(DRAFT) ENCLOSURE 2

TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

INDIANA AND MICHIGAN ELECTRIC COMPANY
DONALD C. COOK NUCLEAR PLANT UNITS 1 AND 2

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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.

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1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at the Indiana and Michigan Electric Company's (IMEC) Donald C. Cook Nuclear Plant Units 1 and 2. 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 provided to control 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 such that their probability of

failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, 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 so as 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:

- 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 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 IMEC, the Licensee for D. C. Cook Units 1 and 2, requesting that the Licensee review provisions for handling and control of heavy loads at D. C. Cook Units 1 and 2, 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. IMEC responded on July 31, 1981 [4]. In

response to a December ~~15~~ 17, 1981 conference call with the NRC and FRC, the Licensee superseded Reference 4 with submittals on June 18, 1982 [5] and September 29, 1982 [6], which have been incorporated into this technical evaluation.

2. EVALUATION

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

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

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

Table 2.1. D. C. Cook Units 1 and 2/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 Specification	Interim Measure 6 Special Attention
1. Polar Crane	250/35	--	--	R	--	--	P	C	--	--
Reactor Vessel Head	148.5	P	R	--	NC	--	--	--	--	P
Upper Internals	58	P	R	--	NC	--	--	--	C	P
Lower Internals	80	P	R	--	--	--	--	--	--	P
Missile Shields	39/87	P	R	--	NC	--	--	--	--	P
Cavity Bulkhead Sections	28/30	P	R	--	--	C	--	--	--	P
Miscellaneous Plant Equipment	38	P	R	--	--	C	--	--	--	P
2. Auxiliary Building Crane	150/20*	--	--	R	--	--	P	R*	--	--
Spent Fuel Shipping Cask	110	P	R	--	--	--	--	--	C	--
Radiation Protection Shields	55	P	R	--	NC	--	--	--	--	--
Irradiated Specimen Shipping Cask	2	P	R	--	--	C	--	--	--	--
Miscellaneous Plant Equipment	4	P	R	--	--	C	--	--	C	--

C = Licensee action complies with NUREG-0612 Guideline.
NC = Licensee action does not comply with NUREG-0612 Guideline.
P = Licensee action partially complies with NUREG-0612 Guideline.
-- = Not applicable.
R = Licensee has proposed revisions or modifications which, when implemented, will be in compliance with NUREG-0612 Guideline.
* = Auxiliary building crane capacity limited to 75 tons pending resolution of outstanding items.

Table 2.1 (Cont.)

Heavy Loads	Height 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 Specification	Interim Measure 6 Special Attention
LSA Waste Boxes	2	P	R	--	--	C	--	--	--	--
Waste Container Metal Bin	2	P	R	--	--	C	--	--	--	--
Reactor Stnl Rack	4-5	P	R	--	--	C	--	--	--	--
Superstructure Dbw and Spent Fuel Crane	25	P	R	--	--	C	--	--	C	--
Equipment Hatch	45	P	R	--	--	C	--	--	C	--
Reactor Coolant Pump Rotating Assembly	28	P	R	--	--	C	--	--	C	--
Reactor Coolant Pump Motor	38	P	R	--	--	C	--	--	C	--
Glycol Tank	5	P	R	--	--	C	--	--	C	--
3. CW Pump and Screen House Bridge Crane	30	--	--	R	--	--	P	R	--	--
CW Pump Motor	15.5	P	R	--	--	C	--	--	--	--
CW Pump Motor Support	8	P	R	--	--	C	--	--	--	--
CW Pump	23	P	R	--	--	C	--	--	--	--
Essential Service Water Pump	4.5	NC	NC	--	--	C	--	--	--	--
Essential Service Water Pump Motor	2.5	NC	NC	--	--	C	--	--	--	--

2.1.1 NUREG-0612, Heavy Load Overhead Handling Systems

a. Summary of Licenseee Statements and Conclusions

The Licensee's review of overhead handling systems at D. C. Cook Units 1 and 2 has identified the following cranes to be subject to the general guidelines of NUREG-0612:

- o polar cranes (250/35 tons)
- o auxiliary building crane (150/20 tons)
- o 30-ton circulating water (CW) pump and screen house bridge crane.

In addition, the following load handling systems have been excluded for the following reasons:

1. Physical separation from safety-related equipment. It was determined by inspection that a load drop could not damage any system or component required for plant shutdown or decay heat removal for the following load handling systems:

   - o turbine building main overhead crane
   - o two turbine building auxiliary cranes

2. Single purpose system. Each of the following load handling systems is used for maintenance of a single piece of safety-related equipment; consequently, these systems will carry heavy loads over safety-related equipment only when plant conditions have been established to allow such equipment to be removed from service:

   - o diesel generator crane
   - o reciprocating charging pump monorail
   - o centrifugal charging pump monorail
   - o safety injection pump monorail
   - o containment spray pump monorail
   - o residual heat removal pump monorail
   - o main steam valve monorail
   - o recirculation valve monorail
   - o auxiliary feedwater pump hoist

3. Weight carried by the handling system. The devices do not carry loads that satisfy the weight requirements for a heavy load:

- o containment building manipulator crane
- o auxiliary building new and spent fuel handling cranes.

b. Evaluation and Conclusion

The Licensee's conclusions concerning the load handling systems at the D. C. Cook plant that are subject to the general guidelines are consistent with NUREG-0612.

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 provided drawings which identify the location of safe shutdown equipment and load handling areas. Safe load paths are being developed for the individual heavy loads and will be incorporated into the appropriate procedures as soon as possible. These component-specific safe load paths remain within the indicated load handling areas and are based on the general concept of handling heavy loads as close to the operating floor as is feasible in order to minimize the potential load drop impact energy, and with the maximum possible horizontal separation from spent fuel. In cases where loads must pass over the reactor vessel, the safe load path is established by considering the minimum time spent over the reactor vessel, the minimum height required for obstacle clearance, and the minimum number of crane operations which require load direction changes.

This approach of using component-specific safe load paths contained within the handling or maintenance procedure for each individual component was

developed in lieu of providing fixed load paths on facility structures such as markings on floors, walls, and crane rails or supports. The maintenance supervisor or leadman directs the crane operator and is responsible for ensuring that heavy load handling remains within the established safe load paths.

The circulating water pump and screen house crane has within its operating area only one set of safety-related equipment, the essential service water pumps. Each of these pumps is individually located inside its own enclosed room. The crane's safe load path covers the entire area except that portion over the essential service water pumps room. With the exception of a lift pertaining to the essential service water pumps or for storage on the essential service water pumps room roof, there is no need or reason for a lift to pass over the essential service water pumps room. This room was designed to withstand the impact of the crane falling on it while carrying a 30-ton load. Therefore, the essential service water pumps are protected from all credible load drops.

For circumstances requiring deviations from established safe load handling paths, an alternate safe load path will be formulated and temporarily incorporated into the handling procedure as provided in the plant manager's instruction PMI-2010.

Miscellaneous loads within the reactor containment building will normally be handled only when the missile shields are in place over the reactor vessel and will follow the general safe load path guidelines previously stated.

In the auxiliary building, miscellaneous loads will be handled as prescribed in procedure 12MHP 5021.001.036, "Control of Heavy Loads in the Auxiliary Building."

b. Evaluation

Development and use of component-specific load paths for individual heavy loads is consistent with the intent of this guideline: to develop individual load paths for heavy loads based upon review by engineering staff familiar with plant layout and system functions. In addition, the use of load handling

areas which encompass these load paths and lift-height restrictions provides an additional factor of safety when handling these loads. Although no mention is made of load path drawings, it is assumed that drawings or equivalent measures are used, based upon the Licensee's statement that the component-specific load paths are contained within procedures for individual heavy loads. Regarding deviations from these load paths, the Licensee states that, if required, PMI-2010 provides guidance to formulate an alternate path and directs temporary incorporation into the handling procedure; verification should be made that a formal review of this temporary deviation is conducted by the plant safety review committee or, if so delegated, the plant manager and qualified alternates.

In addition, the use of the maintenance supervisor/leadman to direct load movements is an acceptable alternative to load path marking. However, the Licensee should ensure that the duties and responsibilities of the maintenance supervisor relative to load handling are specifically delineated in appropriate procedures to ensure that load movement is controlled within the established safe load paths.

The establishment of an exclusion area over the essential service water pump room in lieu of safe load paths for the loads handled by the circulating water pump and screenhouse crane is acceptable because the excluded area is small and well defined. However, taking credit for the design impact loading of the essential service water pump room does not meet the intent of Phase 1 of NUREG-0612, which limits the movement of heavy loads over safe shutdown equipment. Therefore, the Licensee should implement formal administrative controls to prevent movement of heavy loads over this exclusion area. Such controls should direct movement of essential service water pumps so as not to impact any other service water pump as well as to prohibit storage of heavy loads on the roof of any enclosure containing an essential service water pump which is in service.

c. Conclusion and Recommendations

Cook Units 1 and 2 partially comply with Guideline 1 of NUREG-0612. In order to comply fully, the Licensee should perform the following:

1. verify that deviations from safe load paths require formal review and approval by the plant safety review committee.

2. verify that supervisor/leadman responsibilities are clearly defined in load handling procedures.

3. implement formal administrative procedures that prevent movement of heavy loads over the essential service water pump rooms and that prohibit storage of any heavy loads on the roof over any such pump which is in service.

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

A detailed list of heavy loads and procedures governing the handling of each load has been supplied by the Licensee, who has stated that these procedures partially comply with the recommendations of NUREG-0612. As the safe load paths are incorporated into procedures, additional updating will be performed to include equipment identification, inspection and acceptance criteria, step-by-step load handling sequences, and special precautions. Also, spent fuel cask handling procedures will be developed when required and will conform to the requirements of NUREG-0612.

In addition, the Licensee stated [5]:

"Each Essential Service Water Pump is accessed through the roof via its own hatchway. Since the exposed pump is already out for maintenance there would be no change in system status if it was damaged. Therefore, there is no need for special procedures with respect to the Circulating Water Pump and Screen House Crane."

b. Evaluation

Load handling procedures for the auxiliary building crane and the polar crane at the D. C. Cook plant are consistent with the guidance in Section 5.1.1(2) of NUREG-0612 based on the Licensee's commitment to revise the listed procedures to include the following:

1. safe load paths
2. equipment identification
3. inspection and acceptance criteria
4. step-by-step load handling sequences
5. special precautions.

As stated in Section 2.1.2 of this report, appropriate administrative procedures should be implemented to control movement of heavy loads near the essential service water pumps.

c. Conclusion and Recommendations

D. C. Cook Units 1 and 2 comply with Guideline 2 of NUREG-0612 in the auxiliary and reactor buildings on the basis of the Licensee's commitment to revise load handling procedures as indicated. However, the Licensee should implement appropriate administrative controls for handling heavy loads in the vicinity of the essential service water pumps.

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

A Licensee review of crane operator skill training lessons, quality control inspection procedures, and the safety manual used at the D. C. Cook plant for operator training, qualifications, and conduct was performed in comparison to the provisions of Chapter 2-3 of ANSI B30.2-1976. In some instances, ANSI standard items are not specifically addressed, but no stated

exceptions are taken. A Maintenance Head Instruction (MHI) will be prepared to address ANSI B30.2-1976 on operator training.

b. Evaluation

Crane operator training at the D. C. Cook plant is consistent with Section 5.1.1(3) of NUREG-0612 based on the point-by-point review of ANSI B30.2-1976, Chapter 2-3. Further, the Licensee has committed to prepare an MHI to fully address ANSI B30.2-1976 regarding operator training.

c. Conclusion

D. C. Cook Units 1 and 2 will comply with Guideline 3 when the MHI has been prepared and implemented.

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 has stated that arrangements are in progress to provide verification from Westinghouse Electric Corporation of compliance of the reactor vessel head and the upper internals lifting rig with ANSI N14.6-1978. The radiation protection shield lifting device and missile shield lifting device were evaluated to determine compliance with ANSI N14.6-1978. The Licensee determined that both devices meet the intent of ANSI N14.6-1978 with the following exceptions:

Safety factor (AISC):

- o radiation protection shields - 1.5
- o missile shields - 2.0
- o initial proof test of 110% of maximum load
- o continuing acceptance test - 110% of maximum load.

b. Evaluation

Insufficient information has been provided to allow a determination of compliance with respect to Guideline 4 for the reactor vessel head and internals lifting rig. The Licensee has indicated that the radiation protection shield (RPS) and missile shield (MS) lifting devices were built to AISC guidelines, using factors of safety of 1.5 and 2.0, respectively, for yield stress. These safety margins are significantly less than those values specified in ANSI N14.6-1978 and, when combined with a substantially lower load test (110% versus 150%), do not provide the degree of conservatism in design and proof of workmanship necessary for consistency with this guideline. Any of the following options may enable the Licensee to demonstrate that design and continued use of these lifting devices are consistent with the intent of ANSI N14.6-1978:

1. Reevaluation of the design criteria of the RPS and MS lifting devices to identify those components which should be modified or replaced in order to establish design margins consistent with the ANSI N14.6-1978 values of 3 for minimum yield strength and 5 for ultimate strength.

2. Use a load sensing device in the load train (such as a load cell or similar device) set at a maximum of 110% of the rated load, which would prevent exceeding the maximum safe working load (static and impact) of these lifting devices.

3. Use of the present lifting devices may be acceptable if it can be demonstrated that (a) a comprehensive test and inspection program is implemented which requires an annual (or prior to use) load test of 110% combined with inspections specified in ANSI N14.6-1978, Section 5.3.1(2); (b) administrative procedures which provide sufficient details, figures, and precautions to minimize the potential for unexpected loading (load hangup of impact loadings).

For the remaining special lifting devices currently being evaluated, the intent of this guideline, in addition to determining that design and fabrication provide high reliability, is also to make certain that appropriate

steps are taken to ensure that these devices are inspected, tested, and maintained so as to ensure continued reliability. Guidance for a program to support the goal is contained in Section 5 of ANSI N14.6. IMEC has provided no information addressing these issues for the reactor vessel head and internals lift rig.

c. Conclusion and Recommendations

Special lifting devices at D. C. Cook Units 1 and 2 do not comply with Guideline 4. To demonstrate compliance, the Licensee should perform the following:

- For the reactor vessel head and internals lift rig, complete the overall assessment which should include verification of design adequacy of the devices as well as the implementation of a program to ensure continuing compliance in accordance with ANSI N14.6-1978, Section 5.
- For the RPS and MS lifting devices, implement one of the above listed options or propose a suitable alternative.

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

Routine lifting devices (slings, ropes, chains, etc.) follow the guidelines set forth in Handbook for Riggers by W. G. Newberry, revised edition, 1977. This handbook meets the intent of ANSI B30.9-1971.

At present, slings at the Cook plant are selected after the rigger has estimated the load weight to be lifted and the rigging arrangement that is to be used.

Lifting capacity of the wire rope slings is identified by the diameter of rope and lifting arrangement charts provided at each crib. The Tuflex slings are color-coded according to capacity, and the nylon straps are rated by width for their lifting capacities. Ropes and slings throughout the plant are generally used for one particular job (i.e., turbine work, vertical walls, missile blocks, etc.) and are stored in the general area close to the equipment that is lifted.

Marking of slings would require a great deal of time and effort and would not completely eliminate the possibility of selecting an incorrect sling. Further, markings on nylon slings would become obscured as they accumulate grease.

It is the Licensee's opinion that "any further marking of the slings will not provide further assurance of the proper sling being chosen for a particular task."

In addition, the Licensee does not believe that it is practical or necessary to account for a dynamic load factor. Presumably, if such a factor were a real safety concern, the universally accepted ANSI standards would require it. This belief is based on the following factors: first, the hoisting speeds at the Cook plant are relatively slow and any contribution from a dynamic effect would not be significant; second, critical lifts (e.g., reactor vessel head or missile shield) are always done at very slow speeds.

b. Evaluation

The D. C. Cook plant substantially satisfies the requirements of this guideline on the basis that slings are selected and used in accordance with ANSI B30.9-1971. A review of available information indicates that the maximum hoist speeds for the cranes subject to NUREG-0612 are relatively slow:

- Polar crane

  main hoist - 4.75 fpm
  auxiliary hoist - 31 fpm

- Auxiliary building crane

  main hoist - 4.5 fpm
  auxiliary hoist - 35 fpm

- Circulating water pump and screen house crane - 18.75 fpm.

Therefore, dynamic loads imposed on these slings are reasonably small and may be disregarded when determining the static load to be used when selecting and using slings.

Use of wire rope diameter or nylon sling width is an acceptable means of determining sling capacity; however, the Licensee should ensure that this determination is based upon the tables contained in ANSI B30.9-1971.

c. Conclusion

The D. C. Cook 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 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

The Licensee has stated that crane inspection, testing, and maintenance at the D. C. Cook plant is primarily controlled by MHI 5030, the AEP safety manual, maintenance procedures, pre-operational test procedures, quality control inspection procedures, and the crane manufacturer's parts list and operation and maintenance instructions. These documents were reviewed against the criteria set forth in Chapter 2-2 of ANSI B30.2-1976. As a result of this

evaluation, the Licensee considers crane inspection, testing, and maintenance to be in close agreement with ANSI B30.2 with few exceptions.

b. Evaluation

Crane inspection, testing, and maintenance at D. C. Cook Units 1 and 2 is consistent with Guideline 6 in that the Licensee employs a program in close agreement with ANSI B30.2. However, those differences identified between the D. C. Cook program and the ANSI standard should be addressed by the Licensee and incorporated into the inspection program at the D. C. Cook plant.

Crane maintenance procedures should be upgraded to incorporate requirements similar to those contained in ANSI B30.2-1976 for component repair and replacement (Articles 2-2.3.3.C, 2-2.3.1, 2-2.3.2) and wire rope maintenance (Articles 2-2.4.2 and 2-2.4.3).

c. Conclusion and Recommendations

D. C. Cook Units 1 and 2 partially comply with Guideline 6 of NUREG-0612. In order to comply fully, the crane maintenance program and procedures should be revised to include criteria of ANSI B30.2-1976 related to component repair and replacement and wire rope maintenance.

2.1.6 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 Licensee has stated that the auxiliary building crane, the two polar cranes, and the circulating water pump and screen house crane were designed and manufactured in 1969-1970 by the Whiting Corporation according to the guidelines of EOCI Specification 61 and ANSI B30.2-1967. In order to determine compliance, the specifications under which the cranes were designed

were compared item-by-item against the most recent versions of the present specifications.

The study addressing the ANSI Standard and the resulting analysis of the cranes in the areas of discrepancy indicated that the cranes were in compliance. The study comparing CMAA-70 and EOCI-61 was performed by Whiting Corporation and indicated twelve areas in which the cranes did not meet CMAA-70 (1975) design standards:

150/20 Ton Auxiliary Building Crane

1. "The drum pinion strength of the main hoist extra reduction gearing is exceeded by 8% and the gear durability is exceeded by 45%."

   Disposition - Load lifting will be limited to 75 tons maximum until this item is resolved.

2. "The main block bronze sheave bushing is overstressed by 28%."

   Disposition - Whiting states that the 1,000 psi working pressure stated in CMAA-70 - Rev. 75, is not related to any specific type of bearing material supplied. The existing bushings in the block sheaves are #79 bronzoid, which has an ultimate compressive stress rating of 10,000 psi, and Whiting futher states, at a safety factor of 5 as specified by CMAA-70, the bushing should be adequate for working loads up to compressive stresses of 2,000 psi. Therefore, the bushing is satisfactory.

3. "The auxiliary hoist sheave material is Class 35 cast iron with an ultimate tensile strength of 35,000 psi, instead of the Class 40 cast iron with an ultimate tensile strength of 40,000 psi as specified in CMAA-70."

   Disposition - Whiting states that sheaves are generally stressed in compression between their rope contact area and hub. Tensile stresses are usually of minor consequence at bearing hubs and at rope entry points in their flanges. We concur that the sheave material is satisfactory.

4. "The horsepower and torque rating of the auxiliary hoist motor is exceeded by 1.5% when handling a rated load of 20 tons."

   Disposition - The horsepower and torque rating of the auxiliary hoist motor is exceeded because the weight of the load block was added to the 20-ton capacity of the hoist. The gears, bearings, and brake are all adequate for the additional load. Therefore, no modification is necessary since at worst the motor would stall when attempting to lift a full-capacity load.

5. "The longitudinal stiffeners are not located properly and do not meet moment of inertia requirements."

   Disposition - A design change will be initiated to add longitudinal stiffeners to the outside face of each main girder web plate.

6. "In the event of an axle failure, the bridge end truck may drop 1-7/8 inch, instead of the allowed 1 inch."

   Disposition - A design change will be initiated to weld bars to the end truck plates across the runway rail head near each bridge wheel.

250/35 Ton Containment Polar Cranes

7. "The auxiliary hoist sheave material is Class 35 cast iron with an ultimate tensile strength of 35,000 psi, instead of the Class 40 cast iron with an ultimate tensile strength of 40,000 psi as specified in CMAA-70."

   Disposition - Same as Item 3 above; no modification is necessary.

8. "The girder longitudinal stiffener is not located properly."

   Disposition - According to the evaluation by Whiting, the location of the longitudinal stiffeners was determined by the weld length required to transfer bridge rail loadings through the intermediate short depth stiffeners to both webs of each girder, as well as the overall depth required in these short depth stiffeners to transfer the rail load moment across the span between girder webs. Whiting believes that the longitudinal stiffener location specified in CMAA-70 has been established based on the extreme case where only full depth internal stiffeners may be used and that it neglects the reduction in effective unsupported web panel lengths provided by the short depth internal stiffeners. The Licensee concurs with Whiting's conclusion that the probability of web buckling in this critical web compression area is reduced to an extent equal to or exceeding the reinforcement required by the present specification. Therefore, girder stiffener modification is not needed.

30-Ton Circulating Water Pumps and Screen House Crane

9. "The hoist sheave materials is ASTM A48 Class 35 cast iron instead of steel or ASTM A48-64 or later Class 40 iron, as specified in CMAA-70."

   Disposition - A design change will be initiated to install new sheaves. Please note that the reason why the sheaves are being replaced on this crane but not on the containment polar cranes or on the auxiliary building crane is that the sheaves on the circulating

water pump and screen house crane are smaller and thus the compression stress is larger.

10. "The horsepower and torque rating of the hoist motor is exceeded by 4.75% when handling a rated load of 30 tons."

    Disposition - The motor has a 70°C at 60 minutes temperature rise rating at the rated 40 hp. At the required 41.9 hp, the motor has a 77°C temperature rise at 60 minutes. The CMAA standards for Class F insulation allow a 105°C temperature rise. Therefore, the motor will meet the temperature rise limitations and is adequate.

11. "The required hoist brake torque exceeds the rated torque by 2%."

    Disposition - A design change will be initiated to modify the existing brake so that it will meet the required torque rating.

12. "The longitudinal stiffeners do not meet the moment of inertia requirements."

    Disposition - A design change will be initiated to add longitudinal stiffeners to meet the moment of inertia requirements.

The above review indicates that the containment polar cranes are entirely adequate. Two modifications will be made for the auxiliary building crane: installation of additional longitudinal stiffeners and installation of bars to reduce end-truck drop.

The following modifications will be made to the circulating water pump and screenhouse crane: (1) replacement of the hoist sheaves, (2) modification of the hoist brake, and (3) installation of additional longitudinal stiffeners.

b. Evaluation

The polar cranes at D. C. Cook Units 1 and 2 are consistent with Guideline 7 of NUREG-0612 since deviations from CMAA-70 identified in the detailed analysis performed by the Licensee and by Whiting Corporation are not expected to result in crane reliability significantly less than that provided by full compliance with CMAA-70. The auxiliary building crane is not in verbatim compliance with the crane design criteria of CMAA-70; however, the Licensee has demonstrated the adequacy of the present design and has committed to make modifications to the longitudinal stiffeners and to install bars to reduce bridge end truck drop. The Licensee's intent to limit the auxiliary

building crane to a 75-ton maximum lift (normally 150 tons maximum) until the drum pinion strength and gear durability questions are resolved is also consistent with Guideline 7.

Similarly, the circulating water pump and screen house crane is not in verbatim compliance with the crane design criteria of CMAA-70; again, however, the Licensee has demonstrated the adequacy of the current design and committed to the following modifications: (1) the hoist sheaves will be replaced with stronger material, (2) the hoist brake design will be modified to improve braking torque, and (3) longitudinal stiffeners will be added to meet moment of inertia requirements.

c. Conclusion and Recommendations

The polar cranes at D. C. Cook Units 1 and 2 comply with Guideline 7 of NUREG-0612. Contingent upon completion of modifications proposed for both the auxiliary building crane and the CW pump and screen house crane, these cranes will comply with this guideline. However, the auxiliary building crane should be restricted to a capacity of 75 tons until resolution of the drum pinion strength and gear durability questions and subsequent review by the NRC.

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.

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 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

The Technical Specifications for D. C. Cook Units 1 and 2 include a requirement in paragraph 3.9.7 which prohibits the movement of loads in excess of 2500 lb over spent fuel in the storage pool. Since the intent of this interim action is to limit the unnecessary movement of heavy loads over spent fuel in the storage pool, D. C. Cook Units 1 and 2 satisfy this requirement.

b. Conclusion

D. C. Cook Units 1 and 2 comply 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 Reviews for Heavy Loads 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 operations, and content of procedures."

a. Evaluation

Although no information has been provided by the Licensee, it is apparent from the responses to Guidelines 2 and 3 that procedures for handling loads over the core and operator training have been reviewed and upgraded as appropriate. In addition, the design of POLAR cranes at the D. C. Cook plant has been reviewed and found to comply with NUREG-0612. Therefore, to satisfy the requirements of this interim measure, the Licensee should perform the requested special review of all special lifting devices used over the core since a design review has not been completed by the vendor, [redacted].

b. Conclusion and Recommendation

The D. C. Cook plant substantially complies with Interim Protection Measure 6. In order to fully comply, the Licensee should perform a visual inspection of load bearing components of special lifting devices used to handle heavy loads over the core, pending completion of the full design and continuing compliance review being performed in accordance with Guideline 4.

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 D. C. Cook 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 D. C. Cook 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, however, was identified in the following areas:

- IMEC should verify that implementation of safe load paths incorporates the following additional issues: (1) verify that deviations from established load paths require formal review and approval by the plant safety review committee or its equivalent; (2) verify that duties of the supervisor/leadman are clearly defined in procedures; and (3) implement formal administrative procedures that prevent movement of heavy loads over the essential service water pump rooms and prohibit storage of any heavy loads on the roof over any such pump which is in service.

- o IMEC should complete the assessment of the reactor vessel head and internals lift rig. Such an assessment should include verification of the adequacy of design of the devices as well as the implementation of programs to ensure continuing compliance in accordance with Section 5 of ANSI N14.6-1978.

- o IMEC should implement one of the following options for the radiation protection shield and missile shield lifting devices: (a) reevaluate the design margins of load-bearing components and replace or modify the necessary components to establish design margins consistent with ANSI N14.6-1978; (b) install a load-sensing device in the load train which would prevent the operator from exceeding the maximum safe working load of these devices; or (c) implement a comprehensive test and inspection program which requires an annual load test of 110% combined with the comprehensive inspections of ANSI N14.6-1978, Section 5.3.1(2), as well as improved administrative procedures which reduce the potential for unexpected impact loading and effects of a possible load drop.

- o IMEC should upgrade the crane maintenance and inspection program to incorporate ANSI B30.2-1976 requirements for component repair and replacement and wire rope maintenance.

3.2 INTERIM PROTECTION MEASURES

In NUREG-0612, Section 5.3, the NRC staff has established certain measures 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 additional action is required in several areas to satisfy compliance with the Interim Protection Measures. Licensee action for slings has been addressed in Section 3.1 of this evaluation. Further Licensee action necessary for compliance includes the following item:

- IMEC should perform a visual inspection of all load bearing components of special lifting devices used to handle heavy loads over the core.

4. REFERENCES

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