TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS

NEW YORK POWER AUTHORITY

INDIAN POINT UNIT 3

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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. I. H. Sargent and Mr. C. 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 the Power Authority of the State of New York's (PASNY) Indian Point Unit 3 Nuclear Power Plant. 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 U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to assure the safe handling of heavy loads and to recommend necessary changes 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 the guidelines is to ensure that licensees of all operating 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 the Power Authority of the State of New York, the Licensee for Indian Point Unit 3, requesting that the Licensee review provisions for handling and control of heavy loads at Indian Point Unit 3, 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 June 22, 1981, PASNY provided the initial response [4] to this request. A draft Technical Evaluation Report (TER) was prepared and forwarded via the NRC staff

to PASNY for review. Subsequent to this draft TER, the Licensee provided responses on November 17, 1981 [5], April 21, 1982 [6], September 30, 1982 [7], December 6, 1982 [8], and November 15, 1983 [9]. Prior to receipt of the November 15, 1983 submittal, the name of the Licensee was changed from Power Authority of the State of New York (PASNY) to the New York Power Authority (NYPA). This final TER incorporates all information received from these submittals, and the Licensee will be referred to as NYPA throughout the text of this evaluation to avoid confusion.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at Indian Point Unit 3 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 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. The Licensee's verification of the extent to which these guidelines have been satisfied and evaluation of this verification are contained in the succeeding paragraphs.

Table 2.1. Indian Point Unit 3/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	175	--	--	C	--	--	C	R	--	R
Reactor Vessel Head	169	R	C	--	R	--	--	--	--	R
Upper Internals (Plenum)	67	R	C	--	R	--	--	--	--	R
Inservice Inspection Tool	5	R	C	--	R	--	--	--	--	R
Reactor Coolant Pumps	32	R	C	--	R	--	--	--	--	R
Missile Shields	7.5	R	C	--	--	C	--	--	--	R
Crane Load Block	4.5	R	C	--	--	C	--	--	--	R
Concrete Hatch Cover	7.3	R	C	--	--	C	--	--	--	R
Pressurizer Missile Shield	7.5	R	C	--	--	C	--	--	--	R
2. Fuel Handling Crane	40	R	R	C	--	--	C	R	C	--

C = Licensee action complies with NUREG-0612 Guideline.
R = Licensee has proposed revisions/modifications designed to comply with NUREG-0612 Guideline.
-- = Not applicable.

2.1.1 Overhead Heavy Load Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee's review of overhead handling systems identified the following cranes and hoists to be capable of handling heavy loads in the vicinity of irradiated fuel or safe shutdown equipment and therefore subject to the criteria of NUREG-0612:

- o containment polar crane (175/35-ton)
- o 2-ton plant auxiliary building (PAB) monorail (55 ft and 73 ft elev.)
- o (2) 5-ton auxiliary feel pump (AFP) building monorails
- o fuel storage building crane (40/5-ton).

The Licensee also identified several other cranes and hoists that have been excluded from satisfying the criteria of NUREG-0612 on the basis that a load drop is not capable of damaging equipment required for safe shutdown or irradiated fuel:

- o turbine hall crane
- o 2-ton PAB monorail (15 ft elev.)
- o waste drum storage area crane
- o 20-ton heater bay cranes (2).

b. Evaluation and Conclusion

Identification by the Licensee of those handling systems to be evaluated for compliance with the general guidelines is consistent with NUREG-0612 guidance. Further, the basis for excluding those systems identified is also appropriate.

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

For the Indian Point Unit 3 polar crane, operating procedures define two areas over which loads are not allowed to be carried with the exception of certain pre-identified load movements. These areas are as follows:

1. directly over the reactor vessel, where no heavy loads are allowed to be carried [with the exception of movements of the reactor vessel head, upper internals, missile shields, and inservice inspection (ISI) tool into and out of the area]

2. over residual heat removal (RHR) heat exchanger No. 32, which may be exposed to overhead load drops.

The Licensee noted that no unidentified loads are moved over either exclusion area at any time. For certain loads (identified by procedures) which must be moved in and out of the reactor vessel area, the Licensee stated that the loads are moved by the most direct route to predesignated laydown areas. A load handling supervisor is present to ensure that procedures are followed and that exclusion area boundaries are not violated.

To ensure that crane operators remain knowledgeable of load handling precautions, annual refresher training is conducted to identify exclusion areas and to review load handling procedures.

In addition to the above procedures, the Licensee has performed additional structural and systems analyses to determine the consequences of a load drop. Results of these analyses indicate that suitable system redundancy and structural integrity exist so that the consequences of a load drop would not exceed the criteria of NUREG-0612, Section 5.1.

b. Evaluation

Information has been provided by the Licensee that exclusion areas which have been developed are adequate to prevent movement of heavy loads into areas which contain irradiated fuel or equipment required for safe shutdown. For those loads which must be moved into these areas, sufficient information has been provided by the Licensee to determine that major loads of concern are moved between their installed location to preselected laydown areas via the most direct route, which is consistent with the intention of this guideline.

Further, annual refresher training of operators to ensure knowledge of the exclusion areas and presence of a supervisor during load movements provide additional assurances as well as visual reinforcement that exclusion areas will be complied with.

c. Conclusion

Development of exclusion areas and predetermined laydown areas at Indian Point Unit 3 provide administrative controls which are consistent with the requirements of Guideline 1.

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 stated that a series of operating procedures have been developed for operation of load handling equipment at Indian Point Unit 3, including the following: SOP-CM-1, "Polar Crane Operation"; SOP-RP-1, "Preparation for and Return from Refueling"; and SOP-CM-8, "Auxiliary Feed Pump Building Monorail Operation."

The Licensee also stated that load handling procedures provide for the movement of all heavy loads in the vicinity of irradiated fuel or systems and equipment required for safe shutdown and decay heat removal, and that load designation was based on the generic load identified in Table 3-1 of NUREG-0612. Further, the Licensee verified that these procedures contained the precautionary information required by Guideline 2.

b. Evaluation and Conclusion

Procedures developed to control movements of heavy loads at Indian Point

Unit 3 are consistent with the requirements of Guideline 2 on the basis that the procedures contain the information specified.

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' [10]."

a. Summary of Licensee Statements and Conclusions

Procedures for the qualification and training of crane operators at Indian Point Unit 3 have been developed to meet the provisions of ANSI B30.2-1976, with no exceptions taken. Crane operator training and qualification is addressed in (1) "Polar Crane Operator Qualification Procedure" and (2) SOP-CM-8, "Auxiliary Feedwater Pump Building Monorail Operation." These procedures and SOP-CM-1, "Polar Crane Operation," include precautions and instructions to assure proper operator conduct.

b. Evaluation

Crane operator training and qualification programs which have been developed at Indian Point Unit 3 satisfy the criteria of Guideline 3, based upon NYPA's verification that the requirements of Chapter 2-3 of ANSI B30.2-1976 have been invoked. The Licensee has also stated that procedures in use contain adequate precautions and instructions to assure proper crane operator conduct during actual crane operation, in addition to instruction on operator conduct received during the required crane operator training. These actions satisfy the requirements for "Conduct of Operators," Section 2-3.1.7 of ANSI B30.2-1976.

c. Conclusion

Training and qualification of crane operators at Indian Point Unit 3 is performed in a manner consistent with Guideline 3.

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' [11]. 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 identified the following special lifting devices to be subject to compliance with the requirements of Guideline 4:

- o reactor vessel head lifting rig
- o internals lift rig
- o reactor vessel ISI tool.

All three devices were designed and manufactured prior to the existence of ANSI N14.6-1978. Based on review of ANSI criteria, detailed evaluation of these devices has been limited to Sections 3.2 (Design Criteria) and 5 (Acceptance Testing, Maintenance, and Assurance of Continuing Compliance). Detailed comparison of each of the devices indicates that the devices comply with ANSI criteria with limited exceptions.

The designer verified that each device was originally designed with a factor of safety of 5:1 on ultimate strength and that suitable margins to yield exist for all components. The Licensee stated that further consideration of dynamic effects is not necessary since the maximum dynamic load has been calculated to be less than 5.5% of the static load and does not significantly affect the load handling reliability of these devices.

Although only one of the devices was originally load tested to 150% of rated load or greater, the Licensee stated that adequate documentation exists to document proof of workmanship of these devices. The internals lift rig has

been load tested to over 200% of the heavy load of concern (the upper internals). The ISI tool has been load tested to 137% of rated load. The reactor vessel head lift rig was only lifted 100% of rated load on various occasions with no signs of deformation or overstress.

To ensure continued load handling reliability, these devices are inspected by qualified personnel at regular intervals (12 months or prior to use). Inspections include visual, dimensional, and nondestructive examination (NDE). NDE of several components on the devices is performed at extended intervals (5 years) since annual inspection is impractical; these extended intervals are justified on the basis of the limited frequency of use and the controlled storage and handling of these devices.

b. Evaluation

Although not originally designed in accordance with ANSI N14.6-1978, it is apparent from the Licensee's response that these lifting devices will provide a degree of load handling reliability consistent with that identified in the ANSI standard. Automation provided indicates that appropriate design margins were used in the original design and dynamic considerations are negligible. To demonstrate proof of workmanship, the internals lift rig and the ISI tool have been subjected to overstress conditions sufficiently in excess of rated load. Although the reactor vessel head lifting rig has not been overstressed, lifts performed at rated capacity, coupled with the NDE described provide adequate documentation of proof of workmanship.

Finally, programs which have been implemented to ensure continuing compliance are satisfactory since they contain adequate provisions for the inspections identified in ANSI N14.6-1978, Section 5.3.1. Relaxation of NDE frequency to 5-year intervals for selected components is also acceptable based upon the Licensee's justifications.

c. Conclusion

Design of special lifting devices at Indian Point Unit 3, as well as programs which have been implemented to ensure continuing compliance, is consistent with the specifications of 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' [12]. 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

Plant procedures require that sling selection and use for all loads requiring sling lifting devices be in accordance with ANSI B30.9-1971.

As noted for special lifting devices, the Licensee stated that calculations indicate that the maximum dynamic load experienced is only 2.1% of the maximum static load for the main hoist and 5.5% for the auxiliary hoist. Addition of these dynamic loads does not significantly affect load handling reliability and therefore dynamic loads have not been considered in selection of slings at Indian Point Unit 3.

b. Evaluation and Conclusion

Selection and use of slings at Indian Point Unit 3 are performed in a manner consistent with Guideline 6.

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

A program for inspection, testing, and maintenance of the polar crane has been developed that satisfies the criteria in ANSI B30.2-1976 Chapter 2-2, with no exceptions noted. This procedure is entitled "Maintenance Procedure for the Polar Crane." The Licensee also noted that the criteria of ANSI B30.2-1976 are not easily applied to such handling systems as monorails and hand-driven hoists. Accordingly, a procedure has been developed entitled "Maintenance Procedure for Auxiliary Feedwater Pump Building Monorail" based on the criteria of ANSI B30.11-1973, "Monorail Systems and Underhung Cranes" [13], with no exceptions noted from the criteria of the standard.

b. Evaluation

Indian Point Unit 3 satisfies the criteria of this guideline for the polar crane based upon the Licensee's verification that ANSI B30.2-1976 has been implemented with no exceptions. It is agreed that use of the industry standard (ANSI B30.11-1973) is preferable to use of ANSI B30.2-1976 for the auxiliary feedwater pump (AFP) building monorail. Indian Point Unit 3 satisfies this guideline for the AFP building monorail based upon the Licensee's verification that this standard has been implemented with no exceptions.

c. Conclusion

Inspection, testing, and maintenance of cranes at Indian Point Unit 3 satisfy 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' [14]. 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 stated that NYPA has performed a design analysis of each handling system using the design criteria of the applicable standards. The Indian Point Unit 3 polar crane has been evaluated in accordance with ANSI B30.2-1976, while the AFP building monorail has been evaluated in accordance with ANSI B30.11, "Monorail Systems and Underhung Cranes," and ANSI B30.16, "Overhead Hoists" [15].

The polar crane and fuel storage building crane at Indian Point Unit 3 were built prior to the issuance of ANSI B30.2-1976 and CMAA-70.. However, a detailed point-by-point comparison has been performed, comparing information from the manufacturer with the criteria of these standards. Analysis was performed for only those components that are load bearing or are necessary to prevent conditions which could lead to a load drop. This review indicates that both cranes comply with all requirements with the exception of Specification 3.2 of CMAA-70 and Section 2.1.4.1 of ANSI B30.2-1976. These specifications require that welding be performed in accordance with AWS D1.1, "Structural Welding Code" [16], and AWS D14.1, "Specifications for Welding Industrial and Mill Cranes" [17]. The Licensee's evaluation is that the welding procedures used are equivalent to current welding criteria based on the following:

a. welding was performed in accordance with the then-current code AWS D1.1, "Structural Welding Code"

b. practices and procedures used for welding are equivalent to those in AWS D14.1, which was not issued at the time

c. welders were qualified to existing AWS criteria

d. all welds were visually inspected

e. structural integrity was demonstrated when the polar crane was used to perform a 450-ton (250% of rated capacity) construction lift.

In the AFP building, no hoist is permanently attached to the monorail system. Hoist selection criteria comply with the requirements of ANSI B30.16-1978 and have been included in SOP-CM-8, "Auxiliary Feed Pump Building Monorail Operation." Review of monorail design indicates that the monorail complies with the criteria of ANSI B30.11-1973.

Additional specific information concerning design compliance with the more restrictive requirements of CMAA-70 is contained in the following 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 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 feet per minute, it is possible that the impact allowance applied under EOCI-61 will be less than that required by CMAA-70. Since the maximum hoist speed for either crane provided is 15 feet per minute or less, this requirement of CMAA-70 has been satisfied.

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 commonly used in cranes subject to this review), the shear center coincides with the centroid of the girder section and there is no difference between the two requirements. Since box girders were used in the fabrication of both cranes, the intent of this requirement has been satisfied.

3. 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 Licensee has verified that longitudinal stiffeners used at Indian Point Unit 3 cranes conform to the guidance of CMAA-70 and that actual h/t ratios are less than those specified in the standard.

4. Allowable compressive stress. CMAA-70, Article 3.3.3.1.3 identifies allowable compressive stresses of 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 Licensee has verified that b/c ratios for all crane girders are substantially less than 38; thus, allowable compressive stresses employed in the design of this crane are consistent with the requirements of CMAA-70.

5. 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 Licensee has verified that fatigue failure was considered in the design of the cranes and that, since the number of loading cycles in the vicinity of the rated load was specified as 200 for the polar crane and 2000 for the fuel storage building crane, no reduction in allowable stresses on the basis of fatigue was necessary.

6. 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 Licensee has calculated the ratio of capacity load plus load block divided by the number of parts of rope, compared this with published breaking strength, and found it to be less than 20%, thus satisfying CMAA-70.

7. Drum design. 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 Licensee has verified that bending and crushing loads were combined in drum design calculations.

8. Drum design. 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. The Licensee has verified that these recommendations have been satisfied in both cranes.

9. Gear design. CMAA-70, Article 4.5 requires that gearing horsepower rating be based on certain American Gear Manufacturers Association Standards and provides a method for determining allowable horsepower. EOCI-61 provides no similar guidance. The Licensee has performed independent calculations of gear horsepower ratings and verified that these allowables satisfy the requirements of CMAA-70.

10. 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 was not used on the Indian Point Unit 3 polar crane. Bridge brake ratings for the FSB crane satisfy CMAA-70 requirements.

11. Hoist brake design. CMAA-70, Article 4.7.4.2 requires that hoist holding brakes, when used with a method of a 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 Indian Point Unit 3 employs two holding brakes, each rated at 130% of hoist motor torque, while the FSB crane brake is rated at 152% of motor torque.

12. 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 end of bridge and trolley travel. No similar guidance is provided in EOCI-61. The Licensee has verified that bumpers and stops in substantial compliance with the requirements of CMAA-70 have been provided for the polar crane and FSB crane.

13. 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. Magnetic control systems are employed in the Indian Point Unit 3 cranes.

14. 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. The Licensee has verified that spring-return controllers were used in the Indian Point Unit 3 cranes.

c. Evaluation and Conclusion

Design of cranes at Indian Point Unit 3 meets the intent of Guideline 7. Although not procured in accordance with CMAA-70, the requirements of that standard are satisfied in all areas associated with load drop protection.

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 FRC's 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(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 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. Summary of Licensee Statements and Conclusions

None provided by the Licensee.

b. Evaluation

Licensee Technical Specification 3.8.C.2 specifies that loads in excess of 2000 pounds shall be prohibited from travel over fuel assemblies in the spent fuel pool.

c. Conclusion

Indian Point Unit 3 complies with Interim Protection Measure 1.

2.2.2 Administrative Controls [Interim Protection Measures 2, 3, 4, and 5, NUREG-0612, Section 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. Evaluation and Conclusion

Evaluations 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.

2.2.3 Special Reviews for Heavy Loads Over the Core [Interim Protection Measure 6, NUREG-0612, Section 5.3(1)]

"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 has committed [5] to conduct an inspection satisfying the requirements of Interim Protection Measure 6 prior to the next reactor vessel head removal.

b. Evaluation and Conclusion

Indian Point Unit 3 will have satisfied this requirement prior to the next reactor vessel head removal.

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 Indian Point Unit 3. Overall conclusions and recommended Licensee actions, where appropriate, are provided with respect to both general provisions for load handling (NUREG-0612, Section 5.1.5) 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 Indian Point Unit 3 can be expected to be conducted in a highly reliable manner consistent with the staff's objectives as expressed in these guideline.

3.2 INTERIM PROTECTION MEASURES

The NRC staff has established certain measures (NUREG-0612, Section 5.3) that should be inititated 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. Actions needed to satisfy NUREG guidelines for safe load paths have been previously addressed in Section 3.1 of this evaluation. Evaluation of information provided by the Licensee indicates that the Licensee substantially complies with the staff's measures for interim protection at Indian Point Unit 3.

4. REFERENCES

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

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

3. NRC
   Letter to PASNY
   Subject: Request for Review of Heavy Load Handling
   at Indian Point Unit Three
   December 22, 1980

4. J. P. Bayne (PASNY)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads Review
   June 22, 1981

5. J. P. Bayne (PASNY)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   November 17, 1981

6. J. P. Bayne (PASNY)
   Letter to S. A. Varga (NRC)
   Subject: Control of Heavy Loads
   April 21, 1982

7. J. P. Bayne (PASNY)
   Letter to S. A. Varga (NRC)
   Subject: Control of Heavy Loads
   September 30, 1982

8. J. P. Bayne (PASNY)
   Letter to S. A. Varga (NRC)
   Subject: Control of Heavy Loads
   December 6, 1982

9. J. P. Bayne (NYPA)
   Letter to S. A. Varga (NRC)
   Subject: Control of Heavy Loads
   November 15, 1983

10. ANSI B30.2-1976
    "Overhead and Gantry Cranes"

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

12. ANSI B30.9-1971
"Slings"

13. ANSI B30.11-1973
"Monorail Systems and Underhung Cranes"

14. CMAA-70
"Specifications for Electric Overhead Traveling Cranes"

15. ANSI B30.16-1973
"Overhead Hoists"

16. AWS D1.1
"Structural Welding Code"

17. AWS D14.1
"Specifications for Welding Industrial and Mill Cranes"