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U. S. Nuclear Regulatory Commission
Office of Standards Development
Washington, D. C. 20555

Attention: Robert B. Minogue, Director

Subject: NUREG - 0554
Single-Failure-Proof Cranes for Nuclear Power Plants

Gentlemen:

The ASME Committee on Cranes for Nuclear Power Plants has recently completed its review of NUREG - 0554, "Single-Failure-Proof Cranes for Nuclear Power Plants". As a result the attached comments have been generated to represent the consensus position of the Committee on Cranes for Nuclear Power Plants.

Yours truly,

Robert E. Glazier

Robert E. Glazier, Secretary
Committee on Cranes for Nuclear Power Plants
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ASME COMMITTEE ON CRANES

FOR NUCLEAR POWER PLANTS

(April 21, 1980)

COMMENTS ON NUREG-0554

"Single-Failure-Proof Cranes For Nuclear Power Plants"

The USNRC document titled "Single-Failure-Proof Cranes for Nuclear Power Plants" has been reviewed by members of the ASME Committee on Cranes for Nuclear Power Plants which is an ASME administered codes and standards committee under the jurisdiction of the Nuclear Codes and Standards Committee. This committee was selected tor review the above document on the basis of the experience that its members have with the document's subject matter.

On the basis of its specicific working interest with the subject matter, the Committee on Cranes for Nuclear Power Plants was selected to have primary responsibility for review of the above document and as such the committee's consensus position on the document is provided with the comments from individual committee members.

This review by ASME committee members is not to be construed as an approval or endorsement of the subject document by ASME. Rather, the review was performed and the following comments are submitted as a constructive public service for the purpose of improving future revisions of the subject document. The opinions and comments generated represent the consensus of the Committee on Cranes for Nuclear Power Plants rather than that of ASME.

COMMENT No. 1 - Section 1 INTRODUCTION

In the first paragraph it is suggested that the following definition of "critical load" be used:

A critical load is any lifted load whose uncontrolled movement or release could adversely affect any safety related system when such a system is required for unit safety or could result in potential off-site exposure comparable to the exposure guidelines outlined in 10CFR Part 100.

COMMENT No. 2 - Section 1 INTRODUCTION

In the third paragraph it is suggested that ANSI B30.2.0-1976 be referenced instead of the 1967 edition.

COMMENT No. 3 - Section 2.1 CONSTRUCTION AND OPERATING PERIODS

In the first paragraph, sixth line, the term "sufficiently" is non-specific and it's suggested that the differences between hoist drive motors be explained.

Comment No. 4 - Section 2.4 <u>MATERIAL PROPERTIES</u>

In the interest of uniformity, it is suggested that impact testing not be required for material 5/8 inch thick, or less, as is specified in ASME Boiler and Pressure Vessel Code, Section III, NC/ND-2300.

COMMENT No. 5 - Section 2.5 <u>SEISMIC DESIGN</u>

In the first paragraph, second sentence it should be reflected that under a seismic event there may be some movement, or slip, of the load through the holding brakes, but it shall not result in an uncontrolled condition.

COMMENT No. 6 - Section 2.8 <u>WELDING PROCEDURES</u>

Consideration of the physical size or the thickness of the material should be included in this Section.

COMMENT No. 7 - Section 3.3 <u>ELECTRIC CONTROL SYSTEMS</u>

In the second paragraph it is suggested that the phrase "...inadvertent operator action,..." be removed, since there is no way that the system can distinguish, or compensate for, most inadvertent operator actions. If this statement remains, it would seem to call for considerable explanation.

It is also suggested that the phrase "...and assuming no components have failed in any subsystems,... be removed, or completely explained. Cranes are already single-failure proof and this Section describes two failures.

COMMENT No. 8 - Section 4.1 <u>REEVING SYSTEM</u>

The second paragraph, last sentence, leaves open a wide latitude for interpretation. Without discussing the relationship of MCL to DRL, one interpretation permits each reeving system of a dual system to use wire rope with a design factor of five, so long as the dual system has a design factor of ten, with both systems intact. In case of failure of one system, the remaining wire rope system would still have a design factor of five.

Another interpretation requires each reeving system to have wire ropes with a design factor of ten. This would give the combined system a design factor of twenty.

COMMENT No. 9 - Section 4.4 <u>HOISTING SPEED</u>

In the second paragraph it is suggested the last sentence be deleted since line speed at the drum is a function of the design of the crane and should not be a designated number.

COMMENT No. 10 - Section 4.5 DESIGN AGAINST TWO-BLOCKING

In the second paragraph the following provisions should be incorporated.

LIMIT SWITCHES

General

A limit switch is defined as a switch that is operated by some part or motion of a power driven machine or equipment to alter the electric circuit associated with the machine or equipment. This section includes the following limit switch requirements for nuclear power plant cranes:

1. Hoist overtravel
2. Hoist overspeed
3. Hoist overload
4. Bridge and trolley overtravel limits

Limit switch requirements, if any, in addition to the above shall be incorporated in the specifications. It is recommended that the power supply for A.C. cranes include phase reversal protection to assure that the specified limit switches will function in the correct direction of motion. Specifications shall indicate if this protection is to be provided.

High Limits (Type I)

Hoists that handle critical loads shall include two separate overhoist limit switch systems.

First High Limit (Type I)

The first upper hoisting limit shall be a control circuit device such as a geared type, weight operated or paddle switch. Actuation of this switch shall result in the removal of power from the motor and setting the hoist brakes. The operator may lower or back out of this tripped switch without further assistance.

Final Overtravel High Limit (Type I)

Hoists that handle critical loads shall include in addition to a first limit, a final hoisting switch of the power circuit, block actuated type. This switch shall interrupt all power to the hoist motor and the hoist brakes directly without relying on the sequencing of any devices. Actuation of this limit switch shall prevent further hoisting or lowering. When this occurs a person knowlegeable in the hoist control system shall establish and correct the cause of the tripping of the final high limit switch. That person shall direct the lowering out of the final high limit by establishing a back out mode which shall prevent further hoisting. The first high limit shall be tested for further hoisting. The first limit shall be tested for proper operation before making and additional lifts.

High Limits (Hoists on Type II and III cranes and hoists that do not handle critical loads on Type I cranes)

A high limit as recommended by ANSI B30.2.0, 2-1.10.5d shall be furnished when specified in the crane specification.

Low Limits (Type I)

Hoists that handle critical loads shall include two separate low limits.

First Low Limit (Type I)

Each hoist that handles critical loads shall include an overtravel low limit switch. This switch may be of the control circuit type. Actuation of this switch shall stop the lowering motion and set the hoist brakes. The operation of this switch shall not prevent hoisting.

Final Overtravel Low Limit (Type I)

Hoists that handle critical loads shall include in addition to a first low limit, a final lowering limit switch of the control circuit type that shall be mechanically and electrically independent of the first low limit. Operation of this limit switch shall de-energize a power device other than the device operated by the first low limit to interrupt all power to the hoist motor and the hoist brakes. Actuation of this limit switch shall prevent further lowering or hoisting. When this occurs a person knowledgeable in the hoist control system shall establish and correct the cause of tripping of the final low limit switch. That person shall direct the raising out of the final low limit after establishing a back out mode which shall prevent further lowering. The first low limit shall be tested for proper operation before making any additional lifts.

Low Limits (Hoists on Type II and III cranes and hoists that do not handle critical loads on Type I cranes)

A low limit recommended by ANSI B30.2.0, 2-1.10-5e shall be furnished when specified in the crane specifications.

COMMENT No. 11 - Section 4.5 DESIGN AGAINST TWO-BLOCKING

The second paragraph, seventh sentence, results in differences of opinion as to what constitutes "...the maximum torque of the driving motor...," as well as presenting the possibility of contradicting the second paragraph under Section 4.9, which points out the desirability of avoiding excessive torque settings in the holding brakes. If the electrical system includes provisions for emergency removal of power from all motors and brakes, it should not be necessary to select oversized brakes capable of withstanding the maximum peak driving torque of the motor when running at maximum speed in the lower direction with maximum load on the hook.

Because the maximum torque of the driving motor is subject to interpretation it is suggested that the requirements of the proposed ASME Code on Cranes for Nuclear Power Plants be used. Section 4.5 combined with Section 8.3 also implies two independent limit devices. Additionally, it is suggested that orders of testing be described, such as lowest limit last in lifting direction.

COMMENT No. 12 - Section 4.7 WIRE ROPE PROTECTION

Side loadings which are not parallel to the grooves of the drum should not be permitted, because the guards on the drum will not necessarily prevent damage to the hoisting system.

COMMENT No. 13 - Section 4.9 HOIST BRAKING SYSTEM

The third paragraph, first sentence, defines a "braking system" as including one power control braking system and two holding brakes as a minimum. The last sentence requires the minimum number of "braking systems" to be operable for emergency lowering after a single brake failure to be two holding brakes. This might be interpreted as requiring two complete braking systems, each of which includes one power control braking system and two holding brakes, but we do not believe that is what was intended. We believe the confusion could be avoided if the last sentence at the end of Section 4.9 were to be moved to the end of the third paragraph in Section 4.9, and if the present last sentence in the third paragraph is is modified slightly, so that the last two sentences would be, "The minimum number of braking devices that should be operable for emergency lowering after a single failure in the braking system should be two holding brakes for stopping and controlling drum rotation. If a malfunction of a holding brake were to occur and emergency lowering of the load becomes necessary, the holding brake should be restored to working condition before any lowering is started, if an analysis of the situation permits it."

COMMENT No. 14 - Section 4.9 HOIST BRAKING SYSTEM

In the last paragraph, it is not desirable to make any reference to permitting the lowering velocity to increase excessively. After moving the last sentence to the end of the third paragraph, as discussed above, we would suggest that the last paragraph be replaced by the following:

"Provisions shall be made for emergency lowering of the critical load by manual operation of the holding brakes. The braking torque and shall also provide the ability to restore the "brake set" condition promptly thereby allowing the operators of the manual release mechanisms to control the lowering speed. An indication of lowering speed shall be made available. Alternate lowering and holding shall be allowed to provide time for cooling the brake mechanism in order to obtain adequate heat dissipation and to prevent a reduction in braking torque that can occur as the result of excessive heat."

This results in ommiting reference to "portable instruments," since either portable or permanent instruments could be provided to assist the operators of the manual release mechanism to control the lowering speed.

COMMENT No. 15 - Section 5.1 BRAKING CAPACITY

As discussed in COMMENT No.11, selecting brakes capable of withstanding the maximum momentary peak torque of the motor (including the effect of kinetic energy) could result in excessive brake torque. The load swing that could result from the emergency setting of brakes providing excessive torque on trolley and bridge problem could be more harzardous than a more gradual deceleration. The same problem can result if the holding brakes are rated at 100% of the maximum drive torque that can be developed. Except for the retention of the sentence beginning: "Incremental or fractional inch movement...," the remainder of this paragraph could be replaced by the following:

Application

a. All travel drives shall have service braking means.

b. When a friction brake is used for service braking the brake torque shall be sufficient to stop the drive within a distance in feet equal to 10% of rated load speed in feet per minute when traveling at full speed with rated load.

c. Emergency brakes shall be of friction type that will set automatically upon powerfailure and shall be capable of stopping the drive within the distance specified in (b).

d. Any combination of service, emergency and parking functions may be performed by a single friction brake provided that the emergency and parking functions can be obtained without having power available.

For Type I Cranes

Emergency brakes shall be provided for the travel drives.

For Type II and III Cranes

Emergency brakes shall be provided when required by the specifications.

If the prohibition of drag brakes and the provisions of manual release of the emergency brake are considered essential, those requirements could be added.

Unless other means of restricting lateral movement is provided, wheels shall be double flanged with treads accurately machined. Bridge wheels may have either straight treads or tapered treads assembledwith the larger diameter toward the center of the span. Trolley wheels should have straight treads. Drive wheels shall be matched pairs within 0.001 inches per inch of diameter or a totalof 0.010 inches on the diameter which ever is smaller. When flangeless wheels and side roller assemblies are provided they shall be of a type and design recommended by the crane manufacture.

COMMENT No. 16 - Section 5.2 SAFETY STEPS

See COMMENT No. 7 for comments on the use of the phrase "inadvertent operator action."

COMMENT No. 17 - Section 6 DRIVER SELECTION

Selecting the horsepower rating of the hoist driving motor on the basisof the design load and the design hoisting speed, as stated in the first sentence, does not take into consideration the duty to be performed or the type of control to be used with the motor. Frequent starting and stopping, prolonged operation at slow speed, and other requirements for specific installations can affect the motor horsepower rating.

COMMENT No. 18 - Section 8.2 STATIC AND DYNAMIC LOAD TESTS

If this is an acceptance test (ANSI B30.2.0 - 1976), the test load should be at 125 percent of DRL. Then the DRL is 80 percent of the test load.

COMMENT No. 19 - Section 8.3 TWO-BLOCK TESTS

Load hang-up testing by securing the load block to a fixed anchor could result in an unsafe condition and therefore, such a test should be eliminated. Also, a two-block test on the crane absorbing device should be provided.