(DRAFT)

TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

WISCONSIN ELECTRIC POWER COMPANY

POINT BEACH NUCLEAR PLANT UNITS 1 AND 2

NRC DOCKET NO. 50-266, 50-301

NRC TAC NO. 07727, 08074

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506

FRC ASSIGNMENT 13

FRC TASKS 382, 383

Prepared by

Franklin Research Center
20th and Race Streets
Philadelphia, PA 19103

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Author: C. Bomberger, N. Ahmed

FRC Group Leader: I. H. Sargent

Lead NRC Engineer: A. Singh,
T. Chan

June 17, 1983

Franklin Research Center
A Division of The Franklin Institute
The Benjamin Franklin Parkway, Phila., Pa. 19103 (215) 448-1000

CONTENTS

FOREWORD

This Technical Evaluation Report was prepared by Franklin Research Center under a contract with the U.S. Nuclear Regulatory Commission (Office of Nuclear Reactor Regulation, Division of Operating Reactors) for technical assistance in support of NRC operating reactor licensing actions. The technical evaluation was conducted in accordance with criteria established by the NRC.

Mr. I. H. Sargent and Mr. C. R. Bomberger contributed to the technical preparation of this report through a subcontract with WESTEC Services, Inc.

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at Wisconsin Electric Power Company's (WEPC) Point Beach Nuclear Plant Units 1 and 2. This evaluation was performed with the following objectives:

- o to assess conformance to the general load handling guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" [1], Section 5.1.1
- o to assess conformance to the interim protection measures of NUREG-0612, Section 5.3.

1.2 GENERIC BACKGROUND

Generic Technical Activity Task A-36 was established by the 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 in 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 concluded from this evaluation that existing measures to control the handling of heavy loads at operating plants provide protection from certain potential problems, but 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 with a two-part objective. The first part of the objective, to be achieved through a set of general guidelines expressed in NUREG-0612, Section 5.1.1, is to ensure that all load handling systems at nuclear power plants are designed and operated so that their probability of failure is appropriately small for the critical tasks in which they are employed. The second part of the staff's objective, to be achieved through guidelines expressed in NUREG-0612, Section 5.1.2.5, is to ensure that, for load handling systems used 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 make the potential for a load drop 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.

A defense-in-depth approach was used to develop the staff guidelines to ensure that all load handling systems are designed and operated so that their probability of failure is appropriately small. The intent of the guideline is to ensure that licensees of all operating nuclear power plants perform the following:

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

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612; Section 6 recommended that a program be initiated to ensure that these guidelines are implemented at operating plants.

1.3 PLANT-SPECIFIC BACKGROUND

On December 22, 1980, the NRC issued a letter [3] to WEPC, the Licensee for Point Beach Units 1 and 2, requesting that the Licensee review and evaluate provisions for the handling and control of heavy loads, 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. WEPC provided responses on September 30, 1981 [4] and January 11, 1982 [5].

Based on this information, a draft Technical Evaluation Report (TER) was prepared and discussed with WEPC. Following these discussions, WEPC provided a supplemental response [6] addressing issues identified in the draft TER. This final TER is based on information provided in References 4, 5, and 6.

2. EVALUATION AND RECOMMENDATIONS

This section presents a point-by-point evaluation of load handling provisions at Point Beach Nuclear Plant Units 1 and 2 with respect to NRC staff guidelines provided in NUREG-0612. Separate subsections are provided for both the general guidelines of NUREG-0612, Section 5.1.1 and the interim measures of NUREG-0612, Section 5.3. In each case, the guideline or interim measure is presented, Licensee-provided information is summarized and evaluated, and a conclusion as to the extent of compliance, including recommended additional action where appropriate, is presented. These conclusions are summarized in Table 2.1.

2.1 GENERAL GUIDELINES

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

- o Guideline 1 - Safe Load Paths
- o Guideline 2 - Load Handling Procedures
- o Guideline 3 - Crane Operator Training
- o Guideline 4 - Special Lifting Devices
- o Guideline 5 - Lifting Devices (Not Specially Designed)
- o Guideline 6 - Cranes (Inspection, Testing, and Maintenance)
- o Guideline 7 - Crane Design.

These seven guidelines should be satisfied by all overhead handling systems and programs used 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.

2.1.1 <u>Overhead Heavy Load Handling Systems</u>

a. <u>Summary of Licensee Statements and Conclusions</u>

The Licensee has performed a survey of cranes and hoists at Point Beach Units 1 and 2 to identify those overhead handling systems from which a load

Table 2.1. Point Beach Nuclear Plant/NUREG-0612 Compliance Matrix

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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
1. Containment Polar Crane	110/15	--	--	P	--	--	C	C	--	C
Reactor Coolant Pump	20	P	NC	--	--	P	--	--	--	C
RCP Motor	38	P	NC	--	P	--	--	--	--	C
RCP Flywheel	7	P	NC	--	--	P	--	--	--	C
Containment Vent Fans	2.5	P	NC	--	--	P	--	--	--	C
Control Rod Cooling Fan	1.2	P	NC	--	--	P	--	--	--	C
Reactor Vessel Head	102.5	P	NC	--	R	--	--	--	--	C
RVH Stud Rock	3	P	NC	--	--	P	--	--	--	C
Stud Tensioner	1.3	P	NC	--	--	P	--	--	--	C
RVH Missile Shield Plug	7.6	P	NC	--	--	P	--	--	--	C
PAR Vessel Inspection Device	1.9	P	NC	--	--	P	--	--	--	C
RCP Missile Shield Planks	5.8	P	NC	--	--	P	--	--	--	C

C = Licensee action complies with NUREG-0612 Guideline.
R = Licensee has proposed revisions/modifications designed to comply with NUREG-0612 Guideline.
P = Licensee action partially complies with NUREG-0612 Guideline.
NC = License action does not comply with NUREG-0612 Guideline.
-- = Not Applicable.

Table 2.1 (Cont.)

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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
Pzr. Missile Shield Planks	4.4	P	NC	--	--	P	--	--	--	C
Steam Generator Snubber	2	P	NC	--	--	P	--	--	--	C
Vessel Internals	27.5	P	NC	--	R	--	--	--	--	C
RVH H&V Ducts	1	P	NC	--	--	P	--	--	--	C
Crane Hook and Bottom Block	3.4	P	NC	--	--	P	--	--	--	C
2. Auxiliary Bldg. Main Crane	130/20	--	--	P	--	--	C	C	P	--
Charging Pump	4.8	P	NC	--	--	P	--	--	P	--
RHR Pump	3.5	P	NC	--	--	P	--	--	P	--
CCW Pump	1.6	P	NC	--	--	P	--	--	P	--
Spent Fuel Pump	0.9	P	NC	--	--	P	--	--	P	--
Containment Spray Pump	2.7	P	NC	--	--	P	--	--	P	--
Safety Injection Pump	5.1	P	NC	--	--	P	--	--	P	--
Auxiliary Bldg. Stack Exhaust Fan	1.2	P	NC	--	--	P	--	--	P	--

Table 2.1 (Cont.)

	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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
	Carbon Exhaust Fan	1.8	P	NC	--	--	P	--	--	P	--
	Supply Air Fan	1.6	P	NC	--	--	P	--	--	P	--
	Reactor Head Stud Tensioner	1.3	P	NC	--	--	P	--	--	P	--
	Resin Cask	24	P	NC	--	--	P	--	--	P	--
	Filter Cask	1.9	P	NC	--	--	P	--	--	P	--
	New Fuel Shipping Cask	3.5	P	NC	--	--	P	--	--	P	--
	Watergate	1.5	P	NC	--	--	P	--	--	P	--
	Concrete Hatch Covers	9.4	P	NC	--	--	P	--	--	P	--
	Small Filter Cask	1.0	P	NC	--	--	P	--	--	P	--
	Crane Load Block	5.2	P	NC	--	--	P	--	--	P	--
3.	Turbine Bldg. Main Crane	125/20	--	--	P	--	--	C	C	--	--
	Moisture Separator Reheater Bundle	53.5	P	NC	--	--	P	--	--	--	--
	Condensate Pump	17	P	NC	--	--	P	--	--	--	--
	Steam Gen. Feed Pump	3.3	P	NC	--	NC	P	--	--	--	--

Table 2.1 (Cont.)

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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
S/G Feed Pump Base Plate	4.1	P	NC	--		P	--	--	--	--
S/G Pump Fly-wheel	2.9	P	NC	--	--	P	--	--	--	--
S/G FW Pump Motor	8.5	P	NC	--	--	P	--	--	--	--
AFW Pump	2.2	P	NC	--	--	P	--	--	--	--
Common Vacuum Priming Pump	0.8	P	NC	--	--	P	--	--	--	--
Vacuum Priming Pump	0.8	P	NC	--	--	P	--	--	--	--
Generator Rotor	118	P	NC	--	NC	P	--	--	--	--
Generator Hydrogen Cooler	2.1	P	NC	--	--	P	--	--	--	--
Generator Bearing Bracket	7.8	P	NC	--	--	P	--	--	--	--
Generator Bearing	1.1	P	NC	--	--	P	--	--	--	--
Exciter Rotor	9.3	P	NC	--	--	P	--	--	--	--
Exciter Stator	2.8	P	NC	--	--	P	--	--	--	--
Exciter Pedestal	1.2	P	NC	--	--	P	--	--	--	--
Exciter Seat-ing Plate	11	P	NC	--	--	P	--	--	--	--

Table 2.1 (Cont.)

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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
Exciter Housing and Outboard Cooler	7.8	P	NC	--	--	P	--	--	--	--
HP Turbine Outer Cover	40.8	P	NC	--	--	P	--	--	--	--
HP Turbine Rotor	35.0	P	NC	--	NC	--	--	--	--	--
HP Turbine Blade Ring	1.6	P	NC	--	--	P	--	--	--	--
LP Turbine Outer Cover	61.2	P	NC	--	--	P	--	--	--	--
LP Turbine Cylinder	25	P	NC	--	--	P	--	--	--	--
LP Turbine Rotor	80	P	NC	--	--	P	--	--	--	--
LP Turbine Blade Ring	2.5	P	NC	--	--	P	--	--	--	--
LP Inlet Flow Guide	2.5	P	NC	--	--	P	--	--	--	--
LP Bearings	1.7	P	NC	--	NC	--	--	--	--	--
LP Crossover Adapter	3.3	P	NC	--	--	P	--	--	--	--
LP Turbine Crossover Pipe (Kewaunee)	16	P	NC	--	--	P	--	--	--	--
LP Turbine Crossover Piece (Pt. Beach)	6	P	NC	--	--	P	--	--	--	--

Table 2.1 (Cont.)

	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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
	LP Turbine Lifting Gear	5	P	NC	--	--	P	--	--	--	--
	Crane Hook and Load Block	5.2	P	NC	--	--	P	--	--	--	--
	Crane Top Block	1.0	P	NC	--	--	P	--	--	--	--
4.	Unit 2 Containment Polar Crane	100/15	--	--	P	--	--	C	C	--	C
	Reactor Coolant Pump	20	P	NC	--	--	P	--	--	--	C
	RCP Motor	38	P	NC	--	P	P	--	--	--	C
	RCP Flywheel	7	P	NC	--	--	P	--	--	--	C
	Containment Vent. Fans	2.5	P	NC	--	--	P	--	--	--	C
	Control Rod Cooling Fan	1.2	P	NC	--	--	P	--	--	--	C
	Reactor Vessel Head	102.5	P	NC	--	R	--	--	--	--	C
	RVH Stud Rack	3	P	NC	--	--	P	--	--	--	C
	Stud Tensioner	1.4	P	NC	--	--	P	--	--	--	C
	FVH Missile Shield Plug	7.6	P	NC	--	--	P	--	--	--	C
	PAR Vessel Inspection Device	1.9	P	NC	--	--	P	--	--	--	C

Table 2.1 (Cont.)

	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	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
	RCP Missile Shield Planks	5.1	P	NC	--	--	P	--	--	--	P
	Przr. Missile Shield Planks	4.4	P	NC	--	--	P	--	--	--	P
	S/G Snubber	1.0	P	NC	--	--	P	--	--	--	P
	Vessel Internals	27.5	P	NC	--	R	--	--	--	--	P
	RVH H&V Ducts	1.0	P	NC	--	--	P	--	--	--	P
	Crane Hook and Bottom Block	3.4	P	NC	--	--	P	--	--	--	P
5.	CW Pumphouse Monorails (E-W/N-S)	3	NC	NC	P	--	--	C	--	--	--
6.	RPVH Circular Monorails	2	NC	NC	P	--	--	C	--	--	C
7.	Containment Buttress Jib Cranes	--	NC	NC	P	--	--	C	--	--	--
8.	Main Shop Crane	3	NC	NC	P	--	--	C	--	--	--
9.	Jib Cranes over Core Instrumentation	--	NC	NC	P	--	--	C	--	--	C

drop could result in damage to any safe shutdown equipment. These cranes and hoists have been reviewed without consideration for the following:

a. electrical or mechanical interlocks
b. operating procedures controlling load movements
c. location in the plant (e.g., normally unoccupied areas)
d. handling systems used for lifts only during shutdown or refueling.

The Licensee's evaluation has also been based on the assumption that loads, if dropped, would be capable of penetrating floors and causing substantial damage to safe shutdown equipment located on lower floors. In Table 2.2, the Licensee has identified those handling systems which cannot be excluded on the basis of these assumptions and therefore must satisfy the requirements of NUREG-0612. Table 2.3 identifies those handling systems which have been excluded, as well as the reason for excluding each handling system.

Table 2.2. List of Overhead Heavy Load* Handling Systems That Must Comply with NUREG-0612 Description

Licensee Item No.	Handling System
5	Containment Polar Crane (Unit 1)
8	Auxiliary Building Main Crane
16	Turbine Building Main Crane
25	Containment Polar Crane (Unit 2)

*Heavy load defined as 1750 lb or greater.

Table 2.3. Overhead Handling Systems Excluded from NUREG-0612 Compliance

A. Cranes excluded due to physical separation from safe shutdown equipment and irradiated fuel:

1. Personnel Access Hatch Monorails (Units 1 and 2)
2. Seal Water Injection Filters Jib Cranes (Units 1 and 2)
3. Drumming Station Jib Crane

B. Cranes excluded due to the fact that lifted loads, if dropped, would not result in damage to equipment required for safe shutdown or decay heat removal or cause a radioactive release in excess of 10CFR20 limits:

1. Ready Stores Monorail
2. Feedwater Heaters Monorail

3. Water Treatment Area Monorail
4. Monorail, East Wall in Circulating Water Pumphouse
5. Clean Side Maintenance Shop Crane

C. Cranes excluded because loads lifted are not heavy loads:

1. Reactor Cavity Fuel Manipulator (Units 1 and 2)
2. Control Building Electrical Equipment Room Monorail
3. Spent Fuel Handling Device
4. Main Steam Relief Valve Jib Crane (Units 1 and 2)
5. Jib Cranes over Reactor Coolant Pumps (Units 1 and 2)
6. Facade Monorails (L-8, L-15, L-16)

D. Cranes excluded on the basis of physical separation and adequate system redundancy:

1. Circulating water pumphouse monorails (N-S and E-W). These monorails were excluded based on sufficient separation and system redundancy; there are six service water pumps available and only three pumps are required to safely shut down the plant. In addition, no common cables, switchgear, or piping are located under the load path of these monorails.

2. Reactor pressure vessel head circular monorails (Units 1 and 2). The drop of any single load from these monorails will not disable any decay heat removal equipment due to redundancy and separation of the residual heat removal (RHR) supplies to the reactor vessel.

3. Containment buttress jib crane (Units 1 and 2). This crane was eliminated on the basis of separation and redundancy; it does not carry heavy loads over safe shutdown equipment with the exception of cables for a redundant diesel fuel oil transfer pump for diesel generator "A" and the RHR suction line for Units 1 and 2, which are protected since they are imbedded in the basemat concrete.

4. Main shop crane. This crane has been eliminated because the cables for only one train of the AFW may be impacted, leaving the redundant train available.

5. Jib cranes over incore instrumentation (Units 1 and 2). These jib cranes have been eliminated due to separation and redundancy and the reliability of alternate decay heat removal paths (RHR and safety injection).

All of the handling systems listed under Section D of Table 2.3, with the exception of the main shop crane, are monorails or jib cranes with fixed travel paths. However, the travel paths for these handling systems do not allow a load to pass over more than one train of safety-related equipment.

Although it is not possible to avoid portions of one train of identified safety-related equipment, the opposite train equipment would not be affected by a load drop. Due to plant operating requirements, these handling systems must be used on their full range of motion.

In addition, the Licensee stated that an independent evaluation performed by Bechtel demonstrated that failure of any of these load handling systems would not affect redundant safety trains and therefore would not adversely affect plant safety.

b. Evaluation

WEPC's identification of those load handling systems in Table 2.2 which are subject to compliance with the guidelines of NUREG-0612 is consistent with NUREG-0612 guidance. Similarly, exclusion of those handling systems listed in Table 2.3, Items A, B, and C, is reasonable based upon the rationale provided. Exclusion of those systems identified in Table 2.3, Item D, however, is not consistent with the guidance of NUREG-0612.

Although it is recognized that redundant trains may be available to mitigate the consequences of a load drop from any of these systems, such analyses are appropriate to preclude the need for hardware modifications of Phase II of NUREG-0612 but are not adequate justification for exclusion from compliance with the general guidelines of Phase I. As stated in Section 5.1.1 of NUREG-0612, the general guidelines should be satisfied for those systems that handle heavy loads over or near irradiated fuel or safe shutdown equipment, with no regard or credit given for system redundancy, mechanical or electrical interlocks, administrative procedures, or single-failure-proof handling systems. The Licensee should therefore reevaluate those systems identified in Table 2.3, Item D, for compliance with the general guidelines of NUREG-0612.

c. Conclusion and Recommendation

The Licensee's identification of those systems subject to compliance with NUREG-0612 is reasonable with the exception of the following systems which should be further evaluated without regard for system redundancy:

1. Circulating water pumphouse monorails (N-S and E-W)
2. Reactor pressure vessel head monorails
3. Containment buttress jib cranes
4. Main shop crane
5. Jib cranes over incore instrumentation.

2.1.2 Safe Load Paths [Guideline 1, NUREG-0612, Section 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."

a. Summary of Licensee Statements and Conclusions

The Licensee states that safe load paths have been defined only for those cranes whose interactions could not be eliminated due to separation and redundancy or for those that carry loads over safe shutdown equipment. Therefore, load paths have been developed for only the turbine building crane, both containment polar cranes, and the auxiliary building crane. These load paths have been identified on equipment drawings and referenced in load handling procedures. Although interim load paths were defined for each of the five different handling systems listed in Section D of Table 2.3, use of these load paths was discontinued following completion of the safety evaluation.

In the auxiliary building, all heavy loads, with the exception of the spent fuel shipping cask and the resin cask, are carried over the north pool and the spent fuel pool heat exchanger, since all fuel is stored in the south pool. Loss of pool cooling as a result of a load drop has been previously reviewed and deemed acceptable by the NRC in previous WEPC submittals covering re-racking of the spent fuel pool.

Due to the congestion of equipment inside containment, the Licensee reports that priority was given to developing load paths around safe shutdown equipment as opposed to over structural members. The Licensee states that these load paths will be kept in locations convenient to the applicable cranes; however, the load paths will not be marked on floors or structures since such markings would be unduly confusing and hinder safe crane operation. As an alternative to marking load paths on the floor, the Licensee proposes to use large signs (3 ft by 4 ft) which will be strategically located in the turbine hall, control building wall, auxiliary building, and containments. These signs, which are also referenced in load handling procedures, contain information such as safe load paths, heavy loads and weights, sling capacity tables, and an example of proper sizing and use of slings.

Deviations from the prescribed safe load paths are not permitted without prior approval of the manager's supervisory staff which constitutes an onsite Safety Review Committee.

b. Evaluation

Review of safe load paths developed by the Licensee indicates that load paths have been satisfactorily developed for those cranes which the Licensee currently considers to be within the scope of NUREG-0612. In both the auxiliary building and the turbine building, load paths developed around areas containing irradiated fuel or safety-related equipment meet the intent of this guideline. The load paths that have been developed in the containment are reasonable. Assigning a higher priority to protection of safety-related equipment than to following structural members is in keeping with the intent of this guideline. As previously indicated in Section 2.1.1.C, this approach should be extended to other cranes which the Licensee has prepared to eliminate on the basis of system redundancy.

Although marking load paths on the floor could be unduly confusing and counterproductive to achieving the intent of this guideline (due to the number of load paths), the Licensee's proposed use of 3-ft by 4-ft signs does not provide an effective visual aid to assist the crane operator when moving heavy loads. It is not desirable for the crane operator to follow a specified load path by referring to signs. His attention should be directed to the movement and control of the suspended heavy load. Therefore, to provide the necessary visual aid for the adherence of load movement to an established load path, the Licensee should either (1) use a suitable alternative to permanently marking the floors, such as temporary markings (e.g., tape, stanchions) or (2) use a knowledgeable load director or signalman whose duties and functions are delineated in appropriate procedures to assist the crane operator in following safe load paths.

The proposed method of handling of load path deviations by requiring approval by the onsite Safety Review Committee meets the intent of this guideline.

c. Conclusions and Recommendations

The designation of safe load paths at Point Beach Units 1 and 2 is generally consistent with Guideline 1. The Licensee should, however, implement a system of additional visual aids to assist the crane operator in ensuring that designated safe load paths are followed.

2.1.3 Load Handling Procedures [Guideline 2, NUREG-0612, Section 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. At 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 path; and other special precautions."

a. Summary of Licensee Statements and Conclusions

WEPC states that procedures are used at Point Beach Units 1 and 2 to control the handling of loads by the turbine building, containment, and auxiliary building cranes to ensure that the loads remain within the safe load paths. WEPC further states that Point Beach Nuclear Plant administrative procedure PBNP 9.3, "Special Structural Limitations on the Lifting of Heavy Loads," has been reviewed and revised to incorporate the findings of the review of Sections 5.1.2 through 5.1.5 of NUREG-0612.

The Licensee's subsequent submittal [6] reiterated that all overhead handling systems in use at Point Beach Units 1 and 2 are covered by load handling procedures. The Licensee considers these procedures to be adequate for safe load handling. One such procedure (Procedure SLP-6, "Wire Rope Sling Sizing") was submitted as an example.

b. Evaluation

Although the Licensee indicates that specific procedures have been implemented and are being used to control load handling, insufficient information has been provided in the Licensee's response or included in the supporting tables to identify these procedures and to verify that these procedures contain the required information: identification of equipment, inspections and acceptance criteria, steps and proper sequence, definition of safe load path, and other safety precautions. An evaluation of Procedure SLP-6 indicates that although it adequately addresses the specific subject matter, i.e., sizing of wire rope slings, it does not provide information sufficient to reach a conclusion that the information specified in this guideline is provided in other load-specific procedures.

c. Conclusions and Recommendations

Insufficient information has been provided to evaluate compliance with Guideline 2 at Point Beach Units 1 and 2. Therefore, the Licensee should identify specific procedures which control load handling of individual loads or in specific areas and verify that they contain the required information: identification of equipment, inspections and acceptance criteria, steps and proper sequence, definition of the safe load path, and other safety precautions.

2.1.4 Crane Operator Training [Guideline 3, NUREG-0612, Section 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' [7]."

a. Summary of Licensee Statements and Conclusions

The Licensee states that all overhead handling systems are operated by trained operators. In addition, WEPC states that the existing Point Beach Nuclear Plant Training Program (TRNG 2.1) meets the requirements of ANSI B30.2-1976, Chapter 2-3, "Qualifications for Operators," with the following exceptions:

1. (Item 2-3.1.7e) The warning bell will be actuated only as required to advise personnel of crane movement, rather than continuously during crane motion.

2. (Item 2-3.1.7g) The main line disconnect switch will not be left open. Present operating practice is to leave it shut on some cranes, whether or not they are in use, thus reducing the delay when placing the crane in service. WEPC's subsequent submittal indicated that although the main disconnect switches are left closed, local disconnect switches allow the crane to be deenergized for servicing.

3. (Item 2-3.1.7n) The cranes will not be deenergized for normal maintenance since some maintenance requires that the power be on. Contrary to the requirements of this section, certain maintenance and testing operations specifically require that crane be energized. WEPC uses common sense safety practices when servicing cranes and recognizes that appropriate safety practices must be followed while maintaining equipment that is energized.

4. (Item 2-3.1.7o) Crane controls will be not be tested at the beginning of each shift. They will be tested at the beginning of each lifting operation.

5. (Item 2-3.1.2b, 1 and 2) Existing WEPC medical examinations assure compliance with physical requirements as specified in Section 2-3.1.2b, 3 through 6. Future medical examinations, to be scheduled as soon as practicable, will include eye examinations to meet the requirements of Sections 2-3.1.2b, 1 and 2.

b. Evaluation

Point Beach Units 1 and 2 partially satisfy the criteria of this guideline based upon the Licensee's certification that the existing training program meets the requirements of ANSI B30.2-1976, Chapter 2-3, except where noted. An evaluation of the exceptions noted by WEPC follows:

Exception 1. The action proposed by the Licensee is reasonable. Item 2-3.1.7e of the standard states that the warning device "shall be activated each time before traveling, and intermittently when approaching workpersons." The Licensee's intent to activate the device "as required to advise personnel" satisfies the intent of the standard.

Exception 2. The Licensee's action is reasonable provided that the local disconnect switch isolates the crane from the mainline power when left unattended. This acceptability is predicated on verification by the Licensee that the referred local disconnect is in series with the mainline disconnect switch.

Exception 3. The Licensee's proposal for cranes to remain energized during normal maintenance is not consistent with ANSI guidelines. Although it is recognized that certain maintenance and testing procedures require the crane to remain energized, these procedures should be clearly differentiated from the numerous maintenance activities which are more safely performed on deenergized equipment so that potential hazards are clearly identified in procedures by the personnel who perform the maintenance. Use of "common sense safety practices" is not sufficient justification for allowing the crane to remain energized during maintenance that does not require (and in several instances, maintenance that should prohibit) electrification of crane components. Therefore, the Licensee should clearly specify those maintenance and testing procedures which require the crane to remain energized, as well as special precautions to be observed; all remaining procedures should require the crane to be deenergized.

Exception 4. The Licensee's intent to test crane controls only at the beginning of each lifting operation is reasonable, subject to the following limitations:

- If crane operations extend beyond a single shift, all crane controls should be tested at the beginning of each new shift unless the hook is under load. If such is the case, crane controls should be tested at the earliest convenient time.

Exception 5. The intent to perform future medical examinations with the required eye examinations of Section 2-3.1.2b is reasonable. The Licensee should ensure that all presently qualified crane operators are tested for visual acuity.

c. Conclusions and Recommendations

Point Beach Units 1 and 2 partially comply with Guideline 3. To comply fully with this guideline, the Licensee should revise procedures to conform with Chapter 2-3 of ANSI B30.2-1976 or provide suitable justification for nonconformance. Specifically, the following exceptions should be addressed:

1. Provide verification that the local disconnect switch is in series with the mainline disconnect switch and achieves isolation of the crane from the mainline power, when left unattended by the crane operator, which is similar to protection provided by the mainline disconnect switch.

2. Clearly specify those maintenance and testing procedures which require the crane to remain energized, including provisions for special maintenance precautions to be observed, and require all remaining procedures to deenergize the crane prior to performing maintenance.

2.1.5 Special Lifting Devices [Guideline 4, NUREG-0612, Section 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' [8]. 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."

a. Summary of Licensee Statements and Conclusions

The Licensee states that Westinghouse, the supplier of most of the special lifting devices, has performed a review of lifting device design to determine compliance with ANSI N14.6-1978 as supplemented by NUREG-0612, Guideline 4. The special lifting devices reviewed were:

- o reactor head lifting device
- o upper internals lifting device
- o reactor coolant pump motor lifting device

The following special lifting devices are not evaluated for the reasons indicated:

- o The high and low pressure rotor lifting device will not be analyzed since the consequences of a load drop over the condensate storage tanks have been analyzed and determined to be acceptable.
- o The offset lifting rig (used for the turbine upper bearing housing) will not be reviewed since the housings will not be carried over the control building area and safe shutdown equipment.
- o The main feed pump lifting rig will not be reviewed since the consequences of a feed pump drop on the load path over the control building have been analyzed and determined to be acceptable.

The Licensee's evaluation of the remaining lifting rigs for compliance with the requirements of ANSI N14.6-1978 has been provided; this evaluation addresses only those sections which are directly related to the load handling reliability of the lifting rig. The Licensee has provided the following information regarding these lifting devices.

1. Design - Proper consideration was made of design considerations (Section 3.3) and designer's responsibilities (Section 3.1) in the design of the lifting devices. Regarding stress design factors, the Licensee states that, due to the inherent elasticity of the multiple-reeved hoisting system, the dynamic factor would be minimal. In the Licensee's opinion, no compensation need be made for dynamic loads since the ANSI factor of 3 certainly includes consideration of suddenly applied loads for cases where the impact factor may be as high as 2.

   In addition, however, it is noted that all other components of those lifting rigs evaluated meet or exceed ANSI stress design factors of 3 and 5 with the following exceptions noted for the reactor vessel internals lift rig: the adaptor pin, lift lug pin, side lug pin, and sling leg pin. For each of these pins, it is noted that bending stresses exceed material allowable stresses, whereas bearing and shear stresses are well below the ANSI requirements. The Licensee states that calculated bending stresses are overestimated and the pin shear stresses are the governing parameter for pin strength; therefore, all pins satisfy the ANSI stress design criteria.

2. Fabrication - Although a formal quality assurance program was not required, the Licensee states that the vendor reviewed all aspects of the manufacturing process, including material selection, welders, and welding procedures; conformance with drawing requirements is assured by the Westinghouse quality release program.

3. Testing, Inspection, and Continued Compliance - The reactor pressure vessel (RPV) lift rig was load tested to 100% prior to initial use. The RPV internals lift rig was not load tested prior to use, but this rig has lifted the lower internals, which is a load substantially in excess (300%) of the weight of the upper internals (the heavy load of concern). The reactor coolant pump motor lifting rig was not load tested prior to initial use. Regarding annual inspection requirements, the Licensee states that 150% load tests are impractical to perform, and such testing would exceed the crane capacity for the RPV and internals lifting rigs. Critical welds and parts will be visually inspected and documented prior to use each outage.

   In the event of major maintenance or application of substantial stresses, tests will be performed by lifting the designated loads a short distance for ten minutes, and visually inspecting critical welds of concern.

b. Evaluation

Exclusion of the high and low pressure rotor lifting device, the offset lifting rig, and the main feed pump lifting rig on the basis of previously acceptable analyses is not consistent with the intent of this guideline. Similar to the evaluation and recommendations contained in Section 2.1.1(b) of this report, such analyses may be sufficient to preclude the need for Phase II hardware modifications but are not adequate justification for noncompliance with the general guidelines of NUREG-0612. Therefore, the Licensee should reevaluate these lifting devices for compliance with the provisions of ANSI N14.6-1978.

For those lifting devices evaluated by the Licensee, adequate information has been provided to verify that appropriate considerations were observed in the design and fabrication of these devices. The Licensee's observation that dynamic impact forces are accommodated in the ANSI stress design factors is not consistent with this guideline; the intent as perceived by staff discussions is to account for known routine dynamic loads so that the safety factor is reserved for uncontrollable factors such as aging, harsh environments, or unexpected dynamic loads (e.g., load hangup). However, it is also noted that, with limited exceptions, lift rig components satisfy ANSI stress design requirements. In addition, crane speeds used to lift these devices and associated loads are slow (6 feet per minute), and resulting dynamic loads are minimal and may be disregarded.

For those pins noted to exceed ANSI stress design factors in bending stress, it is not agreed that shear stress is the critical parameter. Shear stress is the critical parameter when considering secured mechanical connectors as bolts and rivets; bending stress should be considered for nonsecured connectors such as pins. However, it is noted that this lifting rig is conservatively designed and has lifted the lower internals (202,000 lbs), which is over 300% of the weight of the heavy load of concern, the upper internals. Therefore, the existing design of this device, combined with a lift significantly in excess of the load of concern without consequence, adequately demonstrates the design and fabrication reliability of this device for lifting the upper internals.

The intent of Guideline 4, in addition to verifying the design adequacy of these special lifting devices, is also to ensure that the Licensee inspects and maintains these devices in a manner which assures their continued reliability. An integral part of this program includes performance of an initial or periodic load test to a load sufficiently in excess of the rated load. The performance of a load test in excess of the load subject to NUREG-0612 is an important contributor to the ability to assess the overall reliability of a device. Such a test supplements design reliability by demonstrating that the device was properly fabricated or assembled and that a portion of the design safety margin has been demonstrated. Such proof of workmanship is particularly important for a fairly complicated device. It is recognized, however, that the specification of a 150% overload test is somewhat arbitrary and that, in some cases, the nature of the device is such that the likelihood of workmanship shortcomings is remote. In addition, ANSI N14.6-1978 specifies that an annual program of either load tests or thorough nondestructive examination (NDE) should be performed to demonstrate continued reliability.

A lift of the lower internals by the RPV internals lifting rig is more than sufficient to satisfy the ANSI requirement. However, information provided by the Licensee indicates that the RPV head and the reactor coolant pump motor lifting rigs have not been load tested in excess of the rated load of these devices. It is recommended that load tests or similar lifts be performed or documented for these two lifting rigs to fully satisfy guideline requirements. It is further noted that the weight of the RPV head and lifting rig is 205,000 lb, which is in excess of the rated load of the containment polar crane (100 tons).

Evaluation of the RPV lifting device by the Licensee, however, indicates that the design stress margins are substantial, that the device is uncomplicated, that it is principally assembled with mechanical joints such that an assembly error is unlikely, and lastly, that it has been weight tested to 100% of rated load. In addition, the use of welded joints appears to be minimized, and documentation has been provided to substantiate the NDE performed on each of these welds. Therefore, design, fabrication, and initial 100% load testing of the head lift rig was performed in a manner that results in load handling reliability consistent with the 150% test specified in ANSI N14.6-1978.

The reactor coolant pump motor lift rig has been analyzed in a manner similar to the RPV head lift rig, and supporting documentation has been provided by the Licensee. Information is still needed, however, to substantiate a rated load test in order to agree that this device was designed, fabricated, and tested in a manner consistent with the intent of the 150% load test of ANSI N14.6-1978.

Regarding annual or periodic examinations, ANSI N14.6-1978 specifies that, in cases where cleanliness and conditions permit, "load testing may be omitted, and dimensional testing, visual examination, and nondestructive testing of major load-carrying welds and areas shall suffice." Further information is required from the Licensee to substantiate whether the existing program of visual inspections includes provisions for the dimensional and nondestructive testing specified by the ANSI standard. Similar verification is required for visual inspections following major maintenance and application of substantial stresses.

c. Conclusion and Recommendations

Special lifting devices at Point Beach Nuclear Plant partially satisfy Guideline 4. The Licensee should, however, provide the following information:

1. Evaluate the following special lifting devices for compliance with ANSI N14.6-1978:

   o high and low pressure rotor lifting device

   o offset lifting rig

   o main feed pump lifting rig.

2. Substantiate the performance of a rated load test of the reactor coolant pump motor lifting rig.

3. Verify that visual examinations performed during annual inspections, after major maintenance, and following substantial overstress conditions contain provisions for dimensional and nondestructive testing in accordance with ANSI N14.6-1978.

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

"Lifting devices that are not specially designed should be installed and used in accordance with the guideline of ANSI B30.9-1971, 'Slings' [9]. 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."

a. Summary of Licensee Statements and Conclusions

WEPC states that a review of other lifting devices was conducted to determine compliance with the design, fabrication, and proof-testing requirements of ANSI B30.9-1971 and NUREG-0612, Section 5.1.1(5). The Licensee further states that all slings in use (except for those used in the turbine building south of column line 10 and north of column line 13 and those used in the transport of the turbine rotors) will be replaced with slings meeting the requirements of ANSI B30.9-1971. In the interim, the old slings will be used after being derated by a factor of two, assuming the lowest value for a particular wire diameter.

The Licensee takes exception to the inspection requirements of Section 9-2.8.1 of ANSI B30.9-1971, which requires inspection on a regular basis. Inspections are performed prior to each use; therefore, further inspections on a regular basis would be redundant.

WEPC's subsequent submittal [6] reiterated the Licensee's previous position that all slings used at Point Beach Nuclear plant meet the criteria developed by WEPC to satisfy requirements for adequate factors of safety and dynamic loading considerations.

b. Evaluation

Programs for slings at Point Beach Units 1 and 2 are consistent with this guideline on the basis of the Licensee's certification that slings are being replaced with slings that satisfy the criteria of ANSI B30.9-1971. It is also reasonable to derate slings currently in use until replacements are procured. However, the contention that periodic inspections are a redundancy of inspections prior to use should be reevaluated by the Licensee. Section 9-2.8.1 of ANSI B30.9-1971 states that periodic inspections are to be performed by an appointed or authorized person, that any deterioration which could result in appreciable loss of original strength should be noted, and that future use of the sling should be determined. It is the intent of this requirement to have quality assurance or senior personnel with rigging experience who are not involved in routine maintenance perform an independent inspection of all slings in a more critical and uniform manner than might be performed prior to use. In addition, if inspections prior to use properly identify defective slings, the periodic inspection would be a backup or second check to verify proper performance of these inspections. The Licensee should reevaluate the existing inspection program to ensure that the periodic inspections are, in fact, performed each time prior to use.

No information provided by the Licensee indicates whether the remaining requirements in the guideline have been satisfied:

1. Sling selection is based upon the sum of the static and maximum dynamic loads.

2. Slings are marked with the static load in accordance with this guideline.

3. Slings restricted in use to only certain cranes are clearly marked to so indicate.

c. Conclusions and Recommendations

Point Beach Units 1 and 2 partially comply with this guideline on the basis of the Licensee's verification that slings that are being procured will comply with ANSI B30.9-1971. In order to comply fully, the Licensee should also perform the following:

1. Verify that sling selection and marking are based upon the sum of the maximum static and dynamic loads.

2. Verify that slings restricted in use to only certain cranes are clearly marked to so indicate.

2.1.7 Cranes (Inspection, Testing, and Maintenance) [Guideline 6, NUREG-0612, Section 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)."

a. Summary of Licensee Statements and Conclusions

Point Beach Nuclear Plant inspection, testing, and maintenance operations and procedures have been reviewed by the Licensee against the requirements of ANSI B30.2-1976, Chapter 2-2, and are in compliance, with the exception of the containment polar cranes. The Licensee states that "these (polar) cranes are given an initial inspection in accordance with OSHA requirements prior to use." The major annual inspection, fulfilling the requirements of Chapter 2-2, is performed by the Licensee during the annual refueling outages as time permits.

b. Evaluation

Procedures in use at Point Beach Nuclear Plant satisfy the requirements of this guideline on the basis of the Licensee's certification that these procedures are in compliance with ANSI B30.2-1976, Chapter 2-2. It is acceptable for the Licensee to use OSHA inspection requirements, since applicable ANSI standards have been incorporated into OSHA guidelines. Further, the major annual inspections may be deferred but should be performed prior to use (as opposed to "as time permits" as recommended by the Licensee), as noted in NUREG-0612.

c. Conclusions and Recommendations

Point Beach Nuclear Plant complies with Guideline 6.

2.1.8 Crane Design [Guideline 7, NUREG-0612, Section 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' [10]. 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."

a. Summary of Licensee Statements and Conclusions

The Point Beach auxiliary building crane will be modified by the Licensee to provide adequate redundant lifting features and will take into consideration ANSI B30.2-1976, CMAA-70, and Regulatory Guide 1.13.

The containment, auxiliary, and turbine building cranes were designed to comply with EOCI-61 [11], which was superseded by CMAA-70. As a basis for its evaluation, WEPC states the following:

"It is to be noted that the Franklin Research Center, a division of The Franklin Institute, conducted a comparison of the recommendations of CMAA-70 with those contained in EOCI-61. Generally, the requirements of CMAA-70 represented the codification of good engineering practice which should have been incorporated in cranes built to EOCI-61 specification although specific requirements were not contained in EOCI-61. The Franklin Research Center study is addressed in 'Technical Evaluation Report,' NRC Docket No. 50-334, dated September 24, 1981 performed under NRC Contract No. NRC-03-79-118."

The differences between EOCI-61 and CMAA-70 that affect the safe handling of heavy loads by the containment and turbine building cranes are addressed in the succeeding paragraphs.

1. Impact allowance. CMAA-70, Article 3.3.2.1.1.3, requires that crane design calculations include an impact allowance of 0.5% of the load per foot per minute (fpm) of hoisting speed but not less than 15%. EOCI-61 specifies only a minimum allowance of 15%. Consequently, for cranes with hoist speeds in excess of 30 fpm, it is possible that the impact allowance applied under EOCI-61 will be less than that required by CMAA-70. Except for the containment building crane auxiliary hoist speed of 35 fpm, the overhead cranes subject to this review operate with hoist speeds not in excess of 30 fpm. A modification is deemed unnecessary since all critical loads are handled by the the main hoist.

2. Torsional forces. CMAA-70, Article 3.3.2.1.3, requires that twisting moments due to overhanging loads and lateral forces acting eccentric to the horizontal neutral axis of a girder be calculated on the basis of the distance between the center of gravity of the load, or force center line, and the girder shear center measured normal to the force vector. EOCI-61 states that such moments are to be calculated with reference to girder center of gravity. For girder sections symmetrical about each principal central axis (e.g., box section or I-beam girders), the shear center coincides with the centroid of the girder section and there is no difference between the two requirements. Box section girders are used for the containment building and turbine building cranes.

3. Bending stress. CMAA-70, Article 3.3.2.2, requires that bending stress calculations include a wind load of 5 pounds per square foot in design

stress calculations based on the sum of dead and live loads. EOCI-61 requires that the design of outdoor cranes include a wind load of 10 pounds per square foot of projected area but is not specific concerning the combination of wind loads with other dead and live loads. Although the combination of a wind load with other design loading calculations constitutes a codification of the same good engineering practice that would have been used in the cranes built to EOCI-61 specifications, the containment building and turbine building cranes are installed indoors and therefore are not subject to wind loading.

4. Longitudinal stiffeners. CMAA-70, Article 3.3.3.1, specifies (1) the maximum allowable web depth/thickness (h/t) ratio for box girders using longitudinal stiffeners and (2) requirements concerning the location and minimum moment of inertia for such stiffeners. EOCI-61 allows the use of longitudinal stiffeners but provides no similar guidance. The requirements of CMAA-70 represent a codification of the girder design practice and the design standards employed in the containment building and turbine building cranes built to EOCI-61 specifications.

5. Allowable compressive stress. CMAA-70, Article 3.3.3.1.3, identifies allowable compressive stresses to be approximately 50% of yield strength of the recommended structural material (A-36) for girders, where the ratio of the distance between web plates to the thickness of the top cover plate (b/c ratio) is less than or equal to 38. Allowable compressive stresses decrease linearly for b/c ratios in excess of 38. EOCI-61 provides a similar method for calculating allowable compressive stresses except that the allowable stress decreases from approximately 50% of yield only after the b/c ratio exceeds 41. Consequently, structural members with b/c ratios in the general range of 38 to 52 designed under EOCI-61 will allow a slightly higher compressive stress than those designed under CMAA-70. The b/c ratios of structural members for the containment building and turbine building cranes are 20 and 20.7, respectively.

6. Fatigue considerations. CMAA-70, Article 3.3.3.1.3, provides substantial guidance with respect to fatigue failure by indicating allowable stress ranges for various structural members in joints under repeated loads. EOCI-61 does not address fatigue failure. The requirements of CMAA-70 are not

of consequence for the containment building and turbine building cranes since these cranes are not generally subjected to frequent loads at or near design conditions (CMAA-70 provides allowable stress ranges for loading cycles in excess of 20,000) and are not generally subjected to stress reversal (CMAA-70 allowable stress range is reduced to below the basic allowable stress for only a limited number of joint configurations).

7. Hoist rope requirements. CMAA-70, Article 4.2.1, requires that the capacity load plus the bottom block divided by the number of parts of rope not exceed 20% of the published rope breaking strength. EOCI-61 requires that the rated capacity load divided by the number of parts of rope not exceed 20% of the published rope breaking strength. The capacity load plus the bottom block divided by the number of parts of rope yields 8.62 tons and 8.14 tons for the containment building and turbine building cranes, respectively. These values are less than 20% of the 50.1-ton published breaking strength of 1-1/8 inch 6 x 37 Improved Plow Steel - Fiber Core Wire Rope.

8. Drum design crushing and bending loads. CMAA-70, Article 4.4.1, requires that the drum be designed to withstand combined crushing and bending loads. EOCI-61 requires only that the drum be designed to withstand maximum load bending and crushing loads with no stipulation that these loads be combined. The combination of crushing and bending loads for the subject cranes could not be verified due to lack of information. However, this variation is not expected to be of consequence since the requirements of CMAA-70 represent the codification of good engineering practice that has been incorporated in the containment building and turbine building cranes built to EOCI-61 specifications although a specific requirement was not contained in EOCI-61.

9. Drum design groove depth and pitch. CMAA-70, Article 4.4.3, provides recommended drum groove depth and pitch. EOCI-61 provides no similar guidance. The recommendations in CMAA-70 constitute a codification of good engineering practice with regard to reeving stability and reduction of rope wear and do not differ substantially from practices employed in the design of the containment building and turbine building cranes built to EOCI-61 specifications.

The containment building and turbine building drum groove depth and pitch meet the requirements of CMAA-70.

10. Gear design. CMAA-70, Article 4.5, requires that gearing horsepower rating be based on certain American Gear Manufacturers Association (AGMA) standards and provides a method for determining allowable horsepower. EOCI-61 provides no similar guidance. The recommendations in CMAA-70 constitute a codification of good engineering practice for gear design and do not differ substantially from the practices employed in the design of the containment building and turbine building cranes built to EOCI-61 specifications. The containment building and turbine building crane gears are in accordance with AGMA standards.

11. Bridge brake design. CMAA-70, Article 4.7.2.2, requires that bridge brakes, for cranes with cab control and the cab on the trolley, be rated at least 75% of bridge motor torque. EOCI-61 requires a brake rating of 50% of bridge motor torque for similar configurations. A cab-on-trolley control arrangement is not used for the containment building and turbine building cranes. The containment building and turbine building crane bridge and trolley brakes are rated at 100% of the motor full load torque.

12. Hoist brake design. CMAA-70, Article 4.7.4.2, requires that hoist holding brakes, when used with a method of control braking other than mechanical, have torque ratings no less than 125% of the hoist motor torque. EOCI-61 requires a hoist holding brake torque rating of no less than 100% of the hoist motor torque without regard to the type of control brake employed. The containment building and turbine building main and auxiliary hoist brakes are rated at 150% of the hoist motor full load torque with electrical control braking systems.

13. Bumpers and stops. CMAA-70, Article 4.12, provides substantial guidance for the design and installation of bridge and trolley bumpers and stops for cranes which operate near the ends of bridge and trolley travel. No similar guidance is provided in EOCI-61. The trolley and bridge stops incorporated in the design of the containment building and turbine building cranes employ limit switches which stop the bridge or trolley prior to

reaching the end of travel. These switches provide the equivalent effect of the bumpers or stops described in CMAA-70.

14. Static control systems. CMAA-70, Article 5.4.6, provides substantial guidance for the use of static control systems. EOCI-61 provides guidance for magnetic control systems only. This variation is not an issue of consequence because magnetic control systems were generally employed in cranes designed when EOCI-61 was in effect and the static control requirements identified in CMAA-70 constitute a codification of the same good engineering practice that was used in the design of static control systems in the containment building and turbine building cranes built to EOCI-61 specifications.

15. Restart protection. CMAA-70, Article 5.6.2, requires that cranes not equipped with spring-return controllers or momentary-contact push buttons be provided with a device that will disconnect all motors upon power failure and will not permit any motor to be restarted until the controller handle is brought to the OFF position. No similar guidance is provided in EOCI-61. This variation is not of consequence for the containment building and turbine building cranes since, except for the maintained contact master OFF-ON control, they are designed with spring-return controllers or momentary-contact push buttons.

In addition to those items noted in FRC's evaluation the Licensee has compared ANSI B30.2-1976 and CMAA-70 with EOCI-61 and provided the following additional evaluations:

1. Structural Steel. CMAA-70 requires ASTM A36 structural steel; the ordinary structural steel for containment building and turbine building cranes conforms to ASTM A36, and low alloy structural steel conforms to ASTM A242.

2. Stress Requirements. Although the specification requirements differ, the stress requirements of CMAA-70 for bridge girders, end trucks, and trolley frames are met by the containment building and turbine building cranes.

3. Crane Hook Latches. ANSI B30.2-1976 adds the requirement that crane hooks have latches if practical in that application. This requirement is met by the containment building and turbine building cranes.

b. Evaluation

The Point Beach auxiliary crane satisfies the criteria of Guideline 7 on the basis of the Licensee's certification that modifications currently in progress will comply with ANSI B30.2-1976 and CMAA-70.

The Point Beach containment building and turbine building cranes substantially satisfy the criteria of Guideline 7 on the basis that the cranes were designed and procured to EOCI-61 standards. In addition, the Licensee has satisfactorily addressed the more restrictive design requirements imposed by CMAA-70. The following evaluation of each Licensee exception to a specific requirement of CMAA-70 is provided:

1. Impact allowance. The Licensee notes that the auxiliary hoist speed is 35 fpm, which is in excess of the 30-fpm hoist speed at which other overhead cranes subject to this review operate. It is agreed that modification to reduce this hoist speed is unnecessary since all critical loads are handled by the main hoist.

2. Bumpers and Stops. Trolley and bridge stops for these cranes employ limit switches which stop the bridge or trolley prior to the end of travel; such a design suitably precludes crane operation under load at the end of bridge or trolley travel.

c. Conclusions and Recommendations

The design and fabrication of overhead electric travelling cranes at Point Beach Nuclear Station are consistent with Guideline 7.

2.2 INTERIM PROTECTION MEASURES

The NRC has established six interim protection measures to be implemented at operating nuclear power plants to provide reasonable assurance that no heavy loads will be handled over the spent fuel pool and that measures exist to reduce the potential for accidental load drops to impact on fuel in the core or spent fuel pool. Four of the six interim measures of the report consist of general Guideline 1, Safe Load Paths; Guideline 2, Load Handling Procedures; Guideline 3, Crane Operator Training; and Guideline 6, Cranes

(Inspection, Testing, and Maintenance). The two remaining interim measures cover the following criteria:

1. Heavy load technical specifications
2. Special review for heavy loads handled over the core.

The status of the Licensee's implementation and the evaluation of these interim protection measures are summarized in the succeeding paragraphs of this section.

2.2.1 Technical Specifications [Interim Protection Measure 1, NUREG-0612, Section 5.3]

"Licenses for all operating reactors not having a single-failure-proof overhead crane in the fuel storage pool area should be revised to include a specification comparable to Standard Technical Specification 3.9.7, 'Crane Travel - Spent Fuel Storage Pool Building,' for PWR's and Standard Technical Specification 3.9.6.2, 'Crane Travel,' for BWR's, to prohibit handling of heavy loads over fuel in the storage pool until implementation of measures which satisfy the guidelines of Section 5.1."

a. Evaluation

A review of technical specifications for the Point Beach plant indicates that the Licensee partially satisfies the intent of this guideline in that the following technical specifications have been implemented to restrict and control movement of heavy loads over the spent fuel pool as follows:

"15.3.8.B Limitations on Load Movements over a Spent Fuel Pool

1. One ton shall be the maximum load allowed over either the north half or south half of the spent fuel storage pool when spent fuel which has been subcritical for less than one year is stored in that half of the spent fuel pool.

2. Auxiliary building crane bridge and trolley positive acting limit switches shall be installed to prevent motion of the main crane hook over that half of the spent fuel pool which contains stored spent fuel which has been subcritical for less than one year.

3. When transporting loads exceeding one ton over a pool half which has fuel stored therein, the rigging between the transported load and the crane hook shall consist of either a single rigging device rated at six times the static and dynamic loads or dual rigging devices each

rated at three time the static and dynamic loads. The maximum permissible crane load shall be 39 tons for the main hook and six tons for the auxiliary hook.

4. Whenever possible, loads shall be carried over or placed in the half of the spent fuel pool that does not have any spent fuel assemblies stored therein.

5. Loads not exceeding 52,500 pounds may be carried over either pool half (or placed in the north half of the spent fuel pool) provided that that half of the pool contains no spent fuel assemblies."

These technical specifications were implemented by the Licensee as interim requirements pending completion and implementation of NRC Generic Task A-36, "Control of Heavy Loads Near Spent Fuel," the original predecessor to NUREG-0612. These specifications should be modified to conform with the criteria of the current interim protection measure to prohibit movement of any heavy load over spent fuel in the spent fuel pool, for the following reasons:

1. Heavy loads are presently allowed to be carried over spent fuel which has been subcritical for more than 1 year.

2. Although increased factors of safety or redundant lifting devices are used when lifting heavy loads over fuel in the spent fuel pool, the auxiliary crane itself is not a single-failure-proof crane.

3. Current specifications (15.3.8.B4) are worded in a manner which is subject to interpretation at the time of the lift and thus the intent of the interim protection measure may not be satisfied.

In addition, in the Licensee's response, a heavy load is defined as any load weighing more than 1750 lb, whereas the technical specifications define a heavy load as any load weighing greater than 1 ton. When the specifications are modified, a heavy load should be defined and limited to any load weighing greater than 1750 lb.

b. Conclusions and Recommendations

The Point Beach Nuclear Plant partially complies with this interim protection measure. To comply fully, plant technical specifications should be revised to prohibit all movement of heavy loads over the spent fuel in the spent fuel pool until the auxiliary crane has been certified as a single-failure-proof crane.

2.2.2 Administrative Controls [Interim Protection Measures 2, 3, 4, and 5, NUREG-0612, Section 5.3]

"Procedural or administrative measures [including safe load paths, load handling procedures, crane operator training, and crane inspection]... can be accomplished in a short time period and need not be delayed for completion of evaluations and modifications to satisfy the guidelines of Section 5.1 of [NUREG-0612]."

a. Summary of Licensee Statements and Conclusions

Summaries of Licensee statements and conclusions are contained in discussions of the corresponding general guidelines in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7.

b. Evaluations, Conclusions, and Recommendations

Evaluations, conclusions, and recommendations are contained in discussions for the corresponding general guidelines in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7 of this report.

2.2.3 Special Reviews for Heavy Loads Over the Core [Interim Protection Measure 6, NUREG-0612, Section 5.3]

"Special attention should be given to procedures, equipment, and personnel for the handling of heavy loads over the core, such as vessel internals or vessel inspection tools. This special review should include the following for these loads: (1) review of procedures for installation of rigging or lifting devices and movement of the load to assure that sufficient detail is provided and that instructions are clear and concise; (2) visual inspections of load bearing components of cranes, slings, and special lifting devices to identify flaws or deficiencies that could lead to failure of the component; (3) appropriate repair and replacement of defective components; and (4) verify that the crane operators have been properly trained and are familiar with specific procedures used in handling these loads, e.g., hand signals, conduct of operations, and content of procedures."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that load handling procedures have been evaluated and upgraded to include reference to interim safe load paths. Crane operators are trained. Plant maintenance procedures meeting the requirements of ANSI B30.2, Chapter 2-2, with some exceptions, are observed.

b. Evaluation

Although not specifically addressed by the Licensee, it is apparent from responses to Guidelines 5 and 6 that visual inspections of load bearing components of slings and cranes meet the intent of interim protection measure. Conformance with the requirements of Chapter 2-2 of ANSI B30.2 ensures that appropriate repair and replacement of defective components is performed. Inherent in the responses to Guideline 4, the special lifting devices are visually inspected annually and appropriate quality controls are placed on repairs and replacement parts.

c. Conclusion

The Licensee complies with Interim Protection Measure 6.

3. CONCLUSION

This summary is provided to consolidate the results of the evaluation contained in Section 2 concerning individual NRC staff guidelines into an overall evaluation of heavy load handling at Wisconsin Electric Power Company's (WEPC) Point Beach Nucelar Power Plant Units 1 and 2. Overall conclusions and recommended Licensee actions, where appropriate, are provided with respect to both general provisions for load handling (NUREG-0612, Section 5.1.1) and completion of the staff recommendations for interim protection (NUREG-0612, Section 5.3).

3.1 GENERAL PROVISIONS FOR LOAD HANDLING

The NRC staff has established seven guidelines concerning provisions for handling heavy loads in the area of the reactor vessel, near stored spent fuel, or in other areas where an accidental load drop could damage equipment required for safe shutdown or decay heat removal. The intent of these guidelines is twofold. A plant conforming to these guidelines will have developed and implemented, through procedures and operator training, safe load travel paths such that, to the maximum extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment. A plant conforming to these guidelines will also have provided sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system. As detailed in Section 2, it has been found that load handling operations at the Point Beach Units 1 and 2 can be expected to be conducted in a highly reliable manner consistent with the staff's objectives as expressed in these guidelines. A need for further Licensee action was identified for the following areas:

- o WEPC should reevaluate the following handling systems for compliance with the general guidelines of NUREG-0612 without regard for system redundancy: (1) circulating water pumphouse monorails (N-S and E-W), (2) reactor pressure vessel head monorails, (3) containment buttress jib crane, (4) main shop crane, and (5) the jib cranes over incore instrumentation.

- o WEPC should implement recommended provisions for visual aids as an alternative to permanent marking of load paths on the floor.

Franklin Research Center
A Division of The Franklin Institute

- WEPC should identify those specific procedures that control load handling of individual loads or movements in specific areas, including verification that such procedures contain required information.

- WEPC should verify that the following items are substantiated in the crane operator training and qualification program: (1) verify that the local disconnect switch is in series with the mainline disconnect switch and achieves electrical isolation of the crane similar to the protection provided by the mainline disconnect switch; and (2) verify that maintenance and testing procedures which require the crane to remain energized are clearly specified.

- Regarding special lifting devices, WEPC should perform the following: (1) evaluate the high and low pressure rotor, offset, and main feed pump lifting rigs for compliance with ANSI N14.6-1978; (2) substantiate the performance of a rated load test of the reactor coolant pump motor lifting rig; and (3) verify that visual inspections performed during annual maintenance, after major maintenance, and following substantial overstress conditions contain provisions for dimensional and nondestructive testing.

- WEPC should verify that appropriate consideration is made of routine dynamic loads in the selection and marking of slings, and that slings restricted in use to only certain cranes are clearly marked to so indicate.

3.2 INTERIM PROTECTION MEASURES

The NRC staff has stated in NUREG-0612, Section 5.3 that certain measures should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until implementation of the general guidelines of NUREG-0612, Section 5.1 is complete. Specified measures include the implementation of a technical specification to prohibit the handling of heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement as necessary of cranes, slings, and special lifting devices, to eliminate deficiencies that could lead to component failure. The evaluation of information provided by the Licensee indicates that the following action is necessary to ensure that the staff's measures for interim protection at Point Beach Nuclear Plant are taken:

- Revise plant technical specifications to prohibit all movement of heavy loads over spent fuel in the spent fuel pool.

4. REFERENCES

1. "Control of Heavy Loads at Nuclear Power Plants"
   NRC, July 1980
   NUREG-0612

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

3. Generic letter to Point Beach Nuclear Plant
   Subject: Request for Review of Heavy Load Handling
   NRC, December 22, 1980

4. C. W. Fay (WEPC)
   Letter to H. R. Denton (NRC)
   Subject: Control of Heavy Loads at Nuclear Power Plants
   September 30, 1981

5. C. W. Fay (WEPC)
   Letter to H. R. Denton (NRC)
   Subject: Control of Heavy Loads at Nuclear Power Plants
   January 11, 1982

6. C. W. Fay (WEPC)
   Letter to H. R. Denton (NRC)
   Subject: Control of Heavy Loads at Nuclear Power Plants
   June 30, 1982

7. "Overhead and Gantry Cranes"
   New York: American Society of Mechanical Engineers, 1976
   ANSI B30.2-1976

8. Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials
   New York: American National Standards Institute, Inc., February 15, 1978
   ANSI N14.6-1978

9. "Slings"
   American Society of Mechanical Engineers, 1972
   ANSI B30.9-1971

10. Specifications for Electric Overhead Traveling Cranes
Pittsburgh, PA: Crane Manufacturers Association of America, Inc., 1975
CMAA-70

11. Specifications for Electric Overhead Traveling Cranes
Pittsburgh, PA: Electric Overhead Crane Institute, 1961
EOCI-61

SYNOPSIS OF ISSUES ASSOCIATED WITH NUREG 0612

The following information is provided to identify exceptions or interpretations related to verbatim compliance with NUREG 0612 Guidelines that have occurred during the course of this review. For each of the major Guidelines specific exceptions are identified, a discussion concerning the underlying objective of that Guideline is provided, and approaches felt to be consistent and inconsistent with that guideline are identified. While each such exception has been handled on a case by case basis, and has been considered in light of overall compliance with NUREG 0612 at a particular plant, the topics are of a nature general enough to be of interest to other plants.

GUIDELINE 1 SAFE LOAD PATHS

Exception 1

In the opinion of the licensee, development of individual load paths is impractical since there are a significant number of loads for which the pickup and laydown areas vary from outage to outage. Further, in some cases the location of safety related equipment combined with the design of the floor over which heavy loads are carried indicates that for a number of lifts there is no preferred load path.

Discussion

The purpose of this portion of Guideline 1 is to ensure that the paths over which heavy loads are carried have been developed and approved in advance of the lift and are based on considerations of safety. In particular it is provided to avoid the ad hoc selection of load paths by maintenance personnel since such a situation could result in the use of a load path which has been established by a process wherein considerations other than safety have taken precedence.

It is recognized that there are a class of loads which, although in excess of the weight specified for classification as a heavy load, are actually miscellaneous or maintenance related loads for which it is impractical to identify a specific laydown area which can be fixed from outage to outage. Conversely there are a number of loads for which specific laydown areas have been allocated in the original plant design and which should reasonably be expected to be carried over the same load paths during every outage. A tabulation of loads in this latter category, generally applicable to PWR's and BWR's, was provided in NUREG 0612 as Table 3-1.

A fundamental principal of NUREG 0612 is protection through defense in depth. Specifically, the first line of protection from an accident which could result in damage to spent fuel or equipment required for safe shutdown or decay heat removal is to avoid or minimize the exposure of such equipment to crane borne loads overhead. Where such exposure is minimized, rather than avoided, a second line of defense can then be provided by intervening barriers such as floors or the provision of additional lifting device redundancy or safety factors. Considering the foregoing, the use of exclusion areas, rather than safe load paths, is consistent with this guideline only under circumstances where there is no safety related equipment located beneath the area accessible to the crane hook but outside of the exclusion area. This situation has been found in buildings such as the turbine hall or screen house where safety related equipment is concentrated in a specific area within the crane path. It is unlikely to occur within containment due to the numerous safety related piping and electrical systems provided to support decay heat removal.

Approaches Consistent With This Guideline

Specific safe load paths are prepared and approved for major components for which hazardous areas are well established. For miscellaneous lifts load corridors are established such that any movement within that corridor cannot result in carrying a heavy load over spent fuel or systems required for safe shutdown or decay heat removal (regardless of intervening floors). Movement within these corridors is at the discretion of the load handling party.

Specific safe load paths are prepared and approved for major components for which hazardous areas are well established. For miscellaneous lifts detailed directions are prepared and approved for developing safe load paths which include floor plans showing the location of safety related equipment and instructions to avoid such equipment. Specific safe load paths are then prepared each time a miscellaneous lift qualifying as a heavy load is made. These individual load paths are temporary and may change from outage to outage.

Approaches Inconsistent With this Guideline.

Use of limited exclusion areas in containment which merely prohibited the carrying of heavy loads directly over the core or specific components and allow full load handling party discretion in other areas.

Exception 2

In the opinion of the licensee marking of load paths on the floor is impractical. This may be caused by the general use of temporary floor coverings which would cover the load path markings, or, due to the number of loads involved, a requirement for multiple markings which could confuse the crane operator.

Discussion

The purpose of this feature of Guideline 1 is to provide visual aids to assist the operator and supervisor in ensuring that designated safe load paths are actually followed. In the case of the operator it has the additional function of avoiding undesirable distractions while handling suspended loads (e.g., trying to read procedural steps or drawings while controlling the crane). This feature should also be seen as a provision necessary to complete a plan for the implementation of safe load paths. Specifically it provides some additional assurance that, having spent the time and effort to develop safe load paths, those paths will be followed.

Approaches Consistent With this Guideline

Rather than mark load paths a second member of the load handling party (that is, other than the crane operator) is made responsible for assuring that the designated safe load path is followed. This second person, a signalman is typically used on cab operated cranes, checks out the safe load path prior to the lift to ensure that it is clear, refers to the safe load path guidance during the lift and provides direction to the operator and that the load path is followed. To support this approach the duties and responsibilities of each member of the load handling party should be clearly defined.

Prior to a lift the appropriate load path is temporarily marked (rope, pylons, etc.) to provide a visual reference for the crane operator. In cases where the load path cannot be marked (e.g., transfer of the upper internals in a PWR) temporary or permanent match marks can be employed to assist in positioning the bridge and/or trolley during the lift.

In either case reasonable engineering judgement would indicate that in certain specific lifts marking of safe load paths is unnecessary due to physical constraints on the load handling operation (e.g., simple hoists, monorails, or very short lifts where movement is limited to one coordinate axis in addition to the vertical).

Approaches Inconsistent With this Guideline

Positions which in effect do not recognize the need for realistically providing visual aids to the crane operator and imply that, for all lifts, the operator will remember the load path from review of procedures or by reference to a drawing.

Exception 3

Obtaining written alternative procedures approved by the plant safety review committee for any deviations from a safe load path is considered too cumbersome to accommodate the handling of maintenance loads where laydown areas may have to change or load paths altered as a result of unanticipated maintenance requirements.

Discussion

The purpose of this portion of this guideline is to ensure that deviations from established safe load paths receive a level of review appropriate to their safety significance. In general it is highly desirable that once safe load paths are established they are retained and kept clear of interference rather than routinely deviated from. It is recognized, however, that issues associated with plant safety are the responsibility of an individual licensee plant safety review committee (or equivalent) and the details of their excercizing this responsibility should be within their jurisdiction.

Approach Consistent With this Guideline

A plant safety review committee (or equivalent) delegates the responsibility for approving temporary changes to safe load paths to a person, who may or may not be a member of that committee, with appropriate training and education in the area of plant safety. Such changes are reviewed by the safety review committee in the normal course of events. Any permanent alteration to a safe load path is approved by the plant safety review committee.

Approach Inconsistent With this Guideline

Activities which in effect allow decisions as to deviations from safe load paths to be made by persons not specifically designated by the plant safety review committee.

GUIDELINE 2 LOAD HANDLING PROCEDURES

No significant exceptions to this guideline have been encountered. Occasionally a question arises concerning the need for individual procedures for each lift. In general, it was not the purpose of this guideline to require separate procedures for each lift. A reasonable approach is to provide separate procedures for each major lift (e.g., RV head, core internals, fuel cask) and use a general procedure for handling other heavy loads as long as load specific details (e.g., load paths, equipment requirements) are provided in an attachments or enclosures.

GUIDELINE 3 CRANE OPERATOR TRAINING

Exception

The only exception occassionally encountered with respect to this Guideline other than fairly minor, site unique, exceptions has been a desire to deviate from the requirement of ANSI B30.2-3.1.7.o for testing of all controls before beginning a new shift. In some cases a licensee has qualified a commitment in this area by noting that only crane controls "necessary for crane operation" will be tested at the start of a shift.

Discussion

This requirement (ie. not a recommendation) of ANSI B30.2 is important since crane control system failures are relatively significant contributors to load handling incidents. The only reason that can be seen for an exception in this area is a general aversion to the word "all". Specifically, it appears that some licensees fear that a commitment to this requirement will force them to test all control type devices (eg. motor overloads, load cells, emergency brakes) rather than just those features generally known as controls (ie. hoist, bridge, and trolley motion controllers).

Approaches Consistent With this Guideline

Exceptions that clearly indicate that all normal controls (hoist, bridge, and trolley motion controllers) will be tested at the start of each shift and that the purpose of not committing to "all" controls is to avoid a misunderstanding concerning other control devices.

Approaches Inconsistent With This Guideline

A response that implies that a decision to test or not test a normal control will be made by the crane operator on the basis of what type of lift or direction of motion he expects for the forthcoming shift.

GUIDELINE 4 SPECIAL LIFTING DEVICES

Exception 1

Some licensees have indicated that their special lifting devices were designed and procured prior to the publication of ANSI N14.6 and therefore are not designed in accordance with that standard. This fact is sometimes combined with a reference to the title of that standard to reach a conclusion that the standard is not applicable.

Discussion

The purpose of this section is to ensure that special lifting devices were designed and constructed under controlled conditions and that sufficient documentation is available to establish existing design stress margins and support future maintenance and repair requirements. ANSI N14.6 is an existing standard that provides requirements supporting this goal for lifting device applications where the consequence of a failure could be similar to that which could be expected in the event of the failure of a special lifting device carrying a load within the jurisdiction of NUREG 0612. Consequently it seems appropriate that for special lifting devices subject to NUREG 0612 it should be able to be demonstrated that, from a design standpoint, they are as reliable as a device for which ANSI N14.6 was developed.

Approaches Consistent With This Guideline

Although not originally specified to be designed in accordance with ANSI N14.6 the special lifting device in question was provided by a reactor vendor, in accordance with appropriate quality assurance and quality control procedures, for a specific application associated with power plant components provided by that vendor. Based on either the review of the original stress report or, if such a stress report is unavailable, the preparation of a new stress report, the licensee has determined that margins to material yield and ultimate strength are comparable to those specified in ANSI N14.6. Although not required of the lifting device vendor, the licensee has reviewed the design of the lifting device and prepared a list of critical components whose repair or replacement should be performed under controlled conditions.

Approaches Inconsistent With This Guideline

No information is available concerning the original design but it is probably allright because the device has been used for ten years and never failed.

The device was built before the publication of ANSI N14.6, does not carry shipping containers of nuclear material weighing more than 10,000 pounds, and thus need not comply with ANSI N14.6.

Exception 2

No 150% overload test has been performed and, in the opinion of the licensee, such a test is impractical.

Discussion

The performance of a load test in excess of the load subject to NUREG 0612 is an important contributor to the ability to assess the overall reliability of a device. Such a test supplements design reliability by demonstrating that the device was properly fabricated or assembled and that a portion of the design safety margin has been demonstrated. Such proof of workmanship is particularly important for a fairly complicated device. It is recognized, however, that the specification of a 150% overload test is somewhat arbitrary and that, in some cases, the nature of the device is such that the liklihood of workmanship shortcomings is remote.

Approaches Consistent With This Guideline

The licensee has evaluated the lifting device in question and has determined that design stress margins are substantial. Further it has been established that the device itself is uncomplicated and principally put together with mechanical joints such that an assembly error is highly unlikely. The use of welded joints is severly limited and where employed were performed in accordance with substantial quality controls (eg AWS D1.1) including NDE. The device has been tested to 100% of rated load.

Although a 150% overload test has not been performed the lifting device has been subjected to a manufacturer recommended overload to demonstrate proof of workmanship (typically 120-125%).

Approaches Inconsistent With This Guideline

See this topic for Exception 1 above.

Exception 3

The requirement of ANSI N14.6 for an annual 150% load test or full NDE is excessive. Both the load test (due to the inability to make the test lift within containment) and the NDE (due to the need to remove protective coatings) are impractical and not justified by the infrequent use of these devices.

Discussion

A continuing inspection program to assure the continued maintenance of safety margins incorporated in the original design of the device is important to demonstrate the reliability of special lifting devices. It is recognized, however, that some devices employed in a nuclear power plant, particularly those associated with refueling, are used under conditions of control and at frequencies of use that are substantially less severe than that possible for the type of lifting device for which ANSI N14.6 was originally prepared. Consequently a reasonable relaxation of the inspection interval seems appropriate.

Approaches Consistent With This Guideline

Overload tests will be conducted but at a longer interval, 5 years, between tests to be consistent with the number of operational lifts required.

NDE of load bearing welds will be conducted at 5 year intervals or, alternatively, load bearing welds will be examined through a program that ensures that all welds will be examined over a normal inservice inspection interval of 10 years in a manner similar to that specified in the B&PV Code for Class 2 Component Supports.

Approach Inconsistent With This Guideline

Continuing inspection will be limited to an annual visual examination of the device.

Exception

Licensees have taken exception to the requirement to select slings in accordance with the maximum working load tables of ANSI B30.9 considering the sum of static and dynamic loads. Most commonly it is the licensees position that the approximate factor of safety of five on rope breaking strength inherent in these tables adequately accomodates dynamic loading.

Discussion

The intent of this portion of this Guideline, which also applies to special lifting devices under Guideline 4, is to reserve the ANSI B30.9 safety factors for accomodating sling wear and unanticipated overloads and avoid a reduction of this safety factor as a result of the routine dynamic loads inherent in hook/load acceleration and deceleration. While it is acknowledged that, for operating characteristics typical of cranes employed at nuclear power plants, these dynamic loads are unlikely to be substantial, such a determination cannot be made generically. Typically the actual dynamic load due to hook/load acceleration or deceleration is a function of design hook speeds and the type of hoist control system employed. It should also be recalled that ANSI B30.9 is a general industrial standard which applies to all load handling devices and does not in itself provide for any additional conservatism in consideration of the potential consequences of a load handling accident at a nuclear power plant. Based on this, it is considered reasonable that individual licensees evaluate the potential contribution of dynamic loading in their operations and if such dynamic loading is indeed significant accomodate it in their procedures for sling selection.

Approach Consistent With This Guideline

The licensee has evaluated the potential routine dynamic loading for lifting devices not specially designed and found them to be a relatively small fraction (typically 5-15%) of static load. This estimate has been made on the basis of either calculated acceleration and deceleration rates or through use of the industrial standard for impact loading of cranes specified in CMAA-70. In either case having verified that routine dynamic loading of a specific hoist is indeed small the licensee has drawn the conclusion that revised selection criteria to accomodate such minor additional loads will not have a substantial effect on overall load handling reliability.

Approach Inconsistent With This Guideline

Statement to the effect that dynamic loads are accomodated in the tables of ANSI B30.9 with no indication that the licensee has assessed the actual dynamic loading imposed on cranes subject to NUREG 0612.

GUIDELINE 6 CRANE INSPECTION TESTING AND MAINTENANCE.

Exception

The only exception occasionally encountered with respect to this Guideline other than fairly minor and site-unique exceptions has been a desire to deviate from the requirement of ANSI B30.2-1.1.2.a.2 and 3.2.4 for testing of hoist limit devices before beginning a new shift. In some cases a licensee has qualified a commitment in this area by noting that this limit switch will be tested only if operations in the vicinity of the limit switch are anticipated.

Discussion

While this issue is treated somewhat ambigously in ANSI B30.2 (it is a recommendation in article 1.1.2 and a requirement in article 3.2.4) it is important since two-blocking incidents are relatively significant contributors to load handling incidents. Further it should be noted that this test has been incorporated as a requirement of OSHA in 29 CFR 1910.179.(n).(4).(i). It is recognized, however, that there may be circumstances where such a test is not prudent. First, such a test clearly should not be made with the hook under load. Consequently if a shift change is made with the hook loaded (this, by the way, is not a desireable practice and could be precluded through strict compliance with ANSI B30.2-3.2.3.j) a hoist limit switch test should not be performed. Second, there may be circumstances where the nature of forthcoming load handling operations indicates that the time (and minor risk) associated with this test is not justified. In particular if it is known that a hoist will not be used or used only in an area substantially removed from the upper travel limit, it would seem reasonable to defer the limit switch test until the start of the next shift. If such an approach is taken, however, it should be approached with care. Requirements for deferring an upper limit switch test should accomodate the uncertainty associated with maintenance plans and establish unambiguous criteria concerning what operations can be determined to be remote from upper travel limits. Such criteria should recognize that the need for upper travel limit switch protection may be preceeded by a control system failure and consequently should conservatively allow for operater response time and potential delays associated with emergency shutdown of the crane.

Approach Consistent With This Guideline

General compliance with this requirement. Certain specific provisions made for deferring upper limit switch testing under conditions that are not subject to operater interpretation.

Approaches Inconsistent With This Guideline

An approach that implies that a decision to test or not is left to the discretion of the operator or implies that such a test will be required only if operations are planned in close proximity to the hook upper travel limit.