TECHNICAL EVALUATION REPORT

# CONTROL OF HEAVY LOADS (C-10)

JERSEY CENTRAL POWER AND LIGHT COMPANY

OYSTER CREEK NUCLEAR POWER PLANT

NRC DOCKET NO. 50-219

NRC TAC NO. 47128

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506

FRC ASSIGNMENT 13

FRC TASK 377

*Prepared by*

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*Prepared for*

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: A. Singh
T. Chan

June 10, 1983

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# 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. C. R. Bomberger and Mr. I. H. Sargent 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 the Jersey Central Power & Light Company (JCP&L)/General Public Utilities' (GPU) Oyster Creek Nuclear Power Plant. This evaluation was performed with the following objectives:

- 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
- 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 U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to ensure the safe handling of heavy loads and to recommend necessary changes 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's conclusion from this evaluation was that existing measures to control the handling of heavy loads at operating plants, although providing protection from certain potential problems, do not adequately cover the major causes of load handling accidents and should be upgraded.

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-part objective using an accepted approach or protection philosophy. The first portion of the objective, achieved through a set of general guidelines identified in NUREG-0612, 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 uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Sections 5.1.2 through 5.1.5, is to ensure that, for load handling systems in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (2) conservative evaluations of load-handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

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 this guideline is to ensure that licensees of all nuclear power plants perform the following:

- o 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
- o 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 of NUREG-0612 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 JCP&L, the Licensee for the Oyster Creek plant, requesting that the Licensee review provisions for handling and control of heavy loads at the Oyster Creek plant, 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. On September 22, 1981, JCP&L provided the

initial response [4] to this request. A draft technical evaluation report (TER) was prepared based on this information and was informally transmitted to the Licensee for review and comment. On July 9, 1982, a telephone conference call was conducted with the representatives of NRC, FRC. and JCP&L to discuss unresolved issues. As a result of this call, additional information was provided by the Licensee on February 18, 1983 [5] and on May 27, 1983 [6] which has been incorporated into this final technical evaluation.

# 2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at Oyster Creek Nuclear Power Plant 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 in order to provide the defense-in-depth approach for the handling of heavy loads. These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

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

These seven guidelines should be satisfied for all overhead handling systems that handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems. The Licensee's verification of the extent to which these guidelines have been satisfied and the evaluation of this verification are contained in Sections 2.1.1 through 2.1.8 of this report.

Table 2.1. Oyster Creek Nuclear Station/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. Reactor Building Crane | 100/5 | -- | -- | C | -- | -- | R | C | -- | -- |
| a. Drywell Head | 62 | C | C | -- | R | -- | -- | -- | -- | -- |
| b. Reactor Vessel Head | 92 | C | C | -- | R | -- | -- | -- | -- | C |
| c. Cavity Shield Plugs (8) | 85 ea. | C | C | -- | R | -- | -- | -- | C | -- |
| d. Reactor Vessel Head Insulation | 5 | C | C | -- | -- | C | -- | -- | C | -- |
| e. Steam Dryer | 26 | C | C | -- | C | -- | -- | -- | -- | C |
| f. Steam Separator | 44 | C | C | -- | C | -- | -- | -- | -- | C |
| g. Fuel Pool Gates (2) | Approx. 1 | C | C | -- | -- | C | -- | -- | C | -- |
| h. Spent Fuel Cask | 30/5 | C | C | -- | R | -- | -- | -- | C | -- |

C = Licensee action complies with NUREG-0612 Guideline.
P = Licensee information indicates partial compliance.
R = Licensee has proposed revisions/modifications designed to 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| i. Fuel Transfer Shield | 16.5 | C | C | -- | R | C | -- | -- | C | -- |
| j. Equipment Storage Pool Shield Plugs (4) | 37.5-39 | C | C | -- | R | -- | -- | -- | -- | -- |
| k. Dryer/Separator Sling Assembly | 1.5 | C | C | -- | -- | C | -- | -- | -- | C |
| l. Fuel Storage Pool Shield Plugs (4) | 4.5 ea. | C | C | -- | -- | C | -- | -- | C | -- |
| m. Plant Equipment | Less than 20 | C | C | -- | -- | C | -- | -- | C | -- |
| n. New Fuel and Shipping Containers | 1 | C | C | -- | -- | C | -- | -- | -- | -- |
| o. Head Strongback | 3.2 | C | C | -- | -- | C | -- | -- | -- | -- |
| p. Stud Tensioner Assembly | 10 | C | C | -- | -- | C | -- | -- | -- | -- |
| 2. Recirculation Pump Monorail | 1 | -- | -- | C | -- | -- | R | C | -- | -- |
| 3. Spent Fuel Pool Jib Cranes | 0.5 | -- | -- | C | -- | -- | R | C | C | -- |

2.1.1 NUREG-0612, Heavy Loads Overhead Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee has evaluated the load handling systems at the Oyster Creek plant and concluded that the following load handling systems are subject to NUREG-0612:

- Reactor building crane
- Recirculation pump monorail
- Spent fuel pool jib cranes.

The Licensee has also identified other load handling devices that have been excluded from satisfying the criteria of the general guidelines of NUREG-0612 due to physical separation from safe shutdown equipment or irradiated fuel; these devices include:

- Machine shop monorail
- Turbine building crane
- Equipment handling monorail (outside CRD rebuild room at 75-ft elevation)
- Filter and demineralizer monorail
- Equipment handling monorail (adjacent to reactor building equipment hatch at 95-ft elevation)
- Hatch bay crane
- CRD rebuild room monorail
- Railroad bay monorail
- Jib crane (located 23 ft from reactor building equipment hatch)
- Maintenance building crane
- Radwaste building crane.

A second 1-ton jib crane is located adjacent to the reactor building equipment hatchway and has been excluded from NUREG-0612 guidelines due to separation from the torus by the railroad bay floor. The crane is used to lift small equipment, crates, and tools to various elevations in the reactor building. A conservative analysis shows that a heavy load drop by this crane will not result in perforation or scabbing of this floor to damage the equipment located below it.

The intake gantry crane has been excluded from NUREG-0612 applicability due to removal from service. If at some time in the future this crane is placed back into service, an evaluation will be performed to ensure that NUREG-0612 criteria are satisfied.

The three refueling platform auxiliary hoists have been derated from their current rating of 1000 lb to 750 lb so that heavy loads cannot be handled by these load handling systems. This derating would not affect the lifts that they were originally intended to service.

The drywell air lock monorail has been excluded from NUREG-0612 due to the fact that it handles the air lock a few inches off the floor and there is no safe shutdown equipment in close proximity to the airlock. A load drop will not affect safe shutdown capability based on the evaluation of this handling system.

b. Evaluation

The Licensee's conclusions regarding the applicability of general guidelines are is consistent with the intent of NUREG-0612.

c. Conclusion and Recommendations

The Oyster Creek plant complies with NUREG-0612 regarding applicability of heavy load overhead handling systems.

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 has addressed the handling of heavy loads by defining four safety class designations. Each heavy load is assigned one or more safety classes. The safe load path/procedural requirements corresponding to the assigned safety class have been added to the appropriate plant operating or

maintenance procedures. When more than one safety class assignment is made for a particular load, the safe load path/procedural requirements of all safety class assignments are included in the procedures. Safety class definitions and their respective handling requirements are listed in Table 1, and loads contained in each safety class are listed in Table 2. These safety classes, by procedure, limit lift height and time over areas of concern for the most critical loads (Safety Class 1), define areas over which loads shall not be carried (Safety Class 2), or define safe load paths that follow, to the extent practical, structural floor members, using the minimum practical lift height (Safety Class 3).

All loads designated as Safety Class 3 shall have specified load paths shown on drawings and attached to load handling procedures. In addition, a signalman will be used to ensure that the load is carried along its designated load path. The signalman with the job supervisor will walk down the designated load path prior to load movement to ensure that there are no obstructions that could affect the ability of the crane operator to follow the designated path.

For the reactor building crane load block, shipping casks, fuel channel crates, and new fuel containers, the Licensee stated that the primary concern is the potential for dropping these loads the full length of the equipment hatch located in the southeast quadrant. For these lifts, the crane will be oriented so that the crane hoist is directly over the main structural members for the track bay floor when moving these loads up or down the equipment hatch, in order to assure maximum available resistance to impact in the event of a load drop. In addition, the Licensee added that safe load paths will be defined for movement of shipping casks on the refueling floor prior to their use, including definition of load paths in specific procedures covering movement to and from the equipment hatch, spent fuel pool, and cask washdown area. These load paths will be defined by establishing boundaries around the floor area over which the cask may travel, will be shown on a drawing included in the procedure, and will be marked temporarily using tape on the refueling floor. Within these boundaries, move height will not exceed 6 inches above

Table 1. Load Safety Classes and Safe Load Path Actions

| Heavy Handling Situations | Safe Load Path/Procedural Actions Required |
|---|---|
| Safety Class 1: Load must be carried directly over spent fuel, the reactor vessel, or safe shutdown equipment (i.e., there are no intervening structures such as floors). | Procedurally limit time and height load is carried over the area of concern; define laydown area, show on drawings included in the procedure the prescribed laydown area. Procedures will be reviewed with crane operators and signalmen prior to lifts over an open reactor vessel. |
| Safety Class 2: Load could be carried directly over spent fuel, the reactor vessel, or safe shutdown equipment, i.e., load can be handled during the time when spent fuel or the reactor vessel is exposed or safe shutdown equipment is required to be operable and there are no physical means (such as interlocks or mechanical stops) available to restrict load movement over these objects. | Procedurally limit time and height that load is carried over area of concern; define laydown area, show on drawings attached to procedure the prescribed safe load path and laydown area. |
| Safety Class 3: Load could be carried over spent fuel or safe shutdown equipment, but the fuel or equipment is not directly exposed to the load drop, i.e., intervening structures such as floors provide some protection. | Define safe load paths that follow, to the extent practical, structural floor members. Define laydown areas. Limit load travel height to the minimum height practical. Load paths and laydown areas shown on drawings attached to procedures. |
| Safety Class 4: Load cannot be carried over spent fuel or over safe shutdown equipment when such equipment is required to be operable, i.e., design or operational limitations prohibit movement. | No safe load path or special procedural actions required. |

Table 2. Heavy Load Safety Classification

| Safety Classification | Heavy Load | Additional Safety Classes |
|---|---|---|
| 1 | Drywell head | 3 |
| | Peactor vessel head | 3 |
| | Steam dryer | 3 |
| | Steam separator | 3 |
| 2 | Fuel pool gates | |
| | Spent fuel casks | 3 |
| | Fuel transfer shield | |
| | Equipment storage pool shield plugs | 3 |
| | Dryer/separator sling assembly | |
| | Fuel storage pool shield plugs | 3 |
| | Head strongback | |
| | Stud tensioner assembly | |
| 3 | Reactor vessel head insulation | |
| | Plant equipment | |
| | New fuel and shipping containers | |
| | Cavity shield plugs | |

the floor (or small obstructions) and movement will follow structural members to the extent practical.

With regard to the recirculation pump monorail and the spent fuel pool jib cranes, the Licensee stated that safe load paths are limited by the physical capabilities of the equipment. Operating procedures shall be developed, however, that will caution operators not to carry loads over or in the vicinity of spent fuel or safety-related equipment unless absolutely necessary and, if so, to limit the height and duration of the lifts.

Each heavy load lift will be controlled by a designated individual who will be responsible for enforcing procedural requirements. Deviations from these procedures and load paths require a revision to procedures or a Temporary Procedure Change, either of which must be reviewed and approved by the Plant Operations Review Committee and the resident manager.

b. Evaluation

The Licensee's method of identifying safety classes and differentiating the relative safety significance of the identified loads is consistent with NUREG-0612 guidelines.

As noted by the Licensee for Class 1 and 2 loads, the most direct route to the laydown area is most likely to be an acceptable load path. Other precautions taken by the Licensee (defining laydown areas and incorporating drawings into plant procedures) are adequate to meet the intent of Guideline 1.

Identification of specific loads paths for Class 2 and 3 designated loads and incorporation of these paths in the controlling load handling procedures meets the requirements of this guideline. The use of a knowledgeable signalman is a reasonable alternative which provides the crane operator with visual aids to ensure that load movement adheres to the established load paths. In addition, the handling of load path and procedure deviations meets the intent of Guideline 1 because the authority to approve deviations is vested in the plant operations and review committee and the resident manager.

c. Conclusion

The Oyster Creek plant complies with Guideline 1 based on the implementation of actions proposed by the Licensee.

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

The Licensee has indicated that the following lifting procedures are used at the Oyster Creek plant:

205.0 - Reactor refueling

701.1.001 - Reactor vessel head removal and replacement

701.1.002 - Reactor vessel steam dryer and steam separator removal and replacement

701.1.003 - Reactor vessel insulation removal and replacement

704.1.002 - Drywell head removal and replacement

756.1.002 - Fuel transfer shield installation and removal

756.1.003 - Shield plugs removal and replacement

756.1.004 - Fuel pool gates removal and installation.

The Licensee has stated that all lifting procedures have been revised to satisfy the requirements of Section 5.1.1(2) of NUREG-0612 including:

1. description of the safety concern in the handling of heavy loads with the reactor building bridge crane
2. defined safe load paths
3. precautions
4. prerequisites
5. identification of proper handling equipment
6. training and qualification requirements for crane operators

7. verification that required detailed inspections have been performed
8. sling selection criteria
9. required crane inspection by operator prior to load handling
10. supervision of work involving a heavy load lift by a designated job supervisor
11. critical steps in order to perform the lift.

In addition, the Licensee has indicated that new procedures are being developed for the following load handling devices:

- o reactor building bridge crane
- o recirculation pump monorail and hoist
- o spent fuel pool jib cranes
- o spent fuel cask operation will be governed by a new procedure each time with special lifting requirements applicable to that particular cask.

b. Evaluation

The implementation of procedural controls on load handling at the Oyster Creek plant meets the intent of Guideline 2 of NUREG-0612 based on the Licensee's description of Oyster Creek plant lifting procedures.

c. Conclusion

The Oyster Creek plant complies with Guideline 2 of NUREG-0612.

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 has stated that the current practices for qualification and training of crane operators essentially cover the provisions of ANSI B30.2-1976, Chapter 2-3. However, these practices are not currently in the form of an approved procedure. Portions of the training are performed by the



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maintenance supervisor and other portions are performed by the plant training staff. A new procedure with qualification records has been developed and implemented in order to formalize the program for crane operator qualification for the reactor building and spent fuel pool jib cranes. The new procedure requires that operators be familiar with appropriate handling system operating procedures and pass a practical operating examination with the handling system.

The Licensee has taken exception to ANSI B30.2-1976 with respect to Section 2-3.1.7, "Conduct of Operators, Part F." The standard requires that "before leaving the crane unattended, the operator shall land any attached load, place the controllers in the 'off' position, and open the main line device of the specific crane." However, during reactor disassembly at the Oyster Creek plant, it is necessary to keep the steam separator covered with water during handling to maintain exposure levels as low as practicable. Consequently, the separator is raised incrementally, and then left suspended until the water level rises sufficiently to allow additional raising of the separator. The separator may stay suspended at one level as long as 1.5 hours while flooding is proceeding. During these periods when the separator is left suspended, the crane operator may leave the cab until recalled. However, prior to leaving the crane, the operator places the controller in the "off" position and opens the main line device.

b. Evaluation

Crane operator training at the Oyster Creek plant is considered acceptable based on the Licensee's verification that the program meets the provisions of ANSI B30.2-1976 and that a new procedure has been developed to formalize the program. The Licensee's exception to Chapter 2-3, Section 2.-3.1.7 concerning leaving the crane unattended while loaded is reasonable based upon the specified manner in which the crane is secured. However, it should be noted that this practice appears to be in violation of Title 29 CFR 1910.179.(N).(3).(X) (OSHA) and thus should be evaluated by the Licensee unless such deviation has been previously approved.

c. Conclusion and Recommendation

The Oyster Creek plant complies with Guideline 3 of NUREG-0612 concerning crane operator training.

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 stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device [NUREG-0612, Guideline 5.1.1(4)]."

a. Summary of Licensee Statements and Conclusions

The Licensee has indicated that there are six handling devices made up for special applications and currently used in handling heavy loads:

1. dryer/separator sling
2. head strongback
3. cask yokes and slings
4. fuel transfer shield slings
5. cavity shield plug lifting beam
6. equipment storage pool plug lifting beam.

The comparison of these special lifting devices to ANSI N14.6-1978 was limited to Sections 3.2 and 5 of the standard. The Licensee's review indicated the following exceptions to ANSI N14.6-1978:

1. Sections 3.1 (Designer's Responsibilities), 3.3 (Design Considerations), 4.1 (Fabricator's Responsibilities), 4.2 (Inspector's Responsibilities), and 4.3 (Fabricator's Considerations) are difficult to apply in retrospect. However, information on drawings indicates that sound engineering practices were placed on the fabricator and the inspector for the purpose of ensuring that the designer's intent was accomplished.

2. Sections 1.0 (Scope), 2.0 (Definitions), 3.4 (Design Considerations to Minimize Decontamination Effects in Special Lifting Device Use), 3.5 (Castings), and 3.6 (Lubricants) are not pertinent to load handling reliability.

3. Section 6, Special Lifting Devices for Critical Loads, is not applicable at the Oyster Creek plant because none of the loads lifted by these devices has been identified to be a critical load.

4. Plant procedures do not specify a visual inspection by maintenance or other non-operating personnel at intervals of 3 months or less as required by Section 5.3.7 of ANSI N14.6-1978. Procedures have been revised so that these devices are inspected by a qualified personnel prior to each usage and so that a thorough testing and nondestructive examination is performed prior to each refueling. Based on the controlled storage between periods of usage, dedicated single usage, and complete inspection schedule, the equivalency of Section 5.3.7 is demonstrated.

5. Section 5.3.3 of ANSI N14.6-1978 requires that special lifting devices be load tested according to Section 5.2.1 to 150% of maximum load following any incident in which any load-bearing component may have been subjected to stresses substantially in excess of those for which it was qualified by previous testing, or following an incident that may have caused permanent distortion of load-bearing parts. Since distortion may already have occurred or since defects may have already developed due to the overstressed condition, it seems more prudent and practical to perform the dimensional examinations for deformation and the NDE for defects to determine whether the device is still acceptable for use rather than subject the device to 150% load testing. If defects or deformation are detected, then the device shall be repaired or modified and tested to 150% load followed by examination for defects or deformation.

During the Licensee's review of special lifting devices against Sections 3.2 and 5 of ANSI N14.6-1978, the following results were obtained:

1. The dryer/separator sling design exceeds the criteria in ANSI B30.9 and ANSI N14.6. The lifting device has been load tested to a weight well in excess of 150% of the rated load. In addition, a preventive maintenance procedure has been developed for inspection of this lifting device in accordance with ANSI B30.9 and ANSI N14.6.

2. The head strongback drawings are available showing dimensional and material requirements and types of welds to be used for each weldment. However, information on stress analyses that may have been performed, design safety factors used, load tests performed, or processes and standards used in fabrication were not available. Accordingly, the Licensee performed a stress analysis and design

evaluation to demonstrate the adequacy of the design. As a result of this evaluation, the head strongback was found not in full compliance with ANSI specified factors of safety against bending in the lifting arms although stresses were within AISC allowables. Modifications are being made to the lifting arms to bring the head strongback into compliance with ANSI N14.6. Following these modifications, the device will be load tested in accordance with Section 5.3.2 of ANSI N14.6-1978. In addition, a preventive maintenance procedure including visual and NDE examination and inspections prior to each refueling has been developed to comply with ANSI N14.6 criteria.

3. For casks (including NAC-1) having unique special lifing devices or yokes, the lifting devices are the property of the cask owner. Accordingly, procedures have been revised to require that a certification be obtained from the cask owner, prior to handling the cask on-site, that verifies the cask lifting device or yoke design satisfies the criteria of ANSI N14.6, Section 3.2, and that the device has been inspected and maintained in accordance with ANSI N14.6, Section 5.0.

4. The fuel transfer shield sling is used for the shield and the GE200 cask. The design of the sling assembly was compared to ANSI B30.9 and found to exceed the criteria in this standard. In addition, a new preventive maintenance procedure that complies with ANSI B30.9 criteria requires inspections of the slings prior to each refueling.

5. The cavity shield plug and equipment storage pool plug lifting beams have insufficient documentation to evaluate the beams against the criteria of ANSI N14.6. Therefore, the Licensee performed a stress analysis and design evaluation of these lifting beams. As a result of this evaulation, these beams were found not to comply with ANSI N14.6 for factors of safety against bending. These beams are being modified to bring them in compliance with ANSI N14.6. Following these modifications, the devices will be load tested in accordance with Section 5.3.2 of ANSI N14.6-1978. A preventive maintenance program that includes examination and inspection to satisfy ANSI N14.6 has been developed.

A new lifting device for the core spray sparger will be evaluated against the design criteria of ANSI N14.6 when the design of the sparger and strongback are finalized.

b. Evaluation

The Oyster Creek plant satisfies the criteria of ANSI N14.6-1978 Section 3.2 (Design Criteria) for the dryer/separator sling and the fuel transfer shield sling based upon verification by the Licensee that the design meets or exceeds

the criteria in ANSI N14.6 and/or ANSI B30.9. The head strongback, cavity shield plug lifting beam, and the equipment storage pool plug lifting beam will comply after the proposed modifications and load tests have been completed.

The Licensee's response that Subsections 3.4, 3.5, and 3.6, Section 4, and Section 6 of ANSI N14.6-1978 are not applicable or pertinent is consistent with the desired intent of this guideline. The Licensee's response that design evaluations have been performed for all lifting devices and, where not in compliance, will be modified to satisfy criteria of ANSI N14.6-1978 is also consistent with the requirements of this guideline.

The preventive maintenance program that includes inspection by qualified personnel and nondestructive examination prior to use appears to address the need for continuing compliance testing set forth in Section 5 of ANSI N14.6.

The Licensee's decision to require visual inspection by nonoperating or maintenance personnel prior to each use is in keeping with ANSI N14.6-1978 requirements. In addition, load tests to be performed for the head strongback and lifting beams for the cavity shield plug and the equipment storage pool plug satisfy the guideline requirements, as does the Licensee requirement that cask owners comply with Section 5.0 of ANSI N14.6-1978. No load test is needed for the fuel transfer shield sling since it is only subject to compliance with ANSI B30.9-1971.

c. Conclusion and Recommendations

The Oyster Creek plant complies with Guideline 4.

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 guidelines 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

The Licensee has stated that, to ensure that appropriate slings are selected for use in handling miscellaneous loads and that slings are properly maintained, the following program changes have been made:

1. Load handling procedures require the use of ANSI B30.9 criteria for sling selection and rigging techniques.

2. A new preventive maintenance procedures has been developed for annual inspection of slings.

3. Load handling procedures require a visual inspection of slings for damage prior to making a lift.

4. A tagging procedure has been developed for slings to identify sling rating, application, last examination, and expiration date of examination.

Based on an analysis performed, dynamic loading on slings associated with the reactor buildng crane were found to be approximately 3% of the static load. This 3% increase in loading is insignificant and may be disregarded.

b. Evaluation

Sling installation and usage at the Oyster Creek plant complies with NUREG-0612, Section 5.1.1(5). On the basis of information provided by the Licensee, dynamic loads are a reasonably small percentage of the overall static load and may be disregarded in rating the slings.

c. Conclusion

The Oyster Creek plant complies with Guideline 5 of NUREG-0612.

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 when 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, tests, and maintenance should be performed prior to their use)."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that new procedures for inspection, testing, and maintenance of the recirculation pump monorail, spent fuel pool jib crane, and reactor building crane are being developed. In addition, provisions have been included in the new crane operation procedures, to include appropriate operator inspections prior to load movement. With these revisions and additions, the procedures will satisfy the criteria in ANSI B30.2-1976, Chapter 2-2 without exception.

b. Evaluation

Upon implementation, the Oyster Creek plant inspection procedures will be consistent with Section 5.1.1(6) of NUREG-0612.

c. Conclusion

The Oyster Creek plant complies with Guideline 6 of NUREG-0612.

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 [10], 'Specifications for Electric Overhead Travelling Cranes.' 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 Licensee has stated that the reactor building crane was designed and fabricated by Whiting Corporation to the specifications in EOCI-61 [10], "Specifications for Electric Overhead Traveling Cranes-1961" and in accordance

with additional requirements specified by the architect-engineer. The Licensee performed a review of the original specifications versus CMAA-70 (1975) and ANSI B30.2-1976. The results of this detailed point-by-point comparison were submitted in Reference 5.

b. Evaluation

The reactor building crane at the Oyster Creek plant substantially complies with the criteria specified in Guideline 7 because the original procurement specification was based on EOCI-61. In addition, for those criteria in CMAA-70 noted to be more restrictive than requirements of EOCI-61, the Licensee has demonstrated compliance with CMAA-70 or provided reasonable assurance that the existing design meets the intent of the CMAA criteria.

c. Conclusion

The Oyster Creek plant complies 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 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.

Licensee implementation and evaluation of these interim protection measures are contained in the succeeding paragraphs of this section.

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

"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 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 [of NUREG-0612]."

a. Summary of Licensee Statements and Conclusions

A review of the Oyster Creek Technical Specifications indicates that Section 5.3.1(d) prohibits the movement of loads greater than the weight of one fuel assembly over irradiated fuel in the fuel pool.

b. Evaluation and Conclusions

The Oyster Creek plant complies with Interim Protection Measure 1.

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

"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 respective 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 of the respective general guidelines in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7.

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

"...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 operation, and content of procedures."

a. Summary of Licensee Statements and Conclusions

With regard to the implementation of interim actions, the Licensee has stated that the required changes to procedures have been developed and are currently being reviewed and approved. Full implementation of the approved procedures will be effected prior to the next refueling outage.

b. Evaluation

The Licensee has adequately addressed the requirement for a review of all load handling procedures. In light of responses to Guidelines 2 and 3, it is apparent that procedures for handling loads over the core and operator training have been reviewed and upgraded as appropriate. In addition, design of cranes at the Oyster Creek plant and programs for selection and use of slings have been reviewed and found to comply with NUREG-0612.

c. Conclusion

The Oyster Creek plant complies with Interim Protection Measure 6 based upon Licensee-provided information.

# 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 Oyster Creek Nuclear Power Plant. 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 Oyster Creek Nuclear Power plant can be expected to be conducted in a highly reliable manner consistent with the staff's objectives as expressed in these guidelines.

## 3.2 INTERIM PROTECTION MEASURES

The NRC staff has established certain measures (NUREG-0612, Section 5.3) that should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until final 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 Oyster Creek plant complies with the staff's measures for interim protection.

# 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. NRC
   Letter to Jersey Central Power and Light Company (JCP&L)
   Subject: Request for Review of Heavy Load Handling at Oyster Creek Nuclear Power Station
   December 22, 1980

4. J. T. Carroll (JCP&L)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   September 22, 1981

5. P. B. Fiedler (GPU)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   February 18, 1983

6. Telephone conference call involving J. Lombardo and A. Singh (NRC), C. Bomberger (WSI/FRC), and GPU representatives
   May 27, 1983

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

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

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

10. Crane Manufacturers Association of America, 1975
    "Specifications for Electric Overhead Traveling Cranes"
    CMAA-70

11. Electric Overhead Crane Institute, 1961
"Specifications for Electric Overhead Traveling Cranes"
EOCI-61