TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

GEORGIA POWER COMPANY

EDWIN I. HATCH 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.

Mr. C. 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 Georgia Power Company's (GPC) Edwin I. Hatch 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 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 guideline is to ensure that licensees of all operating nuclear power plants perform the following:

- define safe load travel paths through procedures and operator training so that, to the extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment
- provide sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system.

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612. Section 6 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 GPC, the Licensee for Hatch Units 1 and 2, requesting that the Licensee review provisions for handling and control of heavy loads at Hatch 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. On June 29, 1981, GPC provided the initial response [4] to this request; additional information was provided on May 24, 1982 [5], July 29, 1983 [6], January 23, 1984 [7], and March 12, 1984 [8], and has been incorporated into this final technical evaluation.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at Hatch 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 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

A detailed evaluation of all overhead handling systems has been performed by the Licensee at the Hatch plant. All load handling systems and load paths

Table 2.1. E. I. Hatch Nuclear Plant/NUREG-0612 Compliance Matrix

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 5 Technical Specifications	Interim Measure 6 Special Attention
1. Unit 1 RB Overhead Crane		--	--	C	--	--	C	C	C	C
Reactor Vessel Head	65	C	C	--	B	--	--	--	--	C
Crane Load Block	9	C	C	--	--	C	--	--	--	C
Moisture Separator	56	C	C	--	B	--	--	--	--	C
Steam Dryer	43	C	C	--	B	--	--	--	--	C
Drywell Head	45	C	C	--	B	--	--	--	--	C
Head Insulation	6	C	C	--	--	C	--	--	--	C
SFP Cattle Chute	10	C	C	--	--	C	--	--	--	C
Refueling Slot Plugs	10	C	C	--	--	C	--	--	--	C
D/S Pool Shield Plugs	11	C	C	--	--	C	--	--	--	C
Reactor Well Shield Plugs	81	C	C	--	--	C	--	--	--	C
Vessel Service Platform	5	C	C	--	--	C	--	--	--	C
SFP Gates	55	C	C	--	--	C	--	--	--	C
SFP Racks	15	C	C	--	--	C	--	--	--	C
Head Nut and Washer Rack	1	C	C	--	--	C	--	--	--	C

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

Table 2.1 (Cont.)

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 5 Technical Specifications	Interim Measure 6 Special Attention
2. Unit 2 RB		--	--	C	--	--	C	R	--	C
Moisture Separator	56	C	C	--	R	--	--	--	--	C
Steam Dryer	43	C	C	--	R	--	--	--	--	C
Reactor Well Shield Plugs	81	C	C	--	--	C	--	--	--	C
3. Units 1 and 2 TB Overhead Cranes		--	--	C	--	--	C	R	--	--
Air Handling Unit	53	C	C	--	--	C	--	--	--	--
Filter Unit	2	C	C	--	--	C	--	--	--	--
Exhaust Fan	1	C	C	--	--	C	--	--	--	--
Supply Fan	1	C	C	--	--	C	--	--	--	--
Load Block	45	C	C	--	--	C	--	--	--	--
4. RHR Pump Motors (4)		--	--	C	--	--	C	C	--	--
RHR Pump	3.1	C	C	--	--	C	--	--	--	--
RHR Pump Motor	3.4	C	C	--	--	C	--	--	--	--

Table 7.1 (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
5. Core Spray Pump Motors (4)		--	--	C	--	--	C	C	--	--
Core Spray Pump	1.1	C	C	--	--	C	--	--	--	--
Core Spray Pump Motor	3.5	C	C	--	--	C	--	--	--	--
6. RHR Heat Exchanger Bolts (8)		--	--	C	--	--	C	C	--	--
RHR Heat Exchanger	21.5	C	C	--	--	C	--	--	--	--
7. Recirculation Pump MG Set Bolts (8)		--	--	C	--	--	C	C	--	--
Generator	22	C	C	--	--	C	--	--	--	--
Motor	25.2	C	C	--	--	C	--	--	--	--
Fluid Drive	26.5	C	C	--	--	C	--	--	--	--

were identified, and the potential impact on irradiated fuel or safe shutdown equipment was determined. In this evaluation, no credit was taken for interlocks, technical specifications, or procedural controls. The weight of a heavy load was determined to be any load in excess of 725 lb. Other factors considered in determining loads subject to compliance were load swing arch, structural restrictions, and the potential for floor penetrations. In determining the potential for floor penetrations, the Licensee's analysis assumed a load drop from the maximum height and in the worst orientation in order to produce the most severe consequences. Based upon the findings, the Licensee determined that the following handling systems would be subject to compliance with the general guidelines of NUREG-0612:

- reactor building overhead cranes (2)
- turbine building overhead cranes (2)
- residual heat removal (RHR) pump hoists (4)
- core spray pump hoists (4)
- RHR heat exchanger hoists (4)
- recirculation pump motor generator set hoists (4).

The Licensee also identified numerous handling systems which have been excluded from further consideration. The individual handling systems and bases for exclusion are identified in the following paragraphs.

For the following handling systems, there is sufficient physical separation from any load-impact point and any safety-related component to permit a determination by inspection that no heavy load drop can result in damage to any of the following systems or component required for plant shutdown or decay heat removal:

- control rod drive line (CRD) pump/hatch hoist
- intake structure mobile crane
- CRD repair area jib crane
- reactor water cleanup (RWCU) regenerative heat exchanger trolley (2)
- spent fuel pool cooling heat exchanger trolley (2)
- chiller hoists (2)
- main steam isolation valve (MSIV) hoists (4)
- MSIV bridge crane
- CRD repair area monorail.

While the capacity of the refueling platforms (1,000 lb) exceeds the heavy load criteria for the Hatch plant (725 lb), the design of these

platforms is such that they are limited to the movement of fuel assemblies and lighter loads and thus could not be used to lift a "heavy load."

Each of the following overhead handling systems has a sole-purpose lift function; any system that could be damaged following a load drop will necessarily be out of commission prior to the lift.

- o high pressure coolant injection (HPCI) pump/turbine hoists (2)
- o reactor core isolation cooling (RCIC) pump/turbine/hatch hoist
- o diesel generator hoists (5).

b. Evaluation and Conclusion

GPC's identification of those load handling systems subject to compliance with the guidelines of NUREG-0612 is consistent with NUREG-0612 guidance. Similarly, exclusion of those handling systems identified is reasonable based upon the documentation provided by the Licensee.

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

Safe load paths have been established for lifts over the refueling floor and the control building roof at the Hatch plant. These load paths are included in procedural drawings and are clearly marked on floors. Sketches of these paths have also been provided. Due to the high concentration of equipment and structures in reactor building corner rooms, exclusion areas have been developed to control load movements and have also been identified in

load handling procedures. It is the Licensee's opinion that the intent of this guideline is satisfied based upon the following:

- o established load paths and exclusion areas minimize the potential that a dropped load will impact irradiated fuel or safe shutdown equipment
- o load paths and exclusion areas follow, to the extent practical, structural floor members
- o load paths and exclusion areas are shown in procedural sketches, marked on floors, and clearly posted in lift areas
- o deviations from approved load paths or into exclusion areas require approval of the Superintendent of Engineering Services or his designer.

b. Evaluation

Information has been provided by the Licensee which demonstrates that load paths developed and implemented at Hatch Units 1 and 2 are consistent with this guideline. Further, these predetermined load paths are incorporated in procedures, marked on floors, follow structural members, and require an appropriate level of approval prior to deviation. Use of exclusion areas is also acceptable based upon information provided which demonstrates that these areas are a relatively small proportion of the overall area, areas are well defined by structural walls, and adequate procedural controls have been implemented to control movements as well as deviations.

c. Conclusion

Development and implementation of safe load paths at Hatch Units 1 and 2 is performed in a manner consistent with Guideline 1.

2.1.3 Load Handling Procedures, [Guideline 3, 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 list of all loads determined to be within the scope of the general guidelines and respective load handling procedures has been provided by the Licensee. For these procedures, the Licensee states that each procedure contains identification of required equipment, special precautions, safe load path/exclusion area sketches, and detailed rigging instructions. Rigging inspection and acceptance criteria are referenced and contained in additional procedures.

b. Evaluation and Conclusion

Implementation of load handling procedures at Hatch Units 1 and 2 is consistent with Guideline 2.

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' [9]."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that operator training is currently being implemented per the guidelines of Section 5.1.1(3) of NUREG-0612.

b. Evaluation

Crane operator training at Hatch Units 1 and 2 meets the intent of NUREG-0612 based on the Licensee's verification that operator training meets the guidance in Section 5.1.1(3) with no exceptions for all cab-operated, pulpit-operated, floor-operated, and remote-operated cranes indicated in Reference 5.

c. Conclusion

Training and qualification of crane operators at Hatch Units 1 and 2 is consistent with Guideline 3 of NUREG-0612.

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' [10]. This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. For operating plants, certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device [NUREG-0612, Guideline 5.1.1(4)]."

a. Summary of Licensee Statements and Conclusions

The Licensee identified the following special lifting devices to be subject to compliance with this guideline:

- o reactor head strongback
- o dryer/separator sling assembly.

Documentation has been obtained from the original manufacturer of these devices (GE), and a detailed comparison has been made with those sections of ANSI N14.6-1978 directly related to load handling reliability.

Regarding design of these devices, the Licensee stated that review of the original stress analysis indicates that all components except the hook pins satisfy the ANSI design safety margins based upon maximum static and dynamic conditions. The hook pins will be replaced with pins that satisfy ANSI criteria. Although a detailed fabrication process was not originally specified, the Licensee stated that adequate documentation exists to demonstrate that acceptable fabrication practices were used. Welding was performed in accordance with ASME Section IX, and NDE records are available

for all welds. It is evident from available records that a quality assurance program was enforced during the design and fabrication of these devices. In addition, both devices were load tested to 150% prior to initial use, followed by NDE of all welds. To provide assurance of continuing compliance, all devices are periodically tested in accordance with the criteria of ANSI N14.6-1978, Section 5.3.1. Remaining provisions of Section 5.3 are or will be incorporated into inspection procedures for these devices.

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 Hatch Units 1 and 2, it is evident that these devices will provide a high degree of load handling reliability. The Licensee has verified that both devices satisfy the recommended stress design margins of 3 on yield strength and 5 on ultimate strength, inclusive of dynamic load considerations. In addition, substantial assurances have been provided to demonstrate a high degree of confidence in workmanship quality and structural integrity of these devices.

Regarding continuing compliance, the Licensee indicated that initial 150% load tests were performed and periodic tests or inspections of special lifting devices are performed in a manner consistent with the requirements of ANSI N14.6-1978, Section 5.3.1.

c. Conclusion

Design, fabrication, and continuing compliance programs for special lifting devices at Hatch Units 1 and 2 are consistent with Guideline 4.

2.1.6 Lifting Devices (not specially designed) [Guideline 5, NUREG-0612 Section 5.1.1(5)]

"Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9-1971, [11] 'Slings.' 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

Slings are installed and used at the Hatch plant Units 1 and 2 in accordance with ANSI B30.9-1971. Dynamic loads are compensated for by requiring an additional factor of safety of 2 beyond the safety margin of 5 already a part of the sling, with a resultant factor of safety of 10 for each sling. No slings are restricted in use to certain cranes.

b. Evaluation and Conclusion

Selection and use of slings at Hatch Units 1 and 2 is consistent with Guideline 5 on the basis that use is governed by ANSI B30.9-1971 and suitable provisions have been made to account for dynamic loads.

2.1.7 Cranes (Inspection, Testing, and Maintenance) [Guideline 6, NUREG-0612, Section 5.1.1(6)]

"The crane should be inspected, tested and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' with the exception that tests and inspections should be performed prior to use when it is not practical to meet the frequencies of ANSI B30.2 for periodic inspection and test, or where frequency of crane use is less than the specified inspection and test frequency (e.g., the polar crane inside a PWR containment may only be used every 12 to 18 months during refueling operations and is generally not accessible during power operation. ANSI B30.2, however, calls for certain inspections to be performed daily or monthly. For such cranes having limited usage, the inspections, tests, and maintenance should be performed prior to their use)."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that crane inspection, testing, and maintenance were begun in accordance with the guidelines in Section 5.1.1(6) of NUREG-0612.

b. Evaluation and Conclusion

Crane inspection, testing, and maintenance at Hatch Units 1 and 2 meet the intent of NUREG-0612 based on the Licensee's verification of compliance to Section 5.1.5(6) with no exceptions noted for all overhead and gantry cranes.

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 [12], 'Specifications for Electric Overhead Travelling Cranes.' An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that the Unit 2 turbine building overhead crane was designed in accordance with ANSI B30.2-1976 and CMAA-70, and therefore complies with Guideline 7. For the three remaining reactor and turbine building overhead cranes, design was originally in accordance with EOCI-61, although the Unit 1 reactor building crane satisfies the more restrictive criteria of NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants." For other cranes and hoists subject to compliance with NUREG-0612, the Licensee stated that all were designed to then-current applicable standards; this is considered to meet the intent of this guideline.

For those cranes originally build to EOCI-61, the Licensee has performed a detailed comparison of existing design with the more restrictive criteria of CMAA-70. The findings are contained in the following paragraphs.

1. Impact allowance. CMAA-70, Article 3.3.2.1.1.3, requires that crane design calculations include an impact allowance of 0.5% of the load per foot per minute (fpm) of hoisting speed but not less than 15%. EOCI-61 specifies only a minimum allowance of 15%. Consequently, for cranes with hoist speeds in excess of 30 fpm, it is possible that the impact allowance applied under EOCI-61 will be less than that required by CMAA-70. The subject cranes at the Hatch plant have hoisting speeds from 4 to 28 fpm and therefore satisfy this requirement.

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

3. Bending stress. CMAA-70, Article 3.3.2.2, requires that bending stress calculations include a wind load of 5 pounds per square foot in design stress calculations based on the sum of dead and live loads. EOCI-61 requires that the design of outdoor cranes include a wind load of 10 pounds per square foot of projected area but is not specific concerning the combination of wind loads with other dead and live loads. The subject cranes are installed indoors and therefore are not subject to wind loading.

4. Longitudinal stiffeners. CMAA-70, Article 3.3.3.1, specifies (1) the maximum allowable web depth/thickness (h/t) ratio for box girders using longitudinal stiffeners and (2) requirements concerning the location and minimum moment of inertia for such stiffeners. EOCI-61 allows the use of longitudinal stiffeners but provides no similar guidance. The box girder h/t ratios for the subject cranes range from 279 to 288 and are less than the maximum of 564 specified by CMAA-70. In addition, the location and minimum moments of inertia of the longitudinal stiffeners comply with CMAA-70.

5. Allowable compressive stress. CMAA-70, Article 3.3.3.1.3, identifies allowable compressive stresses to be approximately 50% of yield strength of the recommended structural material (A-36) for girders, where the ratio of the distance between web plates to the thickness of the top cover plate (b/c ratio) is less than or equal to 38. Allowable compressive stresses decrease linearly for b/c ratios in excess of 38. EOCI-61 provides a similar method

for calculating allowable compressive stresses except that the allowable stress decreases from approximately 50% of yield only after the b/c ratio exceeds 41. Consequently, structural members with b/c ratios in the general range of 38 to 52 designed under EOCI-61 will allow a slightly higher compressive stress than those designed under CMAA-70. The b/c ratios for the girder systems of the subject cranes are in the range of 24 to 30.

6. Fatigue considerations. CMAA-70, Article 3.3.3.1.3, provides substantial guidance with respect to fatigue failure by indicating allowable stress ranges for various structural members in joints under repeated loads. EOCI-61 does not address fatigue failure. The requirements of CMAA-70 are not of consequence for the subject cranes because they are not used for frequent lifts at or near design conditions. These cranes are categorized as standby because their use is only intermittently required and the number of lifts required over life is not expected to exceed 5,000 per crane. Furthermore, the majority of the lifts will involve loads that are below the allowable values specified in CMAA-70 and cranes are not subject to stress reversal. It is concluded that the lack of fatigue considerations in EOCI-61 does not constitute a significant discrepancy for the cranes being evaluated.

7. Hoist rope requirements. CMAA-70, Article 4.2.1, requires that the capacity load plus the bottom block divided by the number of parts of rope not exceed 20% of the published rope breaking strength. EOCI-61 requires that the rated capacity load divided by the number of parts of rope not exceed 20% of the published rope breaking strength. The capacity load plus the weight of the bottom block divided by the number of parts of rope is 10% of the manufacturer's published breaking strength for the reactor building hoist rope and 19.9% for the turbine building crane hoist rope; therefore, the subject cranes comply with CMAA-70.

8. Drum design crushing and bending loads. CMAA-70, Article 4.4.1, requires that the drum be designed to withstand combined crushing and bending loads. EOCI-61 requires only that the drum be designed to withstand maximum load bending and crushing loads with no stipulation that these loads be combined. The combination of crushing and bending loads for the subject

cranes could not be verified due to lack of information. However, this variation is not expected to be of consequence since the requirements of CMAA-70 represent the codification of good engineering practice that has been incorporated in the containment building and turbine building cranes built to EOCI-61 specifications although a specific requirement was not contained in EOCI-61.

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

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

11. Bridge brake design. CMAA-70, Article 4.7.2.2, requires that bridge brakes, for cranes with cab control and the cab on the trolley, be rated at least 75% of bridge motor torque. EOCI-61 requires a brake rating of 50% of bridge motor torque for similar configurations. A cab-on-trolley control arrangement is not used for the subject cranes and the bridge brake on each crane is rated at 150% of motor torque.

12. Hoist brake design. CMAA-70, Article 4.7.4.2, requires that hoist holding brakes, when used with a method of control braking other than mechanical, have torque ratings no less than 125% of the hoist motor torque. EOCI-61 requires a hoist holding brake torque rating of no less than 100% of the hoist motor torque without regard to the type of control brake employed.

The hoist holding brakes of the subject cranes have torque ratings of at least 150% of the respective hoist motor torque.

13. Bumpers and stops. CMAA-70, Article 4.12, provides substantial guidance for the design and installation of bridge and trolley bumpers and stops for cranes which operate near the ends of bridge and trolley travel. No similar guidance is provided in EOCI-61. The subject cranes are equipped with bridge bumpers and railway stops. Although existing documentation does not provide a complete evaluation of these devices to CMAA-70 guidelines, sufficient details exist to determine that the designs meet the intent of CMAA-70. This is not considered a significant discrepancy because the crane is not operated under load at substantial bridge or trolley speed near the end of travel.

14. Static control systems. CMAA-70, Article 5.4.6, provides substantial guidance for the use of static control systems. EOCI-61 provides guidance for magnetic control systems only. Static and magnetic control systems installed on subject cranes are in compliance with CMAA-70 criteria.

15. Restart protection. CMAA-70, Article 5.6.2, requires that cranes not equipped with spring-return controllers or momentary-contact push buttons be provided with a device that will disconnect all motors upon power failure and will not permit any motor to be restarted until the controller handle is brought to the OFF position. No similar guidance is provided in EOCI-61. Control arrangements for subject cranes are in compliance with CMAA-70.

For those items for which no design documentation could be found (drum design, drum groove pitch and depth, and gear design), the Licensee provided the following additional information related to quality of the design of the components in question.

- The cranes in question, including drums and drum gear boxes, were manufactured by P&H Harnischfeger which, as a manufacturer, was closely involved in the development of CMAA-70.
- Comparison of existing EOCI-61 crane design with CMAA-70 demonstrated that all other components evaluated were of an equal or greater quality level than required by CMAA-70. Further, the CMAA-70 requirements for drum and gear box design were merely a codification

of good engineering and industrial practices in place at the time the Hatch cranes were manufactured.

- Based upon the length of service (9-10 years), there is strong assurance that the cranes were designed and manufactured to meet required service conditions.

Based upon the previous evaluations and arguments, it is the Licensee's opinion that the reactor building cranes and the Unit 1 turbine building crane comply with the intent of CMAA-70 and provide adequate safety and reliability.

b. Evaluation

Design of the Hatch Unit 2 turbine building overhead crane is satisfactory because it was designed to CMAA-70 and ANSI B30.2-1976 specifications. Similarly, design of the Unit 1 reactor building crane is satisfactory based upon the previous NRC review that determined that this crane met the criteria of NUREG-0554. Structural and mechanical design criteria of NUREG-0554 adequately satisfy the provisions specified in CMAA-70. For other handling systems identified by the Licensee for which EOCI-61 or CMAA-70 are not applicable, design to applicable standards is an acceptable alternative.

For the Unit 1 turbine building overhead crane and the Unit 2 reactor building crane, design of these cranes complies, to a large degree, because their original design was based on EOCI-61. The additional comparison of original design with the more restrictive criteria of CMAA-70 adequately demonstrates, with limited exceptions, that the original design also satisfies these more restrictive design requirements. For those exceptions noted, reasonable assurances have been provided (i.e., hoist manufactured by an major established crane manufacturer) that demonstrate the design adequacy and continuing reliability and safety of these handling systems.

c. Conclusion

Design of cranes and handling systems at Hatch Units 1 and 2 was performed in a manner consistent with the criteria of Guideline 7.

2.2 INTERIM PROTECTION MEASURES

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

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

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

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

"Licenses for all operating reactors not having a single-failure-proof overhead crane in the fuel storage pool area should be revised to include a specification comparable to Standard Technical Specification 3.9.7, 'Crane Travel - Spent Fuel Storage Building,' for PWR's and Standard Technical Specification 3.9.6.2, 'Crane Travel,' for BWR's, to prohibit handling of heavy loads over fuel in the storage pool until implementation of measures which satisfy the guidelines of Section 5.1 [of NUREG-0612]."

a. Evaluation

Although the Licensee has not addressed this issue specifically, a review of the Hatch Technical Specifications indicates that Section 3/4.9.8 (Crane Travel - Spent Fuel Storage Pool) prohibits the handling of loads in excess of the nominal weight of a fuel assembly over fuel in the storage pool.

b. Conclusion

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

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

a. Summary of Licensee Statements and Conclusions

Specifically, the applicable procedures contain sufficient detail, with clear and concise instructions; the required inspections and replacements have

been performed; and operators are trained and are familiar with the applicable procedures.

b. Evaluation and Conclusion

Information has been provided to indicate that adequate measures have been taken to satisfy the provisions 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 Georgia Power Company's E. I. Hatch Nuclear Plant Units 1 and 2. Overall conclusions and recommended Licensee actions, where appropriate, are provided with respect to both general provisions for load handling (NUREG-0612, Section 5.1.1) and completion of the staff recommendations for interim protection (NUREG-0612, Section 5.3).

3.1 GENERAL PROVISIONS FOR LOAD HANDLING

The NRC staff has established seven guidelines concerning provisions for handling heavy loads in the area of the reactor vessel, near stored spent fuel, or in other areas where an accidental load drop could damage equipment required for safe shutdown or decay heat removal. The intent of these guidelines is twofold. A plant conforming to these guidelines will have developed and implemented, through procedures and operator training, safe load travel paths such that, to the maximum extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment. A plant conforming to these guidelines will also have provided sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system. As detailed in Section 2, it has been found that load handling operations at Hatch 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.

3.2 INTERIM PROTECTION MEASURES

The NRC staff has stated in NUREG-0612, Section 5.3 that certain measures should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until implementation of the general guidelines of NUREG-0612, Section 5.1 is complete. Specified measures include the implementation of a technical specification to prohibit the handling of

heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement as necessary of cranes, slings, and special lifting devices, to eliminate deficiencies that could lead to component failure. The evaluation of information provided by the Licensee ensures that the staff's measures for interim protection at Hatch Units 1 and 2 have been satisfied.

4. REFERENCES

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

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

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

4. J. T. Beckham (GPC)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   June 29, 1981

5. J. T. Beckham (GPC)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   May 24, 1982

6. J. T. Beckham (GPC)
   Letter to D. G. Eisenhut (NRC)
   Subject: Control of Heavy Loads
   July 29, 1983

7. J. T. Beckham (GPC)
   Letter to J. F. Stolz (NRC)
   Subject: Control of Heavy Loads
   January 23, 1984

8. L. T. Gucwa (GPC)
   Letter to J. F. Stolz (NRC)
   Subject: Control of Heavy Loads
   March 12, 1984

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

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

11. ANSI B30.9-1971
"Slings"

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

13. Auxiliary and Power Conversion Systems Branch Review and Evaluation of the Hatch Unit 1 Modified Spent Fuel Cask Overhead Handling System