(DRAFT)

TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT, UNIT 1

NRC DOCKET NO. 50-327

NRC TAC NO. 47130

NRC CONTRACT NO. NRC-03-79-118

FRC PROJECT C5257

FRC ASSIGNMENT 3

FRC TASK 449

Prepared by

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

Author: C. R. Bomberger

FRC Group Leader: I. Sargent

Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: F. Clemenson

June 14, 1982

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

CONTENTS

TABLES

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

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at Tennessee Valley Authority's Sequoyah Nuclear Plant, Unit 1. 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 measures in effect at operating nuclear power plants to ensure the safe handling of heavy loads, and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

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

In order to upgrade measures provided to control 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 assure 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 Sequoyah Unit 1, requesting that the Licensee review provisions for handling and control of heavy loads at

Sequoyah Unit 1, 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 March 1, 1982, TVA provided a response [4] to this request.

2. EVALUATION AND RECOMMENDATIONS

The evaluation of load handling at Sequoyah Unit 1 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 polar crane
- o auxiliary building overhead traveling bridge crane
- o ERCW hydraulic pedestal crane
- o auxiliary building 5-ton electric monorail
- o component cooling water pump monorail
- o reactor building jib crane.

The Licensee has also provided an extensive list of over one hundred 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 2,000 pounds and is not considered to be a heavy load.

b. Evaluation, Conclusions, and Recommendations

Based upon review of the information provided, no exception is taken with those handling systems which the Licensee has identified to comply with NUREG-0612 guidelines. Further, this evaluation concurs with exclusion from compliance of those remaining handling systems. For those systems which handle loads over systems or components which are out of service, the Licensee should verify that suitable interlocks or administrative controls are imposed; these measures should be readily available for review by the NRC staff.

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

Safe load paths which have been developed by the Licensee are contained in Sequoyah Standard Practice (SQM) 56. Directions contained within this procedure state that requirements are provided for control of any lift greater than 2000 pounds, lifts in the auxiliary building, and lifts in the upper compartments of the Unit 1 reactor building in those areas designated as critical lifting zones. The critical lifting zones are defined by the Licensee as follows:

1. Reactor building critical lifting zone - the region inside the polar crane wall of the upper compartment when at least one of the horizontal reactor well missile shields has been removed.

2. Spent fuel pit critical lifting zone - the region within 15 feet of the spent fuel pit when spent fuel is in the pit.

3. Auxiliary building critical lifting zone - the region within 15 feet of the residual heat removal and containment spray heat exchanger hatches when the hatch plugs have been removed and the heat exchangers are in service.

To control load movements, SQM-56 directs the operator to "raise and transfer the load to its destination, following the safe load path given. A 'standard' safe load path is the most direct path into and out of the critical zone which miminizes time and proximity to the open vessel or fuel in the racks." Notes contained on the drawing of the reactor building and attached to SQM-56 further state that all miscellaneous lifts shall follow paths designated on the drawing when the reactor vessel head is removed, while all other lifts shall take a "standard" safe load path to the designated laydown area.

b. Evaluation

The intent of this guideline is that safe load paths be determined by a review of the plant arrangements by the engineering staff, that those components and systems needed for safe shutdown be identified on the basis of this review, and the "best" or preferred load path to be taken for movement of major heavy loads thereby determined. Following this review, the "best" load paths would then be formalized and included in the general arrangement drawing or similar plant drawings. Suitable visual aids should be provided for crane operators to direct actual load movement as well as to provide supervisory personnel with a means of ensuring that operators adhere to these paths. Visual aids may consist of clearly marking the floor, the use of crane benchmarks, tape, or temporary stanchions, or merely having a supervisor walk the route prior to the load movement. Any deviation from this path would require a technical review similar to that used to develop the original load path and approval of the written alternative by the plant safety review committee or its equivalent.

Review of the Licensee's submittal indicates that the guideline and its intent have not been satisfied at Sequoyah Unit 1. Formal load paths and laydown areas are presented only for movements of "miscellaneous" loads and have not been distinctly identified for movements of major loads in either the procedure SQM-S6 or its attachments. The Licensee has stated that major loads should take the "standard" load path (most direct route into and out of the critical lifting zone); however, this approach is subject to interpretation by individual operators and does not necessarily coincide with the "best" path determined by engineering review. Therefore the Licensee should identify those major loads which may be handled by each handling system subject to NUREG-0612 compliance, determine the best safe load path for movement to and from the respective load path, and incorporate the load paths into the procedure similar to that already done for "miscellaneous" loads.

No information has been provided by the Licensee to determine whether suitable visual aids exist for operators or whether deviations from established load paths require written alternatives approved by the plant safety review committee or its equivalent.

c. Conclusions and Recommendations

Sequoyah Unit 1 does not comply with Guideline 1. In order to satisfy criteria of this guideline, the Licensee should perform the following:

1. Determine safe load paths for major loads by engineering review similar to those general load paths developed to handle miscellaneous loads in the reactor and auxiliary building, and incorporate into procedures.

2. Provide a suitable means of visual aid to direct the crane operator along the safe load paths during load handling evolutions.

3. Require written alternatives, approved by the plant safety review committee, for deviations to approved load paths.

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

Handling procedures for the reactor building polar crane and the auxiliary building bridge crane are contained in SQM-56, which will be revised to include procedures for the ERCW hydraulic pedestal crane and reactor building jib crane, according to the Licensee. Review of procedure SQM-56 indicates that it contains sections covering scope of control, references, prerequisites, precautions, ALARA considerations, work instructions, tables of heavy loads, and drawings identifying safe load paths. Tables of the various heavy load lifts identify the crane to be used, approved rigging or lifting devices, component weights, and reference drawings and procedures.

b. Evaluation

Review of the procedure provided by the Licensee indicates this procedure (SQM-56) contains selected information required by this guideline; however, information provided is of a broad general nature and does not facilitate adequate control of individual loads. Specifically, the following comments apply to SQM-56:

1. No information or guidance is provided which directs the crane operator or rigging supervisor to perform predetermined inspections or which establishes acceptance criteria for these inspections prior to movement of the load.

2. Steps and sequence of events in the procedure are very general and should be tailored to the specific requirements of the individual lift; according to this procedure, a lift of the 171-ton reactor vessel head is conducted using the same procedural steps as that used to lift a miscellaneous 1-ton load in the auxiliary building.

3. Safe load paths are not clearly defined; as discussed in Guideline 1, the use of "standard" safe load paths is subject to the interpretation of individual crane operators and the path chosen may not be the best path established by engineering review. Further, notes are contained on Attachment A (drawing of reactor building load paths) of SQM-56 which state that "1. All misc. lifts shall follow paths designated in yellow when Rx vessel head is removed"; however, tables provided in SQM-56 do not indicate which loads in the reactor building are considered to be miscellaneous loads.

4. No load-specific special precautions are contained in this procedure.

5. As a minimum, the Licensee has identified the cranes and lifting devices to be used for each heavy load, however evaluation should be made by the Licensee to determine whether additional load-specific equipment should also be identified (i.e., shackles, eye bolts, etc.). In addition, sling designations in this procedure do not correspond with those in other procedures provided by the Licensee.

No procedures have been identified or provided by the Licensee for control of heavy loads handled by the auxiliary building 5-ton electric monorail and the component cooling water pump monorail.

c. Conclusions and Recommendations

Sequoyah Unit 1 does not comply with Guideline 2. In order to fully comply, the Licensee should perform the following:

1. Improve current procedures by incorporating load specific information regarding inspection and acceptance criteria, proper sequence of steps, definition of safe load paths, and special precautions.

2. Develop load handling procedures for monorails subject to NUREG-0612 compliance.

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

Programs for Sequoyah Unit 1 crane operator training, qualification, and conduct are contained in Nuclear Power Division Procedure No. N74M15, "Inspection, Testing, Maintenance, and Operation of Nuclear Plant." This procedure incorporates all of Chapter 2.3 of ANSI B30.2-1976, with no exceptions taken.

b. Evaluation

The Licensee satisfies the requirements of this guideline on the basis that Chapter 2.3 of ANSI B30.2-1976 has been incorporated into crane operator training and qualification.

c. Conclusions and Recommendations

Sequoyah Nuclear Plant Unit 1 complies with 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 [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 leiu 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 closure head and internals lifting rigs, were supplied by Westinghouse Electric Corporation and specified in terms of performance data rather than design criteria. The Licensee is currently negotiating with the vendor to obtain this information.

b. Evaluation

An evaluation with regard to these special lifting devices must be deferred until information being obtained by the Licensee 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 their evaluation of special lifting devices.

It is difficult to make a strict interpretation of compliance of existing special lifting devices with the criteria of ANSI N14.6-1978. Therefore, addressing only those sections which are directly related to load handling reliability of the lifting devices is acceptable. The following sections are not pertinent 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 akin to 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).

c. Conclusions and Recommendations

A determination of compliance with this guideline must be deferred until the Licensee completes the review of special lifting devices at Sequoyah Unit 1.

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 cranes subject to NUREG-0612 criteria are inspected and tested in accordance with Sequoyah Maintenance Section Letter (MSL) A50 and SQNP Outage Group Letter (OTGL) 43 which implement the requirements of ANSI B30.9-1971.

b. Evaluation

Sequoyah Unit 1 satisfies the requirements of this guideline to a large degree on the basis that procedures in use 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 which are generated for the crane speeds in question constitute a reasonably small percentage when compared with static loads.

c. Conclusions and Recommendations

Sequoyah Unit 1 complies with this guideline to a substantial degree on the basis that procedures in use implement the guidelines of ANSI B30.9-1971. To fully comply, the Licensee should implement the following guideline criteria or provide suitable justification for not implementing them:

1. select and mark slings on the basis of the maximum static and dynamic laods

2. clearly mark those slings restricted to use with only certain 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, tests, and maintenance should performed prior to their use.)"

a. Summary of Licensee Statements and Conclusions

Cranes and hoists at Sequoyah Unit 1 are inspected, tested, and maintained in accordance with locally prepared procedures which implement the requirements of the applicable ANSI standard. The load handling systems, local procedures, and applicable standards are listed as follows:

Handling System	Local Procedure	Reference Standard
Polar Crane	M1-9.1	ANSI B30.2-1976, "Overhead and Gantry Cranes"
Auxiliary Building Crane	M1-9.2	ANSI B30.2-1976
Hydraulic Pedestal Crane	MSL-A34	ANSI B30.15-1973, "Mobile Hydraulic Cranes"
5-ton Electric Monorail	MSL-A34	ANSI B30.11-1973, "Monorail Systems and Underhung Cranes" ANSI B30.16-1973, "Overhead Hoists"
4-ton Monorail Chain Hoist	MSL-A34	ANSI B30.11-1973 ANSI B30.16-1973
Reactor Building Jib Crane	DPM N74M15	ANSI B30.11-1973 ANSI B30.16-1973

b. Evaluation

Sequoyah Unit 1 satisfies the intent of this guideline on the basis that local procedures are in effect which require cranes to be inspected, tested, and maintained in accordance with the guidelines of ANSI B30.2-1976 or its equivalent, with no exceptions noted.

Conclusions and Recommendations

Sequoyah Unit 1 complies with Guideline 6.

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

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, "Overhead and Gantry Cranes" and of CMAA-70, "Specifications for Electric Overhead Traveling Cranes"[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 states that the reactor building polar crane will be reviewed for design conformance with CMAA-70 and ANSI B30.2-1976. This analysis will be forwarded at a later date.

For the auxiliary building crane, the Licensee has compared actual design data with the guidelines of CMAA-70 and ANSI B30.2-1976. Where specific compliance was not evident by review, an evaluation was made by imposing these guidelines on the actual design. Principally, this was the approach used for evaluating the design of major structural components by using load combinations and allowable stresses given in CMAA-70. In conclusion, the Licensee states that the results of this review and analysis indicate that the auxiliary building crane meets or exceeds the requirements of CMAA-70 and ANSI B30.2-1976.

The Licensee further states that the hydraulic pedestal crane cannot be analyzed in accordance with CMAA-70 and ANSI B30.2-1976 since it is not an overhead gantry crane. Similarly the 5-ton electric hoist cannot be analyzed, although it was built and conforms to Hoist Manufacturers Institute 100-74.

b. Evaluation

Sequoyah Unit 1 partially satisfies the requirements of this guideline on the basis that the Licensee review indicates that the auxiliary building crane meets or exceeds the requirements of CMAA-70 and ANSI B30.2-1976. Similar

evaluation of the polar crane must be deferred until the Licensee has completed and submitted their evaluation to the NRC for review.

For the remaining hoists and cranes, the Licensee should demonstrate that they were designed in accordance with applicable alternatives, as they have noted for the 5-ton electric monorail hoist, which was built to Hoist Manufacturers Institute 100-74.

c. Conclusions and Recommendations

Sequoyah Unit 1 partially complies with Guideline 7. To fully comply, the Licensee should perform the following:

- o Evaluate the design of the reactor building polar crane with the criteria of CMAA-70 and ANSI B30.2-1976
- o Demonstrate that other handling systems were designed in accordance with suitable alternative standards to those referenced in this guideline.

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 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. Evaluation

Review indicates that Licensee Standard Technical Specification 3.9.7 prohibits loads in excess of 2000 pounds from being carried over spent fuel in the spent fuel pool.

b. Conclusions and Recommendations

Sequoyah Unit 1 complies 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, Conclusions, and Recommendation

Evaluations and conclusions with regard to this interim protection measure must be deferred since 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 Sequoyah Nuclear Plant Unit 1. 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 for 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 Sequoyah Unit 1. This conclusion is summarized in Table 3.1. Specific recommendations for achieving full compliance with these guidelines are as follows:

Guideline		Recommendation
1	a.	Determine safe load paths for major loads similar to those general load paths developed to handle miscellaneous loads in the reactor and auxiliary building by engineering review and incorporate into procedures.
	b.	Provide suitable visual aids to direct the crane operator along the safe load path during load handling evolutions.
	c.	Require written alternatives, approved by the plant safety review committee, for deviations from approved load paths.
2	a.	Improve current procedures by incorporating load specific information regarding inspection and acceptance criteria,

Table 3.1. Sequoyah Nuclear Plant Unit 1/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. Polar Crane	175/35	--	--	C	--	--	C	I	--	I
Missile Shields	92	NC	NC	--	--	P	--	--	--	I
Canal Gates	41	NC	NC	--	--	P	--	--	--	I
Reactor Vessel Head	171.2	NC	NC	--	I	--	--	--	--	I
Upper Internals	102	NC	NC	--	I	--	--	--	--	I
Reactor Coolant Pump Plug	13.3	NC	NC	--	--	P	--	--	--	I
Hatch Plug	10	NC	NC	--	--	P	--	--	--	I
RCP Motor	41.2	NC	NC	--	I	--	--	--	--	I
RCP	I	NC	NC	--	--	P	--	--	--	I
Miscellaneous	1-87.5	NC	NC	--	--	P	--	--	--	I
2. Auxiliary Bldg. Bridge Crane	125/10	--	--	C	--	--	C	C	--	--
3. Hydraulic Pedestal Crane	40	--	--	C	--	--	C	I	--	--
4. Electric Monorail Hoist	5	--	--	C	--	--	C	C	--	--

C = Licensee action complies with NUREG-0612 Guideline.
P = Licensee action partially complies with NUREG-0612 Guidelines.
NC = Licensee action does not comply with NUREG-0612 Guideline.
I = Insufficient information provided by the Licensee.

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
6. Monorail Chain Hoist	4	--	--	C	--	--	C	I	--	--
7. Jib Crane	3	--	--	C	--	--	C	I	C	--
Pool Divider Gates	I	NC	NC	--	I	P	--	--	C	--
Fuel Transfer Canal Gates	I	NC	NC	--	I	P	--	--	C	--
Irradiated Specimen Shipping Cask	I	NC	NC	--	I	P	--	--	C	--
Spent Resin Shipping Cask	I	NC	NC	--	I	P	--	--	C	--
Spent Fuel Shipping Cask	I	NC	NC	--	I	P	--	--	C	--
Failed Fuel Container	I	NC	NC	--	I	P	--	--	C	--
Fuel Transfer Carriage	I	NC	NC	--	I	P	--	--	C	--
Misc. Equipment	I	NC	NC	--	I	P	--	--	C	--

proper sequence of steps, definition of safe load paths, and special precautions.

b. Develop load handling procedures for monorails subject to NUREG-0612 compliance.

3 (Sequoyah Unit 1 complies with this guideline.)

4 (A determination of compliance must be deferred until review of special lifting devices is completed.)

5 a. Select and mark slings on the basis of the maximum static and dynamic loads.

b. Clearly mark those slings restricted to use with only certain cranes.

6 (Sequoyah Unit 1 complies with this guideline.

7 a. Evaluate the design of the reactor building polar crane with the criteria of CMAA-70 and ANSI B30.2-1976.

b. Demonstrate that other handling systems were designed in accordance with suitable alternative standards to those referenced in this guideline.

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. Specified measures include the implementation of a technical specification to prohibit the handling of heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement, as necessary, of cranes, slings, and special lifting devices to eliminate deficiencies that could lead to component failure. The evaluation of information provided by the Licensee indicates that the following actions are necessary to ensure that NRC staff measures for interim protection are met at Sequoyah Unit 1:

Interim Measure	Recommendation
1	(Sequoyah Unit 1 complies with this interim measure.)
2, 3	Implement the recommendations of Guidelines 1 and 2.
4, 5	(Sequoyah Unit 1 complies with these interim measures.)
6	Perform the special review identified in this interim measure

3.3 SUMMARY

NRC general guidelines and interim protection measures outlined in NUREG-0612 have not been satisfactorily complied with at Sequoyah Unit 1. Two issues, crane operator training and programs for crane inspection, testing, and maintenance, are in compliance 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 Sequoyah Nuclear Plant Unit 1
22 December 1980

4. L. M. Mills (TVA)
Letter to E. Adensam (NRC)
Subject: "Control of Heavy Loads
1 March 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