TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION

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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 the Omaha Public Power District's (OPPD) Fort Calhoun Station. 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 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 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 used in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (2) conservative evaluations of load handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

A defense-in-depth approach was used to develop the staff guidelines in order to ensure that all load handling systems are designed and operated so that their probability of failure is appropriately small. The intent of the guidelines is to ensure that licensees of all operating nuclear power plants perform the following:

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

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612. Section 6 of NUREG-0612 recommended that a program be initiated to ensure that these guidelines are implemented at operating plants.

1.3 PLANT-SPECIFIC BACKGROUND

On December 22, 1980, the NRC issued a letter [3] to OPPD, the Licensee for the Fort Calhoun Station, requesting that the Licensee review provisions for handling and control of heavy loads at the Fort Calhoun Station, 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. OPPD responded to this request on June 22, 1981 [4], November 30, 1981 [5], December 21, 1981 [6], and January 21, 1982 [7].

Based upon this information, a draft technical evaluation report (TER) was prepared and informally transmitted to the Licensee. A telephone conference call was subsequently conducted on February 9, 1982 involving representatives of the NRC, FRC, and OPPD to discuss unresolved issues in this draft TER. OPPD provided additional submittals on June 2, 1982 [8], September 1, 1983 [9], and April 6, 1984 [10], which have been incorporated into this final TER.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at the Fort Calhoun Station 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 guidelines or interim measure is presented, Licensee-provided information is summarized and evaluated, and a conclusion as to the extent of compliance, including recommended additional action where appropriate, is presented. These conclusions are summarized in Table 2.1.

2.1 GENERAL GUIDELINES

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

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

These seven guidelines should be satisfied by all overhead handling systems that 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 an evaluation of this verification are contained in the succeeding paragraphs.

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Table 2.1 Fort Calhoun/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. Polar Crane										
Main Hook	130	--	--	C	--	--	C	C	--	--
Aux Hook	10	--	--	C	--	--	C	C	--	--
Reactor Vessel Closure Head	120	R	C	--	R	--	--	--	--	C
Upper Guide Structure	40	R	C	--	R	--	--	--	--	C
Missile Shields	10	R	C	--	--	C	--	--	--	C
2. Auxiliary Building Crane										
Main Hook	75	--	--	C	--	--	C	C	--	--
Aux Hook	10	--	--	C	--	--	C	C	--	--
Spent Fuel Pool Gates	1	R	C	--	--	C	--	--	C	--
New Fuel Receipt	1.5	R	C	--	--	C	--	--	C	--
Spent Fuel Shipping Cask	30	R	C	--	--	C	--	--	C	--
3. Concrete Slab Removal Monorail	--	--	--	C	--	--	C	C	--	--
4. Waste Evaporator Equip. Handling Monorail	--	--	--	C	--	--	C	C	--	--
5. Deborating Demin Area Monorail	--	--	--	C	--	--	C	C	--	--
6. Intake Structure Crane	--	--	--	C	--	--	C	C	--	--

C = Licensee action complies with NUREG-0612 Guideline.
R = Licensee has proposed revisions or modifications which meet the intent of the NUREG-0612 Guideline.
-- = Not applicable.

2.1.1 Overhead Heavy Load Handling Systems

a. Summary of Licensee Statements and Conclusions

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

- o containment polar crane
- o auxiliary building crane
- o concrete slab removal monorail
- o waste evaporator equipment handling monorail
- o deborating demineralizer area monorail
- o intake structure crane

Other handling devices identified by the Licensee have been excluded from compliance with NUREG-0612 for the following reasons:

1. No safety-related equipment or irradiated fuel is located in close proximity to the handling system:

   - o turbine building crane
   - o turbine building hoist
   - o drumming area crane
   - o maintenance shop crane
   - o filter area crane

2. The handling devices are sole-purpose systems that are used only when the related equipment has been placed out of service in accordance with plant technical specifications or administrative procedures:

   - o diesel generator area monorails

3. The system does not carry loads that satisfy the weight requirement for a heavy load:

   - o containment jib crane.

b. Evaluation and Conclusion

The Licensee's exclusion of the listed load handling systems from compliance with NUREG-0612 is consistent with NUREG-0612 on the basis of the Licensee's justification that (1) no systems or components required for plant shutdown or decay heat removal are located in the areas where the handling

systems are located, (2) the devices are sole-purpose systems and are used only when the equipment is out of service, or (3) heavy loads are not carried by the excluded systems.

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

Two areas of concern have been identified by the Licensee where a load drop may damage fuel or safe shutdown equipment: the containment building and the auxiliary building. The Licensee stated that load corridors in the auxiliary building will be developed for movements within the spent fuel pool interlocks to govern movements of the following loads:

- o spent fuel pool gate
- o new fuel
- o spent fuel racks
- o shipping casks.

In the containment building, similar load corridors will be developed to control movements of the following loads:

- o missile shields
- o reactor vessel closure head
- o upper guide structure
- o ventilation ducts.

Procedures in both locations will designate the applicable safe load corridors for load handling in the containment and over the restricted area in the auxiliary building and will include drawings of the corridors. In addition, in lieu of marked load paths, crane signalmen with duties defined in procedures will be responsible for walking the load corridor and verifying

that no obstructions are present in the travel path. Regarding deviation from the safe load corridors, the Licensee stated that any deviations from established plant procedures would require plant review committee approval.

b. Evaluation

Information has been provided by the Licensee which demonstrates that load corridors developed and implemented at Fort Calhoun Station are consistent with the intentions of this guideline. Further, these predetermined pathways will be incorporated into procedures, are identified by drawings in these procedures, require the use of suitable visual aids (signalmen) to ensure that load corridors are properly followed, and require an appropriate level of approval prior to deviation.

c. Conclusion

Development and implementation of safe load paths at Fort Calhoun Station are performed in a manner consistent with 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 written procedures govern the handling of each heavy load, with the exception of the spent fuel shipping cask. These procedures include identification of required equipment, inspections and acceptance criteria required before the movement of the load, and steps and proper sequence to be followed in handling the load. These procedures meet the intent of Section 5.1.1(2) of NUREG-0612.

A procedure for the spent fuel shipping cask will be written prior to first use of the shipping cask. At present, the Licensee does not have a shipping cask.

b. Evaluation and Conclusion

Procedures under development at Fort Calhoun Station are consistent in content with those specified in 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

OPPD has stated that the current training program, "Control of Crane Operations," does comply with ANSI B30.2-1976, and that crane operators will be advised of new requirements resulting from NUREG-0612.

b. Evaluation and Conclusion

Training and qualification of crane operators at Fort Calhoun Station are performed in a manner consistent 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, '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."

a. Summary of Licensee Statements and Conclusions

OPPD stated that the special lifting devices of concern (the reactor closure head and the upper guide structure lift rigs) were designed and purchased in 1968. Steel members and components were designed in accordance with the guidelines of the American Institute of Steel Construction (AISC), Edition 6. Although this code does not provide detailed guidelines, it does provide, in the Licensee's opinion, sufficient requirements to achieve a safe design of steel components. The Licensee has also performed a detailed comparison of these special lifting devices with the specific items related to load handling reliability contained in ANSI N14.6-1978. The results of this comparison are contained in Appendices A and B.

In addition, for the upper guide structure lift rig, information provided by the vendor indicated that design safety factors of 5 on ultimate strength and 2 on yield strength were used in designing this devices. Since ANSI N14.6-1978 did not exist at the time of manufacture, the Licensee stated that using a design factor of 2 instead of 3 was considered adequate.

The Licensee stated that an inspection program will be developed for the reactor closure head and upper guide structure lifting rigs. This program will consist of visual inspections of all welds of both devices each refueling outage. Nondestructive examination (NDE) of all critical welds will also be performed of all critical welds in each lifting device at intervals not to exceed five refueling outages. The inspection procedures will be performed in accordance with Section 5.1 of ANSI N14.6-1978 by qualified control personnel.

To date, no load test in excess of normal operating load has been performed for the vessel head lifting rig, and it is the Licensee's opinion that such a load test is not practical to perform for this device. It is the Licensee's position that the device is of suitably simple design, has ample safety margins, and was fabricated under quality control conditions so that a load test is unnecessary to demonstrate reliability and proof of workmanship.

In conclusion, the Licensee stated that critical items such as design stress, inspection, and testing have been addressed and meet the intent of

ANSI N14.6. In the Licensee's opinion it has been demonstrated that safe engineering practices were used in the design of these rigs.

b. Evaluation

The Licensee performed an extensive comparison of the two lifting devices of concern with the criteria of ANSI N14.6-1978. On the basis of this comparison, both the head lifting rig and the upper guide structure lift rig are noted to substantially comply with ANSI requirements. Both lifting rigs satisfy the requirements of Section 3.1 (Designer's Responsibilities). In addition, it is recognized that information regarding Sections 3.3 and 4.1 may be difficult to obtain since it has been several years since the devices were fabricated, and proof of quality workmanship can be evaluated with the continuing compliance testing program. Regarding design safety margins, detailed analysis performed by the Licensee indicated that two components of the head lift rig do not satisfy the design margins of 3 and 5. Although these components are not in strict compliance with the ANSI requirements, they have been clearly identified and margins to yield and ultimate have been adequately determined so that appropriate considerations can be incorporated into periodic inspection (visual and NDE) to compensate for the existing condition.

The programs that the Licensee identified to comply with Section 5.1 of ANSI N14.6 meet the intent of this guideline. Neither device, however, has been load tested to 150% of the maximum load carried as specified by ANSI N14.6-1978, Sections 5.2.1 and 5.3.1. The Licensee indicated that the upper guide structure lift rig has been tested to 125%; this overstress is considered adequate to meet the intent of the guideline. Although no load test has been performed for the reactor closure head lift rig, information has been provided by the Licensee to clearly establish the proof of workmanship that the load test was intended to accomplish. Specifically, the Licensee determined that, with limited exceptions, ample margins exist for this device, the device is of reasonably simple design, and assurances have been provided that suitable quality controls were used during the fabrication of the device.

Therefore, it is agreed that further load testing of this device is not required.

Proposed inspection programs for these devices are also acceptable, based on the Licensee's statement that visual and NDE will be performed by quality control personnel in accordance with the requirements of the ANSI standard. Further, relaxation of the inspection intervals (each refueling outage for visual inspections and at periods not to exceed five refueling outages for NDE) is also reasonable based upon the limited frequency of use of these devices.

c. Conclusion and Recommendations

Special lifting devices in use at Fort Calhoun Station were designed, fabricated, and, based upon continuing compliance programs, will continue to be used in a manner that assures load handling reliability consistent with that required by Guideline 4.

2.1.6 Lifting Devices (Not Specially Designed) [Guideline 5, NUREG-0612, Section 5.1.1(5)]

"Lifting devices that are not specially designed should be installed and used in accordance with the guideline of ANSI B30.9-1971, 'Slings' [13]. However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the 'static load' which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that non-special lifting devices are installed and used in accordance with ANSI B30.9-1971, including dynamic and static loading.

b. Evaluation

The Licensee satisfies the requirements of this guideline on the basis that slings are installed and used per ANSI B30.9-1971. In addition, Fort

Calhoun Station satisfies the requirements for incorporating dynamic loads into sling selection and use.

c. Conclusion

Selection and use of slings at the Fort Calhoun Station are consistent with Guideline 5.

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

"The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' with the exception that tests and inspections should be performed prior to use where it is not practical to meet the frequencies of ANSI B30.2 for periodic inspection and test, or where frequency (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

The Licensee stated that the crane inspection, testing, and maintenance program at Fort Calhoun Station complies with Chapter 2-2 of ANSI B30.2-1976.

b. Evaluation and Conclusion

Inspection, testing, and maintenance of cranes of Fort Calhoun Station are performed in accordance with Guideline 6.

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

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' and of CMAA-70, 'Specifications for Electric Overhead Traveling Cranes' [14]. An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

a. Summary of Licensee Statements and Conclusions

OPPD evaluated its overhead heavy load handling systems for design compliance with CMAA-70 and ANSI B30.2-1976. The Licensee stated that the auxiliary building crane is currently being retrofitted and will be classified as a "single-failure-proof" retrofitted trolley system. This crane was designed to meet ANSI B30.2-1976 and CMAA-70 standards.

The monorails and intake structure cranes were not designed to the CMAA-70 code or the ANSI B30.2 Chapter 2.1 criteria. However, the intake structure crane was designed to EOCI-61 criteria. With regard to the design of the monorails, the CMAA-70 and ANSI B30.2 codes do not specify criteria for their design.

The containment polar crane was purchased to Gibbs, Hill, Durham, and Richardson (GHD&R) specifications for hoisting equipment. These specifications were based on EOCI-61, "Specifications for Electric Overhead-Traveling Cranes" and USAS Safety Code B30.2-1967. The Licensee compared the design of the intake structure crane and the containment polar crane point by point with CMAA-70. As a result of this comparison, the following items of difference between EOCI-61 and CMAA-70 were noted and, where available, OPPD's compliance with the requirements of CMAA-70 are noted for these cranes.

1. Torsional forces. CMAA-70, Article 3.3.2.1.3 requires that twisting moments due to overhanging loads and lateral forces acting eccentric to the horizontal neutral axis of a girder be calculated on the basis of the distance between the center of gravity of the load, or force center line, and the girder shear center measured normal to the force vector. EOCI-61 states that such moments are to be calculated with reference to the girder center of gravity. For girder sections symmetrical about each principal central axis (e.g., box section or I-beam girders commonly used in cranes subject to this review), the shear center coincides with the centroid of the girder section and there is no difference between the two requirements. Such is not the case for nonsymmetrical girder sections (e.g., channels). Nonsymmetrical girders were not used on the containment polar or on the intake structure crane.

2. Longitudinal stiffeners. CMAA-70, Article 3.3.3.1 specifies (1) the maximum allowable web depth/thickness (h/t) ratio for box girders using longitudinal stiffeners and (2) requirements concerning the location and minimum moment of inertia for such stiffeners. EOCI-61 allows the use of longitudinal stiffeners but provides no similar guidance. Ratios for h/t comply with CMAA-70 for the containment polar crane. The moment of inertia is 5.1% less than that required by CMAA-70 and is considered acceptable by OPPD. No longitudinal stiffeners were used on the intake structure crane.

3. Fatigue considerations. CMAA-70, Article 3.3.3.1.3 provides substantial guidance with respect to fatigue failure by indicating allowable stress ranges for various structural members in joints under repeated loads. EOCI-61 does not address fatigue failure. Since the polar crane lifts loads of less than its design condition on a 2-lifts-per-refueling basis, the near design loading cycle is not close to the CMAA-70 guidelines, and is therefore not of consequence to this crane. The intake structure crane lifts loads weighing less than design capacity; the requirements of CMAA-70 are not considered to be of consequence for this crane.

4. Drum design. CMAA-70, Article 4.4.1 requires that the drum be designed to withstand combined crushing and bending loads. EOCI-61 requires only that the drum be designed to withstand maximum load, bending and crushing loads, with no stipulation that these loads be combined. No information is available regarding this issue.

5. Drum design. CMAA-70, Article 4.4.3 provides recommended drum groove depth and pitch. EOCI-61 provides no similar guidance. Drum groove depth and pitch on the containment polar crane comply with the recommendations of CMAA-70. No information is available regarding this issue for the intake structure crane.

6. Bridge brake design. CMAA-70, Article 4.7.2.2 requires that bridge brakes, for cranes with cab control and the cab on the trolley, be rated at least 75% of bridge motor torque. This issue is not of consequence since the cab control, cab-on-trolley arrangement was not used at Fort Calhoun.

7. Hoist brake design. CMAA-70, Article 4.7.4.2 requires that hoist holding brakes, when used with a method of a control braking other than mechanical, have torque ratings no less than 125% of the hoist motor torque. EOCI-61 requires a hoist holding brake torque rating of no less than 100% of the hoist motor torque without regard to the type of control brake employed. No information is available regarding the polar crane hoist holding brake other than that it was designed to EOCI-61. OPPD states that the 100% provides sufficient margin of safety. For the intake structure crane, hoist brakes are rated at 150% and are therefore in compliance.

8. Bumpers and stops. CMAA-70, Article 4.12 provides substantial guidance for the design and installation of bridge and trolley bumpers and stops for cranes which operate near the end of bridge and trolley travel. Because it is a polar crane, no bumpers are necessary for the polar crane bridge. Bumpers and stops are provided for the trolley near the end of trolley travel. Spring-type bumpers on the trolley and rubber bumpers on the bridge satisfy CMAA-70 requirements for the intake structure crane.

9. Static control systems. CMAA-70, Article 5.4.6 provides substantial guidance for the use of static control systems. EOCI-61 provides guidance for magnetic control systems only. The Fort Calhoun polar crane uses a static control system; however, insufficient information is available in order to address the requirements of CMAA-70. The intake structure crane uses a full magnetic variable speed crane controls and therefore satisfies CMAA-70.

10. Restart protection. CMAA-70, Article 5.6.2 requires that cranes not equipped with spring-return controllers or momentary-contact pushbuttons be provided with a device that will disconnect all motors upon power failure and will not permit any motor to be restarted until the controller handle is brought to the OFF position. OPPD states that the polar crane is equipped with momentary contact push buttons and therefore complies with CMAA-70. The intake structure crane uses a relay that drops out on loss of power, deenergizing the crane motors and requiring that the crane be restarted; such a system satisfies CMAA-70 requirements.

b. Evaluation

Fort Calhoun Station satisfies the requirements of Guideline 7 for the auxiliary building crane on the basis of the Licensee's verification that this crane was designed and built to CMAA-70 and ANSI B30.2-1976 standards.

In the case of the containment polar crane and intake structure crane, the deviations from full compliance with those provisions of CMAA-70 noted by the Licensee are not felt to result in a substantial reduction in overall reliability of those cranes. None of these deviations by themselves or in the limited combinations reported are expected to result in a measurable difference in the probability of a load drop from these cranes compared to cranes constructed in strict compliance with CMAA-70.

c. Conclusion

The design of overhead electric traveling cranes at the Fort Calhoun Station is consistent with Guideline 7.

2.2 INTERIM PROTECTION MEASURES

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

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

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

The Licensee stated that the potential to impact irradiated fuel is minimized by not allowing loads to be carried over irradiated fuel and by the fact that a new retrofitted "single-failure-proof" crane in the auxiliary building is being installed.

b. Evaluation and Conclusion

The Fort Calhoun Station will satisfy this interim protection measure by providing a single-failure-proof crane.

2.2.2 Administrative Controls [Interim Protection Measures 2, 3, 4, and 5, NUREG-0612, Section 5.3(2) - 5.3(5)]

"Procedural or administrative measures [including safe load paths, load handling procedures, crane operator training, and crane inspection]... can be accomplished in a short time period and need not be delayed for completion of evaluations and modifications to satisfy the guidelines of Section 5.1 of [NUREG-0612]."

b. Evaluation

The specific requirements for load handling administrative controls are contained in NUREG-0612, Section 5.1.1, Guidelines 1, 2, 3, and 6. The Licensee's compliance with these guidelines has been evaluated in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7, respectively, of this report.

b. Conclusions and Recommendations

Conclusions and recommendations concerning the Licensee's compliance with these administrative controls are contained in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.7 of this report.

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 of deficiencies that could lead to failure of the component; (3) appropriate repair and replacement of defective components; and (4) verify that the crane operators have been properly trained and are familiar with specific procedures used in handling these loads, e.g., hand signals, conduct of operations, and content of procedures."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that clear and concise instructions for handling heavy loads over the core will be provided. Also, requirements for necessary inspections will be included. If required, appropriate repairs will be made. In addition, only qualified crane operators are allowed to operate cranes; they are also briefed prior to the start of the procedures.

b. Evaluation and Conclusion

OPPD complies with this interim protection measure.

3. CONCLUSION

This summary is provided to consolidate the results of the evaluation contained in Section 2 concerning individual NRC staff guidelines into an overall evaluation of heavy load handling at the Fort Calhoun Station. Overall conclusions and recommended Licensee actions, where appropriate, are provided with respect to both general provisions for load handling (NUREG-0612, Section 5.1.1) and completion of the staff recommendations for interim protection (NUREG-0612, Section 5.3).

3.1 GENERAL PROVISIONS FOR LOAD HANDLING

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

3.2. INTERIM PROTECTION

The NRC staff has established certain measures (NUREG-0612, Section 5.3) 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. Evaluation of information provided by the Licensee indicates that all interim protection actions have been satisfactorily implemented at Fort Calhoun Station.

4. REFERENCES

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

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4. W. C. Jones (OPPD)
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5. W. C. Jones (OPPD)
Letter to R. A. Clark (NRC)
Subject: Control of Heavy Loads
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6. W. C. Jones (OPPD)
Letter to R. A. Clark (NRC)
Subject: Control of Heavy Loads
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7. W. C. Jones (OPPD)
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January 21, 1982

8. W. C. Jones (OPPD)
Letter to R. A. Clark (NRC)
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9. W. C. Jones (OPPD)
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10. W. C. Jones (OPPD)
Letter to J. Miller (NRC)
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April 6, 1984

11. American National Standards Institute
"Overhead and Gantry Cranes"
New York: 1976
ANSI B30.2-1976

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

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"Slings"
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14. Crane Manufacturers Association of America
"Specification for Electric Overhead Traveling Cranes"
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APPENDIX A

COMPARISON OF FORT CALHOUN SPECIAL LIFTING DEVICES WITH ANSI N14.6-1978

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Appendix A

Comparison of Fort Calhoun Special Lifting Devices with ANSI N14.6-1978

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
Section 3.1		
3.1.1 Limitations on the use of the lifting device.	Used only for reactor vessel head.	Used only for upper guide structure.
3.1.2 Identification of critical components and definition of critical characteristics.	All components are considered critical.	All components are considered critical.
3.1.3 Signed stress analyses, demonstrating appropriate margins of safety.	Information verified from CE report S/102/P dated Aug. 14, 1970. See Appendix B.	Unable to address for lack of information from the vendor. Margins of safety were in accordance with AISC, 6th Edition.
3.1.4 Indication of permissible repair procedures.	No repairs are contemplated, so no procedures are available.	No repairs are contemplated, so no procedures are available.
Section 3.2		
3.2.1 Use of stress design factors of 3 for minimum yield strength and 5 for ultimate strength.	See Appendix B.	Designed with a 5:1 safety factor (ultimate). In addition, use of a design factor of 2 instead of 3 (on yield) is considered adequate.
3.2.4 Similar stress design factors for load bearing pins, links, and adapters.	Complies. See Appendix B.	Unable to address for lack of information from the vendor.
3.2.5 Slings used comply with ANSI B30.9.	Complies.	Complies.

Appendix A (Cont.)

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
3.2.6 Subject materials to dead weight test or charpy impact test.	Unable to address for lack of information from the vendor.	Unable to address for lack of information from the vendor.
Section 3.3		
3.3.1 Consideration of problems related to possible lamellar tearing.	Unable to address for lack of information from vendor.	Unable to address for lack of information from vendor.
3.3.4 Design shall ensure even distribution of the load.	Complies (CE Report).	Unable to address for lack of information from vendor. However, the AISC, 6th Edition requires that design shall ensure even distribution of the load.
3.3.5 Retainers fitted for load carrying components which may become inadvertently disengaged.	Unable to address due to lack of information from the vendor.	Unable to address due to lack of information from the vendor.
Section 4.1		
4.1.3 Verify selection and use of materials.	Materials verified from the list indicated on drawings.	Materials verified from the list indicated on drawings.
4.1.4 Compliance with fabrication practice.	Fabricated in accordance with AISC, 6th Edition.	Fabricated in accordance with AISC, 6th Edition.
4.1.5 Qualification of welders, procedures, and operators.	Unable to address due to lack of information from the vendor.	Unable to address due to lack of information from the vendor.

Appendix A (Cont.)

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
4.1.6 Provisions for a quality assurance program.	Unable to address due to lack of information from the vendor.	Unable to address due to lack of information from the vendor.
4.1.7 Provisions for identification and certification of equipment.	Unable to address due to lack of information from the vendor.	Unable to address due to lack of information from the vendor.
4.1.8 Verification that materials or services are produced under appropriate controls and qualifications.	Unable to address due to lack of information from the vendor.	Unable to address due to lack of information from the vendor.
Section 5.1		
5.1.3 Implementation of a periodic testing schedule and a system to indicate date of expiration.	By procedure visually inspect prior to use.	By procedure visually inspect prior to use.
5.1.4 Provisions for establishing operating procedures.	Proced[illegible]e of lift [illegible]etailed in the [illegible]l of RCVH procedu[illegible]MP-RC-6-1, RC-6-2.	Procedure MP-RC-7-2, guidelines for use of UGS lift rig.
5.1.5 Identification of subassemblies which may be exchanged.	Subassemblies may not be exchanged.	Subassemblies may not be exchanged.
5.1.6 Suitable markings.	Complies.	Complies.
5.1.7 Maintaining a full record of history.	This requirement is being met as follows: (a) This device is used to lift the reactor vessel head, only. (b) The lift rig is qualified for this load.	This requirements is being met as follows: (a) This device is used to lift the upper guide structure, only. (b) The lift rig is qualified for this load.

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
5.1.7 (Cont.)	(c) The lift rig is visually inspected prior to every lift. (d) The lift rig is used twice during the refueling outage only.	(c) The lift rig is visually inspected prior to every lift. (d) The lift rig is used twice during the refueling outage only.
5.1.8 Conditions for removal from service.	Subject to visual inspection.	Subject to visual inspection.
Section 5.2		
5.2.1 Load test to 150% and appropriate inspections prior to initial use.	Load test was not performed. However, the lifting rigs have been inspected and used to rated loads for over 10 years without any defect.	Tested to 125% inspected prior to use.
5.2.2 Qualification of replacement parts.	No program established for qualification of replacement parts.	No program established for qualification of replacement parts.
Section 5.3		
5.3.1 Satisfying annual load test or inspection requirements.	Inspected prior to use every 1.25-1.5 years depending upon frequency of refueling.	Inspected prior to use every 1.25-1.5 years depending upon frequency of refueling.
5.3.2 Testing following major maintenance.	Devices will be tested in accordance with ANSI requirements.	Devices will be tested in accordance with ANSI requirements.
5.3.4 Testing after application of substantial stress.	Devices will be tested in accordance with ANSI requirements.	Devices will be tested in accordance with ANSI requirements.
5.3.6 Inspections by operating personnel.	Visual inspections performed by operating personnel in accordance with ANSI requirements.	Visual inspections performed by operating personnel in accordance with ANSI requirements.
5.3.7 Nonoperating or maintenance personnel.	Inspections are performed by quality control personnel.	Inspections are performed by quality control personnel.

APPENDIX B

SUMMARY OF STRESS LEVELS AND SAFETY FACTORS IN HEAD LIFT RIG COMPONENT PARTS

Appendix B

Summary of Stress Levels and Safety Factors in Head Lift Rig Component Parts

Element	Stress Condition	Ratio = Ult. Stress/ Nor. Load	Ratio = Yld. Stress/ Nor. Load
Tripod Lifting Eye	Tension	14.7	7.4
	Shear	9.4	4.1
Tripod Lifting Eye Shank	Tension	6.4	3.2
Lifting Frame Lug	Shear	7.5	3.5
	Bearing	5.3	2.85*
Pin	Shear	9.9	6.6
Rod	Tension	10.7	8.3
	Shear (THD)	19.0	12.7
Clevis	Shear	11.9	5.2
	Bearing	8.9	4.5
	Tension	28.0	14.2
Pipe and Pipe Weld	Compression	17.1	
	Shear	22.8	13.9
Tubing Lifting Eye and Weld	Tension	6.4	4.5
	Bearing	11.7	5.9
	Shear	16.7	7.2
Tube and Tube Shell Weld	Tension	7.6	4.7
	Shear	3.7*	2.3*
Shell	Tension	48.3	30.0

*The safety margins are lower than required by ANSI N14.6-1978. However, the safety margins are not significantly lower than required.

[Ref.: Combustion Engineering Calculation No. RS-102 dated August 24, 1970 and CE Letter No. CE-18074-989 dated June 30, 1981.]