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RECIP. NAME RECIPIENT AFFILIATION
DENTON, H. R. Document Control Branch (Document Control Desk)

SUBJECT: Advises that util proceeds w/plans to modify current auxiliary bldg crane to meet single-failure-proof requirements. Info on proposed single-failure-proof mods provided for review. Fee paid.

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April 10, 1987
AEP:NRC:0514T

Donald C. Cook Nuclear Plant Unit Nos. 1 and 2
Docket No. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
SINGLE-FAILURE-PROOF MODIFICATIONS TO THE
AUXILIARY BUILDING CRANE

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

ATTN: H. R. Denton

Dear Mr. Denton:

In accordance with our presentation to your staff during a meeting in December 1986, we are proceeding with our plans to modify our current auxiliary building crane to meet single-failure-proof requirements. Currently, Whiting Corporation, the manufacturer of our existing crane, is in the process of analyzing and designing a new trolley to meet the single-failure-proof requirements of NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants." The purpose of this letter is to provide information on the proposed single-failure-proof modifications and to request your review and comment on this information.

Information on the single-failure-proof modifications is contained in Attachment 1. Attachment 2 contains a preliminary seismic analysis for the modified crane.

The existing crane was not built to single-failure-proof criteria. The Donald C. Cook Nuclear Plant went into operation prior to issuance of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." In order to comply with the requirements of NUREG-0612, and Technical Specification (T/S) Section 3.9.7, certain administrative controls had to be imposed on the handling of heavy loads in the auxiliary building. The restrictions and the maintenance activities associated with the operation of the crane were noted in our earlier submittals AEP:NRC:0514N (dated January 29, 1986) and AEP:NRC:05140 (dated February 14, 1986). It is our intention to remove these administrative burdens by replacing the existing trolley with a single-failure-proof trolley built to the criteria noted in NUREG-0554. This will also assist us in future activities involving handling of heavy loads that would require upgrading the crane. We believe we have no alternative to upgrading the crane, since no other solution would alleviate the plant administrative burden required for compliance with T/S 3.9.7 and NUREG-0612. Therefore, we have decided to upgrade the crane to the single-failure-proof criteria of NUREG-0554 and will request deletion of T/S Section 3.9.7 later this year.

A033 w/ check $150.00
1/1 # 093-0123

Attachment 2 contains a preliminary seismic analysis of the modified crane. This analysis is not applicable to the existing crane. The design-rated load of the modified crane is 150 tons. As noted in the preliminary analysis, the maximum critical load (MCL) the modified crane can carry during a design-basis seismic event is 50 tons. A similar analysis with a 55-ton load resulted in an overstress of 1%. When the final design and analysis are completed, if necessary, some modification to the crane components will be made to remove the overstress condition so that the crane can be rated up to a 55-ton MCL. Please note that the seismic analysis has not been independently verified at this time, since it is a preliminary analysis. The final seismic analysis will be completed later this year and submitted at that time.

The design of the crane may require some modification to accommodate accessibility needs at the plant. If such modifications become necessary, information on the changes will be submitted along with the final seismic analysis.

We believe that with a modified crane which meets the single-failure-proof requirement as described in Attachments 1 and 2, the operational restrictions on the crane to meet the applicable requirements of NUREG-0612 and T/S Section 3.9.7 will no longer be required. We therefore intend to seek deletion of T/S Section 3.9.7 through a T/S change request and to delete the other administrative restrictions that were put in place to meet the requirements of NUREG-0612. We request your review and comments by June 15, 1987 so that we can answer any comments and submit the Technical Specification change request on a timely basis.

A check in the amount of $150.00 is attached with this letter for the processing of the aforementioned requests.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to insure its accuracy and completeness prior to signature by the undersigned.

Very truly yours,

M. P. Alexich
Vice President

cm

Attachments

cc: John E. Dolan
W. G. Smith, Jr. - Bridgman
R. C. Callen
G. Bruchmann
G. Charnoff
NRC Resident Inspector - Bridgman
A. B. Davis - NRC Region III

Attachment 1 to AEP:NRC:0514T

Information on the Single-Failure-Proof Modifications to the Auxiliary Building Crane at the Donald C. Cook Nuclear Plant

[illegible]

This attachment provides information on the single-failure-proof modifications to the existing auxiliary building crane. The crane will be upgraded by replacing the existing crane trolley with a new 150-ton single-failure-proof trolley. The upgraded crane was evaluated based on guidelines given in Attachment 1 of Reference 3, entitled "Single-Failure-Proof Handling Systems." Following are the results of this evaluation in response to the items in Attachment 1 of Reference 3.

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."

Response

The crane manufacturer is Whiting Corporation, who will also be responsible for modifications to the crane. The design-rated load (DRL) of the upgraded crane will be 150 tons. In meeting the requirements of NUREG-0554, the MCL is being limited to the maximum load the crane can handle during a seismic event. A preliminary seismic analysis has shown that the crane can handle at least 50 tons during a seismic event. However, the MCL will be finalized upon completion of the final analysis and design of the modified crane.

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 recommendation 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." (Footnote: "If the crane in question has previously been approved by the staff as satisfying NUREG 0554, Reg. Guide 1.104, or Part B to BTP-ASB-1, please reference the date of the staff's safety evaluation report or approval letter in lieu of providing the information requested by item 2.")

Response

The new trolley and its associated control systems were compared, on a point-by-point basis, with the guidelines provided in NUREG 0554. The comparison given below was developed by the crane manufacturer, Whiting Corporation, and the American Electric Power Service Corporation.

[illegible]

1. INTRODUCTION

The proposed modifications will meet all applicable sections of CMAA (Crane Manufacturers Association of America) Specification #70 Rev. 75 and ANSI B30.2.0-1967. The modifications include the replacement of the existing 150/20-ton capacity trolley with a 150-ton capacity single-failure-proof trolley. In addition, an inching mechanism and second holding brake will be added to the bridge drive.

2. SPECIFICATION AND DESIGN CRITERIA

2.1 Construction and Operating Periods

Since this is an operating plant the construction portion of this section is not applicable. For the operating period, the proposed crane will be designed per CMAA #70, Rev. 75. In this section, dynamic loads are considered due to load accelerations and not seismic loadings. Simultaneous static and dynamic loading will not stress the equipment beyond the material yield. The proposed hoist control is considered compensating since an eddy current brake is used.

2.2 Maximum Critical Load

Since the crane is indoor service, degradation due to exposure will not be considered a factor in the crane design. However, items subject to wear will have an additional design factor applied to them, as noted in the table at the end of this attachment. The modified crane has a maximum MCL of 150 tons, which is subject to reduction based on seismic analysis. The largest possible rating for DRL is 150 tons, since it is not recommended to exceed CMAA #70, Rev. 75 allowable. Once the final MCL has been established, it will be clearly marked on the crane.

2.3 Operating Environment

Inasmuch as the auxiliary building design requires no special venting requirements, such considerations have not been followed in the design of the crane.

2.4 Material Properties

In addition to impact testing requirements on the main hook, trolley structural members essential to structural integrity and greater in thickness than 5/8 inch are made of impact tested material in accordance with Section III of the ASME Code. The minimum operating temperature of the crane will be established by a cold proof test, and administrative controls will be used to prevent operation of the crane below the minimum operating temperature. In addition, low-alloy steels are not used in the fabrication of the crane, and cast iron is restricted to non-load bearing components.

2.5 Seismic Design

Non-linear seismic analysis on this equipment will be performed in accordance with the procurement specification requirements and suitable

restraints provided as appropriate to insure that the bridge and/or trolley remain in place on their respective runways should a seismic event occur.

2.6 Lamellar Tearing

The structural load support members of the trolley, specifically those members supporting the critical load, are fabricated from structural plate. Welded, rolled structural shapes are not used for these members. Moreover, weld joints associated with the structural members within the main hoist load path are typically oriented such that the induced stresses will not be manifested in lamellar tearing at the weld zone. All weld joints whose failure could result in the drop of a critical load will be nondestructively examined. If any of these weld joint geometrics would be susceptible to lamellar tearing, the base metal at the joints will be nondestructively examined.

2.7 Structural Fatigue

Since this is an operating plant, the modified crane will not be subjected to loads similar to plant construction lifts (i.e., loads greater than the design-rated load of 150 tons). A fatigue analysis will not be performed on the structures of this crane, nor does it seem reasonable that the results of such an investigation would prove meaningful. Designing for endurance in consideration of cyclic loading and material fatigue limits has generally not proven to be governing in overhead crane design. Moreover, the fatigue stress level of materials is typically beyond normal design stress allowables. Therefore, a load-stress excursion to qualify as one cycle would imply an overload condition.

2.8 Welding Procedures

Welding, welding procedures (pre-heat, post-weld heat treatments), and welder qualifications are in accordance with AWS D1.1 "Structural Welding Code" as required by the Specification DCC-MH-103-QCN. Further, low-alloy materials will not be used in the main load support structure.

3. SAFETY FEATURES

3.2 Auxiliary Systems

Where dual components are not provided within either hoist mechanical load path, redundancy is provided through an increased design factor on such components as required per NUREG-0612.

3.3 Electric Control Systems

Limit controls are incorporated to minimize the likelihood of inflicting damage to the hoisting drive machinery and structure that otherwise might occur through overtravel, resulting from inattentive and/or unskilled operator action. Control provisions are included to directly interrupt main line power as recommended.

3.4 Emergency Repairs

This crane is designed so that, should a malfunction or failure of controls or components occur, it will be able to hold the load while repairs and adjustments are made.

4. HOISTING MACHINERY

4.1 Reeving System

The static-inertia design factor of the wire rope, with all parts in the dual system supporting the DRL, is 11 to 1. Such conservative design more than surpasses requirements to sustain the dynamic effects of load transfer due to the loss of one of the two independent rope systems with an ample design margin remaining in the six parts supporting the load. Compliance with this recommendation requires high-alloy rope. By definition, reverse bends do not exist in the reeving system of the main hoist. Studies have been conducted to establish the effects of reverse bends on fatigue life. In consideration for the geometry of the wire rope (helix) construction, unless the distance between the sheaves in the load block and head block is under one lead of the wire rope, a reverse bend cycle is not incurred. Moreover, the ratio of rope to sheave diameter, in the only qualifying area of the hoist mechanism, is related to the drum and is 30 to 1 (125% of minimum requirement per CMAA Spec. #70, Rev. 75)

The pitch diameter of running sheaves and drums shall be in accordance with CMAA Spec. 70, Rev. 75. All fleet angles within the main hoist reeving are within the recommended 3 1/2 degrees. The crane is equipped with an equalizer beam/fixed sheave arrangement that provides two separate and complete reeving systems.

4.2 Drum Support

The indicated drum support provisions are included in the design which, as required, would insure against disengagement of the drum from its braking control system.

4.3 Head and Load Blocks

Each load-attaching point (sister hook and eye bolt) is amply designed to sustain 200% of the DRL. The overhead crane shall be load-tested at 125% of the DRL.

Nondestructive examination of the sister hook and eye bolt will be performed. After successful completion of the load test, a complete inspection of the crane, including a nondestructive examination of the sister hook and eye bolt, will be performed.

4.4 Hoisting Speed

The main hoist full rated load speed at 4.5 FPM is considered to be "slow" for this rated load. Further, the rope line speed at the drum at approximately 27 FPM is considered to be conservative.

4.5 Design Against Two-Blocking

The main hoist is equipped with two independent travel limit control devices in addition to a load sensing system, as suggested, to insure against two-blocking. Actuation of hoist travel limit switches or load-sensing device will deenergize the hoist drive.

4.6 Lifting Devices

Lifting devices for attachment to the main hook will meet or exceed these specified requirements.

4.7 Wire Rope Protection

Operation of the hoist is only to be attempted with the trolley and block aligned over the center of the load for a vertical lift. Side loading will not be permitted.

4.8 Machinery Alignment

The provisions of this paragraph are incorporated in the design of the overhead crane.

4.9 Hoist Braking System

The provisions of this paragraph will be incorporated in the design of the overhead crane.

5. BRIDGE AND TROLLEY

5.1 Braking Capacity

The bridge and trolley drives will each be provided with an appropriately sized electric holding brake which, upon interruption of power, will be applied through operator action or applied automatically through violation of travel limit provisions on the trolley and restrict area limit controls for the bridge. Further, the brake is capable of being operated manually. The brakes are checked during load tests.

The AC induction motors and magnetic controls utilized for these drives are not prone to an overspeed condition attributed to inherent operating characteristics. Therefore, overspeed limit controls for bridge and trolley motion equipped with this type of drive would represent a needless feature. Moreover, the motor controls are provided with adequate overload protection.

The mechanical drive components are designed to sustain maximum peak loadings capable of being transmitted by either the motor or brake under all attitudes of normal crane operation.

All other recommendations of this section are compatible with the design of the crane.

5.2 Safety Stops

As stated in Section 5.1, an overspeed condition, considering the type of drive used for the bridge and trolley, is not a concern with this equipment. Appropriately designed and sized bumpers and stops are provided in accordance with CMAA Spec. #70, Rev. 75 and are adequate to absorb the energy of the trolley and stop and hold it against the drive motor force in the event of a limit switch malfunction.

6. DRIVERS AND CONTROLS

6.1 Driver Selection

The main hoist motor was selected on the basis of hoisting the design-rated load (150 tons) at the design hoisting speed. Further, all proper and due consideration was given to the design of related mechanical and structural components to adequately resist peak torques transmitted by this motor within normal design limits.

Overspeed and overload-sensing limit control provisions have been incorporated to guard against such occurrences. Additionally, the hoist-holding brakes are capable of controlling the design-rated load within the 3 in (8 cm) specified stopping distance. Since the MCL rating is less than the DRL rating, administrative controls will be established to reset the overload-sensing device.

6.2 Driver Control Systems

The design considerations discussed in this section have been properly addressed and incorporated as appropriate except for the restriction of simultaneous operation of motions. The crane is not used to handle spent fuel assemblies.

6.3 Malfunction Protection

Features to sense, respond to, and secure the load in the event of an overspeed, overcurrent, overload, overtravel, and loss of one rope of the dual reeving system have been incorporated.

6.4 Slow Speed Drives

Features recommended in this paragraph will be incorporated as part of the motion control circuitry.

6.5 Safety Devices

Limit controls of whatever type provided are not intended as normal means for intervention of motion. Nonetheless, each hoist is equipped with two independent hoist overtravel limit controls.

6.6 Control Stations

Although the hoist, bridge, and trolley motions are capable of being operated manually under emergency conditions, no special means have been

provided to minimize the effort required for such operation. The crane is equipped with both a pendant and radio control scheme which should provide all necessary facility for the proper and complete operation of this equipment. Further, no special attention or provisions have been made for the location or any other devices for the purpose of control during emergency conditions. The crane is not equipped with an operator's cab.

7. INSTALLATION INSTRUCTIONS

7.1 General

Complete operation, maintenance, installation and testing instructions will be provided by the manufacturer for the overhead crane in accordance with the specifications.

7.2 Construction and Operating Periods

The crane will be designed for Class A-1 service, as defined in CMAA Spec #70, Rev. 75 and when operated and maintained within its design-rated load, can be expected to perform properly and adequately for all normal attitudes of plant service loads.

8. TESTING AND PREVENTIVE MAINTENANCE

8.1 General

The only components of the hoist that will have been proof-tested at the time of installation are the main hook-and-eye bolt and the wire rope. These items should not require further proof-testing beyond normal crane load testing.

8.2 Static and Dynamic Load Tests

The overhead crane shall be load-tested at 125% of DRL. The crane motions shall be limited with the 125% load due to physical restrictions of the plant. During the no-load test, however, each crane motion shall be operated to its full travel limit.

8.3 Two-Block Test

Although the hoist is equipped with an overload sensing device, under no circumstances should such a test be conducted for the mere purpose of demonstrating design adequacy. The whole purpose in providing numerous limit control devices was to ensure against such an occurrence. The two travel limit control switches will be checked prior to lifting a load. The overload sensing device can be operationally checked within the design rated load of the crane and without the need to secure the hoist to a fixed anchor for the purpose of generating an excessive load.

8.4 Operation Tests

Whiting standard procedures require a no-load running test before shipment. Calibration and adjustments for hoist overload and overspeed will be done after erection.

8.5 Maintenance

The maintenance of the crane will be performed by the plant under a program to be developed with the assistance of the AEPSC Materials Handling Division.

9. OPERATING MANUAL

Whiting's Standard Operations and Maintenance Manual, which is to be provided for the overhead crane, will provide sufficient information on the proper operation of the overhead crane, lubrication instructions, parts ordering information, and periodic inspection points.

10. QUALITY ASSURANCE

The quality assurance program followed during the manufacture of this equipment fully complies with the applicable requirements of 10 CFR 50. The Whiting Corporation is on the Donald C. Cook Nuclear Plant Qualified Suppliers List for spare and replacement crane parts. Whiting has a QA Program that complies with ANSI N.45.2 1971/NRC Regulatory Guide 1.28. This program applies also to the fabrication of new cranes for nuclear power plants. Whiting will be audited for QSL recertification in April 1987. Procedure MHI 2071, "Qualification and Training of Crane Operators," covers qualification requirements of crane operators and will be revised as necessary to reflect the features of the modified crane.

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."

Response

As indicated in Item 1, the MCL is being limited to the maximum load that the crane can handle during a seismic event; based on the preliminary seismic analysis, this value is at least 50 tons. The preliminary seismic analysis supporting this value is contained in Attachment 2. This lift capacity of 50 tons will be finalized upon completion of the final seismic analysis and design of the crane.

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."

Response

The special lifting beams used to move heavy loads such as concrete missile shields at Cook Plant were recently rebuilt to conform to a factor of

safety of 3 and 5 against yield/ultimate strengths as per the requirements of NUREG 0612. These will be modified or rebuilt as necessary to have a factor of safety of 10 in accordance with the requirements of NUREG 0612.

Item 5

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

Response

The interfacing lift points will be designed to meet the guidelines of NUREG 0612, Section 5.1.6. Any exceptions, if needed, will be submitted to the NRC for review.

UPGRADED 150-TON CAPACITY SINGLE-FAILURE-PROOF CRANE

DESIGN FACTORS

	100%	125%
Main hoist unit	10.0	8.0
Main hoist cable	12.0	9.6
Main trolley drive unit	9.8	8.3
Main trolley wheel assemblies	6.1	5.2

Design factors based on average ultimate stress and all components in tact.

Attachment No. 2 to AEP:NRC:0514T

Preliminary Crane Seismic Report