TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS

ARKANSAS POWER AND LIGHT COMPANY

ARKANSAS NUCLEAR ONE UNITS 1 AND 2

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FOREWORD

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

Mr. C. 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 the an independent review of general load handling policy and procedures at the Arkansas Power and Light Company's Arkansas Nuclear One (ANO) Nuclear Power Plant. This evaluation was performed with the following objectives:

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

1.2 GENERIC BACKGROUND

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to assure the safe handling of heavy loads and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

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

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-part objective using an accepted approach or protection philosophy. The first portion of the objective, achieved through a set of general guidelines identified in NUREG-0612, Section 5.1.1, is to ensure that all load handling systems at nuclear power plants are designed and operated so that their probability of failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Sections 5.1.2 through 5.1.5, is to ensure that, for load handling systems in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (2) conservative evaluations of load handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

A defense-in-depth approach was used to develop the staff guidelines to ensure that all load handling systems are designed and operated so that their probabilities of failure are 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 ensure reliable operation of the handling system.

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

1.3 PLANT-SPECIFIC BACKGROUND

On December 22, 1980, the NRC issued a letter [3] to Arkansas Power and Light Company (APL), the Licensee for ANO, requesting that the Licensee review provisions for handling and control of heavy loads at ANO, 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 February 17, 1981, APL provided the initial response [4] to this request. The Licensee provided additional information by letter on June 22, 1981 [5] and by telephone conversation on November 30, 1981 [6]. Additional information was provided subsequent to the telephone conversation on November 12, 1982 [7], June 8, 1984 [8], and August 31, 1984 [9], and has been incorporated into this final technical evaluation.

2. EVALUATION

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

2.1 GENERAL GUIDELINES

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

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

These seven guidelines should be satisfied by all overhead handling systems and programs in order to handle heavy loads in the vicinity of the reactor vessel, near spent fuel in the spent fuel pool, or in other areas where a load drop may damage safe shutdown systems. The Licensee's verification of the extent to which these guidelines have been satisfied and an evaluation of this verification are contained in the succeeding paragraphs.

Table 2.1. ANO/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. (L-2) Unit 1 Polar Crane	180/25	--	--	R	--	--	C	R	--	R
RV Closure Head	81.2	R	C	--	R	--	--	--	--	R
Upper Internals	55	R	C	--	R	--	--	--	--	R
ISI Tool	15.8	R	C	--	R	--	--	--	--	R
RCP Motor	51.4	R	C	--	--	R	--	--	--	R
Missile Shields	42.0	R	C	--	--	R	--	--	--	R
Crane Load Block	--	R	C	--	--	R	--	--	--	R
Port. Stud Storage Rack	4.5	R	C	--	--	R	--	--	--	R
Head & Internals Handling Tripod	6	R	C	--	--	R	--	--	--	R
Refueling Cavity Seal Plate	3	R	C	--	--	R	--	--	--	R
Upender	7.1	R	C	--	--	R	--	--	--	R
Refueling Machine	31.2	R	C	--	--	R	--	--	--	R
Aux. Refueling Machine	21.7	R	C	--	--	R	--	--	--	R

C = Licensee action complies with NUREG-0612 Guideline.
R = Licensee has proposed revisions/modifications designed to comply with NUREG-0612 Guideline.

Table 2.1 (Cont.)

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
2. (2L-2) Unit 2 Polar Crane	150/25	--	--	R	--	--	C	C	--	R
Reactor Vessel Head	58.4	R	C	--	R	--	--	--	--	R
Upper Guide Structure	54.3	R	C	--	R	--	--	--	--	R
ISI Tools	0.5	R	C	--	R	--	--	--	--	R
RCP Motor	54.9	R	C	--	--	R	--	--	--	R
Crane Load Block	--	R	C	--	--	R	--	--	--	R
Maintenance Structure	17.5	R	C	--	--	R	--	--	--	R
CEDM Duct Work	1.4	R	C	--	--	R	--	--	--	R
CEDM Shroud	9.8	R	C	--	--	R	--	--	--	R
Upender	7.2	R	C	--	--	R	--	--	--	R
Refueling Machine	31.2	R	C	--	--	R	--	--	--	R
Jib Crane	7.9	R	C	--	--	R	--	--	--	R
Refueling Cavity Seal Plate	32.0	R	C	--	R	--	--	--	--	R
Stud Tensioner	1.2	R	C	--	--	R	--	--	--	R

Table 2.1 (Cont.)

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
3. (L-3) Fuel Handling Crane	100/10	--	--	R	--	--	C	R	C	--
Spent Fuel Shipping Cask	--	R	C	--	--	--	--	--	--	--
Pool Divider Gate (ANO-1/2)	2.0	R	C	--	--	R	--	--	--	--
Fuel Transfer Tube Gate Valve (ANO-2)	2.3	R	C	--	--	R	--	--	--	--
Fuel Handling Machine (ANO-1/2)	29.7	R	C	--	--	R	--	--	--	--
Upender (ANO-1/2)	7.2	R	C	--	--	R	--	--	--	--
New Fuel Shipping Container (ANO-1/2)	2.0	R	C	--	--	R	--	--	--	--
Hatch-over-Train Bay	1.0	R	C	--	--	R	--	--	--	--
4. (2L35) New Fuel Handling Crane	4	--	--	R	--	--	C	C	C	--

Table 2.1 (Cont.)

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
5. (L-7) Intake Structure Crane	25	--	--	R	--	--	C	R	--	--
Service Water Pump										
ANO 1 Motor	2.3	R	C	--	--	R	--	--	--	--
Pump	4.3	R	C	--	--	R	--	--	--	--
ANO 2 Motor	3.6	R	C	--	--	R	--	--	--	--
Pump	5.7	R	C	--	--	R	--	--	--	--
Fire Pump (P-6A)										
Motor	1.7	R	C	--	--	R	--	--	--	--
Pump	1.6	R	C	--	--	R	--	--	--	--
Fire Pump (P-6B)										
Engine	1.5	R	C	--	--	R	--	--	--	--
Pump	2.2	R	C	--	--	R	--	--	--	--
Room Hatch Plugs	3.6	R	C	--	--	R	--	--	--	--
6. Auxiliary Fuel Handling Crane	2	--	--	C	--	--	C	C	--	--

2.1.1 Safe Load Paths [Guideline 1, NUREG-0612, Article 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

The Licensee indicated that safe load paths have been 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. These load paths are defined in procedures, shown on equipment layout drawings, and will be clearly marked on the floor in the area where the load is to be handled prior to moving the load. Deviations from defined load paths will require written alternative procedures approved by the Plant Safety Committee. In addition, safe load zones have been developed for the spent fuel shipping casks, which provide specific bounds for crane movement and delineate pathways where casks are to be carried. The Licensee noted that these load paths will be reviewed when casks are eventually moved and deviations, if necessary, will require the approval of the Plant Safety Committee.

b. Evaluation and Conclusion

Safe load paths which have been developed at ANO satisfy the criteria of Guideline 1, including those load paths which have been developed for spent fuel shipping casks.

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

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

a. Summary of Licensee Statements and Conclusions

The Licensee stated that "procedures have been developed to cover load handling operations for heavy loads that are or could be handled over or in proximity to irradiated fuel or safe shutdown equipment. These procedures cover handling of loads listed in Table 3-1 of NUREG-0612. These procedures include the following: inspections and acceptance criteria required before movement of the load; the steps and proper sequence to be followed in handling the load; definition of the safe load paths; other special precautions."

Generic procedures which comply with this criterion have also been developed for the spent fuel shipping casks. As noted for safe load paths, these generic procedures will be reviewed prior to movement of any shipping cask, and deviations or revisions, if required, will receive the proper approvals.

b. Evaluation and Conclusion

Load handling procedures have been developed and implemented by APL in a manner consistent with that specified in Guideline 2, including those procedures developed for the spent fuel shipping cask. This finding is based on APL's verification that these procedures cover handling of all loads listed in Table 3-1 of NUREG-0612 and satisfy the criteria specified in the guideline.

2.1.3 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' [10]."

a. Summary of Licensee Statements and Conclusions

Selected ANO employees have been trained and qualified as crane operators in accordance with Chapter 2-3 of ANSI B30.2-1976.

APL has also made a commitment to establish appropriate procedures for monitoring operator conduct and assuring proper qualification of crane operators. This program is to include preparation of a training effectiveness evaluation to be administered to crane operators.

b. Evaluation and Conclusion

Crane operator training, conduct, and qualification programs being implemented at ANO satisfy the criteria of Guideline 3.

2.1.4 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' [11]. 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

The Licensee identified the following special lifting devices to be subject to the criteria of Guideline 4:

Unit 1

- head and internals handling fixture (tripod) (HIHF)
- internals handling adapter (IHA)
- internals handling extension (IHE)
- ISI tool lift rig (ARIS)

Unit 2

- o reactor head maintenance structure lift beam (RHMS LB)
- o refueling seal plate lift rig (RSP LR)
- o closure head lift rig (CH LR)
- o upper guide structure lift rig (UGS LR)
- o ISI (PAR) tool lift rig
- o hydraset

A complete list of load bearing components, actual stresses, yield stress, and ultimate stress has been tabulated. Review of available documentation indicates that all devices were specifically designed for the intended application, and were assigned to either AISC criteria or in-house criteria similar to that of ASME Section III, Division 1, Subsection NF.

The following are the minimum design factors of safety for each of the devices:

	Device	Minimum Y.S.	Minimum U.S.
Unit 1	HIHF	2.7	4.3
	HIA	2.96	3.53
	HIE	3.8	6.1
	ARIS	2.55	6.38
Unit 2	CHLR	4.63	9.0
	RHMS LB	3.16	5.1
	RSP LR	5.2	8.4
	UGS LR	3.2	5.06
	PAR	2.63	4.73
	Hydraset	3.24	4.94

For the Unit 1 head and internals handling fixture, the Licensee stated that actual margins are considered to be acceptable since the design load of the device is in excess of 300 tons (actual load weight is 81 tons). Similarly for the internals handling adapter, existing values are considered acceptable since design load is nearly three times actual load. For the ISI (ARIS) tool lift rig, review of vendor documentation indicates that this device was designed to meet the intent of NUREG-0612. Although the minimum yield strength of this device is only 85% of ANSI N14.6-1978 criteria, the design margin was based upon extreme load conditions, not normal operational loads. The minimum yield strength of the Unit 2 PAR lift rig is 88% of the specified ANSI design margin, which is also considered to be acceptable. (Dynamic considerations were applied in the determination of design margins for all devices.)

Based upon a review of design requirements and available documentation, the Licensee reached the following conclusions:

- o Special lifting devices in use in Unit 1 meet the intent of ANSI N14.6-1978 with the following exceptions:

  1. No documentation is available on the load tests performed on the head and internals handling fixture or the handling fixture extension (the internals handling adapter legs were load tested to the full weight of the core barrel assembly).

  2. While design specifications do not exist, design requirements are adequately documented in design calculations and on design drawings.

- o Special lifting devices in use at Unit 2 meet the intent of ANSI N14.6-1978 with the following exceptions:

  1. The closure head lift rig, reactor head maintenance structure lift beam, the refueling seal plate lift rig, and the ISI tool lift rig were not load tested.

As a baseline for future compliance, NDE inspections of all devices have been performed with satisfactory results. (The Unit 1 head and internals lift rig will be inspected; any defects noted will be corrected in accordance with guidance of ANSI N14.6.). To ensure that these devices will provide continuing reliability, the Licensee plans to incorporate inspections identified in ANSI N14.6-1978 (non-destructive examination [NDE]) into the plant's ISI plan, such that critical welds and components will be inspected over a 10-year ISI interval.

b. <u>Evaluation</u>

Although not originally designed to ANSI N14.6-1978, it is apparent from the Licensee's response that devices in use will provide a high degree of load handling reliability. Design margins employed in these devices satisfy ANSI requirements, with limited exceptions. For the exceptions noted, devices were designed based on design loads in excess of the actual loads lifted, or the design margins are within a reasonable percentage of ANSI values.

Although all lifting devices have not been load tested, the Licensee has provided assurances of fabrication practices and reliability of the devices based upon the well-established design margins and the extensive inspections and NDE performed on these devices.

Lastly, the Licensee has provided reasonable assurances that these devices will continue to perform their functions in a highly reliable manner. NDE of critical welds on a periodic basis is consistent with the intent of the ANSI standard based upon the limited frequency of use, sole-purpose design, and controlled storage of these devices.

c. Conclusion

Design of special lifting devices at ANO, as well as implementation of programs which ensure their continued reliability, is consistent with the intent of Guideline 4.

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

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

APL made a commitment to establish a suitable program for use and installation of slings, with respect to inspection, replacement, and other safe operating practices, which will satisfy the requirements of ANSI B30.9-1971. The Licensee also stated that selection and marking of slings will incorporate dynamic loading as identified in the general guideline.

b. Evaluation and Conclusion

APL satisfies the requirements of this guideline based on their verification that a program will be etablished for installation and use of slings which complies with ANSI B30.9-1971 and the dynamic loading criteria identified in this guideline.

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

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

a. Summary of Licensee Statements and Conclusions

A program has been developed which satisfies the criteria of Guideline 6 for inspection, testing, and maintenance of overhead and gantry cranes.

b. Evaluation and Conclusion

The Licensee satisfies the criteria of Guideline 6, based on the verification of such compliance by APL of its crane inspection, testing, and maintenance program.

2.1.7 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' [13]. 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 evaluated the following ANO cranes to determine design compliance with CMAA-70 and ANSI B30.2-1976:

- Unit 1 and Unit 2 polar cranes
- fuel and new fuel handling cranes
- auxiliary fuel handling crane
- intake structure gantry crane.

The Licensee stated that the ANO Unit 2 polar crane (2L2) and new fuel handling crane (2L35) were both designed and constructed to CMAA-70 and ANSI B30.2-1976 specifications. Both cranes, therefore, comply with the criteria of Guideline 7.

The auxiliary fuel handling crane is a 2-ton standard manufacturer's motorized-trolley hoist, which is suspended from an I-beam welded to one of the main bridge girders of the fuel handling crane. Since the hoist is integral with the fuel handling crane, the Licensee states that certain CMAA and ANSI requirements should be met by the hoist, particularly where the structural integrity of the fuel handling crane is affected. The auxiliary fuel handling crane was also reviewed by ANO to verify conformance with the requirements of ANSI B30.11-1973, "Monorail Systems and Underhung Cranes" [14], and ANSI B30.16-1973, "Overhead Hoists" [15], and were found to comply with the intent of both standards.

The ANO Unit 1 polar crane (L2) and fuel handling crane (L3) were designed and constructed prior to the issuance of CMAA-70 and ANSI B30.2-1976. Both cranes were constructed in accordance with EOCI-61, "Specifications for Electric Overhead Traveling Cranes" [16], which was then superseded by CMAA-70.

The Licensee stated that the intake structure gantry crane was also designed and constructed prior to the issuance of CMAA-70 and ANSI B30.2-1976 but was built to EOCI-61. APL performed a point-by-point review of CMAA-70 and ANSI B30.2-1976 requirements. The intake structure gantry crane was found to be in non-compliance with only one criterion (2-1.3.1.d) of ANSI B30.2-1976, which specifies that outdoor storage gantry cranes shall be provided with remotely operated rail clamps or equivalent devices and equipped with a wind indicating device which provides an audible and visual alarm at a predetermined wind velocity. The installed crane does not have remotely operated rail clamps or a wind indicating alarm. However, the crane does have a storm lock. ANO procedures require that crane operation be terminated, the crane load block placed on the ground or anchored upwind, and the storm lock set upon receipt of a Severe Weather Warning from the National Weather Service (NWS) indicating a high probability of a tornado or winds in excess of 40 knots in the area. Therefore, the Licensee stated that the intent of this ANSI requirement is met by existing design (storm lock) and by weather warnings which are readily available from the NWS, so that a potentially hazardous load handling condition does not result from specific non-compliance with this criterion.

Review has identified the following items where revisions incorporated into CMAA-70 were different from criteria contained in EOCI-61. However, actual design of the Unit 1 polar, fuel handling, and intake structure gantry cranes complies with the more restrictive standards of CMAA-70. These criteria are identified as follows:

1. Impact allowance. CMAA-70, Article 3.3.2.1.1.3 requires that crane design calculations include an impact allowance of 0.5% of the load per foot per minute of hoisting speed but not less than 15%. EOCI-61 specifies only a minimum allowance of 15%. Consequently, for cranes with hoist speeds in excess of 30 feet per minute, it is possible that the impact allowance applied under EOCI-61 will be less than that required by CMAA-70. ANO satisfies the criteria of CMAA-70 and EOCI-61 since main hoist speeds do not exceed 30 fpm.

2. Torsional forces. CMAA-70, Article 3.3.2.1.3 requires that twisting moments due to overhanging loads and lateral forces acting eccentric to the horizontal neutral axis of a girder be calculated on the basis of the distance between the center of gravity of the load, or force center line, and the girder shear center measured normal to the force vector. EOCI-61 states that such moments are to be calculated with reference to girder center of gravity. For girder sections symmetrical about each principal central axis (e.g., box section or I-beam girders 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). Box girders were used in the manufacture of cranes at ANO, satisfying the CMAA-70 requirements.

3. Allowable compressive stress. CMAA-70, Article 3.3.3.1.3 identifies allowable compressive stresses of approximately 50% of yield strength of the recommended structural material (A-36) for girders where the ratio of the distance between web plates to the thickness of the top cover plate (b/c ratio) is less than or equal to 38. Allowable compressive stresses decrease linearly for b/c ratios in excess of 38. EOCI-61 provides a similar method for calculating allowable compressive stresses except that the allowable stress decreases from approximately 50% of yield only after the b/c ratio exceeds 41. Consequently, structural members with b/c ratios in the general range of 38 to 52 designed under EOCI-61 will allow a slightly higher compressive stress than those designed under CMAA-70. Ratios for cranes at ANO are less than 33.6 and therefore satisfy this criterion.

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

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

6. 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. Longitudinal

stiffeners were not used on the intake structure crane; stiffeners used on the Unit 1 polar crane and fuel handling crane were chosen to satisfy seismic loading criteria and substantially meet CMAA-70 requirements.

7. 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. (CMAA-70 provides allowable stress ranges for loading cycles in excess of 20,000) and are not generally subjected to stress reversal (CMAA-70 allowable stress range is reduced to below the basic allowable stress for only a limited number of joint configurations). Fatigue failure is not a factor of consequence based on the allowable stress level for the ANO cranes.

8. Hoist rope requirements. CMAA-70, Article 4.2.1 requires that the capacity load plus the bottom block divided by the number of parts of rope not exceed 20% of the published rope breaking strength. EOCI-61 requires that the rated capacity load divided by the number of parts of rope not exceed 20% of the published rope breaking strength. Hoist rope capacities for the ANO cranes each exceed 20% of breaking strength and therefore satisfy CMAA-70 criteria.

9. 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. Drum designs of these cranes satisfy CMAA-70 criteria.

10. 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 of the intake structure crane satisfy CMAA-70 requirements. For the auxiliary hoists of both the Unit 1 polar crane and the fuel handling crane, this minimum depth is not met (deviations noted are 11.1% for the fuel handling crane and 6.7% for the polar crane). It is the Licensee's position that the actual hoist groove depths provide sufficient margin of load handling safety.

11. Gear design. CMAA-70, Article 4.5 requires that gearing horsepower rating be based on certain American Gear Manufacturers Association Standards and provides a method for determining allowable horsepower. EOCI-61 provides no similar guidance. Gear horsepower ratings for each crane satisfy CMAA-70 criteria.

12. Hoist brake design. CMAA-70, Article 4.7.4.2 requires that hoist holding brakes, when used with a method of control braking other than mechanical, have torque ratings no less than 125% of the hoist motor torque. EOCI-61 requires a hoist holding brake torque rating of no less than 100% of the hoist motor torque without regard to the type of control brake employed. For the intake structure crane, two 150% holding brakes are installed. For the polar and fuel handling cranes, the vendor states CMAA-70 criteria are satisfied.

13. Bumpers and stops. CMAA-70, Article 4.12 provides substantial guidance for the design and installation of bridge and trolley bumpers and stops for cranes which operate near the ends of bridge and trolley travel. No similar guidance is provided in EOCI-61. Bridge and trolley bumpers and stops for the intake structure crane satisfy CMAA-70. For remaining cranes, the vendor indicates that cranes comply with CMAA-70 (no bridge bumpers installed on polar crane).

14. Static control systems. CMAA-70, Article 5.4.6 provides substantial guidance for the use of static control systems. EOCI-61 provides guidance for magnetic control systems only. Control systems used on all cranes conform with applicable requirements of CMAA-70.

b. Evaluation

The Unit 2 polar crane and the new fuel handling crane satisfy the criteria of Guideline 7 based upon the Licensee's verification that both cranes were originally designed and constructed to CMAA-70 and ANSI B30.2-1976 standards.

Design of the auxiliary fuel handling crane satisfies the criteria of this guideline based upon the Licensee's verification that this crane conforms to the requirements of applicable industry standards.

Although the ANO Unit 1 polar crane, fuel handling crane, and intake structure gantry crane were not designed in accordance with MAA-70, original design in accordance with EOCI-61 indicates that they were designed in accordance with existing industrial standards. Furthermore, the Licensee performed a detailed comparison of existing design with the more restrictive criteria of CMMA-70 and determined that existing design conforms with CMAA-70. Therefore, design of these cranes is also consistent with that identified in this guideline.

For the intake structure gantry crane, the Licensee's response that Criterion 2-1.3.1d of ANSI B30.2-1976 is satisfied by the existing crane storm lock and use of APL's administrative procedures to terminate load handling operations in the event of severe weather conditions is acceptable based upon the fact that suitable procedural and administrative measures have been identified to verify that the dispatcher will notify the operator, load handling operations will be terminated, and the storm lock will be applied in the event of a Severe Weather Warning from the NWS.

c. Conclusion

Design of cranes at ANO 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 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

Technical specifications implemented by the Licensee (Technical Specification 3.8.15 at ANO Unit 1 and 3.9.7 at ANO Unit 2) state the following: "Loads in excess of 2000 pounds shall be prohibited from travel over fuel assemblies in the fuel storage pool." These technical specifications satisfy the criteria of Interim Protection Measure 1.

b. Conclusion

ANO complies with Interim Protection Measure 1.

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

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

a. Summary of Licensee Statements and Conclusions

Summaries of Licensee statements and conclusions are contained in discussions of the respective general guidelines in Sections 2.1.1, 2.1.2, 2.1.3, and 2.1.6.

b. Evaluation and Conclusions

Evaluations, and conclusions, are contained in discussions of the respective general guidelines in Sections 2.1.1, 2.1.2, 2.1.3, and 2.1.6.

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

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

a. Summary of Licensee Statements and Conclusions

Special attention will be given to procedures, equipment, and personnel for the handling of heavy loads over the core.

b. Evaluation and Conclusion

Based upon the Licensee's verification, the criteria of this interim protection measure will be satisfied at ANO.

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 Arkansas Nuclear One. 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 Arkansas Nuclear One can be expected to be conducted in a highly reliable manner consistent with the staff's objectives as expressed in these guidelines.

3.2 INTERIM PROTECTION

The NRC staff has established (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 ANO complies with the staff's measures for interim protection.

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