CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

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Author
N. Maringas

Principal Technical Investigator
T. H. Stickley

EG&G Idaho, Inc.

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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 compliance 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 the Grand Gulf Nuclear Station Units 1 and 2.

EXECUTIVE SUMMARY

The Grand Gulf Nuclear Station Units 1 and 2 do not totally comply with the guidelines of NUREG-0612. In general, additional evaluations are required in the following areas:

- Special lifting devices
- Slings

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

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TECHNICAL EVALUATION REPORT
FOR
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

1. INTRODUCTION

1.1 Purpose of Review

This technical evaluation report (TER) documents the EG&G Idaho, Inc. review of general load handling policy and procedures at Mississippi Power & Light Company's Grand Gulf Nuclear Station Units 1 and 2. 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,"[1] Section 5.1.1.

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 ensure 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,[2] to all power reactor licensees, 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 (1) 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 (2) 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 ensure 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[3] to Mississippi Power & Light Company, the Licensee for Grand Gulf Nuclear Station Units 1 and 2 requesting that the Licensee review 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. On November 23, 1981, Mississippi Power & Light Company provided the initial response[4] to this request.

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize Mississippi Power & Light Company's review of heavy load handling at Grand Gulf Nuclear Station Units 1 and 2 accompanied by EG&G's evaluation, conclusions and recommendations to the Licensee for bringing the facilities more completely into compliance with the intent of NUREG-0612. The Licensee has indicated the weight of a heavy load for this facility (as defined in NUREG-0612, Article 1.2) as 1140 pounds.

2.2 Heavy Load Overhead Handling Systems

This section reviews the Licensee's list of overhead handling systems which are subject to the criteria of NUREG-0612 and a review of the justification for excluding overhead handling systems from the aforementioned list.

2.2.1 Scope

Report the results of the Licensee's review of plant arrangements to identify all overhead handling systems from which a load drop may result in damage to any system required for plant shutdown or decay heat removal (taking no credit for any interlocks, technical specifications, operating procedures, or detailed structural analysis) and justify the exclusion of any overhead handling system from your list by verifying that there is sufficient physical separation from any load-impact point and any safety-related component to permit a determination by inspection that no heavy load drop can result in damage to any system or component required for plant shutdown or decay heat removal.

2.2.1.1 Summary of Licensee Evaluation on Overhead Handling Systems

The Licensee's review of overhead handling systems identified the cranes and hoists shown in Table 2.1 as those which handle heavy loads in the vicinity of irradiated fuel or safe shutdown equipment.

In Table 2.2, the Licensee has identified other cranes that have been excluded from satisfying the criteria of the general guidelines of NUREG-0612. These various overhead handling devices were reviewed by the Licensee to the criteria of NUREG-0612 and were excluded based on sufficient physical separation from any load-impact point that could damage any system or component required for plant shutdown or decay heat removal. Some of the devices have been excluded because the Licensee has indicated that the heavy load of approximately 1140 pounds for this facility would not be exceeded.

2.2.1.2 EG&G Evaluation, Conclusions and Recommendations for Overhead Handling Systems

The Licensee's response indicates that each overhead handling device at the Grand Gulf Nuclear Station Units 1 and 2 is listed in Tables 2.1 and 2.2. Figures 1 through 7 of Reference 4 show the locations of all the overhead handling systems in the plant and their proximity to safety-related components. EG&G concludes that the Licensee's list of cranes and hoists in the aforementioned tables is complete and satisfies the requirements of NUREG-0612.

TABLE 2.1 OVERHEAD HANDLING DEVICES IN VICINITY OF SAFE SHUTDOWN EQUIPMENT GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Handling System	Capacity (tons)	Location
Containment Polar Crane/Auxiliary Hoist	125/35	Containment
Spent Fuel Cask Crane	150	Auxiliary Building
New Fuel Bridge Crane	5	Auxiliary Building
Monorail for LPCS & RHR "C" Hatches	10	Auxiliary Building (elevation 139 ft)

TABLE 2.2 OVERHEAD HANDLING DEVICES EXCLUDED FROM FURTHER CONCERN
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Handling System	Capacity (tons)	Location
Component Cooling Water Pump Monorail	2	Auxiliary Bldg. 93 ft
Floor Drain Transfer Pumps Monorail	3	Auxiliary Bldg. 93 ft
Control Rod Drive Pump Monorails (2)	5	Auxiliary Bldg. 93 ft
Control Building Hot Machine Shop Monorail	15	Control Bldg. 93 ft
Control Rod Drive Removal Hoist	10	Containment 93 ft
HPCS Hatch/Equipment Monorail	25	Auxiliary Bldg. 113 ft
RCIC Hatch Monorails	5	Auxiliary Bldg. 113 ft
Chilled Water Pump Monorail	2	Auxiliary Bldg. 134 ft
RHR "A" Hatch & Equipment Monorail	10	Auxiliary Bldg. 139 ft
RHR "B" Hatch & Equipment Monorail	10	Auxiliary Bldg. 139 ft
Main Steam Tunnel Crane	12	Auxiliary Bldg. 139 ft
Railroad Bay Monorail	5	Auxiliary Bldg. 139 ft
Fuel Pool Cooling & Cleanup Pump Monorails (2)	5	Auxiliary Bldg. 166 ft
Control Rod Drive Repair Room Monorail	1/2	Auxiliary Bldg. 166 ft
Spent Fuel Cask Hatch Monorail	10	Auxiliary Bldg. 166 ft
Containment Cooler Monorail	2	Containment 166 ft
Valve Handling Crane	12	Containment 166 ft
Spent Fuel Pool Cooling Heat Exchanger Monorail	7-1/2	Auxiliary Bldg. 185 ft
Jib Crane	1/2	Containment and Auxiliary Bldg. 208 ft
Diesel Generator Cranes (2)	6	Diesel Generator Bldg.
Standby Service Water Pump House Monorails (2)	12	Standby Service Water Pump Houses

The Licensee performed a review of the various overhead handling devices to the criteria of NUREG-0612 by a physical inspection of the plant and by studying plant layout drawings. For those devices which were excluded, the Licensee has provided justification that indicates sufficient physical separation exists between components necessary for safe shutdown or decay heat removal and load-impact points. The Licensee also included electrical cabling, valves, and instrumentation tubing effects in their assessment. EG&G concludes that the Licensee has met the requirements of NUREG-0612 concerning exclusion of overhead handling systems.

2.2.1.3 Summary on Heavy Load Overhead Handling Systems

The Grand Gulf Nuclear Station Units 1 and 2 complies with the criteria of NUREG-0612 on Heavy Load Overhead Handling Systems.

2.3 General Guidelines

This section addresses the extent to which the applicable handling systems comply with the general guidelines of NUREG-0612, Article 5.1.1. EG&G's conclusions and recommendations are provided in summaries for each guideline.

The NRC has established seven general guidelines which must be met in order to provide the defense-in-depth approach for the handling of heavy loads. These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

Guideline 1--Safe Load Paths
Guideline 2--Load Handling Procedures

Guideline 3--Crane Operator Training
Guideline 4--Special Lifting Devices
Guideline 5--Lifting Devices (not specially designed)
Guideline 6--Cranes (Inspection, Testing, and Maintenance)
Guideline 7--Crane Design.

These seven guidelines should be satisfied for all overhead handling systems and programs in order to handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems. The succeeding paragraphs address the guidelines individually.

2.3.1 Safe Load Paths [Guideline 1, NUREG-0612, Article 5.1.1(1)]

Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact. These load paths should be defined in procedures, shown on equipment layout drawings, and clearly marked on the floor in the area where the load is to be handled. Deviations from defined load paths should require written alternative procedures approved by the plant safety review committee.

2.3.1.1 Summary of Licensee's Evaluation of Safe Load Paths

Due to the many different load handling situations for the cranes of Table 2.1, the Licensee has determined that safe load paths are neither required nor prudent for every situation and would unnecessarily restrict plant operations and maintenance activities. To

address this problem, the Licensee has identified possible load handling situations and has assigned a safety class designation to each category. Table 2.3 lists the Load Safety Classes and Safe Load Path and/or Procedural Actions required. Each of the heavy loads listed in Tables 2.4, 2.5, 2.6, and 2.7 has been assigned one or more safety classes. For each of the heavy loads listed, the safe load path and/or procedural requirements corresponding to the assigned safety classes have been added to the appropriate plant procedures. The Licensee actions taken to address each of these loads were summarized for each of the handling systems in Table 2.1.

In that summary, the Licensee has addressed safe load paths, drawings, minimum lift heights, procedural restrictions, technical specification changes, markings in the area where the load is to be handled, supervision of heavy lifts and deviations that require prior approval of Operations Superintendent.

2.3.1.2 EG&G Evaluations, Conclusions, and Recommendations on Safe Load Paths

EG&G has reviewed the Licensee's handling of Guideline 1 and finds that the Licensee has met the criteria for safe load paths.

The four cranes listed in Table 2.1 cannot have safe load paths defined because their loads must be carried over irradiated fuel or safe shutdown equipment. For these cases, the Licensee has defined load safety classes, Table 2.3, and the actions required for handling heavy loads. The heavy load paths will be

TABLE 2.3 LOAD SAFETY CLASSES AND SAFE LOAD PATH ACTIONS
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Heavy Load[a]-Handling Situation	Safe Load Path/ Procedural Actions Required
Safety Class 1. Load must be carried directly over (i.e., there are no intervening structures such as floors) spent fuel, the reactor vessel, or safe shutdown equipment.	1. Procedurally limit time and height load is carried over the area of concern.
Safety Class 2. Load could be carried directly over spent fuel, the reactor vessel, or safe shutdown equipment, i.e., load can be handled during the time when spent fuel or the reactor vessel is exposed or safe shutdown equipment is required to be operable and there are no physical means (such as interlocks or mechanical stops) available to restrict load movement over these objects.	2. Procedurally define an area over which loads shall not be carried so that if load is dropped, it will not result in damage to spent fuel or operable safe shutdown equipment or compromise reactor vessel integrity.
Safety Class 3. Load can be carried over spent fuel or safe shutdown equipment, but the fuel or equipment is not directly exposed to the load drop, i.e., intervening structures such as floors provide some protection.	3. See 3A and 3B.
Safety Class 3A. Preliminary evaluation indicates that intervening structures will protect spent fuel or safe shutdown equipment.	3A. No load travel path is required at this time. General precautions limiting load travel height is prudent.
Safety Class 3B. Preliminary evaluation cannot conclusively demonstrate that intervening structures will protect fuel or safe shutdown equipment.	3B. Define safe load paths that follow, to the extent practical, structural floor members. Limit load travel height to minimum height practical.

TABLE 2.3 (CONTINUED)

Heavy Load[a]-Handline Situation	Safe Load Path/ Procedural Actions Required
Safety Class 4. Load cannot be carried over spent fuel or over safe shutdown equipment when such equipment is required to be operable, i.e., design or operational limitations prohibit movement.	4. No safe load path required.

a. A heavy load is defined as a load that is greater than the weight of a channeled fuel assembly and its associated handling tool.

TABLE 2.4. POLAR CRANE HEAVY LOADS[a] - GRAND GULF NUCLEAR STATION UNITS 1 AND 2

	Load	Safety Class	Approximate Weight (tons)	Applicable Lift Procedures[i]	Lifting Equipment
1.	Reactor Pressure Vessel Head (RPV)	1/3B	117	07-S-14-184[b]	Head Strongback Carousel
2.	Steam Dryer	1/2/3B	40	--[g]	Dryer & Separator Strongback
3.	Shroud Head/ Steam Separator	1/3B	68	07-S-14-186[c]	Dryer & Separator Strongback
4.	Drywell Head	1/3B	61.5	07-S-14-182[e]	Drywell Head Lifting Frame
5.	Portable Refueling Shield	2/3A	12	07-S-14-187[d]	Shackles & Slings
6.	RPV Head Insulation with Support Structure	1/3A	10.5	--[h]	Drywell Head Lifting Frame
7.	Reactor Well/Steam Dryer Storage Area Gate	2/3A	3.5	07-S-14-189[f]	Shackles & Slings
8.	Upper Containment Fuel Pool/Transfer Pool Gate	2/3A	3.5	07-S-14-189[f]	Shackles & Slings
9.	Load Block	2/3B	5.6 (M) 1 (Aux.)	--[i]	N/A
10.	RWCU Regenerative HX Hatches (2)	2/3B	15	--[i]	Shackles & Slings
11.	RWCU Non-Regenerative HX Hatches (3)	2/3B	15-17	--[i]	Shackles & Slings

TABLE 2.4 (CONTINUED)

Load	Safety Class	Approximate Weight (tons)	Applicable Lift Procedures[i]	Lifting Equipment
12. RWCU Filter Demineralizer Hatches (2)	2/3B	20	--[i]	Shackles & Slings

a. A heavy load is defined as a weight exceeding the weight of a channeled fuel assembly and its associated handling tool (approximately 1140 lb).

b. General Maintenance Instruction, 07-S-14-184, "Installation and Removal of Reactor Vessel Head, Safety Related."

c. General Maintenance Instruction, 07-S-14-186, "Installation and Removal of the Reactor Moisture Separator, Non-Safety Related."

d. General Maintenance Instruction, 07-S-14-187, "Installation and Removal of the Portable Refueling Shield (Cattle Chute), Non-Safety Related."

e. General Maintenance Instruction, 07-S-14-182, "Installation and Removal of the Drywell Head, Non-Safety Related."

f. General Maintenance Instruction, 07-S-14-189, "Installation and Removal of the Fuel Pool and Canal Gates, Non-Safety Related."

g. A Maintenance instruction for the installation and removal of the steam dryer has not yet been prepared. When an instruction is prepared, it will include the necessary detail, precautions, etc., to adequately address the requirements of NUREG-0612.

h. As with the steam dryer (addressed above), no maintenance instruction for the installation and removal of the Reactor Vessel Insulation Assembly has yet been prepared. The same condition for procedure development and content apply as for the steam dryer (g, above).

i. The Maintenance Instruction for Polar Crane Operation in general is applicable to all loads. In addition, it governs the lifts of all loads listed in this table that do not have special lift procedures designated.

TABLE 2.5 SPENT FUEL CASK CRANE HEAVY LOADS
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Load	Safety Class	Approx. Weight (tons)	Applicable Lift Procedures	Lifting Equipment
1. Spent Fuel Cask	N/A	125	--[a]	Dual Load Path Cask Lifting System
2. Recirculating Pump Motor	N/A	30	--[a]	Slings and Shackles
3. HPCS Pump Motor	N/A	18	--[a]	Slings and Shackles

a. Detailed lift procedures have not yet been developed for the Spent Fuel Cask Crane. Such procedures will be developed, but are not required to meet the guidelines of NUREG 0612 for this "single failure proof" handling system.

TABLE 2.6 NEW FUEL BRIDGE CRANE HEAVY LOADS
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Load	Safety Class	Approx. Weight (tons)	Applicable Operating Procedures	Lifting Equipment
1. New Fuel Shipping Containers	2	1.5	--[a]	Slings and Shackles
2. Fuel Pool & Clean Up Filter Demineralization Hatch (2)	2	3	--[a]	Slings and Shackles
3. Spent Fuel Canal Gate	2	3.5	--[a]	Slings and Shackles

a. The Maintenance Instruction for New Fuel Bridge Crane Operation is applicable to all lifts.

TABLE 2.7 LPCS AND RHR PUMP "C" EQUIPMENT AND HATCH HOIST HEAVY LOADS
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Load	Safety Class	Approx. Weight (lb)	Applicable Procedures	Lifting Equipment
1. Hatch Cover (2)	2	9,000	--[a]	Slings and Shackles
2. RHR Pump	2	16,000	--[a]	Slings and Shackles
3. RHR Motor	2	7,600	--[a]	Slings and Shackles
4. LPCS Pump	2	20,000	--[a]	Slings and Shackles
5. LPCS Motor	2	17,000	--[a]	Slings and Shackles
6. LPCS Lower Shell	2	17,000	--[a]	Slings and Shackles

a. Proposed Maintenance Instruction for the LPCS/RHR "C" Hatch Hoist is applicable to all lifts.

defined in procedures and shown on drawings. The cranes will be match marked for proper alignment during heavy load lifts. In addition, supervision will be provided during heavy load lifts to enforce procedural requirements.

For deviations from defined load paths, the Licensee will require approval of only the Operations Superintendent. In matters affecting plant safety, the Plant Safety Review Committee should be consulted for deviations from defined load paths. The Operations Superintendent is probably a member of that committee.

2.3.1.3 Summary on Safe Load Paths

Grand Gulf Nuclear Station Units 1 and 2 complies with the criteria of Guideline 1, "Safe Load Paths," except for the following:

(a) Complete development of procedures prior to fuel load and have them available for possible NRC audit.

(b) On deviations from defined load paths, the Plant Safety Review Committee should be included in approval actions.

2.3.2 Load Handling Procedures [Guideline 2, NUREG-0612, Article 5.1.1(2)]

Procedures should be developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. As a minimum, procedures should cover handling of those loads

listed in Table 3-1 of NUREG-0612. These procedures should include: identification of required equipment, inspections and acceptance criteria required before movement of load, the steps and proper sequence to be followed in handling the load, defining the safe load path, and other special precautions.

2.3.2.1 Summary of Licensee's Evaluation on Load Handling Procedures

The Licensee is developing procedures for the heavy loads handled by each crane (see Tables 2.4, 2.5, 2.6, and 2.7) and will contain the following information:

(a) Identification of required equipment

(b) Inspections and acceptance criteria required before movement of load

(c) The steps and proper sequence to be followed in handling the load

(d) Defining the safe load path

(e) Any other special precautions.

2.3.2.2 EG&G Evaluations, Conclusions, and Recommendations on Load Handling Procedures

With the Licensee preparing the necessary load handling procedures, EG&G considers the criteria of Guideline 2 will be accomplished.

2.3.2.3 Summary on Load Handling Procedures

Grand Gulf Nuclear Station Units 1 and 2 complies with the criteria of Guideline 2, "Load Handling Procedures," except the development of load handling procedures should be completed prior to fuel load. The Licensee should have these procedures available for possible NRC audit.

2.3.3 Crane Operator Training [Guideline 3, NUREG-0612, Article 5.1.1(3)]

Crane operators should be trained, qualified and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976, "Overhead and Gantry Cranes."[5]

2.3.3.1 Summary of Licensee's Evaluation of Crane Operator Training

The Licensee has developed a new procedure for the qualification and training of overhead crane operators and meets the provisions of ANSI B30.2-1976, Chapter 2-3. The procedures include training, examination, experience, and physical requirements for crane operators as well as precautions and instructions to ensure proper conduct of crane operation. In addition, required crane operator training includes instruction in crane operator conduct, such as proper hand signals, testing of controls, limit devices, attaching the load, and moving the load. The Licensee has taken no exceptions to this guideline.

2.3.3.2 EG&G Evaluation, Conclusions and Recommendations on Crane Operator Training

The Licensee has met the criteria of this guideline for training, qualification and conduct as specified by Chapter 2-3 of ANSI B30.2-1976.

2.3.3.3 Summary on Crane Operator Training

To complete compliance with the criteria of Guideline 3, the Licensee should complete their new procedure prior to fuel load and have the entire training qualification and operator conduct program available for possible NRC review.

2.3.4 Special Lifting Devices [Guideline 4, NUREG-0612, Article 5.1.1(4)]

Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials."[6] This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. For operating plants, certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device.

2.3.4.1 Summary of Licensee's Evaluation on Special Lifting Devices

The Licensee has identified three special lifting devices that are used to handle heavy loads in the containment. These special lifting devices are:

(a) Head Strongback Carousel
(b) Dryer/Separator Strongback
(c) Drywell Head Lifting Frame (Strongback)

The Licensee provided a description of each of the devices and the plant function or operations in which those devices are used. The Licensee evaluated the devices against ANSI N14.6-1978 and provided detailed comparison to Sections 3.2 and 5 of the standard. The Licensee could not apply the remaining sections in retrospect. The Licensee has indicated that sound engineering practices were placed on the fabricator and inspector by the designer for the purpose of assuring that the designer's intent was accomplished. On that basis, the Licensee considers that there is reasonable assurance that the intent of the standard was accomplished in the design, fabrication, inspection, and testing of these devices.

The Licensee considered Sections 1.0, 2.0, 3.4, 3.5, and 3.6 as not pertinent to load-handling reliability of the devices and, therefore, did not address them.

Section 6 concerning critical loads was not considered because a determination of critical loads requires an analysis of the consequences of various load drop scenarios and is not required until the final report to the NRC.

In Section 3.2, the Licensee addressed stress design factors and fracture toughness of materials utilized to fabricate devices.

The Head Strongback Carousel and Dryer/Separator Strongback were designed with stress design factors consistent with ANSI N14.6, Section 3.2. The Drywell Head Lifting Frame was designed to AISC criteria which resulted in lower design factors being realized than required by ANSI N14.6. However, the Licensee considers that based on conservative load criteria used in the design, the resulting design factors are consistent with those generally required for safety related items.

For Fracture Toughness considerations, the materials utilized to fabricate the load-bearing components in the lifting devices were evaluated in terms of their fracture toughness properties. All materials have been determined to possess adequate resistance to brittle fracture with the possible exception of A-53 utilized for the vertical supports and bracing in the RV Head Strongback. Therefore, to ensure that brittle failure of these load-bearing components is remote, the Licensee shall perform periodic inspections of these components. The Licensee considers these actions appropriate to ensure that brittle failure of these load-bearing components is extremely remote.

In Section 5, the Licensee will establish a program for inspection, testing and maintenance of the devices that meets the provisions of ANSI N14.6-1978 with the following four exceptions:

(1) The Licensee does not consider an inspection of three months or less

necessary because between usages, these devices are stored in a specific location under controlled environment and are not subjected to any other usage except the dedicated usage. The Licensee has revised their procedures to inspect these devices prior to each usage or a thorough test and inspection annually. Based on these factors, the Licensee has demonstrated equivalency to Section 5.3.7.

(2) In Section 5.3.3, special lifting devices should be load tested to 150% of maximum load following any incident in which any load-bearing component may have been subjected to stresses substantially in excess of those for which it was qualified by previous testing or following an incident that may have caused permanent distortion of load-bearing parts. The Licensee considers dimensional examinations for deformation and nondestructive examinations for defects to determine whether the device is still acceptable for use rather than subject the device to 150% load testing. If defects or deformation are detected, the device will be repaired or modified and then tested to 150% load followed by examination for defects or deformation. The Licensee considers this action an equivalent alternative to Section 5.3.3.

(3) The lifting devices were subjected to 125% proof load test rather than the 150% load

test required by Section 5.2.1. Following the proof tests, all load-bearing welds were subjected to NDE. The Licensee considers the potential for overloading these devices is extremely remote because the devices are dedicated to one or two specific loads throughout their service life. In addition, the devices will receive thorough periodic examinations and, if damaged or repaired, will be subjected to a 150% load test before being returned to service. For these reasons, the Licensee considers the 125% initial proof test as adequate.

(4) Several components of the lifting devices will be subjected to NDE and dimensional inspections on intervals longer than those required by Section 5.3.1(2) as those components require disassembly or removal of paint. The Licensee will inspect those components on a 5-year interval because they are difficult and time consuming inspections that are not judged to be justified for a shorter interval based on their very limited and dedicated usage.

2.3.4.2 EG&G Evaluation, Conclusion, and Recommendations on Special Lifting Devices

EG&G does not concur with the Licensee's evaluation of Sections 3.1, 3.3, 4.1, 4.2, and 4.3 as difficult to apply in retrospect. Good engineering practice is not an acceptable substitute for design specifications,

stress analysis, design considerations, fabrication and welding, inspection, and fabrication considerations. The Licensee's designer must have a stress analysis on the lifting devices or they could be used to lift any load desired in the facility.

Sections 1.0, 2.0, 3.4, 3.5, and 3.6 are also pertinent to the special lifting devices and should be addressed in the Licensee's report.

EG&G recommends the Licensee address each item in ANSI N14.6-1978 and provide the necessary documentation to indicate that the special lifting devices can be safely used for handling heavy loads.

EG&G feels that lifts conducted with the devices identified by the Licensee have a high probability of qualifying as critical loads under the definition found in Section 2, especially considering the phrase "uncontrolled movement." The lifts identified in Tables 2.4, 2.5, 2.6, and 2.7 will be conducted when the plant is shut down, thus reducing the number of systems required for unit safety, but greatly increasing the possibility of breaching containment in the event of inadvertent heavy load drop. In addition, it should be pointed out that Section 2.1 of NUREG-0612 specifies the allowable offsite radioactive release applicable to heavy loads as 25% of the guideline exposures outlined in 10 CFR Part 100. For the lifts considered in this guideline, the definition of "critical load" in ANSI N14.6 should be so amended.

In Guideline 4 of NUREG-0612, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be

based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. The Licensee's evaluation of the lifting devices failed to include this change in stress design factors.

In the Licensee's evaluation of fracture toughness properties of materials utilized in fabrication of load-bearing components in each of the lifting devices, it is not clear to EG&G how periodic inspections can be performed to detect pending brittle failure. The Licensee should furnish the procedures describing the techniques that will be employed to ensure that brittle failure does not occur.

EG&G concurs with the Licensee's plan to inspect the special lifting devices prior to each usage and supplement that program with a thorough testing and nondestructive examination performed annually. Based on the controlled storage of the lifting devices, their dedicated single usage and the complete inspection schedule, the Licensee has demonstrated compliance with this section of ANSI N14.6.

EG&G agrees with the Licensee's actions on Section 5.3.3 where inspections and examinations are performed prior to a 150% load test if the device has been deformed. The special lifting devices should be load tested to 150% even though repairs or modifications may not have been required.

EG&G agrees with the Licensee's assessment of the 125% proof load test and their exception to performing a 150% load test as required by Section 5.2.1 of ANSI N14.6. When the device is to be used, the Licensee

will have to perform a 150% load test to comply with ANSI N14.6. Therefore, the initial 125% proof load test would not be required for those devices already tested. New devices should be proof tested as recommended by ANSI N14.6-1978.

EG&G does not concur with the Licensee's plan to inspect the components of the lifting devices on 5-year intervals, contrary to the requirements of Section 5.3.1(2) of ANSI N14.6-1978. The Licensee should reevaluate the criteria of ANSI N14.6 and develop a plan based on usage level and time intervals. Inconvenience is not an adequate substitution for the safe handling of heavy loads at nuclear power plants.

2.3.4.3 Summary on Special Lifting Devices

In order to comply with the criteria of Guideline 3, the Licensee should perform the following:

(a) A design analysis of the special lifting devices using the stress design factors for dynamic and static loads showing that these devices meet ANSI N14.6.

(b) Review and report on Sections 1.0, 2.0, 3.1, 3.3, 3.4, 3.5, 3.6, 4.1, 4.2, and 4.3 of ANSI N14.6-1978 describing conformance or proposed alternatives that are equivalent in terms of load-handling reliability.

(c) Provide method in detail showing techniques that will be employed to ensure that brittle fracture does not occur.

(d) Supplement inspections and examinations to include 150% proof load test when repairs or modifications were not required.

(e) Develop plan to inspect components of lifting devices within the intent of Section 5.3.1(2) of ANSI N14.6-1978.

(f) Reevaluate Section 6, Special Lifting Devices for Critical Loads.

2.3.5 Lifting Devices (Not Specially Designed) [Guideline 5, NUREG-0612, Article 5.1.1(5)]

Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9-1971, "Slings".[7] However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the "static load" which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used.

2.3.5.1 Summary of Licensee's Evaluation on Lifting Devices (Not Specially Designed)

The Licensee did not address slings to ANSI B30.9-1971.

2.3.5.2 EG&G Evaluation, Conclusions, and Recommendations on Lifting Devices (Not Specially Designed)

An evaluation by EG&G cannot be performed pending further information from Licensee.

2.3.5.3 Summary on Lifting Devices (Not Specially Designed)

The Licensee has not complied with Guideline 5 of NUREG-0612.

2.3.6 Cranes (Inspection, Testing, and Maintenance) [Guideline 6, NUREG-0612, Article 5.1.1(6)]

The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, "Overhead and Gantry Cranes," with the exception that tests and inspections should be performed prior to use where it is not practical to meet the frequencies of ANSI B30.2 for periodic inspection and test, or where frequency of crane use is less than the specified inspection and test frequency (e.g., the polar crane inside a PWR containment may only be used every 12 to 18 months during refueling operations, and is generally not accessible during power operation). ANSI B30.2, however, calls for certain inspections to be performed daily or monthly. For such cranes having limited usage, the inspections, test, and maintenance should be performed prior to their use).

2.3.6.1 Summary of Licensee's Evaluation on Cranes (Inspection, Testing, and Maintenance)

The Licensee has reviewed the maintenance procedures and instructions of the cranes in Table 2.1 and amended them as required to meet the criteria of Chapter 2-2 of ANSI B30.2-1976. No exceptions were taken to ANSI B30.2. The LPCS/RHR "C" Hatch Monorail/ Hoist System is not directly applicable to ANSI B30.2; however, activities of this system are covered by procedures prepared following guidelines of ANSI B30.16-1973, Section 16-2.2.

2.3.6.2 EG&G Evaluation, Conclusions, and Recommendations on Cranes (Inspection, Testing and Maintenance)

It appears to EG&G that the Licensee meets the criteria of NUREG-0612 for inspection, testing, and maintenance of their cranes. The Licensee should have the maintenance procedures and instructions available for possible NRC review.

2.3.6.3 Summary on Cranes (Inspection, Testing and Maintenance)

Grand Gulf Nuclear Station Units 1 and 2 complies with Guideline 6 of NUREG-0612.

The licensee should have maintenance procedures and instructions available for possible NRC review.

2.3.7 Crane Design [Guideline 7, NUREG-0612, Article 5.1.1(7)]

The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, "Overhead and Gantry Cranes," and of CMAA-70, "Specifications for Electric Overhead Traveling Cranes."[8] An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied.

2.3.7.1 Summary of Licensee's Evaluation of Crane Design

The overhead cranes of Table 2.1 were compared to the 1975 revision CMAA-70 and to the additional safety requirements o. ANSI B30.2-1976, Section 2-1 by the Licensee. A similar comparison for the Spent Fuel

Cask crane was not performed as this crane has been designed to "Single Failure Proof Criteria" and that comparison can be found in the FSAR, Appendix 3A.

Based on these comparisons, the Licensee found that the Polar Crane and the New Fuel Bridge Crane comply with the guidelines of CMAA-70-1975 and ANSI B30.2-1976, except for one minor exception in regard to welding. ANSI B30.2-1976 requires welding to AWS D1.1 as modified by AWS D14.1. The Licensee's review indicated no significant differences between AWS D1.1 and D14.1 that would affect load-handling reliability except for requirements on storage of low hydrogen welding rods. The Licensee communicated with the crane manufacturer and found that their shop practices provided for control of low hydrogen rods even though AWS D1.1 was not used. Therefore, the welding requirements in effect were equivalent to the requirements of ANSI B30.2.

The LPCS and RHR "C" Hatch Monorail/Hoist System are not directly applicable to CMAA-70 and ANSI B30.2-1976; however, the design did meet applicable industry standards. ANSI B30.16, "Overhead Hoists-1973," and Hoist Manufacturers Institute Standard HMI 100-74, "Standard Specification for Electric Wire Rope Hoists," are the industry standards that apply to these hoists. The Licensee compared the design of their hoists to the criteria in these standards and found that they meet or exceed the requirements of ANSI B30.16 and HMI 100-74. In addition, the Licensee also discussed design with the hoist manufacturer and obtained their input. Therefore, the Licensee

considers that the design of LPCS/RHR "C" Monorail System satisfies the intent of NUREG-0612, Section 5.1.1(7).

2.3.7.2 EG&G Evaluation, Conclusions, and Recommendations on Crane Design

It appears that the Licensee has demonstrated equivalency of actual design requirements where compliance with CMAA-70 and ANSI B30.2-1976 were not met. EG&G considers the Licensee has met Guideline 7, Crane Design for the Containment Polar Crane and New Fuel Bridge Crane. In addition, EG&G also concurs with the Licensee's assessment of the LPCS/RHR "C" Monorail System to this guideline. The Spent Fuel Cask Crane was designed to "Single Failure Proof Criteria" of Regulatory Guide 1.104 and no further action by Licensee is required.

2.3.7.3 Summary on Crane Design

Grand Gulf Nuclear Station Units 1 and 2 fully complies with Guideline 7, Crane Design of NUREG-0612, Section 5.1.1(7). However, the Licensee should have all information demonstrating equivalency on file for possible NRC review.

3. CONCLUDING SUMMARY

3.1 Applicable Load Handling Systems

The list of cranes and hoists supplied by the Licensee as being subject to the provisions of NUREG-0612 is complete (see Section 2.2). In Section 2.2.1.2, the Licensee fulfilled the requirements of NUREG-0612 concerning exclusion of various overhead handling systems.

3.2 Guideline Recommendations

Compliance with five of the NRC guidelines for heavy load handling (Section 2.3) are satisfied at the Grand Gulf Nuclear Station Units 1 and 2; i.e., Safe Load Paths, Load Handling Procedures, Crane Operator Training, Cranes (Inspection, Test, and Maintenance), and Crane Design. The conclusions are presented in tabular form on Table 3.1. Specific recommendations to aid in compliance with the intent of the Special Lifting Devices and Slings guidelines are presented in Table 3.2.

3.3 Interim Protection

If compliance with the seven guidelines of NUREG-0612 Section 5.1 cannot be ensured before the plant operation date, interim protection must be implemented. The six measures defined in NUREG-0612, Article 5.3 must be completed prior to power operation and refueling.

TABLE 3.? GRAND GULF NUCLEAR STATION UNIT 1 AND 2 COMPLIANCE MATRIX

Equipment Designation	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design
Polar Crane	C	125/35	C	C	C	NC	NC	C	C
Spent Fuel Cask Crane	C	150	C	C	C	NC	NC	C	C
New Fuel Bridge Crane	-	5	C	C	C	NC	NC	C	C
Monorail for LPCS & RHR "C" Hatches	NA	10	--	--	--	--	--	--	--

C = Licensee action complies with NUREG-0612 Guideline, subject to review by NRC staff.

NC = Licensee action does not comply with NUREG-0612 Guideline.

TABLE 3.2 SUMMARY OF RECOMMENDATIONS FOR
GRAND GULF NUCLEAR STATION UNITS 1 AND 2

Guideline	Recommendation
1. Section 2.3.1 - Safe Load Paths	(a) Complete development of procedures prior to fuel load and have them available for possible NRC audit. (b) Plant Safety Review Committee should be included on any approval actions to deviate from defined load paths.
2. Section 2.3.2 - Load Handling Procedures	Complete development of load handling procedures prior to fuel load and have them available for possible NRC audit.
3. Section 2.3.3 - Crane Operator Training	Complete new training procedures prior to fuel load and have the entire training/qualification and operator conduct program available for possible NRC review.
4. Section 2.3.4 - Special Lifting Devices	Complete the following: (a) Design analysis of special lifting devices using stress design factors for dynamic and static loads showing that these devices meet ANSI N14.6. (b) Review and report on Sections 1.0, 2.0, 3.1, 3.3, 3.4, 3.5, 3.6, 4.1, 4.2, and 4.3 of ANSI N14.6-1978 describing conformance or proposed alternatives that are equivalent in terms of load- handling reliability. (c) Provide detailed method showing techniques that will be employed to assure that brittle fracture does not occur. (d) Supplement inspections and examinations to include 150% proof load test when repairs or modifications were not required. (e) Develop plan to inspect components of lifting devices within the intent of Section 5.3.1(2) of ANSI N14.6-1978. (f) Reevaluate Section 6, Special Lifting Devices for Critical Loads.

TABLE 3.2 (CONTINUED)

Guideline	Recommendation
5. Section 2.3.5 - Slings	Compliance with Guideline 5 has not been addressed by Licensee.
6. Section 2.3.6 - Crane (Inspection, Testing, and Maintenance)	Maintenance procedures and instructions should be available for possible NRC review.
7. Section 2.3.7 - Crane Design	Information demonstrating equivalency to CMAA-70 and ANSI B30.2 should be on file for possible NRC review.

4. REFERENCES

1. U.S. Nuclear Regulatory Commission, Regulatory Guide, NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

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

3. U.S. Nuclear Regulatory Commission, Letter to Mississippi Power & Light Company, Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, dated December 22, 1980.

4. L. F. Dale, Mississippi Power & Light Company, Letter to D. G. Eisenhut (NRC), Subject: Response to Staff Position, Interim Actions for Control of Heavy Loads, dated November 23, 1981.

5. American National Standards Institute, ANSI B30.2-1976, "Overhead and Gantry Cranes."

6. American National Standards Institute, ANSI N14.6-1978, "Standard for Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials."

7. American National Standards Institute, ANSI B30.9-1971, "Slings".

8. Crane Manufacturers Association of America, Inc., CMAA-70, "Specifications for Electric Overhead Traveling Cranes."