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DESCRIPTION:

Ltr re our 9-25-74 ltr....trans the following..

PLANT NAME: H.B. Robinson

ENCLOSURES:

Proposed modifications to the 125 ton crane for the spent fuel cask handling.....

ACKNOWLEDGED (40 cys encl rec'd)

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FOR ACTION/INFORMATION 10-22-74 JB

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CP&L
Carolina Power & Light Company

October 17, 1974

50-261

File: NG-3514 (R)
Serial: NG-74-1246

Mr. Karl R. Goller
Assistant Director for Operating Reactors
Directorate of Licensing
Office of Regulation
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Goller:

H. B. ROBINSON UNIT NO. 2
LICENSE DPR-23
SPENT FUEL CASK HANDLING

Your letter of September 25, 1974, requested that we provide our analysis and evaluation of the design and performance of structures, systems and components of the replacement 125 ton capacity spent fuel cask handling crane. The attached response provides our review of the considerations specified in your letter. The review includes our analysis and evaluation of the replacement 125 ton crane for the prevention of accidents and mitigation of the consequences of accidents.

Based on our review, plant modifications in addition to those described in the attachment are not required. In accordance with 10CFR Parts 50.59(a) and 50.59(c) and the Robinson Technical Specifications, the planned modification has been reviewed by the various safety committees of Carolina Power & Light Company and has been determined not to involve an unreviewed safety question or a change to the Technical Specifications thus not requiring Commission authorization. In our opinion, this modification will reduce the danger to the health and safety of the public resulting from postulated fuel handling accidents.

The cask handling crane replacement and structural modifications, including installation testing, are now scheduled for completion by December 20, 1974. No spent fuel shipping or cask handling will occur prior to this date. Spent fuel shipments are scheduled to begin in January, 1975, upon completion of the modification.

Yours very truly,

E. E. Utley
Vice-President
Bulk Power Supply

JMB:mvp
Attachment

cc: Messrs. N. B. Bessac
T. E. Bowman
W. B. Howell
J. B. McGirt
D. V. Menscer
D. B. Waters

10825

RESPONSE TO AEC QUESTIONS - SEPTEMBER 25, 1974

Question

In your letter dated May 14, 1974, you indicated that the existing 100-ton cask handling crane will be replaced with a 125-ton capacity crane in November, 1974. Our letter to you dated March 6, 1974, contained the following position statement:

> "The Regulatory staff's review of reactor power plant safety includes consideration of postulated spent fuel shipping cask drop accidents. These events must be adequately documented and analyzed by licensees and applicants and evaluated by the staff. Possible damage that could occur to plant structures, systems, and components important to safety in the event of a cask drop caused by a failure in the crane system or handling devices must be evaluated."

In regard to this position and pursuant to 10CFR Part 50, Section 50.34 (b)4 please provide, for your spent fuel handling systems as they will exist with the planned replacement crane, your analysis and evaluation of the design and performance of structures, systems and components of the facility. The objective of the analysis and evaluation is to assess the risk to public health and safety and, in particular, to determine the adequacy of structures, systems and components provided for the prevention of accidents and mitigation of the consequences of accidents.

Considerations that should be included in your analysis and evaluation are:

1. Spent fuel integrity: Can a cask be positioned near spent fuel so that it could be deflected onto the spent fuel (e.g., by a cask drop on a pool edge or an eccentric drop caused by a break of the yoke or trunnion on one side of the cask)?

2. Integrity of critical safety systems and equipment: In moving a cask to or from the spent fuel storage pit, does it pass over any systems or equipment important to safety which could be damaged by a cask drop? This should include consideration of the capability of floors to protect equipment or systems important to safety which are located below.

3. Integrity of a dropped cask: Could a cask be positioned so that the distance it could fall exceeds that for which casks are required to be designed (30 feet per 10CFR § 71.36)?

All crane parts equal or exceed applicable design criteria in CMAA Specification #70, ANSI B30.2.0 "Overhead and Gantry Cranes," and OSHA §1910.179 "Overhead and Gantry Cranes." The train hoist load block will be suitable for underwater operation.

c. Installation Testing, Periodic Testing, Preventive Maintenance and Crane Operation will be in accordance with ANSI B30.2.0, OSHA §1910.179 and manufacturer's recommendations.

d. Factors of Safety

Structural members of the crane are designed in accordance with CMAA Specification #70. The maximum allowable stress for a combined load is 17,600 psi. Based on the yield point for ASTM-A-36 of 36,000 psi, a minimum factor of safety of two will exist for welded box girders in the bridge. The minimum safety factor for any non-redundant load-bearing parts, except structural members and ropes, is 3.5 based on yield strength.

The minimum safety factor for one path of redundant load carry parts, except structural members and ropes, is 2.5 (or 5 for both paths) based on yield strength.

e. Brakes

The main hoist has two electric stopping and holding brakes (Whiting Type 13" SESA) mounted on motor shaft on each side of the motor and two mechanical control brakes which are built into each main hoist reduction gear (Whiting Type #25). Each brake is capable of stopping and holding 150% of the rated load. A solenoid is energized to release each electric brake thereby releasing the brake shoes from the wheels. Brakes are applied by opening the circuit to the solenoids allowing a compression spring to extend and force the brake arms to the set position. Electric brakes always maintain a safe condition by automatically setting and holding the load in case of power interruption. Brake solenoids are connected across two phases of the main hoist motor which results in the brakes being released when the motor is energized and being set when the motor is deenergized. The major components of the mechanical control brakes are located on a brake shaft in each main hoist reduction gear case. Situated between the brake gear and pinion on each brake shaft is a rachet wheel which is governed by a pawl actuated by a friction sleeve on the motor drive shaft. The pinion on the motor drive shaft transmits its torque to the brake gear. The rachet wheel is provided with two friction washers and is free to idle on the brake shaft but is held stationary when engaged by the pawl. The brake gear is not keyed to the brake shaft but transmits its torque to the shaft, through a brake nut which turns on a screw that is an integral part of the shaft. The brake pinion transmits its torque to the gear on the output shaft.

The starting of the hoisting cycle causes the brake nut to advance along the screw in the direction of the ratchet wheel until the friction washers are engaged, at which point the entire assembly operates as if it were simply a shaft with a gear and pinion keyed to it.

In addition, please provide a description of all cranes and other equipment planned and currently installed that may be used in lifting, moving, or positioning shipping casks within the H. B. Robinson Unit No. 2. This should include a description of: (a) the performance specification as related to travel and hoisting speeds with range of loads and the operating requirements; (b) the conditions to which the crane(s) was designed; (c) the installation testing performed, the preventive maintenance program and whether the testing, maintenance and operation are in accordance with ANSI B30.2; (d) the factor of safety based on yield that you believe to exist in the structural and mechanical components of the crane systems; (e) the control, holding, and emergency brakes for the hoisting system and the type of brakes provided for trolley and bridge travel; (f) the maximum torque of the crane(s) complete hoisting system with motor controls and include such items as full load starting and the instantaneous stalling condition at full load and maximum speed; (g) describe the safety and limiting devices that are installed to protect against hoisting failures such as the protective features that would prevent a "two blocking" situation from occurring should the load be raised too high.

Also, provide a description of all lifting devices, such as slings, hooks, ropes, and other devices which will be used in lifting or moving casks.

In the event your review indicates to you the need for plant modifications in addition to those currently planned, you are urged to initiate the necessary action, pursuant to 10 CFR Part 50, Section 50.59, as soon as practicable. Please describe in your response to this letter all planned modifications, including your schedule for their implementation and your findings, pursuant to Section 50.59, as to whether prior Commission approval is required.

Additionally, please develop and furnish your plans for additional precautionary measures in the event fuel cask handling is necessary during the period of your evaluation and, if necessary, the completion of plant modifications. This information, along with your schedule for submitting the other information requested in this letter, is requested to be furnished within three weeks of receiving this letter.

Answer

1. A postulated cask drop at the pool edge could result in the cask being deflected into spent fuel. However, provisions have been made to eliminate the spent fuel cask drop as a credible accident. Redundancy has been incorporated in the design of the spent fuel cask lifting lugs, lifting rig and the replacement 125-ton spent fuel cask handling crane to eliminate any risk to public health and safety.

A detailed discussion of the safety features of each component follows:

a. Spent Fuel Cask

The cask, including the four lifting lugs, is designed for protection against single failure in that each pair of opposing lugs will alone support 300 percent of the fully loaded cask weight (rail cask weighs approximately 100 tons and truck cask weighs approximately 24 tons) without exceeding the yield strength of the material. The cask will be proof-load tested (125 percent of the fully loaded cask weight) prior to being put in service. This design requirement eliminates the cask from further consideration in contributing to a cask drop accident.

b. Spent Fuel Cask Lifting Rig

The lifting rig supplied for the spent fuel shipping cask is furnished as part of a package which includes the shipping cask and its special transport vehicle. Specific details of the lifting rig are not available at this time; however, it will conform to the following criteria. The design and fabrication of the shipping cask, transport vehicle, and handling equipment will conform to all the applicable regulations of the AEC (10CFR71) and the DOT (49CFR170-178). The shipping cask lifting rig will be of all steel construction and composed entirely of structural members. In addition to the above criteria the lifting rig will be designed for protection against single failure in that each lifting arm will alone support 300 percent of the fully loaded cask weight without exceeding the yield strength of the material. One lifting arm will be connected to the sister hook of the crane and the remaining arm will be independently attached to the lifting eye of the crane.

Before shipment, the lifting rig will be proof-load tested (125 percent of the fully loaded cask and rig weight) to assure compliance with the single failure criteria, and non-destructively tested i.e. magnetic particle or dye penetrant, and examined to ensure that no permanent deformations and/or other damage has occurred. This design and testing eliminates the lifting rig as a factor contributing to a cask drop accident.

c. Cask Handling Crane (125 Ton Capacity)

(1) The Whiting Redundant Hoist System consists of a dual load path through the hoist gear train, the reeving system, and the hoist load block along with restraints at critical points to provide load retention and minimize uncontrolled motions of the load upon failure of any single hoist component. The system includes two complete gear trains connecting the single hoist motor to the hoist drum.

Each gear train is designed to accept full motor torque at rated load capacity along with peak strength ratings adequate to absorb shock loadings within the yield strength of the component materials. Separate motor brakes are included with wheels mounted on an extension of each motor pinion input shaft.

The hoist drum and its shafts and bearings are designed to accept the forces and moments produced by full load tension on either half of its grooving or reeving and in addition is provided with close clearance retainers at its hubs to support the drum and prevent loss of pinion mesh in case of shaft or bearing failure at either or both ends of the drum.

Reeving consists of a sufficient number of parts of rope sized as commercially available to provide a minimum static factor of safety of 7.4 with all parts of rope effective, and based on the ultimate rope strength and the static rated load as defined by CMAA #70 specifications. This rope is furnished as two separate pieces, each of which is fastened at one end to the drum in conventional manner, reeved through the upper and lower blocks of the trolley as described below, and the other end adjustably attached to a specially damped equalizer assembly. Each rope is 1 1/8" dia. 6 x 37 type 304 stainless steel with a breaking strength of 59.3 tons. This equalizer assembly is also provided with special retainers to assure its continued support of the load in case of pivot pin failure. Hydraulic dampers and mechanical stops are also provided on this assembly to define its maximum rate and extent of rotation about its pivot pin in either direction. If either piece of rope should fail, the equalizer assembly dampens the forces developed in the remaining rope caused by its increase in strain in order to continue support of the load. This damping system, however, does not interfere with the normally small and slow oscillations of the equalizer during rope tension equalizing functions while all parts of rope are effectively supporting the load. A special limit switch system is also supplied on this equalizer assembly which can either stop the hoist or provide a warning to the operator if unequal rope stretch or other causes have moved either end of the assembly to the danger point where insufficient damping travel remains for proper damping action in case of rope failure in the longer rope. This signal implies that an adjustment of either or both rope anchors at the equalizer should be made prior to critical load handling.

Upper and lower block sheaves are a minimum of 24 rope diameters and are uniquely arranged in upper and lower blocks so that the total sustaining force of all effective ropes remain nearly coaxial and concentric with the vertical axis of the hook shanks whether either or both pieces of rope are supporting the load. Each sheave in both the upper and lower block is also provided with vertical and lateral restraints that will assure continued rope tension in its ropes in case of sheave shaft or bearing failures.

The load block provides a dual concentric pair of load connecting devices to carry the load into and through the block housing and sheaves, either of which has the ability to sustain the full load, while still providing normal load rotation capabilities. The normal load path is to the lower connector consisting of an "eye" similar to that found on the ordinary crane hook and capable of connection to any existing handling devices designed for such load connection. The upper device consists of a sister type crane hook also capable of supporting the full load which will accommodate secondary load connections such as slings or pinned links connecting to the load or handling device.

(2) Structural members - All structural, i.e. load bearing, members have been fabricated of ASTM A-36 steel. In accordance with CMAA Specification #70.

In addition, the crane will be proof-load tested to 125% of its rated capacity prior to being put in service. All applicable portions of OSHA and ANSI B30.2.0 have been incorporated in the crane design.

(3) Limit switches - Limit switches have been provided to limit the horizontal movement of the trolley and of the bridge. The switches have been located so that movement of the loaded crane over the spent fuel pool is prevented. Limit switches have also been provided to prevent overloads and critical elevations of the block assembly. See Paragraph 4.g below for detailed description.

(4) The brake system consists of the following: (See Paragraph 4.e below for detailed description).

(a) One disc mechanical load brake for each hoist gear case, a total of two for the crane.

(b) One electric shoe brake on each motor shaft of each hoist gear case, a total of two for the crane.

(c) A service (electric shoe) brake has been provided on the trolley.

(d) A hydraulic brake with electric stopping feature has been provided on the bridge.

This redundant breaking system together with the other redundant components of the crane insures that dropping the spent fuel cask is not a credible accident.

The three components (spent fuel cask, lifting rig and crane - both components and functions) whose failure could result in a cask drop accident have been discussed in detail. The conclusion reached is that adequate provision has been made in

the design of these components so that dropping the spent fuel cask is not a credible accident.

2. The spent fuel cask cannot be handled over critical safety systems or equipment within the coverage provided by the 125 ton spent fuel cask handling crane.

3. The spent fuel cask can be positioned during handling operations so that the vertical distance between it and a flat essentially unyielding horizontal surface exceeds the hypothetical accident condition of a 30 foot drop (per 10CFR § 71.36). This will occur when the cask is moved between the cask decontamination room and the entrance to the spent fuel building. The cask decontamination room floor is approximately 50 feet below the entrance to spent fuel building. As explained in 1. above, the cask drop has been eliminated as a credible accident due to safety features designed into the crane.

4. The replacement spent fuel cask handling crane is a Whiting Corporation bride crane and is described as follows:

   a. Performance Specifications

   The crane will be equipped with a single trolley which contains a 125 ton capacity main hoist with redundant features as described in 1. above and a 5 ton capacity auxiliary hoist. The speeds and motor requirements are listed as follows:

		Main Hoist	Auxiliary Hoist	Trolley Traverse	Bridge Travel
Speeds (Ft/Min)	Full Load	3	25	40	60
	No Load	3	25	40	60
Motor Horsepower		40	10	5	15
Motor Speed (RPM)		900	900	1200	1200

   All motors are controlled by magnetic controllers to provide variable speed for each crane motion by means of variance of motor secondary currents through resistors. Each motor has five steps of control with each step providing a reduction of approximately 20% in speed.

   The bridge span for the replacement 125 ton crane is the same as the 100 ton crane at 37 feet. The vertical travel of the main hook is 77 feet 10 3/4 inches and the auxiliary hook is 87 feet 9 inches.

   b. Design Conditions

   The crane is designed for outside service and in accordance with Class A1 (Standby Service) as defined by the Specifications for Electric Overhead Traveling Cranes (CMAA-Specification #70).

When the motor is reversed to lower, the pawl actuated by the motor drive shaft promptly engages the ratchet wheel and holds it stationary. The continued turning of the brake gear backs the brake nut off the screw, thereby loosening the entire assembly and allowing the load to lower. Should the load begin to drop faster than the speed for which the motor controller is set, the brake immediately tightens up and retards the load to the controller speed. At the same time that the lowering load is tightening the brake, the torque of the motor is being used to keep the brake loose, resulting in an alternate tightening and loosening that occurs in rapid succession. Hence, the load is lowered smoothly, without exceeding the speed for which the controller is set.

The auxiliary hoist has one electric stopping and holding brake (Whiting Type 13" SESA) mounted on a shaft extended from the first pinion shaft and one mechanical control brake which is built into the auxiliary hoist reduction gear (Whiting Type #10). These brakes operate in the same manner as described above for the main hoist brakes.

The trolley has one electric stopping and holding brake (Whiting Type 6" SESA). Operation of the brake is the same as described above for the electric brake for the main hoist. The solenoid for this brake is connected across two phases of the trolley drive motor.

The bridge has one hydraulic drum type brake mounted on the bridge drive shaft with a automatic electric parking brake feature (Wagner Type 10" HM). For stopping duty it operates by pressing on a foot pedal in the cab which transmits hydraulic pressure to the brake unit which closes the brake shoes onto the brake drum thereby bringing the crane to a stop. Whenever electric power to the crane is broken, whether due to power failure, or opening of the main line switch, the brake automatically sets, bringing the crane to an emergency stop. The brake remains set until electric power is restored.

f. Main Hoist Motor Torque

Rated torque for the main hoist motor is 233 ft.-lbs. Total gear reduction which includes the main hoist unit and extra drum reduction gear is 430.2 to 1. This is for one section of the redundant hoist mechanism. Drum torque at rated motor torque is approximately 98,000 ft.-lbs. (assuming a 98% gear efficiency). An instantaneous full load start or a stalling condition could result in a torque of 250% of the rated torque. However, this is prevented by the overload limit device which deenergizes the hoist motor above rated capacity. An instantaneous start is also prevented by the five step motor controller. The initial starting contactor, plus accelerating contactors, provide five points of acceleration for hoisting or lowering during normal operations. A time delay relay automatically cuts in between the last two points. This delay fully protects the motor but lets the motor develop its rated torque.

g. Protection Against Hoisting Failures

A two blocking situation which would result from raising the load too high is prevented by a paddle type limit switch which opens the hoist motor circuit as the hook reaches the upper limit of travel. The operation of the limit switch does not prevent lowering the hook. Operational procedures prohibit using this upper limit switch as a routine operational limit.

A special limit switch system on the reeving equalizer assembly warns the operator if unequal rope stretch or an unbalanced condition occurs in the assembly. See 1.c (1) above for more details concerning the system.

A slack cable condition which would result from overhoisting is prevented by a limit switch which opens the hoist motor circuit as the cable becomes slack.

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

5. Lifting Devices other than those described in Paragraph 1 above will not be used for lifting or moving casks.

6. Crane Support Structure Modifications

a. The crane support structure will be modified to accomplish the following:

(1) Upgrade capacity of existing structure for weight of new crane plus 125 ton lift load. Due to removal of end frames at column line 23, Columns 23 J and K will require stiffner plates welded the full length on both sides of each column. Columns 20 J and K will require stiffners at elevation 301.17'. (See Figure 2 for locations.)

(2) The runway will be extended one bay from Column Line 23 to Column Line 24 in the west direction to provide additional crane coverage necessary to erect a rail cask. The runway will be extended approximately 3 feet in the east direction to provide crane coverage over the center of the cask sit-down area in the spent fuel pool. (See Figure 2 for extensions.)

(3) The existing 100 lb. rails will be replaced with 175 lb. rails to handle increased wheel loading.

b. The design criteria used in the original structure was used for the modifications. The design criteria is as follows:

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

(2) The basic wind loading is 30 psf.

(3) Seismic loadings are 5% of the dead load.

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

(5) Horizontal forces are as follows:

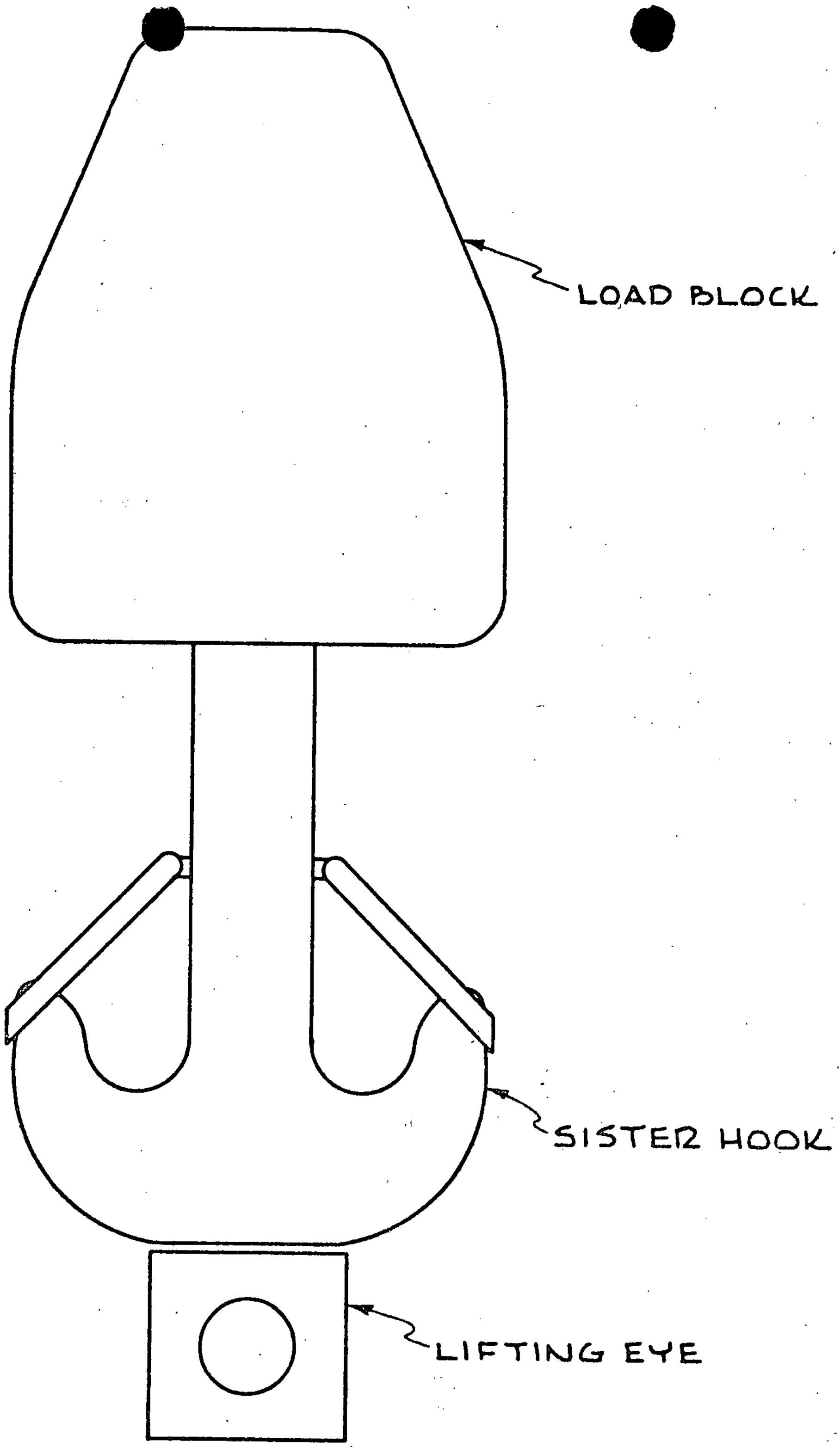
   (a) Lateral live load - 10% (Lift Load + Wt. of Trolley)

   (b) Longitudinal live load - 10% (Dead Load + Lift Load)

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

c. <u>Allowable Stresses</u>

The structure is fabricated of ASTM A-36 steel with a yield of 36,000 psi. The allowable unit stresses are less than those permitted by AISC. Stresses are based on combined loads determined in accordance with the design criteria listed in b.(2), (3), (4), (5), and (6) above.



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

REDUNDANT HOOK & LOAD BLOCK

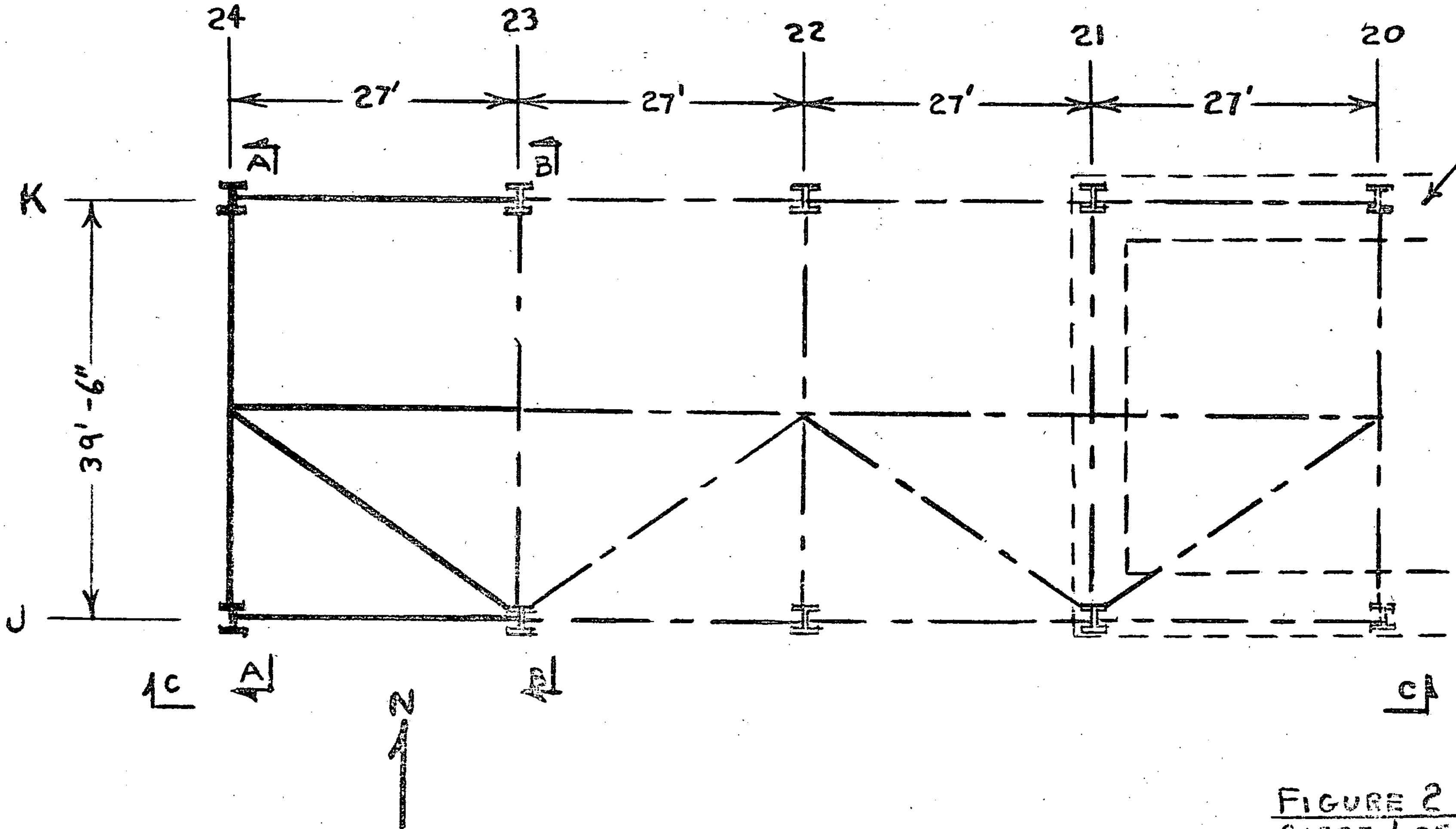
FIG. NO. 1

LEGEND

- - - EXISTING FRAME

——— NEW FRAME

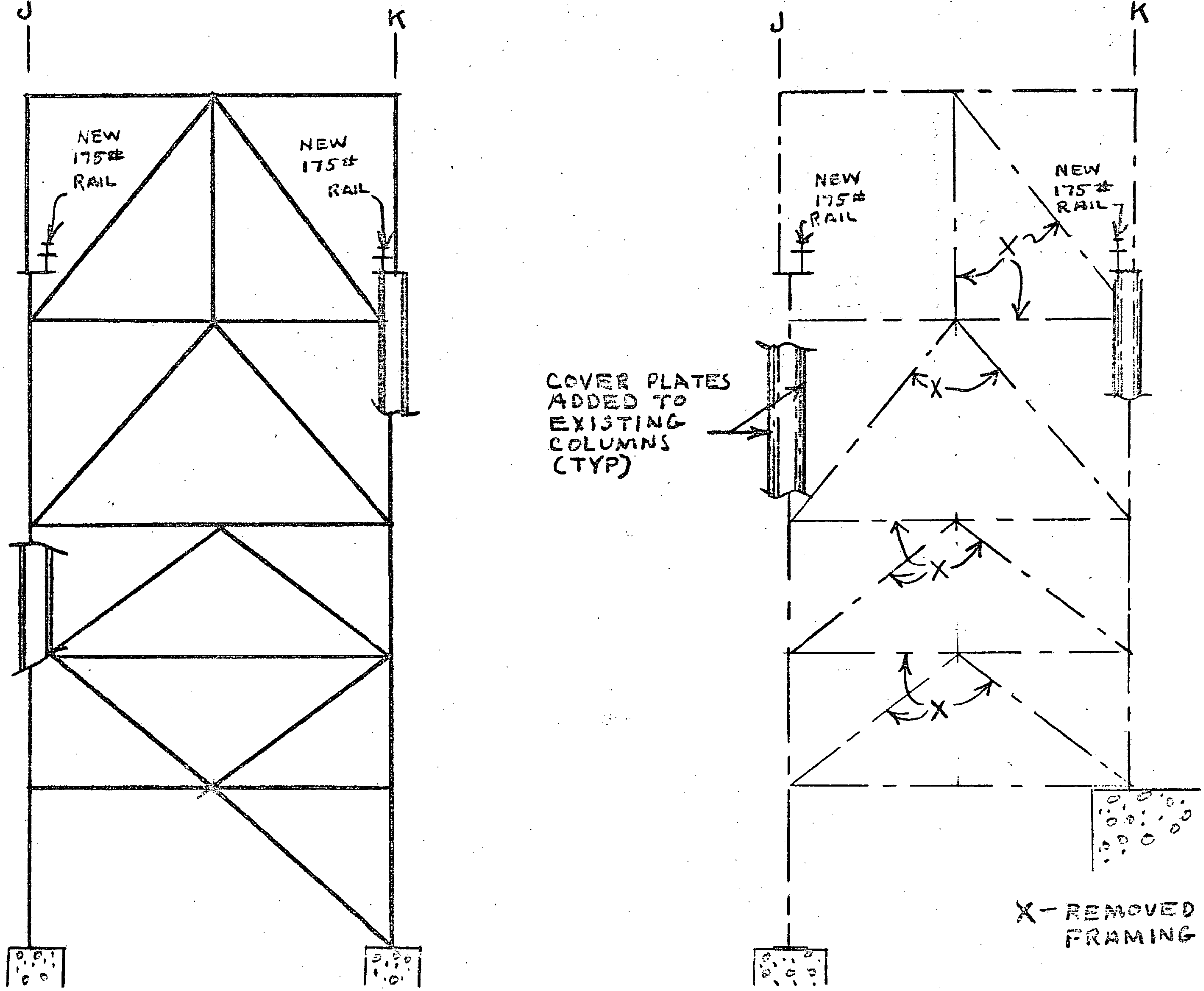
REFERENCE: EBASCO DWG G-211000



FRAMING PLAN
EL 329.42

FIGURE 2
SHEET 1 OF 3

H.B. ROBINSON UNIT 2
STRUCTURAL MOD-
IFICATION FOR
125 TON REPLACEMENT
CRANE

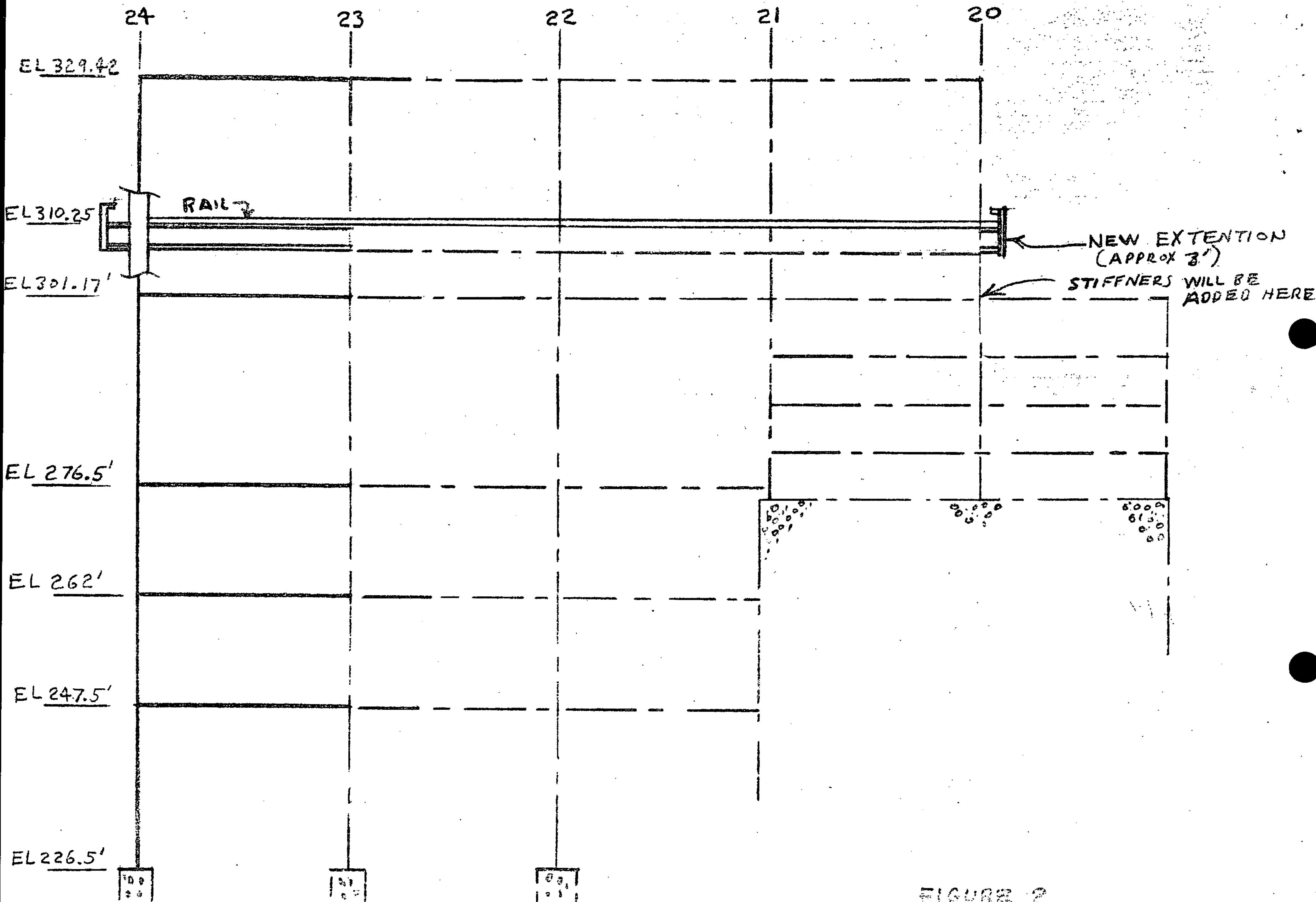


SECTION A-A

FIGURE 2

SECTION B-B

SHEET 2 OF 3



SECTION C-C

FIGURE 2

SHEET 3 OF 3