NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

NRC DISTRIBUTION FOR PART 50 DOCKET MATERIAL

DOCKET NUMBER: 50-261

FILE NUMBER:

TO: MR. ROBERT W. REID

FROM: CAROLINA POWER & LIGHT COMPANY, RALEIGH, NORTH CAROLINA, E. E. UTLEY

DATE OF DOCUMENT: 5/14/76

DATE RECEIVED: 5/19/76

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INPUT FORM

NUMBER OF COPIES RECEIVED: ONE SIGNED

DESCRIPTION

LTR RE OUR OCT 24/75 LTR. TRANS THE FOLLOWING:

(ERROR IN DOCKET NUMBER: LISTED ON LETTER AS 50-263 - SHOULD BE 50-261)

ENCLOSURE

ADDITIONAL INFORMATION REQUESTED BY US CONCERNING THE SPENT FUEL CASK HANDLING CRANE.

ACKNOWLEDGED

DO NOT REMOVE

PLANT NAME:

H. B. ROBINSON #2

FOR ACTION/INFORMATION — ENVIRO 5/24/76 RJL

SAFETY		ENVIRO	
ASSIGNED AD :		ASSIGNED AD :	
X BRANCH CHIEF :	REID (6)	BRANCH CHIEF :	
PROJECT MANAGER:		PROJECT MANAGER :	
X LIC. ASST. :	INGRAM	LIC. ASST. :	

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CP&L
Carolina Power & Light Company

May 14, 1976

File: NG-3514 (R)   Serial: NG-76-691

Director of Nuclear Reactor Regulations
Attention: Mr. Robert W. Reid, Chief
Operating Reactors Branch #4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

RECEIVED
MAY 19 1976
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

Dear Mr. Reid:

H. B. ROBINSON UNIT NO. 2
DOCKET NO. 50-263
LICENSE NO. DPR-23
RESPONSE TO QUESTIONS ON SPENT FUEL SHIPPING CRANE

In response to your request of October 24, 1975, to provide information on additional items of concern regarding the spent fuel cask handling crane at the H. B. Robinson Unit No. 2, we are providing as an attachment the requested information, analysis and schedule for completion of several minor crane modifications for your review.

Carolina Power & Light Company considers the presently installed cask handling system adequate to assure safe handling of spent fuel. However, the Company will install the minor modifications as discussed in the attachment to expedite resolution of the few remaining outstanding NRC Staff concerns. The information contained in the attachment should be sufficient to satisfy your staff regarding the safety of the cask handling system and assure that spent fuel can continue to be removed from the Robinson Unit No. 2 without risk to the public health and safety.

Very truly yours,

E. E. Utley
Vice President
Bulk Power Supply

DOCKETED
USNRC
MAY 19 1976
U.S. NUCLEAR REGULATORY COMMISSION
Mail Section

DBW:jwk
Attachment

336 Fayetteville Street • P. O. Box 1551 • Raleigh, N. C. 27602

CP&L RESPONSES TO NRC REQUESTS
FOR ADDITIONAL INFORMATION ON THE
SPENT FUEL CASK HANDLING SYSTEM
H. B. ROBINSON UNIT NO. 2, DOCKET NO. 50-261

The following requests and responses are keyed to the NRC requests of October 24, 1975.

1.c. Provide quantitative data in support of position that seismically induced loadings are "negligible."

Response - The information provided in our letter of April 15, 1975, stated that "The effects of a swinging load induced by an earthquake with the same vertical and horizontal accelerations have been analyzed and found to be negligible." The accelerations mentioned are .2 g vertical and .2 g horizontal acting simultaneously. To support our position that seismically induced swinging loads are negligible the following information is provided:

Vertical accelerations do not induce swinging of the load, therefore, only the horizontal effects are considered. The effects of the swinging load were analyzed based on ground motions at the bridge wheels. This analysis shows that the maximum distance the load will swing relative to crane is 2.03×10^{-4} inches. This swing is considered negligible and results in no additional stress to the crane.

3.d. Provide justification that the head and load block alignment will be maintained in the event of a single wire rope failure, or demonstrate that maximum shifting of the critical load (horizontal and vertical) resulting from a single wire rope failure can be safely tolerated at all points on the spent fuel cask hoisting and travel paths.

Response - In the unlikely event of a failure of either rope of the redundant reeving system, the load will shift from its centered position the maximum amount indicated in the following table:

	Load at Top of Lift	Load at Bottom of Lift
<u>Failure of Rope No. 1</u>		
<u>Horizontal Shift</u>		
East-West	1.15 Inches East	6.82 Inches West
North-South	.63 Inches South	.63 Inches South
<u>Vertical Shift</u>	.03 Inches Down	.02 Inches Down
<u>Failure of Rope No. 2</u>		
<u>Horizontal Shift</u>		
East-West	1.15 Inches West	6.82 Inches East
North-South	.63 Inches North	.63 Inches North
<u>Vertical Shift</u>	.03 Inches Down	.02 Inches Down

The above shifts of the load can be safely tolerated at all points on the spent fuel cask hoisting and travel paths.

3.h. The description of the Robinson crane does not include any reference to any devices for detecting bridge and/or trolley overtravel. Such devices are required in order to prevent the crane and critical load from passing beyond the boundaries of previously established safe handling paths. If such devices are included in the crane design, they should be described. If not currently included, the crane design should be modified to include the necessary equipment to safely prevent bridge and trolley overtravel.

Response - A. Electrical devices installed to limit crane travel are described as follows:

The system has a two position key lock selector switch unit in the crane cab marked "Normal" and "Restricted." The unit allows for removal of the key when in the "Restricted" position only. This feature insures supervisory personnel that the restrictions are in effect when critical loads are being handled, and that any operational malfunction must be called to their attention while the key is in their possession.

The limit switches involved in the system include

field adjustable rotating cam and gear types to define the two critical elevations with 1/4" repeatable accuracies for any given load value, and maintained contact proximity type switches mounted on the bridge with trips mounted along the runway and trolley trucks to define each path border with respect to either trolley or bridge motions.

A panel of relays is mounted on the crane bridge to interconnect these various components and the crane controllers to provide the following parameters.

1. Activation or deactivation of the entire system is dependent upon the position of the key selector switch in the crane cab. When the system is deactivated (key switch at "Normal") all crane motions are available to the crane operator throughout their normal travels, restricted only by end travel limits.

2. When activated (key lock in "Restricted") the system provides the following features.

    a. No operator capability for horizontal motions until the hook has reached the correct elevation for either portion of the critical path.

    b. No further hoisting or lowering capabilities until lateral travels have been completed to elevation transition points along the critical path.

    c. Horizontal travel capabilities only in the directions available along the prescribed paths at all corners, ends, or path intersections.

    d. Complete shutdown of all crane motion capability in the event of any attempt on the part of the operator to travel beyond restricted path borders or at improper hook elevations within the defined paths; with reset possible only by supervisory return to "Normal" for corrective "back-off" motions.

    e. Initiation, speed, and duration of all motions are in complete command of the crane operator at all times as long as load motions remain within the prescribed limits.

f. No "Automation" features are included, therefore, the system is operative regardless of the location of "Start" or "Stop" locations or direction of travel within the prescribed limits.

In addition to the electrical devices described above an audible warning device will be installed to warn the operator in the event of failure of the restricted path circuitry to keep the crane in the restricted path when traveling in the south direction. It is anticipated that this modification will be completed by September, 1976. All other directions are protected from overtravel due to failure of the restricted path circuitry as described in B. below.

B. Bridge end stops prevent travel of the centerline of the cask beyond 1'-4" from the centerline of the cask sit down area in the east direction. Trolley travel in the north direction is limited by end stops which prevent the centerline of the cask from traveling more than nine inches from the centerline of the cask sit down area. Overtravel in the south direction is prevented as described in A. above. There is no requirement to prevent overtravel in the west direction while in the area of the spent fuel building as motion in this direction takes the cask out of the spent fuel building. Bridge end stops are provided, on the extreme west end of the runway to prevent overtravel.

3.i. The main hoist motor stall torque is stated as being 275% of that required to lift design rated load at maximum speed. This motor torque should be limited to 175% of required torque in order to preclude excessive stresses on crane components in the event of load hangup unless it can be shown that adequate features exist in the restricted handling path to insure that load hangup cannot occur. Provide a justification if the modification is not proposed.

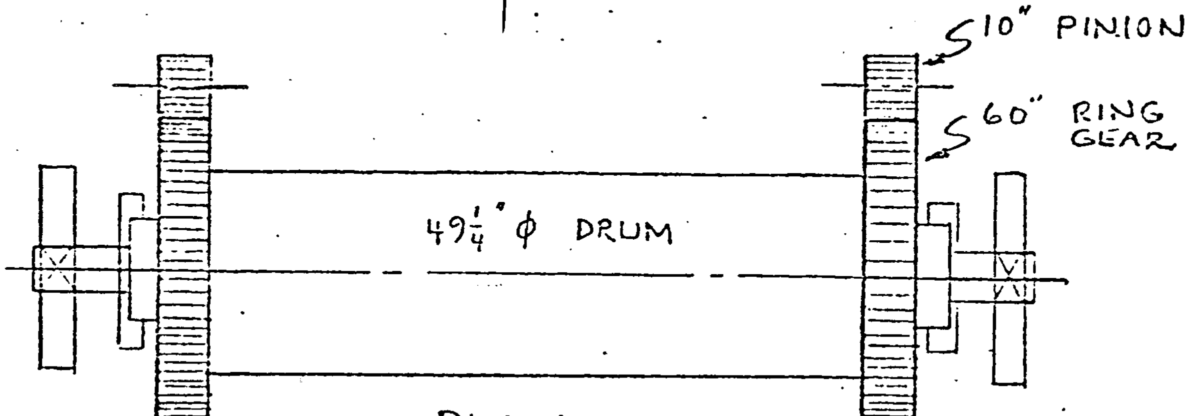
Response - A modification to limit the motor torque to 175% of the required torque to preclude excessive stresses on crane components in event of load hangup is not required. The restricted path system backed up by mechanical stops and a warning device as described in the response to 3.h. above prevents the crane from operating in critical areas where a load hangup could occur.

3.j. The crane design makes no provision for absorbing the kinetic energy of rotating machinery in the event of two-blocking. Such provisions should be made in order to preclude damaging impact loadings on essential crane load bearing members should two-blocking occur. Either a shock absorber device between the head and load blocks, or some positive, mechanical means of interrupting line power to the hoist motor in sufficient time for hoist holding brakes to absorb all energy prior to two-blocking will conform to our position. Please advise us of your plans for addressing this concern.

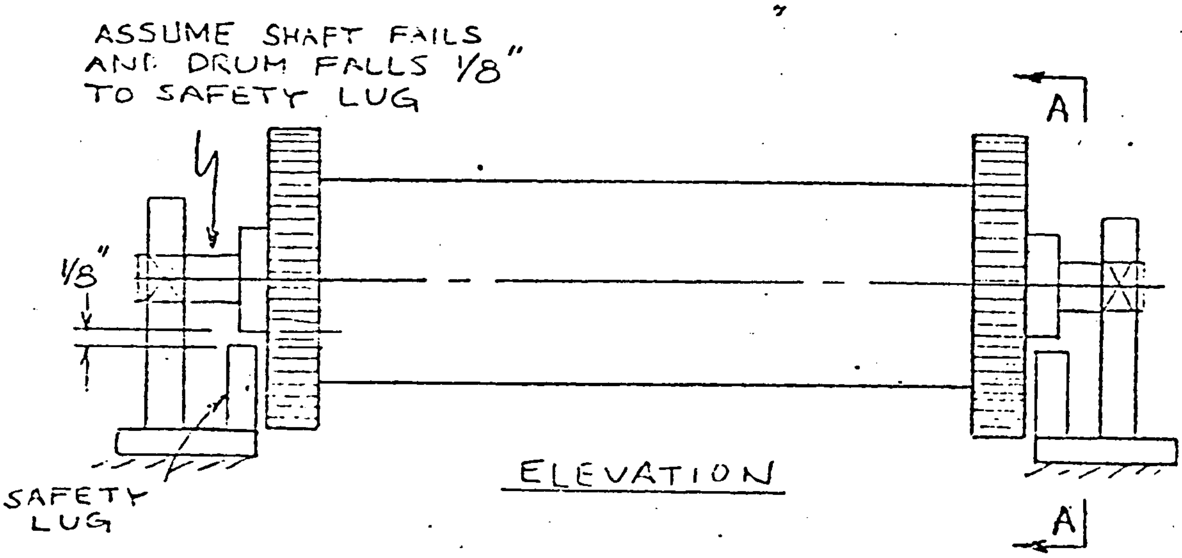
Response - A modification will be made to install a main hoist upper limit switch in addition to the existing upper limit switches. The new upper limit switch will directly interrupt line power to the main hoist motor and holding brakes in sufficient time for the two holding brakes to absorb all energy prior to two-blocking. It is anticipated that this modification will be completed by September, 1976.

3.k. The main hoist drum is a single component, the failure of which would cause loss of the critical load. It is our position that mechanical restraints should be provided which will catch and hold the drum in the event of support failure at one end of the drum and which would allow for emergency lowering of the critical load. Provide details of the drum restraints including the amount the drum can drop in the event of an end support failure. Also, provide an analysis which shows that the misalignment on the gear train opposite the failed support as a result of the drum dropping is within the design limits of the gearing, and that the combination of misalignment and added friction of the drum on the restraint will not cause excessive loading on this gearing during emergency lowering of the load.

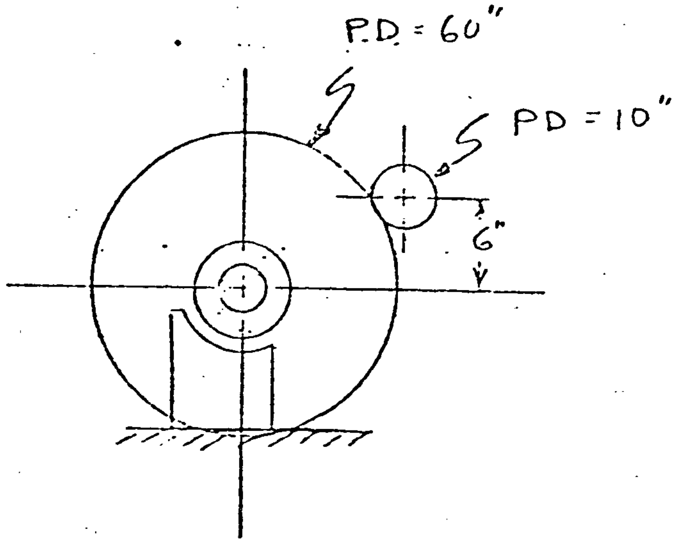
Response - Each end of the drum is provided with a hub which is concentric with the drum shaft. A safety lug, (receptacle) is built into the trolley frame on both ends of the drum. The safety lug has a surface which is concentric with the drum hub and is located 1/8" under the drum hub. In the event of failure of a drum shaft or support, the drum hub comes into contact with the safety lug which prevents the drum from falling. An analysis shows that the misalignment on the gear train opposite the failed shaft, or support, as a result of the drum dropping is within the design limits of the gearing, and that the combination or misalignment and added friction of the drum hub on the safety lug will not cause excessive loading on the gearing during emergency lowering of the load. The analysis is attached for information.



PLAN

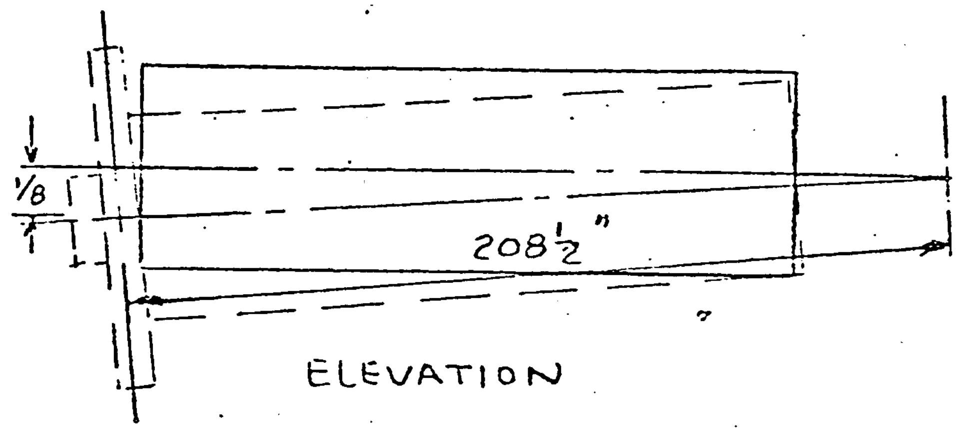


ELEVATION

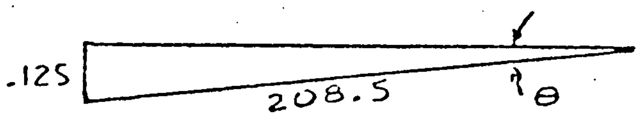


VIEW A-A

MISALIGNMENT OF GEARING DUE TO SHAFT FAILURE

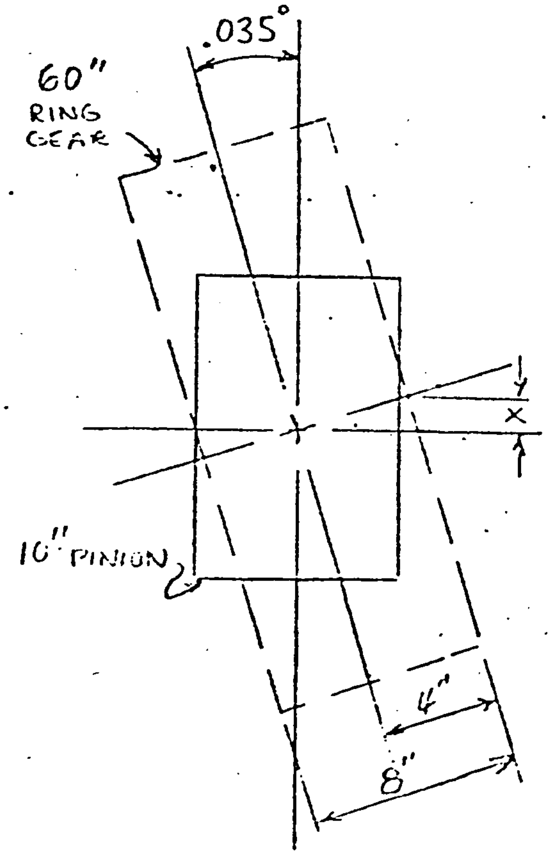


ELEVATION



$$\theta = \sin^{-1} \frac{.125}{208.5}$$

$$\theta = .035^\circ$$



$$X = 4 \sin\theta = 0.0024 \text{ in}$$

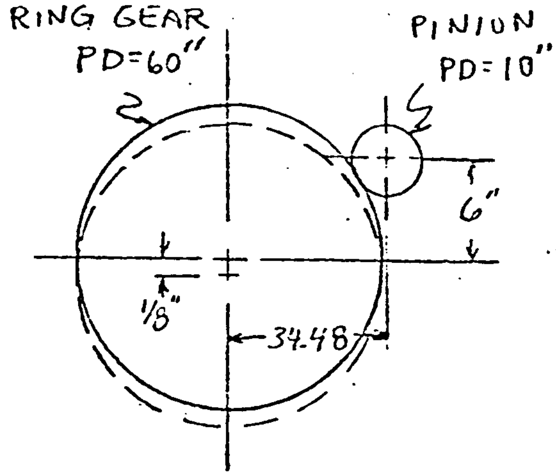
$$e = \text{ALLOWABLE BACKLASH BETWEEN GEARS} = \frac{.040}{\text{D.P.}}$$

$$DP = 1.5$$

$$e = \frac{.040}{1.5} = 0.0270 \text{ in}$$

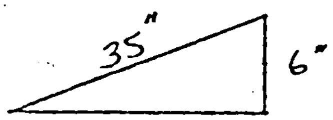
THEREFORE, THE ROTATION OF THE RING GEAR IS STILL WITHIN THE BACKLASH LIMITS.

SEPARATION OF GEARS DUE TO 1/8" FALL OF RING GEAR



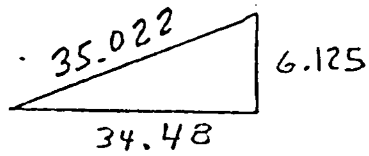
BEFORE FAILURE

℄ RG TO ℄ P = 35"



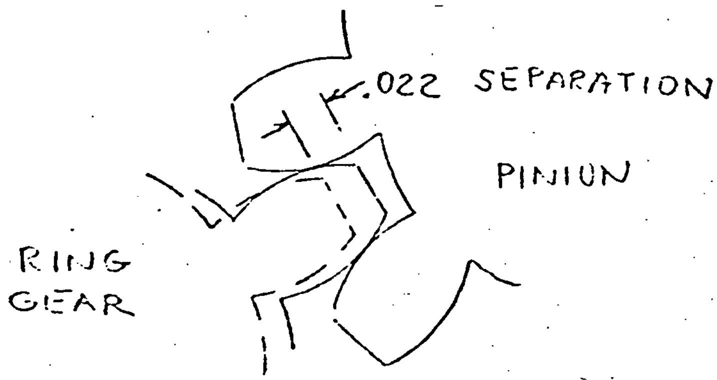
AFTER 1/8" FALL

℄ RG TO ℄ P = 35.41 in



$$\begin{array}{r} 35.022 \\ -\ 35.000 \\ \hline 0.022 \text{ in} \end{array}$$

THE RING GEAR MOVES 0.022 in. AWAY FROM PINION.



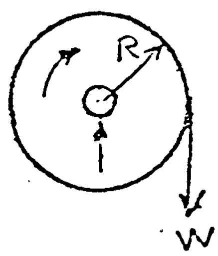
BENDING MOMENT IN GEAR TOOTH

WORKING DEPTH OF TOOTH $= \frac{1.6}{PD} = \frac{1.6}{1.5} = 1.067$ IN

DECREASE IN WORKING DEPTH $= \frac{.022}{1.067} \times 100 = 2\%$ (NEGLIGIBLE)

INCREASE IN TORQUE

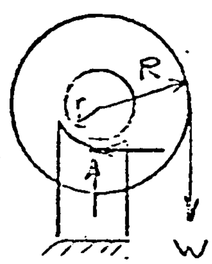
OPERATING POSITION



$T_1 = WR$ R = 24.63 IN (DRUM)

$T_1 = 24.63\ W$

HUB FAILURE POSITION



$T_2 = WR + W\mu r$ $\mu = 0.57$ STEEL ON STEEL, $r = 5.25$ IN

$T_2 = 24.63\ W + W(0.57)(5.25)$

$T_2 = 27.62\ W$

INCREASE OF TORQUE $= \frac{T_2 - T_1}{T_1} \times 100 = 12\%$ INCREASE IN REQ'D TORQUE

HOIST MOTOR

$$\text{RATED TORQUE} = \frac{5250\ HP}{RPM} = \frac{(5250)(40)}{900} = 233\ \text{FT-\#}$$

$$\text{REQ'D TORQUE} = \frac{WT \times \text{DRUM RADIUS}}{\text{RATIO} \times E_1 \times E_2}$$

$$\text{REQ'D TORQUE} = \frac{(16000)(24.63)}{(12)(6)(71.7)(.875)(.9)} = 97\ \text{FT-\#}$$

$97 + (.12)(97) = 109$ FT-# NEEDED TO OPERATE LOAD IN HUB FAILURE POSITION.

THERE IS NO EXCESSIVE LOADING ON THE GEARS OR ON THE MOTOR AFTER THE DRUM SHAFT FAILURE.