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August 10, 1983

Docket Nos. 50-277
50-278

Mr. John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SUBJECT: Peach Bottom Atomic Power Station
NUREG 0612 - Control of Heavy Loads

Dear Mr. Stolz:

This letter provides information relative to the Technical Evaluation Report (TER) dated May 17, 1983, concerning NUREG 0612 which was requested by Mr. I. H. Sargent of Westec during a telephone conference held on July 19, 1983, between N. Wagner (NRC) and A. Tsing (NRC), I. H. Sargent (WESTEC), W. M. Alden (PECo.) and J. C. Nagle (PECo.). Mr. Sargent's requests are paraphrased below, followed by our response.

Request:

Provide a statement to the effect that modifications to special lifting devices, as recommended by GE, will be completed. Also, commit to the continuing compliance testing program of ANSI N14.6.-1978 (See TER item 2.15, pg. 20.)

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Response:

The modifications to the GE-provided special lifting devices are underway, with anticipated completion no later than December 22, 1983. Special lifting devices will be subject to a continuing compliance testing program which meets the requirement of N14.6 with the following exceptions:

1) The frequency of inspection will be once per reactor operating cycle, rather than annual. The frequency is consistent with the use of this equipment.

2) In lieu of the 150% capacity test lift, appropriate non-destructive testing will be performed on critical welds.

Request:

Clarify the postion that all slings will meet the requirements of ANSI-B30.9-1971 with regards to testing, inspection and storage. (TER item 2.1.6, page 21)

Response:

Procedures require that all slings used to lift equipment over/in proximity to safety related equipment meet the requirements of ANSI B30.9-1971. In addition, a 25% dynamic load factor has been applied to these slings. Confusion with previous submittals may have resulted from use of the term "Q-listed" and as a result of misunderstanding concerning lifting of Q equipment versus lifting over Q equipment.

The appropriate procedures not only address the lifting of Q-listed equipment, but also lifting of equipment which, if dropped, could potentially damage safety-related Q equipment.

Request:

Item 2.1.3.F of Enclosure 3 "Request for additional information on Control of Heavy Loads" requires a design review of the pertinent cranes against CMAA-70. You have completed the review for the Reactor Building Cranes. The installation of mechanical stops on the diesel generator cranes precludes this review; however, you have not provided the review for the Turbine Hall and Circulating Water Pump Structure Cranes.

Response:

As discussed in our June 1981 letter (S. L. Daltroff to D. G. Eisenhut) the Turbine Hall and Pump Structure Cranes were designed to EOCI-61, the applicable Standard at the time these cranes were manufactured. Although EOCI-61 is very similar to CMAA-70, we have provided the attached analysis, directed toward addressing the points of Question 2.1.8 of the TER.

Should there be any further questions, please do not hesitate to contact us.

Sincerely,

Attachment

cc: R. A. Blough, Site Inspector
I. H. Sargent, WESTEC Services, Inc.

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ATTACHMENT 1
CONTROL OF HEAVY LOADS
RESPONSE TO
TER QUESTION 2.1.8

2.1.8 Crane Design (Guide 7, NUREG-0612, Section 5.1.1.(7))

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' and of CMAA-70, 'Specifications for Electric Overhead Traveling Cranes' (8). An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

2.1.8.b. Evaluation

The reactor building cranes, turbine building cranes, pump structure crane, and diesel generator cranes substantially meet the criteria of Guideline 7 of NUREG-0612 on the basis of procurement to EOCI-61 standards. However, several more restrictive design requirements were imposed by CMAA-70 which could affect the cranes' ability to safely handle heavy loads.

Response

Our responses to the more restrictive design requirements imposed by CMAA-70 for the turbine building (TB) and pump structure (PS) cranes are contained in the following sections. The diesel generator cranes are not affected by the more restrictive CMAA-70 requirements. Mechanical stops prevent the movement of a heavy load over safety-related systems.

2.1.8.b. Evaluation (Continued)

A comparison of the recommendations of CMAA-70 and those of EOCI-61 has revealed several areas where revisions incorporated into CMAA-70 may affect crane safety. The Licensee should evaluate these areas to determine whether the intent of NUREG-0612 is satisfied. In particular, the following issues should be addressed in the Licensee's review:

1. Torsional forces. CMAA-70, Article 3.3.2.1.3 requires that the twisting moments due to overhanging loads and lateral forces acting eccentric to the horizontal neutral axis of a girder be calculated on the basis of the distance between the center of gravity of the load, or force center line, and the girder shear center measured normal to the force vector. EOCI-61 states that such moments are to be calculated with reference to girder center of gravity. For girder sections symmetrical about each principal central axis (e.g., box section or I-beam girders commonly used in cranes subject to this review), the shear center coincides with the centroid of the girder section and there is no difference between the two requirements. Such is not the case for non-symmetrical girder sections (e.g. channels).

Response

a. Turbine Building (TB) Cranes

The TB crane girder is a rigid box symmetrical about each of the principal axis. The shear center of the box girders coincides with the centroid of the girder section.

b. Pump Structure (PS) Crane

The PS crane girder is a rigid box symmetrical about each of the principal axis. The shear center of the box girders coincides with the centroid of the girder section.

2. Longitudinal Stiffeners. CMAA-70, Article 3.3.3.1 specifies (1) the maximum allowable web depth/thickness (h/t) ratio for box girders using longitudinal stiffeners and (2) requirements concerning the location and minimum moment of inertia for such stiffeners. EOCI-61 allows the use of longitudinal stiffeners but provides no similar guidance. The requirements of CMAA-70 represent a codification of girder design practice and they are expected to be equivalent to design standards employed in cranes built to EOCI-61 specifications.

Response

a. TB Cranes

The TB crane girder was constructed with longitudinal stiffeners. The longitudinal stiffeners conform to the requirements of CMAA-70. The allowable h/t ratios of the box girders, with stiffeners, do not exceed the ratios specified in CMAA-70.

b. PS Crane

The PS crane girders are constructed in accordance with the requirements of CMAA-70.

3. Allowable compressive stress. CMAA-70, Article 3.3.3.1.3 identifies allowable compressive stresses of approximately 50% of yield strength of the recommended structural material (A-36) for girders, where the ratio of the distance between web plates to the thickness of the top cover plate (b/c ratio) is less than or equal to 38. Allowable compressive stresses decrease linearly for b/c ratios in excess of 38. EOCI-61 provides a similar method for calculating allowable compressive

stresses except that the allowable stress decreases from approximately 50% of yield only after the b/c ratio exceeds 41. Consequently, structural members with b/c ratios in the general range of 38 to 52 designed under EOCI-61 will allow a slightly higher compressive stress than those designed under CMAA-70. This variation is not expected to be of consequence for cranes subject to this review since b/c ratios of structural members are expected to be less than 38.

Response

a. TB Cranes

The TB crane girders use b/c ratios less than 38 which is required by CMAA-70. The b/c ratio of the TB crane girders is 17.75.

b. PS Crane

The PS crane girders b/c ratio is 43.75. The stress on the PS crane girders does not exceed the compressive stress specified in CMAA-70, Article 3.3.3.1.3 for a b/c ratio of 43.75.

4. Fatigue considerations. CMAA-70, Article 3.3.3.1.3 provides substantial guidance with respect to fatigue failure by indicating allowable stress ranges for various structural members in joints under repeated loads. EOCI-61 does not address fatigue failure. The requirements of CMAA-70 are not expected to be of consequence for cranes subject to this review since the cranes are not generally subjected to frequent loads at or near design conditions (CMAA-70 provides allowable stress ranges for loading cycles in excess of 20,000) and are not generally subjected to stress reversal (CMAA-70 allowable stress range is reduced to below the basic allowable stress for only a limited number of joint configurations).

Response

a. TB Cranes

Fatigue failure was considered in TB crane design and the number of design loading cycles at or near rated load was less than 20,000 cycles.

TB crane is classified as a standby service crane as defined by the guidelines of CMAA-70. Structural fatigue is not expected to be of significant design concern.

b. PS Crane

Fatigue failure was considered in PS crane design and the number of design loading cycles at or near rated load was less than 20,000 cycles.

The PS crane is classified as standby service crane as defined by the guidelines of CMAA-70. Structural fatigue is not expected to be of significant design concern.

5. Hoist rope requirements. CMAA-70, Article 4.2.1 requires that the capacity load plus the bottom block divided by the number of parts of rope not exceed 20% of the published rope breaking strength. EOCI-61 requires that the rated capacity load divided by the number of parts of rope not exceed 20% of the published rope breaking strength. The effect of this variation on crane safety margins depends on the ratio of the weights of the load block and the rated load.

Response

a. TB Cranes

The sum of the maximum TB crane main hoist load weight (205 tons), the weight of the bottom blocks (6 tons for 2 blocks), and the weight of the lifting beam (12 tons) divided by the number of ropes (12 ropes x 2 cranes in tandem) is 9.29 tons. This does not exceed 20% of the manufacturer's rope breaking strength of 9.8 tons. The TB crane main hoist wire rope is a one inch diameter, special flexible alloy plow steel wire rope, 6 strands, 37 wires, with independent wire rope core.

The sum of the TB crane auxiliary hoist load weight (15 tons) and the weight of the bottom block (0.3 ton) divided by the number of wire ropes (8 parts) is 1.91 tons. This does not exceed 20% of the manufacturer's wire rope breaking strength of 1.93 tons. The TB crane auxiliary hoist crane wire rope is a 7/16 diameter, special flexible alloy plow steel wire rope, 6 strands, 37 wires, with independent wire rope core.

b. PS Crane

The sum of the maximum PS crane main hoist load weight (35 tons) and the weight of the bottom block (0.55 ton) divided by the number of wire ropes (12 parts) is 2.96 tons. This does not exceed 20% of the manufacturer's wire rope breaking strength of 3.18 tons. The PS crane main hoist wire rope is a 9/16" diameter, Roebling Royal Blue wire rope, 6 strands, 37 wires, with independent wire rope core.

The sum of the PS crane auxiliary hoist load weight (12 tons) and the weight of the bottom block (0.1875 ton) divided by the number of wire ropes (6 parts) is 2.03 tons. This does not exceed 20% of the manufacturer's wire rope breaking strength of 2.55 tons. The PS crane auxiliary hoist crane wire rope is a 9/16" diameter, stainless steel wire rope, 6 strands, 37 wires, with independent wire rope core.

6. Drum design. CMAA-70, Article 4.4.1 requires that the drum be designed to withstand combined crushing and bending loads. EOCI-61 requires only that the drum be designed to withstand maximum load, bending and crushing loads, with no stipulation that these loads be combined. This variation is not expected to be of consequence since the requirements of CMAA-70 represent the codification of the same good engineering practice that would have been incorporated in cranes built to EOCI-61 specifications although a specific requirement was not contained in EOCI-61.

Response

a. TB Cranes

The main hoist and auxiliary hoist drums are designed and calculated to withstand the combined crushing and bending loads in accordance with the requirements of CMAA-70.

b. PS Crane

The main hoist and auxiliary hoist drums are designed and calculated to withstand the combined crushing and bending loads in accordance with the requirements of CMAA-70.

7. Drum design. CMAA-70, Article 4.4.3 provides recommended drum groove depth and pitch. EOCI-61 provides no similar guidance. The recommendations in CMAA-70 constitute a codification of good engineering practice with regard to reeving stability and reduction of rope wear and are not expected to differ substantially from practices employed in the design of cranes subject to this review and built to EOCI-61 specifications.

Response

a. TB Cranes

The TB crane drum groove depth and pitch conform to the recommendations of CMAA-70, Article 4.4.3. The drum grooves were machined from solid metal and grooved left and right hand.

b. PS Crane

The PS crane drum groove depth and pitch conform to the recommendations of CMAA-70, Article 4.4.3. The drum grooves were machined from solid metal and grooved left and right hand.

8. Gear design. CMAA-70, Article 4.5 requires that gearing horsepower rating be based on certain American Gear Manufacturers Association Standards and provides a method for determining allowable horsepower. EOCI-61 provides no similar guidance. The recommendations in CMAA-70 constitute a codification of good engineering practice for gear design and are not expected to differ substantially from the practices employed in the design of cranes subject to this review and built to EOCI-61 specifications.

Response

a. TB Cranes

The Turbine building (TB) cranes were purchased in 1968 and were originally designed to meet EOCI-61, Specification for Electric Overhead Traveling Cranes, the manufacturer's standard practices. EOCI-61 was the standard in force at the time the TB cranes were manufactured.

According to the manufacturer's standard practice at that time, the tooth beam strength horsepower ratings of the TB crane were calculated according to the tooth forms, using the Lewis formula with the Barth velocity factor for the gearing. The pinion stresses used were based on the allowable working stresses with a safety factor of 5 or better. Calculations were performed to determine if the TB crane complied with CMAA #70. With the exception of the main hoist extra reduction gearing durability, the turbine building crane meets all requirements. The cranes noncompliance to CMAA #70 main hoist extra reduction gearing durability requirements will be compensated for by the addition of a maintenance procedure to check the backlash and surface pitting of the extra reduction gearing of each crane during its scheduled inspection. The durability horsepower rating for the extra reduction gearing for the main hoist is approximately 34% less than the requirements of CMAA-70 (with the microdrive being approximately 17% under). Due to the facts that the strength horsepower ratings exceed CMAA-70 requirements, and the crane is of low useage (standby service), and in consideration of the proposed addition to the inspection program, the shortfall of the durability rating is of minimal significance.

b. PS Crane

The horsepower rating for all spur and helical gearing meets the requirements of CMAA-70.

9. Bridge brake design. CMAA-70, Article 4.7.2.2 requires that bridge brakes, for cranes with cab control and the cab on the trolley, be rated for at least 75% of bridge motor torque. EOCI-61 requires a brake rating of 50% of bridge motor torque for similar configurations. A cab-on-trolley control arrangement is not expected for cranes subject to this review.

Response

a. TB Cranes

The cab on the bridge arrangement is used in the TB crane. This section is not applicable.

b. PS Crane

The cab-control and cab-on-trolley configuration is not used in the design and construction of the PS crane. The PS crane is controlled from a pendant and from the cab-on-gantry. This section is not applicable.

10. Hoist brake design. CMAA-70, Article 4.7.4.2 requires that hoist holding brakes, when used with a method of a control braking other than mechanical, have torque ratings no less than 125% of the hoist motor torque. EOCI-61 requires a hoist holding brake torque rating of no less than 100% of the hoist motor torque without regard to the type of control brake employed. This variation is not expected to be of consequence for cranes subject to this review since mechanical load brakes were typically specified for cranes built to EOCI-61 specifications. The addition of a holding brake safety margin in conjunction with electric control braking is a codification of good engineering practice. Some manufacturers provide holding brakes rated at up to 150% of hoist motor torque when used with electrical control braking systems.

Response

a. TB Cranes

The TB crane hoist holding brake torque rating is greater than 125% of the hoist motor torque. The main and auxiliary holding brake torque rating is greater than 150% of the hoist motor torque.

b. PS Crane

The PS crane hoist holding brake torque rating is greater than 125% of the hoist motor torque. The main and auxiliary holding brake torque rating is greater than 150% of the hoist motor torque.

11. Bumpers and stops. CMAA-70, Article 4.12 provides substantial guidance for the design and installation of bridge and trolley bumpers and stops for cranes which operate near the end of bridge and trolley travel. No similar guidance is provided in EOCI-61. This variation is not expected to be of significance for cranes subject to this review since these cranes are not expected to be operated under load at substantial bridge or trolley speed near the end of travel. Further, the guidance of CMAA-70 constitutes the codification of the same good engineering practice that would have been used in the design of cranes built to EOCI-61 specifications.

Response

a. TB Cranes

The TB crane operation is compensated for by bumpers and stops, for both trolley and bridge, which satisfy the intent of CMAA-70. The bumpers and stops are designed with sufficient energy absorbing capacity to stop the crane at a speed of 50% of full load rated speed which is 10% better than CMAA-70. Bumpers are mounted so that there is no direct shear on bolts.

b. PS Crane

The PS crane operation is compensated for by bumpers and stops, for both trolley and gantry, which satisfy the intent of CMAA-70. The bumpers and stops are designed with sufficient energy absorbing capacity to stop the crane at a speed of 50% of full load rated speed which is 10% better than CMAA-70. Bumpers are mounted so that there is no direct shear on bolts.

12. Static control systems. CMAA-70, Article 5.4.6 provides substantial guidance for the use of static control systems. EOCI-61 provides guidance for magnetic control systems only. This variation is not expected to be of safety significance because magnetic control systems were generally employed in cranes designed when EOCI-61 was in effect and the static control requirements identified in CMAA-70 constitute a codification of the same good engineering practice that would have been used in the design of static control systems in cranes built to EOCI-61 specifications.

Response

a. TB Cranes

The TB crane static power components were selected by the crane manufacturer to match the rated horsepower, voltage, and time rating for which the components are used. Any static control systems in use conform to the requirements of CMAA-70.

b. PS Crane

The PS crane static power components were selected by the crane manufacturer to match the rated horsepower, voltage, and time rating for which the components are used. Any static control systems in use conform to the requirements of CMAA-70.

13. Restart protection. CMAA-70, Article 5.6.2. requires that cranes not equipped with spring-return controllers or momentary-contact push buttons be provided with a device that will disconnect all motors upon power failure and will not permit any motor to be restarted until the controller handle is brought to the OFF position. No similar guidance is provided in EOCI-61. This variation is not expected tc be of consequence for cranes subject to this review since they are generally designed with spring-return controllers or momentary contact push buttons.

Response

a. TB Cranes

All motors of the TB crane are disconnected from the line upon power failure. No motor can be restarted after the power failure, until the magnetic reset switch is operated. The TB crane has momentary contact push buttons.

b. PS Crane

All motors of the PS crane are disconnected from the line upon power failure. No motor can be restarted, after the power failure, until the magnetic reset switch is operated. The TB crane has momentary contact push buttons.