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April 10, 1981

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U.S. NUCLEAR REGULATORY COMMISSION

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Zion Station Units 1 and 2
Control of Heavy Loads Near Spent Fuel
NRC Docket Nos. 50-295 and 50-304

References (a): July 31, 1980 letter from D. G. Eisenhut to D. L. Peoples

(b): November 7, 1980 letter from T. R. Tramm to H. R. Denton

(c): January 2, 1981 letter from T. R. Tramm to H. R. Denton

Dear Mr. Denton:

Reference (a) requested two reports documenting the results of our review of controls for the handling of heavy loads near spent fuel. References (b) and (c) provided the information requested for the first report. Attachment A to this letter contains the second and final report.

One (1) signed original and thirty-nine (39) copies of this letter are included for your use.

Please address questions regarding this matter to me.

Very truly yours,

T. R. Tramm

T. R. Tramm
Nuclear Licensing Administrator
Pressurized Water Reactors

Attachment

cc: Zion Resident Inspector
S.P. Carfagno, Franklin Research Center

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ATTACHMENT A

Partial Response to Request for Additional Information on Control of Heavy Loads

2.2. Fuel Storage Pool Vicinity

Request 1:

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 1:

The fuel building crane was manufactured by P&H Harnischfeger and is a 125 ton electric overhead traveling bridge crane with a 15 ton aux. hook designed for lifting and carrying a load 25% above the rated capacity.

An additional design consideration allows for lifting and carrying a 230-ton load nine feet from the centerline of the north crane rail.

The fuel handling bridge is a one ton electric traveling bridge manufactured by Dwight Foote with two 1 ton electric P&H Harnischfeger hoists. The electric hoists are interlocked so that it is only possible to operate one at a time.

Request 2:

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 2:

The load drop analysis for the fuel building crane has been previously submitted to the NRC in the 4/8/76 letter from R.L. Bolger to A. Schwencer, 9/14/76 letter from R.L. Bolger to A. Schwencer, and the 8/9/77 letter from D.L. O'Brien to A. Schwencer. This crane is therefore excluded from the above category.

Request 3:

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 add tional design features). For each crane so evaluated, provide the load-handling-system (i.e., crane-load-combination) information specified in Attachment 1.

Response 3:

The fuel building crane was designed to withstand an earthquake force due to horizontal accelerations of .26g transverse to the crane bridge and 2.8g longitudinal to the crane bridge in conjunction with a vertical acceleration of .06g all applied at the crane rail. The crane was designed to remain intact for horizontal accelerations of .37g transverse to the crane bridge and 4.05g longitudinal to the crane bridge in conjunction with a vertical acceleration of .09g all applied at the crane rail.

The design evaluation and load handling system have already been presented as started in 2.2.2 above.

The fuel handling bridge and all its component parts is designed to resist seismic response loads at twice the operating level of .29g horizontal and .19g vertical applied simultaneously at the center of gravity, and transmit these forces through the support to the foundations.

The design evaluation and load handling system description has been provided to the NRC in a letter dated 3/7/79 from W.F. Naughton to H.R. Denton.

Request 4:

For cranes identified in 2.2-1, above, not categorized according to 2.2-3, demonstrate that the criteria of NUREG 0612, Section 5.1, are satisfied. Compliance with Criterion IV will be demonstrated in response to Section 2.4 of this request. With respect to Criteria I through III, provide a discussion of your evaluation of crane operation in the spent fuel area and your determination of compliance. This response should include the following information for each crane:

Which alternatives (e.g., 2, 3, or 4) from those identified in NUREG 0612, Section 5.1.2, have been selected.

Response 4:

As described in Operating licenses DPR 39 and DPR 48 for Zion Units 1 & 2, no loads heavier than the weight of a single spent fuel assembly plus the tool for moving that assembly shall be carried over fuel stored in the spent fuel pool. Fuel handling tools shall not be carried at heights greater than two feet over fuel stored in the spent fuel pool.

Alternative 3 identified in Secton 5.1.2 of NUREG 0612 is applicable to Zion Units 1 & 2. The load drop analysis for the fuel building crane described in the letters referenced in 2.2.2 above preclude a heavy load drop on spent fuel and shows that the floor of the spent fuel cask well can withstand the impact of a 110 ton load consisting of the wire rope, load block, hook, lifting device, and loaded cask dropping as one unit to its floor.

This analysis also describes crane motion limitations.

Letters dated 3/5/79 and 3/17/79 from W.F. Naughton of Commonwealth Edison to H.R. Denton of the NRC provide an analysis showing that a fuel assembly and tool can be dropped on a rack from a height of two feet without causing unacceptable damage.

In conclusion to this section, the likelihood of a load drop in which spent fuel might be damaged is extremely small, and the estimated consequences of load drops from either the fuel building crane or the fuel handling bridge will not exceed the limits set by the evaluation criteria of NUREG 0612, Section 5.1, Criteria I through IV.

2.3 Containment

Request 1:

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 1:

The Zion polar cranes are Whiting Corporation 230/40 ton (rerated and reanalyzed from 225/35 ton prior to installation) double gantry circular.

The underhung hand geared bridge cranes (1 per unit) have permanently mounted seismic class 1 rails mounted to run the length of the reactor cavity. The one ton 16 wheel underhung hand geared Budgit bridge crane is installed only during an outage (it is removed and stowed in containment at all other times).

The manipulator cranes (maintenance bridge) are one ton electric traveling bridge cranes manufactured by Stearns-Roger, Inc.

Request 2:

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 2:

The underhung hand geared bridge crane is used to remove the head bolts (.5 ton) and, once the bolts have been removed, the crane is moved to the south end of the cavity on Unit 2 and the north end on Unit 1 where it is stored until the head is replaced.
When the head has been reinstalled, this crane is used to replace the head bolts, then to decontaminate the cavity walls. It is not capable of dropping anything into or on the reactor vessel when the head is off due to its location restriction. This crane is therefore excluded from the above category.

Request 3:

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 3:

The polar cranes at Zion were designed with a safety factor of 5. They were purchased for an initial lift of 460 tons with the load to be held stationary at any point within a 6 foot radius from the center of the bridge span for a 6 week period. The cranes were then rereeved and a 230 ton sister hook installed.

The polar cranes were designed to withstand an earthquake force of .16g horizontal acceleration and .06g vertical acceleration applied at the bases using working stresses for design. The cranes were also designed to remain intact and erect with a base acceleration of .34g horizontal and .12g vertical allowing the stress in the material to be at yield.
The seismic analysis for the main hook was performed for:

1) A 170 ton static load on thru leg end
2) A 170 ton dynamic load on thru leg end
3) A 170 ton static load at center of span
4) A 170 ton dynamic load at center of span

The aux. hook seismic analysis was performed for a 40 ton static and a 40 ton dynamic load on the hoist anywhere along the entire span including the full length of the overhang.

For the following reasons, Commonwealth Edison feels the likelihood of a load drop from the polar crane is extremely small:

1) A safety factor of 5 was used for the design of the 230/40 ton polar crane.
2) The box girders were designed for a 460 ton load and the maximum normal load is only 37% of this design.
3) The seismic analysis of the 230 ton hook was performed loaded with the maximum normal load (the 170 ton RPV head) on the main hook. This is only 74% of the rated load.
4) The aux hook was analyzed to include a 40 ton load while the maximum normal load is 37.5 tons or 94% of rated load.
5) The cranes are inspected in accordance with ANSI B30.2-1976 and Secion 179 of 29CFR 1910 prior to use at the beginning of each outage.

6) The main hook makes a maximum of two head lifts per outage. The aux hook makes a maximum of eight movements per outage of its heaviest load, the Reactor Coolant Pump Motor. Any other loads handled by the aux hook (17-ton shield blocks, etc.) and by the main hook (lower internals, upper internals) are greater than 50% less than the seismic design load and are approximately 33-50% of the rated load.
7) Crane operators at the Zion Station have been trained in accordance with a Commonwealth Edison Crane Operator Training Program that is in compliance with Chapters 2-3 of ANSI B30.2-1976.

Request 4:

For cranes identified in 2.3.1, above, not categorized according to 2.3-3, demonstrate that the evaluation criteria of NUREG 0612, Section 5.1, are satisfied. Compliance with Criterion IV will be demonstrated in your response to Section 2.4 of this request. With respect to Criteria I through III, provide a discussion of your evaluation of crane operation in the containment and your determination of compliance.

Response 4:

The manipulator crane was designed to the same seismic criteria as the spent fuel handling bridge (identified in response to question 2.2.3) and the design evaluation and load handling system description is identical to that of the spent fuel handling bridge. That design evaluation was presented to the NRC in the March 7, 1979 letter from W.F. Naughton to H.R. Denton. The load drop analysis provided to the NRC in the letters dated March 5, 1979 and March 17, 1979 from W.F. Naughton to H.R. Denton is also applicable to this crane. Therefore, a load drop from the manipulator crane will not exceed the limits set by the evaluation criteria of NUREG 0612, Section 5.1, Criteria I through IV.

2.4 Areas containing equipment required for Reactor shutdown, core decay heat removal, or spent fuel pit cooling.

General:

NUREG 0612, Section 5.1.5, provides guidelines concerning the design and operation of load-handling systems in the vicinity of equipment or components required for safe reactor shutdown and decay heat removal. Information provided in response to this section should be sufficient to demonstrate that adequate measures have been taken to ensure that in these areas, either the likelihood of a load drop which might prevent safe reactor shutdown or prohibit continued decay heat removal is extremely small, or that damage to such equipment from load drops will be limited in order not to result in the loss of these safety-related functions. Cranes which must be evaluated in this section have been previously identified in your response to 2.1-1, and their loads in your response to 2.1-3-c.

General Response:

Four cranes identified in 2.1.1 will be eliminated from discussion.

The underhung hand geared bridge crane is rated at 1 ton capacity and carries a maximum load of approximately .5 ton. This is less than the defined heavy load of NUREG 0612. Because of the size of the largest load and the restriction on its movement during the times the head is removed a load drop from this crane would not cause the loss of any safety-related functions.

The 2 ton trolley in the aux building is deleted since a load drop of 2 tons (such as a fan motor or plenum) would not damage any safety related equipment as it is located to the northeast side of the stairwell between columns 23 and 17 on drawing MS-681. No safety related equipment is located in this area of the 642' level. No safety related equipment is located within 10 feet of the stairwell all the way down to the 542' level. A physical inspection down the stairwell has confirmed that no safe shutdown or decay heat removal component would be damaged by the drop of any load being moved.

The 2 ton trolleys located in each diesel generator room have been eliminated since only one diesel generator may be removed from service during plant operations as specified in the Zion technical specifications. A load drop could remove a diesel from service. However, as provided in the technical specifications, the redundancy of the other four diesels will allow for plant operations for seven (7) days (12 days if the 1A diesel is removed from service) with no loss of safety-related functions. If repairs have not been effected in this period the reactor must be shut down.

The 10 ton hoist on the 16 ton crib house monorail is also eliminated from this category.

The service water system has six service water pumps feeding a common header. Normal plant operations require two pumps on each unit with a third pump serving as a standby. Per the Zion technical specification one pump may be out of service for maintenance.
The worst case accident for the 10 ton hoist on the 16 ton crib house monorail would be dropping one service water pump motor directly on to a second service water pump motor thereby destroying both of them.
Per the Zion tech specs, should this happen the units shall be brought to the hot shutdown condition within 4 hours and to the cold shutdown condition within 24 hours after that.
Therefore, damage to this equipment from a load drop does not result in the loss of safety-related functions of the system.

Request 1:

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 1:

The analyses described in 2.2 and 2.3 above show the spent fuel building crane, the spent fuel bridge, and the manipulator cranes have sufficient design features to make the likelihood of a load drop extremely small. The load drop analyses have shown that the consequences of load drops from any of these three cranes will not exceed the limits set by the evaluation criteria of NUREG 0612, Section 5.1, Criteria I through IV. The postulated load drop for the manipulator crane inside the reactor cavity would result in no loss of safe shutdown or decay heat removal equipment since these lines are not in the movement path. The design description of the 230/40 ton polar cranes of 2.3 above show that these cranes have sufficient design features to make the likelihood of a load drop extremely small.

The load handling system for the spent fuel crane is the crane, load block, hook, cask yoke and the NLI 10/24 spent fuel cask. The load handling system for the spent fuel bridge and the manipulator crane is the fuel handling tool and a spent fuel assembly.
The load handling system for the 230 ton main polar crane hook is the crane, load block, hook, lifting rig, and reactor vessel head.
The RCP, tripod, braided cable, shackle, hook, and load block is the handling system for the 40 ton aux hook on the polar crane.

Request 2:

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 for 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. Figure 1 provides a typical matrix.

Response 2:

Table 2.4.2 shows the matrix for heavy loads and potential impact areas.

* This designation on the table indicates that these loads move over the reactor cavity.

** Loads with this designation can only be moved around the containment at the 617' level as shown on drawing MS-682. This is the only area open enough to allow movement of anything on the aux hook around the containment.

Request 3:

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. Elimination on the basis of the aforementioned considerations should be supplemented by the following specific information:

(1) 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 3:

No safety related equipment other than the reactor pressure vessel is located inside the reactor cavity. Only the vessel head and upper internals are moved over the open vessel. The lower internals can only be moved when the core has been off-loaded, thus eliminating this load drop from safety consideration.

A load drop inside the reactor cavity area that might cause damage to a primary coolant leg would not disable the RHR, SI, or charging lines as they all have hot and cold leg taps outside the missile wall.

The following load/target combinations have been eliminated because of physical separation from and/or redundancy of safety-related equipment:

1. Manipulator crane - one spent fuel cell and fuel handling tool.
2. Underhung had geared bridge crane - reactor head bolt
3. Polar crane main hook - reactor pressure vessel head, lower and upper internals.
4. Polar crane aux. hook - 17 ton concrete slabs

The following load has been eliminated because of physical separation from safety related equipment (from 2.4 general).

The 2 ton trolley at the 666' level in the aux. bldg - fan motor or plenum.

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The following loads have been eliminated because of redundancy of safety-related equipment (from 2.4 general):

1. The 2 ton trolley in each diesel generator room - exhaust manifold or supercharger

2. The 10 ton trolley on the 16 ton monorail on the crib house roof. - service water pump motor

The spent fuel building crane and fuel cask, and the spent fuel bridge and the manipulator crane and their load of a spent fuel cell with fuel handling tool have been eliminated as described in 2.2 and 2.3.

Request 4:

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 4:

The only load not eliminated by response 3 above is the reactor coolant pump motor on the polar crane aux. hook.

On drawing MS-682, provided in our response to Section 2.1, the containments have been divided into two (2) areas: 1) that area at the entry way of Unit 1 between Z4 and Z6 and that area at the entry way of Unit 2 between Z29 and Z31; and 2) all other areas inside the Unit 1 and Unit 2 containments.

The following will address only Unit 1 but will apply to the same area of Unit 2 as described above.

The small area between Z4 and Z6 at elevation 617' is directly over the pipe penetration area that contains the RHR, charging, and SI headers. Each of these headers splits into two orificed semicircular loops: the east side loop feeding primary loops 1 and 2 and the west side loop feeding primary loops 3 and 4.

Should a load drop of a reactor coolant pump motor occur outside the area bounded by Z4 and Z6, it could only destroy one loop of the headers. Because all three systems, RHR, SI, and charging are orificed, the water flow from the damaged loops would be restricted and the other half of the header could supply total water requirements to the reactor.

Because of the redundancy of the systems, a load drop outside Z4 and Z6 is eliminated from this category.

Between Z4 and Z6 the potential for a loss of safety function accident exists. A highest average of four coolant pump motor movements an outage are made in this area and each move is kept as close to the floor as practical. When considered with the total number of load movements in this area each outage (e.g. welding units, replacement pipe, snubbers, etc.) and our response to question 2.3.3 above, the likelihood of a load drop that would disable the decay heat removal systems is extremely small. Therefore no changes to Zion plant design or plant procedures are being considered by Commonwealth Edison.

TABLE 2.4.2

Crane	Location	Elevation	Load	Hazard Area	S/R Equip.	Hazard Elimination Category
Spent fuel building crane	Fuel Building	617'	Spent fuel cask NLI 10/24	Spent fuel cask well	Spent fuel pit	b
Spent fuel handling bridge	Fuel Building	617'	Spent fuel cell and handling tool	Spent fuel pool	Spent fuel and racks	c,e
Two ton trolley	Aux. Building	660'0"	Fan motor or plenum	Fan room Col. Row N/18-20	None	c
Two ton trolley	Aux. Bldg.-Each Diesel Generator Room	615'0"	Exhaust manifold or supercharger	Diesel Generator Room	Diesel Generator	b
Two ton trolley	Crib house	647'0"	SW pump motor	Crib house SW pump area	SW pumps	b
Underhung hand-geared bridge crane	Rx Building	591'0"	Rx head bolts	Rx cavity	Rx vessel	c,e
Manipulator crane	Rx Building	591'0"	Spent fuel cell and handling tool	Rx cavity	Rx vessel Spent fuel	c,e
Polar crane 230 ton	Rx Building	Rail Elev. 617'	*170 ton RPV head	Rx cavity	Rx vessel	d
			*73.5 to lower internals	Rx cavity	Rx vessel	d
			*60 ton upper internals	Rx cavity	Rx vessel	d
Polar Crane 35 ton Aux hook	Rx Building	Rail Elev. 617'	*17 ton concrete slab	Rx cavity	Rx vessel	d
			**37.5 ton RCP motor	617' elev. outside the missile wall	Containment fans, fan coolers, SI, decay heat removal, charging lines.	d
			**51 ton RC pump (removed in parts)	617' elev. outside the missile wall	Containment fans, fan coolers, SI, decay heat removal, charging lines.	

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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. section 5.1.6 NUREG 0612 satisfied).

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

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