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CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
SEABROOK STATION UNITS 1 AND 2
(PHASE II)

Docket Nos. 50-443 and 50-444

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ABSTRACT

The Nuclear Regulatory Commission (NRC) has requested that all nuclear plants, either operating or under construction, submit a response of compliancy with NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." EG&G Idaho, Inc., has contracted with the NRC to evaluate the responses of those plants presently under construction. This report contains EG&G's evaluation and recommendations for Seabrook Units 1 and 2 for the requirements of Sections 5.1.2, 5.1.3, 5.1.5, and 5.1.6 of NUREG-0612 (Phase II). Section 5.1.1 (Phase I) was covered in a separate report [1].

EXECUTIVE SUMMARY

Seabrook Station does not totally comply with the guidelines of NUREG-0612. In general, compliance is insufficient in the following areas:

- o Information on the Spent-Fuel Pool Area cranes to determine that the criteria for NUREG-0612 are met.

- o Information on the effects of possible load drops from the containment area cranes is inadequate.

- o Information on cranes and hoists located over safe shutdown equipment was inadequate for determining full compliance with NUREG-0612 criteria.

The main report contains recommendations which will aid in bringing the above items into compliance with the appropriate guidelines.

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SEABROOK STATION UNITS 1 AND 2
(PHASE II)

1. INTRODUCTION

1.1 Purpose of Review

This technical evaluation report documents the EG&G Idaho, Inc., review of general load-handling policy and procedures at Seabrook. This evaluation was performed with the objective of assessing conformance to the general load-handling guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" [2], Sections 5.1.2, 5.1.3, 5.1.5, and 5.1.6. This constitutes Phase II of a two-phase evaluation. Phase I assesses conformance to Section 5.1.1 of NUREG-0612 and was documented in a separate report [1].

1.2 Generic Background

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to assure the safe handling of heavy loads and to recommend necessary changes to these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [3], to all power reactor applicants, requesting information concerning the control of heavy loads near spent fuel.

The results of Task A-36 were reported in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The staff's conclusion from this evaluation was that existing measures to control the handling of heavy loads at operating plants, although providing protection from certain potential problems, do not adequately cover the major causes of load-handling accidents and should be upgraded.

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-phase objective using an accepted approach or protection philosophy. The first portion of the objective, achieved through a set of general guidelines identified in NUREG-0612, Article 5.1.1, is to ensure that all load-handling systems at nuclear power plants are designed and operated such that their probability of failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Articles 5.1.2 through 5.1.5, is to ensure that, for load-handling systems in areas where their failure might result in significant consequences, either (a) features are provided, in addition to those required for all load-handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (b) conservative evaluations of load-handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense in depth and is summarized as follows:

- Provide sufficient operator training, handling system design, load-handling instructions, and equipment inspection to assure reliable operation of the handling system

- Define safe load travel paths through procedures and operator training so that, to the extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment

- Provide mechanical stops or electrical interlocks to prevent movement of heavy loads over irradiated fuel or in proximity to equipment associated with redundant shutdown paths.

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612.

1.3 Plant-Specific Background

On December 22, 1980, the NRC issued a letter [4] to the applicant for Seabrook requesting that the applicant review provisions for handling and control of heavy loads at Seabrook, evaluate these provisions with respect to the guidelines of NUREG-0612, and provide certain additional information to be used for an independent determination of conformance to these guidelines. The Public Service Company of New Hampshire provided responses to this request in September 1982 [5] and June 1983 [6].

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize the Public Service Company of New Hampshire's review of heavy load handling at Seabrook accompanied by EG&G's evaluation, conclusions, and recommendations to the applicant for bringing the facilities more completely into compliance with the intent of NUREG-0612.

2.2 Heavy Load Overhead Handling Systems

Table 2.1 presents the applicant's list of overhead handling systems which are subject to the criteria of NUREG-0612. The applicant has indicated that the weight of a heavy load for the facilities as 2000 lbs per the NUREG-0612 definition.

2.3 Guidelines

2.3.1 Spent-Fuel Pool Area [NUREG-0612, Article 5.1.2]

(1) "The overhead crane and associated lifting devices used for handling heavy loads in the spent-fuel pool area should satisfy the single-failure-proof guidelines of Section 5.1.6 of this report.

OR

(2) "Each of the following is provided:

(a) Mechanical stops or electrical interlocks should be provided that prevent movement of the overhead crane load block over or within 15 feet horizontal (4.5 meters) of the spent-fuel pool. These mechanical stops or electrical interlocks should not be bypassed when the pool contains 'hot' spent fuel, and should not be bypassed without approval from the shift supervisor (or other designated plant management personnel). The mechanical stops and electrical interlocks should be verified to be in place and operational prior to placing 'hot' spent fuel in the pool.

TABLE 2.1 CRANE/HOIST SYSTEMS CONSIDERED AS POTENTIAL SOURCES FOR DAMAGE OF SAFETY COMPONENTS

TAG NO.	HANDLING SYSTEM	CAPACITY	LOCATION
MM-CR-3	Polar Gantry Crane	420 Ton Main 50 Ton Auxiliary	Containment
FH-RE-24	Radial Arm Stud Tensioner Hoists (3)	2 Tons	Containment
FH-RE-1	Spent Fuel Cask Handling Crane	125 Ton Main, Two Auxiliary Hooks at 5 Tons Each	Fuel Storage Building
CS-CR-5	Filter Cask Monorail Hoist	7.5 Tons	Primary Auxiliary Building
CS-CR-6	Boric Acid Batching Monorail Hoist	4.5 Tons (2.25T)*	Primary Auxiliary Building
CS-CR-13	CVCS Heat Exchanger Service Monorail Hoist	5 Tons	Primary Auxiliary Building
CS-CR-14A, 14B & 14C	Charging Pump Service Monorail Hoist	2.5/2.5/6.0 Tons	Primary Auxiliary Building
CC-CR-15A & 15B	Component Cooling Water Pump Service Monorail Hoist	5 Tons	Primary Auxiliary Building
CBS-CR-18A & 18B	Radioactive Pipe Tunnel Service Monorail Hoist	2 Tons	Radioactive Pipe Tunnel
MS-CR-25A & 25B	Main Stream and Feedwater Pipe Chase Crane	7.5 Tons	MS and FW Pipe Chase
FW-CR-27	Emergency Feed Pump Monorail Hoist	5 Tons	Emergency Feedwater Pump Building
DG-CR-28A & 28B	Diesel Generator Service Crane	8 Tons	Diesel Generator Building

* Capacity shown in parentheses is the derated capacity.

(b) The mechanical stops or electrical interlocks of 5.1.2(2)(a) above should also not be bypassed unless an analysis has demonstrated that damage due to postulated load drops would not result in criticality or cause leakage that could uncover the fuel.

(c) To preclude rolling if dropped, the cask should not be carried at a height higher than necessary and in no case more than six (6) inches (15 cm) above the operating floor level of the refueling building or other components and structures along the path of travel.

(d) Mechanical stops or electrical interlocks should be provided to preclude crane travel from areas where a postulated load drop could damage equipment from redundant or alternate safe shutdown paths.

(e) Analyses should conform to the guidelines of Appendix A.

<u>OR</u>

(3) "Each of the following are provided (Note: This alternative is similar to (1) above, except it allows movement of a heavy load, such as a cask, into the pool while it contains 'hot' spent fuel if the pool is large enough to maintain wide separation between the load and the 'hot' spent fuel.):

(a) 'Hot' spent fuel should be concentrated in one location in the spent-fuel pool that is separated as much as possible from load paths.

(b) Mechanical stops or electrical interlocks should be provided to prevent movement of the overhead crane load block over or within 25 feet horizontal (7.5 m) of the 'hot' spent fuel. To the extent practical, loads should be moved over load paths that avoid the spent-fuel pool and kept at least 25 feet (7.5 m) from the 'hot' spent fuel unless necessary. When it is necessary to bring loads within 25 feet of the restricted region, these mechanical stops or electrical interlocks should not be bypassed unless the spent fuel has decayed sufficiently as shown in Table 2.1-1 and 2.1-2, or unless the total inventory of gap activity for fuel within the protected area would result in off-site doses less than 1/4 of 10 CFR Part 100 if released, and such bypassing should require the approval from the shift supervisor (or other designated plant management individual). The mechanical stops or electrical interlocks should be verified to be in place and operational prior to placing 'hot' spent fuel in the pool.

(c) Mechanical stops or electrical interlocks should be provided to restrict crane travel from areas where a postulated load drop could damage equipment from redundant or alternate safe shutdown paths. Analyses have demonstrated that a postulated load drop in any location not restricted by electrical interlocks or mechanical stops would not cause damage that could result in criticality, cause leakage that could uncover the fuel, or cause loss of safe shutdown equipment.

(d) To preclude rolling, if dropped, the cask should not be carried at a height higher than necessary and in no case more than six (6) inches (15 cm) above the operating floor level of the refueling building or other components and structures along the path of travel.

(e) Analyses should conform to the guidelines of Appendix A.

OR

(4) "The effects of drops of heavy loads should be analyzed and shown to satisfy the evaluation criteria of Section 5.1 of this report. These analyses should conform to the guidelines of Appendix A."

A. Summary of Applicant's Statements

The applicant has not identified any cranes as being capable of carrying heavy loads over the vicinity of the fuel storage pit. The following statements were made by the applicant regarding cranes in the vicinity of the spent fuel pool:

(1) Spent Fuel Pool Bridge and Hoist

The spent fuel pool bridge and hoist does not handle heavy loads. The only loads carried by the hoist over the spent fuel pool are the fuel assemblies with or without control elements and their associated handling tools, and burnable poison rod assemblies and handling tools. The hoist will be derated to one (1) ton by displaying new rated load on the unit, clearly legible from the operating position. Therefore, this load handling system has not been included.

(2) Spent Fuel Cask Handling Crane

The cask handling crane is excluded because of its location in the Fuel Storage Building relative to the spent fuel storage pool.

The design of the layout of the cask loading pool, spent fuel storage area and cask storage and decontamination area eliminates the need to move the cask and other heavy loads over the spent fuel. Since both the cask handling crane rails are outside the boundaries of the spent fuel storage pool--both rails are on the east side--it is physically impossible for any of the three hooks to travel over the spent fuel storage pool.

In the extreme position of the trolley, the centerline of the 125 ton main hook is 10 ft away from the spent fuel storage pool boundary. The cask design has not yet been finalized; however, use of the preliminary dimensions in the load drop analysis indicates that in the unlikely event of a cask drop in the loading pool, integrity of the storage pool will not be breached nor would any damage occur to the stored spent fuel. A loss os spent fuel storage pool water will be prevented by the isolation gate in the wall.

The centerline of the two 5 ton auxiliary hooks, in the extreme position of the hoists, cannot move closer than 8 ft-8 in. to the storage pool boundary.

The auxiliary hook number 1 is normally used to handle single fuel elements. The new fuel containers, each weighing about 6,700 lbs, are normally handled by auxiliary hook number 2. The area in the Fuel Storage building allocated to storage and handling of the new fuel containers eliminates the need to carry the containers near the spent

fuel storage area or the cask loading pool. In the unlikely event of inadvertent carrying of the new fuel containers near the spent fuel storage area and coincident failure of the load handling system, the container will fall in the cask loading pool only since the center of gravity of the load falls approximately 2 ft-8 in. from the outer edge (or 8 ft-8 in. from the inner edge) of the spent fuel storage pool wall.

PSNH takes exception, on the basis of plant specific design, to the 15 ft requirement for minimum distance of the hook centerline from the spent fuel pool boundary. The ten (10) feet separation presently allowed in the Seabrook Station design is more than sufficient, due to the physical layout, to ensure that the cask, if dropped, does not fall into the spend fuel storage pool or compromise its integrity. The limits imposed on the hook travel will again be reviewed, when the cask dimensions are finalized; and, if necessary, feasibility of moving the fixed mechanical stops to increase this distance will be examined.

Radiological consequences of a spent fuel cask drop accident are presented in FSAR Section 15.7.5.

B. EG&G Evaluation

EG&G agrees with the applicant's statement that the spent fuel pool bridge and hoist need not conform to this guideline since no heavy loads are handled by it. However, we feel that the guideline requirements are applicable to the spent fuel cask handling crane.

Based on the statements made by the applicant the spent fuel cask handling crane is consistent with the intent of NUREG-0612 criteria to a substantial degree. Areas of concern are as follows:

(1) The applicant states that the radiological consequences of a spent fuel cask drop accident are presented in the FSAR. Since this material was not provided to EG&G we were unable to evaluate this item. NUREG 0612 suggests that doses be equal to or less than 1/4 of 10 CFR 100 limits. We were unable to determine if this requirement is met.

(2) Mechanical stops used at Seabrook keep the main crane hook approximately 10 ft-0 in. from the storage pool. NUREG-0612 requirements are that a 15 ft-0 in. distance be used. However, an adequate justification of the 10 ft-0 in. distance is provided.

(3) In the extreme position the auxiliary hooks are 8 ft-8 in. from the storage pool. If the loads carried by these hooks are precluded from rolling into the pool then the intent of the guideline seems to be met for this situation.

(4) Procedures for installation and removal of mechanical stops are not discussed. The stops appear to be in place at all times however this is not clear. Discussion of who is designated to allow bypass of stops was not provided by the applicant.

(5) NUREG-0612 5.1.2 2c requires that casks be carried no higher than necessary and in no case more than six (6) in. above the floor level. No information was available from the applicant on this requirement.

C. EG&G Conclusions and Recommendations

Information available to EG&G was inadequate to properly evaluate whether the applicable Seabrook crane is consistent with the requirements of this guideline. EG&G recommends that the applicant provide additional information as stated in the previous evaluation.

2.3.2 Reactor Building [NUREG-0612, Article 5.1.3]

(1) "The crane and associated lifting devices used for handling heavy loads in the containment building should satisfy the single-failure-proof guidelines of Section 5.1.6 of this report.

OR

(2) "Rapid containment isolation is provided with prompt automatic actuation on high radiation so that postulated releases are within limits of evaluation Criterion I of Section 5.1 taking into account delay times in detection and actuation; and analyses have been performed to show that evaluation criteria II, III, and IV of Section 5.1 are satisfied for postulated load drops in this area. These analyses should conform to the guidelines of Appendix A.

OR

(3) "The effects of drops of heavy loads should be analyzed and shown to satisfy the evaluation criteria of Section 5.1. Loads analyzed should include the following: reactor vessel head; upper vessel internals; vessel inspection platform; cask for damaged fuel; irradiated sample cask; reactor coolant pump; crane load block; and any other heavy loads brought over or near the reactor vessel or other equipment required for continued decay heat removal and maintaining shutdown. In this analysis, credit may be taken for containment isolation if such is provided; however, analyses should establish adequate detection and isolation time. Additionally, the analysis should conform to the guidelines of Appendix A."

A. Summary of Applicant's Statements

The applicant has identified the polar gantry crane and the stud tensioner hoists as being capable of carrying heavy loads over the reactor vessel. The manipulator crane and a jib crane are excluded on the basis that their loads are less than the defined heavy load. The following statements were made regarding the applicable crane and hoists:

"The polar gantry crane has been evaluated as having sufficient design features to make the likelihood of a load drop extremely small. The basis selected for this evaluation is essential compliance with NUREG 0612, Section 5.1.6, supplemented by additional design features."

"The stud tensioner hoists are used for removal and installation of stud tensioners during reactor vessel head removal and installation. In normal operation, these hoists are not stored on the monorails attached to the underside of the head lifting device, and therefore do not pose any safety hazard. During refueling shutdowns, the hoists are suspended from the monorails and handle studs and stud tensioners. The heaviest load is the stud tensioner weighing about 2,500 lb. Since these components are handled only when the head is still covering the reactor vessel, no damage can be caused to the irradiated fuel or safety related equipment. When the head is removed to its storage location, the stud tensioner hoists are also removed along with the head lifting device."

Based on the above statement the applicant excluded the stud tensioner hoists from further consideration.

B. EG&G Evaluation

Our evaluation of the polar crane is contained in the section on single-failure-proof handling systems. (See Section 2.3.4B.)

The applicants statement that the load tensioner hoist can be excluded is probably consistent with the intent of the guideline based on our opinion as to what the effects of a load drop from these hoists would be. However, without some sort of analysis this is just an opinion and is not backed up by any hard facts. A simple analysis of the effects of a load drop on the reactor or reactor head is recommended by EG&G.

C. EG&G Conclusions and Recommendations

Conclusions and recommendations for the polar crane are included in Section 2.3.4C. We recommended that an analysis of the effects of a load drop from the stud tensioner hoist be performed.

2.3.3 Other Areas [NUREG-0612, Article 5.1.5]

(1) "If safe shutdown equipment are beneath or directly adjacent to a potential travel load path of overhead handling systems, (i.e., a path not restricted by limits of crane travel or by mechanical stops or electrical interlocks) one of the following should be satisfied in addition to satisfying the general guidelines of Section 5.1.1:

(a) The crane and associated lifting devices should conform to the single-failure-proof guidelines of Section 5.1.6 of this report;

OR

(b) If the load drop could impair the operation of equipment or cabling associated with redundant or dual safe shutdown paths, mechanical stops or electrical interlocks should be provided to prevent movement of loads in proximity to these redundant or dual safe shutdown equipment. (In this case, credit should not be taken for intervening floors unless justified by analysis.)

OR

(c) The effects of load drops have been analyzed and the results indicate that damage to safe shutdown equipment would not preclude operation of sufficient equipment to achieve safe shutdown. Analyses should conform to the guidelines of Appendix A, as applicable.

(2) "Where the safe shutdown equipment has a ceiling separating it from an overhead handling system, an alternative to Section 5.1.5(1) above would be to show by analysis that the largest postulated load-handled by the handling system would not penetrate the ceiling or cause spalling that could cause failure of the safe shutdown equipment."

A. Summary of Applicant's Statements

Four (4) types of cranes or hoists applicable to this guideline are associated with the servicing of redundant equipment. They are provided exclusively for maintenance of equipment underneath and carry no other loads. The following cranes or hoists were classified by the applicant as being applicable to the above statements:

(1) Charging Pump Service Monorail Hoists (CS-CR-14A, -14B and -14C)

(2) Radioactive Pipe Tunnel Service Monorail Hoists (CBS-CR-18A and 18B)

(3) Main Steam and Feedwater Pipe Chase Cranes (MS-CR-25A and 25B)

(4) Diesel Generator Service Cranes (DG-CR-28A and 28B)

The polar gantry crane boric acid batching monorail, the emergency feed pump monorail, CVCS heat exchanger service monorail, filter cask monorail and the component cooling water pump service monorails are considered to have sufficient design features to make the likelihood of a load drop extremely small for all load-impact area combinations. The basis selected for this evaluation is essential compliance with Section NUREG 0612, including increased design safety factors.

B. EG&G Evaluation

The cranes and hoist systems which service only one piece of safety related equipment are probably consistent with the guideline. However the applicant should confirm our assumption that during servicing no loads can be carried over other items

needed for safe shutdown. Discussion of mechanical locks, electrical interlocks, and other procedures to prevent movement of loads over safety related equipment was inadequate in most cases. If the hoists and cranes are incapable of carrying loads over other safety related equipment then we feel that the four (4) types of handling systems mentioned are consistent with this guideline.

Evaluation of cranes and hoists classified as essentially single-failure-proof is included in Section 2.3.4B.

C. EG&G Conclusions and Recommendations

We recommend that where dual or redundant equipment is involved that the applicant confirm that load drops for servicing or maintaining one piece of equipment will not damage the redundant piece or other safe shutdown equipment. This could be done by stating in a more definite and detailed fashion how movement in proximity to safe shutdown equipment is prevented.

Conclusions and recommendations for cranes and hoists classified by the applicant as single-failure-proof are in 2.3.4C of the following section.

2.3.4 Single-Failure-Proof Handling Systems [NUREG-0612, Article 5.1.6]

(1) "Lifting Devices:

(a) Special lifting devices that are used for heavy loads in the area where the crane is to be upgraded should meet ANSI N14.6 1978, 'Standard For Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More For Nuclear Materials,' as specified in Section 5.1.1(4) of this report except that the handling device should also comply with Section 6 of ANSI N14.5-1978. If only a single lifting device is

provided instead of dual devices, the special lifting device should have twice the design safety factor as required to satisfy the guidelines of Section 5.1.1(4). However, loads that have been evaluated and shown to satisfy the evaluation criteria of Section 5.1 need not have lifting devices that also comply with Section 6 of ANSI N14.6.

(b) Lifting devices that are not specially designed and that are used for handling heavy loads in the area where the crane is to be upgraded should meet ANSI B30.9-1971, 'Slings' as specified in Section 5.1.1(5) of this report, except that one of the following should also be satisfied unless the effects of a drop of the particular load have been analyzed and shown to satisfy the evaluation criteria of Section 5.1:

(i) Provide dual or redundant slings or lifting devices such that a single component failure or malfunction in the sling will not result in uncontrolled lowering of the load;

OR

(ii) In selecting the proper sling, the load used should be twice what is called for in meeting Section 5.1.1(5) of this report.

(2) "New cranes should be designed to meet NUREG-0554, 'Single-Failure-Proof Cranes for Nuclear Power Plants.' For operating plants or plants under construction, the crane should be upgraded in accordance with the implementation guidelines of Appendix C of this report.

(3) "Interfacing lift points such as lifting lugs or cask trunions should also meet one of the following for heavy loads handled in the area where the crane is to be upgraded unless the effects of a drop of the particular load have been evaluated and shown to satisfy the evaluation criteria of Section 5.1:

(a) Provide redundancy or duality such that a single lift point failure will not result in uncontrolled lowering of the load; lift points should have a design safety factor with respect to ultimate strength of five (5) times the maximum combined concurrent static and dynamic load after taking the single lift point failure.

<u>OR</u>

(b) A non-redundant or non-dual lift point system should have a design safety factor of ten (10) times the maximum combined concurrent static and dynamic load."

A. <u>Summary of Applicant's Statements</u>

The polar gantry crane, boric acid batching monorail, emergency feed pump monorail, CVCS heat exchanger service monorail, filter cask monorail, and component cooling water pump service monorail were considered by the applicant to be in essential compliance with the above requirements. The applicant has made a point-by-point comparison of the polar crane to the requirements delineated in NUREG 0554. Areas where full compliance is indicated are not repeated here. Areas where alternate methods of compliance are indicated are as follows:

1. <u>Requirement</u>: Auxiliary hoisting systems employed to lift or assist in handling critical loads should be single-failure-proof.

The main hoisting mechanism should be provided with redundant or dual components.

<u>Actual</u>: The main and auxiliary hoists are not single-failure-proof; however, they have sufficient design features to guard against a load drop. The hoists are equipped with dual upper limit switches to prevent two-blocking. The heavy loads identified do not exceed 50% of the rated capacity of the hoists, with the exception of equipment hatch cover, thereby increasing the available safety factors to 10 or greater. A

minimum safety factor of 5 will be maintained while handling equipment hatch cover with the auxiliary hoist and the hatch cover handling boom.

The equipment hatch cover will be handled only when the reactor is in COLD SHUTDOWN with the residual heat removal system in operation. Technical Specifications also prohibit opening of the equipment hatch during refueling operations.

2. Requirement: Dual reeving system each providing separate load balance on the head and load blocks through a configuration of ropes and rope equalizers, is required.

Actual: The auxiliary hook is equipped with a single rope reeving system employing a single drum and 12 parts of 5/8 in. diameter 6 x 37 regular lay wire center rope. The anticipated loads to be handled by this hook during plant operation will provide design safety factors of greater than 10, except equipment hatch cover for which a minimum safety factor of 5 is maintained.

3. Requirement: The load hoisting drum 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.

Actual: Each of the two load hoisting drums is supported at each end by a roller bearing mounted in a pedestal, and is driven through a gear and pinion at one end. The crane design does not include any special retaining features to limit the excessive drop of the drum in the event of a shaft or

bearing failure. Therefore, depending upon the failure, the drum might disengage from the driving pinion, or alternatively in the case of a small drop it may still remain partially engaged. However, this failure is not credible because of increased safety margins allowed in the design of the polar crane. By considering an MCL of 210 tons, the safety factor provided is 10.

4. Requirement: The load block assembly should be provided with two load-attaching points, each designed to support a load of three times the load being handled without permanent deformation.

Actual: The crane is equipped with a single attachment sister hook (main) with a pinhole and safety latches. As per Appendix C to NUREG 0612, a safety factor of 10 is provided to compensate for loss of the single-failure-proof feature.

The 50 ton auxiliary hook is of the single prong type and is equipped with a safety latch. The increased safety factors provided for the auxiliary hoisting system enhance the reliability of the load hoisting system.

5. Requirement: Where gear trains are interposed between the holding brakes and the hoisting drum, these gear trains should be of single failure proof design.

Actual: The hoisting machinery is not equipped with single failure proof or redundant gear trains. Depending upon the failure, a single active component failure in the gear train between the holding brakes and the hoisting drum could render

the train ineffective in transmitting power or holding the drum with the brakes activated. However, increased factors of safety employed in the design of the gear case and other components will make sure failures incredible.

6. Requirement: The holding brake system should be single failure proof.

Provision for manual operation of the hoisting brakes during emergency conditions should be included in the crane design.

Actual: One of the two holding brakes is directly applied to the motor shaft and the other with a time delay is designed to apply to an intermediate shaft in the gear train. Following a malfunction or failure of one brake, the other independent brake is capable of holding the hoisting drums to eliminate the possibility of an accidental load drop. The interposing gear trains are discussed above. The brakes are automatically applied upon power interruption or in the event of an overspeed or overload condition.

The holding brakes are not equipped with any level or other design feature to aid in controlled lowering of the load under emergency conditions. However, the design of this crane makes the occurrence of an event requiring such action extremely remote. The main hoist and the auxiliary hoist each have an independent precision drive in addition to the primary drive. However, should a manual lowering of the load be required,

one of several means of control of brake shoe adjustment could be locally devised to permit a controlled lowering of the load.

The applicant's statements regarding the remaining hoists classified as essentially single-failure-proof are as follows:

BORIC ACID BATCHING MONORAIL HOIST (CS-CR-6)

The boric acid batching monorail system is designed for a capacity of 4.5 tons. The normal loads anticipated for this hoist such as pallets of boric acid will be limited to 50 percent of the hoist capacity. That is, the monorail will be derated to 2.25 ton capacity. In addition, the standard lifting apparatus will have a safety factor of 10 or greater, or will be of redundant design.

EMERGENCY FEED PUMP MONORAIL HOIST (FW-CR-27)

This is a 5 ton monorail with a hand chain hoist normally used to handle individual pump, turbine or motor components during maintenance or repair of the two emergency feed pumps. All of these loads weigh much less than half the monorail capacity each, thus ensuring twice the required design safety factors as per applicable design standards.

The pump motor (4800 lb) or turbine (3900 lb) if handled as a complete unit also weigh less than half the hoist capacity. The only load heavier than 5000 lb will be the pump unit which weighs 5700 lb. However, the feed pump will be first disassembled and only individual pump parts such as casing, rotor, etc. will be handled by the hoist. Considering these increased safety factors for the individual loads together with a safety factor of 10 or greater for the standard lifting devices, the likelihood of a load drop will be extremely small. (The monorail has been upgraded from a 4 ton to 5 ton capacity.)

CVCS HEAT EXCHANGER SERVICE MONORAIL (CS-CR-13)

The rated capacity of the heat exchanger service monorail has been increased from 3 tons to 5 tons. All the loads to be handled by this monorail weigh less than half the hoist capacity. Therefore, available design safety factors for the monorail track and the hand chain powered hoist are increased to twice the values required by the applicable design standards. In addition, the standard lifting devices such as slings and associated fittings will be selected for each load to provide a minimum design safety factor of 10, or will be of redundant design.

As a result, the reliability of the load handling system will be enhanced through increased safety factors; and consequently the likelihood of a load drop during load handling operations is considered to be extremely small.

FILTER CASK MONORAIL (CS-CR-5)

The rated capacity of the filter cask monorail has been increased from 4.5 tons to 7.5 tons. The new capacity is designed to provide increased safety margins for all loads, thereby contributing substantially to the overall reliability of this load handling system. The rated capacity of the monorail is such that the weight of the heaviest load, the filter cask, does not exceed half the hoist capacity, thus providing twice the required design safety factors.

In addition, the hoist is equipped with safety control devices such as two independent upper limit switches of different design, a lower limit switch, and an inching drive capability. Also, the lifting devices will maintain a safety factor of 10 or greater, or will be of redundant design.

COMPONENT COOLING WATER PUMP SERVICE MONORAILS (CC-CR-15A AND 15B

These monorails have also been upgraded from an initial capacity of three (3) tons to five (5) tons to provide increased safety margins. The hoists are of the hand chain powered type, and are used during maintenance of the primary component cooling water pumps in the two loops. The monorail capacity and weights of the various loads such as the pumps, pump motors, etc. are such that safety factors of approximately two times the required values will be assured during handling of these loads. The standard lifting apparatus will also provide a minimum safety factor of 10, or will be of dual or redundant design.

The design of the above five monorails will prevent the hoists from leaving the tracks in an unloaded condition during a seismic event equal to safe shutdown earthquake (SSE). The monorails are not designed to retain the lifted load during an SSE. However, occurrence of a seismic event at the same time when the hoist is in use and supporting a load is considered to be a low probability event.

B. EG&G Evaluation

The polar gantry crane meets the requirements of this guideline in many respects. Where compliance is not exact the applicant has relied on the statement that all heavy loads except the handling equipment hatch cover are less than 50% of the rated capacity of the crane hoists.

Although this is not in strict compliance with the guideline it is consistent with the intent of the guideline except for lifting the equipment hatch cover.

The other hoists mentioned also rely on increased safety factors for their ability to meet the intent of this guideline. Since many of the requirements are not readily applicable to hand chain

hoists a detailed comparison is difficult. If a safety factor of ten (10) can be demonstrated, similar to the requirement for lift points and slings, we feel that the intent of the guideline is satisfied. The safety factor of ten is not mandatory but doubling the hoist capacity may only provide safety factors of three (3) in some cases.

C. EG&G Conclusions and Recommendations

EG&G concludes from the information provided that the polar crane is con. tent with the intent of the guideline except for the handling equipment hatch cover. We recommend that an analysis of the effects of dropping the hatch cover be performed.

The remaining hoists mentioned in this section do not appear to meet the requirements of the guideline. However, if safety factors of ten (10) can be demonstrated along with the other safety features mentioned by the applicant, then the intent of the guideline may be satisfied.

3. CONCLUDING SUMMARY

3.1 Guideline Recommendations

The NRC staff has established guidelines for judging the safety implications for handling heavy loads in the area of the reactor vessel, near stored spent fuel, or in other areas where an accidental load drop could damage safe shutdown systems. These guidelines are established to ensure that potential for load drops is extremely small or that potential consequences of load drops are acceptably small.

3.2 Additional Recommendations

1. Spent-Fuel Pool Area Cranes NUREG-0612 Article 5.1.2	The applicant should provide additional information showing that the guidelines of NUREG-0612 are met.
2. Reactor Building Cranes NUREG-0612 Article 5.1.3	The applicant should provide additional information showing that chances of a serious load drop from the stud tensioner hoists are small or that there will be minimal consequences.
3. Cranes Over Safe Shutdown Equipment NUREG-0612 Article 5.1.5	The applicant should provide additional information showing that the guidelines of NUREG-0612 are met.
4. Single-Failure-Proof Handling Systems NUREG-0612 Article 5.1.6	The applicant should provide additional information on safety factors on hoists.

4. REFERENCES

1. Control of Heavy Loads at Nuclear Power Plants, NUREG-0612, Phase I, EG&G TER for Seabrook Station Units 1 and 2, November, 1982.

2. NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, NRC.

3. V. Stello, Jr. (NRC), Letter to all applicants. Subject: Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 17 May 1978.

4. USNRC, Letter to Commonwealth Edison. Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 22 December 1980.

5. Public Service Company of New Hampshire, Letter to Director of Nuclear Regulatory Regulation. Subject: Response to NRC Request for Additional Information on Control of Heavy Loads, September 1982.

6. Public Service Company of New Hampshire, Letter to G. W. Knighton (NRC). Subject: NUREG-0612 Control of Heavy Loads (Revised Report). June 1983.