TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

IOWA ELECTRIC LIGHT AND POWER COMPANY

DUANE ARNOLD ENERGY CENTER

NRC DOCKET NO. 50-331
NRC TAC NO. 07988
NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506
FRC ASSIGNMENT 13
FRC TASK 352

Prepared by

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

Author: F. W. Vosbury, C. Bomberger

FRC Group Leader: I. E. Sargent

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: A. Singh

May 30, 1984

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

TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

IOWA ELECTRIC LIGHT AND POWER COMPANY

DUANE ARNOLD ENERGY CENTER

NRC DOCKET NO. 50-331

NRC TAC NO. 07988

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506

FRC ASSIGNMENT 13

FRC TASK 352

Prepared by

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

Author: F. W. Vosbury, C. Bomberger

FRC Group Leader: I. H. Sargent

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: A. Singh

May 30, 1984

Prepared by:	Reviewed by:	Approved by:
C Bomberger	S. Pardee	O P Cartagno
Principal Author	Project Manager	Department Director
Date: 5/30/84	Date: 5/30/84	Date: 5-30-84

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

CONTENTS

FOREWORD

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

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

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at the Iowa Electric Light and Power Company's Duane Arnold Energy Center (DAEC). 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 ensure the safe handling of heavy loads and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

The results of Task A-36 were reported in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The staff's conclusion from this evaluation was that existing measures to control the handling of heavy loads at operating plants, although providing protection from certain potential problems, do not adequately cover the major causes of load handling accidents and should be upgraded.

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-part objective using an accepted approach or protection philosophy. The first portion of the objective, achieved through a set of general guidelines identified in NUREG-0612, Section 5.1.1, is to ensure that all load handling systems at

nuclear power plants are designed and operated so that their probability of failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Sections 5.1.2 through 5.1.5, is to ensure that, for load handling systems in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (2) conservative evaluations of load handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

A defense-in-depth approach was used to develop the staff guidelines to ensure that all load handling systems are designed and operated so that their probability of failure is appropriately small. The intent of 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 Iowa Electric Light and Power Company, the Licensee for DAEC, requesting that the Licensee review provisions for handling and control of heavy loads at DAEC, 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 August 6, 1981 [4] and December 15, 1981 [5], Iowa Electric Light and Power Company provided initial responses to this request.

A draft Technical Evaluation Report (TER) was prepared, informally transmitted, and discussed with the Licensee [6]. Following this discussion, Iowa Electric Light and Power Company provided supplemental responses on December 2, 1982 [7], August 22, 1983 [8], September 22, 1983 [9], and May 15, 1984 [10] addressing unresolved issues identified in the draft TER. This TER is based on information provided in References 4 through 10.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at the Duane Arnold Energy Center 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 to provide the defense-in-depth appropriate for the safe handling of heavy loads. They are identified under the following topics in 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 by all overhead handling systems and programs used to handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems.

2.1.1 Overhead Heavy Load Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee conducted a review of all overhead handling systems at DAEC to determine which overhead handling systems are subject to this review. The

Table 2.1. Duane Arnold/NUREG-0612 Compliance Matrix

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
1. Reactor Building Crane	Main 100	--	--	C	--	--	C	C	--	--
	Aux 5	--	--	C	--	--	C	C	--	--
Drywell Head	42	C*	C	--	R	--	--	--	R	C
Reactor Vessel Head	52	C	C	--	R	--	--	--	R	C
Steam Dryer	24	C	C	--	R	--	--	--	R	C
Shroud Head and Steam Separator	33.4	C	C	--	R	--	--	--	R	C
Reactor Well Plugs	3 at 70 1 at 75 2 at 67.5	C	C	--	--	R	--	--	R	C
Plugs between Reactor Well/ Steam Dryer/ Separator Storage Pool	1 at 65 3 at 40	C	C	--	--	R	--	--	R	C
Plugs between Reactor Well and Fuel Storage Pool	1 at 7.5 1 at 6.5	C	C	--	--	R	--	--	R	C
Service Support Platform	5	C	C	--	R	--	--	--	R	C
Jib Crane for Service Platform	--	C	C	--	--	R	--	--	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.

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 Specifications	Interim Measure 6 Special Attention
Invessel Work Platform and Vessel Wall Shield	--	C	C	--	--	R	--	--	R	C
Vessel Head Insulation	--	C	C	--	--	R	--	--	R	C
New Fuel Crates	--	C	C	--	--	R	--	--	R	C
Pool Gates	1 at 5.5 1 at 2.5	C	C	--	--	R	--	--	R	C
Spent Fuel Cask	65	C	C	--	R	--	--	--	R	C
2. Turbine Building Crane Main	125	--	--	C	--	--	C	C	--	--
Aux	25	--	--	C	--	--	C	C	--	--
High-Pressure Turbine Upper Shell	68	R	R	--	--	R	--	--	--	--
Exhaust Hood A	65	R	R	--	--	R	--	--	--	--
Exhaust Hood B	65	R	R	--	--	R	--	--	--	--
Low-Pressure Upper Inner Casing A	49	R	R	--	--	R	--	--	--	--
Low-Pressure Upper Inner Casing B	49	R	R	--	--	R	--	--	--	--

Table 2.1 (Cont.)

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
High-Pressure Rotor	44	R	R	--	R	--	--	--	--	--
Low-Pressure Rotor A	125	R	R	--	R	--	--	--	--	--
Low-Pressure Rotor B	129	R	R	--	R	--	--	--	--	--
High-Pressure Turbine Diaphragms	1.9	R	R	--	--	R	--	--	--	--
Low-Pressure Turbine Diaphragms	2.2	R	R	--	--	R	--	--	--	--
Control Valve Parts	9	R	R	--	--	R	--	--	--	--
Main Stop Valve Parts	20.5	R	R	--	--	R	--	--	--	--
Combined Intermediate Valve Parts	21	R	R	--	--	R	--	--	--	--
Generator Outer End Shield	5	R	R	--	--	R	--	--	--	--
Generator Inner End Shield	1.5	R	R	--	--	R	--	--	--	--
Generator Hydrogen Cooler	1	R	R	--	--	R	--	--	--	--

Table 2.1 (Cont.)

	Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
	Generator Field	141	R	R	--	--	R	--	--	--	--
	Alterrex	25	R	R	--	--	R	--	--	--	--
	Reactor Feed Pump Motor	18	R	R	--	--	R	--	--	--	--
3.	Recirculation Pump Motor Hoist	12	--	--	C	--	--	C	--	--	--
	Recirculation Pump Motor	12	R	R	--	--	R	--	--	--	--
4.	Shield Blocks and Personnel Lock Hoist	24	--	--	C	--	--	C	--	--	--
	Shield Blocks	4 at 17 4 at 10 1 at 16	R	R	--	--	R	--	--	--	--
5.	Fuel Pool Demineralizer Area Hoist	10	--	--	C	--	--	C	--	--	--
	Control Rod Drive	450 lb	R	R	--	--	R	--	--	--	--
6.	Steam Valve Area Monorail	10	--	--	C	--	--	C	--	--	--
7.	Drywell Maintenance Hoists										
	Upper	3	--	--	C	--	--	C	--	--	--
	Lower	5	--	--	C	--	--	C	--	--	--
8.	Spent Fuel Pool Gamma-Scan Collimator Port Hoist	1	--	--	C	--	--	C	--	--	--
9.	Torus Monorail	3	R	R	C	-	--	C	--	--	--

Licensee identified the following overhead handling systems and equipment as those from which a load drop could result in damage to plant shutdown or decay heat removal systems:

- reactor building crane
- turbine building crane
- recirculation pump motor hoist
- shield blocks and personnel lock hoist
- fuel pool demineralizer area hoist
- steam valve area monorails
- drywell maintenance hoists
- spent fuel pool gamma-scan collimator port hoist
- torus monorail.

During the course of this review, the Licensee also identified other load handling systems at DAEC which need not, in accordance with NRC staff criteria, be considered within the scope of NUREG-0612. Such systems were excluded on the basis that either they are not capable of carrying a heavy load or they are located so that they cannot carry a heavy load above or near fuel or safe shutdown equipment.

b. Evaluation and Conclusion

The Licensee's conclusions concerning load handling systems subject to the general guidelines of NUREG-0612, Section 5.1.1 are consistent with the objectives of 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 stated that safe load paths have been established for loads carried by the reactor building crane. These safe load paths follow structural floor members, beams, or concrete walls, where practical, so that if the load is dropped, the structure is more likely to withstand the impact. Safe load paths are defined on equipment layout drawings. Procedures used to control the handling of heavy loads by the reactor building crane define the path of movement that is to be followed for each load handled by this crane.

Heavy loads handled by the turbine building crane and by monorail and fixed hoists which are moved in the vicinity of safe shutdown equipment but are not carried over spent fuel in the storage pool or reactor vessel will be controlled by general load handling procedures. These procedures will provide, in addition to the information discussed in Section 2.1.3.a, guidance for safe load path selection.

A procedure is being developed for future handling of the spent fuel shipping casks which warns the user to ascertain and document a safe load path since no specific data are available about the casks. The Licensee anticipates no spent fuel shipments in the near future.

In lieu of safe load path markings, the Licensee stated that procedures will be written to require the presence of a crane supervisor/signalman who will direct heavy load movements according to the safe load path drawings. Deviations from defined safe load paths must be reviewed and documented by written procedures approved by the DAEC Operatons Committee.

Evaluation

DAEC substantially satisfies the criteria of Guideline 1 on the basis that load paths have been developed and incorporated into drawings for all loads, with the exception of those handled by the turbine building crane and monorail/fixed hoists. For the turbine building crane, the Licensee stated

that procedures which include guidance for safe load path selection will be written. Development of similar load path guidance for monorail/fixed hoists is also to be provided, although it is recognized that such guidance will be minimal since the path for load movement is fixed in such cases and a load path can be specified by a travel limit. Intended Licensee actions to develop a preliminary load path for the spent fuel shipping cask and provide a signalman to direct load movements, as well as to develop procedures for handling deviations from any approved load path, are consistent with requirements of this guideline.

c. Conclusion and Recommendation

Development of safe load paths at DAEC satisfies the criteria 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

DAEC's procedures for the handling of loads by the reactor building crane and the refueling platform hoists above the refueling floor of the reactor building include the following:

- o identification of required equipment
- o inspections and acceptance criteria required before movement of a heavy load
- o the steps and proper sequence to be followed in handling the load
- o safe load paths for the movement of heavy loads.

The Licensee expressed its intention to provide general load handling procedures, including instructions on selection and use of equipment, verification of current inspection, and bases for load path selection, for other loads handled in the vicinity of safe shutdown equipment. Loads that are carried over spent fuel in the storage pool or reactor vessel will be covered by specific procedures.

A procedure for handling a spent fuel shipping cask is being developed.

b. Evaluation

Load handling procedures at DAEC for the reactor building crane satisfy the criteria of this guideline. As previously stated by the Licensee, no written procedures exist which cover the handling of heavy loads with the turbine building crane or monorail-mounted and fixed hoists. The Licensee intends to provide general written procedures for those loads handled in the vicinity of safe shutdown equipment but not carried over spent fuel in the storage pool or reactor vessel. As also addressed in Guideline 1, the Licensee is preparing load handling procedures for the spent fuel cask; these procedures should be implemented for full compliance with Guideline 2.

c. Conclusion

Load handling operations at DAEC are consistent with Guideline 2 based on the Licensee's verification that (1) procedures for loads handled by the reactor building crane are consistent with this guideline, (2) general procedures consistent with this guideline will be written for the turbine building crane and monorail-mounted and fixed hoists, and (3) specific procedures consistent with this guideline will be prepared for handling of the spent fuel cask.

9.1.4 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' [11]."

. Summary of Licensee Statements and Conclusions

The Licensee stated [4]:

"A new procedure has been prepared which contains all of the elements necessary to establish a program for crane operator training, qualification, and operator conduct in accordance with Chapter 2-3 of ANSI B30.2-1976, 'Overhead and Gantry Cranes'."

. Evaluation and Conclusion

Crane operator training, qualification, and conduct at DAEC will be upported by administrative controls consistent with Guideline 3.

.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' [12]. 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."

Summary of Licensee Statements and Conclusions

The following special lifting devices have been identified by the censee to be in use at the Duane Arnold plant:

- o head strongback
- o dryer-separator sling
- o rotor lifting beam.

In addition to these lifting devices, the Licensee stated that a special fting device may be used at some future date to handle spent fuel casks, but

that the supplier of such a device would be required to meet the requirements of ANSI N14.6-1978.

The lifting devices currently in use were designed and fabricated prior to the issuance of ANSI N14.6-1978 and therefore may not meet the requirements of this standard. Design of all three devices has been compared with ANSI N14.6-1978 criteria related to component design and load handling reliability. The results of this review indicate that the dryer-separator sling assembly and the rotor lifting beam have been shown to comply with ANSI criteria. A modification has been made to the vessel head strongback to provide safety margins of 10:1. A load test to 200% of rated load has been performed on the dryer-separator sling, and the vessel head strongback will be load tested to 150% as a result of modifications. The Licensee stated that a load test of the rotor lifting beam has not been performed and is not deemed necessary for the following reasons:

1. Maximum working load is no greater than 1/5 of the minimum breaking strength of the wire rope and fittings used.

2. Maximum working stress in lifting beams shall be no greater than 1/3 of the minimum yield strength or 1/5 of the minimum tensile strength, whichever is smaller, of the beam structure and its attachments.

3. All welds were done by welders qualified to Section IX of the ASME Pressure Vessel Code (or equivalent) and were magnetic particle tested.

4. Loads that are carried by the lifting beam do not have unacceptable consequences if dropped.

Regarding testing to ensure continuing compliance, the Licensee stated that future maintenance and testing will be performed in accordance with ANSI N14.6-1978, Section 5 requirements, which include:

- implementation of the responsibilities of Iowa Electric as the owner or user

- acceptance testing of any new or modified special lifting device in accordance with Section 5.2

- testing to verify continuing compliance in accordance with Section 5.3.1
- maintenance and repair
- nondestructive testing procedures, personnel qualification, and acceptance criteria in accordance with Section 5.5.

The Licensee also stated that the testing for continuing compliance will be performed once every 5 years rather than annually, based on the following considerations:

- the devices are used approximately four times every refueling outage
- the option to proof-test these devices would increase the usage of these devices by 25%
- it is believed that the recommendations for testing in ANSI N14.6-1978 are intended for high-usage lifting devices and therefore an exception to these requirements is justified.

b. Evaluation

Although it cannot be determined that the specific requirements of ANSI N14.6-1978 for component design and fabrication have been satisfied for the special lifting devices in use at DAEC, it is apparent from the Licensee's response that these devices will provide a high degree of load handling reliability. Adequate information has been provided to demonstrate that design safety margins of these devices are consistent with the criteria of the ANSI standard and satisfy other concerns related to load handling reliability. Load tests of the dryer-separator sling and the vessel head strongback also provide reasonable assurances of the workmanship of the devices. Information provided by the Licensee for the rotor lifting beam has also been evaluated and is sufficient to conclude that a load test of this device is not warranted.

Licensee programs to ensure continuing compliance are consistent with the requirements of this guideline and ANSI N14.6-1978. Further, relaxation of the frequency of periodic inspections is reasonable considering the limited use of these devices.

c. Conclusion and Recommendations

Documentation of design and programs for continued use of special lifting devices at DAEC are consistent with the requirements 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' [13]. However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the 'static load' which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used."

a. Summary of Licensee Statements and Conclusions

The Licensee made a commitment to replace all lifting devices that were not specially designed with new rigging which will satisfy ANSI B30.9-1971 criteria and will be accompanied by proof test certification. All slings will be permanently marked with their rated "static load" capacity. Sling capacity has been derated according to the impact allowance from CMAA Specification 70, which the Licensee stated is a more conservative method than that described in NUREG-0612. Dynamic loads which could be imposed by individual hoists will be accounted for individually. Any slings that are restricted to use on certain loads will be clearly marked to so indicate.

The Licensee also indicated that the inspection, maintenance, and repair or replacement of these lifting devices will be in accordance with the requirements of ANSI B30.9-1971.

b. Evaluation

The Licensee has agreed to replace all lifting devices that are not specially designed with devices that comply with ANSI B30.9-1971. Sling capacity will be derated to include the impact allowance; the system to be

used for rating of rigging is a safe and conservative alternative to the system specified in NUREG-0612, Section 5.1.1. The Licensee's rating is equivalent to, and in some instances more conservative than, the rating method required under this guideline. The Licensee satisfies the requirements of guideline based upon its commitment to perform inspection, maintenance, and repair or replacement in accordance with ANSI B30.9-1971.

c. Conclusion

Proposed Licensee actions for the selection and use of slings are consistent with Guideline 5.

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 has been developed which satisfies the criteria of Guideline 6 for inspection, testing, and maintenance of overhead and gantry cranes.

b. Evaluation and Conclusion

Crane inspection, testing, and maintenance at DAEC will be consistent with Guideline 6.

2.1.8 Crane Design [Guideline 7, NUREG-0612, Section 5.1.1(7)]

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' and of CMAA-70, 'Specifications for Electric Overhead Traveling Cranes' [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

With regard to the turbine and reactor building crane designs, the Licensee provided a list of deviations from the applicable criteria of Chapter 2-1 of ANSI B30.2-1976 and CMAA-70. The following is a summary of those deviations and, where provided, the Licensee's commentary on the significance of such discrepancies.

1. Motor Branch Short Circuit Protection. Both CMAA-70 and ANSI B30.2 require that wiring and equipment conform to the latest issue of the National Electric Code (NEC).

   The current NEC specifies that crane hoist and monorail hoist motor branch circuits be protected by fuses or inverse time circuit breakers rated in accordance with tabulated values in the 1981 NEC. Both the turbine building and reactor building cranes were built to the specifications of the 1971 NEC, which did not include any requirement for motor branch circuit protection.

2. Clearance. CMAA-70 requires that electrical equipment conform to the latest issue of the NEC. The current NEC specifies that 2-1/2 feet of working space be available for examination, servicing, and maintenance of parts, and that where such parts are enclosed in cabinets, the doors either open to 90° or be removable. Both the turbine building and the reactor building cranes were built to 1971 NEC specifications, which do not include any provisions for control clearances.

3. Pendant Pushbutton Arrangement. Both CMAA-70 and ANSI B30.2 specify an arrangement of pushbuttons in a vertical line, whereas the pushbuttons on the pendant stations at both the turbine building and the reactor building cranes are arranged in two sections. Furthermore, CMAA-70 requires that the "stop" pushbutton be red, and the stop pushbutton is black for both the reactor building and the turbine building cranes.

4. Operator's Circuit Breaker. For cab-operated cranes, ANSI B30.2 requires the provision of an enclosed switch or circuit breaker which may be padlocked in an open position, located in the leads from the runway conductors. When in the cab, the operator should be able to open this switch, which sets the holding brake. On the reactor building and turbine building cranes, such a switch is mounted on the bridge platform rather than in the cab; however, the cab contains a pushbutton which controls the contactor and will set all holding brakes on the crane.

5. Pendant Pushbutton Station Grounding Conductor. CMAA-70 specifies the provision of a grounding conductor between the crane and a ground terminal in the station for pendant pushbutton stations. The reactor building crane interconnection drawings do not show this feature, but it is in place in the pendant pushbutton cable.

6. Wheel Load. CMAA-70 tabulates maximum bridge and trolley wheel loadings for various rail sections and wheel diameters. The estimated wheel load for the turbine building crane exceeds the maximum value specified by CMAA-70 by one percent, which the Licensee concludes will not have a negative effect on crane operation.

The Licensee's evaluation concluded that the safe operation of these two cranes is not downgraded.

b. Evaluation

The enumerated deviations of the design features of the turbine building and reactor building cranes from the design requirements of CMAA-70 and Chapter 2-1 of ANSI B30.2-1976 are judged to result in no significant reduction of overall load handling reliability.

c. Conclusion

Design of cranes at DAEC is consistent with Guideline 7.

2.2 INTERIM PROTECTION MEASURES

The NRC has established six interim protection measures to be implemented at operating nuclear power plants to provide reasonable assurance that no heavy loads will be handled over the spent fuel pool and that measures exist to reduce the potential for accidental load drops to impact on fuel in the core

or spent fuel pool. Four of the six interim measures of the report consist of general Guideline 1, Safe Load Paths; Guideline 2, Load Handling Procedures; Guideline 3, Crane Operator Training; and Guideline 6, Cranes (Inspection, Testing, and Maintenance). The two remaining interim measures cover the following criteria:

1. Heavy load technical specifications

2. Special review for heavy loads handled over the core.

Licensee implementation and evaluation of these interim protection measures is 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. Summary of Licensee Statements and Conclusions

At present, the reactor building crane is not single-failure proof. The Licensee made a commitment to upgrade the reactor building crane to comply with the single-failure-proof guidelines of NUREG-0612, Appendix C; completion of the modification is scheduled for July 1985. To comply with the interim measure, control procedures have been modified to prohibit movement of heavy loads over the spent fuel pool.

b. Evaluation, Conclusion, and Recommendation

Licensee programs intended to prevent movements of heavy loads over the spent fuel pool until the single-failure-proof crane modification is completed are consistent 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 the Licensee's 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. Summary of Licensee Statements and Conclusions

The Licensee stated that it is committed to upgrade the reactor building crane to the single-failure-proof guidelines of NUREG-0612, paragraphs

5.1.6(1) and (3). In the interim, an inspection of that crane will be performed in accordance with ANSI B30.3-1976, paragraph 2-3.2.1.1, subparagraphs a, b, and d. This inspection will be made before the next refueling outage.

The Licensee made no further statements or conclusions regarding this interim protection measure.

b. Evaluation

Interim Protection Measure 6 requires a special review of four issues for the handling of heavy loads over the core:

1. Review of procedures to ensure that sufficient detail is provided and that instructions are clear and concise
   a. for installation of rigging or lifting devices
   b. for movement of the load.
2. Visual inspections of load-bearing components to identify flaws or deficiencies that could lead to failure of the component
   a. for cranes
   b. for slings
   c. for special lifting devices.
3. Appropriate repair and replacement of defective components
   a. of cranes
   b. of slings
   c. of special lifting devices.
4. Verification regarding crane operators
   a. of proper training
   b. of familiarity with specific procedures used in handling loads.

Section 2.1.1 of this report describes the definition of safe load paths, and Section 2.1.2 describes procedures for the handling of loads by the reactor building crane. These measures fulfill the requirements for review of procedures for movement of heavy loads over the core.

The Licensee stated that the reactor building crane will be inspected before the next refueling outage. This statement is summarized, above, in this section. Section 2.1.6 of this TER quotes the Licensee's assurance that

inspection of lifting devices which are not specially designed will be inspected in accordance with ANSI B30.9-1971. Section 2.1.5 verifies that DAEC fulfills the criteria of ANSI N14.6-1978 for testing, maintenance, and continued compliance of special lifting devices. These three statements indicate that the procedures for visual inspection for load-bearing components of cranes, slings, and special lifting devices have been reviewed.

Section 2.1.7 of this report confirms that DAEC's program for maintenance of cranes fulfills Guideline 6. Section 2.1.5 states that the Licensee satisfies the criteria of ANSI N14.6-1978 for maintenance and continued compliance of special lifting devices. In Section 2.1.6, Iowa Electric has indicated that inspection, maintenance, and repair or replacement of all other lifting devices will be performed as required by ANSI B30.9-1971. These three statements fulfill the requirements of Interim Protection Measure 6 for appropriate repair and replacement of defective components.

Section 2.1.4 of this report quotes the Licensee's statement that a new procedure has been prepared to establish a crane operator training program in accordance with ANSI B30.2-1976. This constitutes a special review of crane operator training.

c. Conclusion

The Licensee's review of procedures, equipment, and personnel for the reactor crane fulfills all criteria of Interim Protection Measure 6.

3. CONCLUSION

This summary is provided to consolidate the results of the evaluation contained in Section 2 concerning individual NRC staff guidelines into an overall evaluation of heavy load handling at the Duane Arnold Energy Center (DAEC). 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 Duane Arnold Energy Center can be expected to be conducted in a highly reliable manner consistent with the staff's objective as expressed in these guidelines.

3.2 INTERIM PROTECTION MEASURES

The NRC staff has established (NUREG-0612, Section 5.3) that certain measures should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until 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. Evaluation of information provided by the Licensee indicates that measures have been properly implemented which ensure compliance with the staff's measures for interim protecion at DAEC.

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
May 17, 1978

3. NRC
Generic letter 81-07
December 22, 1980

4. Larry D. Root (Iowa Electric)
Letter to D. G. Eisenhut (NRC)
Subject: Control of Heavy Loads at Nuclear Power Plants
August 6, 1981

5. L. D. Root (Iowa Electric)
Letter to H. Denton (NRC)
Subject: Transmittal of Response to Request for Information on Heavy Loads at Duane Arnold Energy Center
December 15, 1981

6. I. H. Sargent and F. W. Vosbury (FRC)
Telephone Memorandum
Subject: Conversation with F. Clemenson (NRC) and DAEC
March 12, 1982

7. L. D. Root (Iowa Electric)
Letter to H. Denton (NRC)
Subject: Control of Heavy Loads at Duane Arnold Energy Center
December 2, 1982

8. R. W. McGaughy (Iowa Electric)
Letter H. Denton (NRC)
Subject: Control of Heavy Loads
August 22, 1983

9. R. W. McGaughy (Iowa Electric)
Letter H. Denton (NRC)
Subject: Control of Heavy Loads
September 22, 1983

10. R. W. McGaughy (Iowa Electric)
Letter H. Denton (NRC)
Subject: Control of Heavy Loads
May 15, 1984

11. ANSI B30.2-1976
"Overhead and Gantry Cranes"
American Society of Mechanical Engineers
1976

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

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

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