CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
SOUTH TEXAS PROJECT, UNITS 1 AND 2
(PHASE II)

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Author
C. R. Shaber

Principal Technical Investigator
T. H. Stickley

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EG&G Idaho, Inc.
Idaho Falls, Idaho 83415

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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 consistency 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 South Texas Project, 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

South Texas Project, Units 1 and 2 is not totally consistent with the guidelines of NUREG-0612. In general, inconsistencies exist in the following areas:

- The interface lift points for five heavy loads handled by the FHB overhead crane should be upgraded to meet NUREG-0612 Article 5.1.6.

- Information for proper evaluation of the auxiliary hook of the FHB overhead crane is needed.

- Mechanical stops or electrical interlocks are needed to supplement administrative control for heavy loads handled over the in-containment fuel holding pool when it contains fuel.

- Information for proper evaluation of the Containment Building Polar Crane Auxiliary hook is needed.

- Complete tabular information on heavy loads subject to NUREG-0612 criteria is not provided. Either complete the tabular entries or justify their omission.

The main report contains recommendations which will aid in making the above items consistent with the appropriate guidelines.

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CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
SOUTH TEXAS PROJECT, 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 South Texas Project, Units 1 and 2 (STP). 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 as follows:

- "Releases of radioactive material that may result from damage to spent fuel based on calculations involving accidental dropping of a postulated heavy load produce doses that are well within 10 CFR Part 100 limits of 300 rem thyroid, 25 rem whole body (analyses should show that doses are equal to or less than 1/4 of Part 100 limits);

- "Damage to fuel and fuel storage racks based on calculations involving accidental dropping of a postulated heavy load does not result in a configuration of the fuel such that k_{eff} is larger than 0.95;

- "Damage to the reactor vessel or the spent-fuel pool based on calculations of damage following accidental dropping of a postulated heavy load is limited so as not to result in

water leakage that could uncover the fuel, (makeup water provided to overcome leakage should be from a borated source of adequate concentration if the water being lost is borated); and

- "Damage to equipment in redundant or dual safe shutdown paths, based on calculations assuming the accidental dropping of a postulated heavy load, will be limited so as not to result in loss of required safe shutdown functions."

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense in depth. This plan includes proper operator training, equipment design, and maintenance coupled with safe load paths and crane interlock devices restricting movement over ciritical areas.

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 Houston Lighting and Power, the applicant for STP requesting that the applicant review provisions for handling and control of heavy loads at STP, 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. Houston Lighting and Power provided responses to this request on December 19, 1983 [5].

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize Houston Lighting and Power review of heavy load handling at STP accompanied by EG&G's evaluation, conclusions, and recommendations to the applicant for making the facilities more consistent 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 not indicated the weight of a heavy load for the facilities per the NUREG-0612 definition.

2.3 Guidelines

The basic guidelines of NUREG-0612 for Phase II evaluations are quoted and followed with: (a) a summary of the applicant's statements, (b) EG&G's evaluation, and (c) recommendations. The criteria include guideline 5.1. for Boiling Water Reactors only. STP are pressurized water reactors and need to show consistency with guidelines 5.1.2, 5.1.3, and 5.1.5. The alternative Guideline 5.1.6 may be used for upgrading to meet the required 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

TABLE 2.1. OVERHEAD HANDLING SYSTEMS SUBJECT TO NUREG-0612 CRITERIA

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
Reactor Containment Building (RCB) Polar Crane Unit 1 7C101NCP101A (417/15)	Reactor Vessel Internals Lift Rig	21,000	Load Cell Linkage	Mainsteam Piping	68 ft/Figures 16, 18, 19	NA
	Lower Internals	131,000	Internals Lift Rig	RC Pump	52 ft/Figure 16	SS, NA
RCB Polar Crane Unit 2 7C102NCP201A (500/15)	Load Cell Linkage	3,000	None	Vessel	68 ft/Figures 16, 18	SS, IL
	Containment Fuel Pool Gate	8,520	None	Steam Generators	102 ft/Figures 16, 18, 19	NA
	Reactor Coolant Pump Flywheel	16,500	RCP Lift Device	HVAC ducting	120 ft/Figures 16, 18, 19	NA
	Reactor Coolant Pump Motor	97,600	RCP Lift Device	Cable Trays	68 ft/Figure 16	NA
	Reactor Coolant Pump Rotor	36,800	RCP Lift Device	Pressurizer	101 ft/Figures 16, 19	NA
	Inservice Inspection Rig	3,600	None	Hydrogen Recombiner	68 ft/Figure 16	NA
	RHR Pump	6,900	None	RHR Piping Conduit	-2 ft	SR
	RHR Pump Motor	5,700	None			
	RHR Heat Exchanger	29,000	None			
	RHR Heat Exchanger Tube Bundle	14,000	None			
	Integrated Head Package (includes the following to be lifted together during rapid refueling)	612,000	Head Lift Rig			

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
PCB Polar Cranes (continued)	a. Head Lift Rig	8,800				
	b. Missile Shield	30,000				
	c. Cooling Shroud	30,000				
	d. Cables on Shroud	5,000				
	e. Cooling Fans and Ducts	2,400				
	f. Vessel Head Plus Water	230,000				
	g. Cable Tray	7,500				
	h. Cables on Tray	15,000				
	i. Stud Tensioners	6,000				
	j. Upper Internals	137,400	Internals Lift Rig (Non-rapid refueling)			
	Studs, Nuts, Washers (12 in carrier)	30,000	None			
	Hatches (HE) (3)	21,700	None			
	Hatch (Pump motors)	15,850	None			
	Hatch	13,400	None			
RCB Monorail 9C101NCM102A 9C102NCM202A (3)	RCFC Fan	4,414	None	Safety Injection Piping	-2 ft/Figure 17	SR

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
RCB Monorail 9C101NCM104A 9C102NCM204A (4)	RHR Pump	6,500	None	RHR Piping	-2 ft/Figure 17	SR
	RHR Pump Motor	5,700	None	RHR Pump	-2 ft/Figure 17	SR
RCB Monorail 9C101NCM107A 9C102NCM207A (4)	RHR Pump	6,500	None	RHR Piping	-2 ft/Figures 17, 19	SR
	RHR Pump Motor	5,700	None	RHR Pump	-2 ft/Figures 17, 19	SR
RCB Monorail 9C101NCM107D 9C102NCM207D (4)	RHR Pump	6,500	None	RHR Piping	-2 ft/Figures 17, 19	SR
	RHR Pump Motor	5,700	None	RHR Pump	-2 ft/Figures 17, 19	SR
Mechanical Electrical Auxiliary Building (MEAB) Monorail 9M101NCM103A 9M102NCM203A (7.5)	CCW Pump	10,200	None	CCW Piping	10 ft/Figures 20, 24, 26	SR
	CCW Pump Motor	2,500	None	CCW Pump	10 ft/Figures 20, 24, 26	SR
	Supplementary Cooler	5,502	None			
MEAB Monorail 9M101NCM104A 9M102NCM204A (7.5)	CCW Pump	10,200	None	CCW Piping	10 ft/Figures 20, 24, 26	SR
	CCW Pump Motor	2,500	None	CCW Pump	10 ft/Figures 20, 24, 26	SR
	Supplementary Cooler	5,502	None			
MEAB Monorail 9M101NCM105A 9M102NCM205A (7.5)	CCW Pump	10,200	None	CCW Piping	10 ft/Figures 20, 24, 26	SR
	CCW Pump Motor	2,500	None	CCW Pump	10 ft/Figures 20, 24, 26	SR

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
	Supplementary Cooler	5,502	None			
MEAB Monorail 9M101NCM106A 9M102NCM206A (3)	Charging Pump	2,400	None	Charging Pump Piping	10 ft/Figures 20, 27	SR
	Charging Pump Motor	4,400	None	Charging Pump	10 ft/Figures 20, 27	SR
	Charging Pump Gear	2,700	None			
	Charging Pump Base	5,100	None			
	Supplementary Cooler	2,938	None			
MEAB Monorail 9M101NCM107A 9M102NCM207A (3)	Charging Pump	2,400	None	Charging Pump Piping	10 ft/Figures 20, 27	SR
	Charging Pump Motor	4,400	None	Charging Pump	10 ft/Figures 20, 27	SR
	Charging Pump Gear	2,700	None			
	Charging Pump Base	5,100	None			
	Supplementary Cooler	2,938	None			
MEAB Monorail 9M101NCM141A 9M102NCM241A (2)	Hatch	3,000	None	Boric Acid Tank	10 ft/Figures 20, 24, 27	SR
MEAB Monorail 9M101NCM142A 9M102NCM242A (3)	Hatch	3,000	None	Boric Acid Tank	10 ft/Figures 20, 24, 27	SR
MEAB Monorail 9M101NCM156A 9M102NCM256A (3)	Hatches (9) Heaviest	5,500	None	CVC Cation Bed Demineralizers	41 ft/Figures 21, 25, 28	NA
				CVC Mixed Bed Demineralizers	41 ft/Figures 21, 25, 28	NA

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
MEAB Monorail 9M101NCM160A 9M102NCM260A (5)	Hatches (22)	5,280	None	Letdown Preheat filter	41 ft/Figures 21, 28	NA
				Seal Water Injection Filter	41 ft/Figures 21, 28	NA
				Seal Water Return Filters	41 ft/Figures 21, 28	NA
				Reactor Coolant Filters	41 ft/Figures 21, 28	NA
MEAB Monorail 9M101NCM160B 9M102NCM260B (5)	Hatches (22)	5,280	None	Letdown Preheat filter	41 ft/Figures 21, 28	NA
Fuel Handling Building (FHB) Overhead Crane 7F101NCB1G3A 7F102NCB203A (15/2)	Containment Spray Pumps	7,155	None	Spent Fuel Pool	68 ft/Figures 30, 31, 33, 34	SF
	Containment Spray Pump Motors	5,820	None			
	Containment Spray Pump Outer Barrel	3,924	None	SFP Heat Exchangers	Figure 34	SF, SR
	L.H. Safety Injection Pump	7,155	None			
	L.H. Safety Injection Pump Motors	3,400	None			
	L.H. Safety Injection Pump Outer Barrel	3,924	None			
	H.H. Safety Injection Pump	7,155	None			

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
FHB Overhead Crane (continued) 7F101NCB103A 7F102NCB203A (15/2)	H.H. Safety Injection Pump Motor	3,400	None			
	H.H. Safety Injection Pump Outer Barrel	3,924	None			
	Inner Gate (FTC to SFP)	8,400	None			
	Outer Gate (FTC to SFP)	5,950	None			
	Inner Gate (SFP to CLP)	8,400	None			
	Outer Gate (SFP to CLP)	5,950	None			
	Spent Fuel Pool Heat Exchanger Hatch	10,200	None			
	Spent Fuel Pool Heat Exchangers	14,320	None			
	Spent Fuel Shipping Cask Head	Not Available	None			
	New Fuel Shipping Containers	5,000	None			
FHB Monorail 9F101NCM104A 9F102NCM204A (5)	L.H. Safety Injection Pump	7,155	None	LH Safety Injection Pump	-19 ft/Figures 29, 33, 34	SR
	L.H. Safety Injection Pump Motor	5,820	None			
	L.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104B 9F102NCM204B (5)	H.H. Safety Injection Pump	7,155	None	HH Safety Injection Pump	-19 ft/Figures 29, 33, 34	SR
	H.H. Safety Injection Pump Motor	5,820	None			

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
	H.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104C 9F102NCM204C (5)	Containment Spray Pump	7,155	None	Containment Spray Pump	-19 ft/Figure 29, 33, 34	SR
	Containment Spray Pump Motor	5,820	None			
	Containment Spray Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104D 9F102NCM204D (5)	L.H. Safety Injection Pump	7,155	None	LH SI Pump	-19 ft/Figures 29, 33, 34	SR
	L.H. Safety Injection Pump Motor	5,820	None			
	L.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104E 9F102NCM204E (5)	H.H. Safety Injection Pump	7,155	None	HH SI Pump	-19 ft/Figures 29, 33, 34	SR
	H.H. Safety Injection Pump Motor	5,820	None			
	H.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104F 9F102NCM204F (5)	Containment Spray Pump	7,155	None	Containment Spray Pump	-19 ft/Figure 29, 33, 34	SR
	Containment Spray Pump Motor	5,820	None			
	Containment Spray Pump Outer Barrel	3,924	None			

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
FHB Monorail 9F101NCM104G 9F102NCM204G (5)	L.H. Safety Injection Pump	7,155	None	LH Safety Injection Pump	-19 ft/Figures 29, 33, 34	SR
	L.H. Safety Injection Pump Motor	5,820	None			
	L.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104H 9F102NCM204H (5)	H.H. Safety Injection Pump	7,155	None	HH SI Pump	-19 ft/Figures 29, 33, 34	SR
	H.H. Safety Injection Pump Motor	5,820	None			
	H.H. Safety Injection Pump Outer Barrel	3,924	None			
FHB Monorail 9F101NCM104I 9F102NCM204I (5)	Containment Spray Pump	7,155	None	Containment Spray Pump	-19 ft/Figure 29, 33, 34	SR
	Containment Spray Pump Motor	5,820	None			
	Containment Spray Pump Outer Barrel	3,924	None			
Essential Cooling Water (ECW) Intake Gantry 7P200NCG001C (20)	ECW Pump and Motor	26,300	None	ECW Piping	34 ft/Figure 36	SR
	Traveling Screen	19,700	None	ECW Pumps	34 ft/Figure 36	SR
	Strainers (Wet)	19,467	None	ECW Screens	34 ft/Figure 36	SR
	Stop Log	5,300	None	Strainers	31.5 ft/Figure 36	SR
	Hatch to Screens	38,250	None			

TABLE 2.1. (continued)

Crane/Tag Number (Capacity in Tons)	Load(s)	Weight (lbs)	Special Lifting Device	Targets (for all loads associated with crane)	Target Elevation/Location	Elimination Category (Note 1)
	Hatch to Pumps	24,500	None			
	Hatch to Strainers	25,500	None			
Diesel Generator Building (DGB) Overhead Crane 8D101NCB101A 8D102NCB201A (3)	Starting Air Tank	2,710	None	Diesel Generators	29 ft/Figure 37	SR
	Flywheel	4,450	None			
	Bearing & Stand	2,300	None			
	Air Filter	5,400	None			
DGB Overhead Crane 8D101NCB101B 8D102NCB201B (3)	Starting Air Tank	2,710	None	Diesel Generators	29 ft/Figure 37	SR
	Flywheel	4,540	None			
	Bearing & Stand	2,300	None			
	Air Filter	5,400	None			
DGB Overhead Crane 8D101NCB101C 8D102NCB201C (3)	Starting Air Tank	2,710	None	Diesel Generators	29 ft/Figure 37	SR
	Flywheel	4,540	None			
	Bearing & Stand	2,300	None			
	Air Filter	5,400	None			

Notes:

1. In the elimination category column the following abbreviations are used to indicate the method of elimination.

   SR = separation and redundancy
   IL = interlocks
   SS = site specific
   AN = analysis
   SF = single-failure-proof crane
   NA = not required for safe shutdown, decay heat removal or spent fuel cooling.

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.

(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.

OR

(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 (7.5 m) horizontal 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 response information is presented in the specific sequence of the statements used in the NRC 81-07 Generic Letter, Section 2.2 subparagraphs 1 through 4.

The cranes physically capable of carrying loads which could, if dropped, land or fall into the spent fuel pool are the FHB Overhead Crane and Containment Polar Crane. The latter crane is considered because the STP includes an in-containment fuel pool for temporary fuel holding

capability during refueling. Administrative procedure will state that no heavy loads will be moved while spent fuel is being held in this pool. One exception, at inservice inspection requiring removal of the lower internals from the vessel (10-year interval), the internals are moved to the adjacent lower internal storage stand. It is not reasonable to postulate the movement of this load over the Fuel Pool.

The FHB Overhead Crane design makes the likelihood of a load drop extremely small for all loads based on the fact that it is designed to meet the intent of RG 1.104. The information requested in Attachment 1 of the Generic letter is provided in Attachment D of this submittal.

The Polar Crane is the only crane identified in the response to the request for crane identification (not excluded below) which is evaluated as not having sufficient design features to make the likelihood of a drop extremely small. Since no spent fuel will be in the in-containment fuel pool during load movement, the Criteria of NUREG-0612 Article 5.1 are not addressed.

The Cranes excluded are:

Cask Handling Crane New Fuel Area Bridge Crane	Incapable of carrying heavy loads within 15 ft of the FHB pool boundary
Fuel Handling Machine Refueling Machine	Do not carry "heavy loads"
Monorails in FHB and Containment	Located at levels below the spent fuel pools.

B. EG&G Evaluation

The Generic Letter 81-07 Section 2.2 guides and NUREG-0612 Article 5.1.2 guideline are sufficiently different to cause some confusion in matching responses for one to the other. The basis for EG&G review is the NUREG-0612 guideline. Matching the applicant statements and references prompts the following evaluation.

- The two cranes, FHB Overhead Crane and Containment Building Overhead Crane, are justified as the only ones of concern with this guideline.

- The FHB Overhead Crane information through the statement given in A above and details given in the Attachment D and references is shown to meet the single failure proof guidelines, NUREG-0612 Article 5.1.2 Option (1). The RG 1.104 design used has subsequently been replaced by NUREG 0554. The crane is rated for 15 tons, but the maximum critical load handled weighs 6.16 tons. The auxiliary 2-ton hook on this crane is not of single failure proof design and its use has not been addressed. The main hook single failure proof status must be extended to include the "associated lifing devices" which it handles. The submittal in its Appendix D indicates that no special lifting devices will be used, and that slings will be procured and used in accordance with ANSI B30.9-1971 as modified by NUREG-0612 Article 5.1.1.(5) and 5.1.6. The Appendix also identifies five loads for this crane hook, whose interface lift point design does not meet NUREG-0612 Article 5.1.6 requirements. STP indicates that safe load paths, procedures and the single failure proof crane are considered adequate to show consistency with requirements. Since the Article 5.1.6 requirements are specified to supplement Article 5.1.1, the consideration is not valid. The "system" for these

five loads is not single failure proof and requires upgrade of the interface lift points.

- The exclusion of the Containment Building Overhead Crane from NUREG-0612 Article 5.1.2 on the basis of Administrative procedure is less than the "defense in depth" requirement of NUREG-0612, for cranes that can operate over a spent fuel pool. The premise of Article 5.1.2 specifies that its requirements are in addition to satisfying the requirements of Article 5.1.1 which requires procedures, safe load paths, etc. Specific attention should be given to Article 5.1.2 (a) and (b). The Administrative procedures, safe load paths plus controls of mechanical stops or electrical interlocks would show consistency with the guideline.

C. EG&G Conclusions and Recommendations

The information provided for the FHB Overhead Crane, main hook, indicates it is consistent with NUREG-0612 Article 5.1.2. However, the method of upgrading the interface lift points on five loads it handles should be provided to show that the crane and its associated lifting devices are consistent with the guideline.

The use of and control of the 2-ton auxiliary hook of the FHB Overhead Crane should be provided, and show that it is consistent with one NUREG-0612 Article 5.1.2 option.

The Containment Building Polar Crane dependence on an Administrative procedure only to prevent heavy load handling over the in-containment fuel holding pool, when it contains fuel, is not consistent with the guideline. Mechanical or electrical stops should be installed and arranged to provide positive controls. The Administrative procedure should be

used to show consistency with the other parts of NUREG-0612 Article 5.1.2(2). Since both the main hook and auxiliary hook could handle heavy loads, the controls should apply to both of the crane hooks.

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 polar crane is the only crane physically capable of carrying heavy loads over the reactor vessel. This crane is not of single failure proof design.

To prevent loads from being carried over the reactor vessel, the polar crane will be equipped with an interlock to

prevent the trolley from moving within a given radius of the reactor vessel (the zone of the interlock is shown in Figure 38). Heavy loads that are required to pass within the interlock zone (with or without the head in place on the vessel) are the upper and lower internals, the in-service inspection rig, the integrated head package, the stud carrier rack containing twelve studs, nuts, and washers, the stud tensioners, and the Internals Lift Rig.

The polar crane is used only during shutdown and refueling. Once the integrated head package is removed, the only loads required to be carried through the interlock while fuel is in the vessel are the internals lift rig which is required to change the O-rings and the upper internals if they are removed separately from the IHP.

The interlocks are active at all times unless bypassed by key. The bypass will be in effect as long as the key is inserted. The key cannot be removed without reactivating the interlock.

An integrated head package (IHP) drop analysis which is applicable to STP was performed by Westinghouse and submitted to the NRC by Westinghouse letter NS-CE-1101 dated June 11, 1976, on the RESSAR-41 docket. This analysis determined that dropping the head would not result in an unacceptable degree of core damage. It received NRC approval on November 30, 1976.

The Polar Crane meets Criteria I to III. The Westinghouse head drop analysis covers compliance for all large loads less than 636,000 lbs.

The internals lift rig is shown on submittal Figure B-3. It is 14 ft in diameter and 30 ft high. Because of its size and shape, it is impossible for it to hit the fuel. The effects of a drop of this rig onto the vessel are enveloped

by the Westinghouse Head Drop Analysis since the rig is much lighter than the IHP. The effects of a drop of the upper internals are also enveloped by the Westinghouse Head Drop Analysis.

The lower internals and inservice inspection rig are moved only when all the fuel has been removed from the vessel.

The key to the vessel interlock will be under the control of the refueling director. The interlock will be bypassed to remove the IHP. Once the IHP is removed from the vessel and clears the area above the vessel, the interlock will be restored. During rapid refueling, bypass will only be permitted for replacement of the O-rings. During nonrapid refueling bypass will be permitted to remove the internals as well. The interlock will be bypassed to replace the IHP.

The key for bypassing the vessel interlock of the polar crane will be controlled by the refueling director and released only upon proper authorization. Procedures will also control the use and bypass of the interlock; additional technical specifications are not warranted.

The interlock boundaries will be tested before the interlocks are bypassed and following replacement of the IHP. The tests will be run without load on the crane hook.

For the Polar Crane, reliance is placed on other site specific considerations only for the movement of the lower internals and the inservice inspection rig. Movement of these loads is performed once every 10 years and will only occur after all the fuel has been removed from the vessel. Consequently bypassing the interlock at this time poses no hazard to the fuel.

Since the lower internals are never removed and the inservice inspection rig is never used while fuel is in the

vessels no additional administrative, physical controls, or technical specifications over those described above are required for these items.

B. EG&G Evaluation

The information presented provides specific answers to the guide of the Generic letter 81-07. Section 2.3 sub items 1, 2, 3, 4a, 4b, and 4c. Collectively these show consistency with NUREG-0612 Article 5.1.3 Option (3). However, it is not stated that the information applies to both the main and auxiliary hooks of the crane.

The EG&G evaluation concerning the use of this crane when the in-containment fuel pool is holding fuel, was discussed in 2.3.1c above. It is not intended that the discussions here for NUREG-0612 Article 5.1.3 change the recommendation concerning Article 5.1.2.

C. EG&G Conclusions and Recommendations

Verify the status of the Auxiliary hook to confirm consistency. For the other Reactor Building hoists STP shows there is consistency with guidelines of NUREG-0612 Article 5.1.3.

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

The original tabulation of STP overhead handling systems indentified those from which a load drop may result in damage to any system required for plant shutdown or decay heat removal. Targets which were at risk from a load drop were identified and a code system was used to identify elimination categories, e.g.:

Separation and redundancy
Interlocks
Site specific
Analysis
Single failure proof crane
Not required for safety shutdown or decay heat removal.

STP has been designed to ensure that redundant safety-related trains are provided with adequate separation and protection to ensure their continued function following a wide variety of events and conditions. Also considered are the consequences of floor failures where there is an intervening floor(s) between the load and the target.

Bases for determination of hazard elimination categories are justified for loads handled in each of five buildings. These include the Fuel Handling Building and Containment Building which have been discussed specifically for NUREG-0612 Article 5.1.2 and 5.1.3 above. Hazard elimination categories, where applicable, for these have been given here also. The other loads are those in the Mechanical Electrical Auxiliary, Essential Cooling Water Intake, and Diesel Generator Buildings.

The FHB overhead crane is single failure proof and its loads meet NUREG-0612 Article 5.1.5(1)(a) except the problem concerning interface lifting points previously discussed.

The Containment Building system of crane mechanical stops and electrical interlocks with Administrative controls used to supplement them are presented. Special discussion is given to the RHR system and RCFC fan/SI piping heavy loads which indicate that NUREG-0612 Article 5.1.5(1)(b) or (1)(c) as appropriate has been met.

Five load groupings handled by the Mechanical Electrical Auxiliary Building monorails are discussed and appropriate justifications established. Administrative procedures as appropriate will address operational restrictions.

For both the Diesel Generator Building and Essential Cooling Water Intake Building, elimination is based on separation and redundancy. Where appropriate for the ECWI loads, Administrative procedures provide operational restrictions.

B. EG&G Evaluation

The response in the submittal is very specific to the Generic letter guides and in the above summary of the applicant statements the comments relative to application of NUREG-0612 Articles was added by EG&G.

Evaluation indicates the aplicant has shown consistency with the requirements of NUREG-0612 Article 5.1.5 for those loads where an elimination category has been specified (see Table 2.1). For loads handled by monorails it is not clear from the tabular information if a hazard elimination category used for one load is valid for all loads handled by that monorail. It seems logical to assume that one target below a monorail would be a target for any load it handles. However, equal logic cannot be applied for unspecified hazard elimination categories because the size, shape, and weights of the loads vary. The information on the charts, if the blank areas were completed, would improve the presentation and prevent misunderstanding. Similarly the lack of information in the table for loads of the ECW Intake Gantry and DG Building Overhead Crane prevents making valid evaluation for all loads they handle.

C. EG&G Conclusions and Recommendations

General, but not total, consistency with this guideline, NUREG-0612 Article 5.1.5 for other areas has been shown. To show total consistency, all loads not covered by 2.3.1 or 2.3.2 above, of Table 2.1 (Submittal Table 1) should be addressed in the last three columns of the table to confirm their status. This will permit an accurate complete evaluation.

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.

OR

(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. Summary of Applicant's Statements

Specific coverage information concerning the alternative of equipment upgrade for NUREG-0612 Articles 5.1.2, 5.1.3 and 5.1.5 by use of Article 5.1.6 specifications is not chosen and is not addressed. Specific information on the interface lift points of five loads handled by the single failure proof FHB Overhead Crane has been discussed previously (2.3.1 above).

B. EG&G Evaluation

In the Spent Fuel Area discussions, above, on the interface lift points of five loads handled by the FHB overhead crane there is a need to meet the Article 5.1.6 upgrade option. The unresolved issue concerning the loads handled over the in-containment fuel pool by the Containment Building Polar Crane might also be resolved by use by the Article 5.1.6 alternative.

Except for the above two comments, Article 5.1.6 remains as an option for upgrading that has not been chosen for STP.

C. EG&G Conclusions and Recommendations

The recommendations relative to the two items commented on in the above evaluation have been given previously and are not repeated. The viable option of upgrading other overhead handling systems by use of Article 5.1.6 guides remains as a choice that may be used.

3. CONCLUDING SUMMARY

3.1 Guideline Recommendations

3.1.1 Spent Fuel Pool Areas

- The FHB Overhead Crane main hook and associated lifting devices, except for five loads, meet single failure proof requirements. The interface lift points on the five loads should be upgraded to meet one of the options of NUREG-0612 Article 5.1.6

- The details concerning use and loads handled by the 2-ton auxiliary hook should be given to show how it is consistent with NUREG-0612 Article 5.1.2

- The physical (mechanical stops and/or electrical interlocks) controls to supplement administrative procedure should be established for heavy load handling control when fuel is in storage in the in-containment fuel holding pool, Containment Building.

3.1.2 Reactor (Containment) Building

Information submitted indicates that the Containment Building Polar Crane main hook heavy load handling is consistent with the guideline of NUREG-0612 Article 5.1.3. However the auxiliary hook of this crane was not discussed. Information should be given to indicate if the information provided applies equally to the auxiliary hook. If it does not, provide suitable information on the auxiliary hook for evaluation.

3.1.3 Other Areas

Most other area hoists entered in the tables for Phase II evaluation have one or more loads that are shown to be consistent with the guideline requirements. However a number of heavy loads

handled by these other area cranes involve potential risk but have no elimination categories in the submittal information table. Information on these loads should be provided.

3.2 Additional Recommendations

Information specifying the weight of a heavy load in accord with the NUREG-0612 definition should be provided, e.g., more than the combined weight of a single spent fuel assembly and its associated handling tool.

3.3 Summary

The Phase II evaluation based on NUREG-0612 Articles 5.1.2, 5.1.3, 5.1.5 and as appropriate 5.1.6 has reported some areas where more information or action is recommended. These are identified and discussed in this report.

4. REFERENCES

1. Control of Heavy Loads at Nuclear Power Plants, South Texas Projects Unit 1 and 2 C. R. Shaber, Author, T. H. Stickley, Principal Investigator; Draft Report May 1984.

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 Houston Lighting and Power Co. Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 22 December 1980.

5. J. H. Goldberg, Houston Lighting and Power Co. Letter to D. G. Eisenhut, NRC, Wahington, D.C. Subject: South Texas Project Units 1 and 2, Schedule for Submittal of Response to Generic Letter 81-07, Control of Heavy Loads, 19 December 1983.