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An Exelon/British Energy Company

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10 CFR 50.90

April 4, 2001
2130-01-20042

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

Subject: Oyster Creek Generating Station (OCGS)
Docket No. 50-219
Facility License No. DPR-16
Technical Specification Change Request No. 281

In accordance with 10 CFR 50.90, AmerGen Energy Company, LLC (AmerGen) requests a review and approval of a change to the Facility License Technical Specifications contained in Appendix A as discussed in Enclosure 1. The requested change would delete Specifications 5.3.1.B and 5.3.1.C. These specifications provide restrictions on the handling of heavy loads over irradiated fuel stored in the spent fuel storage pool. The basis for deleting the specifications is the upgrade of the reactor building crane and associated handling systems to the single-failure-proof criteria contained in NUREG-0612 and NUREG-0554. This request is consistent with the Standard Technical Specifications (STS) in that specifications for heavy load handling were relocated from the STS.

Information on the reactor building crane upgrade that was completed in August 2000 is in Enclosure 2. A markup of Technical Specification page 5.3-1 denoting the proposed Technical Specification change is contained in Enclosure 3.

NRC review and approval of this change is requested by December 1, 2001. Approval by this date will provide AmerGen with sufficient time to use the crane to remove a waste container from the spent fuel pool and prepare to perform planned fuel movements to dry storage early in 2002. AmerGen needs to move spent fuel to dry storage to allow refueling in September 2002. The spent fuel transfers to dry storage must be complete by May 30, 2002. AmerGen cannot move fuel between Memorial Day and Labor Day as required by local zoning restriction. Therefore, to ensure fuel moves to dry storage are complete by May 30, 2002, preliminary preparations including dry runs will commence as early as January 2002. A waste container currently stored in the cask drop protection system area of the spent fuel storage pool must be removed since this is the location where the spent fuel transfer cask will be placed in the spent fuel pool. AmerGen is planning to move this waste container in December 2001. The waste

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container cannot be moved and transfers to dry storage cannot occur until the license amendment is issued.

Using the standards in 10 CFR 50.92, AmerGen has concluded that the proposed change does not constitute a significant hazard, as described in the enclosed analysis performed in accordance with 10 CFR 50.91 (a)(1).

Pursuant to 10 CFR 50.91 (b)(1), also enclosed is the Certificate of Service for this request certifying service to the designated official of the State of New Jersey Bureau of Nuclear Engineering and the Mayor of Lacey Township, Ocean County, New Jersey.

Pursuant to 10 CFR 51.22 an environmental review of this change is not required in accordance with the criteria of 10 CFR 51.22 (c)(9). The proposed change does not involve a significant hazard, the change pertains to an increase in the reliability of the reactor building crane that does not effect the amounts of effluents released offsite and there is no associated increase in individual or cumulative occupational radiation exposure.

The proposed change has undergone a safety review in accordance with Section 6.5 of the Oyster Creek Technical Specifications.

Should you have any questions or require any additional information please contact Mr. George B. Rombold at 610-765-5516.

Very truly yours,

Ron J. DeGregorio
Vice President
Oyster Creek

Enclosures: Enclosure 1 – Technical Specification Change Request No. 281
Enclosure 2 – Safety Analysis Report for Reactor Building Crane
Enclosure 3 – Technical Specification Markup

c: H. J. Miller, Administrator, USNRC Region I
L. A. Dudes, USNRC Senior Resident Inspector, Oyster Creek
H. N. Pastis, USNRC Senior Project Manager, Oyster Creek
File No. 01036

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April 4, 2001

Mr. Kent Tosch, Director
Bureau of Nuclear Engineering
Department of Environmental Protection
CN 415
Trenton, NJ 08628

Subject: Oyster Creek Generating Station
Facility License No. DPR-16
Technical Specification Change Request No. 281

Dear Mr. Tosch:

Enclosed is one copy of Technical Specification Change Request No. 281 for the Oyster Creek Generating Station Operating License.

This document was filed with the U.S. Nuclear Regulatory Commission on April 4, 2001.

Very truly yours,

Ron J. DeGregorio
Vice President
Oyster Creek

Enclosures

AmerGen℠

An Exelon/British Energy Company

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April 4, 2001

The Honorable Ronald Sterling
Mayor of Lacey Township
818 West Lacey Road
Forked River, NJ 08731

Subject: Oyster Creek Generating Station
Operating License No. DPR-16
Technical Specification Change Request No. 281

Dear Mayor:

Enclosed is one copy of Technical Specification Change Request No. 281 for the Oyster Creek Generating Station Operating License.

This document was filed with the U.S. Nuclear Regulatory Commission on April 4, 2001.

Very truly yours,

Ron J. DeGregorio
Vice President
Oyster Creek

Enclosures

United States of America
Nuclear Regulatory Commission

In the Matter of)

AmerGen Energy Company, LLC)

Docket No. 50-219

Certificate of Service

This is to certify that a copy of Technical Specification Change Request No. 281 for the Oyster Creek Generating Station Operating License, filed with the U.S. Nuclear Regulatory Commission on April 4, 2001 has this 4th day of April 2001, been served on the Mayor of Lacey Township, Ocean County, New Jersey, and the designated official of the State of New Jersey Bureau of Nuclear Engineering, by deposit in the United States mail, addressed as follows:

The Honorable Ronald Sterling
Mayor of Lacey Township
818 West Lacey Road
Forked River, NJ 08731

Mr. Kent Tosch, Director
Bureau of Nuclear Engineering
Department of Environmental Protection
CN 411
Trenton, NJ 08625

By: ______________________
Ron J. DeGregorio
Vice President
Oyster Creek

Oyster Creek Generating Station

Facility Operating License
No. DPR-16

Technical Specification Change
Request No. 281
Docket No. 50-219

Applicant submits by this Technical Specification Change Request No. 281 to the Oyster Creek Generating Station Facility Operating License a change to delete Specifications 5.3.1.B and 5.3.1.C.

By: ______________________
Ron J. DeGregorio
Vice President
Oyster Creek

Sworn to and subscribed before me this 4th day of April 2001.

____
Notary Public
MARITA ZAREMBA
NOTARY PUBLIC OF NEW JERSEY
Commission Expires 5/31/2005

Enclosure 1

Oyster Creek Generating Station
Technical Specification Change Request No. 281

Safety Evaluation
and
No Significant Hazards Determination

I. Technical Specification Change Request No. 281

The purpose of this Technical Specification Change Request (TSCR) is to delete Oyster Creek Generating Station (OCGS) Technical Specifications (TS) 5.3.1.B and 5.3.1.C.

AmerGen Energy Company, LLC (AmerGen) requests that the following change be made to the existing Facility License Appendix A Technical Specifications:

Revised Technical Specification Page: 5.3-1

The deletion of Specifications 5.3.1.B and 5.3.1.C occurs on page 5.3-1. The Section 5.3 bases contained on page 5.3-1 are being relocated to bases page 5.3-2. The relocation of the bases is a purely administrative change. Associated deletion of the bases for Specifications 5.3.1.B and 5.3.1.C is also reflected on page 5.3-1. The markup of page 5.3-1 is contained in Enclosure 3. Replacement technical specification and bases pages will be forwarded to the NRC upon imminent approval of this request.

II. Background and Reason for Change

By letter dated December 22, 1980 (Reference 1), supplemented by Generic Letters 81-07 (Reference 2) and 83-42 (Reference 3), NRC requested all licensees to assess and report on the degree of compliance with the defense-in-depth guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The NRC required this issue be addressed by licensees in two phases. Phase I addressed NUREG-0612 general guidelines, Section 5.1.1. Phase II addressed specific guidelines, which included NUREG-0612, Section 5.1.4, "Reactor Building - BWR."

Section 5.1.1 of NUREG-0612 established seven general guidelines to provide a defense-in-depth approach for the handling of heavy loads. These include safe load paths, load handling procedures, crane operator training, special lifting devices, lifting devices (not specially designed), cranes (inspection, testing and maintenance), and crane design. By letter dated June 21, 1983 (Reference 4), NRC approved the Oyster Creek Phase I response as having satisfied these guidelines.

As part of the Phase II evaluation, Section 5.1.4 of NUREG-0612 required, in addition to satisfying the general guidelines of Section 5.1.1, assurance that the evaluation criteria of Section 5.1 are satisfied by one of the following conditions:

1. The reactor building crane, and associated lifting devices used for handling the heavy loads identified in Section 5.1.4, should satisfy the single-failure-proof guidelines of Section 5.1.6 of NUREG-0612.

<u>OR</u>

2. The effects of heavy load drops in the reactor building should be analyzed to show that the evaluation criteria of Section 5.1 are satisfied. The loads analyzed should include: shield plugs, drywell head, reactor vessel head; steam dryers and separators; refueling canal plugs and gates; shielded spent fuel shipping casks; vessel inspection platform; and any other heavy loads that may be brought over or near safe shutdown equipment as well as fuel in the reactor vessel or the spent fuel pool. Credit may be taken in this analysis for operation of the Standby Gas Treatment System if facility technical specifications require its operation during periods when the load being analyzed would be handled. The analysis should also conform to the guidelines of Appendix A.

On June 28, 1985, NRC issued Generic Letter 85-11 (Reference 5) to close out NUREG-0612 issues. In this generic letter NRC indicated that "All licensees have completed the requirement to perform a review and submit a Phase I and a Phase II report. Based on the improvement in heavy loads handling obtained from implementation of NUREG-0612 (Phase I), further action is not required to reduce the risks associated with the handling of heavy loads . . . Therefore, a detailed Phase II review of heavy loads is not necessary and Phase II review is considered completed. However, while not a requirement, we encourage the implementation of any actions you identified in Phase II regarding the handling of heavy loads that you consider appropriate."

In the Oyster Creek response to Phase II of NUREG-0612, improving the reliability of the reactor building crane was to be evaluated. That evaluation was terminated when Generic Letter 85-11 was issued. Over the years, improvements were made to the reactor building crane to enhance its reliability. In August 2000 the upgrade of the reactor building crane to the single-failure-proof criteria contained in NUREG-0612 and NUREG-0554 was conducted.

The NRC issued Bulletin 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety-Related Equipment," on April 11, 1996. The bulletin was issued as a direct result of plans to move a 100-ton spent fuel transfer cask in the reactor building during plant power operation at Oyster Creek. In response to the bulletin, Oyster Creek committed, among other things, to evaluate the impact of heavy load drops in the reactor building when moved during power operation. With the upgrade of the reactor building crane and when used with single-failure-proof lifting devices, the drop of heavy loads by the reactor building crane is no longer required to be considered, as outlined in NUREG-0612 described above, during all plant modes.

Technical Specification 5.3.1.B prohibits heavy loads to be moved over stored irradiated fuel in the spent fuel storage pool. A heavy load at Oyster Creek is considered to be any load greater than 800 lbs., which is the approximate maximum weight of fuel assemblies and their handling tool used at Oyster Creek. Technical Specification 5.3.1.B also provides (License Amendment No. 187) requirements for handling the shield plug when it is moved over fuel assemblies contained in the dry shielded canister in the spent fuel transfer cask while it is in the cask drop protection system (CDPS). Technical Specification 5.3.1.C limits the height to which casks can be moved above the CDPS to 6 inches. It also requires limit switches to be operable to restrict cask height to 6 inches above the CDPS. The proposed change is the deletion of Specifications 5.3.1.B and 5.3.1.C. As a result, heavy loads will be able to be moved over stored irradiated fuel assemblies in the spent fuel storage pool by the reactor building crane using single-failure-proof rigging and the CDPS will no longer be required to protect the spent fuel storage pool from a cask drop.

The reactor building crane is the only crane that is capable of handling a heavy load over the spent fuel storage pool. The reactor building crane includes the main hoist, which has a maximum critical load (MCL) capacity of 105 tons, and the auxiliary hoist, which has a MCL capacity of 10 tons. Both the main and auxiliary hoists have been upgraded to single-failure-proof. All other hoists that can be used above or in the spent fuel storage pool have been derated to less than 800 lbs. and are not capable of moving heavy loads.

The deletion of Specifications 5.3.1.B and 5.3.1.C is justified by the upgrade of the reactor building crane and is consistent with the Standard Technical Specifications, which do not contain heavy load handling restrictions.

III. Safety Evaluation Justifying Change

1.0 Effects on Safety

The proposed Technical Specification change will eliminate restrictions on movement of heavy loads, i.e. loads greater than the weight of a spent fuel assembly and its handling tool, over spent fuel in the spent fuel storage pool (SFSP). It also removes requirements relating to the design function of the CDPS for cask moves into the SFSP. To effect this, the reactor building crane has been upgraded to single-failure-proof as defined by NUREG-0612.

1.1 Current Licensing Basis

By letter dated December 22, 1980 (Reference1), supplemented by Generic Letters 81-07 (Reference 2) and 83-42 (Reference 3), the NRC requested all licensees to assess and report on the degree of compliance with the defense-in-depth guidelines of NUREG-0612. The NRC required this issue be addressed by licensees in two phases. Phase I addressed NUREG-0612 general guidelines, Section 5.1.1. Phase II addressed specific guidelines which included NUREG-0612, Section 5.1.4, "Reactor Building-BWR".

Section 5.1.1 of NUREG-0612 establishes seven general guidelines to provide a defense-in-depth approach for the handling of heavy loads. These include safe load paths, load handling procedures, crane operator training, special lifting devices, lifting devices (not specially designed), cranes (inspection, testing and maintenance), and crane design. By letter dated June 21, 1983 (Reference 4), NRC approved Phase I implementation at Oyster Creek as having satisfied these guidelines.

As part of the Phase II evaluation, Section 5.1.4 of NUREG-0612 required, in addition to satisfying the general guidelines of Section 5.1.1, one of the following should also be satisfied by the reactor building crane.

1. Single-failure-proof guidelines of Section 5.1.6 of NUREG-0612

<u>OR</u>

2. Analyze the effects of heavy load drops to demonstrate that the evaluation criteria of Section 5.1 are satisfied. The analysis should also conform to the guidelines of Appendix A.

The licensing basis of the reactor building crane followed alternative 2 for handling heavy loads over the spent fuel pool, including spent fuel shipping casks, and is as follows:

1. Administrative controls limit crane movements over the spent fuel pool.

2. Mechanical rail stops prevent travel of the crane outside the analyzed load path over the CDPS.

3. Loads greater than the weight of one fuel assembly are prohibited [TS 5.3.1.B(1)] from travel over stored irradiated fuel in the spent fuel storage pool with one exception. The exception [TS 5.3.1.B(2)] is that the NUHOMS® transfer cask lid can be moved over the loaded cask with single-failure-proof rigging.

4. A cask must not be lifted more than six inches above the top plate of the CDPS. Vertical limit switches must be operable to assure the six-inch limit is met. The CDPS must be used when casks are lowered into and taken out of the SFSP (TS 5.3.1.C).

1.2 Single-Failure-Proof Reactor Building Crane

The reactor building crane was upgraded to single-failure-proof as defined in NUREG-0612, Section 5.1.6. The upgraded crane is rated for 105 tons maximum critical load on the main hook and 10 tons maximum critical load on the auxiliary hook. A 10 CFR 50.59 evaluation determined that there are no unreviewed safety questions involved in using the crane. The upgraded crane was placed into service in August 2000.

The information in Enclosure 2 documents compliance of the design with criteria contained in NUREG-0612 and NUREG-0554. A failure mode and effects analysis considered active components on the crane and concluded that no single mechanical or electrical component failure can result in a load drop.

The following is a summary of the upgraded crane design features and evaluations performed to verify seismic adequacy of the crane bridge, rail girder and the reactor building steel superstructure.

1.2.1 New Trolley

The original trolley was replaced with a new single-failure-proof trolley designed and tested to satisfy all criteria in NUREG-0554. Where the NUREG did not provide sufficient criteria guidelines, criteria from NOG-1-1998 (Reference 6) were used. The trolley is designed in accordance with CMAA Specification #70 for class D service for a 125 ton load on the main hook and 10 ton load on the auxiliary hook. However, the main hook is rated for 105 tons, which is the rating of the bridge girder and the reactor building steel superstructure.

The main and auxiliary hoist rope reeving system is dual (redundant) with each system providing independent load balance on the head and load blocks through configuration of the ropes and rope equalizers. The design employs two individual ropes, with a right and a left lay to assure proper winding on to the drum. The equalizer design limits the load on the intact reeving system to less than 40% of the rope breaking strength, including dynamic effects caused by a broken rope condition.

The head and load blocks maintain a vertical load balanced about the center of the lift from the load block through the head block. The design of the load block assembly provides only one attachment point consistent with the requirements with NUREG-0612, Appendix C.

Each drum employs a drum catching device which prevents the drums from falling and disengaging from the emergency stop disc caliper brakes. The drum catching device incorporates a ring built into the side of the end truck that engages the outside diameter of the drum shell. This arrangement effectively locks each drum between the end trucks, and prevents disengagement of the emergency stop disc caliper brakes.

Each hoist braking system employs two holding brakes and one power controlled braking system (dynamic braking supplied by the flux vector drive). The primary holding brake is located at the motor and the secondary or redundant holding brake is located on the drum (disc caliper air brake). Excessive stopping force or torque is avoided in the system by the primary brake actuating at a faster rate than the secondary pneumatic brakes. The holding brake system is single-failure-proof. Each holding brake is designed to actuate should any hoisting fault be detected, including over-speed, overload or out of balance. The holding brakes can be manually operated to lower a load if necessary.

The bridge and trolley controls are of the variable frequency drive type with dynamic braking. The drives provide the ability to limit the torque of the drive motor. The variable frequency drives provide for fractional inch movements. The trolley and bridge both have a dynamic control brake and disc holding brakes, one on the bridge and two on the trolley. The holding brakes are of the fail-safe design, and will be deployed in the event of malfunction of the power supply.

Special features are contained in the trolley electric control system to preclude system accidents. The special features include:

(a) A limit switch detects over-speed of each of the drums. When over-speed is detected, both the emergency stop disc caliper brakes mounted on the drum, as well as the motor mounted holding brakes will set and stop the load.

(b) An overload limit switch prevents lifting loads greater than the capacity of each of the hoists. Upon actuation only lowering motion is allowed.

(c) Over-travel limit switches prevent over-travel in raising and lowering direction, redundant upper and lower limit switches are provided on each hoist. The redundant upper limit switch is of the power paddle type that removes 3-phase power to the motor assuring that the motor is no longer energized.

(d) A mis-spooling limit switch protects each hoist cable from mis-spooling on the wire rope drum. This limit switch prevents cutting of a wire rope across the drum grooving.

(e) An unbalanced limit switch is provided on each hoist. This switch detects movement in the equalizer system, which could indicate that one of the two hoist ropes has stretched or yielded.

Protection against two-blocking is provided by two upper, redundant, limit switches of different design and actuation.

The wire rope is protected from side loading by unbalanced load limit switches mounted on the equalizer. They detect excessive motion of the equalizer that will indicate an unbalanced load or side pulling.

Over-travel of both the bridge and trolley is prevented by both mechanical and electrical limiting devices. Mechanical bumpers on the bridge and trolley limit end of travel. Electrically actuated travel limit switches on the bridge and trolley prevent over-travel.

Malfunction protection employs sensors in the motor control circuits to detect and respond to excessive electrical current, over-speed, overload and over-travel. The electric dynamic brakes absorb the kinetic energy for the rotating machinery and stop the hoisting motion. Additionally, these forces are designed to be absorbed via the mechanical holding brake system. The kinetic energy released during rope failure is absorbed by the auxiliary hoist bar equalizer system and absorbed via the main hoist's composite honeycomb crush pad located in the equalizer system.

The damaging effects of jogging and plugging is eliminated by incremental drives used for hoisting via the flux vector variable frequency drive which is a stepless speed control. The drive accomplishes safe plugging by first electrically and then mechanically stopping the hoist drive before reversing the drive. The damage caused by jogging is also eliminated as the drive accelerates and then decelerates the system to zero speed before an additional jog is allowed. The drive is programmed to prevent abrupt changes in motion.

Limit switches provided for malfunction protection, inadvertent operator action or failures are separate from the limiting means provided for hoist and crane operation.

The horsepower rating of the drive hoist motor has been matched with the calculated requirement to lift and accelerate the design rated load (DRL) to design hoisting speed. The maximum torque capacity of the hoist motor does not exceed the rating of the individual components of the hoist system required to hoist the DRL at maximum design hoist speed. Over-speed is limited by the over-speed limit switch which is designed to actuate both holding brakes upon detection of an over-speed. The controls and limit switches provide the capability of stopping hoist motion before damage can occur. Hoisting motion can be stopped within 3 inches when hoisting the maximum critical load at the maximum design hoist speed. This can be achieved with either or both braking systems operating.

Electrical circuits of the crane are designed with additional safeguards to detect such events as phase loss, under voltage, over voltage and over current. Upon detection of any of these faults, the drive system de-energizes causing the holding brakes to set. This then places the crane in a safe condition.

The operator's control of the crane is cab control or radio transmitter control. Electrical interlock between the cab and radio control permits only one control station to be operable at any one time. An emergency stop button is provided in the cab, while an emergency stop selector switch is provided on the radio control transmitter, either of which will remove power from the crane and set all brakes. Additionally, a manual disconnect switch is provided on the refuel floor to provide an additional means to independently disconnect the power from the crane and runway.

Manual controls for lowering the hoists are on the trolley. A battery powered digital readout on the trolley displays hoisting speed during emergency conditions. Manual actuation of the emergency stop disc caliper brakes is via a proportional air control valve. Emergency controls for control of the bridge and trolley are by manual actuation on the bridge service platform.

The minimum operating temperature for the crane was determined to be +45°F by laboratory testing.

Critical welds on the bridge girders were non-destructively tested using ultrasonic test method. Weld indications were evaluated for the crane load demand of 105 tons and determined to be adequate. The indications originated during fabrication and have not grown since.

1.2.2 Seismic Design and Evaluation

The response spectrum method of dynamic analysis was used to analyze/design the new trolley and analyze/evaluate the existing bridge girders. The analysis used the 4% OBE and 7% SSE spectra from the crane bridge rails as the input for the seismic analysis. The analysis evaluated three locations of the trolley on the bridge, at the end, quarter and mid-span with the hook in the up and down positions. The acceptance criterion for the allowable stress for the SSE condition was set at 1.33 times the basic allowable stress given in CMAA Specification #70. No detailed analysis was performed for the OBE loading condition since the allowable stress level for the SSE condition is conservatively set to a low value. The analysis/design/evaluation qualified the new trolley for a 125 ton lifted load and the bridge/bogeys for a 105 ton lifted load.

1.2.3 Broken Rope Accident Analysis

An equivalent static analysis using a dynamic load factor to account for dynamic effects of a broken rope was performed in lieu of a detailed dynamic analysis. The evaluation determined that the trolley structure is qualified for a broken rope accident.

1.2.4 Seismic Evaluation of the Reactor Building Steel Superstructure

The reactor building steel superstructure that supports the crane structure was evaluated for the crane upgrade project. The entire superstructure was modeled on the SAP2000 Plus computer code and was analyzed for the SSE and OBE seismic load cases. The analysis model was analyzed with the crane bridge and trolley at two critical locations. The evaluation determined that a modification would be required to better tie the crane bridge rails to the building steel columns at all column locations. This modification was performed. The reactor building steel superstructure is adequate for the maximum critical load of 105 tons on the crane hook during a seismic event.

1.3 Technical Specification Change

1.3.1 Description of Change

The proposed change to the Technical Specifications is shown in Enclosure 3. The change removes all requirements for limiting heavy loads over the SFSP and reliance on the design function of the cask drop protection system.

Technical Specifications 5.3.1.B and 5.3.1.C will be deleted.

1.3.2 Justification for Technical Specification Change

NUREG-0612, issued in July 1980, recommended that technical specifications should be established to address various aspects of heavy load handling and drop consequences. The NRC Safety Evaluation Report (SER) dated June 21, 1983 (Reference 4), confirmed the adequacy of measures taken to address Phase I of NUREG-0612 implementation. The SER concluded that technical specifications regarding heavy load handling already in place were adequate. The specifications included the restriction on moving heavy loads over stored irradiated fuel in the spent fuel storage pool.

Interim protection measure 1 in Section 5.3 of NUREG-0612 states: "Licenses for all operating reactors not having a single-failure-proof overhead crane in the fuel storage pool area should be revised to include a specification comparable to Standard Technical Specification 3.9.7, 'Crane Travel – Spent Fuel Storage Building,' for PWRs and Standard Technical Specification 3.9.6.2, 'Crane Travel,' for BWRs, to prohibit handling of heavy loads over fuel in the storage pool until implementation of measures which satisfy the guidelines of Section 5.1." Since one of the alternatives of Section 5.1 is a single-failure-proof crane, this specification is no longer required by NUREG-0612. The Standard Technical Specifications (STS) cited by NUREG-0612 have been superceded by Improved STS.

During the development of the Improved STS, the specifications associated with heavy load handling were removed. NUREGs-1433 and 1434, Revision 1, dated April 7, 1995 contain specifications for typical BWR 4 and 6 plants, respectively. The specifications contained in the NUREGs were determined necessary to comply with 10 CFR 50.36. They do not include requirements for heavy load handling. The specifications associated with heavy load handling are allowed to be removed from the Technical Specifications and relocated to plant controlled documents. Consistent with the Standard Technical Specifications, the requirements necessary to assure compliance with the single-failure-proof handling systems associated with the reactor building crane and other restrictions regarding the potential for heavy loads to be handled by other hoists over the SFSP will be incorporated into the Updated FSAR and/or plant procedures, as appropriate. This supports deleting Technical Specifications 5.3.1.B and 5.3.1.C.

There are four cranes in the reactor building that can be used to move loads over the spent fuel pool. The refueling platform hoists, the two spent fuel pool jib cranes and the reactor building crane hoists. The load handling design basis of the refueling platform hoists and the two spent fuel pool jib cranes for movement of loads over or in the vicinity of the SFSP was reviewed and approved by the NRC in Reference 4. The use of the reactor building crane is addressed in this license amendment request for revision to its licensing basis.

The existing technical specifications are no longer required for a single-failure-proof crane. The restrictions imposed by Technical Specifications 5.3.1.B and 5.3.1.C are unnecessary when the single-failure-proof reactor building crane is used to transport a heavy load over the spent fuel storage pool.

IV. No Significant Hazards Determination

In accordance with 10 CFR 50.91 the following provides an analysis that concludes no significant hazards are involved with the proposed change. The standards in 10 CFR 50.92 are used in this determination.

The proposed amendment does not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated.

Until August 2000, the reactor building crane was not single-failure-proof. For heavy load handling associated with the spent fuel pool, Oyster Creek is consistent with Section 5.1.4(2) of NUREG-0612: "The effects of heavy load drops in the reactor building should be analyzed to show that the evaluation criteria of Section 5.1 are satisfied." An alternative to this is Section 5.1.4(1): "The reactor building crane, and associated lifting devices used for handling of ... heavy loads, should satisfy the single-failure-proof guidelines of Section 5.1.6 of this report." The upgraded crane and handling systems satisfy the guidelines of Section 5.1.6. Therefore, the licensing basis for the reactor building crane with regard to its use in handling heavy loads above the spent fuel storage pool is being revised to include Section 5.1.4(1) of NUREG-0612 in addition to 5.1.4(2).

The cask drop protection system was required with the original crane since load drop analysis will yield unacceptable consequences to the SFSP structure. The CDPS serves to mitigate the consequences of a cask drop accident involving the original crane which complied with NUREG-0612 Phase I. The upgraded single-failure-proof crane satisfies the criteria of NUREG-0612 Section 5.1.6. Therefore, the reactor building crane eliminates reliance on the design function of the CDPS since the probability of a heavy load drop is very low.

With the proposed change to the technical specifications, the evaluation criteria of NUREG-0612, Section 5.1 is met with a single-failure-proof crane that satisfies the guidelines of Section 5.1.6 or consequence analysis that satisfies Section 5.1.4(2). A fault tree evaluation performed by the NRC to establish the bases for NUREG-0612 guidelines shows that:

(a) The likelihood for unacceptable consequences in terms of excessive releases of gap activity or potential for criticality due to accidental dropping of postulated heavy loads after implementation of the guidelines of Section 5.1 is very low; and

(b) The potential for unacceptable consequences is comparable for any of the alternatives evaluated by fault tree, indicating the relative equivalency between alternatives.

Since the NRC fault tree evaluation shows that the potential for unacceptable consequences is comparable for the two alternatives in Section 5.1.4 of NUREG-0612, the proposed technical specification change does not significantly change the potential for unacceptable consequences to the plant in conducting heavy load handling above the SFSP. The probability of a load drop accident caused by use of the reactor building crane has been reduced to where it is so small to be considered not credible within regulatory accepted standards. The reason for this is attributed to the following:

(a) The reactor building crane is single-failure-proof.

(b) The rigging used with the crane will be single-failure-proof per Section 5.1.6 of NUREG-0612.

(c) Other aspects associated with lifts using the reactor building crane such as inspection, maintenance, training, safe load paths and procedures are adequate to meet the NUREG-0612 criteria.

(d) The requirements of NUREG-0612 Phase I have been implemented. Such requirements are training and qualification of personnel, load handling procedures, load path that avoids safety related equipment and using certified lifting devices.

Therefore, the proposed technical specification change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated.

The deletion of Technical Specifications 5.3.1.B and 5.3.1.C will allow the handling of loads in excess of the weight of one fuel assembly (approximately 800 lbs.) over spent fuel assemblies in the SFSP which is an area previously off limits for such loads. It will also allow the handling of heavy loads up to the maximum critical load rating of the main hoist (105 tons). It will remove the requirement to use the CDPS design function to mitigate effects of spent fuel cask drops. It is known that the drop of a spent fuel cask without the CDPS can cause structural failure of the SFSP structure. However, with the single-failure-proof reactor building crane handling heavy loads over the SFSP, the need to address drops in this previously restricted area is eliminated since a load drop is not considered credible by regulatory accepted standards as described in NUREG-0612. The use of a single-failure-proof crane to handle heavy loads has been accepted as the equivalent to overall risk to currently established heavy load controls of a non single-failure-proof crane with acceptable drop consequences. Therefore, operation of the facility in accordance with the proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

(3) Involve a significant reduction in a margin of safety.

Current Technical Specification 5.3.1.B limits loads over irradiated fuel in the SFSP to those that have been evaluated and determined to have acceptable consequences as a result of a drop. The limit is set at the weight of one fuel assembly, approximately 800 pounds. In addition, Specifications 5.3.1.B and 5.3.1.C provide restrictions on the use of the shield plug, and the CDPS for use with casks. The proposed technical specification change will remove the load limit over the SFSP and shield plug and CDPS restrictions when the reactor building crane is used with single-failure-proof handling systems that comply with criteria in Section 5.1.6 of NUREG-0612.

The reactor building crane was upgraded to single-failure-proof in compliance with NUREG-0554. The upgraded crane and handling system is in compliance with NUREG-0612, Sections 5.1.1 and 5.1.6. The NRC in NUREG-0612, Section 5.2 documented their review of the potential consequences of a load drop when handled by a single-failure-proof crane using single-failure-proof rigging compared with other alternatives and concluded as follows:

> "The likelihood for unacceptable consequences in terms of excessive releases of gap activity or potential for criticality due to accidental dropping of postulated heavy loads after implementation of the guidelines of Section 5.1 is very low."

This means that a load drop is considered to be unlikely within regulatory accepted standards when the load is handled by a single-failure-proof crane and handling system, and performed in accordance with Section 5.1 of NUREG-0612. A single-failure-proof crane design incorporates the applicable design basis event that in this case is a seismic event. A load drop is of such low probability that it is considered unlikely when it is handled with the reactor building crane since the crane and its handling systems satisfy the NUREG-0612 criteria for a single-failure-proof crane. Therefore, any load lifted over the SFSP using the reactor building crane has a very low probability of falling into the spent fuel pool accidentally or as a result of a design basis event. Therefore, the proposed change does not involve a significant reduction in a margin of safety.

References

1) NRC Letter from Mr. Darrell G. Eisenhut to licensees, dated December 22, 1980, "Control of Heavy Loads"
2) NRC Generic Letter 81-07, dated February 3, 1981, "Control of Heavy Loads"
3) NRC Generic Letter 83-42, dated December 19, 1983, "Clarification to Generic Letter 81-07 Regarding Response to NUREG-0612, Control of Heavy Loads at Nuclear Power Plants"
4) NRC Letter, dated June 21, 1983, "Control of Heavy Loads (Phase I) – NUREG-0612 – Oyster Creek Nuclear Generating Station"
5) NRC Generic Letter 85-11, dated June 28. 1985, "Completion of Phase II of 'Control of Heavy Loads at Nuclear Power Plants' NUREG-0612"
6) ASME NOG-1-1998, 'Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)'

Enclosure 2

Oyster Creek Generating Station
Technical Specification Change Request No. 281

Reactor Building Crane
Compliance with NUREG-0612 and NUREG-0554

NUREG-0554/0612 COMPLIANCE/ SAFETY ANALYSIS REPORT

FOR

OYSTER CREEK GENERATING STATION

REACTOR BUILDING CRANE SINGLE-FAILURE-PROOF UPGRADE

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Attachments: Attachment A - Quality Matrix

United States Nuclear Regulatory Commission
2130-01-20041
Enclosure 2

NUREG-0554

1. Introduction

"A general requirement for design and operation of light-water reactors is that fuel storage and handling systems be designed to ensure adequate safety under normal and accident conditions. Overhead cranes are used to lift and transfer heavy component parts such as spent fuel casks and reactor vessel heads. When a load being handled by a crane can be a direct or indirect cause of release of radioactivity, the load is called a critical load.

NRC has licensed reactors on the basis that the safe handling of critical loads can be accomplished by adding safety features to the handling equipment, by adding special features to the structure and areas over which the critical load is carried, or by a combination of the two. When reliance for the safe handling of critical loads is placed on the crane system itself, the system should be designed so that a single failure will not result in the loss of the capability of the system to safely retain the load. This report identifies features of the design, fabrication, installation, inspection, testing, and operation of single-failure-proof overhead crane handling systems that are used for handling critical loads. These features are limited to the hoisting system and to braking systems for trolley and bridge. Other load-bearing items such as girders should be conservatively designed but need not be considered single-failure-proof.

The general value of existing standards is recognized in this report, and reliance is placed on quality levels indicated in CMAA Specification #70 and in ANSI B30.2.0-1967 as supplemented by the recommendations in the following sections of this report.

The typical plant layout for pressurized water reactors (PWRs) is such that two different cranes may be required to handle critical loads. One of these cranes is located in the spent fuel storage and transfer areas where the largest critical load would be a spent fuel shipping cask. The other crane is located inside the containment structure over the reactor vessel where it is used to lift the reactor vessel head during refueling periods; this crane is called a polar crane because of the circular track for the bridge structure.

In the plant layout for the majority of the boiling water reactors (BWRs) designed and built, a single crane handles critical loads near the reactor vessel and at the spent fuel storage area. However, for recent BWR plant designs (BWR Mark 6), two cranes could be needed to handle critical loads."

Introductory Statement

AmerGen, using the services of the American Crane and Equipment Company (ACECO), has installed a 105/10 ton maximum critical load (MCL) single-failure-proof main and auxiliary hoist replacement trolley at Oyster Creek Generating Station. The replacement trolley is used on the existing 100/5 Ton reactor building crane. The original crane was fabricated by the Whiting Corporation in 1966-1967 in accordance with EOCI Specification No. 61 and Burns and Roe Specification S-2299-32, and then later requalified to CMAA Specification No. 70 as part of NUREG-0612 Phase I compliance.

In 1995, the existing reactor building crane control systems were upgraded to include AC Flux Vector controls on the hoist units and AC Variable Frequency controls on the bridge and trolley. The upgraded controls, which included new motors and brakes, increased the crane's performance capabilities and provided numerous enhancements in the crane control's safety systems.

The single-failure-proof trolley will allow heavy loads to be moved to and around the refuel floor in accordance with the requirements of NUREG-0612. This will also allow movement of spent nuclear fuel, within casks, to the onsite Independent Spent Fuel Storage Installation (ISFSI). The use of the replacement single-failure-proof trolley, designed so that a single failure will not result in the loss of the capability to safely retain the load, will allow movement of heavy loads in compliance with the requirements of NUREG-0612 Phase II.

The design basis for the supply of the new single-failure-proof trolley is NUREG-0554, as well as NUREG-0612 Appendix C. As NUREG-0554 incorporates by reference CMAA Specification #70, the most current 1999 version was used. The 1975 edition of CMAA Specification #70 was reviewed to ensure the requirements of this edition are enveloped in the design basis. In areas where NUREG-0554 provides limited guidance, ASME NOG-1-1998 was used. As an example, this was used in the seismic design. NUREG-0554 states seismic design is to be in accordance with Regulatory Guide 1.29. ASME NOG-1 is in compliance with Regulatory Guide 1.29, which further defines how Regulatory Guide 1.29 should be applied with respect to crane design.

The crane vendor American Crane & Equipment Corporation (ACECO) maintains a 10 CFR 50 Appendix B/ASME NQA-1 nuclear quality assurance program to ensure that the quality of the single-failure-proof replacement trolley is consistent with the requirements of the nuclear industry.

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2. Specification and Design Criteria

2.1 Construction and Operating Periods

"When an overhead crane handling system will be used during the plant construction phase prior to its intended service in the operating plant, separate performance specifications may be needed to reflect the duty cycles and loading requirements for each service. At the end of the construction period, changes to the crane system may be required to reflect the specifications for the permanent operating plant condition. For example, if the specification for the size of the hoist drive motor differs sufficiently for the two applications, the motor and the affected control equipment would have to be replaced or changed for the operating plant phase. Features and functions needed for the cranes during the plant construction period are not considered in this report except where the use of the crane during construction may influence its design and operation for the permanent plant operation.

If the load lifts during construction are heavier than those for plant operation, the performance specifications should include design criteria for a permanent crane for construction as well as for operation. The allowable design stress limits for the crane intended for plant operation should be those indicated in Table 3.3.3.1.3-1 of CMAA Specification #70 and reflecting the appropriate duty cycle in CMAA Specification #70. The sum total of simultaneously applied load (static and dynamic) should not result in stress levels causing permanent deformation, other than localized strain concentration, in any part of the handling system during either the construction or the operating phase. The effects of cyclic loading induced by jogging or plugging an uncompensated hoist control system should be included in the design specification."

Compliance Statement

The period of operation for the replacement trolley will be approximately thirty years. This is based on the current forty year plant license with the possible addition of life extension, as well as plant decommissioning following shutdown.

The replacement trolley will not be used for construction lifts.

The allowable design stress limits for the crane/bridge are those indicated in Table 3.3.3.1.3-1 of CMAA Specification #70-1975. The allowable design stress limits for the replacement trolley are those defined in Section 3.4 of CMAA Specification #70 1999. The crane design basis (service classification) is CMAA Class D (heavy service). The design is such that the simultaneous applied loads, static and dynamic, do not result in stress levels causing permanent deformation, other than localized strain concentration, in any part of the handling system during its intended years of operation. The effects of cyclic loading induced by jogging or plugging a non-compensated hoist control system is not included in the design basis as the replacement trolley design employs flux vector variable frequency drives which provide for smooth slow speed positioning and for gradual acceleration and deceleration

NUREG-0554

2.2 Maximum Critical Load

"A single-failure-proof crane should be designed to handle the maximum critical load (MCL) that will be imposed. However, a slightly higher design load should be selected for component parts that are subject to degradation due to wear and exposure. This will provide a margin in the crane's load-handling ability before it drops below its MCL capacity. An increase of approximately 15% of the design load for these component parts would be a reasonable margin. The MCL rating should be clearly marked on the crane.

Certain single-failure-proof cranes may be required to handle occasional non-critical loads of magnitude greater than the MCL during plant maintenance periods. For such cases, the maximum noncritical load will be the design rated load (DRL). The design of certain components may be decided to a greater extent by the MCL rating even though standard commercial practice may be used for the DRL rating. The DRL rating should be marked on the crane separately from the MCL marking."

Compliance Statement

The requirement for a 105 ton and 10 ton maximum critical load capacity for the main hook and auxiliary hoists was established. The design rated load (DRL) of the main hoist will be 125 tons, while the auxiliary hoist DRL will be 10 tons. A slightly higher design load has been applied to the major wearing components, which included the wire rope and holding brakes. The main hoist wire rope reeving system also has an approximate 15% increase in its design load margin while the auxiliary hoist also has a 15% increase. The braking systems also are provided with additional design margin based on load torque requirement. The main hoist primary motor mounted holding brake has a 175% margin while the drum emergency stop disc caliper brake has an approximate 165% margin based on 100% torque requirement. The auxiliary hoist primary motor mounted holding brake has a 65% margin while the drum emergency stop disc caliper bake has an approximate 30% margin based on 100% torque requirement.

The crane is marked to clearly indicate the MCL and DRL.

NUREG-0554

2.3 Operating Environment

"The operating environment, including maximum and minimum pressure, maximum rate of pressure increase, temperature, humidity, and emergency corrosive or hazardous conditions, should be specified for the crane and lifting fixtures.

For cranes inside the containment structure, the closed box sections of the crane structure should be vented to avoid collapse during containment pressurization. Drainage should be provided to avoid standing water in the crane structure."

Compliance Statement

The operating environment for the crane is listed in Specification No. SP-1302-12-292. It states in Section 7.9 Environmental Conditions:

7.9.1. Normal Operation

7.9.1.1 The Reactor Building 119'-3" elevation has EQ zones designated as areas 1, 2, 3 & 4. These areas have the following environmental parameters listed for normal operation:

Aging Temperature: 79 degrees F

Temperature Range:	40 degrees F to 130 degrees F (see below) {see Section 2.4 for minimum operating temperature}
Radiation:	6.13×10^{3} Rads (40 year TID)
Humidity:	100%
Pressure:	Atmospheric

7.9.1.2 The aging temperature is a measure of the average temperature expected over the life of the plant at the 119'-3" elevation. The crane and its controls are elevated above the floor. The following factors can contribute to elevated temperatures at the crane:

- Extreme Outside Temperature (105 degrees F has been recorded)
- Loss of Reactor Building HVAC
- HVAC Duct Location at Floor Level Only (Stratification)
- Short Duration Extreme Heat Loads (removal of reactor cavity shield plugs during shutdown)

7.9.1.3 Maximum temperature at the crane elevation during normal operation is expected to be 130 degrees F. The Reactor Building HVAC system is designed to maintain a minimum temperature of 50 degrees F. Extremes in outside temperature or problems with the HVAC system could result in temperatures as low as 40 degrees F.

7.9.2 Accident Conditions

7.9.2.1 The Reactor Building 119'-3" elevation has EQ zones designated as areas 1, 2, 3 & 4. These areas have the following environmental parameters listed for accident conditions:

Peak Temperature:	221 degrees F
Radiation:	4×10^{4} Rads
Pressure:	15.8 PSIA
Humidity:	100%

7.9.2.2 The reactor building crane is not required to function during accident conditions. The accident conditions listed above are transient in nature. It is desirable that the equipment described in this specification be capable to function normally once environmental conditions have returned to normal. It is required that the crane continue to support the load safely during and following all accident conditions, including a safe shutdown earthquake (SSE).

This equipment is operating in the secondary containment (Reactor Building). The pressure differential during accident conditions has been analyzed. Closed box sections have been provided with drain holes. In accordance with Section 7.9.1.3, the crane and new trolley are designed to operate in the 130 degree F maximum temperature. The crane and trolley are not designed to operate during the accident conditions described in Section 7.9.2. The crane is designed to support the load during and after the accident conditions listed.

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2.4 Material Properties

"Cranes are generally fabricated from structural shapes and plate rolled from carbon steel (no alloying elements except for 1% manganese in heavier section) or low-alloy steel (less than 5% total alloy content). Some of these steel parts exceed 12 mm (1/2 in) in thickness and may have brittle-fracture tendencies when exposed to lower operating temperatures so that testing of the material toughness becomes necessary. When low-alloy steels are used, weld metal toughness is of greater concern than the base metal.

However, it may be impractical to perform toughness tests for cranes that have progressed too far in the manufacturing sequence or for cranes already built and operating. Such cranes should therefore be tested by subjecting the crane to a test lift at the lowest anticipated operating temperature. It is desirable to include the crane manufacturer in the planning of the test.

Minimum operating temperatures should be specified in order to reduce the possibility of brittle fracture of the ferritic load-carrying members of the crane. In order to ensure resistance to brittle fracture, materials for structural members essential to structural integrity should be tested in accordance with the following impact test requirements. Either drop weight test per ASTM E-208 or Charpy tests per ASTM A-370 may be used for impact testing. The minimum operating temperature based on the drop weight test should be obtained by following procedures in paragraph NC-2300 of Section III of the ASME Code. The minimum operating temperature based on the Charpy V-notch impact test should be obtained by following the procedures in paragraph ND-2300 of Section III of the ASME Code. Alternative methods of fracture analysis that achieve an equivalent margin of safety against fracture may be used if they include toughness measurements on each heat of steel used in structural members essential to structural integrity. In addition, the fracture analysis that provides the basis for setting minimum operating temperatures should include consideration of stress levels; quality control; the mechanical checking, testing, and preventive maintenance program; and the temperatures at which the DRL test is run relative to operating temperature.

These toughness recommendations were developed at a time when typical material section thickness for crane girders was a maximum of 51 mm (2 in). However, later information indicates that material thicknesses of 102 mm (4 in) or more may be needed for some applications. The rules for ASME Code Class 3 Charpy Testing do not make any adjustments for thicknesses greater than 64 mm (2 1/2 in), and for this reason it is felt that the NC-2300 and ND-2300 requirements give equivalent requirements only for the smaller thicknesses. For thicknesses over 64 mm (2 1/2 in), it is recommended that the NC-2300 requirements be used exclusively.

As an alternative to the above recommendations, the crane and lifting fixtures for cranes already fabricated or operating may be subjected to a coldproof test consisting of a single dummy load test as follows: Metal temperature of the structural members essential to the structural integrity of the crane handling system should be at or below the minimum operating temperature. The corresponding dummy load should be equal to 1.25 times the MCL. If the desired minimum operating temperature cannot be achieved during the test, the minimum operating temperature should be that of the test until the crane is retested at a lower temperature. The coldproof test should be followed by a nondestructive examination of welds whose failure could result in the drop of a critical load. The nondestructive examination of critical areas should be repeated at 4-year intervals or less.

Cranes and lifting fixtures made of low-alloy steel such as ASTM A514 should be subjected to the coldproof test in any case.

Cast iron should not be used for load-bearing components such as rope drums. Cast iron may be used for items such as electric motor frames and brake drums."

Compliance Statement

The trolley load beams (girt) as well as end trucks are fabricated from rolled plate to form fabricated box sections. The materials for these structures are ASTM A572 Grade 50 and 60. Mechanical components including shafts, pins and axles are fabricated from ASTM A322 Grade 4140, 4340 & 8620; ASTM A108 Grade 1045; and ASTM A576 Grade 1045. The drums are fabricated from ASTM A514. Testing of all these materials is in accordance with Attachment A - Quality Matrix. Note upon review of Attachment A - Quality Matrix, that the load girt and end truck materials require Certified Material Test Reports, as well as Charpy Impact Tests at 30 degrees F below the lowest operating temperature. As all structural materials greater than 5/8" required to support the load are Charpy Impact Tested, the structure was not nondestructively inspected or cold proof tested. The shafting materials were ultrasonic and magnetic particle inspected, as well as having Certified Material Test Reports. Cast iron is not being used for any load bearing components.

As the original bridge is reused for the crane upgrade, critical welds on the bridge were identified and nondestructively examined prior to initial use of the replacement trolley.

The minimum operating temperature for the crane was determined to be +45°F by laboratory testing. The minimum operating temperature assures absence of brittle-fracture tendency in the crane material.

NUREG-0554

2.5 Seismic Design

"Overhead cranes may be operating at the time that an earthquake occurs. Therefore, the cranes should be designed to retain control of and hold the load, and the bridge and trolley should be designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event. If a seismic event comparable to a safe shutdown earthquake

(SSE) occurs, the bridge should remain on the runway with brakes applied, and the trolley should remain on the crane girders with brakes applied.

The crane should be designed and constructed in accordance with regulatory position 2 of Regulatory Guide 1.29, 'Seismic Design Classification.' The MCL plus operational and seismically induced pendulum and swinging load effects on the crane should be considered in the design of the trolley, and they should be added to the trolley weight for the design of the bridge."

Compliance Statement

NUREG-0554 states seismic design is to be in accordance with Regulatory Guide 1.29. ASME NOG-1 is in compliance with Regulatory Guide 1.29, which further defines how Regulatory Guide 1.29 should be applied with respect to crane design.

The seismic design of the trolley is based upon response spectrum analyses satisfying the requirements of Regulatory Guide 1.92 for SSE considering seven percent critical damping. The three components of earthquake motion are combined by the square root of the sum of the squares of the co-directional responses. The bridge girders are analyzed considering the reduced dead load of the replacement trolley.

The trolley, bridge, and runway are represented by a generalized three-dimensional system of nodes and elements, which reflect the overall size, length, connectivity, stiffness and mass distribution of the various structural members and loads. The trolley seismic design is based upon the acceptance criteria of CMAA #70-1999, Section 3.4.3. The seismic design for the bridge girders and bogeys is based upon the acceptance criteria of CMAA #70-1975. The consideration of the seismic pendulum effect of the trolley design is based upon CMAA #70-1975. The consideration of the seismic pendulum effect for the trolley design is based upon the discussion in ASME NOG-1 where it is stated that the increase in horizontal load due to the pendulum effect need not be considered due to the relatively small displacement of the load. The design ensures that the maximum critical load can be safely supported by the crane during a SSE.

The reactor building structural steel framing is analyzed to include the seismic loads resulting from the new trolley, bridge girders, bogeys, and runway. The seismic design is based upon response spectrum analyses considering the requirements of Regulatory Guides 1.60, 1.61 and 1.92. The acceptance criteria for the reactor building structural steel seismic design satisfies current Oyster Creek licensing commitments and industry standards.

NUREG-0554

2.6 Lamellar Tearing

"Bridge and trolley structures are generally fabricated by welding structural shapes together. Problems have been experienced with weld joints between rolled structural members. Specifically, subsurface lamellar tearing has occurred at the weld joints during fabrication, and the through-thickness strength of the material has thus been reduced. When weld joints are carefully designed and fabricated, lamellar tearing is not expected to occur, but for certain weld joints it may be necessary to examine the joint by radiography or ultrasonic inspection, as appropriate, to ensure the absence of lamellar tearing in the base metal and the soundness of the weld metal.

All weld joints whose failure could result in the drop of a critical load should be nondestructively examined. If any of these weld joint geometries would be susceptible to lamellar tearing, the base metal at the joints should be nondestructively examined."

Compliance Statement

As stated in Compliance Statement 2.4, the trolley load girt, as well as end trucks are fabricated from rolled plates to form fabricated box sections. The engineering philosophy focused on eliminating areas where potential lamellar problems can occur. The American Institute of Steel Construction (AISC) Manual of Steel Construction, Ninth Edition discusses the potential of lamellar tearing. It states this is primarily a problem when using thick plates and heavy structural shapes in highly restrained joints. Lamellar tearing can, however, be prevented through good design practice, as well as specifying steels with special properties which minimize the chances of lamellar tearing.

The area in the trolley prone to lamellar tearing is the connection between the load girt and the trolley end trucks. This connection is typically welded and normally requires the load girt ends to be welded to the side of the trolley end trucks resulting in a potential lamellar tear area in the trolley end truck. The Oyster Creek design, however, uses plates, which are not considered thick. The new trolley design uses plates 1" thick or less and therefore lamellar tearing is not a design concern for this application.

The Oyster Creek design eliminated all single failure point welds within the trolley frame by designing connections, which put the base metal in shear or tension. These proven designs are employed on the load girt to end trucks, upper block, and equalizer assemblies, which traditionally have had single failure point welds.

The existing bridge is fabricated from 1 1/4" top and bottom plates and 5/16" side plates, both of which are not considered heavy plates subject to lamellar tearing. The joint configurations of single failure point welds in the box girder are not susceptible to lamellar tearing. All single failure point welds in the bridge have been nondestructively examined and found acceptable.

NUREG-0554

2.7 Structural Fatigue

"Since each crane loading cycle will produce cyclic stress, it may be necessary to investigate the potential for failure of the metal due to fatigue. If a crane will be used during the construction period, it will experience additional cyclic loading, and these loads should be added to the expected cyclic loading for the permanent plant operation when performing the fatigue evaluation.

A fatigue analysis should be considered for the critical load-bearing structures and components of the crane handling system. The cumulative fatigue usage factors should reflect effects of the cyclic loading from both the construction and operating periods."

Compliance Statement

The design basis for the single-failure-proof trolley will be CMAA Specification #70-1999 fatigue allowables based on Class D (heavy) service, which considers the crane to lift the MCL frequently with other loads being between 1/3 and 2/3 of the rating, for a minimum of 100,000 cycles.

The crane bridge was built in 1967 in accordance with EOCI Specification No. 61, and then later requalified to CMAA Specification #70-1975 as part of Phase I NUREG-0612 compliance. Specification No. 70-1975, Section 3.3.3.1.3 includes design for "Repeated Loads." Contained in this section is Table 3.3.3.1.3-1, which is a table describing allowable stresses for cyclic loading. The minimum number of cycles at full load is 20,000 to 100,000 corresponding to CMAA Service Classifications A and B. The limited use of the crane at Oyster Creek indicates that the cyclic loading of the bridge is not a concern, considering it was designed for a minimum of 20,000 full load cycles.

Experience in the crane industry has shown physical evidence of fatigue in crane bridges normally manifests itself as cracked end truck to girder connections and reverse camber in the bridge girders. Neither of these conditions is present on the existing bridge.

NUREG-0554

2.8 Welding Procedures

"Problems with welding of low-alloy steels can occur if the base metal temperature is not properly controlled during welding and the postweld heat treatment.

Preheat temperatures and postweld heat-treatment (stress relief) temperatures for all weldments should be specified in the weld procedure. Welds described in the recommendations of Section 2.6 should be postweld heat treated in accordance with Subarticle 3.9 of AWS D1.1, 'Structural Welding Code.'"

Compliance Statement

Only pre-qualified AWS D1.1 weld procedures were employed. Preheat temperature, as well as post-weld heat treatment (stress relief) temperatures for all weldments are specified in the pre-qualified procedure. Implementation and control of the welding and weld procedures was the responsibility of an AWS Certified Weld Inspector.

The existing areas of the crane already manufactured, i.e., bridge, may or may not have been welded to the requirements of this section. Critical areas of the bridge were therefore nondestructively examined to ascertain that the welds are acceptable in accordance with NUREG-0612 Appendix C.

NUREG-0554

3. SAFETY FEATURES

3.1 General

"Numerous applications have been reviewed by the NRC staff, and the need for inclusion of certain safety features and the magnitudes of specific operational limits to provide adequate safety have been determined.

A crane handling system includes all the structural, mechanical, and electrical components that are needed to lift and transfer a load from one location to another. Primary or principal load-bearing components, equipment, and subsystems such as the driving equipment, drum, rope reeving system, hooks, blocks, control systems, and braking systems should receive special attention."

Compliance Statement

Special attention is paid to the entire trolley in that it is a custom manufactured piece of equipment designed and manufactured to the quality standards of 10 CFR50 Appendix B/NQA-1. Attachment A defines the components of the trolley, which are critical and the quality checks these components are subjected to. In particular, all primary and principle load bearing components of the main and auxiliary hoist drive systems are redundant in accordance with the requirements of this standard.

NUREG-0554

3.2 Auxiliary Systems

"All auxiliary hoisting systems of the main crane handling system that are employed to lift or assist in handling critical loads should be single-failure-proof.

Auxiliary systems or dual components should be provided for the main hoisting mechanism so that, in case of subsystem or component failure, the load will be retained and held in a stable or immobile safe position."

Compliance Statement

The auxiliary hoist will be used to handle critical loads and, therefore it is designed as a single-failure-proof unit.

Dual systems are being provided for both the main and the auxiliary hoist ensuring that upon the occurrence of a subsystem or component failure, the load will be retained and held in a stable safe position.

NUREG-0554

3.3 Electric Control Systems

"It is important to prevent the release of radioactivity in case of failure, malfunction, or loss of load. It may be necessary to include special features and provisions to preclude system incidents that would result in release of radioactivity.

The automatic controls and limiting devices should be designed so that, when disorders due to inadvertent operator action, component malfunction, or disarrangement of subsystem control functions occur singly or in combination during the load handling, and assuming no components have failed in any subsystems, these disorders will not prevent the handling system from stopping and holding the load. An emergency stop button should be added at the control station to stop all motion."

Compliance Statement

Special features are included in the trolley electric control system design to preclude system accidents, which could potentially release radioactivity. These electrical safety features are defined in the ASME NOG-1 specification for Type 1 Cranes. Special features provided on the trolley include a limit switch which will detect over-speed of each of the drums. When over-speed is detected, both the emergency stop disc caliper brakes mounted on the drum, as well as the motor mounted holding brake will set and stop the load. An overweight limit switch is also included in the design. This prevents lifting loads greater than the capacity of each of the hoists. Upon actuation of this limit switch, only the lowering motion is allowed. To prevent over-travel in the raising and lowering directions, redundant upper and lower limit switches are provided on each hoist. The redundant upper limit switch is of the power paddle type, which removes 3-phase power to the motor assuring the motor is no longer energized. In order to protect each of the hoist cables from potential mis-spooling on the wire rope drum, a mis-spooling limit switch is provided to assure both parts of rope wrapping and unwrapping from the drum spool properly into the drum machined grooves. This limit switch prevents the potentially dangerous situation of cutting a wire rope across the drum grooving. Finally, an unbalanced load limit switch is also provided on each hoist. This switch detects movement in the equalizer system, which would indicate one of the two hoist ropes has stretched or yielded. All of these limit switches are provided in accordance with NUREG-0554 and are in addition to the limit switches required for CMAA Specification #70 for Class D (heavy) service. Additionally, the bridge and trolley motions are provided with travel limit switches.

The current design includes emergency stop buttons in the operator's cab, as well as the radio control transmitter. The current design also includes undervoltage, overvoltage, phase loss and overcurrent protection. All these features are retained in the new design configuration.

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3.4 Emergency Repairs

"A crane that has been immobilized because of malfunction or failure of controls or components while holding a critical load should be able to hold the load or set the load down while repairs or adjustments are made. This can be accomplished by inclusion of features that will permit manual operation of the hoisting system and the bridge and trolley transfer mechanisms by means of appropriate emergency devices.

Means should be provided for using the devices required in repairing, adjusting, or replacing the failed component(s) or 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. As an alternative to repairing the crane in place, means may be provided for safely transferring the immobilized hoisting system with its load to a safe lay down area that has been designed to accept the load while the repairs are being made.

The design of the crane and its operating area should include provisions that will not impair the safe operation or safe shutdown of the reactor or cause unacceptable release of radioactivity when corrective repairs, replacements, and adjustments are being made to place the crane handling system back into service after component failure(s)."

Compliance Statement

The trolley design includes a feature to allow controlled lowering of the load if a malfunction or failure of the controls occurs. Manual operation of the hoists is possible via the use of pneumatic emergency stop disc caliper brakes located on each drum. These brakes are a fail-safe type in that air pressure is required to release the brakes, i.e., spring set air released. Emergency lowering can be completed with no external utilities to the crane. An accumulator is provided on the trolley with sufficient air capacity to cycle the brakes to allow a load to be safely lowered.

The drum emergency stop disc caliper brakes also provide the means for repairing, adjusting, or replacing failed components within the hoist drive train. The hoist drive train components, which could be repaired, adjusted, or replaced, includes the motor, holding brake, and shafting connecting the motor to gearbox. As the braking system is fail-safe and requires no electrical power to operate, the entire electrical system can also be safely repaired, adjusted, or replaced if necessary. Means have also been provided in the design to move both the bridge and trolley under no power. Each braking system is provided with a manual release. The trolley is also provided with attachment points, which will allow manual controlled movement of the trolley under load. The bridge motion can also be moved by manually turning the bridge line shaft after release of the brake.

The arrangement allows the hoists to be safely repaired with a load suspended, or repaired after safely lowering the load to a lay down area. This defense in depth concept employed for making necessary repairs assures that the crane systems will not impair the safe operation or safe shutdown of the reactor, or cause unacceptable release of radioactivity when repairs, replacements, and adjustments are being made to the trolley and hoist.

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4. HOISTING MACHINERY

4.1 Reeving System

"Component parts of the vertical hoisting mechanism are important. Specifically, the rope reeving system deserves special consideration during design of the system. The load-carrying rope will suffer accelerated wear if it rubs excessively on the sides of the grooves in the drum and sheaves because of improper alignment or large fleet angles between the grooves. The load-carrying rope will furthermore suffer excessive loading if it is partly held by friction on the groove wall and then suddenly released to enter the bottom of the groove. The rope can be protected by the selection of conservative fleet angles. Ropes may also suffer damage due to excessive strain developed if the rope construction and the pitch diameter of the sheaves are not properly selected. Fatigue stress in ropes can be minimized when the pitch diameter of the sheaves is selected large enough to produce only nominal stress levels. The pitch diameter of the sheaves should be larger for ropes moving at the highest velocity near the drum and can be smaller for sheaves used as equalizers where the rope is stationary. Protection against excessive wire rope wear and fatigue damage can be ensured through scheduled inspection and maintenance.

Design of the rope reeving system(s) should be dual with each system providing separately the load balance on the head and load blocks through configuration of ropes and rope equalizer(s). Selection of the hoisting rope or running rope should include consideration of the size, construction, lay, and means or type of lubrication, if required, to maintain efficient working of the individual wire strands when each section of rope passes over the individual sheaves during the hoisting operation. The effects of impact loadings, acceleration and emergency stops should be included in selection of rope reeving systems. The maximum load (including static and inertia forces) on each individual wire rope in the dual reeving system with the MCL attached should not exceed 10% of the manufacturer's published breaking strength.

The ratio of wire rope yield strength to ultimate strength may vary sufficiently for different production runs to influence the wire rope rating in such a manner that the initial safety margin selected would be too small to prevent the critical load from straining the wire rope material beyond the yield point under abnormal conditions. It would, therefore, be prudent to consider the wire rope yield strength as well as the ultimate strength when specifying wire rope in order to ensure the desired margin on rope strength.

The maximum fleet angle from drum to lead sheave in the load block or between individual sheaves should not exceed 0.061 rad (3-1/2°) at any one point during hoisting except that for the last 1 m (3 ft) of maximum lift elevation the fleet angle may increase slightly. The use of reverse bends for running wire ropes should be limited, and the use of larger sheaves should be considered for those applications where a disproportionate reduction in wire rope fatigue life would be expected from the use of standard sheave diameters for reverse bends.

The equalizer for stretch and load on the rope reeving system may be of either beam or sheave type or combinations thereof. A dual rope reeving system with individual attaching points and means for balancing or distributing the load between the two operating rope reeving systems will permit either rope system to hold the critical load and transfer the critical load without excessive shock in case of failure of the other rope system.

The pitch diameter of running sheaves and drums should be selected in accordance with the recommendations of CMAA Specification #70. The dual reeving system may be a single rope from each end of a drum terminating at one of the blocks or equalizer with provisions for equalizing beam-type load and rope stretch, with each rope designed for the total load. Alternatively, a 2-rope system may be used from each drum or separate drums using a sheave equalizer or beam equalizer or any other combination that provides two separate and complete reeving systems."

Compliance Statement

Design of the main and auxiliary hoist rope reeving systems are dual (redundant) with each system providing independent load balance on the head and load blocks through configuration of the ropes and rope equalizers. As the design employs two individual ropes, the construction of the ropes is right and left lay to assure proper winding onto the drum. Lubrication of the ropes is provided and is consistent with the chemistry requirements of the spent fuel storage pool.

The maximum load (including static and inertia forces) on each individual wire rope in the dual reeving system with the maximum critical load (MCL) attached is less than 10% of the rope manufacturer's published breaking strength. For the main hoist this is achieved by using 1 1/2" diameter EEIPS rope with a minimum breaking strength of 172.8 tons with a rope classification of 9 x 25 and reeved in 2 x 4 parts providing a total of 8 parts to support the load. For the auxiliary hoist this is achieved by using 5/8" diameter EEIPS rope with a 9 x 25 rope classification, providing a minimum breaking strength of 30.6 tons, and reeved in 2 x 2 parts providing a total of 4 parts to support the load. Note, the additional strands of the 9 x 25 rope construction provide for a more flexible rope than the 6 x 37 rope construction (9 strands vs. 6 strands).

With respect to the ratio of wire rope yield strength to ultimate strength, the design complies with the requirements of ASME NOG-1 Section NOG-5423.1(c)(5) which states;

> "In the event of a broken rope, the remaining intact reeving system shall not be loaded to more than 40% of the breaking strength of the wire rope, including the dynamic effects of the load transfer."

The design of the equalizer systems will limit the load on the remaining intact reeving system to less than 40% of the breaking strength of that rope, including the dynamic effects of load transfer caused by a broken rope condition.

The main and auxiliary hoist reeving system design basis is to limit fleet angles between the drum, load block and head blocks to a maximum of 3 1/2 degrees. The reeving systems do not use reverse bends for ropes.

The design of the main hoist equalizer for stretch and load on the rope reeving system is a combination of the beam and sheave type. With this system, the rope enters the equalizer and each of the two equalizer ropes turns 90 degrees so it is in the horizontal plane. Each rope then travels to a sheave where it is turned 180 degrees. Each of the two ropes is fitted with dead ends, which are attached to the double acting cylinder, which provides the energy absorption for the load transfer. The design of the end attachment allows initial stretch of either of the two individual ropes in the reeving system via a means to shift the center line of the two ropes with respect to the center line of the trolley and energy absorbing cylinder. The energy absorbing cylinder is fitted with a honeycomb crush pad. The honeycomb crush pad provides several advantages over hydraulic and pneumatic energy absorbing systems. The major design advantage of the honeycomb crush pad material is that the force during crushing remains nearly constant. The use of other systems may not produce a similar result. As the force in the crush pad is nearly constant through the entire travel, the wire rope, which is absorbing the energy transfer will not receive an initial "shock" during transfer. The honeycomb crush pad also offers significant operational and maintenance advantages as the system is entirely static and requires no maintenance. The potential problem of a seized hydraulic or pneumatic cylinder is eliminated as the honeycomb crush pad (which can be replaced) is designed to destroy itself in the process of absorbing energy. The design of the equalizer load absorbing system uses field proven honeycomb crush pad material. The design of the system is such that the transfer of the critical load does not impart excessive shock into the remaining rope, which could possibly cause failure.

The design of the auxiliary hoist equalizer is of the beam type. Travel of the equalizer is limited to provide a system that limits the energy in the intact reeving to less than 40% of the breaking strength of the rope.

The pitch diameter of the main and auxiliary hoist running sheaves and drum are in accordance with CMAA Specification #70 Class D service. CMAA Specification #70 provides a minimum 20:1 ratio between sheave and wire rope diameter based on the less flexible 6 x 37 rope construction. Further, the higher speed rope leaving the drum uses a 22:1 ratio sheave in the load block for the main hoist, and a 26:1 ratio sheave in the load block for the auxiliary hoist. The dual reeving systems also provide a twist resistant system by using a single rope from each side of the drum with each rope terminating at the upper block equalizing system.

The above designs of the main and auxiliary hoist reeving systems, in conjunction with scheduled inspection and maintenance, provide protection against excessive loading and/or strain, accelerated wear, fatigue or unequalized rope loading during emergency stopping.

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4.2 Drum Support

"Proper support of the rope drums is necessary to ensure that they would be prevented from falling or disengaging from their braking and control system.

The load hoisting drum on the trolley 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 or bearing s were to fail or fracture."

Compliance Statement

The drums employ a drum catching device which prevents the drum from falling and disengaging from the emergency stop disc caliper braking system. The drum catching device incorporates a ring built into the side of the end truck, which engages the outside diameter of the drum shell. Approximately 1/8" clearance is maintained between these two surfaces. This arrangement effectively locks the drum between the end trucks, and prevents disengagement of the emergency stop disc caliper brakes.

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4.3 Head and Load Blocks

"The head and load blocks should be designed to maintain a vertical load balance about the center of lift from load block through head block and have a reeving system of dual design.

The load-block assembly should be provided with two load-attaching points (hooks or other means) so designed that each attaching point will be able to support a load of three times the load (static and dynamic) being handled without permanent deformation of any part of the load-block assembly other than localized strain concentration in areas for which additional material has been provided for wear.

The individual component parts of the vertical hoisting system components, which include the head block, rope reeving system, load block, and dual load-attaching device, should each be designed to support a static load of 200% of the MCL. A 200% static-type load test should be performed for each load-attaching hook. Measurements of the geometric configuration of the hooks should be made before and after the test and should be followed by a nondestructive examination that should consist of volumetric and surface examinations to verify the soundness of fabrication and ensure the integrity of the hooks. The load blocks should be nondestructively examined by surface and volumetric techniques. The results of examinations should be documented and recorded."

Compliance Statement

The design of the head and load blocks maintains a vertical load balanced about the center of the lift from the load block through the head block. To accomplish this, the design employs a dual reeving design. The design of the load block assembly provides only one attaching point consistent with the requirements of NUREG-0612, Appendix C, "Implementation of NUREG-0554 for Operating Plants No. 5." As existing building height limitations require minimum hook height, the single attachment point, i.e., sister hook, is designed with a safety factor increased to a minimum of 10:1 to compensate for loss of the single-failure-proof feature. This safety factor is equivalent to the safety factor for the wire rope. Additionally, the design of the load block is such that each attachment point is designed to support a load of three times the static and dynamic load being handled without permanent deformation of any part of the load block assembly. This is exclusive of any localized strain concentration in areas where additional material has been provided for. Specifically, the prongs of the sister hook include approximately a 15% increase in strength, based on the maximum critical load to account for this type of wear. The auxiliary hoist hook is a commercially available item, which, as part of its design, has built-in wear indicators to limit the allowable wear.

Design of the individual components of the vertical hoisting system, including head block, rope reeving system, load block, and load attachment device, is designed for a static load of 200% of the maximum critical load. A 200% static type load test was performed on each load attaching point, the hook prongs, and, for the main hoist, the hook pin hole. Measurements of the geometric configuration of each hook attachment point were made before and after the test. Hook nondestructive examinations consistent with the requirements of Attachment A - Quality Matrix have been completed including ultrasonic testing of the base material followed by MT or PT of the surface after the 200% load test. The hooks are also supplied with certified material test reports. The results of all these tests shown in Attachment A - Quality Matrix are documented and recorded in the quality assurance documentation package provided with the trolley.

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4.4 <u>Hoisting Speed</u>

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

Selection of hoisting speed is influenced by such items as reaction time for corrective action for the hoisting movement and the potential behavior of a failed rope. To prevent or limit damaging effects that may result from dangerous rope spinoff in case of a rope break, the hoisting speed should be limited. The rope traveling speed at the drum is higher than at other points in the reeving system, and the potential for damage due to rope failing and interference with other parts of the system should be considered. Conservative industry practice limits the rope line speed to 1/4 m/s (50 fpm) at the drum."

Compliance Statement

The reactor building crane is in compliance with the requirement that states the maximum hoisting speed for the critical loads should be limited to the slow speed column of Figure 70.6 of CMAA Specification #70-1975 which indicates that the maximum main hoist speed should be 5 FPM, while the auxiliary hoist, rated at 10 tons, is 20 FPM.

The design limits rope line speed of critical lifts at the drum to 20 FPM on the main hoist while the auxiliary hoist is limited to 40 FPM. Both are less than the NUREG requirement. This low rope line speed is designed to prevent or limit damaging affects that could result from rope spin off in the case of a rope break.

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4.5 Design Against Two-Blocking

"A potential failure of a hoist travel-limit switch could result in a 'two-block' incident and in the cutting or crushing of the wire rope. In order to protect the wire rope, the reeving system should be designed to prevent the cutting or crushing of the wire rope if a two-blocking incident were to occur.

The mechanical and structural components of the complete hoisting system should have the required strength to resist failure if the hoisting system should 'two-block' or if 'load hangup' should occur during hoisting. The designer should provide means within the reeving system located on the head or on the load-block combinations to absorb or control the kinetic energy of rotating machinery during the incident of two-blocking. As an alternative, the protective control system to prevent the hoisting system from two-blocking should include, as a minimum, two independent travel-limit devices of different designs and activated by separate mechanical means. These devices should de-energize the hoist drive motor and the main power supply. The protective control system for load hangup, a part of the overload protection system, should consist of load cell systems in the drive train or motor-current-sensing devices or mechanical load-limiting devices. The location of mechanical holding brakes and their controls should provide positive, reliable, and capable means to stop and hold the hoisting drum(s) for the conditions described in the design specification and in this recommendation. This should include capability to withstand the maximum torque of the driving motor if a malfunction occurs and power to the driving motor cannot be shut off. The auxiliary hoist, if supplied, should be equipped with two independent travel-limit switches to prevent two-blocking."

Compliance Statement

The design prevents two-blocking by including the NUREG-0554 alternative of employing two upper (redundant) limit switches of different design and actuation.

The first limit switch is of the control type which interrupts power to the hoist control raising circuit. This limit switch is designed to count drum rotation in order to safely limit upper travel.

The second or final upper limit switch is a power paddle limit switch. This type of limit switch de-energizes the hoist motor power supply when the lower block lifts a weighed arm suspended from the trolley frame. This limit switch de-energizes all three phases of hoist motor power, as well as control signal for the hoist raise command.

The control system to prevent load hang up again employs a defense in depth concept as both a load sensing system is provided in the reeving system, and the flux vector drive is inherently a current regulation device. Therefore, motor output torque can be limited. The location of the primary mechanical holding brake is at the hoist drive motor. The redundant or secondary holding brakes are applied directly to the hoist drum. Each of these braking systems is designed as a fail-safe brake thereby positively and reliably stopping the hoisting drum. The design of the two brake systems is such that the combined torque capacity of the braking systems is in excess of 2 times greater than the maximum driving torque of the motor. This is based on setting the electrical flux vector drive to limit the drive motor torque to 150% of hoisting torque.

The auxiliary hoist is identical to the main hoist.

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4.6 Lifting Devices

"Lifting devices that are attached to the load block such as lifting beams, yokes, ladle or trunnion-type hooks, slings, toggles, and clevises should be conservatively designed with a dual or auxiliary device or combinations thereof. Each device should be designed or selected to support a load of three times the load (static and dynamic) being handled without permanent deformation."

Compliance Statement

Lifting devices used over the spent fuel storage pool will meet the associated requirements in NUREG-0612, Section 5.1.6.

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4.7 Wire Rope Protection

"Sideloads would be generated to the reeving system if hoisting were done at angles departing from a normal vertical lift and resulting damage could be incurred in the form of excessive wear on sheaves and wire rope. A potential would also exist for the wire rope to be cut by jumping its groove barrier on the drum. If sideloads cannot be avoided, the reeving system should be equipped with a guard that would keep the wire rope properly located in the grooves on the drum."

Compliance Statement

A wire rope protection system is employed to prevent side loading. The design provides for unbalanced load limits consistent with the requirements of ASME NOG-6445.2, which states:

> "Dual reeved hoists that handle critical loads on Type I cranes shall include a device to detect excessive movement of the equalizer mechanism. Tripping of this device shall initiate a flashing warning light visible to the crane operator and shall shut down the hoisting motion. Means shall be provided to allow the use of hoist under administrative

> control. Reeving shall then be corrected before returning hoist to additional service."

Unbalanced load limit switches are mounted on the equalizer and detect excessive motion of the equalizer indicating an unbalanced load or side pulling.

Also employed is a wire rope protection system to ensure that the hoist does not operate if a rope has jumped its groove barrier on the drum. The design employs hoist drum rope level wind limit switches consistent with the requirements of ASME NOG-6446.1, which states:

> "Hoists that handle critical loads shall include a hoist drum rope level wind limit switch to detect improper threading of hoist rope in hoist drum grooves.
>
> Actuation of this switch shall result in removal of power from all crane drive motors and setting of brakes.
>
> Actuation of this limit switch shall prevent further hoisting or lowering. When this occurs, a person knowledgeable in the hoist control system shall determine and correct the cause of the tripping of the limit switch. That person shall direct the lowering out of the limit by utilizing a key-operated back-out mode which shall prevent further hoisting. The limit shall be tested for proper operation before making any additional lifts."

The auxiliary hoist level wind system is of the bar type with the addition of a nylon sleeve over the steel bar to prevent damage to the rope. The main hoist level wind system employs non-contact photoelectric sensors using fiber optic technology to focus a light beam across the outside diameter of the drum at a diameter slightly larger than the outside diameter of the rope. Should a rope jump its groove barrier, the rope will break the light beam causing removal of power from the hoist motor and setting of the brakes.

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4.8 Machinery Alignment

"Power transmission gear trains are often supported by fabricated weldments of structural parts. The proper alignment of shafts and gears depends on the adequacy of bearings and their supports to maintain correct alignment of all components. The proper functioning of the hoisting machinery during load handling can best be ensured by providing adequate support strength of the individual component parts and the welds or bolting that binds them together. 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."

Compliance Statement

The design of the single-failure-proof hoisting machine employs machined surfaces on all the hoisting drive machinery. This includes all components from the motor to the drum, including the gearbox. As all surfaces are machined, the need to "float" or manually align components is eliminated. As the manual alignment process is eliminated, the potential for errors due to manual alignment is also eliminated. The design is such that after the components are machined, the entire hoisting assembly simply bolts together using piloted bores and dowel alignment pins to maintain accuracy of alignment far greater than what is required of the mechanical couplings. This method of manufacture (machining all components), although initially more costly than the "floating" method, assures the position alignment of the components and the longevity and safety of the system as misalignment is not present in the design. The design does not employ gear trains between the holding brake and the hoisting drum. Therefore, the gear train is not a single-failure-proof or dual design. The single-failure-proof design includes an emergency stop disc caliper brake on the hoist drum.

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4.9 Hoist Braking System

"Mechanical holding brakes in the hoisting system (raising and lowering) that are automatically activated when electric power is off or mechanically tripped by overspeed devices or overload devices in the hoisting system will help ensure that a critical load will be safely held or controlled in case of failure in the individual load-bearing parts of the hoisting machinery.

Each holding brake should have more than full-load stopping capacity but should not have excessive capacity that could cause damage through sudden stopping of the hoisting machinery. A minimum brake capacity of 125% of the torque developed during the hoisting operation at the point of brake application has been determined to be acceptable.

The minimum hoisting braking system should include one power control braking system (not mechanical or drag brake type) and two holding brakes. The holding brakes should be applied when power is off and should be automatically applied on overspeed to the full holding position if a malfunction occurs. Each holding brake should have a torque rating not less than 125% of the full-load hoisting torque at point of application (location of the brake in the mechanical drive). The minimum number of braking systems that should be operable for emergency lowering after a single brake failure should be two holding brakes, for stopping and controlling drum rotation.

The holding brake system should be single-failure-proof; i.e., any component or gear train should be dual if interposed between the holding brakes and the hoisting drums. The dynamic and static alignment of all hoisting machinery components, including gearing, shafting, couplings, and bearings, should be maintained throughout the range of loads to be lifted, with all components positioned and anchored on the trolley machinery platform.

Manual operation of the hoisting brakes may be necessary during an emergency condition, and provision for this should be included in the design conditions. Adequate heat dissipation from the brake should be ensured so that damage does not occur if the lowering velocity is permitted to increase excessively. It may be necessary to stop the lowering operation periodically to prevent overheating and permit the brake to dissipate the excess heat.

Portable instruments should be used to indicate the lowering speed during emergency operations. If a malfunction of a holding brake were to occur and emergency lowering of the load become necessary, the holding brake should be restored to working condition before any lowering is started."

Compliance Statement

Each of the two independent holding brake systems is designed with sufficient torque to stop the full load capacity of each hoist. The braking systems employ differing designs to preclude the possibility of a common mode type failure. Each brake system is a commercially available system. The primary holding brake located at the motor is designed with a minimum brake capacity of 150% of the torque required at its point of application. The secondary holding brake located on the drum is a disc caliper air brake. It also functions as an emergency stop brake. It is designed to provide a minimum braking capacity of 150% of the torque developed at its point of application. Excessive stopping force or torque is avoided in the system through the use of the two differently designed systems. The electric primary brake actuates at a faster rate then the secondary pneumatic brake. This assures that the system will not be "shocked" when both brakes are actuated.

The braking system consists of one power controlled braking system (dynamic braking supplied by the flux vector drive), and the two previously described holding brakes. Each of the two holding brakes is fail-safe, i.e.; power released and spring actuated. Each holding brake is designed to actuate should any hoisting fault be detected, including over-speed, overload or out of balance.

The holding brake system is single-failure-proof. The gear train is not of dual design as the second holding brake is mounted on the hoisting drum providing the single-failure-proof design. As stated in Section 4.8, alignment of all hoisting machinery is via machined surfaces. This assures the alignment of all components within the hoisting machinery. The trolley frame, as well as the hoisting machinery, are analyzed throughout the range of loads, i.e., no load to MCL, to assure all components are anchored properly to the trolley platform, and that deflections within the system are in compliance with alignment allowables.

Manual operation of the hoisting brakes has been provided. The emergency stop disc caliper brakes are provided with an air accumulator located on the trolley which allows these brakes to be cycled under no power, as well as emergency conditions. A manually operated air valve on the trolley allows the emergency brake to be easily and safely actuated. The large disc on the caliper brakes provides sufficient heat dissipation to ensure that damage will not occur when lowering the load at minimum speed. Checking the temperature of the discs is easily accomplished using temperature sticks, as the discs are easily accessible. Checking this temperature will prevent overheating the brake.

The design employs a long battery life speed indicator connected to the end of the drum. This instrument can be used during emergency operations to monitor the lowering speed of the drum. The battery in the system, as stated, is long life and is replaced on a 5 year cycle.

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5. BRIDGE AND TROLLEY

5.1 Braking Capacity

"Failure of the bridge and trolley travel to stop when power is shut off could result in uncontrolled incidents. This would be prevented if both bridge and trolley drives are provided with control and holding braking systems that would be automatically applied when the power is shut off or if an overspeed or overload condition occurs because of malfunction or failure in the drive system.

To avoid the possibility of drive motor over torque within the control system, the maximum torque capability of the driving motor and gear reducer for trolley motion and bridge motion of the overhead bridge crane should not exceed the capability of gear train and brakes to stop the trolley or bridge from the maximum speed with the DRL attached. Incremental or fractional inch movements, when required, should be provided by such items as variable speed controls or inching motor drives. Control and holding brakes should each be rated at 100% of maximum drive torque that can be developed at the point of application. If two mechanical brakes, one for control and one for holding, are provided, they should be adjusted with one brake in each system leading the other and should be activated by release or shutoff of power. This applies to both trolley and bridge. The brakes should also be mechanically tripped to the 'on' or 'holding' position in the event of a malfunction in the power supply or an overspeed condition. Provisions should be made for manual emergency operation of the brakes. The holding brake should be designed so that it cannot be used as a foot-operated slowdown brake. Drag brakes should not be used. Mechanical drag-type brakes are subject to excessive wear, and the need for frequent service and repair tends to make this type of brake less reliable; they should therefore not be used to control movements of the bridge and trolley.

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

Trolley and bridge speed should be limited. The speed limits indicated for slow operating speeds for trolley and bridge in specification CMAA #70 are recommended for handling MCLs."

Compliance Statement

The bridge motor, bridge braking system, as well as controls were previously replaced during the 1995 modification described in Section 1. The bridge and trolley controls are of the variable frequency drive type with dynamic braking. These drives provide the ability to limit the torque of the drive motor. The maximum torque capacity of the driving motor and gear reducer for both motions is selected to not exceed the capacity of the gear train and brakes to stop either of the motions from the maximum speed with the design rated load attached. The use of AC squirrel cage motors inherently provides over-speed protection as the design of this motor type limits over-speed to 5% greater than synchronous speed of the motor which is typically 10% greater than the maximum design speed. The variable frequency drives provide for fractional inch movements. Both the dynamic control brake and disc holding brakes (one on bridge and two on the trolley) are designed to be rated no less than 100% of the maximum driving torque at the point of application. The holding brakes are of fail-safe design, and will be applied in the event of a malfunction of the power supply. Both the bridge and trolley brakes are provided with a manual emergency release to allow manual movement of either the bridge or trolley. The holding brakes are electrically actuated and, therefore, cannot be used as a foot operated slow down brake. The design does not employ the use of drag brakes.

Opposite driven wheels on the trolley have been supplied matched and have diameters consistent with the requirements of ASME NOG-1 5452.1, which states:

> "Unless other means of restricting lateral movement are provided, wheels shall be double flanged with treads accurately machined. Wheels may

have either straight treads or tapered treads assembled with the large diameter toward the center of the span. Drive wheels shall be matched pairs within 0.001 in./in. of diameter, or a total of 0.010 in. on the diameter, whichever is smaller. When flangeless wheel and side roller assemblies are provided, they shall be of a type and design recommended by the crane manufacturer."

A visual inspection has been performed to verify the bridge is tracking properly on the runway. The bridge appears to be tracking properly on the runway as excessive wear was not noted on either the runway rail or crane bridge wheels. Had excessive wear been observed, it would have been an indication that the bridge drive wheels were not manufactured to the tolerances described in this section.

The bridge and trolley speeds are in compliance with the slow operating speeds for bridge and trolley in CMAA Specification #70-1975. The trolley speed is 20 FPM and the bridge speed is 40 FPM.

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5.2 **<u>Safety Stops</u>**

"Limiting devices, mechanical and/or electrical, should be provided to control or prevent over travel and overspeed of the trolley and bridge. Buffers for bridge and trolley travel should be included at the end of the rails.

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 or control devices provided for operation."

Compliance Statement

Over-travel limiting devices, both mechanical and electrical are provided on both the bridge and trolley. Mechanical buffers or bumpers are provided on both the bridge and trolley to limit end of travel. Electrically actuated travel limit switches are provided on the trolley and bridge to prevent its over-travel.

As stated in Section 5.1, the AC squirrel cage motor's design limits over-speed to approximately 110% of maximum design speed.

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6. DRIVERS AND CONTROLS

6.1 Driver Selection

"The horsepower rating of the hoist driving motor should be matched with the calculated requirement that includes the design load and acceleration to the design hoisting speed. Overpowering of the hoisting equipment would impose additional strain on the machinery and load-carrying devices by increasing the hoisting acceleration rate.

To preclude excessive drive motor torque, the maximum torque capability of the electric motor drive for hoisting should not exceed the rating or capability of the individual components of the hoisting system required to hoist the MCL at the maximum design hoist speed. Overpower and overspeed conditions should be considered an operating hazard as they may increase the hazard of malfunction or inadvertent operation. It is essential that the controls be capable of stopping the hoisting movement within amounts of movement that damage would not occur. A maximum hoisting movement of 8 cm (3 in) would be an acceptable stopping distance.

Normally, a crane system is equipped with mechanical and electrical limiting devices to shut off power to driving motors when the crane hook approaches the end of travel or when other parts of the crane system would be damaged if power were not shut off. It is prudent to include safety devices in the control system for the crane, in addition to the limiting devices, for the purpose of ensuring that the controls will return to or maintain a safe holding position in case of malfunction. Electric circuitry design should be carefully considered so that the controls and safety devices ensure safe holding of the critical load when called upon to perform their safety function. For elaborate control systems, radio control, or ultimate control under unforeseen conditions of distress, an 'emergency stop button' should be placed at ground level to remove power from the crane independently of the crane controls. For cranes with a DRL rating much higher than the MCL rating, it may be necessary to provide electrical or mechanical resetting of overload sensing devices when changing from one operation to the other. Such resetting should be made away from the operator cab location and should be included in an administrative control program.

Compliance Statement

The horsepower rating of the hoist drive motor has been matched with the calculated requirement to lift and accelerate the DRL to design hoisting speed.

The maximum torque capacity of the hoist motor does not exceed the rating of the individual components of the hoisting system required to hoist the DRL at maximum design hoist speed. As stated, the design does not over power the hoisting mechanism, however, over-speed conditions could present an operating hazard as increased speed conditions could cause malfunction or inadvertent operation. Over-speed is limited via the over-speed limit switch which is designed to actuate both holding brakes upon detection of an over-speed. The controls and limit switches provide the capability of stopping the hoisting motion before damage could occur. Hoisting motion can be stopped within 3 inches assuming maximum critical load at maximum design hoist speed. This can be achieved with either or both braking systems operating.

Section 4 of this report describes several safety devices included in the control system for the hoist which provide for safe movement of the MCL. Electrical circuits for the crane are designed with additional safeguards to detect such events as phase loss, under voltage, over voltage, and over current. Upon detection of any of these faults, the drive system de-energizes causing the holding brakes to set. This then places the crane in a safe condition. The operator's control for the crane is cab control with a backup radio control system. An emergency stop button is provided in the cab while an emergency stop selector switch is provided on the radio control transmitter either of which will remove power from the crane and set all brakes. Additionally, a manual disconnect switch is provided on the refuel level to provide an additional means to independently disconnect the power from the crane and runway. The main/auxiliary hoist MCL rating (105/10 tons) is less than or equal to the DRL rating (125/10 tons). However, the DRL of the crane, i.e., bridge, is the MCL of the main hoist. Therefore, it is unnecessary to provide electrical or mechanical resetting of overload sensing devices.

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6.2 Driver Control Systems

"The control systems should be designed as a combination of electrical and mechanical systems and may include such items as contactors, relays, resistors, and thyristors in combination with mechanical devices and mechanical braking systems. The control system(s) provided should include consideration of the hoisting (raising and lowering) of all loads, including the rated load, and the effects of the inertia of the rotating hoisting machinery such as motor armature, shafting and coupling, gear reducer, and drum. If the crane is to be used for lifting spent fuel elements, the control system should be adaptable to include interlocks that will prevent trolley and bridge movements while the load is being hoisted free of a reactor vessel or a storage rack, as may be recommended in Regulatory Guide 1.13, 'Spent Fuel Storage Facility Design Basis.'"

Compliance Statement

The control system of the crane's bridge and trolley features variable frequency drives while the hoist control system uses flux vector variable frequency drives. The control system has been designed to include consideration for hoisting and lowering of loads, including the DRL. The affects of the inertia of the rotating hoisting machinery, such as the motor armature, shafting and coupling, gear reducer, and drum are included in mechanical calculations used to size the emergency brakes. The crane will be used to lift spent fuel casks and cask components from the spent fuel pool, as well as other loads defined as critical. Note, this crane will not be used to move individual fuel elements.

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6.3 Malfunction Protection

"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 over travel. Controls should be provided to absorb the kinetic energy of the rotating machinery and stop the hoisting movement reliably and safely through a combination of electrical power controls and mechanical braking systems and torque controls if one rope or one of the dual reeving systems should fail or if overloading or an overspeed condition should occur."

Compliance Statement

The design employs sensors in the motor control circuits to detect and respond to excessive electrical current, excessive motor temperature via Klixon switches embedded in the motor windings, over-speed via the drum actuated over-speed switch, overload via weight sensing switches, and over travel via the hoisting limit switches. The electrical dynamic brakes are designed to absorb the kinetic energy for the rotating machinery and stop the hoisting motion. Additionally, these forces are also designed to be absorbed via the mechanical holding brake systems. Finally, the kinetic energy released during rope failure is designed to be accommodated by the auxiliary hoist's bar equalizing system, and designed to be absorbed via the main hoist's composite honeycomb crush pad located in the equalizer system.

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6.4 Slow Speed Drives

"Increment drives for hoisting may be provided by stepless controls or inching motor drive. 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 only for the lowest operating speeds."

Compliance Statement

The crane design provides for incremental drives for hoisting via the flux vector variable frequency drive, which is a stepless speed control. The drive eliminates the damaging effects of jogging or plugging. The drive accomplishes safe plugging by first electrically and mechanically stopping the hoist drive before reversing the drive. The damage caused by jogging is also eliminated as the drive accelerates and then decelerates the system to zero speed before an additional jog is allowed. The drive is programmed to prevent abrupt changes in motion. Drift points are not provided in the electrical power system for bridge or trolley motion.

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6.5 Safety Devices

"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 or control devices provided for operation."

Compliance Statement

The safety devices provided, such as the numerous limit switches previously described (provided for malfunction, inadvertent operator action or failure) are separate from the limiting means provided for hoist and crane operation. Examples include redundant upper travel limit switches and redundant overload sensing. The redundant overload sensing capabilities of the hoist system (separate from those requiring operator intervention) are the overweight limit switch and the inherent torque limiting capability of the hoist flux vector drive unit.

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6.6 Control Stations

"The complete operating control system and provisions for emergency controls for the overhead crane handling system should preferably be located in a cab on the bridge. When additional operator stations are considered, they should have control systems similar to the main station. Manual controls for hoisting and trolley movement may be provided on the trolley. Manual controls for the bridge may be located on the bridge. Remote control or pendant control for any of these motions should be identical to those provided on the bridge cab control panel. Cranes that use more than one control station should be provided with electrical interlocks that permit only one control station to be operable at any one time. In the design of the control systems, provision for and locations of devices for control during emergency conditions should be provided."

Compliance Statement

The operating control system for the crane is via cab control with radio control backup. The radio control transmitter is in compliance with the requirements of

CMAA Specification #70. Research has shown that putting the operator closer to the load results in safer operation. This is the reason for the radio control, as well as cab control. Current state-of-the-art radio control systems use encrypted codes with verification of the code prior to motion. Manual controls for lowering the hoist are provided on the trolley. An electrical interlock is provided between the cab and radio control. As stated previously, a battery powered digital readout is located on the trolley indicating hoisting speed during emergency conditions. Additionally, manual actuation of the emergency stop disc caliper brakes mounted on the drum is via a proportional air control valve. This device is marked to assure the operator understands the operation of the valve. Emergency controls for control of the bridge and trolley are by manual actuation on the bridge service platform.

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7. INSTALLATION INSTRUCTIONS

7.1 General

"Installation instructions should be provided by the manufacturer. These should include a full explanation of the crane handling system, its controls, and the limitations for the system and should cover the requirements for installation testing, and preparations for operation."

Compliance Statement

Installation instructions were used by ACECO's site personnel during crane upgrade activities. The operation and maintenance manual includes a full explanation of the crane handling system, its controls and the limitations for the system.

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7.2 Construction and Operating Periods

"When the permanent plant crane is to be used for construction and the operating requirements for construction are more severe than those required for permanent plant service, the construction operating requirements should be defined separately. The crane should be designed structurally and mechanically for the construction loads, plant service loads, and their functional performance requirements. At the end of the construction period, the crane handling system should be modified as needed for the performance requirements of the nuclear power plant operating service. After construction use, the crane should be thoroughly inspected by nondestructive examination and load tested for the operating phase. The extent of nondestructive examination, the procedures used, and the acceptance criteria should be defined in the design specification. If allowable design stress limits for the plant operating service are to be exceeded during the construction phase, added inspection supplementing that described in Section 2.6 should be specified and developed.

During and after installation of the crane, the proper assembly of electrical and structural components should be verified. The integrity of all control, operating, and safety systems should be verified as to satisfaction of installation and design requirements."

Compliance Statement

As the crane is being used for the permanent plant operation and there is no planned construction period, there is no need for after construction use testing and inspection, as it is not applicable.

After upgrade, the crane was subject to the requirements of ASME NOG 7420, "Pre-operational Testing and Inspection" and NOG 7421, "No Load Test." This is in addition to the testing at the vendor's test facility, which also included NOG-7422, "Full Load Test" and NOG-7423, "Rated Load." Upon completion of these tests, a written report, in compliance with the requirements of NOG 7424, was completed.

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8. TESTING AND PREVENTIVE MAINTENANCE

8.1 General

"A complete check should be made of all the crane's mechanical and electrical systems to verify the proper installation and to prepare the crane for testing.

Information concerning proof testing on components and subsystems that was required and performed at the manufacturer's plant to verify the ability of components or subsystems to perform should be available for the checking and testing performed at the place of installation of the crane system."

Compliance Statement

In order to verify the crane's mechanical and electrical systems are properly installed, the requirements of NOG 7500, "Qualification for Permanent Plant Service," as they apply to the new trolley, were used. These requirements include Section 7520, "Inspection Prior to Performance Testing," NOG 7521.2, "Mechanical Inspection," NOG 7521.3, "Electrical Inspection (Visual) While Crane is Immobile," and NOG 7530 which invokes the requirements of NOG 7420 which was discussed in Section 7.2. Additionally, all tests performed at vendor plants were compiled in a Quality Assurance Documentation Package for approval by AmerGen.

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8.2 Static and Dynamic Load Tests

"The crane system should be static load tested at 125% of the MCL. The tests should include all positions generating maximum strain in the bridge and trolley structures and other positions as recommended by the designer and manufacturer. After satisfactory completion of the 125% static test and adjustments required as a result of the test, the crane handling system should be given full performance tests with 100% of the MCL for all speeds and motions for which the system is designed. This should include verifying all limiting and safety control devices. The features provided for manual lowering of the load and manual movement of the bridge and trolley during an emergency should be tested with the MCL attached to demonstrate the ability to function as intended."

Compliance Statement

The trolley was tested at 125% of the DRL (125/10 tons) in accordance with NOG Section 7423 at ACECO's test facility. Performance testing, manual lowering of the hoists, and manual positioning of the trolley at 100% of the MCL (105/10 tons) was also verified at ACECO's test facility. The crane was not load tested at Oyster Creek as the replacement trolley is of a lighter design which does not impose any new loadings on the crane bridge which have not been previously verified through load testing. The most recent bridge load test was performed in 1995 in the hatchway when the crane controls were replaced.

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8.3 Two-Block Test

"When equipped with an energy-controlling device between the load and head blocks, the complete hoisting machinery should be allowed to two-block during the hoisting test (load block limit and safety devices are bypassed). This test, conducted at slow speed without load, should provide assurance of the integrity of the design, the equipment, the controls, and the overload protection devices. The test should demonstrate that the maximum torque that can be developed by the driving system, including the inertia of the rotating parts at the over torque condition, will be absorbed or controlled during two-blocking or load hangup. The complete hoisting machinery should be tested for ability to sustain a load hangup condition by a test in which the load-block-attaching points are secured to a fixed anchor or an excessive load. The crane manufacturer may suggest additional or substitute test procedures that will ensure the proper functioning of protective overload devices."

Compliance Statement

The crane does not employ an energy controlling device between the load and head blocks. It uses the NUREG-0554 alternative redundant upper limit switch design. These limit switches were functionally tested at ACECO's plant, as well as during the site testing described in Section 8.1. Additionally, the over weight limit switch was tested under load and calibrated to trip at 110% of MCL.

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8.4 Operational Tests

"Operational tests of crane systems should be performed to verify the proper functioning of limit switches and other safety devices and the ability to perform as designed. However, special arrangements may have to be made to test overload and overspeed sensing devices."

Compliance Statement

The crane system was operated to verify the proper functionality of all limit switches and other safety devices in accordance with the requirements of NOG 7421, "No Load Test," as well as the additional requirements contained in NOG 7421.1. The hoist overload sensor was tested during the 125% load test for the auxiliary hoist and during the 100% load test for the main hoist. The over-speed sensing device was tested via the flux vector variable speed drive's ability to be reprogrammed to over-speed. The drive was reprogrammed to operate at 115% of design speed in order to verify the over-speed sensing device is functioning properly.

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8.5 Maintenance

"After installation, equipment usually suffers degradation due to use and exposure. A certain degree of wear on such moving parts as wire ropes, gearing, bearings, and brakes will reduce the original design factors and the capacity of the equipment to handle the rated load. With good maintenance practice, degradation is not expected to exceed 15% of the design load rating, and periodic inspection coupled with a maintenance program should ensure that the crane is restored to the design condition if such degradation is found. Essentially, the MCL rating of the crane should be established as the rated load capacity, and the design rating for the degradable portion of the handling system should be identified to obtain the margin available for the maintenance program. The MCL should be plainly marked on each side of the crane for each hoisting unit. It is recommended that the critical load-handling cranes should be continuously maintained above MCL capacity."

Compliance Statement

The annual OSHA 1910.179 crane inspection is performed to verify the equipment has not degraded due to use and/or exposure. Section 2.2 describes the major wearing components (including wire rope, hook and holding brakes) have increased design margins to account for potential wear. This will assure the machinery can be operated safely between inspections. The other requirements of OSHA 1910.179 assure that the equipment operates properly throughout its entire design life. The MCL is plainly marked on each side of the crane for each hoisting unit in accordance with these requirements.

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9. OPERATING MANUAL

"The crane designer and crane manufacturer should provide a manual of information and procedures for use in checking, testing, and operating the crane. The manual should also describe a preventive maintenance program based on the approved test results and information obtained during the testing. It should include such items as servicing, repair and replacement requirements, visual examinations, inspections, checking, measurements, problem diagnosis, nondestructive examination, crane performance testing, and special instructions.

The operating requirements for all travel movements (vertical and horizontal movements or rotation, singly or in combination) incorporated in the design for permanent plant cranes should be clearly defined in the operating manual for hoisting and for trolley and bridge travel. The designer should establish the MCL rating and the margin for degradation of wear-susceptible component parts."

Compliance Statement

The crane designer and manufacturer provided a manual of information to use for checking, testing, and operating the crane. The manual also describes a preventive maintenance program based upon the requirements of OSHA 1910.179 and ASME NOG-1. Information obtained during crane testing is also provided in the manual. The preventive maintenance program provides such items as servicing, repair, and replacement requirements. Additionally, visual examinations, equipment diagnostics, and nondestructive examinations are also described where required in the manual.

The operating portion of the manual clearly defines the vertical and horizontal movements of the crane and trolley. The maximum critical load is 105/10 tons. The margin for degradation of wear- susceptible components has been included based on the increased design margins provided in the design, which are discussed in Section 2.2.

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10. QUALITY ASSURANCE

"Although crane handling systems for critical loads are not required for the direct operation of a nuclear power plant, the nature of their function makes it necessary to ensure that the desired quality level is attained. A quality assurance program should be established to the extent necessary to include the recommendations of this report for the design, fabrication, installation, testing, and operation of crane handling systems for safe handling of critical loads.

In addition to the quality assurance program established for site assembly, installation, and testing of the crane, applicable procurement documents should require the crane manufacturer to provide a quality assurance program consistent with the pertinent provisions of Regulatory Guide 1.28, 'Quality Assurance Program Requirements (Design and Construction),' to the extent necessary.

The program should address all the recommendations in this report. Also included should be qualification requirements for crane operators."

Compliance Statement

The design and manufacture of the trolley and hoists is in accordance with the ACECO QAM-96 quality assurance program. This quality assurance program is in full compliance with the requirements of 10 CFR 50 Appendix B/ASME NQA-1. This program has been audited by numerous commercial, as well as Department of Energy facilities, and has been found acceptable. ACECO recently passed a NUPIC audit further attesting to the quality program. The QAM-96 controls the entire design and manufacturing process to assure that what is designed is verified, and what has been verified in design is built in accordance with the design requirements.

Attachment A - Quality Matrix lists critical components on the trolley and defines the nondestructive and other testing of the component.

Qualification requirements for the crane operators are included in the operation and maintenance manual. AmerGen has used these for the development of training and testing procedures for crane operators. This then completes the final check of quality in that the operators who operate the crane and trolley do so within the equipment design parameters.

QUALITY MATRIX
REQUIRED INSPECTIONS OR TESTS
ATTACHMENT A

ITEMS	TESTS									
	CERT. MATL. TEST REP.	CERT. OF CONF. FROM ITEM MFGR.	RT OR UT OF BUTT WELDS	MT OR PT OF COMPLETED WELDS	UT BASE MATL.	MT OR PT OF SURFACE	IMPACT TEST Note 1	PROOF LOAD TEST (Including Dimensional)	BREAKING STRENGTH TEST	WELD FILLER MATL C.C. TYP. VALUE
Hook	X	X			X	X		X		
Hook Nut or Attachment Device	X	X			X	X		X		
Trunnion or Cross Head	X	X			X	X				
Load Block Load Structures	X	X					X			
Load Block Structural Welds				X						X
Load Bock - Sheave Pin	X	X			X	X				
Wire Rope		X							X	
Hoist Drum	X	X								
Hoist Drum Shell and Hub Welds			X	X						X
Upper Block Sheave Pin	X	X			X	X				
Upper Block Load Structure	X	X					X			
Upper Block Structural Welds				X						X
Sheaves		X								
Trolley Load Girt Structure	X	X					X			
Trolley Girt - Structural Welds [Note 2]				X						X
Fastener Material for Critical Structural Interconnection [Note 3]	X	X					X			
Trolley Seismic Restraints - Structural	X	X								
Trolley Seismic Restraints - Structural Welds										X
Wire Rope Eyes and Sockets [Note 3]								X		

Notes:
1. Material thickness 5/8" or less in thickness shall be exempt from testing
2. 1/8" throat thickness and greater, 100% weld inspection.
3. Exempt from impact test provided bolt nominal diameter is 1" or less.
4. Proof tested to 200% of the rated capacity of the wire rope as demonstrated by test samples.

Enclosure 3

Oyster Creek Generating Station
Technical Specification Change Request No. 281

Marked-up Technical Specification Page

5.3 AUXILIARY EQUIPMENT

5.3.1 Fuel Storage

A. The fuel storage facilities are designed and shall be maintained with a K-effective equivalent to less than or equal to 0.95 including all calculational uncertainties.

B. ~~1. Loads greater than the weight of one fuel assembly shall not be moved over stored irradiated fuel in the spent fuel storage facility, except as noted in 5.3.1.B.2.~~

Deleted

~~2. The shield plug and the associated lifting hardware may be moved over irradiated fuel assemblies that are in a dry shielded canister within the transfer cask in the cask drop protection system.~~

Deleted

C. ~~The spent fuel shipping cask shall not be lifted more than six inches above the top plate of the cask drop protection system. Vertical limit switches shall be operable to assure the six inch vertical limit is met when the cask is above the top plate of the cask drop protection system.~~

D. The temperature of the water in the spent fuel storage pool, measured at or near the surface, shall not exceed 125°F.

E. The maximum amount of spent fuel assemblies stored in the spent fuel storage pool shall be 3035.

BASIS ← Move to next page.

The specification of a K-effective less than or equal to 0.95 in fuel storage facilities assures an ample margin from criticality. This limit applies to unirradiated fuel in both the dry storage vault and the spent fuel racks as well as irradiated fuel in the spent fuel racks. Criticality analyses were performed on the poison racks to ensure that a K-effective of 0.95 would not be exceeded. The analyses took credit for burnable poisons in the fuel and included manufacturing tolerances and uncertainties as described in Section 9.1 of the FSAR. Calculational uncertainties described in 5.3.1.A are explicitly defined in FSAR Section 9.1.2.3.9. Any fuel stored in the fuel storage facilities shall be bounded by the analyses in these reference documents.

~~The effects of a dropped fuel bundle onto stored fuel in the spent fuel storage facility has been analyzed. This analysis shows that the fuel bundle drop would not cause doses resulting from ruptured fuel pins that exceed 10 CFR 100 limits (1,2,3) and that dropped waste cans will not damage the pool liner.~~

~~Administrative controls over crane movements, which include mechanical rail stops, serve to prevent travel of the crane outside the analyzed load path over the cask drop protection system. A safety factor greater than 10 with respect to ultimate strength, and redundant shield plug lift cables provide adequate margin for the shield plug lift. These features combined with operator training and required inspections, contribute to the determination that dropping the shield plug onto a loaded dry shielded canister in the spent fuel pool is not a credible event.~~