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TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR POWER STATION UNITS 1, 2, AND 3

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FOREWORD

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

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1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load-handling policy and procedures at Tennessee Valley Authority's Browns Ferry Nuclear Station Units 1, 2, and 3. 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 Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of [illegible]s in effect at operating nuclear power plants to ensure the safe handling of heavy loads, and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

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

In order to upgrade measures provided to control the handling 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 part 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 part 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.

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense-in-depth, and the intent of the guidelines is to ensure that licensees of all operating nuclear power plants perform the following:

1. provide sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system

2. 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

3. provide mechanical stops or electrical interlocks to prevent movement of heavy loads over irradiated fuel or in proximity to equipment associated with redundant shutdown paths.

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 Tennessee Valley Authority (TVA), the Licensee for Browns Ferry Nuclear Plant Units 1, 2, and 3, requesting that the Licensee review provisions for handling and control of

heavy loads at Browns Ferry Units 1, 2, and 3, evaluate these provisions with respect to the guidelines of NUREG-0612, and provide certain additional information to be used for an independent determination of conformance to these guidelines. On June 3, 1982, TVA provided a response [4] to this request.

2. EVALUATION AND RECOMMENDATIONS

The evaluation of load handling at Browns Ferry Units 1, 2, and 3 is divided into two categories. These categories deal separately with the general guidelines of Section 5.1.1 and the recommended interim measures of Section 5.3 of NUREG-0612. Applicable guidelines are referenced in each category. Conclusions and recommendations are provided in the summary for each guideline.

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:

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

These seven guidelines should be satisfied by all overhead load handling systems and procedures used to handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems. The Licensee's statements and conclusions relative to the extent to which these guidelines have been satisfied and the evaluation of this and other information are contained in Sections 2.1.1 through 2.1.8 of this report.

2.1.1 Overhead Heavy Load Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee's review of overhead load handling systems has identified the following handling systems to be subject to the criteria of NUREG-0612:

- o reactor building crane (Units 1, 2, and 3)
- o two operator, self-propelled, full revolving, truck-type, rubber-tired diesel-powered truck crane (yard)
- o 4-ton, hook-type, manual chain hoist (Units 1, 2, and 3).

The Licensee has also provided an extensive list of more than 100 overhead load handling systems which have been excluded on the basis that a load drop would not result in damage to any system required for plant shutdown or decay heat removal for one of the following reasons:

1. There is sufficient physical separation of the overhead handling system from any system or component required for safe shutdown or decay heat removal.
2. The system or component over which the load is carried is out of service while the load handling system is used.
3. The load weighs less than 1,000 lb and is not considered to be a heavy load. This weight is a conservative estimate of a fuel assembly and its handling device.

b. Evaluation

Based on a review of the information provided, two exceptions are taken with the load handling systems which the Licensee has excluded from compliance with the general guidelines of NUREG-0612:

1. 3-ton jib crane (#27) - Although this load handling system has been excluded because the loads carried weigh less than 1000 lb, the crane has the capacity to carry loads greater than this weight over the Class IE equipment within its area of coverage.
2. 7.5-ton electric wire rope hoist (#48) - This load handling system has been excluded on the basis of physical separation from any system or components required for safe shutdown or decay heat removal. However, drawings 47W200-6 and 47W200-13 indicate that an 18-inch SECW header is within the hoist's area of coverage.

c. Conclusion and Recommendation

The Licensee should reevaluate the 3-ton jib crane (#27) and the 7.5-ton wire rope hoist (#48) for inclusion under the general guidelines 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 Conclusion

The Licensee has stated that safe load paths for the reactor building crane are contained in Browns Ferry Mechanical Maintenance Instruction (MMI) 119.

Safe load paths for the truck crane are shown in Browns Ferry drawings 37W300-1, 47W220-1, and 47W220-2.

The 4-ton manual chain hoist (47B/C) is used over hatches to remove various equipment from lower floors to the elev. 565 floor as shown on Browns Ferry drawing 44N330. When operating over the hatches shown on Browns Ferry drawings 47W220-6, -7, -13, and -14 during unit operation, the hoist must not lift heavy loads over the core spray pumps and piping.

b. Evaluation

Drawings indicate that the Licensee has indicated safe load paths for the reactor building crane, and safe load areas for the 24-ton truck crane and the various hoists. This action is consistent with NUREG-0612. However, although safe load paths and areas are identified on equipment layout drawings, the Licensee has not addressed the use of visual aids for operators and load handling supervisors.

Visual aids should be provided to crane operators and their supervisors as a means to monitor the proper execution of load handling evolutions and to clearly identify those areas where the movement of heavy loads will occur. Load path visual aids will alert personnel not involved in load handling to keep these pathways clear of non-related equipment in order to avoid interference when load handling is in progress.

In addition, insufficient information has been provided to evaluate the method of handling safe load path deviations. Deviations from safe load paths should require written alternative procedures approved by the plant safety review committee.

c. Conclusion and Recommendations

Browns Ferry Units 1, 2, and 3 partially comply with Guideline 1 of NUREG-0612. In order to fully comply, the Licensee should perform the following:

1. Verify that visual aids identifying safe load paths/areas are provided for operators and supervisors.

2. Verify that deviations from safe load paths/areas are approved with written alternative procedures by the plant safety review committee.

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 load path; and other special precautions."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that handling procedures for the reactor building crane are contained in MMI-119. Handling procedures for the truck crane will be developed and implemented to meet the requirements of the interim

guidelines delineated in NUREG-0612. Administrative controls for the 4-ton manual chain hoist will be invoked to ensure that safe handling operations are maintained over these hatches during unit operation.

b. Evaluation

MMI-119 provides procedural controls consistent with NUREG-0612 for the movement of heavy loads on the refueling floor by the reactor building crane. Further, the reactor building crane (5-ton and 125-ton hooks) is the only handling device approved for lifts greater than 1000 lb on the refueling floor in a critical lifting zone (CLZ). The CLZs are defined in this instruction as the following areas:

1. The region, defined as the spent fuel pool, within 15 ft of the spent fuel pools when spent fuel is in the pools

2. The region, defined as the reactor well CLZ, within 15 ft of the reactor well when at least one of the lower horizontal reactor well shield blocks has been removed.

Figure 1 of MMI-119 designates the safe load paths for heavy loads specified in Table 1 (Reactor Well CLZ Lifts) and Table 2 (Fuel Pool CLZ Lifts).

Tables 1 and 2 further specify approved lift number, lifting devices to be used, load handling system (5-ton or 125-ton hook), load weight, and special restrictions. In addition, Data Sheet A provides a checklist for critical lifting zone lifts. Supporting procedures for crane inspection, operator training, and lifting device inspection requirements are referenced in MMI-119.

Insufficient information has been provided by the Licensee to determine that administrative controls consistent with Section 5.1.1(2) of NUREG-0612 have been implemented for the loads handled by the truck crane and the 4-ton manual chain hoist.

c. Conclusion and Recommendation

Browns Ferry Units 1, 2, and 3 substantially comply with Guideline 2 of NUREG-0612. In order to fully comply, the Licensee should provide additional

information describing the administrative controls for load handling by the truck crane and 4-ton manual chain hoist.

2.1.4 Crane Operator Training [Guideline 3, NUREG-0612, Section 5.1.1(3)]

"Crane operators should be trained, qualified, and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976, 'Overhead and Gantry Cranes' [7]."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that qualification requirements for reactor building crane operators are in Browns Ferry Standard Practice BF 4.3, "Crane Operator Qualification and Authorization," which implements the requirements of ANSI B30.2-1976.

Operators for the truck crane are journeyman operators from the International Unit of Operating Engineers, Local 320.

Qualification of operators of hand-powered chain hoists is not required.

b. Evaluation

Crane operator training, qualification, and conduct described in BF 4.3 is consistent with the intent of Section 5.1.1(3) of NUREG-0612. Further, although operator training outlined in ANSI B30.2-1976 is not required for such handling systems as the truck crane and the 4-ton manual chain hoist, the Licensee should ensure that indoctrination and training covering Browns Ferry administrative controls for these load handling systems is in effect.

c. Conclusion and Recommendation

Browns Ferry Units 1, 2, and 3 comply 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 [6], 'Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 pounds (4500 kg) or More for Nuclear Materials.' 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 (stactic load) of the load and of the intervening components of the special handling device."

a. Summary of Licensee Statements and Conclusions

The Licensee states that all nuclear steam supply system special lifting devices, such as the drywell/reactor vessel head strongback and steam dryer and moisture separator lifting devices, were supplied by General Electric Corporation and specified in terms of performance data rather than design criteria. The Licensee is currently negotiating with the vendor to obtain the design information.

Special lifting devices used with the reactor building crane that were designed by the Nuclear Engineering Branch, Division of Engineering Design (EN DES) were analyzed using the guidelines of ANSI N14.6-1978 and ANSI B30.9-1979 and supplemented by Sections 5.1.1(5) of NUREG-0612. Included in this analysis is a statement of fracture toughness criteria used for evaluating the Browns Ferry fuel cask redundant link.

b. Evaluation

An evaluation with regard to the special lifting devices supplied by General Electric Corporation must be deferred until Licensee information has been forwarded to the NRC for review.

An independent evaluation has been performed to determine relevant items in ANSI N14.6-1978 and is forwarded to assist the Licensee in evaluating special lifting devices.

It is acknowledged that a strict interpretation of compliance of existing special lifting devices with the criteria of ANSI N14.6-1978 cannot be made. Therefore, to address only those sections which are directly related to load

handling reliability of the lifting devices is acceptable. The following sections are not pertinent to, nor do they contain requirements which affect, load handling reliability: Scope (Section 1), Definitions (Section 2), Design Considerations to Minimize Decontamination Efforts (Section 3.4), Coatings (Section 3.5), Lubrication (Section 3.6), Inspector's Responsibilities (Section 4.2), and Fabrication Considerations (Section 4.3). In addition, Section 6 (Special Lifting Devices for Critical Loads) need not be included in this review since none of the loads identified by the Licensee has been determined to be a "critical load" at present.

Evaluation and review of ANSI N14.6-1978 has identified several areas where load handling reliability is an issue. Certain sections (3.1, Designer's Responsibilities; 3.2, Design Criteria; 3.3, Design Considerations; 4.1, Fabricator's Responsibilities; and 5.0, Acceptance Testing, Maintenance, and Assurance of Continued Compliance) identify important information which should be readily available or requirements to which the Licensee should adhere in order to adequately substantiate the load handling reliability of the special lifting devices. Although this standard may not have existed when lifting devices were designed and manufactured, it is not anticipated that procurement of information or compliance with the standard's criteria will create undue hardship since the criteria of the standard are commensurate with established industry practices and this standard codifies such practices for special lifting devices. Further, these special lifting devices are used for infrequent lifts of the plant's largest components, generally in the direct vicinity of irradiated fuel, which makes the reliability of design, fabrication, and continued testing of the special lifting devices a relatively sensitive concern.

It has been determined that compliance with Guideline 4 requires that the following specific sections of ANSI N14.6-1978 be addressed:

Section 3.1:

a. limitations on the use of the lifting devices (3.1.1)
b. identification of critical components and definition of critical characteristics (3.1.2)

c. signed stress analyses which demonstrate appropriate margins of safety (3.1.3)
d. indication of permissible repair procedures (3.1.4)

Section 3.2:

a. use of stress design factors of 3 for minimum yield strength and 5 for ultimate strength (3.2.1)
b. similar stress design factors for load bearing pins, links, and adapters (3.2.4)
c. slings used comply with ANSI B30.9-1971 (3.2.5)
d. subjecting materials to dead weight testing or Charpy impact testing (3.2.6)

Section 3.3:

a. consideration of problems related to possible lamellar tearing (3.3.1)
b. design shall assure even distribution of the load (3.3.4)
c. retainers fitted for load carrying components which may become inadvertently disengaged (3.3.5)
d. verification that remote actuating mechanisms securely engage or disengage (3.3.6)

Section 4.1:

a. verify selection and use of material (4.1.3)
b. compliance with fabrication practice (4.1.4)
c. qualification of welders, procedures, and operators (4.1.5)
d. provisions for a quality assurance program (4.1.6)
e. provisions for identification and certification of equipment (4.1.7)
f. verification that materials or services are produced under appropriate controls and qualifications (4.1.9).

Section 5.1:

a. implementation of a periodic testing schedule and a system to indicate the date of expiration (5.1.3)
b. provisions for establishing operating procedures (5.1.4)
c. identification of subassemblies which may be exchanged (5.1.5)
d. suitable markings (5.1.6)
e. maintaining a full record of history (5.1.7)
f. conditions for removal from service (5.1.8)

Section 5.2:

a. load test to 150% and appropriate inspections prior to initial use (5.2.1)
b. qualification of replacement parts (5.2.2)

Section 5.3:

a. satisfying annual load test or inspection requirements (5.3.1)

b. testing following major maintenance (5.3.2)
c. testing after application of substantial stresses (5.3.4)
d. inspections by operating (5.3.6) and non-operating or maintenance personnel (5.3.7).

In addition to special lifting devices supplied by General Electric, several Licensee-designed special lifting devices have been identified:

- o fuel cask rotator
- o fuel cask redundant link assembly
- o core spray pump handling slings
- o refueling canal shield sling
- o fuel pool gate shield sling
- o miscellaneous handling slings.

Data provided by the Licensee indicates that stress design factors and acceptance testing for the fuel cask rotator are consistent with ANSI N14.6-1978. However, the Licensee should provide a more detailed review of the fuel cask rotator and the other EN DES specially designed lifting devices consistent with the criteria outlined above so that an adequate evaluation can be performed. In addition, the Licensee should review the sling design data because many of the slings have safety factors of less than 5 and proof tests of less than 200%, which are not consistent with the requirements of ANSI B30.9-1971, Section 9.2.

c. Conclusion and Recommendation

A determination of compliance with this guideline must be deferred until the Licensee completes the review of special lifting devices at Browns Ferry Units 1, 2, and 3.

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 guideline of ANSI B30.9-1971, 'Slings' [7]. 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 states that all slings used with load handling systems subject to NUREG-0612 criteria are inspected and tested in accordance with Browns Ferry MMI-102 (Rigging Equipment Program) which implements the requirements of ANSI B30.9-1971.

b. Evaluation

Browns Ferry Units 1, 2, and 3 satisfy the requirements of this guideline to a large degree on the basis that current procedures implement the requirements of ANSI B30.9-1971. Review of these procedures, however, indicates that selection and marking of slings are not based upon the maximum static and dynamic loads which may be experienced by the particular sling. To fully satisfy this guideline, the Licensee should (1) select and mark slings on the basis of the maximum static and dynamic loads or (2) demonstrate that dynamic loads that are generated for the crane speeds in question constitute a reasonably small percentage when compared with static loads.

c. Conclusion and Recommendation

Browns Ferry Units 1, 2, and 3 comply with this guideline to a substantial degree on the basis that current procedures implement the guidelines of ANSI B30.9-1971. To fully comply, the Licensee should implement the following guideline criteria or provide suitable justification for exclusion:

- Verify that slings are selected and marked with rated loads based on the maximum static and 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 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, tests, and maintenance should performed prior to their use.)"

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that inspection, testing, and maintenance requirements for the reactor building crane are contained in Browns Ferry MMI-117, which implements the requirements of ANSI B30.2-1976.

ANSI B30.2-1976 is not applicable for inspection, testing, and maintenance of the truck crane. These requirements are imposed by ANSI B30.5-1968 (Crawler, Locomotive, and Truck Cranes), and implemented in Browns Ferry MMI-130. Periodic inspections are performed by the TVA Power Services shop crane inspection team in accordance with the requirements in MMI-130.

Inspection and test requirements for the 4-ton manual chain hoist are contained in Browns Ferry MMI-102 which complies with ANSI B30.16-1973 (Overhead Hoists, Underhung).

b. Evaluation

Crane inspection, testing, and maintenance at Browns Ferry Units 1, 2, and 3 are consistent with the guidance in NUREG-0612 in that MMI-117 is based on ANSI B30.2-1976. The Licensee has noted that MMI-117 requires further revision. In addition to the outstanding items noted by the Licensee, the following areas of concern should be addressed:

1. Planned maintenance program requirements should include performance periodicity.

2. Inspection, testing, and maintenance data cover sheets should include a check point for the completion of electrical checks.

   Rope reeving checks should be included as a frequent inspection item.

In addition, the use of ANSI B30.5 and ANSI B30.16 inspection, testing, and maintenance requirements for the yard crane and the 4-ton manual chain hoist meets the intent of NUREG-0612.

c. Conclusion and Recommendation

Browns Ferry Units 1, 2, and 3 comply with Guideline 6 of NUREG-0612. However, the Licensee should ensure that the areas of concern noted above are addressed in MMI-117 and are made available for NRC review.

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 Overnead Traveling Cranes'[8]. An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that a review of the reactor building crane design indicates that the crane meets the requirements of CMAA-70 (1975) and ANSI B30.2.

The truck crane was not analyzed in accordance with CMAA-70 and ANSI B30.2 because these standards address the design of multiple girder, overhead, and gantry cranes. Purchase specifications of this crane required that all applicable parts of ANSI B30.5-1976 be met.

b. Evaluation

Crane design for the Browns Ferry reactor building crane and the yard truck crane meets the intent of NUREG-0612 based on compliance to CMAA-70/ANSI B30.2 and ANSI B30.5, respectively.

c. Conclusion

Browns Ferry Units 1, 2, and 3 comply with Guideline 7 of NUREG-0612.

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 are Guideline 1, Safe Load Paths; Guideline 2, Load Handling Procedures; Guideline 3, Crane Operator Training; and Guideline 6, Cranes (Inspection, Testing, and Maintenance). The two remaining interim measures cover the following criteria:

1. Heavy load technical specifications

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

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

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

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

a. Evaluation

Review indicates that Browns Ferry Technical Specifications Section 5.5.C prohibits loads in excess of 1000 lb from being carried over spent fuel in the spent fuel pool.

b. Conclusion

Browns Ferry Units 1, 2, and 3 comply with this interim protection measure.

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 Section 2.1.2, 2.1.3, 2.1.4, and 2.1.7.

b. Evaluations, Conclusions, and Recommendations

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

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

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

a. Evaluation, Conclusion, and Recommendation

An evaluation of this interim protection measure must be deferred as no information has been provided by the Licensee.

3. CONCLUDING SUMMARY

This summary is provided to consolidate the conclusions and recommendations of Section 2 and to document the overall evaluation of the handling of heavy loads at Browns Ferry Nuclear Plant Units 1, 2, and 3. It is divided into two sections dealing with (1) general provisions for load handling at nuclear power plants (NUREG-0612, Section 5.1.1) and (2) the staff recommendations for interim protection pending complete implementation of the guidelines of NUREG-0612, Section 5.3. In each case, recommendations are made for additional Licensee action and, where appropiate, for additional NRC staff action.

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 safe shutdown systems. Compliance with these guidelines is necessary to ensure that load handling system design, administrative controls, and operator training and qualification are such that the possibility of a load drop is very small for the critical functions performed by cranes at nuclear power plants. These guidelines are partially satisfied at Browns Ferry Units 1, 2, and 3. This conclusion is summarized in Table 3.1. Specific recommendations for achieving full compliance with these guidelines are as follows:

Guideline	Recommendation
1	a. Verify that visual aids identifying safe load paths/areas are provided for operators and supervisors.
	b. Verify that deviations from safe load paths are approved with written alternative procedures by the plant safety review committee.
2	Provide information describing the administrative controls for load handling for the truck crane and the 4-ton manual chain hoist.

Table 3.1. Browns Ferry Nuclear Plant Units 1, 2, and 3/NUREG-0612 Compliance Matrix

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
1. Reactor Bldg. Crane	125/5	--	--	C	--	--	C	C	--	--
a. Reactor Well Shield Blocks	99.5	P	C	--	--	P	--	--	--	--
b. Equipment Pool Shield Plugs	50	P	C	--	--	P	--	--	--	--
c. Drywell Head	65	P	C	--	I	--	--	--	--	--
d. Reactor Head	105	P	C	--	I	--	--	--	--	I
e. Steam Dryer	45	P	C	--	I	--	--	--	--	I
f. Refueling Slot Shield Plugs	5.5	P	C	--	--	P	--	--	--	--
g. Refueling Canal Shield	12	P	C	--	--	P	--	--	--	--
h. Moisture Separator	70	P	C	--	I	--	--	--	--	I
i RPV Head Insulation	4	P	C	--	--	P	--	--	--	--
j. Skip Box Loaded	1.25	P	C	--	--	P	--	--	--	--
k. RPV Service Platform	7	P	C	--	--	P	--	--	--	--
l. Equipment Pool Covers	1.5	P	C	--	--	P	--	--	--	--

C = Licensee action complies with NUREG-0612 Guideline.
I = Insufficient information provided by the Licensee.
P = Licensee action partially complies with NUREG-0612 Guideline.
-- = Not applicable.

Table 3.1 (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
m. MG Sets	7.5	P	C	--	--	P	--	--	--	--
n. Tensioner Carousel with 4 tensioners	1	P	C	--	--	P	--	--	--	--
o. Spent Fuel Cask	67	P	C	--	--	P	--	--	C	--
p. Surge Tank Plug	2.1	P	C	--	--	P	--	--	C	--
q. Portable Jib Crane	1	P	C	--	--	P	--	--	C	--
r. New Fuel Assemblies	0.5	P	C	--	--	P	--	--	C	--
s. Fuel Pool Gates	2	P	C	--	--	P	--	--	C	--
t. New Fuel Storage Vault Covers	4.25	P	C	--	--	P	--	--	C	--
u. RWCU Demin Vault Plugs and Vessel Head	6	P	C	--	--	P	--	--	C	--
v. Control Rod Storage Rack	0.5	P	C	--	--	P	--	--	C	--
2. Self Propelled Truck Crane	1	--	--	C	--	--	C	C	--	--
a. Reactor Building Exhaust Fans	1700lb	P	I	--	--	P	--	--	--	--
b. CCW Pumps	20.35	P	I	--	--	P	--	--	--	--

Table 3.1 (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
c. CCW Pump Motors	24.35	P	I	--	--	P	--	--	--	--
d. Fire Pumps	25301b	P	I	--	--	P	--	--	--	--
e. RHR Service Pumps	1.7	P	I	--	--	P	--	--	--	--
3. Hook Type Manual Chain Hoist (47B and 47C)	4	--	--	C	--	--	C	C	--	--
a. Core Spray Pump Motor	2.6	P	I	--	--	P	--	--	--	--
b. CRD Pump Motor	1.25	P	I	--	--	P	--	--	--	--
c. Hatch Shield Blocks	0.75	P	I	--	--	P	--	--	--	--

Guideline	Recommendation
3	(Browns Ferry Units 1, 2, and 3 comply with this guideline.)
4	a. Review GE- and EN DES-designed special lifting devices for compliance to ANSI N14.6-1978.
	b. Review EN DES-provided data for specially designed slings for compliance to ANSI B30.9-1971 relative to safety factors and proof tests.
5	Verify that slings are selected and marked with rated loads based on the maximum static and dynamic loads.
6	(Browns Ferry Units 1, 2, and 3 comply with this guideline.)
7	(Browns Ferry Units 1, 2, and 3 comply with this guideline.)

In addition, the Licensee should reevaluate the 3-ton jib crane and the 7.5-ton wire rope hoist for inclusion under the general guidelines of NUREG-0612.

3.2 INTERIM ACTIONS

The NRC staff has established in NUREG-0612, Section 5.3, certain measures that should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until final implementation of the general guidelines of NUREG-0612, Section 5.1 is complete. Specific measures include the implementation of a technical specification to prohibit the handling of heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement, as necessary, of cranes, slings, and special lifting devices to eliminate deficiencies that could lead to component failure. The evaluation of information provided by the Licensee indicates that the following actions are necessary to ensure that NRC staff measures for interim protection are met at the Browns Ferry plant:

Interim Measure	Recommendation
1	(Browns Ferry Units 1, 2, and 3 comply with this interim measure.)
2, 3	Implement the recommendations of Guidelines 1 and 2.
4, 5	(Browns Ferry Units 1, 2, and 3 comply with these interim measures.)
6	Perform the special review identified for this interim measure.

3.3 SUMMARY

NRC general guidelines and interim protection measures outlined in NUREG-0612 have been substantially complied with at Browns Ferry Units 1, 2, and 3. Several issues (crane operator training; programs for crane inspection, testing, and maintenance; crane design; and technical specifications) comply with and meet the intent of NUREG-0612. Licensee action is required on the remaining general guidelines and interim protection measures.

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
   NRC, 17 May 1978

3. NRC
   Letter to Tennessee Valley Authority
   Subject: Request for Review of Heavy Load Handling at Browns Ferry Nuclear Plant Units 1, 2, and 3
   22 December 1980

4. D. S. Kammer (TVA)
   Letter to D. B. Vassallo (NRC)
   Subject: Control of Heavy Loads
   3 June 1982

5. American National Standards Institute
   "Overhead and Gantry Cranes"
   ANSI B30.2-1976

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

7. American National Standards Institute
   "Slings"
   ANSI B30.9-1971

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