebolt rated capacity below 2000 lbs. The threaded connection for each eyebolt is capable of supporting the maximum capacity of the eyebolt. Therefore, the safety factor for the interfacing lift point exceeds 10 which is in conformance with the requirements of NUREG-0612, Section 5.1.6.

Stud Rack - The stud rack interfacing lift points consist of four lugs welded to the structural frame. Analysis of the lug and welding indicates that the lugs to have a minimum safety factor of 3.37 based on yield strength. Since this lifting arrangement is a four point pick, failure of one attachment point will not result in a load drop. In the unlikely event of a single lift point failure, the rack would be immediately set down. Movement of the rack would not resume until repairs were completed, inspected and accepted. Therefore, CP&L considers the design of the stud rack lifting lugs to be adequate and that reasonable assurance is provided to assure a load drop will not occur.

Response to 2.3.3: (cont'd)

Hatch Covers - The interfacing lift points between the standard lifting apparatus described earlier and the hatch covers consists of three different designs. Each of the 3 types of lift points are embedded and/or bolted into the hatch covers to form an integral part of the cover. The three are discussed below.

Type 1 - The pressurizer cover, lifting lug arrangement consists of four embedded forged steel hair pin anchors and matching lifting rings. Based on ultimate material strength and weight of the pressurizer cover the four lifting lugs provide a safety factor in excess of 10. Therefore, if one attachment point were to fail, the safety factor would not be reduced below 5. This configuration meets the requirements of NUREG-0612.

Type 2 - The lifting lug arrangement for the pie blocks, RCP covers and seal table plug consists of a welded embedment and shackle arrangement. The safety factor for the attachment point (shackle) varies as follows: 7.62 for the RCP cover, 24.5 for the seal table cover and 12.96 for the pie blocks. All of the above have a four point lift arrangement. Therefore, in the unlikely event of a single attachment point failure, a load drop would not occur.

Type 3 - The attachment points to the R.V. missile shield consists of 4 welded embedments. Each of these lifting lugs is designed to carry a maximum load of 53 Kips with a leg angle of 45 degrees. This design provides for a safety factor of greater than 11. Should one attachment point fail, the safety factor would not fall below 5.5.

Response to 2.3.3.: (cont'd)

R.V. Missile Shield Frame - The missile shield frame is upended and transported to its storage location by using the two lifting lugs which are welded to one end of the frame. Review of the lug design, determined that the lugs have a safety factor of 5.31 based on yield strength. CP&L considers the additional margin of safety above the 3.0 normally required to provide reasonable assurance that a lifting lug failure will not occur and that the intent of NUREG-0612 has been met.

Air Recirculation Fan Motor - The attachment points to the motor consists of two 7/8" diameter threaded holes for insertion of two 7/8" diameter eyebolts. Therefore, the lifting points (eyebolts and threaded holes) are only loaded to approximately 50% of their rated Safe Working Load. CP&L believes this arrangement to meet the requirements of NUREG-0612.

Request 2.3.4:

"For cranes identified in 2.3-1, above, not categorized according to 2.3-3, demonstrate that the evaluation criteria of NUREG-0612, Section 5.1, are satisfied. Compliance with Criterion IV will be demonstrated in your response to Section 2.4 of this request. With respect to Criteria I through III, provide a discussion of your evaluation of crane operation in the containment and your determination of compliance. This response should include the following information for each crane:

a. Where reliance is placed on the installation and use of electrical interlocks or mechanical stops, indicate the circumstances under which these protective devices can be removed or bypassed and the administrative procedures invoked to ensure proper authorization of such action. Discuss any related or proposed technical specification concerning the bypassing of such interlocks.

b. Where reliance is placed on other site-specific considerations (e.g., refueling sequencing), provide present or proposed technical specifications and discuss administrative or physical controls provided to ensure the continued validity of such considerations.

c. Analyses performed to demonstrate compliance with Criteria I through III should conform with the guidelines of NUREG-0612, Appendix A. Justify any exception taken to these guidelines, and provide the specific information requested in Attachment 2, 3, or 4, as appropriate, for each analysis performed.

Response to 2.3.4:

Section 2.3-3 provides an evaluation of the polar crane which indicates sufficient design features to make the likelihood of a load drop extremely small for all loads. Since the only other crane identified in Section 2.3-1 (manipulator crane) was eliminated in our response to Section 2.3-2, no cranes fall into this category.

2.4 Specific Requirements for Overhead Handling Systems Operating in plant areas containing equipment required for reactor shutdown, core decay heat removal, or spent fuel pool cooling.

"NUREG-0612, Section 5.1.5 provides guidelines concerning the design and operation of load-handling systems in the vicinity of equipment or components required for safe reactor shutdown and decay heat removal. Information provided in response to this section should be sufficient to demonstrate that adequate measures have been taken to ensure that in these areas, either the likelihood of a load drop which might prevent safe reactor shutdown or prohibit continued decay heat removal is extremely small, or that damage to such equipment from load drops will be limited in order not to result in the loss of these safety related functions. Cranes which must be evaluated in this section have been previously identified in your response to 2.1-1, and their loads in your response to 2.1-3-C."

Request 2.4-1:

"Identify any cranes listed in 2.1-1, above, which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e. complete compliance with NUREG-0612, Section 5.1.6, or partial compliance supplemented by suitable alternative or additional design features). For each crane so evaluated, provide the load-handling-system (i.e., crane-load-combination) information specified in Attachment 1."

Response to 2.4-1:

The cask handling crane and the polar crane have been evaluated to have sufficient design features which make the likelihood of a load drop extremely small for all loads carried. The cask crane as discussed in our response to 2.2 is "single failure-proof". The polar crane has been discussed in detail during our response to 2.3.

Appendix V consists of a list of the hazard elimination categories and Table 4-1a "Hazard Elimination Index". The index provides a summary of the hazard eliminations for each of the 25 loads (by crane) identified in the load/impact matrix table (Table 4-1, Sheets 1-5) located in Appendix IV.

Request 2.4-2:

"For any cranes identified in 2.1-1 not designated as single failure-proof in 2.4-1, a comprehensive hazard evaluation should be provided which includes the following information:"

2.4-2(a): "The presentation in a matrix format of all heavy loads and potential impact areas where damage might occur to safety-related equipment. Heavy loads identification should include designation and weight or cross reference to information provided in 2.1-3-C. Impact areas should be identified by construction zones and elevations or by some other method such that the impact area can be located on the plant general arrangements drawings."

Response to 2.4-2(a):

Appendix IV, Table 4-1 (Sheets 1-5) provides load/impact matrices for cranes identified in our response to 2.1-1 which have not been designated as "single failure-proof". A load/impact matrix sheet was developed for the polar crane to assist in preparation of our response to Section 2.3 of this report and is included in Appendix IV.

CONTROL OF HEAVY LOAD

Request 2.4-2b:

"For each interaction identified, indicate which of the load and impact area combinations can be eliminated because of separation and redundancy of safety-related equipment, mechanical stop and/or electrical interlocks, or other site specific considerations. Elimination on the basis of the aforementioned considerations should be supplemented by the following specific information:

1) For load/target combinations eliminated because of separation and redundancy of safety-related equipment, discuss the basis for determining that load drops will not affect continued system operation (i.e., the ability of the system to perform its safety-related function).

2) Where mechanical stops or electrical interlocks are to be provided, present details showing the areas where crane travel will be prohibited. Additionally, provide a discussion concerning the procedures that are to be used for authorizing the bypasing of interlocks or removable stops, for verifying that interlocks are functional prior to crane use, and for verifying that interlocks are restored to operability after operations which require bypassing have been completed.

3) Where load/target combinations are eliminated on the basis of other, site specific considerations (e.g., maintenance sequencing), provide present and/or proposed technical specifications and discuss administrative procedures or physical constraints invoked to ensure the continued validity of such considerations."

CONTROL OF HEAVY LOADS

Response to 2.4-2b:

Load target combinations eliminated because of separation and or redundancy of safety-related equipment are as follows:

a) Turbine Building Crane (S/N 9700)

Turbine Component Loads to 144 Tons

A load drop from the turbine building crane when carrying the heavy turbine components could result in damage to 4160V and 480V switchgear located at the East end of the mezzanine floor (elev. 242.5') below the operating deck. However, our investigation concludes that these power supplies are not safety related. Therefore, no equipment is in danger that could effect ability to maintain safe shutdown.

b) Boric Acid Batch Room Monorail

A load drop from this crane is not considered likely due to the increased S.F. of the crane and handling equipment. The maximum load handled by this crane is less than 1,000 lbs. Failure of the floor slab in this area is not considered likely due to the thickness of the slab which is 2-1/2'. However, should a load drop occur and penetrate the floor slab or cause secondary missiles which could cause damage to a Service Water Booster Pump, two pumps provide redundancy.

CONTROL OF HEAVY LOADS

Request 2.4-2c:

"For interactions not eliminated by the analysis of 2.4-2b, above, identify any handling systems for specific loads which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small and the basis for this evaluation (i.e. complete compliance with NUREG-0612, Section 5.1.6 or partial compliance supplemented by suitable atlternative or additional design features). For each crane so evaluated, provide the load-handling-system (i.e. crane-load-combination) information specified in Attachment 1."

Response to 2.4-2c:

a) Boric Acid Batch Room Monorail - 2 ton capacity.

Our reply to Section 2.4-2b eliminated this crane due to equipment redundancy. In addition, the Boric Acid Batch Room Monorail has an MCL of less than 1/4 of the DRL. CP&L considers this load handling system to be in partial compliance to NUREG-0612 due to the increased safety factor. Further discussion relative to Attachment 1 has not been provided for this monorail since it was also eliminated in 2.4-2b.

Response to 2.4-2c: (cont'd)

b) Solid Waste Handling Crane - Five-ton capacity

Manufacturer: Philadelphia Tramrail Company.

This crane consists of a single-bridge girder and underhung monorail. Verbal conversations with the manufacturers of the bridge assembly and the hoist have indicated:

(1) The bridge was designed in accordance with accepted industry standards prior to existence of CMAA-70 and ANSI B30.

(2) The P&H five-ton capacity hoist is manufacturer's standard and meets or exceeds current requirements contained in HMI-100 and/or ANSI B80.16. The hoist is protected by two upper limit switches and one lower limit switch. The upper limit switches consist of one gear type and one paddle type. The paddle limit switch also provides for reverse plugging. The hoist is designed to have a minimum safety factor of five based on ultimate strength of material.

The crane's DRL is 10,000 lbs. The MCL is 8,500 lbs. Therefore, since the hoist was designed to have a minimum S.F. of five based on the DRL, the hoist safety factor when handling the MCL increases to 5.88. CP&L believes this load handling system provides reasonable assurance that a load drop will not occur.

Lifting Devices - A maximum of one liner at 8,500 lbs. is handled by this crane. The liner is lifted by standard lifting equipment which consists of two slings and four welded shackles which are supplied with and are an integral part of the liner. This arrangement was sized to provide for safety factors in excess of 10.

Response to 2.4-2c: (cont'd)

Interfacing Lift Points - The above lifting assembly attaches to the liner at four points. A conversation with the manufacturer (Chem-Nuclear) confirmed that the liner lift points were designed to carry a load three times the design capacity of the liner. Failure of a single-lift point in this arrangement could result in an uncontrolled movement of the load. However, CP&L does not consider the potential for uncontrolled movement of the load to present any substantial hazardous condition with regard to safety related equipment or the ability to maintain safe shutdown. During normal handling of the liner, the load is normally maintained at a height of 4"-6" above the floor. In the unlikely event of a lift point failure, a portion of the liner could strike the floor slab. The resultant impact would not cause failure or severe damage to the 2-1/2' thick floor slab. Therefore, a load drop does not present a potential for damage to the safety related equipment below the floor slab (diesel generator).

c) RHR Monorail and Hoist - 6-ton capacity

Manufacturer: Yale - hand operated

This is a hand-operated, standard, off-the-shelf hoisting system used to handle the RHR pump components and the shield blocks covering their location. The load handling system (hoist and monorail) was designed with a DRL approximately three times greater than the MCL (the four shield blocks). Each block weighs approximately 3,000 to 4,000 lbs.

Since this load handling system is a hand-operated monorail, evaluation for compliance to the requirements of NUREG-0554 or NUREG-0612, Appendix C, is not relevant.

Response to 2.4-2c: (cont'd)

This load handling system is not designed to retain its load during a SSE. However, CP&L considers the potential for a SSE occurrence during use of this system to be extremely small and, therefore, an acceptable risk.

Because of the lower seismic probability and the MCL which is approximately 1/3 of the DRL, CP&L considers this system to be adequately designed and to provide reasonable assurance that a load drop will not occur.

Lifting Devices

All equipment used with this load handling system is of standard manufactured design. The slings, shackles, and other devices used to handle the pump components and shield blocks are sized to provide a safety factor or 10 or greater.

Interfacing Lift Points

The shield blocks lift points consist of two 1-1/2" diameter hair pins each with a maximum safe working load of 39,000 lbs. (safety factor of six) embedded into the shield block.

Visual inspection of these lifting lugs indicates no deficiencies or deterioration have occurred over the 13 years of plant operation.

Response to 2.4-2c: (cont'd)

The RHR pump components are handled by standard lifting equipment in such configuration that the rigging is redundant and conform to the requirements of NUREG-0612, Section 5.1.6.

Request 2.4-2d:

"For interactions not eliminated in 2.4-2b or 2.4-2c, above, demonstrate using appropriate analysis that damage would not preclude operation of sufficient equipment to allow the system to perform its safety function following a load drop (NUREG-0612, Section 5.1, Criterion IV). For each analysis so conducted, the following information should be provided:

a) An indication of whether or not, for the specific load being investigated, the overhead crane-handling system is designed and constructed such that the hoisting system will retain its load in the event of seismic accelerations equivalent to those of a safe shutdown earthquake (SSE).

b) The basis for any exceptions taken to the analytical guidelines of NUREG-0612, Appendix A.

c) The information requested in Attachment 4."

Response to 2.4-2d:

All interactions were eliminated in our response to 2.4-2b or 2.4-2c.

APPENDIX I

TABLE 1
Identification of Crane
Codes and Standards

	Cranes	Design Spec. No.	Codes & Standards Applicable at Construction Time	Current Codes & Standards	Comment
1.	Polar Crane (Whiting)	WELC 5379-54	EOCI-61	CMAA-70	
2.	Turbine Building (Whiting)	WELC 5379-56	EOCI-61	CMAA-70	
	Overall Design		EOCI-61(61)	CMAA-70(75)	
	Construction and Installation		EOCI-61 ANSI B30.2(67)	CMAA-70(75) ANSI B30.2(76)	
3.	Solid Waste Bridge Crane and Monorail (Underhung Type) (P&H)	WELC 5379-S12	EOCI-61	CMAA-74 ANSI B30.11	
	Overall Design of Bridge		EOCI 61, MMA	CMAA-74(74), ANSI B30.11(80)	
	Hoist and Trolley	Mfr. Standard	HMI 100	ANSI B30.16(81)	Hoist and trolley are manufacturer's standard.

NOTE: Extracted from Part I T.E.R. reply dated december 15, 1982.

APPENDIX I

TABLE 2-A
General Crane Information

Description of Design Features	Polar Crane	T. B. Crane	Drumming Room Bridge & Monorail Crane
Manufacturer and Serial No.	Whiting 9701	Whiting 9700	P&H 689-1018
Type	Circular Gantry Bridge	Gantry Bridge Outdoor	Top Underhung
Main Hoist Rating/Speed (Ton/FPM)	155/2.75	145/4.5	5/6-18
Aux. Hoist Rating/Speed (Ton/FPM)	15/25	25/23	None
Gantry Speed (FPM)	60	65	30
Trolley Speed (FPM)	25	25	35
Span (Ft)	92 dia	100	26
Hook Lift (Ft)	60	26	25

NOTE: Extracted from Part I T.E.R reply dated December 15, 1982.

APPENDIX I

TABLE 2-B
Comparable Design Adequacy

Design, Construction and Fabrication Features as Specified

Description of Design Features	Polar Crane	T.B. Crane	Drumming Room Bridge & Monorail Crane	CMAA 70/ (EOCI 61) Requirements	Conformance with CMAA 70	Conformance with B30.2
Material (ASTM)						
Structural Steel	A-36	A-36	A-36	A-36/(A-7)	Yes	Yes
Sheaves, Drum, Couplings, etc.	A-48	A-48	ND	A-48 or C140/ (Specified Steel or CI)	Yes	Yes
Factors of Safety						
Ropes for Main and Aux. Hoist (5)	5	5	5	5/(5)	Yes	Yes
Gears, Shafts, Drums Blocks, etc. (5)	5	5	ND	5/(5)	Yes	Yes
Maximum Allowable Combined Stresses KIPS						
Tension	17.6	17.6	ND	17.6/(16)	Yes	Yes
Compression	17.6	17.6	ND	17.6/(16)	Yes	Yes
Shear	13.2	13.2	ND	13.2/(12)	Yes	Yes
Bending	8	8	ND	--		
Torsion	4	4	ND	--		

APPENDIX I

TABLE 2-B
Comparable Design Adequacy

Design, Construction and Fabrication Features as Specified

Description of Design Features	Polar Crane	T.B. Crane	Drumming Room Bridge & Monorail Crane	CMAA 70/ (EOCI 61) Requirements	Conformance with CMAA 70	Conformance with B30.2
Seismic						
Horizontal (% of Dead Load max.)	50	--	ND	--		
Vertical (% of Dead Load max.)	15	--	ND	--		
Wind (Psf)	N/A	30	ND	--		
Impact Load (% of Lift Load)	15	15	ND	15-50/(15)	Yes	Yes
Welding (AWS)	D14.1	D14.1	ND	D14.1/ (Unspecified AWS)	Yes	Yes(1)
Deflection Under Max Load (Inch/Inch of Span)	0.001	0.001	ND	0.00125	Exceed	Exceed
Bearings, Antifriction (in Hours and Life Expectancy)	5,000	5,000	ND	3,000(B10/ (1,000)	Exceed	Exceed

APPENDIX I

TABLE 2-B
Comparable Design Adequacy

Design, Construction and Fabrication Features as Specified

Description of Design Features	Polar Crane	T. B. Crane	Drumming Room Bridge & Monorail Crane	CMAA 70/ (EOCI 61) Requirements	Conformance with CMAA 70	Conformance with B30.2
Brakes - Torque Capacity (% of Motor Torque/Type)						
Bridge and/or Gantry	100/ Hydraulic	100/ Hydraulic	ND	100/ Unspecified	Yes	Yes
Parking	100/ Electric	100/ Electric	ND	100 elec/ (75 elec)	Yes	Yes
Trolley	100/ Electric Spring Set	100/ Electric Spring Set	ND	50 elec/ (50 elec)	Exceed	Exceed
Hoist for Main & Auxiliary						
Holding Brake	Two,Each 150/elec Spring Set	Two, Each 150/elec Spring Set	ND	Two 100 elec/ (100 elec) One 125 elec/ (125 elec)	Exceed	Exceed
Control Brake - (1 each)	150/Dynamic D. C.	150/Dynamic D. C.	N/A	125/(125)	Exceed	Exceed
Motors						
One Motor for Each Motion Wound Rotor Totally Enclosed	Yes	Yes	N/A	Yes	Yes	Yes

APPENDIX I

TABLE 2-B
Comparable Design Adequacy

Design, Construction and Fabrication Features as Specified

Description of Design Features	Polar Crane	T. B. Crane	Drumming Room Bridge & Monorail Crane	CMAA 70/ (EOCI 61) Requirements	Conformance with CMAA 70	Conformance with B30.2
Controllers	Yes	Yes	N/A	Yes	Yes	Yes
Resistors	Yes	Yes	N/A	Yes	Yes	Yes
Protection	Yes	Yes	N/A	Yes	Yes	Yes
Limit Switches	Yes	Yes	N/A	Yes	Yes	Yes
Testing (% of Rated Capacity	125	125	125	125/(125)	Yes	Yes

NOTES: (1) - See text evaluation for comparable adequacy.
N/A - Not Applicable.
ND - Not Determinable.
MMA - Monorail Manufacturers Association
HMI - Hoist Manufacturers Institue
EOCI - Electric Overhead Crane Institue
CMAA - Crane Manufacturers Association of America
ANSI - American National Standards Institute

Extracted from Part I T.E.R. reply dated December 15, 1982.

APPENDIX II

H. B. Robinson No. 2 Containment Polar Crane
Temporary Upgrade for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. #1 Analysis Item No.	NPED Justification for Crane Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements for 155 Tons	210 Tons
Trolley						
Hook Swivel (Stress exceeds design allowable (15,000 psi) by 17%)	1	1	The calculated stress level (= 17,600 psi) is acceptable based on material min. yield strength (53,000 psi). This item stays well within the elastic range for the load imposed.	Field to clean up and perform visual inspection at time of reroping.	Yes	No
Hook Sheave Bushings (Stress exceeds design allowable by 17%. Called sleeve bearing by CMAA-70.)	2	2	Stress level is acceptable based upon material yield strength. Wear consideration.	Field is to visually inspect, clean up, and lubricate in accordance with the crane manufacturer's recommendations at time of reroping (checking for wobble of the sheaves).	Yes	No
Main Hoist Rope (Rating exceeds design allowable by 9%; Factor of Safety is less than CMAA-70 required F.O.S. of 5.0)	3	3	Existing rope is original and provides for a single load path. Prudent to replace.	Procure and install new main hoist rope. (Whiting Dwg. S-79699, Item #49)	Yes	Yes
Equalizer Sheave Bushing (Stress exceeds design allowable (Whiting Standard) by 41%)	4	4	The factor of safety is acceptable because the material minimum yield strength is 14,000 psi (ASTM B-144) and this part will have limited rotation and limited heavy loading.	Field is to clean up, visually inspect, and lubricate in accordance with the crane manufacturer's recommendations at time of reroping (checking for wobble of the sheaves).	CMAA-70 Code Per Whiting	N/A

APPENDIX II

H. B. Robinson [illegible]2 Containment Polar Crane
Temporary Upgrade for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. #1 Analysis Item No.	NPED Justification for Crane Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements 155 Tons	210 Tons
Drum Bearing Support Bolts (Exceed design shear allowable by 30%)	5	5	These bolts restrain the main drum support. Prudent to replace.	Procure bolts, ream holes if required, and replace with high strength ASTM A-325 bolts. (Whiting Dwg. No. S-79699, Items 36 and 37)	Yes	Yes
Drum Pinion Gear Shaft (Stress exceeds design allowable by 28%)	6	6	This component is in the drive path for load lifting. It is a machined shaft with stress concentrating geometry. Fatigue is a consideration. Present shaft condition unknown. Prudent to replace.	Procure and replace drum pinion shaft. (Whiting Dwg. No. S-79679)	Yes	Yes
Drum Pinion Bearing Support Bolts (Stress exceeds design shear allowable by 6%)	7	7	Factor of safety (1.53) based on AISC shear is considered marginal. Prudent to replace.	Procure bolts, ream holes if required, and replace with high strength ASTM A-325 bolts. (Whiting Dwg. Nos CS-0112 and CS-0113)	Yes	Yes
Main Hoist Motor (rated hp and torque exceeded by 31%. Main hook speed will be changed from 30 to 6 inches/minute with the micro-drive system as gearing is also changed.)	8	8	Present motor not adequate to supply power necessary to make heavy lifts. New main hoist motor is expensive and has a long lead time as compared to proposed micro-drive system. Also, present power supply is adequate for micro-drive. (Rev. 1 of Analysis states motor hp rating and torque exceeded by 23%)	Procure and install a micro-drive using a 10 H.P. continuous duty motor. 40 H.P. will not operate when using micro-drive. (Whiting Dwg. No. S-79699)	Yes	Yes

H. B. Robinson [illegible]2 Containment Polar Crane
Temporary Upgrade for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. #1 Analysis Item No.	NPED Justification for Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements for 155 Tons	210 Tons
Main Hoist Motor Brake Rating (Existing 12" brake rating exceeded by 6%)	9	-	Existing 12" brake is obsolete. Most likely is original brake, must be moved due to relocation of main hoist motor for installation of micro-drive. No extra brake capacity available with original brake.	Replace brake when relocating the main hoist motor. (Whiting Dwg. No. U-76079)	Yes	Yes
Main Hoist Brake Rating (Rating exceeded by 9%)	10	9	Existing may be original brake. New brake will assure adequate holding of the load(s). (Rev. 1 of Analysis states gear strength exceeded by less than 1%) Prudent to replace.	Procure and install new 23" main hoist brake. (Whiting Brake No. S-79699)	Yes	Yes
Drum Pinion Gear Strength Rating (Exceeds design by 24%)	11	10	Small drive gear. Gear is in drive path and necessary to lift load. (Rev. 1 of Analysis states gear strength exceeded by 17%)	Procure and install new drum pinion gear. (Whiting Dwg. No. S-79699)	Yes	Yes
Main Drum Gear Strength (Rating exceeded by 2%)	12	-	Drum gear strength meets current CMAA-70 Standards per Whiting letter 12/8/82.	N/A	Yes	Yes
Hoist Case Bearing Cap Bolts (Rating exceeded by 12%)	13	11	Rev. 1 of Rerate Analysis states that rating is exceeded by 5%. Telecon of 2/24/83 with Whiting notes that subject bolts now meet CMAA-70 standards.	N/A	Yes	Yes

H. B. Robinson No. 2 Containment Polar Crane
Temporary Upgrade for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. #1 Analysis Item No.	NPED Jusitification for Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements for	
					155 Tons	210 Tons
#1 Main Load Girt (Trolley) a. The stress in top weld exceeds design allowable by 19%. b. The transverse shear stress exceeds the design allowable by 2%. c. The vertical shear stress exceeds the design allowable by 20%.	14	12	This is a highly stressed/ loaded part of the structure.	Procure engineering drawings in order to perform field modifications.	Yes	Yes
#2 Load Girt (Trolley) (Weld exceeds allowable by 22%)	15	13	This is a highly stressed/ loaded part of the structure.	Procure engineering drawings in order to perform required field modifications.	Yes	Yes
Trolley Wheel Load (Exceeds CMAA-70 design (Section 4.11) code for wheel loads by 13%)	16	14	The CMAA-70 Code states loads for normal conditions without undue wear. The existing wheels should be sufficient to function under limited loading for heavy lifts for Steam Generator Replacement Project.	Field to visually inspect for wear.	Yes	No

APPENDIX II

H. B. Robinson No. 2 Containment Polar Crane
Temporary Upgradd for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. #1 Analysis Item No.	NPED Justification for Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements for	
					155 Tons	210 Tons
Bridge						
Bridge Rail (Bending stress exceeds CMAA-70 design allowable by 25%)	17	15	Rail is technically adequate. Not necessary to replace rail. Replacement may cause warpage to cover plate of bridge girders. Rail stress is not at or near the material yield stress: controlled, cooled, min. yield stress = 75,500 psi heat treated, min. yield stress = 114,000 psi.	N/A	Yes	No
Girder Stiffener Weld (Weld stress exceeds design allowable by 37%)	18	16	Factor of safety not sufficient to justify leaving as is.	Provide additional welding on inside of main girts, for short stiffeners as instructed by Whiting design drawings to be provided.	Yes	Yes
Girder Stiffener Bearing Stress (Exceeds design allowable by 17%)	19	17	Factor of safety is acceptable per AISC Requirements.	N/A	Yes	No
Turn Bolts at Top of (LHE) Leg Connection. (Exceed allowable design stress by 85%)	20	18	Excessive overstress will result if existing bolts allowed to remain.	Procure bolts, ream holes if required, and replace with high strength ASTM A-325 bolts. (Whiting Dwg. No. T-46160)	Yes	Yes

ENDIX II

H. B. Robinson No. 2 Containment Polar Crane
Temporary Upgrade for Steam Generator Replacement Project
NPED Final Disposition

Item/Subject	Original Analysis Item No.	Rev. 1 Analysis Item No.	NPED Justification for Crane Modifications or Omission	Modification Work Performed	Modified Crane Meets CMAA-70,1975 Code Requirements for 155 Tons	210 Tons
Turn Bolts at Lower (LHE) Leg Connection (Exceed allowable design stress by 62%)	21	19	Excessive overstress will result if existing bolts allowed to remain.	Procure bolts, ream holes if required, and replace with high strength ASTM A-325 bolts. (Whiting Dwg. No. U-57178)	Yes	Yes
Turn Bolts at Top (RHE) Leg Connection. (Exceeds allowable design stress by 90%)	22	20	Excessive overstress will result if existing bolts allowed to remain.	Procure bolts, ream holes if required, and replace with high strength ASTM A-325 bolts. (Whiting Dwg. No. U-57224)	Yes	Yes
Stress in Trunion Connection Weld (Exceeds design allowable by 107%)	23	21	At present rating of crane, this area is overstressed by today's CMAA-70 Standards.	Perform necessary field modifications as designed by Whiting. (Whiting Dwg. No. T-46094)	Yes	Yes
Internal Welds of the "Lower Leg Connection" (Stress is well into the plastic range)	24	22	At present rating of crane, this area is overstressed by today's CMAA-70 Standards.	Perform necessary field modifications as designed by Whiting.	Yes	Yes

NOTE: All percentage overstresses/overratings shown in the Item/Subject Column above, are taken from the original Rerate Analysis, Summary of Results, Pages V through VII.

APPENDIX IIA

H. B. Robinson Unit 2
Previous Polar Crane Modifications

Plant Mod. No.	
#89	Cutting of 136 ventilation holes in boxed sections of Polar Crane.
#203	Install emergency stop and limit switches.
#214	Install a screw type (geared) limit switch on the main hoist drum to prevent the main hoist from travelling beyond its upper limit.
#231	Install emergency stop button and forward and reverse limit switches on Polar Crane track and connect in bridge control circuit to prevent collision between Polar Crane and manipulator crane.
#313	Install automatic stoppage of Polar Crane bridge before colliding with manipulator crane.

Control of
Heavy Loads
NUREG 0612

APPENDIX III
COMPARISON SUMMARY
POLAR CRANE VS NUREG 0554

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

Requirement / Extent of Compliance		Full Compliance	Complies with Intent Alternative Design Features	Does Not Comply
2.1	Construction and Operating Periods	X		
2.2	Maximum Critical Load		X	
2.3	Operating Environment	X		
2.4	Material Properties	X		
2.5	Seismic Design			X
2.6	Lamellar Tearing		See Note 1	
2.7	Structural Fatigue	X		
2.8	Welding Procedures	X		
3.0	Safety Features			
3.1	General		X	
3.2	Auxiliary Systems		X	
3.3	Electric Control Systems	X		
3.4	Emergency Repairs	X		
4.1	Reeving System		See Note 2	
4.2	Drum Support		X	
4.3	Head & Load Blocks		X	
4.4	Hoisting Speed	X		
4.5	Design Against Two Blocking	X		
4.6	Lifting Devices		X	
4.7	Wire Rope Protection	X		
4.8	Machinery Alignment		X	
4.9	Hoist Braking System		X	
5.0	Bridge & Trolley			
5.1	Braking Capacity	X		
5.2	Safety Stops	X		
6.0	Drivers & Controls			
6.1	Driver Selection	X		
6.2	Driver Control Systems	X		
6.3	Malfunction Protection	X		
6.4	Slow Speed Drives	X		
6.5	Safety Devices	X		
6.6	Control Station	X		

APPENDIX III

COMPARISON SUMMARY
POLAR CRANE VS NUREG 0554

Control of
Heavy Loads
NUREG 0612

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

Requirement / Extent of Compliance		Full Compliance	Complies with Intent Alternative Design Features	Does Not Comply
7.0	Installation Instructions			
7.1	General	X		
7.2	Construction & Operating Periods		X	
8.0	Testing & Preventive Maintenance			
8.1	General	X		
8.2	Static & Dynamic Load Test	X		
8.3	Two Block Test	N/A		
8.4	Operational Tests	X		
8.5	Maintenance	X		
9.0	Operating Manual	X		
10.0	Quality Assurance	X		

NOTE: 1. NDE of load bearing members during fabrication was performed. However, the extent to which NDE was performed is not readily available.

Design modifications requiring welding of load bearing members have been and will continue to be N.D. Examined in accordance with approved techniques & plant procedures.

2. The increased safety factor of the newly installed wire rope is considered to be an acceptable alternative to the dual reeving system.

CONTROL OF
HEAVY LOADS
NUREG 0612

APPENDIX IV
LOAD/IMPACT AREA MATRIX
TABLE 4-1

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE: Turbine Building

Date: 11/04/83

LOCATION / IMPACT AREA / LOADS Load No.	BUILDING: Turbine Building Zone: Column Line 1 - 3, Column Line A - E, El. 242.50		
	Elevation	Safety Related Equipment	Hazard Elimination Category
1) H.P. Cyl. Cover	Elev. 267' East End Mezzanine Floor	NONE	e
2) H.P. Rotor	"	"	e
3) L.P. Outer Cyl. Cover	"	"	e
4) L.P. Inner Cyl. Cover #1	"	"	e
5) L.P. Inner Cyl. Cover #2	"	"	e
6) L.P. Rotor	"	"	e
7) Generator Rotor	"	"	e

APPENDIX IV
LOAD/IMPACT AREA MATRIX
TABLE 4-1

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE: Polar Crane | Date: 11/04/83

LOCATION | BUILDING: Containment

Zone: Column Line — Refer to Load Path Drawings: 81022-M-001 Rev.A Sheets 1-4
Column Line — 81022-M-002 Rev.A

LOADS \ IMPACT AREA	Elevation	Safety Related Equipment	Hazard Elimination Category	
8) Reactor Vessel Head	248.66'	R.V.	d	
9) Upper Internals	248.66'	R.V.	d	
10) Lower Internals	248.66'	R.V.	e	
11) Inservice Inspection Tool	248.66'	Fuel	d&e	(See Note 1)
12) Reactor Coolant Pumps Motors and Internals	251.50'	RCP's, Seal Table	d	"
13) Stud Tensioner	275.00'	R.V.	d	"
14) Stud Rack Loaded	275.00'	R.V.	d	"
15) Hatch Covers				
Head Storage	275.00'	RCP (A)	d	"
Pump Bay	275.00'	RCP's	d	"
Pressurizer Cover	294.00'	Pressurizer	d	"
16) Seal Table Plug	275.00'	Flux Drive Assy.	d	"
17) R.V. Missile Shield	275.00'	R.V., RCP (A) Pressurizer	d	"
18) R.V. Missile Shield Frame	275.00'	R.V., RCP (C)	d	"
19) Air Recirc Fan Motor	275.00'	None	d	"

Note 1: Increased safety factor of 10 or greater and no fuel in R.V.

CONTROL OF
HEAVY LOADS
NUREG 0612

LOAD/IMPACT AREA MATRIX
TABLE 4-1

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE: Solid Waste Handling Crane - 5 Ton			Date: 11/04/83
LOCATION	BUILDING: Auxiliary Building		
IMPACT AREA / LOADS	Zone: Column Line 2-3 Column Line None		
	Elevation	Safety Related Equipment	Hazard Elimination Category
20) Drummed Waste	246.00'	Diesel Generator	d

Comment: The MCL of this crane is approximately 65% of the DRL, therefore, the crane should be eliminated under Category d.

LOAD/IMPACT AREA MATRIX
TABLE 4-1

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE: Boric Acid Batch Room Monorail - 2 Ton Capacity			Date: 11/04/83
LOCATION	BUILDING: Auxiliary Building		
IMPACT AREA / LOADS	Zone: Column Line 2 - 3 Column Line None		
	Elevation	Safety Related Equipment	Hazard Elimination Category
21) Bulk Boric Acid	246.00'	SW Booster Pump	b & d
22) Miscellaneous Equipment	246.00'	SW Booster Pump	b & d

Comment: This crane has an MCL of less than one half its DRL. However, in the unlikely event that a load drop should occur and cause damage to a single SW Booster Pump, the other SW Booster Pump provides redundancy.

LOAD/IMPACT AREA MATRIX
TABLE 4-1

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE: RHR Monorail - 6 Ton Capacity (Hand Operated) | Date: 11/04/83

LOCATION	BUILDING: Outside - Below Grade		
IMPACT AREA / LOADS	Zone: Column Line / Column Line — Between R.C.B., Auxiliary Building & New Fuel Storage Building		
	Elevation	Safety Related Equipment	Hazard Elimination Category
Residual Heat Removal Pumps			
23) Motor	206'-9"	Redundant RHR Pump	d
24) Pump	206'-9"	Redundant RHR Pump	d
25) Hatch Covers	231.00'	RHR Pumps	d

Comment: The maximum load handled by this crane is the RHR pit hatch covers which weigh approximately 3000-4000 lbs. each. The minimum safety factor of the 6 ton monorail when considering the MCL is 15. The hatch covers are handled by a 2 point lifting arrangement which has a safety factor in excess of 10. The standard lifting equipment used provides for a safety factor of 10 or greater and if possible redundant lifting configurations.

APPENDIX V

HAZARD ELIMINATION CATEGORIES

a. Crane travel for this area/load combination prohibited by electrical interlocks or mechanical stops.

b. System redundancy and separation precludes loss of capability of system to perform its safety-related function following this load drop in this area.

c. Site-specific considerations eliminate the need to consider load/equipment combination.

d. Likelihood of handling system failure for this load is extremely small (i.e., Section 5.1.6 NUREG 0612 satisfied).

e. Analysis demonstrates that crane failure and load drop will not damage safety-related equipment.

HAZARD ELIMINATION INDEX
TABLE 4-1a

CAROLINA POWER & LIGHT COMPANY
H. B. ROBINSON UNIT 2

CRANE/LOAD	Load No.	Hazard Elimination Category a	b	c	d	e	CRANE/LOAD	Load No.	Hazard Elimination Category a	b	c	d	e
Turbine Building Crane													
H.P. Cyl.Cover	1					X							
H.P. Rotor	2					X							
L.P. Outer Cyl.Cover	3					X							
L.P. Inner Cyl.Cover #1	4					X							
L.P. Inner Cyl.Cover #2	5					X							
L.P. Rotor	6					X							
Generator Rotor	7					X							
Polar Crane													
Reactor Vessel Head	8				X								
Upper Internals	9				X								
Lower Internals	10					X							
Inservice Inspection Tool	11				X	X							
Reactor Coolant Pumps Motors & Internals	12				X								
Stud Tensioner	13				X								
Stud Rack Loaded	14				X								
Hatch Covers	15												
Head Storage					X								
Pump Bay					X								
Pressurizer Cover					X								
Seal Table Plug	16				X								
Missile Shield	17				X								
Missile Shield Frame	18				X								
Air Recirc Fan Motor	19				X								
Solid Waste Handling Crane - 5 Ton													
Drummed Waste	20				X								
Boric Acid Batch Room Monorail - 2 Ton Capacity													
Bulk Boric Acid	21		X		X								
Misc. Equipment	22		X		X								
RHR Monorail - 6 Ton Capacity													
Residual Heat Removal Pumps													
Motor	23				X								
Pump	24				X								
Hatch Covers	25				X								

TABULATION OF HEAVY LOADS
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2

Date: 2/22/84 (Revised)
Date: 8/7/81

CRANES	LOAD IDENTIFICATION	WEIGHT	LIFTING DEVICE	PROCEDURE
CONTAINMENT				
Polar Crane 155 Ton Capacity Whiting S/N 9701	Reactor Vessel Head	139 Tons	Head Lifting Rig	FHP-015, FHP-014, FHP-036, MST-907, MST-908, MST-909
	Upper Internals	85,500 lbs	Internals Lifting Rig	EST-030, FHP-017
	Lower Internals	235,500 lbs	Internals Lifting Rig	FHP-018
	In-Service Inspection Tool	10,000 lbs	Removable Lifting Tool	To be provided by W when inspection is performed.
	Reactor Coolant Pumps			
	Motor	68,700 lbs	Motor Lift Sling	Service Manual, MMM-009
	Internals	42,000 lbs	4-1 1/4" Dia.6x37 IWRC Slings 4-1 5/8" Pin Dia. Shackles & Eye Hooks	" " "
	Stud Tensioners	2,000 lbs	3/8" Dia 6x19 IWRC Sling	FHP-015, MMM-009
	Studs	750 lbs	5/16" Dia. IWRC Sling	FHP-015
	Studs & Stud Rack	7,300 lbs	4 Leg Sling 5/8" Dia. 6x19 IWRC and 4 - 8½Ton Capacity Shackles	FHP-015
	Hatch Covers			
	Head Storage	50,000 lbs	4-2¼" Dia. 6x37 IWRC Slings & 4-1½" Pin Dia. Shackles	MMM-009
	Pump Bay	85,000 lbs	4-2¼"Dia. 6x37 IWRC Slings & 4-1½" Pin Dia. Shackles	MMM-009
	Pressurizer Cover	80,000 lbs	4-2¼"Dia 6x37 IWRC Slings & 4-17 Ton Capacity Shackles	MMM-009
	RV Head Plus Radiation Shield	146 Tons	Head Lifting Rig	FHP-015, FHP-014, FHP-036, MST-907, MST-908, MST-909

TABULATION OF HEAVY LOADS
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2

Date: 2/22/84 (Revised)
Date: 8/7/81

CRANES	LOAD IDENTIFICATION	WEIGHT	LIFTING DEVICE	PROCEDURE
CONTAINMENT	Hatch Covers (cont'd) Seal Table	22,000 lbs	4 Leg Sling 2¼"Dia 6x37 IWRC & 4-13½ Ton Shackles	MMM-009
	Missile Shield	93,000 lbs (approx.)	4 Leg Sling-2" Dia. 6x37 IWRC & 4-55 Ton Capacity Shackles	*(See note below) MMM-009
	Missile Shield Frame	16,000 lbs (approx.)	2 Leg Sling-2" Dia. 6x37 IWRC & 2-25 Ton Capacity Shackles	MMM-009
	Guide Studs	1,500 lbs	5/16" Dia. 6x19 IWRC Sling & Spring Scale	FHP-015, FHP-036
	Air Recirc. Fan Motor	3,800 lbs.	2-1/2" Dia. 6x19 IWRC Slings & 2-5/8" Dia. Eye Bolts	MMM-009
FUEL HANDLING BLDG.				
Spent Fuel Cask	Spent Fuel Cask	140,000 lbs	Redundant Lifting Yoke	MST-907, MST-908, MST-909
Handling Crane				EST-042, EST-044 EST-045, FHP-033, FHP-034
125 Ton Capacity Whiting S/N 10698	Fuel Gates	2,500 lbs	2-5/8" Dia. 6x19 IWRC Slings	MMM-009
	Removable Siding	2,800 lbs	2-3/4" Dia. 6x19 IWRC Slings	MMM-009
	Fuel Storage Racks	26,000 lbs	Lifting Frame & Slings (To be sized when work is performed.)	To be installed later by Special Procedure.
	Removable Roof Hatch	6,552 lbs	2 Leg Spreader 3/4" Dia. 6x19 IWRC & 2-1" Dia. Eye Bolts (Lift one end at a time)	Note: *Each of 4 lift point. Have max. load capacity of 53,000 lbs.
	Cask Washdown Roof Hatch	6,600 lbs	[illegible]eg Spreader Assembly [illegible]" Dia. 6x19 IWRC and 4-1" Dia.Eye Bolts	

TABLE 3-1

TABULATION OF HEAVY LOADS
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2

Date: 2/22/84 (Revised)
Date: 8/7/81

CRANES	LOAD IDENTIFICATION	WEIGHT	LIFTING DEVICE	PROCEDURE
AUXILIARY BLDG.				
Monorail-Hoist	Residual Heat Removal			
6 Ton Capacity	Pumps - Motors - Pumps Shield Blocks	2,400 lbs 2,300 lbs 4,000 lbs	2-1/2" Dia. 6x19 IWRC Slings 2-1/2" Dia. 6x19 IWRC Slings 2-5/8" Dia. 6x19 IWRC Slings	MMM-009 MMM-009
Monorail-Hoist	Bulk Boric Acid & Misc. Equipment			MMM-009
2 Ton Capacity (Boric Acid Batch Room)		Less than 1,000 lbs	Nylon Sling	
Solid Waste Handling Crane	Drummed Waste	6,500 lbs	4-5/8" Dia. 6x19 IWRC Slings	MST-907, MST-908, MST-909 MMM-009
5 Ton Capacity Philadelphia Tramrail Co.				
TURBINE BLDG.				
Turbine Bldg.	Turbine Components			
Crane	H.P. Cyl. Cover	170,000 lbs	Lifting Beam & 3 Point Sling	MMM-009
145 Ton Capacity Overhead Traveling Bridge			Assembly-See W Drawing 718-J-193, Shts. 1 & 2	
Whiting S/N 9700	H.P. Rotor	110,000 lbs	Lifting Beam & 4 Point Sling Assembly - See W Drawing 718-J-193, Shts. 1 & 2	MMM-009

TABLE 3-1

TABULATION OF HEAVY LOADS
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2

Date: 2/22/84 (Revised)
Date: 8/7/81

CRANES	LOAD IDENTIFICATION	WEIGHT	LIFTING DEVICE	PROCEDURE
TURBINE BLDG. (cont'd)	Nos. 1&2 L.P. Turbine L.P. Outer Cyl. Cover	140,000 lbs	2-2 Leg Slings - 2" Dia. with 2-3/4" Dia. Turnbuckles. See W Drawing 719-J-103, Shts. 1 & 2.	MMM-009
	L.P. Inner Cycl. Cover #2	115,000 lbs	4 Lifting Pads & 4 Sling Assemblies 1 1/2" Dia. IWRC Slings 2 3/4" Turnbuckles & 2" Dia. Pin-Shackles. See W Drawing 719-J-103, Shts. 1 & 2.	MMM-009
Turbine Bldg. Crane	L.P. Inner Cycl. Cover #1	56,000 lbs	Similar to Inner Cycl.Cover #2. See W Drawing 719-J-103, Shts. 1 & 2.	MMM-009
	L.P. Rotor	200,000 lbs	Same as H.P. Rotor. See W Drawing 719-J-103, Shts. 1&2.	MMM-009
	Generator Rotor	288,000 lbs	2 Braided Slings Consisting of 3 Parts of 1" Dia. 6x19 IWRC Wire Rope, Hand Tucked.	MMM-009

NOTES:

1. All slings used are of IWRC improved plow steel construction or equal.
2. Unless specifically noted all slings have swagged fittings.

TABLE 3-?

TABULATION OF HEAVY LOADS
FOR
H. B. ROBINSON STEAM ELECTRIC PLANT - UNIT 2

Date: 2/22/84 (Revised)
Date: 8/7/81

CRANES	LOAD IDENTIFICATION	WEIGHT	LIFTING DEVICE	PROCEDURE
	NOTES: (cont'd) 3. Sling sizes given are considered minimum to be used for given configuration, i.e., vertical or basket hitch. Site personnel are permitted to use larger size slings or can vary rigging configuration. 4. Sling capacities are based on ANSI B30.9 tables; however, recommended capacities from sling/wire rope mfg. may be used provided a safety factor of 5 is maintained for standard lifts. 5. Lifts which could result in damage to spent fuel or safety related equipment as a result of a load drop should maintain a safety factor of 10 whenever possible for standard lifting equipment. Refer to NUREG-0612 Part II Report for Exceptions. 6. Turbine lifting gear is used only for handling turbine/generator components.			