TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

January 24, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

References: 1. D. G. Eisenhut's letter dated December 22, 1980 regarding NUREG-0612, Control of Heavy Loads at Nuclear Plants.

2. D. G. Eisenhut's letter dated February 3, 1981 regarding Control of Heavy Loads (Generic Letter 81-07).

TVA's response to Section 2.1 of Enclosure 3 to references 1 and 2 was submitted to you for our Sequoyah Nuclear Plant by L. M. Mills' March 1, 1982 letter. A draft technical evaluation report (TER) on the control of heavy loads for our Sequoyah Nuclear Plant was transmitted to TVA by your June 30, 1982 letter to H. G. Parris. A subsequent telephone conversation was held with NRC staff members on December 3, 1982 to discuss TVA comments on the draft TER. A supplemental response, which provided additional information and commitments, as requested by the NRC in the December 3, 1982 telephone conversation was submitted on February 25, 1983.

As requested by your June 30, 1982 letter to H. G. Parris, additional comments to guidelines 5a, 7a, and 7b were provided to you by the February 28, 1984 letter from L. M. Mills. An additional response to guideline 4 of the NRC TER regarding special lifting devices and a revision to footnote 1 for guideline 7a was provided to you by the December 7, 1984 letter from J. W. Hufham.

Enclosed is TVA's response to sections 2.2, 2.3, and 2.4 of references 1 and 2.

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If you have any questions concerning this matter, please get in touch with Jerry Wills at FTS 858-2683.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. A. Domer

J. A. Domer
Nuclear Engineer

Sworn to and subscribed before me
this 24th day of January 1985

Paulette H. White
Notary Public
My Commission Expires 8-24-88

Enclosure

cc: U.S. Nuclear Regulatory Commission (Enclosure)
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

RESPONSE TO

ENCLOSURE 3 TO NRC LETTER DATED DECEMBER 22, 1980

QUESTION 2.2

NUREG 0612 - CONTROL
OF HEAVY LOADS AT
NUCLEAR POWER PLANTS

SEQUOYAH NUCLEAR PLANT

REFERENCES

1. Crane Manufacturer Association of America, Inc.
   Specifications for Electrical Overhead Traveling Cranes.
   C.M.A.A. Specification Number 70. 1971.

2. American Welding Society, Inc.
   Specifications for Welded Highway and Railway Bridges.
   AWS D2.0-69. 1969.

3. U. S. Nuclear Regulatory Commission.
   Control of Heavy Loads at Nuclear Power Plants. NUREG-0612. 1980.

4. U. S. Regulatory Commission.
   Single-Failure-Proof Cranes for Nuclear Power Plants. NUREG-0554.
   1979.

5. Tennessee Valley Authority.
   Design Criteria for Reactor Building Polar Cranes. SQN-DC-2.6.
   1970.

6. Tennessee Valley Authority.
   Design Criteria for Auxiliary Building Crane. SQN-DC-V-1.1.3. 1970.

7. U. S. Nuclear Regulatory Commission.
   Seismic Design Classification. Regulatory Guide 1.29. 1973.

8. Tennessee Valley Authority.
   Preoperational Test for 125 Ton Auxiliary Building Crane. TVA-43B.
   1979.

9. Tennessee Valley Authority.
   Preoperational Test for 175 Ton Polar Crane. TVA-43A. 1979.

0. Tennessee Valley Authority.
   Acceptance Test for 125 Ton Auxiliary Building Crane. 1979.

1. Tennessee Valley Authority.
   Acceptance Test for 175 Ton Polar Crane. 1978.

2. Tennessee Valley Authority.
   Final Safety Analysis Report. Sequoyah Nuclear Plant. Section 3.8.6
   Category I Cranes. 1984.

3. The American Society of Mechanical Engineers.
   Overhead and Gantry Cranes. ANSI B30.2.0-1976.

4. The American Society of Mechanical Engineers.
   Failure Analysis of a Redundant Reeving Hoist. No. 76-DE-21.

5. The American Society of Mechanical Engineers.
   Dynamic Testing of a Redundant Reeving Hoist. No. 76-WA/DE-6.

2.2-1 REQUEST

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

RESPONSE

The only crane capable of carrying heavy loads in the vicinity of the spent fuel pool is the auxiliary building crane which is an overhead crane with a 125-ton capacity using the main hoist and a 10-ton capacity using the auxiliary hoist.

2.2-2 REQUEST

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

RESPONSE

The auxiliary building crane cannot be excluded from the category identified in request 2.2-1.

2.2-3 REQUEST

Identify any cranes listed in 2.2-1, above, which you have evaluated as having sufficient design features to make the likelihood of a load drop extremely small for all loads to be carried and the basis for this evaluation (i.e., complete compliance with NUREG-0612, Section 5.1.6 or partial compliance supplemented by suitable alternative or additional design features). For each crane so evaluated, provide the load-handling-system (i.e., crane-load-combination) information specified in Attachment 1.

RESPONSE

The following is in response to items 1 through 5 of attachment 1 to enclosure 3 of the NRC transmittal letter for NUREG-0612 dated December 22, 1980. These responses describe sufficient design features for the auxiliary building crane or appropriate corrective actions to be taken to make the likelihood of a load drop extremely small.

SINGLE-FAILURE-PROOF HANDLING SYSTEMS

(2.2-3 Response)

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

Response

Manufacturer: Crane Hoist Engineering Company

DRL: 125 Tons - Main Hoist
10 Tons - Auxililary Hoist

MCL: 100 Tons - Main Hoist
10 Tons - Auxiliary Hoist

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

Response

Attachment A provides an enumeration of NUREG-0554 requirements based on NRC's interpretation provided to TVA in the Browns Ferry Nuclear Plant draft Technical Evaluation Report (TER) C5257-181. Refer to Table A for the evaluation of the Sequoyah auxiliary building crane.

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

Response

Refer to Attachment B.

SINGLE-FAILURE-PROOF HANDLING SYSTEMS

(2.2-3 Response)

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

Response

A response to item 4 cannot be provided until the items identified as "E" are accepted by NRC.

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

Response

A response to item 5 cannot be provided until the items identified as "E" are accepted by NRC.

ATTACHMENT A
SPECIFIC NUREG 0554 REQUIREMENTS
(AS PRESENTED IN TER C5257-181 - BROWNS FERRY NUCLEAR PLANT)

2. Specification and Design Criteria

2.1 Construction and Operating Periods

1. When an overhead crane handling system will be used during the plant construction phase, separate performance specifications may be needed to reflect the duty cycles and loading requirements for each service.

2. 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 No. 70 and reflecting the appropriate duty cycle in CMAA Specification No. 70.

3. The sum total of simultaneously applied loads (static and dynamic) should not result in stress levels causing permanent deformation other than localized strain concentration.

4. The effects of cyclic loading induced by jogging or plugging an uncompensated hoist control system should be included in the design specification.

2.2 Maximum Critical Load

1. The crane should be designed to handle the maximum critical load (MCL) that will be imposed.

2. A slightly higher design load should be selected for component parts that are subject to degradation due to wear and exposure. An increase of approximately 15% of the design load for these component parts would be a reasonable margin.

3. The MCL rating should be clearly marked on the crane.

4. The DRL rating should be marked on the crane separately from the MCL marking.

2.3 Operating Environment

1. 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.

2.4 Material Properties

1. The crane and lifting fixtures for crane already fabricated or operating may be subjected to a cold-proof test consisting of a single dummy load test as follows:

   a. Metal temperature of the structural members essential to the structural integrity of the crane handling system should be at below the minimum operating temperature.

   b. The corresponding dummy load should be equal to 1.25 times the MCL.

   c. The cold-proof test should be followed by a nondestructive examination of welds whose failure could result in the drop of a critical load.

   d. The nondestructive examination of critical areas should be repeated at 4-year intervals or less.

2. Cranes and lifting fixtures made of low-alloy steel such as ASTM A514 should be cold-proof tested in any case.

3. Cast iron should not be used for load-bearing components.

2.5 Seismic Design

1. The crane should be designed and constructed in accordance with regulatory position 2 of Regulatory Guide 1.29.

2. 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.

2.6 Lamellar Tearing

1. All weld joints whose failure could result in the drop of a critical load should be nondestructively examined.

2. If any of these weld joint geometries would be susceptible to lamellar tearing, the base metal at the joints should be nondestructively examined.

2.7 Structural Fatigue

1. 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.

2.8 Welding Procedures

1. Preheat temperatures and postweld heat-treatment (stress relief) temperatures for all weldments should be specified in the weld procedure.

2. Welds described in the recommendations of Section 2.6 should be postweld heat treated in accordance with Subarticles 3.9 of AWS D1.1, "Structural Welding Code."

3. Safety Features

3.1 General

3.2 Auxiliary Systems

1. 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.

2. 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.

3.3 Electrical Control Systems

1. 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 subsystem, these disorders will not prevent the handling system from stopping and holding the load.

2. An emergency stop button should be added at the control station to stop all motion.

3.4 Emergency Repairs

1. 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 position with the handling system immobile.

4. Hoisting Machinery

4.1 Reeving System

1. 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 the configuration of ropes and rope equalizer(s).

2. The maximum load (including static and inertia forces) on each individual wire rope in the dual reeving system with the MCL at ached should not exceed 10% of the manufacturer's published breaking strength.

3. 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^{o}) at any point during hoisting except that for the last 1 meter of maximum lift elevation the fleet angle may increase slightly. The use of reverse bends for running wire ropes should be limited.

4. The equalizer for stretch and load on the rope reeving system may be 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 the case of failure of the other rope system.

5. The pitch diameter of running sheaves and drums should be selected in accordance with the recommendations of CMAA Specification No. 70.

6. 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. Alternately, 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.

4.2 Drum Support

1. 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 bearings were to fail or fracture.

4.3 Head and Load Blocks

1. 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.

2. 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.

3. The individual components 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.

4. 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.

4.4 Hoisting Speed

1. Maximum hoisting speed for the critical load should be limited to the given in the "slow" column of Figure 70-6 of CMAA Specificiation No. 70.

   Conservative industry practice limits the rope line speed to 1/4 m/s (50 fpm) at the drum.

4.5 Design Against Two-Blocking

1. 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.

2. As an alternative, the protective control system to prevent the hoisting system from two blocking should include as a minimum:

   - o Two independent travel-limit devices of different designs and activated by separate mechanical means.

   - o These devices should de-energize the hoist drive motor and main power supply.

3. The protective control system for load hang-up, 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.

4. The mechanical holding brakes and their controls should include the capability to withstand the maximum torque of the driving motor if a malfunction occurs and power to the driving motor cannot be shut off.

5. The auxiliary hoist should be equipped with two independent travel-limit switches to prevent two-blocking.

4.6 Lifting Devices

1. Lifting devices should be conservatively designed with a dual or auxiliary device or combination 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.

4.7 Wire Rope Protection

1. 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.

4.8 Machinery Alignment

1. 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.

4.9 Hoist Braking System

1. 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.

2. 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.

3. 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.

4. Provision for manual operation of the hoisting brakes should be included in the design conditions.

5. Bridge and Trolley

5.1 Braking Capacity

1. 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.

   Control and holding brakes should each be rated at 100% of maximum drive torque that can be developed at the point of application.

2. 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.

3. 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.

4. Provisions should be made for manual emergency operation of the brakes.

5. The holding brake should be designed so that it cannot be used as a foot-operated slowdown brake.

6. Drag brakes should not be used.

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

8. Trolley and bridge speed should be limited. The speed limits indicated for slow operating speeds for trolley and bridge in Specification CMAA No. 70 are recommended for handling MCLs.

5.2 Safety Stops

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

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

6. Drivers and Controls

6.1 Driver Selection

1. The maximum torque capability of the electric motor drive for hoisting should not exceed the rating of capability of the individual component of the hoisting system required to hoist the MCL at the maximum design hoist speed.

2. 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.

3. 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.

6.2 Driver Control Systems

1. 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.

2. 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.

6.3 Malfunction Protection (Drivers)

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

2. 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.

6.4 Slow Speed Drives

1. If jogging or plugging is to be used, the control circuit should include features to prevent abrupt change in motion.

2. Drift point in the electric power system when provided for bridge or trolley movement should be provided only for the lowest operating speeds.

6.5 Safety Devices

1. 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.

6.6 Control Stations

1. 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.

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

3. Manual controls for hoisting and trolley movement may be provided on the trolley, while manual controls for the bridge may be located on the bridge.

4. 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.

7. Installation Instructions

7.1 General

1. Installation instructions provided by the manufacturer 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 preparation for operation.

7.2 Construction and Operating Periods

1. After construction use, the crane should be thoroughly inspected by nondestructive examination and load tested for the operating phase. The extent of nondestructive examinations, the procedures used, and the acceptance criteria should be defined in the design specification.

2. 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.

8. Testing and Preventative Maintenance

8.1 General

1. Information concerning proof testing on components and sub-systems 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.

8.2 Static and Dynamic Load Tests

1. 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 strucures and other positions as recommended by the designer and manufacturer.

2. 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.

3. 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.

8.3 Two-Block Test

1. 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).

2. 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.

8.4 Operating Tests

1. 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.

8.5 Maintenance

1. 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.

2. The MCL should be plainly marked on each side of the crane for each hoisting unit.

9. Operating Manual

1. The crane designer and manufacturer should provide a manual of information and procedures for use in checking, testing, and operating the crane.

2. 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.

10. Quality Assurance

1. 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.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
2.1-1	C	Separate performance specifications (for construction and plant operation) are not required for this crane, since the design specification considered both phases of operation.
-2	E	This crane was not specifically designed in accordance with table 3.3.3.1.3-1 of CMAA specification No. 70. However, the allowables used for the bridge and trolley structures as required in the design criteria are less than those stated in the table.
-3	C	The specified allowable stress levels for simultaneous applied loads are half the materials yield strength necessary to cause permanent deformation.
-4	E	The crane is compensated with stepless regulated speed control for smooth acceleration and deceleration of all motions. Slowdown is also attained by controlled jogging or plugging as required in the design specification.
2.2-1	C	This crane was designed for 125 tons load. The maximum critical load (MCL) is the spent fuel shipping cask which weighs 100 tons.
-2	C	The design load is 25 percent higher than the actual MCL. Refer to 2.2-1 above.
-3	C	The MCL for the main and auxiliary hoists will be displayed on the crane.
-4	C	The design rated load (DRL) is clearly marked on the crane.
2.3-1(a)	C	Considerations for environment (temperature, humidity, pressure, etc.) were specified in the design criteria.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREC 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-1(b)	NA	This crane is not located in the containment area.
2.4-1 a-d	E	Specific considerations for brittle fracture were not made during design, and a cold-proof test has not been performed. In lieu of a cold-proof test, a minimum operating temperature will be established based on NDTT+30 °F criterion for critical lifts governed by NUREG-0612.
-2	C	No low-alloy steel was used in the structural components of this crane.
2.4-3	C	Cast iron was not used on this crane as required in NUREG 0554.
2.5-1	C	The crane was designed in accordance with regulatory position 2 of Regulatory Guide 1.29.
-2	C	The MCL plus operational and seismically induced pendulum and swinging load were considered in the design of trolley and bridge.
2.6-1	C	All critical load carrying welds were tested by nondestructive examination (NDE) methods, such as magnetic particle, ultrasonic or radiography inspections.
-2	C	All critical weld joints were NDE tested.

TABLE A

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
2.7-1	E	A fatigue analysis was not conducted on all critical load-bearing structures and components; however, design stress levels for these critical areas are lower than the endurance limits (40% of material's tensile strength) for the various materials.
2.8-1	C	The crane manufacturer submitted approved welding procedures for each type of weld joint specifying preheat and stress relief temperatures. These procedures were performed in accordance with AWS D2.0-69 "Welded Highway and Railway Bridges".
-2	E	Critical weld joints were postweld heat treated in accordance with AWS D2.0-69.
3.2-1	E	The auxiliary hoist is dual reeved with a 6.9:1 safety factor on the wire ropes. A redundant drive train with the ability to continue a lift after a single failure is also incorporated. All drive components are designed to a 5:1 safety factor. Two different over-hoist limit switches of different design are provided.
3.2-2	E	A subsystem or component failure will not result in a load drop for either the main or auxiliary hoist. However, failure of one of the dual ropes on the auxiliary hoist would result in a unstable load at the moment of failure. This instability for the auxiliary hoist presents no apparent hazard.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
3.3-1	C	Automatic controls and limiting devices are properly designed to stop and hold any load, as required in the design specification, under all identified inadvertent disorders.
-2	C	An emergency stop pushbutton is located in the cab and three are located at the floor level.
3.4-1	C	All vulnerable active components can be repaired or replaced while supporting the MCL for the main and auxiliary hoist. (See Active Component Replacement Guide of Tables A1 and A2). However, in some cases an in-place repair or replacement of failed components other than active components is impractical and a defined alternate means of moving the load to a safe laydown area is unavailable. A method will be developed and implemented for the manual emergency movement of the bridge and trolley.
4.1-1	E	Dual reeving and equalizing systems are used for the main and auxiliary hoists. Load balancing through cross-reeving is not used for either hoist.
-2	E	The maximum load on each individual wire rope for the main and auxiliary hoists does exceed 10% of the manufacturer's published breaking strength with their respective maximum critical load (MCL) attached. However, all ropes exceed the requirements of CMAA 70 with the following factors of safety with the MCL's attached: Main Hoist - 7.6 to 1; Auxiliary Hoist - 6.9 to 1. During routine maintenance, as replacement of wire rope is required, extra extra improved plowed steel wire rope will be used which will yield a minimum of 15% increase in the factory of safety.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-3	C	The maximum fleet angle for the main or auxiliary hoist is 3.5 degrees which complies with this NUREG. There are no reverse bends on these hoists.
-4(a)	C	The main hoist equalizer consist of a double ended double acting hydraulic cylinder designed to equalize the two ropes and prevent dropping the load in case of a single rope failure.
-4(b)	E	The auxiliary hoist was not designed with an automatic equalizer in the reeving system. Since this is a two part direct reeved hoist, an equalizing system is not employed. A loss of one line will not impart severe shock to the system or severe swinging because of the short span trunnion.
4.1-5	C	The pitch diameter of the running sheaves and drums were selected in accordance with CMAA Specification No. 70
-6(a)	C	The main hoist is provided with a redundant reeving and hydraulic equalizer system as presented in the plant FSAR.
-6(b)	E	The auxiliary hoist reeving system is a single rope from each end of the drum terminating at the block with adjustment provisions for rope stretch at the trunnion.
4.2-1	C	No drop plates were provided for either hoist. Drop plates will be designed and installed for both hoists in accordance with 4.2-1 of NUREG 0554 and any other appropriate industry standards.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
4.3-1(a)	C	The main hoist reeving system is of dual design and the equalizing cylinder maintains vertical balance and alignment with both ropes intact.
4.3-1(b)	E	Auxiliary hoist is not equipped with an equalizing system; however, it does have dual ropes and the auxiliary hoist rope exceeds the requirements of CMAA-70 with the MCL attached.
4.3-2	E	This crane was not equipped with dual attaching points. However, the crane hooks were designed and manufactured in accordance with CMAA 70, and are nondestructively examined periodically in accordance with ANSI B30.10-1971.
-3	C	The mechanical parts for this crane are designed for five times the Design Rated Load (DRL) under normal conditions. The DRL is 25 percent greater than the MCL for this crane.
-4(a)	E	The hooks were prooftested to 200 percent of the DRL and examined by ultrasonic and magnetic particle testing methods.
-4(b)	E	The load blocks were not nondestructively examined by surface and volumetric techniques. However, the load block is visually inspected annually in accordance with ANSI B30.2.0-1976. If the forthcoming visual inspection warrant disassembly of the block, the block will be nondestructively examined by surface and volumetric techniques, and necessary replacements made.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
4.4-1(a)	C	The main hoist speed is a maximum at 5 FPM which satisfies the requirement in figure 70-6 of CMAA Specification No. 70.
-1(b)	E	The auxiliary hoist speed is greater than the required speed in Figure 70-6 of CMAA Specification No. 70 (25.2 FPM vs 20.0 FPM). However, we believe this difference is insignificant considering that critical lifts using this hoist are administratively controlled.
-1(c)	C	The line speed for the main and auxiliary hoists are less than the required 50 FPM.
4.5-1	NA	NUREG 0554 provides alternatives to the requirements of this section in section 4.5-2 below. These will be analyzed for compliance.
4.5-2	C	To protect against two-blocking, two upward travel limit switches of different design and acting independently were installed on both hoists.
-3	C	Both hoists are equipped with motor-current sensing devices for overload protection.
-4	C	The holding brakes' torque capacity exceeds the maximum torque of the driving motor (stall).

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-5	C	The auxiliary hoist is equipped with two independent travel limit switches of different design to prevent two blocking.
4.6-1	NA	TVA is reviewing the design of critical lifting devices for compliance with NUREG 0612 as requested by the NRC. Refer to our report from L. M. Mills to E. Adensam dated March 1, 1982, for compliance.
4.7-1	C	No critical lifts require sideloading; nonetheless, a bar guard was employed on both hoists.
4.8-1	C	Both hoists have gear trains that are interposed between the holding brakes and drums. Vendor drawings illustrate that the gears are single-failure-proof and of dual design.
4.9-1	C	Both hoists are equipped with overspeed controls, emergency dynamic braking, holding brakes (each set at 150 percent of the full load torque) and regenerative lowering.
-2	C	Single failure of the regenerative braking system on the main and auxiliary hoists will activate two holding brakes for stopping and controlling the load.
-3	C	As stated in sections 4.8-1 and 4.9-2; both hoist holding brake systems are single-failure-proof.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
4.9-4	C	All brakes are equipped with a manual release feature as required in the design specification.
5.1-1	C	The capability of the gear train and brakes, as required on the vendor drawings, exceeds the maximum torque capability of the driving motor and gear reducer for trolley and bridge motion.
-2(a)	E	The bridge is equipped with a hydraulic manually operated foot control brake and a spring set, electrically released holding brake. The holding brake will activate when a release or shutoff of power occurs.
-2(b)	C	The trolley is equipped with two brakes that are adjusted with one brake as the primary and the other as a back up or secondary brake. These brakes will activate when a release of the control handle or shutoff of power occurs.
-3	C	All brakes are set upon the interruption of power for any reason. Additionally, the system has undervoltage protection which keeps the brakes set after power is momentarily interrupted.
-4	C	All holding brakes have provisions for manual emergency operation.
-5	C	The hydraulic control brakes are foot operated, however, the holding brakes as stated previously are electrically actuated.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-6	C	No drag brakes are used.
-7	C	All bridge and trolley wheels are machined in pairs.
-8	C	Both bridge and trolley speeds comply with the requirements of CMAA 70 as stated in the vendor calculations.
5.2-1	C	The bridge and trolley are equipped with several limit switches that control movements of the crane around the spent fuel pit. Spring-cushioned bumpers are provided for the trolley and bridge travel limit stops.
5.2-2	C	All limit switches, overspeed switches, overcurrent relays, etc. are provided as safety backup devices and are not intended for normal operating use.
6.1-1	C	The calculated power requirement and the motor rating for the main hoist are identical at 50 horsepower. The auxiliary hoist motor is rated at 20 horsepower and the calculated requirement is 18.3 horsepower.
-2	C	The maximum stopping distance for these hoists has been established.
-3	C	TVA electrical drawings show three emergency stop pushbuttons located at ground level which are independent of the crane controls.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
6.2-1	C	The main and auxiliary hoists are equipped with overspeed switches, emergency dynamic braking, torque limiting devices, overcurrent protection and undervoltage protection all of which are designed to provide a safe hoisting operation.
-2	C	As shown on vendor and TVA drawings there are limit switches which prevent the trolley and bridge movements over the spent fuel pit.
6.3-1	C	Motor control circuits sense and respond to overcurrent, overspeed, motor overload, motor temperature, and over travel as required in the design specification.
-2	C	Controls are provided to absorb the kinetic energy of the rotating machinery and to stop the hoisting movement safely and reliably.
6.4-1	C	Slow down by controlled plugging is required in the design specification for the bridge and trolley. The hoist has control features such as smooth acceleration and deceleration, stepless regulated speed control and static reversing which protects the hoist mechanism from the harmful effects of plugging or jogging.
-2	E	Design specification does require drift control for the crane; however, this provision was not limited to the lowest speed, but the critical lifts are adminstratively controlled.

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

TABLE A

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
6.5-1	C	The limit switches provided for malfunction or inadvertent operator action are supplied in addition to and separate from the cont:ol devices provided for normal operation. (Refer to Section 5.2 of this table.)
6.6-1	C	The bridge mounted cab has complete operating and emergency controls.
6.6-2	NA	No additional operator stations were provided for this crane.
-3	NA	
-4	NA	No additional stations were provided.
7.1-1	C	An operating and maintenance manual satisfying the intent of this requirement was supplied by the crane manufacturer.
7.2-1	E	Although the main and auxiliary hoists were load tested to 125 percent of the Design Rated Load (DRL), no nondestructive Examination (NDE), except a visual inspection, was performed. In lieu of a one time full NDE, accessible welds are visually inspected annually in accordance with ANSI B30.2.C-1976.
7.2-2	C	No predetermined loads exceeded allowable design stress limits established for the plant operating service during the construction phase.
8.1-1	C	Any information concerning work performed at the crane manufacturers' plant was documented by the TVA Inspection and Testing Branch Inspection Report and is on file at Sequoyah Nuclear Plant.

TABLE A

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
8.2-1	C	The Acceptance Test requires a complete performance check of the crane after load tests are performed at no load, 50 percent, 100 percent, and 125 percent of the DRL.
-2	C	All speeds and motions for which the crane was designed were tested with 100 percent of the DRL attached. The DRL is 25 percent greater than the MCL.
-3	C	As stated in section 4.9-4 of this report, the hoist holding brakes can be manually released for lowering the load. However, no means for emergency manual movement of the bridge or trolley with the MCL attached was provided. A method will be developed and implemented for emergency movement of the bridge or trolley with the MCL attached. Additionally, a test for verification of this function will be performed.
8.3-1	E	No two-blocking test was performed; however, Appendix C of NUREG 0612 allows functional verification of the limit switches in lieu of an actual two-blocking test. The Preoperational Test verified these limit switches to be functional.
-2	E	No load hang-up test was performed; however, the crane is designed for stall loadings and will be equipped with a load readout system and an overload warning device set at 100 percent of DRL. Additionally, a load limiter set at 125 percent of the DRL which will shut off power to the crane if this setting is exceeded, will be installed.

TABLE A

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
125/10 TON AUXILIARY BUILDING CRANE
2.2-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
8.4-1	C	In addition to Acceptance and Preoperational Tests performed after installation and prior to fuel load, respectively, periodic operational tests and visual inspections are made, in accordance with ANSI B30.2 - 1976, to demonstrate safe performance of the crane.
8.5-1	C	The DRL is 25 percent greater than the MCL and the crane was designed to CMAA Specification No. 70 class C (moderate service); whereas, operationally it should be designed to class A1 (standby service) crane rating.
-2	C	As previously stated in this report (section 2.2-3), the MCL will be installed on the crane.
9.1-1	C	The crane manufacturer supplied a set of operation and instruction manuals.
-2	C	The operating requirements for all travel movements are clearly defined in the crane operation and instruction manual.
10.1-1	E	This crane was designed, fabricated, installed, tested, and initially operated under an approved Quality Assurance program that was prior to the issuance of NUREG 0554. The requirements used to manufacture and operate this crane in addition to the satisfactory completion of the recommendations contained herein should satisfy the intent of NUREG 0554.

TABLE A1

ACTIVE COMPONENT REPLACEMENT GUIDE

2.2-3 RESPONSE

(NUREG 0554 - SECTION 3.4)

Lift System:
125/10 Ton Auxiliary Building Crane
Main Hoist

ACTIVE COMPONENT	Design Factor of Safety	Set Down Capa-bility	Cont. Lift Capa-bility	Repair or Replace Capa-bility	Spare Parts Avail-able
1. Hoist Motor	NA	Yes	No	Yes	Yes
2. Primary Holding Brake	(6)	Yes	Yes	Yes	N/A
3. Secondary Holding Brake	(6)	Yes	Yes	Yes	N/A
4. Primary Gear Reducer	(7)	Yes(1)	Yes	Yes	N/A
5. Secondary Gear Reducer	(7)	Yes(2)	Yes	Yes	N/A
6. Primary Pinion/Drum Gear	7.6:1(8)	Yes(1)	Yes(1)	Yes/No(1)	N/A
7. Secondary Pinion/Drum Gear	7.6:1(8)	Yes(2)	Yes(2)	Yes/No(2)	N/A
8. Wire Rope Drum	6.4:1(8)	No	No	No	N/A
9. Wire Rope Drum Shaft	7.4:1(8)	No	No	No	N/A
10. Wire Rope	7.6:1(8)	Yes(3)	Yes(3)	Yes	Yes
11. Drive Couplings	NA	Yes	Yes	Yes	Yes
12. Primary Pinion Shaft Bearings	NA	Yes(1)	Yes(1)	Yes	Yes
13. Secondary Pinion Shaft Bearings	NA	Yes(2)	Yes(2)	Yes	N/A
14. Drum Support Bearings	NA	Yes	No	Yes	Yes
15. Power Track (Festoon) System	NA	No(4)	No	Yes	N/A(5)

NA - Not Applicable

Special Conditions:
1. Postulate single component failure.
2. Disabled trolley or bridge can be physically moved by portable winches tied to appropriate structures.

TABLE A1
ACTIVE COMPONENT REPLACEMENT GUIDE
2.2-3 RESPONSE
(NUREG 0554 - SECTION 3.4) SHT. 2 of 2

Lift System:
125/10 Ton Auxiliary Building Crane
Main Hoist

FOOTNOTES

(1) Remove primary pinion
(2) Remove secondary pinion
(3) Based on studies performed by the University of Tennessee Mechanical Engineering Department (refer to ASME papers No. 76-DE-21 and No. 76-WA/DE-6), continued lifting and lowering of the load after a single rope failure is possible. This study was modeled from a 125 ton fuel cask handling crane composed of a dual non-crossed twelve part reeving system.
(4) When a power failure occurs there is no upward hoisting movement possible. Even though the manual release provided on the holding brake will allow lowering of the load, the hook (with load attached) could be in a physical location that would require upward motion before the load could be moved laterally to a safe laydown area.
(5) A temporary power supply will be used.
(6) 150% of full load motor torque
(7) Vendor supplied and designed in accordance with AGMA
(8) Based on a MCL rating of 100 tons

TABLE A2

ACTIVE COMPONENT REPLACEMENT GUIDE

2.2-3 RESPONSE

(NUREG 0554 - SECTION 3.4) SHT. 1 of 2

Lift System:
125/10 Ton Auxiliary Building Crane
Auxility Hoist

ACTIVE COMPONENT	Design Factor of Safety	Set Down Capa- bility	Cont. Lift Capa- bility	Repair or Replace Capa- bility	Spare Parts Avail- able
1. Hoist Motor	NA	Yes	No	Yes	Yes
2. Primary Holding Brake	(6)	Yes	Yes	Yes	N/A
3. Secondary Holding Brake	(6)	Yes	Yes	Yes	N/A
4. Primary Gear Reducer	(7)	Yes(1)	No	Yes	Yes
5. Secondary Gear Reducer	(7)	Yes(2)	Yes	Yes	N/A
6. Primary Pinion/Drum Gear	10.4:1(8)	Yes(1)	No	Yes/No(1)	N/A
7. Secondary Pinion/Drum Gear	10.4:1(8)	Yes(2)	Yes(2)	Yes/No(2)	N/A
8. Wire Rope Drum	5.3:1(8)	No	No	No	N/A
9. Wire Rope Drum Shaft	5.2:1(8)	No	No	No	N/A
10. Wire Rope	6.9:1(8)	Yes(3)	Yes(3)	Yes(3)	Yes
11. Drive Couplings	NA	Yes	No	Yes	Yes
12. Primary Pinion Shaft Bearings	NA	Yes(1)	No	Yes	Yes
13. Secondary Pinion Shaft Bearings	NA	Yes(2)	Yes	Yes	N/A
14. Drum Support Bearings	NA	Yes	No	Yes	Yes
15. Power Track (Festoon) System	NA	No(4)	No	Yes	N/A(5)

NA - Not Applicable

Special Conditions:
1. Postulate single component failure.
2. Disabled trolley or bridge can be physically moved by portable winches tied to appropriate structures.

TABLE A2
ACTIVE COMPONENT REPLACEMENT GUIDE
2.2-3 RESPONSE
(NUREG 0554 - SECTION 3.4) SHT. 2 of 2

Lift System:
125/10 Ton Auxiliary Building Crane
Auxiliary Hoist

FOOTNOTES

(1) Remove primary pinion
(2) Remove secondary pinion
(3) Remove damaged rope - Use remaining good side
(4) When a power failure occurs there is no upward hoisting movement possible. Even though the manual release provided on the holding brakes will allow lowering of the load, the hook (with load attached) could be in a physical location that would require upward motion before the load could be moved laterally to a safe laydown area.
(5) A temporary power supply will be used.
(6) 150% of full load motor torque
(7) Vendor supplied and designed in accordance with AGMA
(8) Based on a MCL of 9.9 tons

ATTACHMENT B

Method of Seismic Analysis
Sequoyah Nuclear Plant
Auxiliary Building Crane
2.2-3 Response

The analysis was performed using idealized lumped-mass models. Since the mass of the equipment attached to each girder is not the same, each girder was analyzed separately.

Three loading conditions of the crane were considered in the analysis. The hoist trolley is assumed to provide a rigid connection between the crane girders for motion in the horizontal direction. The three loading conditions are as follows:

Loading condition 1 assumed the trolley with the live load to be at the wheel stop.

Loading condition 2 assumed the trolley with the live load to be at the third point of the span.

Loading condition 3 assumed the trolley with the live load to be at the midpoint of the span.

For the lateral analysis, the support points of the crane girder were assumed to be fixed for translation and restrained from rotation by a spring, the stiffness of which was the rotational stiffness of the main girder-end girder joint. The two parallel girders were connected at the ends and at the trolley position by a translational spring, the stiffness of which was the longitudinal stiffness of the end girder. The effect of the live load, a mass hung by a long cable which would act as a pendulum of very low frequency, was neglected. Spectral accelerations were taken from TVA Report CEB 80-20, "Dynamic Earthquake Analysis of the Auxiliary-Control Building and Response Spectra for Attached Equipment," using 1-percent structural damping. For the longitudinal direction, parallel to the main girder axis, the crane girder is assumed to be rigid.

For the vertical analysis, the crane girders were assumed to be simply supported and act independently. The effect of the live load, idealized as a weight hung by a spring and attached to the crane was considered. The live load was taken as 125 tons and the hoist cables were extended the maximum length. The vertical spectral accelerations were taken from the same report as the lateral analysis.

RESPONSE TO

ENCLOSURE 3 TO NRC LETTER DATED SEPTEMBER 22, 1980

QUESTION 2.3

NUREG 0612 - CONTROL
OF HEAVY LOADS AT
NUCLEAR POWER PLANTS

SEQUOYAH NUCLEAR PLANT

REFERENCES

1. Crane Manufacturer Association of America, Inc.
   Specifications for Electrical Overhead Traveling Cranes.
   C.M.A.A. Specification Number 70. 1971.

2. American Welding Society, Inc.
   Specifications for Welded Highway and Railway Bridges.
   AWS D2.0-69. 1969.

3. U. S. Nuclear Regulatory Commission.
   Control of Heavy Loads at Nuclear Power Plants. NUREG-0612. 1980.

4. U. S. Regulatory Commission.
   Single-Failure-Proof Cranes for Nuclear Power Plants. NUREG-0554.
   1979.

5. Tennessee Valley Authority.
   Design Criteria for Reactor Building Polar Cranes. SQN-DC-2.6.
   1970.

6. Tennessee Valley Authority.
   Design Criteria for Auxiliary Building Crane. SQN-DC-V-1.1.3. 1970.

7. U. S. Nuclear Regulatory Commission.
   Seismic Design Classification. Regulatory Guide 1.29. 1973.

8. Tennessee Valley Authority.
   Preoperational Test for 125 Ton Auxiliary Building Crane. TVA-43B.
   1979.

9. Tennessee Valley Authority.
   Preoperational Test for 175 Ton Polar Crane. TVA-43A. 1979.

10. Tennessee Valley Authority.
    Acceptance Test for 125 Ton Auxiliary Building Crane. 1979.

11. Tennessee Valley Authority.
    Acceptance Test for 175 Ton Polar Crane. 1978.

12. Tennessee Valley Authority.
    Final Safety Analysis Report. Sequoyah Nuclear Plant. Section 3.8.6
    Category I Cranes. 1984.

13. The American Society of Mechanical Engineers.
    Overhead and Gantry Cranes. ANSI B30.2.0-1976.

14. The American Society of Mechanical Engineers.
    Failure Analysis of a Redundant Reeving Hoist. No. 76-DE-21.

15. The American Society of Mechanical Engineers.
    Dynamic Testing of a Redundant Reeving Hoist. No. 76-WA/DE-6.

2.3-1 **REQUEST**

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

RESPONSE

The only crane capable of carrying heavy loads over the reactor vessel is the reactor building crane which is an overhead polar crane with a 175-ton capacity using the main hoist and a 35-ton capacity using the auxiliary hoist.

2.3-2 **REQUEST**

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

RESPONSE

The reactor building crane cannot be excluded from the category identified in request 2.3-2.

2.3-3 **REQUEST**

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

RESPONSE

The following is in response to items 1 through 5 of attachment 1 of Enclosure 3 of the NRC transmittal letter for NUREG-0612 dated December 22, 1980. These responses describe sufficient design features of the Reactor Building Crane or appropriate corrective actions to be taken to make the likelihood of a load drop extremely small.

SINGLE-FAILURE-PROOF HANDLING SYSTEMS

(2.3-3 Response)

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

<u>Response</u>

Manufacturer: Star Iron and Steel Company

DRL: 175 Tons - Main Hoist
35 Tons - Auxililary Hoist

MCL: 165 Tons - Main Hoist
28 Tons - Auxiliary Hoist

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

<u>Response</u>

Attachment C provides an enumeration of NUREG-0554 requirements based on NRC's interpretation provided to TVA in the Browns Ferry Nuclear Plant draft Technical Evaluation Report (TER) C5257-181.

Refer to Table B for the evaluation of the Sequoyah reactor building crane.

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

<u>Response</u>

Refer to Attachment D.

SINGLE-FAILURE-PROOF HANDLING SYSTEMS

(2.3-3 Response)

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

Response

A response to item 4 cannot be provided until the items identified as "E" are accepted by NRC.

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

Response

A response to item 5 cannot be provided until the items identified as "E" are accepted by NRC.

ATTACHMENT C
SPECIFIC NUREG 0554 REQUIREMENTS
(AS PRESENTED IN TER C5257-181 - BROWNS FERRY NUCLEAR PLANT)

2. Specification and Design Criteria

2.1 Construction and Operating Periods

1. When an overhead crane handling system will be used during the plant construction phase, separate performance specifications may be needed to reflect the duty cycles and loading requirements for each service.

2. 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 No. 70 and reflecting the appropriate duty cycle in CMAA Specification No. 70.

3. The sum total of simultaneously applied loads (static and dynamic) should not result in stress levels causing permanent deformation other than localized strain concentration.

4. The effects of cyclic loading induced by jogging or plugging an uncompensated hoist control system should be included in the design specification.

2.2 Maximum Critical Load

1. The crane should be designed to handle the maximum critical load (MCL) that will be imposed.

2. A slightly higher design load should be selected for component parts that are subject to degradation due to wear and exposure. An increase of approximately 15% of the design load for these component parts would be a reasonable margin.

3. The MCL rating should be clearly marked on the crane.

4. The DRL rating should be marked on the crane separately from the MCL marking.

2.3 Operating Environment

1. 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.

2.4 Material Properties

1. The crane and lifting fixtures for crane already fabricated or operating may be subjected to a cold-proof test consisting of a single dummy load test as follows:

   a. Metal temperature of the structural members essential to the structural integrity of the crane handling system should be at below the minimum operating temperature.

   b. The corresponding dummy load should be equal to 1.25 times the MCL.

   c. The cold-proof test should be followed by a nondestructive examination of welds whose failure could result in the drop of a critical load.

   d. The nondestructive examination of critical areas should be repeated at 4-year intervals or less.

2. Cranes and lifting fixtures made of low-alloy steel such as ASTM A514 should be cold-proof tested in any case.

3. Cast iron should not be used for load-bearing components.

2.5 Seismic Design

1. The crane should be designed and constructed in accordance with regulatory position 2 of Regulatory Guide 1.29.

2. 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.

2.6 Lamellar Tearing

1. All weld joints whose failure could result in the drop of a critical load should be nondestructively examined.

2. If any of these weld joint geometries would be susceptible to lamellar tearing, the base metal at the joints should be nondestructively examined.

2.7 Structural Fatigue

1. 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.

2.8 Welding Procedures

1. Preheat temperatures and postweld heat-treatment (stress relief) temperatures for all weldments should be specified in the weld procedure.

2. Welds described in the recommendations of Section 2.6 should be postweld heat treated in accordance with Subarticles 3.9 of AWS D1.1, "Structural Welding Code."

3. Safety Features

3.1 General

3.2 Auxiliary Systems

1. 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.

2. 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.

3.3 Electrical Control Systems

1. 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 subsystem, these disorders will not prevent the handling system from stopping and holding the load.

2. An emergency stop button should be added at the control station to stop all motion.

3.4 Emergency Repairs

1. 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 position with the handling system immobile.

4. Hoisting Machinery

4.1 Reeving System

1. 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 the configuration of ropes and rope equalizer(s).

2. 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.

3. 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 point during hoisting except that for the last 1 meter of maximum lift elevation the fleet angle may increase slightly. The use of reverse bends for running wire ropes should be limited.

4. The equalizer for stretch and load on the rope reeving system may be 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 the case of failure of the other rope system.

5. The pitch diameter of running sheaves and drums should be selected in accordance with the recommendations of CMAA Specification No. 70.

6. 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. Alternately, 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.

4.2 Drum Support

1. 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 bearings were to fail or fracture.

4.3 Head and Load Blocks

1. 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.

2. 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.

3. The individual components 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.

4. 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.

4.4 Hoisting Speed

1. Maximum hoisting speed for the critical load should be limited to the given in the "slow" column of Figure 70-6 of CMAA Specificiation No. 70.

   Conservative industry practice limits the rope line speed to 1/4 m/s (50 fpm) at the drum.

4.5 Design Against Two-Blocking

1. 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.

2. As an alternative, the protective control system to prevent the hoisting system from two blocking should include as a minimum:

   o Two independent travel-limit devices of different designs and activated by separate mechanical means.

   o These devices should de-energize the hoist drive motor and main power supply.

3. The protective control system for load hang-up, 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.

4. The mechanical holding brakes and their controls should include the capability to withstand the maximum torque of the driving motor if a malfunction occurs and power to the driving motor cannot be shut off.

5. The auxiliary hoist should be equipped with two independent travel-limit switches to prevent two-blocking.

4.6 Lifting Devices

1. Lifting devices should be conservatively designed with a dual or auxiliary device or combination 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.

4.7 Wire Rope Protection

1. 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.

4.8 Machinery Alignment

1. 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.

4.9 Hoist Braking System

1. 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.

2. 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.

3. 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.

4. Provision for manual operation of the hoisting brakes should be included in the design conditions.

5. Bridge and Trolley

5.1 Braking Capacity

1. 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.

   Control and holding brakes should each be rated at 100% of maximum drive torque that can be developed at the point of application.

2. 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.

3. 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.

4. Provisions should be made for manual emergency operation of the brakes.

5. The holding brake should be designed so that it cannot be used as a foot-operated slowdown brake.

6. Drag brakes should not be used.

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

8. Trolley and bridge speed should be limited. The speed limits indicated for slow operating speeds for trolley and bridge in Specification CMAA No. 70 are recommended for handling MCLs.

5.2 Safety Stops

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

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

6. Drivers and Controls

6.1 Driver Selection

1. The maximum torque capability of the electric motor drive for hoisting should not exceed the rating of capability of the individual component of the hoisting system required to hoist the MCL at the maximum design hoist speed.

2. 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.

3. 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.

6.2 Driver Control Systems

1. 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.

2. 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.

6.3 Malfunction Protection (Drivers)

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

2. 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.

6.4 Slow Speed Drives

1. If jogging or plugging is to be used, the control circuit should include features to prevent abrupt change in motion.

2. Drift point in the electric power system when provided for bridge or trolley movement should be provided only for the lowest operating speeds.

6.5 Safety Devices

1. 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.

6.6 Control Stations

1. 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.

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

3. Manual controls for hoisting and trolley movement may be provided on the trolley, while manual controls for the bridge may be located on the bridge.

4. 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.

7. Installation Instructions

7.1 General

1. Installation instructions provided by the manufacturer 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 preparation for operation.

7.2 Construction and Operating Periods

1. After construction use, the crane should be thoroughly inspected by nondestructive examination and load tested for the operating phase. The extent of nondestructive examinations, the procedures used, and the acceptance criteria should be defined in the design specification.

2. 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.

8. Testing and Preventative Maintenance

8.1 General

1. Information concerning proof testing on components and sub-systems 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.

8.2 Static and Dynamic Load Tests

1. 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 strucures and other positions as recommended by the designer and manufacturer.

2. 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.

3. 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.

8.3 Two-Block Test

1. 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).

2. 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.

8.4 Operating Tests

1. 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.

8.5 Maintenance

1. 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.

2. The MCL should be plainly marked on each side of the crane for each hoisting unit.

9. Operating Manual

1. The crane designer and manufacturer should provide a manual of information and procedures for use in checking, testing, and operating the crane.

2. 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.

10. Quality Assurance

1. 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.

TABLE B

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
2.1-1	C	The crane specifications for normal use include consideration for special loading conditions during construction. (i.e., Construction load of 450-tons on girder). The design specification is typical of a CMAA Specification No. 70 class C (moderate service) crane; whereas, the actual normal use is typical of a CMAA No. 70 class A1 (standby service) crane.
-2	E	Crane was not designed to the requirements of the referenced table in CMAA No. 70; however, the crane's allowable design stress limits and appropriate duty cycles are less than those limits in the referenced table.
-3	C	The designed allowables for simultaneous applied loads are half the material's yield necessary to cause permanent deformation.
-4	E	Both hoists' drive systems are compensated stepless DC adjustable voltage drives with regenerative braking and static reversing incorporated which eliminates the effects of cyclic loading through acceleration control.
2.2-1	C	The crane was designed to safely lift and transport the Design Rated Load (DRL) and to control that load during a seismic event. The DRL is 6% greater than the established Maximum Critical Load (MCL).
-2	E	A slightly higher design load for component parts, that are subject to possible degradation, was not included for this crane; however, the DRL is approximately 6% higher than the MCL. Additionally, this crane was designed to CMAA No. 70 Class C (moderate service) standards, whereas plant operation requires a Class A1 (standby service) crane.

TABLE B

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-3	C	The MCL rating for the main and auxiliary hoists will be displayed on the crane.
-4	C	The DRL is clearly shown on the crane.
2.3-1	E	The environmental conditions of the crane are specified in the plant safety analysis report which is referenced in the Design Criteria and was used to establish adverse conditions in containment. These potentially adverse conditions were taken into account while specifying the paint, insulation, and electrical components. Closed box sections of the crane are equipped with vents and drain holes to eliminate possible collapse during containment pressurization.
2.4-1a-d	E	Crane has not been cold proof tested. In lieu of a cold-proof test, a minimum operating temperature will be established based on NDTT+30 °F criterion for critical lifts governed by NUREG-0612.
-2	C	No low-alloy steel was used in the structural components of this crane.
-3	C	No cast iron is used for any load bearing members.
2.5-1	C	The design is in accordance with Regulatory Position 2 of Reg. Guide 1.29.
-2	C	The MCL plus operational and seismically induced pendulum and swinging loads were considered in the design of the bridge and trolley.

TABLE B

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E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
2.6-1	C	Nondestructive testing was performed during fabrication on all critical load bearing welds.
-2	C	All welds in critical areas were nondestructively tested to ensure lamellar tearing had not occurred in the base metal.
2-7-1	E	A fatigue analysis was not conducted on all critical load-bearing structures and components; however, design stress levels for these critical areas are lower than the endurance limits (40% of material's tensile strength) for the various materials.
2.8-1	C	Specification required all welding to be done in accordance with AWS D2.0-1969, which delineates preheat and stress relief temperature requirements.
-2	E	Critical welds were postweld heat treated in accordance with AWS D2.0-1969.
3.2-1	E	The entire auxiliary hoisting system in its present configuration is not single-failure-proof; however, duality of the hoist mechanism and reeving, established quality assurance of the nondual lower block and hook, and the fact that the MCL is 80% of the DRL substantiates an equivalent system.
-2	C	The main hoisting system is dual acting; consequently, the system is able to retain and hold the load in a stable position in case of a subsystem or component failure.

TABLE B

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SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
3.3-1	C	Automatic controls and limiting devices are properly designed to stop and hold any load under all identified inadvertent disorders.
-2	C	Control station is equipped with an emergency stop pushbutton.
3.4-1	C	All vulnerable active components can be repaired or replaced while supporting the MCL for the main and auxiliary hoist. (Refer to Active Component Replacement Guide of Tables B1 and B2). However, in some cases an in-place repair or replacement of failed components other than active components is impractical, and an alternate means of moving the load to a safe laydown area is unavailable. A method will be developed and implemented for the manual emergency movement of the bridge and trolley.
4.1-1	E	Dual reeving and equalizing systems are used for the main and auxiliary hoists. Load balancing through cross-reeving is not used for either hoist.
-2(a)	E	For the main hoist, the maximum load on each individual wire rope with the MCL attached exceeds 10% of the manufacturer's published breaking strength. However, the main hoist wire ropes exceed the requirements of CMAA 70 with a factor of safety of 6.6 to 1 with the MCL attached. During routine maintenance as replacement of wire rope is required, extra extra improved plowed steel wire rope will be used which will yield a 15% increase in the factory of safety.
-2(b)	C	For the auxiliary hoist, the maximum load on each individual wire rope with the MCL attached does not exceed 10% of the manufacturer's published breaking strength.

TABLE B
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

C= Compliance
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NA= Not Applicable

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-3(a)	E	The maximum fleet angle for the main hoist is 3.7 , with the load block in the low block position. This angle is a minor deviation from the maximum allowable by NUREG 0554, and is considered insignificant since the crane is designed to CMAA No. 70 Class C standards. No reverse bends are used in this reeving system.
-3(b)	C	The maximum fleet angle for the auxiliary hoist is less than 3.5 . No reverse bends are used in this reeving system.
-4	C	The equalizing device is a double-ended, double-acting hydraulic cylinder that will prevent dropping the load in case of single failure. This is true for both the main and auxiliary hoists.
-5	C	Pitch diameter of running sheaves and drums were selected in accordance with CMAA No. 70.
4.1-6	C	A two rope system off the drum with a hydraulic equalizer is used for both the main and auxiliary hoists.
4.2-1	C	Neither main nor auxiliary hoists are equipped with structural or mechanical safety devices to limit the drop of the load hoisting drum in the case of a failure. Both hoisting systems will be equipped with plates to prevent the drums from dropping sufficiently to permit pinion/drum gear separation during bearing or shaft failure.

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TABLE B
SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
4.3-1	C	The head and load blocks for both the main and auxiliary hoists are dual reeved and designed to maintain a true vertical load balance.
-2	E	Dual attaching points are not provided for either the main or auxiliary hoist load block assemblies. However, the main hook was designed and manufactured in accordance with CMAA 70; and is nondestructively examined periodically in accordance with ANSI B30.10-1971.
-3	C	Crane was nominally designed with a factor of safety of 5:1 on the DRL.
-4(a)	E	The hooks were prooftested to 200 percent of the DRL and examined by ultrasonic and magnetic particle testing methods.
-4(b)		The load blocks were not nondestructively examined by surface and volumetric techniques. However, the load block is visually inspected annually in accordance with ANSI B30.2.0-1976. If the forthcoming visual inspection warrant disassembly of the block, the block will be nondestructively examined by surface and volumetric techniques, and necessary replacements made.
4.4-1(a)	C	The maximum hoisting speed for the main hoist is less than the "slow" speed shown in figure 70-6 of CMAA No. 70. Additionally, the rope line speed for the main hoist at the drum is 31.2 FPM.

TABLE B

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SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
4.4-1(b)	E	The maximum hoisting speed for the auxiliary hoist is more than the "slow" speed shown in figure 70-6 of CMAA No. 70. The rope line speed at the drum for the auxiliary hoist is greater than 50 FPM. The maximum hoisting speed will be limited to the "slow" speed for critical lifts by administrative control using plant maintenance procedures.
4.5-1	NA	The design to prevent two-blocking is presented in the following section as an alternative.
-2	C	Two independently operated limit switches of different design are used in series to limit the upward travel of each hoist hook. A lever-type limit switch is used on the wire rope and a rotary-type limit switch is used on the hoist machinery. Both types of limit switches are designed to de-energize the drive motor and main power supply for main and auxiliary hoists.
-3	C	The protective control system for both main and auxiliary hoists includes a motor-current sensing device.
-4	E	Two independent limit switches protect against the possibility of two-blocking. The brake electrical control circuit is separate from the hoist control circuit therefore, a double failure of the control contactors would be required to prevent brake setting. Motor stall conditions produce 850 ft.-lbs. torque which is less than the 1100 ft. lbs. torque dual brake capability. Brakes have 29% design margin above stall requirements.

TABLE B

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SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-5	C	Auxiliary hoist is equipped with two independent travel limit switches, as described in the comments to 4.5-2.
4.6-1	NA	TVA is reviewing the design of critical lifting devices for compliance with NUREG 0612 as requested by the NRC. Refer to our report from L. M. Mills to E. Adensam dated March 1, 1982, for compliance status.
4.7-1	C	No critical lifts require sideloading, nonetheless, a bar guard is employed on both hoists.
4.8-1	C	The gear trains are interposed between the hoisting drums and the holding brakes consist of two separate gearing systems designed as single-failure-proof, for both the main and auxiliary hoists.
4.9-1	C	Each hoisting braking system (main and auxiliary) consists of the following: Two holding brakes each rated at 150% of the full-load hoisting torque; regenerative braking, and emergency dynamic braking.
-2	C	Single failure of the regenerative braking system will result in two holding brakes for stopping and controlling the load, for both main and auxiliary hoists.
-3	C	The holding brakes, for both hoists, are single-failure-proof and of dual design.
-4	C	Design conditions included provisions for the manual operation of the hoisting brakes.

TABLE B

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
5.1-1(a)	C	The brakes and gear train are designed to stop bridge and trolley travel from the maximum speed with the DRL attached.
5.1-1(b)	E	Holding brakes for both bridge and trolley motion and control braking for bridge motion are rated at least 100% of the maximum drive torque at the point of application. The trolley does not have control braking; however, a stepless regulated speed control system serves to slow trolley motion.
-2(a)	C	The bridge is equipped with two electric holding brakes and two manual hydraulic control brakes. The electric brakes are activated by a release or loss of power. The hydraulic brakes are independent of electrical control.
-2(b)	C	The trolley is equipped with one electric holding brake and automatically sets in the event of a power loss.
-3	C	All electric brakes are actuated on interruption of power for any reason.
-4	C	The electric holding brakes can be manually operated during an emergency.
-5	C	The holding brakes for bridge and trolley are designed so that they cannot be foot operated. The hydraulic control brakes on bridge are independent.
-6	C	No drag brakes are used.

TABLE B

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SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-7	C	All bridge and trolley wheels are machined in pairs to the same diameter.
-8	C	Trolley and bridge speeds are limited and the same as the "slow" speeds indicated in Figure 70-6 of CMAA No. 70.
5.2-1	C	Polar crane does not have bridge overtravel limiting devices. Trolley does not use mechanical or electrical interlocks; however, the crane is equipped with bumpers, designed to absorb impact at maximum speed with maximum suspended load. The speed of the bridge and trolley is controlled by a speed regulation static device.
5.2-2	C	All limit switches, overspeed switches, current relays, etc., are provided as safety backup devices and are not intended for normal operating use.
6.1-1	C	The calculated power requirement and the motor rating for the main and auxiliary hoists are identical at 50 horsepower. It is the basis for design of all driving and braking components.
-2	E	Specification requires a maximum hoisting movement of 6-inches at full speed with MCL attached. During Preoperational Tests both main and auxiliary hoists satisfied this requirement.
-3	C	There are three "Emergency Stop Buttons" located at floor level.
6.2-1	C	The control system complies fully with item 6.2 of NUREG 0554.

TABLE B

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-2	C	Polar crane does not handle spent fuel elements.
6.3-1	C	Means are provided in the motor control circuits to sense and respond to adverse conditions.
-2	C	Controls are provided to absorb the kinetic energy of the rotating machinery and to stop the hoisting movement safely and reliably.
6.4-1	C	These features are inherent in the General Electric Company's maxspeed DC adjustable voltage systems used on both hoist and trolley drives.
-2	E	Drift point is provided in the electrical power system for this crane; however, this provision was not limited to the lowest speed, but the critical lifts are administratively controlled.
6.5-1	C	All safety devices are provided as backup safety devices and are not available for controlled use by the operator.
6.6-1	C	Bridge-mounted cab has complete operating and emergency controls, with the exception of emergency manual control brake operation.
-2	NA	No other crane operator stations exist in the Reactor Building.
-3	NA	Not a requirement.

TABLE B

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-4	NA	There are no other operator stations.
7.1-1	C	Operation and instruction manuals were supplied by the manufacturer and include all pertinent information to satisfy this requirement.
7.2-1	E	After construction use a preoperational load test was performed; however, no provisions are in the preoperational test nor were any nondestructive examination of welds performed prior to operational use. In lieu of a one time full NDE, all accessible welds are visually inspected annually in accordance with ANSI B30.2.0-1976.
-2	C	No predetermined loads exceeded allowable design stress limits established for the plant operating service during the construction phase.
8.1-1	C	All work performed at the vendor's facilities was acceptable and is documented and available.
8.2-1	C	Acceptance tests included complete performance tests at no load, 50%, 100%, and 125% or DRL (DRL is greater than MCL).
-2	C	The crane was given full performance tests with 100% of DRL for all speeds and motions.

TABLE B

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-3	C	No test was performed on the emergency manual movement of the bridge and trolley with the MCL attached. A method will be developed and implemented for the manual emergency movement of the bridge and trolley. A functional test will be performed for the verification of these movements .
8.3-1	E	No two-blocking test was performed; however, Appendix C of NUREG 0612 allows for functional verification of the limit switches in lieu of an actual two-blocking test. The Preoperational Test verified these limit switches to be functional.
-2	E	No load hang-up test was performed; however, the crane is designed for 275% stall loadings and is equipped with a 125% load limiter and load readout systems. The functional testing and acceptance of these systems provides alternative compliance of Appendix C, NUREG 0612.
8.4-1	C	In addition to Acceptance and Preoperational Tests performed after installation and prior to fuel load, respectively, periodic operational tests and visual inspections are made to demonstrate safe performance of the crane.
8.5-1	C	This crane's MCL is 6% less than the DRL: and the crane was designed to CMAA No. 70 Class C (moderate service) standards whereas operationally it should be class A1 (standby service). These factors lead to the crane being continuously maintained above normal requirements.

TABLE B

C= Compliance
E= Equivalency
N= Noncompliance
NA= Not Applicable

SINGLE FAILURE-PROOF CRANE COMPLIANCE
NUREG 0554 COMPARISON
175/35 TON POLAR CRANE - REACTOR BLDG.
2.3-3 RESPONSE

NUREG 0554 SECTION	TVA'S POSITION	COMMENTS/IMPLEMENTATION RECOMMENDATIONS
-2	C	As previously stated in this report (section 2.2-3), the MCL will be installed on the crane.
9.1-1	C	The specification required and the crane manufacturer supplied a set of operation and instruction manuals.
9.1-2	C	The operating requirements for all travel movements are clearly defined in the crane operation and instruction manual.
10.1-1	E	This crane was designed, fabricated, installed, tested, and initially operated under an approved Quality Assurance program that was prior to the issuance of NUREG 0554. The requirements used to manufacture, maintain, and operate this crane in addition to the satisfactory completion of the recommendations contained herein should satisfy the intent of NUREG 0554.

TABLE B1
ACTIVE COMPONENT REPLACEMENT GUIDE
2.3-3 RESPONSE
(NUREG 0554 - SECTION 3.4)

Lift System:
175/35 TON POLAR CRANE
MAIN HOIST

ACTIVE COMPONENT	Design Factor of Safety	Set Down Capa-bility	Cont. Lift Capa-bility	Repair or Replace Capa-bility	Spare Parts Avail-able
1. Hoist Motor	NA	Yes	No	Yes	Yes
2. Primary Holding Brake	(6)	Yes	Yes	Yes	N/A
3. Secondary Holding Brake	(6)	Yes	Yes	Yes	N/A
4. Primary Gear Reducer	(7)	Yes(1)	Yes	Yes	N/A
5. Secondary Gear Reducer	(7)	Yes(2)	Yes	Yes	N/A
6. Primary Pinion/Drum Gear	8.0:1 (8)	Yes(1)	Yes(1)	Yes/No(1)	N/A
7. Secondary Pinion/Drum Gear	8.0:1 (8)	Yes(2)	Yes(2)	Yes/No(2)	N/A
8. Wire Rope Drum	5.5:1 (8)	No	No	No	N/A
9. Wire Rope Drum Shaft	(9)	No	No	No	N/A
10. Wire Rope	6.6:1(8)	Yes(3)	Yes(3)	Yes	Yes
11. Drive Couplings	NA	Yes	Yes	Yes	Yes
12. Primary Pinion Shaft Bearings	NA	Yes(1)	Yes(1)	Yes	Yes
13. Secondary Pinion Shaft Bearings	NA	Yes(2)	Yes(2)	Yes	N/A
14. Drum Support Bearings	NA	Yes	No	Yes	Yes
15. Power Track (Festoon) System	NA	No(4)	No	Yes	N/A(5)

N/A - Not Applicable

Special Conditions:
1. Postulate single component failure.
2. Disabled trolley or bridge can be physically moved by portable winches tied to appropriate structures.

TABLE B1
ACTIVE COMPONENT REPLACEMENT GUIDE
2.3-3 RESPONSE
(NUREG 0554 - SECTION 3.4) SHT. 2 of 2

Lift System:
175/35 Ton Polar Crane
Main Hoist

FOOTNOTES

(1) Remove primary pinion
(2) Remove secondary pinion
(3) Based on studies performed by the University of Tennessee Mechanical Engineering Department (refer to ASME papers No. 76-DE-21 and No. 76-WA/DE-6), continued lifting and lowering of the load after a single rope failure is possible. This study was modeled from a 125 ton fuel cask handling crane composed of a dual non-crossed twelve part reeving system.
(4) When power failure occurs there is no upward hoisting movement possible. Even though the manual release provided on the holding brake will allow lowering of the load, the hook (with load attached) could be in a physical location that would require upward motion before the load could be moved laterally to a safe laydown area.
(5) A temporary power supply will be used.
(6) 150% of full load motor torque
(7) Vendor supplied and designed in accordance with AGMA.
(8) Based on a MCL of 165 tons
(9) The materials mechanical properties cannot be verified. A field test to determine the actual properties is being conducted. Reference TVA's response to Sequoyah draft TER No. C5257-449 for further details.

TABLE B2
ACTIVE COMONENT REPLACEMENT GUIDE
2.3-3 RESPONSE
(NUREG 0554 - SECTION 3.4) SHT. 1 of 2

Lift System:
175/35 Ton Polar Crane
Auxiliary Hoist

ACTIVE COMPONENT	Design Factor of Safety	Set Down Capability	Cont. Lift Capability	Repair or Replace Capability	Spare Parts Available
1. Hoist Motor	NA	Yes	No	Yes	Yes
2. Primary Holding Brake	(6)	Yes	Yes	Yes	N/A
3. Secondary Holding Brake	(6)	Yes	Yes	Yes	N/A
4. Primary Gear Reducer	(7)	Yes(1)	Yes	Yes	N/A
5. Secondary Gear Reducer	(7)	Yes(2)	Yes	Yes	N/A
6. Primary Pinion/Drum Gear	7.9:1(8)	Yes(1)	Yes(1)	Yes/No(1)	N/A
7. Secondary Pinion/Drum Gear	7.9:1(8)	Yes(2)	Yes(2)	Yes/No(2)	N/A
8. Wire Rope Drum	8.6:1(8)	No	No	No	N/A
9. Wire Rope Drum Shaft	8.9:1(8)	No	No	No	N/A
10. Wire Rope	10.0:1(8)	Yes(3)	Yes(3)	Yes	Yes
11. Drive Couplings	NA	Yes	Yes	Yes	Yes
12. Primary Pinion Shaft Bearings	NA	Yes(1)	Yes(1)	Yes	Yes
13. Secondary Pinion Shaft Bearings	NA	Yes(2)	Yes(2)	Yes	N/A
14. Drum Support Bearings	NA	Yes	No	Yes	Yes
15. Power Track (Festoon) System	NA	No(4)	No	Yes	N/A(5)

N/A - Not Applicable

Special Conditions:
1. Postulate single component failure.
2. Disabled trolley or bridge can be physically moved by portable winches tied to appropriate structures.

TABLE B2
ACTIVE COMPONENT REPLACEMENT GUIDE
2.3-3 RESPONSE
(NUREG 0554 - SECTION 3.4) SHT. 2 of 2

Lift System:
175/35 Ton Polar Crane
Auxiliary Hoist

FOOTNOTES

(1) Remove primary pinion
(2) Remove secondary pinion
(3) Based on studies performed by the University of Tennessee Mechanical Engineering Department (refer to ASME papers No. 76-DE-21 and No. 76-WA/DE-6), continued lifting and lowering of the load after a single rope failure is possible. This study was modeled from a 125 ton fuel cask handling crane composed of a dual non-crossed twelve part reeving system.
(4) When power failure occurs there is no upward hoisting movement possible. Even though the manual release provided on the holding brake will allow lowering of the load. The hook (with load attached) could be in a physical location that would require upward motion before the load could be moved laterally to a safe laydown area.
(5) A temporary power supply will be used.
(6) 150% of full load motor torque
(7) Vendor supplied and designed in accordance with AGMA.
(8) Based on a MCL of 28 tons.

ATTACHMENT D
Method of Seismic Analysis
Sequoyah Nuclear Plant
Reactor Building Polar Cranes
2.3-3 Response

The analysis was performed using idealized lumped-mass models. Both girders were modeled for the horizontal load case in order to simulate the interaction between the girders. The small differences in the masses of the beams were modeled. For the vertical case, only the girder with the weight of the cab included was analyzed.

Three loading conditions of the crane were considered in the analysis. The hoist trolley is assumed to provide a rigid connection between the crane girders for motion in the horizontal direction. The three loading conditions are as follows:

Loading condition 1 assumed the trolley and live load to be at the support.

Loading condition 2 assumes the trolley and live load at the third point of the span.

Loading condition 3 assumes the trolley and live load at the midpoint of the span.

For the lateral analysis, the support points of the crane girder were assumed to be fixed for translation and restrained from rotation by a spring, the stiffness of which was the rotational stiffness of the main girder-end girder joint. The effect of the live load, a mass hung by a long cable, which would act as a pendulum of very low frequency, was neglected. Spectral accelerations were taken from TVA Report CEB-80-23 "Dynamic Earthquake Analysis of the Interior Concrete Structure and Response Spectra for Attached Equipment," using 1-percent structural damping. For the longitudinal direction, parallel to the main girder axis, the crane girder is assumed to be rigid.

For the vertical analysis, the crane girder was assumed to be simply supported. The effect of the live load, idealized as a weight hung by a spring and attached to the crane, was considered in this analysis. The live load was taken as 175 tons and the hoist cables were extended to the maximum length. The vertical spectral accelerations were taken from the same report as the lateral analysis.

RESPONSE TO

ENCLOSURE 3 TO NRC LETTER DATED DECEMBER 22, 1980

QUESTION 2.4

NUREG 0612 - CONTROL
OF HEAVY LOADS AT
NUCLEAR POWER PLANTS

SEQUOYAH NUCLEAR PLANT

2.4-1 REQUEST

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

RESPONSE

The following cranes (lift systems) are listed in 2.1-1 and were not excluded by section 2.1-2.

Lift System

1. 125/10 Ton Auxiliary Building Crane - Addressed in Response 2.2-3.
2. 175/35 Ton Reactor Building Polar Crane - Addressed in Response 2.3-3.
3. 4 Ton Monorail w/4 Ton Hoist and Trolley - Auxiliary Building
4. 5 Ton Monorail w/5 Ton Hoist and Trolley - Auxiliary Building
5. 3 Ton Jib Crane - Reactor Building
6. 20 Ton Hydraulic Pedestal Crane - ERCW Pumping Station

Items 3 through 6 above do not meet the criteria of single-failure-proof, nor do they qualify for partial compliance with supplements. These items are evaluated in section 2.4-2.

2.4-2 REQUEST

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

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

RESPONSE

a. Refer to Table C for evaluation.

REQUEST

b. For each interaction identified, indicate which of the load and impact area combinations can be eliminated because of separation and redundancy of safety-related equipment, mechanical stops and/or electrical interlocks, or other site-specific considerations.

RESPONSE

b. Refer to Table C for evaluation. Note Hazard Elimination Categories listed below.

Hazard Elimination Categories

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

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

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

D. Likelihood of handling system failure for this load is extremely small (i.e., 10:1 safety factor for specific lift).

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

2.4-2.b(1) REQUEST

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

RESPONSE

b(1) TVA has established the bases for elimination of those items appearing in Table C in accordance with its quality procedures. These bases are designated as Office of Engineering (OE) Calculations and are maintained as auditable records.

2.4-2.b(2) REQUEST

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

b(2) RESPONSE

Of the cranes listed under 2.4-1 only the 125 ton auxiliary building crane has mechanical stops or electrical interlocks to prevent travel over critical areas. These limited areas are depicted upon TVA drawings 44N304 and 44N305-1 (see figures 1 and 2).

Procedures will be included in the plant instructions manual for authorizing bypassing of interlocks, or stops, and for verifying that interlocks are functional before operations and restored to operability after operations requiring bypassing are complete.

2.4-2(c) REQUEST

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

RESPONSE

None of these systems comply with section 5.1.6 of NUREG 0612 or have a suitable alternative and we can therefore not eliminate any specific loads by use of this method.

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Main Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Reactor Building (RB) Equipment Hatch Plug A (50 Tons) 48N1341 Mk. 1	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
RB Equipment Hatch Plug B (50 Tons) 48N1341 Mk. 1	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
RB Equipment Hatch Plug C (50 Tons) 48N1341 Mk. 1	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Control Air Lines, Sample Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Main Hoist)
Drawing 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Spent Resin Liner (10.4 Tons) See Footnote 8	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Spent Fuel Shipping Cask (100 Tons) See Footnote 1	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sample Lines, Sense Lines, Control Air Lines	See Footnote 2			
Miscellaneous Equipment (60 Tons Max.)	734.0	Spent Fuel Pit	A, D(3)			
	734.0	Sample Lines Sense Lines, Control Air Lines	D(3)			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D(3)			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Pool Divider Gate (2 Tons) 44N330	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Fuel Transfer Canal Gate (2 Tons) 44N330	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Irradiated Specimen Shipping Cask (3.2 Tons) See Footnote 9	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Control Air Lines, Sample Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
New Fuel Shipping Container - Empty (1.7 Tons) See Footnote 10	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
New Fuel Shipping Container - w/Fuel (3.3 Tons) See Footnote 10	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Failed Fuel Container See Footnote 1	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sense Lines, Control Air Lines, Sample Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Fuel Transfer Carriage (1.6 Tons) 68C60-91934 940J332	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Fuel Cask Decontamination Hatch Cover (1.2 Tons) 48N1230 Mk 8	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Fuel Cask Decontamination Hatch Cover (1.3 Tons) 48N1230 Mk 9	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
New Fuel Vault Cover (3.7 Tons) 48N1249 Mk 3	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Containment Spray Heat Exchanger Shield Plug (9.9 Tons) 48N1262-1	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Residual Heat Exchanger Shield Plug (3.7 Tons) 48N1262-1	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Control Air Lines, Sample Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION: Auxiliary Building (47W200-1 through 47W200-9)

IMPACT AREA: Refueling Deck
Column A5-A11 @ U-Y

LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Containment Spray Heat Exchanger Shell (4.4 Tons) 71C30-92645 F-6662-2 and F-6663-2	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Transfer Cask Fully Assembled (5.9 Tons) 44N394-3	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Drum Cask (for 55 gallon drum) (8.1 Tons) 44N394-3 Mk 22	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sense Lines, Control Air Lines, Sample Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 125 Ton/10 Ton Overhead Crane (Auxiliary Hoist)
Drawing - 44N300
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Refueling Deck Column A5-A11 @ U-Y					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Drum Cask (for 55 gallon drum) (6.3 Tons) 44N394-3 Mk 23	734.0	Spent Fuel Pit	A			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	See Footnote 2			
	734.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Drum Cask (for 30 gallon drum) (3.5 Tons) 44N394-4	734.0	Spent Fuel Pit	A, D			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D			
	734.0	Sense Lines, Sample Lines, Control Air Lines	D			
Miscellaneous Equipment (5 Tons Max.)	734.0	Spent Fuel Pit	A, D(3)			
	734.0	Instrumentation Panels 0-L-221, 235, 243, 244, 389, 390, 428, 429	D(3)			
	734.0	Sense Lines, Control Air Lines, Sample Lines	D(3)			

TABLE C

LOAD/IMPACT MATRIX FOR: 5 Ton Monorail w/5 Ton Hoist and Trolley
Drawing 44N387 Mk 11 and 48N1347 Mk 122
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Floor Slab Column A9 @ V-W					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Transfer Cask Without Bottom (5 Tons) 44N394-3	653.0	RHR Pump Valve-Central Cooler Support	B			
	653.0	RHR Pump Valve - Minimum Flow	B			

TABLE C

LOAD/IMPACT MATRIX FOR: 4 Ton Monorail w/4 Ton Hoist and Trolley
Drawing 44N389 and 48N1348 Mk 224
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Floor Slab Column A2 @ T-U			Floor Slabs Column A2 @ T-U		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Component Cooling Pump 1B-B (3.8 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 2B-B	B	683.0	24" Diameter Pipe From RWST to SIS,RHR, CS & CVC Systems	A,C(11)
	690.0	Component Cooling Pump Motor 2B-B	B	669.0	Auxiliary Feedwater Pump 1A-S and Piping	B
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2	669.0	Conduit 2A-2PL 4518B (LG-B) 2A-2PL 4508A (MS-A)	See Footnote 2
	690.0 and 669.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2	669.0	Miscellaneous Conduit	B
Component Cooling Pump Motor 1B-B (2.4 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 2B-B	B	683.0	24" Diameter Pipe RWST to SIS RHR, CS & CVC Systems	A,C(11)
	690.0	Component Cooling Pump Motor 2B-B	B	669.0	Auxiliary Feedwater Pump 1A-S and Piping	B
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2	669.0	Conduit 2A-2PL 4518B (LG-B) 2A-2PL 4508A (MS-A)	See Footnote 2
	690.0 and 669.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2	669.0	Miscellaneous Conduit	B

TABLE C

LOAD/IMPACT MATRIX FOR: 4 Ton Monorail w/4 Ton Hoist and Trolley
Drawing 44N389 and 48N1348 Mk 224
2.4-2a and b Response

LOCATION	Auxiliary Building					
IMPACT AREA	Floor Slab Column A2 @ T-U			Floor Slab Column A2 @ T-U		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Component Cooling Pump 2B-B (3.8 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 1B-B	B	683.0	24" Diameter Pipe to SIS, RHR, CS & CVC Systems	A.C(11)
	690.0	Component Cooling Pump Motor 1B-B	B	669.0	Auxiliary Feedwater Pump 1A-S and Piping	B
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2	669.0	Conduit 2A-2PL 4518B (LG-B) 2A-2PL 4508A (MS-A)	See Footnote 2
	690.0 and 669.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2	669.0	Miscellaneous Conduit	B
Component Cooling Pump Motor 2B-B (2.4 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 1B-B	B	683.0	24" Diameter Pipe to SIS, RHR, CS & CVC Systems	A,C(11)
	690.0	Component Cooling Pump Motor 1B-B	B	669.0	Auxiliary Feedwater Pump 1A-S and Piping	B
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2	669.0	Conduit 2A-2PL 4518B (LG-B) 2A-2PL 4508A (MS-A)	See Footnote 2
	690.0 and 669.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2	669.0	Miscellaneous Conduit	B

TABLE C

LOAD/IMPACT MATRIX FOR: 4 Ton Monorail w/4 Ton Hoist and Trolley
Drawing 44N389 and 48N1348 Mk 221
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Floor Slab Column A3 @ S-T					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Component Cooling Pump 1A-A (3.8 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump Motor 1A-A	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Component Cooling Pump Motor 1A-A (2.4 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 1A-A	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 4 Ton Monorail w/4 Ton Hoist and Trolley
Drawing 44N389 and 48N1348 Mk 223
2.4-2a and b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Floor Slab Column A2 @ S-T					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Component Cooling Pump 2A-A (3.8 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump Motor 2A-A	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Component Cooling Pump Motor 2A-A (2.4 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump 2A-A	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2	669.0		

TABLE C

LOAD/IMPACT MATR : FOR: 4 Ton Monorail w/4 Ton Hoist and Trolley
Drawing 44N3°, and 48N1348 Mk 222
2.4-2a an: b Response

LOCATION	Auxiliary Building (47W200-1 through 47W200-9)					
IMPACT AREA	Floor Slab Column A2 @ S-T					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Component Cooling Pump CS (3.8 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump Motor CS	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Component Cooling Pump Motor CS (2.4 Tons) 47W464-3,-9,-14	690.0	Component Cooling Pump CS	B			
	690.0	Instrumentation Panels 1-L-58, 68	See Footnote 2			
	690.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedest.. Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck South End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump JA Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump KA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump JA Head, Column , and Bowl (Equipment Removed in sections, the heaviest is 2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump KA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump JA Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump KA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck South End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump JA Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump KA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump JA Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump KA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump KA Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump JA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck South End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump KA Head, Column & Bowl (Equipment removed in sections, the heaviest is 2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump JA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump KA Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump JA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump KA Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump JA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck South End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump KA Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump JA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck North End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump QA Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump RA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump QA Head Column and Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump RA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump QA Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump RA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.[illegible]-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck North End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump QA Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump RA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump QA Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump RA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump RA Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump QA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck North End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump RA Head Column & Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump QA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump RA Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump QA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump RA Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump QA Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck North End					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump RA Bowl Assembly (2.9 Tons) 75K31-83725	720.0	ERCW Pump QA Motor	B			
H-5149-DN	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump LB Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump MB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump LB Head Column and Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump MB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump LB Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump MB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump LB Column Sect (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump MB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump LB Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump MB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump MB Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump LB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump MB Head, Column & Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump LB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump MB Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump LB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump MB Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump LB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump MB Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump LB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump NB Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump PB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump NB Head Column & Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump PB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump NB Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump PB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump NB Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump PB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump NB Bowl Assembly (2.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump PB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump PB Motor (6.1 Tons) 75K31-83725 992C876	720.0	ERCW Pump NB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump PB Head Column and Bowl (Equipment removed in sections, the heaviest is 2.9 tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump NB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump PB Disch Head (1.3 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump NB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck Middle of Building					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Pump PB Column Sect. (1.4 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump NB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
ERCW Pump PB Bowl Assembly (2.9 Tons) 75K31-83725 H-5149-DN	720.0	ERCW Pump NB Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Traveling Water Screen A-A (Heaviest sections removed for maintenance 2.1 Tons) 76K35-87201 H96057-1,-2,-3, -4, & -40	720.0	Screen Wash Pump A-A Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
Traveling Water Screen B-B (Heaviest sections removed for maintenance 2.1 Tons) 76K35-87201 H96057-1,-2,-3, -4, & -40	720.0	Screen Wash Pump B-B Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			
Traveling Water Screens C-B (Heaviest sections removed for maintenance 2.1 Tons) 76K35-87201 H96057-1,-2,-3, -4, & -40	720.0	Screen Wash Pump C-B Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hudraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Traveling Water Screen D-A (Heaviest sections removed for maintenance 2.1 Tons) 76K35-87201 H96057-1,-2,-3, -4, & -40	720.0	Screen Wash Pump D-A Motor	B			
	720.0	Local Instrumentation Panels	See Footnote 2			
	720.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck			Mechanical Equipment Room		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Screen Wash Pump A-A (2.0 Tons) 76K35-820227 H-5517-DN and 992C888-1	720.0	Traveling Water Screen A-A	C(5)	688.0	ERCW Strainer A1A-A	C(5)
	720.0	Local Instrumentation Panels	See Footnote 2	688.0	Local Instrumentation Panels	See Footnote 2
	720.0	Sense Lines	See Footnote 2	688.0	Sense Lines	See Footnote 2
Screen Wash Pump B-B (2.0 Tons) 76K35-820227 H-5517-DN and 992C888-1	720.0	Traveling Water Screen B-B	C(5)	688.0	ERCW Strainer B1B-B	C(5)
	720.0	Local Instrumentation Panels	See Footnote 2	688.0	Local Instrumentation Panels	See Footnote 2
	720.0	Sense Lines	See Footnote 2	688.0	Sense Lines	See Footnote 2
Screen Wash Pump C-B (2.0 Tons) 76K35-820227 H-5517-DN and 992C888-1	720.0	Traveling Water Screen C-B	C(5)	688.0	ERCW Strainer B2B-B	C(5)
	720.0	Local Instrumentation Panels	See Footnote 2	688.0	Local Instrumentation Panels	See Footnote 2
	720.0	Sense Lines	See Footnote 2	688.0	Sense Lines	See Footnote 2

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck			Mechanical Equipment Room		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Screen Wash Pump D-A (2.0 Tons) 76K35-820227 H-5517-DN and 992C888-1	720.0	Traveling Water Screen D-A	C(5)	688.0	ERCW Strainer A2A-A	C(5)
	720.0	Local Instrumentation Panels	See Footnote 2	688.0	Local Instrumentation Panels	See Footnote 2
	720.0	Sense Lines	See Footnote 2	688.0	Sense Lines	See Footnote 2

TABLE C
LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Mechanical Equipment Room			Roof Deck		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Strainer A1A-A (7.8 Tons) 76K36-820061	690.0 and 674.0	Instrumentation Panels O-L-144, 145, L-386, 387	See Footnote 2	720.0	Screen Wash Pump A-A Motor	B
17661 Rev. C and 5622D11 sub XX4	690.0 and 674.0	Sense Lines	See Footnote 2			
ERCW Strainer A2A-A (7.8 Tons) 76K36-820061	690.0 and 674.0	Instrumentation Panels O-L-144, 145, L-386, 387	See Footnote 2	720.0	Screen Wash Pump D-A Motor	B
17661 Rev. C and 5622D11 Sub XX4	690.0 and 674.0	Sense Lines	See Footnote 2			
ERCW Strainer B1B-B (7.8 Tons) 76K36-820061	690.0 and 674.0	Instrumentation Panels O-L-144, 145, L-386, 398	See Footnote 2	720.0	Screen Wash Pump B-B Motor	B
17661 Rev. C and 5622D11 Sub XX4	690.0 and 674.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Mechanical Equipment Room			Roof Deck		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
ERCW Strainer B2B-B (7.8 Tons) 76K36-820061 17661 Rev. C and 5622D11 Sub XX4	690.0 and 674.0	Instrumentation Panels 0-L-144, 145, L-386, 387	See Footnote 2	720.0	Screen Wash Pump C-B Motor	B
	690.0 and 674.0	Sense Lines	See Footnote 2			
Transformer 1A-A (2.0 Tons) 35W312	688.0	ERCW Strainer A1A-A	B	720.0	Screen Wash Pump A-A Motor	B
	688.0	Instrumentation Panels 0-L-144, 145, L-386, 387	See Footnote 2			
	688.0	Sense Lines	See Footnote 2			
Transformer 1B-B (2.0 Tons) 35W312	688.0	ERCW Strainer B1B-B	B	720.0	Screen Wash Pump B-B Motor	B
	688.0	Instrumentation Panels 0-L-144, 145, L-386, 387	See Footnote 2			
	688.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Mechanical Equipment Room			Roof Deck		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Transformer 2B-B (2.0 Tons) 35W312	688.0	ERCW Strainer B2B-B	B	720.0	Screen Wash Pump C-B Motor	B
	688.0	Instrumentation Panels 0-L-144, 145, L-386, 387	See Footnote 2			
	688.0	Sense Lines	See Footnote 2			
Transformer 2A-A (2.0 Tons) 35W312	688.0	ERCW Strainer A2A-A	B	720.0	Screen Wash Pump D-A Motor	B
	688.0	Instrumentation Panels 0-L-144, 145, L-386, 387	See Footnote 2			
	688.0	Sense Lines	See Footnote 2			

TABLE C

LOAD/IMPACT MATRIX FOR: 20 Ton Hydraulic Pedestal Crane
Drawing 34N230
2.4-2a and b Response

LOCATION	ERCW Pumping Station (31W211)					
IMPACT AREA	Roof Deck					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Missile Shield (7.7 Tons) 38N342 thru 38N346	720.0	ERCW Pump Motor	B			
	720.0	Screen Wash Pump Motor	B			
	720.0	Traveling Water Screen	B			
Stoplog (4.1 Tons) 34N215-1 and 34N215-2	720.0	Traveling Water Screen	B			
MCC Board 1A-A (1.6 Tons) 35W312	720.0	Screen Wash Pump A-A Motor	C(5)			
MCC Board 1B-B (1.6 Tons) 35W312	720.0	Screen Wash Pump B-B Motor	C(5)			
MCC Board 2B-B (1.6 Tons) 35W312	720.0	Screen Wash Pump C-B Motor	C(5)			
MCC Board 2A-A (1.6 Tons) 35W312	720.0	Screen Wash Pump D-A	C(5)			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Main Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11,-12, -13)					
IMPACT AREA	Inside Crane Wall			Inside Crane Wall		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Missile Shield (92 Tons) 41N741-2 and 48N935 Mk. 7	702.0	Reactor Vessel Head and Pipe	C(12)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	See Footnote 2			
	702.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Missile Shield (73 Tons) 41N741-2 and 48N935 Mk. 6	702.0	Reactor Vessel Head and Pipe	D, C(6)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	D			
	702.0	Sense Lines, Sample Lines, Control Air Lines	D			
Missile Shield (56 Tons) 48N935 Mk. 8 41N741-2	702.0	Reactor Vessel Head and Pipe	D, C(6)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	D			
	702.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Main Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Crane Wall			Inside Crane Wall		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Canal Gate (41 Tons) 48N934 Mk. 1 41N741-1	702.0	Reactor Vessel Head and Pipe	D, C(6)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	D			
	702.0	Sense Lines, Sample Lines, Control Air Lines	D			
Canal Gate (41 Tons) 48N934 Mk. 2 41N741-1	702.0	Reactor Vessel Head and Pipe	D, C(6)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	D			
	702.0	Sense Lines, Sample Lines, Control Air Lines	D			
Canal Gate (41 Tons) 48N934 Mk. 3 41N741-1	702.0	Reactor Vessel Head and Pipe	D, C(6)	715.0	CRDM	C(12)
	702.0	Local Instrumentation Panels	D			
	702.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Main Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Crane Wall					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Upper Internals (102.3 Tons) 68C60-91934 686J256 Sht. 4	702.0	Reactor Vessel Pipe and Lower Internals	C(12)			
	693.0	Local Instrumentation Panels	See Footnote 2			
	693.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Lower Internals (164 Tons with Lift Rig) 68C60-91934 686J256	702.0	Reactor Vessels Pipe and Lower Internals	C(7)			
	693.0	Local Instrumentation Panels	See Footnote 2			
	693.0	Sense Lines, Sample Lines, Control Air Lines	See Footnote 2			
Reactor Coolant Pump Motor and Motor Support (41.9 Tons) 637F784 and 638F232	700.0	Reactor Coolant Pump and Piping	D, C(6)			
	693.0	Local Instrumentation Panels	D			
	693.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Main Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Crane Wall					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Reactor Vessel Head (165 Tons) 68C60-91934 30616-1061	695.0	Reactor Vessel Upper Internals	C(12)			
	693.0	Local Instrumentation Panel	See Footnote 2			
	693.0	Sense Lines Sample Lines Control Air Lines	See Footnote 2			
Reactor Coolant Pump Plug (13.3 Tons) 41N741-1	695.0	RC Pump, Motor, and Piping	D, C(6)			
	693.0	Local Instrumentation Panels	D			
	693.0	Sense Lines, Sample Lines, Control Air Lines	D			
Lower Compartment Access Plug (Equipment Hatch) (10 Tons) 41N741-1	733.0	RC Pump, Motor Piping, and Pressurizer Relief Tank	D, C(6)			
	693.0	Local Instrumentation Panels	D			
	693.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Auxiliary Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Crane Wall			Inside Crane Wall		
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Nozzle Shield Plug (1.8 Tons) 44N268 Mk 1	727.0	Hydrogen Igniter	B, D	703.0	CRDM	D
	727.0	Local Instrumentation Panels	D			
	727.0	Sense Lines, Sample Lines, Control Air Lines	D			
Nozzle Shield Plug (2.1 Tons) 44N268 Mk 2	727.0	Hydrogen Igniter	B, D	703.0	CRDM	D
	727.0	Local Instrumentation Panels	D			
	727.0	Sense Lines, Sample Lines, Control Air Lines	D			
Nozzle Shield Plug (1.9 Tons) 44N268 Mk 3	703.0	CRDM	D, C(6)			
	703.0	Local Instrumentation Panels	D			
	703.0	Sense Lines, Sample Lines, Control Air Lines, Seal Table	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 175 Ton/35 Ton Polar Crane (Auxiliary Hoist)
Drawing 44N230
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Crane Wall					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Reactor Coolant Pump Internals (27.6 Tons) 68C60-91934 618J940 and 618J941	695.0	Reactor Coolant Pump Piping	D, C(6)			
	693.0	Local Instrumentation Panels	D			
	693.0	Sense Lines, Sample Lines, Control Air Lines	D			

TABLE C

LOAD/IMPACT MATRIX FOR: 3 Ton Jib Crane
Drawing 44N384
2.4-2a and b Response

LOCATION	Reactor Building (47W200-2, -11, -12, -13)					
IMPACT AREA	Inside Containment Near Equipment Hatch and Personnel Lock - Azimuth 270!o#					
LOADS	Elevation	Safety-Related Equipment	Hazard Elimination Category	Elevation	Safety-Related Equipment	Hazard Elimination Category
Hatch Cover (1.6 Tons) 48N921	Below 646.63	Sample Lines Control Air Lines	See Footnote 2			
Miscellaneous Equipment (3 Tons or Less)	Below 646.63	Sample Lines Control Air Lines	See Footnote 2			

TABLE C
LOAD/IMPACT MATRIX FOOTNOTES
2.4-2a and b Sheet 53 of 53

1. Will be leased when neededµ equipment does not exist at this time.

2. These items are field routed and require a field investigation to determine if they can be eliminated from the Matrix. We recommend that NUC PR provide this information to OE or authorize OE to obtain this infromation such that a complete 7.4 response can be provided.

3. Miscellaneous restrictionsµ 10 to 1 safety factor for the particular crane in question.

4. This load is less than 2000-lbs and therefore is not considered a heavy load.

5. This equipment is repaired in small sections of which are less than 2000-lbs. and therefore is not considered a heavy load.

6. Equipment is in cold shutdown when this lift is performed.

7. All fuel is removed before lift is performed.

8. Browns Ferry Nuclear Plant drawing PSS2-M-D-102-R3 (two sheets), typical drawing.

9. Drawing in SQNP Fuel Handling Instruction Manual, Vol. 16, figures I and J.

10. Leased from Westinghouse, drawing No. 1553E30, 1596E24 sheets 1 and 3, and 1596E25.

11. Lifts may be made by one of the following yard cranes, depending on availabililty:

    a. 15-ton Galion 150-A truck crane
       74P35-6487 or
    b. 40-ton Lorain MC-680 truck crane
       77K31-821156-2 (14N206) or
    c. 140-Ton Manitowoc 3900-T truck crane
       72C36-99967