ENCLOSURE 2

TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS

ALABAMA POWER COMPANY

JOSEPH M. FARLEY 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 Alabama Power Company's Joseph M. Farley Nuclear Plant Units 1 and 2. This evaluation was performed with the following objectives:

- o to assess conformance to the general load handling guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" [1], Section 5.1.1
- o to assess conformance to the interim protection measures of NUREG-0612, Section 5.3.

1.2 GENERIC BACKGROUND

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to assure the safe handling of heavy loads and to recommend necessary changes to 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-phase 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

determination of conformance to these guidelines. On May 15, 1981, Alabama Power Company provided the initial response [4] to this request. Additional information was provided by the Licensee on June 24, 1981 [5]; September 22, 1981 [6]; March 15, 1982 [7]; June 1, 1982 [8]; May 15, 1984 [9]; and June 18, 1984 [10]. References 4 through 7 have been incorporated into this technical evaluation.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at Farley Nuclear Plant with respect to NRC staff guidelines provided in NUREG-0612. Separate subsections are provided for both the general guidelines of NUREG-0612, Section 5.1.1 and the interim measures of NUREG-0612, Section 5.3. In each case, the guideline or interim measure is presented, Licensee-provided information is summarized and evaluated, and a conclusion as to the extent of compliance, including recommended additional action where appropriate, is presented. These conclusions are summarized in Table 2.1.

2.1 GENERAL GUIDELINES

The NRC has established seven general guidelines which must be met in order to provide the defense-in-depth approach for the handling of heavy loads. These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

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

These seven guidelines should be satisfied for all overhead handling systems 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 FRC's evaluation of this verification are contained in the succeeding paragraphs.

Table 2.1. Farley 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 1 Technical Specifications	Interim Measure 6 Special Attention
1. Containment Polar Cranes	140	--	--	C	--	--	R	C	--	--
Reactor Vessel Head	59.1	C	R	--	R	--	--	--	--	C
Upper Internals (Plenum)	55	C	R	--	R	--	--	--	--	C
Inservice Inspection Tools	5	C	R	--	R	C	--	--	--	C
Missile Shields	70	C	R	--	--	C	--	--	--	C
Reactor Coolant Pumps	38.7	C	R	--	--	C	--	--	--	C
Crane Load Block	4.5	C	R	--	--	C	--	--	--	C
2. Demineralizer Hatch Monorail Hoist	--	--	--	C	--	--	C	C	--	--
Demineralizer Hatch	9.1	R	R	--	--	C	--	--	--	--
3. Spent Fuel Pool Bridge Crane	2.0	--	--	C	--	--	C	C	R	--
Transfer Slot Gate	1.5	R	R	--	--	C	--	--	R	--

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

2.1.1 Heavy Load Overhead Handling Systems

a. Summary of Licensee Statements and Conclusions

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

- o containment polar crane
- o demineralizer hatch monorail hoist
- o spent fuel pool bridge crane.

The Licensee also identified numerous other cranes that have been excluded from satisfying the criteria of the general guidelines of NUREG-0612. These handling systems include the following:

1. drumming station bridge crane
2. auxiliary building equipment hatch monorail hoist
3. decontamination room monorail hoist
4. blowdown drum storage area bridge crane
5. diesel generator building hoists
6. external portable maintenance cranes
7. new fuel monorail hoist
8. new fuel bridge crane
9. spent fuel cask crane
10. tendon surveillance area hoists
11. various maintenance mo. rail hoists.

For cranes 1 through 4 above, the Licensee stated that no safety-related equipment is located at any evaluation beneath these cranes and, therefore, these cranes need not comply with NUREG-0612 guidelines.

For the diesel generator building hoists, the Licensee stated that these hoists are used solely for maintenance performed on the non-standby diesel. In addition, the diesels are physically separated by concrete walls, precluding damage to the adjacent diesel generator.

External portable maintenance cranes have been excluded from satisfying NUREG-0612 on the basis that loads drops from these cranes onto the river water

or service water intake structures or the outside buried service water piping would not preclude safe shutdown.

For the remaining handling systems, the Licensee stated that sufficient physical separation exists between load impact points and safety-related components so that a load drop would be of no consequence to safe shutdown.

b. Evaluation and Conclusion

The Licensee's determination of those handling systems subject to compliance with the guidelines of NUREG-0612, as well as those excluded from further consideration, is 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

Safe load paths for heavy loads inside containment have been developed and incorporated into appropriate plant procedures. In the auxiliary building, only the demineralizer hatch monorail hoist is capable of carrying a heavy load over safe shutdown equipment (a demineralizer hatch cover over the boric acid transfer system). However, safe load paths are not considered necessary in this instance since the load pathway is restricted by the monorail track and safe shutdown functions will not be lost. For the spent fuel bridge crane, the only heavy load handled is the spent fuel pool transfer slot gate (1.5 tons). Movement of this heavy load is directed by use of administrative controls, which prevent movement of the transfer slot gate into a position where it may cause damage to spent fuel.

Safe load paths inside containment are clearly marked on drawings contained in the procedures. In lieu of permanent floor markings, these procedures will be modified to require the use of a signalman to direct movements of the polar crane.

Deviations from safe load paths are reviewed and approved as required by plant technical specifications.

b. Evaluation

Development of safe load paths in the containment and as defined by procedures over the spent pool area are consistent with NUREG-0612. Further, it is agreed that due to the restricted movements of the demineralizer hatch monorail in the auxiliary building, safe load paths are not deemed necessary for this hoist.

Use of a signalman in lieu of permanent floor markings is also consistent with Guideline 1 by providing the crane operator with suitable visual aids to ensure that load paths are followed. Deviations from load paths are also processed in a manner consistent with that required for all formally approved procedures.

c. Conclusion

Development of safe load paths at Farley Units 1 and 2 meets the intent of Guideline 1.

2.1.3 Load Handling Procedures [Guideline 2, NUREG-0612, Section 5.1.1(2)]

"Procedures should be developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. At a minimum, procedures should cover handling of those loads listed in Table 3-1 of NUREG-0612. These procedures should include: identification of required equipment; inspections and acceptance criteria required before movement of load; the steps and proper sequence to be followed in handling the load; defining the safe path; and other special precautions."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that procedures have been developed to cover load handling operations for those loads listed in Table 3-1 of NUREG-0612. These procedures meet the requirements of this guideline.

b. Evaluation and Conclusion

Load handling procedures being developed at the Farley Nuclear Plant satisfy the criteria of 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' [11]."

a. Summary of Licensee Statements and Conclusions

The requirements of ANSI B30.2-1976, Chapter 2-3 have been incorporated into the crane operator training, qualification, and conduct procedures.

b. Evaluation and Conclusion

Programs for crane operator training and qualification satisfy the criteria of Guideline 3.

2.1.5 Special Lifting Devices [Guideline 4, NUREG-0612, Section 5.1.1(4)]

"Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, 'Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials' [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."

3. Summary of Licensee Statements and Conclusions

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

- o reactor vessel head lifting device
- o core upper internals lifting device.

A design review was performed which determined that both lifting devices were designed with safety factors of 5 for lifting loads under dynamic conditions. The Licensee stated that this factor provides confidence that the heavy load will not be dropped on the core.

Following design and fabrication, a 125% load test was performed for each of the Unit 2 reactor vessel head and internals lifting devices. The devices were then visually inspected and found free of faults or distortion, and critical weld areas were nondestructively examined (NDE) with satisfactory results. Although special lifting devices for Unit 1 were not load tested at the time of fabrication, the Unit 1 reactor vessel head and upper internal lifting devices have been load tested to 113% and 213% of rated load, respectively. Proof of workmanship for Unit 1 devices is also provided based on welding which was performed in accordance with ASME Section XI, followed by appropriate NDE, dimensional tolerances, materials and heat treatment records, and radiography and ultrasonic test results which were also reviewed and verified to be in accordance with design specifications.

To establish continuing reliability of these devices, the Licensee made a commitment to implement a program in which critical load bearing welds of these devices are nondestructively examined on a systematic basis consistent with the Inservice Inspection Program (i.e., all welds examined over a 10-year period).

b. Evaluation

Although not built in strict compliance with the criteria of ANSI N14.6-1978, it is apparent that the special lifting devices in use at Farley Units 1 and 2 were designed, fabricated, and will be maintained in a manner

consistent with the ANSI recommendations. Information has been provided which demonstrates that design margins consistent with ANSI N14.6-1978 have been employed in the design of these devices. Adequate proof of workmanship has also been provided (through documented load tests and identification of fabrication records) to demonstrate that the fabricated devices are in accordance with the original design. Lastly, programs which the Licensee has made a commitment to implement will meet the intent of periodic inspections required by ANSI N14.6-1978, Section 5.3.1. Relaxation of the annual ANSI inspection periodicity is also justifiable based upon the sole use, limited frequency of lifts, and controlled storage environment of these devices.

c. Conclusion

Design and fabrication of special lifting devices at Farley Units 1 and 2, as well as programs that provide continued reliability of these devices, meet the intent of Guideline 4.

2.1.6 Lifting Devices (Not Specially Designed) [Guideline 4, 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

Slings used for rigging loads are installed and used per ANSI B30.9-1971. It is the Licensee's opinion that specific consideration of dynamic effects of loads is included in the sling's design safety factors and that further consideration is not necessary. It is noted, however, that actual dynamic conditions experienced by these slings are not expected to be of consequence due to the relatively slow speeds of the cranes of concern

(polar crane, 5 fpm; spent fuel bridge crane, 7 fpm). Therefore, no slings are marked for use on specific cranes.

b. Evaluation and Conclusions

Lifting devices (slings) in use at Farley Units 1 and 2 satisfy the requirements of Guideline 5 on the basis that they are used in accordance with ANSI B30.9-1971. Impact loads may be disregarded due to the relatively slow speeds of applicable cranes.

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

Crane inspection, testing, and maintenance requirements has been revised to incorporate the requirements of Chapter 2-2 of ANSI B30.2-1976, except for certain test frequencies which cannot be met due to inaccessibility as noted in NUREG-0612.

b. Evaluation and Conclusion

Alabama Power Company's crane inspection, testing, and maintenance program satisfies the criteria of 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

Crane design complies with the guidelines of CMAA-70 and Chapter 2-1 of ANSI B30.2-1976.

b. Evaluation and Conclusion

The Farley Nuclear Plant satisfies the criteria of Guideline 7 on the basis of the Licensee's verification that the cranes meet the criteria of CMAA-70 and ANSI B30.2-1976.

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

Farley Technical Specification 3.9.7.1 allows the movement of loads up to 3000 lb over fuel assemblies in the storage pool. The Licensee stated that this load limit is based on the weight of the spent fuel transfer slot gate and is slightly greater than the combined weight of a fuel assembly and grippers (approximately 2500 lb per FSAR 9.1.4.3.1). At the beginning of fuel transfer operations, the transfer slot gate is moved from its normal position directly to its storage position which is located immediately adjacent to its normal position. This operation does not move the transfer slot gate into a position where it could damage spent fuel.

b. Evaluation

Review of the technical specifications implemented by the Licensee indicates that they are consistent with the intent of Interim Measure 1 because, with one exception, heavy loads are prohibited from movement over spent fuel assemblies. For the execption noted (the spent fuel transfer slot gate), suitable administrative restrictions have been implemented to ensure that this load will not be carried over spent fuel.

c. Conclusion

Technical specifications and procedures implemented at Farley Units 1 and 2 satisfy the intent of 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. respectively.

b. Evaluation and Conclusion

Evaluations and conclusions are contained in discussions of the respective general guidelines in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7.

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

Plant procedures will be reviewed as part of the update required by General Guidelines 1, 2, and 6. Visual inspections are routinely performed at the Farley Nuclear Plant prior to all lifts. Defective components are

routinely repaired or replaced as appropriate. Crane operators will be trained accordingto the basic requirements of ANSI B30.2-1976 and plant procedures.

b. Evaluation and Conclusion

Information provided by the Licensee, coupled with programs and procedures which satisfy the General Guidelines (1-7) of NUREG-0612, demonstrates that Interim Protection Measure 6 is satisfied.

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 Farley Nuclear Plant. Overall conclusions and recommended Licensee actions, where appropriate, are provided with respect to both general provisions for load handling (NUREG-0612, Section 5.1.5) and completion of the staff recommendations for interim protection (NUREG-0612, Section 5.3).

3.1 GENERAL PROVISIONS FOR LOAD HANDLING

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

3.2 INTERIM PROTECTION MEASURES

The NRC staff has established (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 unitl 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 Guidelnes 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 protection at Farley Nuclear Plant.

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