Omaha Public Power District

1623 HARNEY ■ OMAHA, NEBRASKA 68102 ■ TELEPHONE 536-4000 AREA CODE 402

June 2, 1982
LIC-82-224

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

Control of Heavy Loads

In November, 1981, Mr. Tourigny of your staff forwarded a draft Technical Evaluation Report (TER-C5257-94) to Omaha Public Power District for comment. The TER reported the results of Franklin Research Center's (FRC's) assessment of the Fort Calhoun Station's heavy load handling capabilities. Please find enclosed the District's response to each of FRC's comments in the TER.

It should be noted that some of the detailed information requested is not available and only some could be developed through additional detailed and costly analysis. The District believes that, based upon our ten years of operational experience and the existence of commonly accepted design and manufacturing practices for cranes at the time of manufacture, the unavailability of this information is not a significant concern, as discussed in the enclosed responses. The District is not considering further action on this issue, pending further review by the Commission.

Sincerely,

W. C. Jones
Division Manager
Production Operations

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Enclosure

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036

Comments to FRC's

Evaluation

Section 2.1.1 Overhead Heavy Load Handling Systems

FRC Comment:

Criteria for the implementation of these phases are contained in Section 5.1 of NUREG-0612: Phase 1 is contained in Section 5.1.1.; Phase II is cont ned in Sections 5.1.2 through 5.1.5. All handling systems which handle heavy loads in the area of the reactor vessel, spent fuel pool, or over safe shutdown equipment should satisfy the general guidelines requirements. Based upon this, FRC does not concur with the Licensee's exclusion of the two concrete slab removal cranes, the waste evaporator equipment handling crane, the deborating demineralizer area crane, and the intake structure crane.

The requirements of NUREG-0612 Sections 5.1.2 through 5.1.5 provide for the identification of the need for additional design features (e.g., a single - failure-proof crane) for cranes in those areas. For the cranes the Licensee has excluded from satisfying NUREG-0612, the existence of intervening floors may eliminate the need for providing single-failure-proof cranes; however, the Licensee is not exempt from satisfying the general guidelines of Section 5.1.1 for each of these cranes. Therefore, the Licensee should include these cranes on the list of overhead heavy load handling systems which are evaluated in accordance with these general guidelines.

OPPD Response:

The Intake Structure Crane, Waste Evaporator Crane, Deborating Demineralizer Area Crane, and the two Concrete Slab Removal cranes are included in the Section 2.1.1 response and is addressed accordingly in each subsection below.

Section 2.1.2 Safe Load Paths [Guideline 1, NUREG-0612, Article 5.1.1(1)]

FRC Comment:

The Fort Calhoun Station does not satisfy the safe load path criteria of Guideline 1. Although the Licensee believes that the restrictions placed on the polar and auxiliary building cranes minimize the potential for damage due to a load drop, these restrictions do not satisfy the requirement that safe load paths be defined for each heavy load handled in the vicinity of safe shutdown equipment or irradiated fuel.

The Licensee does not satisfy the requirement that safe load paths be clearly marked on the floor.

The Licensee partially satisfies the requirements concerning deviations from defined load paths since deviations from restrictions placed on the polar and auxiliary building cranes require Plant Review Committee approval. However, the Licensee must still address deviations from individual safe load paths.

The Licensee did not submit sufficient information to allow FRC to determine whether load paths follow structural floor members.

The Fort Calhoun Station does not comply with the criteria of Guideline 1. The Licensee should develop a program by which each individual heavy load is handled in accordance with the safe load path criteria (i.e., safe load paths are defined in procedures, follow structural members, are defined in equipment arrangement drawings, and are clearly marked, and deviations are properly controlled).

OPPD Response:

a) Definition and marking of load paths:

The District contends that we do meet the intent of the criteria in Guideline 1. The safe load paths are defined in the load handling procedures, wherein all paths with the exception of the restricted areas are considered equally acceptable. By defining a safe load path (area) for all loads, this is equivalent to defining a safe load path for each load. For example, the Polar crane is currently restricted from operating over the reactor (unless removing the Vessel head and internals). This area has been indicated in plant layout drawings which were submitted with our original Section 2.1 response. These drawings will be incorporated into the load handling procedures. Similarly, the Auxiliary Building crane is limited from moving over the spent fuel pool area. Since all other areas except for the restricted areas defined above are safe load path areas, defining individual load paths is not necessary.

NUREG-0612 states that the load paths should follow structural members. This, in our opinion would result in increased complexity and greater operator stress and as such may result in higher probability of a load drop due to operator error.

As to the actual physical marking of the load paths on the floor, no provision is being made to physically mark these paths. However, other indications of safe load path boundaries are provided. In the Containment the Polar crane is operated from a pendant control station. The operator would not have full visual access to follow each individual marking, due to the irregularities of the floors and walls. It would be confusing to try and follow a physically marked load path. This could increase the probability of a load drop occuring. Further, marking of the load paths in Containment is not feasible since markings in the reactor cavity could contaminate the reactor coolant and such marking could be incompatible to the Stainless Steel liner in a boric acid environment. Also, markings on the crane bridge would have to be reversible (symmetric).

With respect to the Auxiliary Building Crane, this crane operates without restriction except over the spent fuel pool. The unrestricted area does not extend over any safe shutdown equipment or irradiated fuel. The Auxiliary Building crane safe load path boundary (the Spent Fuel Pool) is visually evident to the crane operator since the sides of the pool are elevated 13.5' above the surrounding floor level.

Safe Load Paths for the Monorails is a moot issue, since there is only one possible load path for these cranes (Waste Evaporator, Deborating Demineralizer, and Concrete Slab Removal cranes).

For the Intake Structure crane, the District believes that marking load paths along the structural members would add to the complexity of load handling and thereby increase the possibility of a load drop accident due to increased operator stress.

The only safety related equipment in the intake structure are Raw Water Pumps and associated piping, valves and cabling. Raw Water pumps are not required for Hot Shutdown. However, two pumps will be required to achieve cold shutdown following a load drop accident. As indicated in our response to sections 2.4.2a of NUREG-0612, a load drop accident in most parts of the Intake Structure will not effect more than one Raw Water Pump. The only area where a load drop may result in failure of all Raw Water Pumps is the area bounded by columns D-D and C-C by rows 102 and 105, an area of about 650 sq. ft. this represents 15% of the whole crane accessibility. A load drop accident in this area may result in failure of power and control cables of the Raw Water Pumps. Considering that the Intake Structure Crane is very rarely used for handling of heavy loads and the area where the load drop could result in failure of all raw water pumps is only 15% of the total crane accessiblity area, the probability of a load drop accident resulting in failure of raw water pumps is very insignificant. Also, the Raw Water Pumps will not be required for approximately eight (8) hours following an accident and repairs can be made in a reasonable time to affect cold shutdown. In addition, fire pumps can be used as a backup.

It is, therefore, our conclusion that marking of load paths in the Intake Structure would not improve plant safety and would create unnecessary restrictions on load handling possibly increasing the probability of load drop accidents due to increased operator stress and as such we request an exemption from meeting this requirement.

b. Deviation from Load Paths:

This item has been addressed by plant procedures. Any deviations from the established plant procedures, which define load paths by exclusion, require PRC approval. This would be equivalent to handling deviations from individual load paths. In addition to the area restrictions placed on the Polar Crane, this crane is restricted in operation over the reactor core, additional restrictions are made to minimize the height of the lift, and prohibit polar crane operation when the reactor coolant system temperature is greater than 225°F. (Thus ensuring that equipment will not be damaged which could inhibit the plants capability to Safely Shutdown.)

Deviations from safe load paths for monorails is not addressable since these hoists cannot deviate from their path.

There is no deviation from a safe load path in the Intake Structures since all areas are considered equally safe.

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

FRC Comment:

The Fort Calhoun Station partially satisfies the criteria of Guideline 2, on the basis of the Licensee's verification of compliance with Section 5.1.1(2) of NUREG-0612 with the exceptions that the safe load paths have not been defined in the procedures and no procedures have been developed for the spent fuel shipping cask. Since the review by FRC constitutes the only comprehensive evaluation of load handling practice at the Fort Calhoun Station, all issues should be resolved either by compliance or by instituting the recommended corrective actons within a reasonable period of time so that no items will be deferred to a future unspecified date.

The Fort Calhoun Station partially complies with the criteria of Guideline 2. To comply fully, the Licensee should ensure that safe load paths are defined in procedures for handling heavy loads and that procedures are developed for handling the spent fuel shipping cask.

OPPD RESPONSE:

At this time the District does not have a shipping cask. A procedure will be written when utilizing the shipping cask becomes necessary. The intent of NUREG-0612, Guideline 5.1.1(2) will be met when the procedure is written.

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

FRC Comment:

The crane operator training and qualification program that will be implemented at the Fort Calhoun Station will fully satisfy the Criteria of Guidelines 3.

OPPD RESPONSE:

With respect to Polar crane and Aux. Bldg. crane, Fort Calhoun is in complete compliance with the NUREG-0612 requirements.

ANSI B30.2 code does not specify that operators of monorail cranes be trained or qualified and as such this requirement is not applicable to monorail operators.

Operators for the Intake Structure crane are not trained in accordance with ANSI B30.2. However, as explained earlier the probability of a load drop accident which could result in failure of Raw Water Pumps is very small as such we would like to take exception to the requirement of retraining the intake structure crane operator in accordance with ANSI B30.2.

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

FRC Comment:

No information was provided for FRC to evaluate whether specially designed lifting devices at the Fort Calhoun Station meet the criteria of ANSI 14.6-1978.

OPPD Response:

The Fort Calhoun Station Lift Rigs identified in our previous response to Section 2.1 were designed and purchased in 1968. At that time no special industry standards existed for the design of lifting rigs. The steel members and components were designed in accordance with the guidelines of the American Institute of Steel Construction (AISC), Edition 6. This code does not provide detailed guidelines pertaining to the design of the lift rigs but does provide sufficient requirements to achieve a safe design of steel components.

We have evaluated all items of the ANSI Code relating to our lift rigs, as requested by the FRC. We have searched our files and contacted our vendor to obtain the necessary data for the design of the lift rigs. In some cases, the vendor has shown his inability to provide the information pertaining to some of the items required by ANSI Code, due to lack of information available in vendor's files or lack of time.

Our response to these items are as follows:

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 components.	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. 24, '70. See Table #1, in Appendix.	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

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
3.2.1 Use of stress design factors of 3 for minimum yield strength and 5 for ultimate strength.	See Table #1, Appendix	Unable to address for lack of information from the vendor.
3.2.4 Similar stress design factors for load bearing pins, links, and adapters.	Complies See Table #1 Appendix	Unable to address for lack of information from the vendor.
3.2.5 Slings used comply with ANSI B30.9	Complies	Complies
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 lack of information from vendor.
3.3.4 Design shall assure 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 assure 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.

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
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.	Procedures for use of Lift rigs, are detailed in the removal of RCVH procedure #MP-RC-6-1, RC-6-2	Procedure MP-RC-7-2 guidelines for use of UGS Lift Rig
5.1.5.1 Identification of subassemblies which may be exchanged.	Subassemblies may not be exchanged	Subassemblies may not be exchanged
5.1.5.1 Suitable markings	Complies	Complies
5.1.6 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. c) The lift rig is visually inspected prior to every lift. d) The lift rig is used twice during the refueling outage only.	This requirement 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. c) The lift rig is visually inspected prior to every lift. d) The lift rig is used twice during the refueling outage only.
5.1.7 Conditions for removal from service.	Subject to visual inspection	Subject to visual inspection

ANSI N14.6-1978 Section Reference	Reactor Closure Head Lift Rig	Upper Guide Structure Lift Rig
Section 5.2		
5.2.1 Load test to 150% and appropriate inspections prior to initial use.	Load tests was not performed. However, the lifting rigs have been inspected and used to its rated loads for over ten 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.	
Section 5.3		
5.3.1 Satisfying annual load test or inspection requirements.	Inspected prior to use every 1.25-1.5 yrs depending upon frequency of refueling.	
5.3.2 Testing following major maintenance	No procedures for testing after major maintenance	
5.3.4 Testing after application of substantial stress	No procedure for testing after substantial stress	
5.3.6 Inspections by operating personnel	Inspections are performed by quality control personnel	
5.3.7 Non operating or maintenance personnel	Not applicable	

As indicated above, most of the design data available has shown that the lift rigs designed, in accordance with AISC, 6th Edition do comply with the intent of the ANSI Code. We were unable to address some of the items, either due to lack of information available to us or the guidelines were not required by the code at that time.

In some areas such as load testing the load tests were not performed because AISC, 6th Edition did not require it. However, the lifting rigs have been inspected and used to it's rated load capacity over ten years without any identified defects. The District believes our operating experience demonstrates there is sufficient justification that the load testing could be waived. Regarding quality assurance and fabrication procedures, we could not provide enough information as no documents were available in our files.

The critical items, such as the design stresses, inspection and testing are addressed in our response. We believe that they meet the intent of the ANSI N14.6 Code, which is namely to provide good engineering. We acknowledge that we could not address properly, the areas dealing with documentation control due to lack of the information available to us. However, it has been demonstrated that safe engineering practices were used in the design of the rigs and lack of documentation does not affect the safety and performance of the lift rigs.

In light of the above, we believe exceptions to some of the items listed by the FRC are justified.

Special Lift Rigs are not used with the monorails or the Intake Structure Crane.

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

FRC Comment:

The Licensee did not provide information to allow FRC to evaluate whether the lifting device not specially designed meet ANSI B30.9-1971.

OPPD Response: Lifting Devices that are not Specially Designed Slings are installed and used in accordance with ANSI B30.9 - 1971. This includes dynamic and static loading.

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

FRC Comment:

The Licensee has developed a program of crane inspection, testing, and maintenance which satisfies the criteria of Guideline 6.

OPPD Response:

With regard to the Polar Crane and Aux Bldg. Crane we are in compliance with criteria of Guideline 6.

The monorails are not required to be inspected by the ANSI B30.2 code. However, the monorails are inspected annually and nondestructive testing of the crane hooks are performed at that time also.

The Intake Structure Crane is not presently required to be inspected by the ANSI B30.2 code, but it is inspected and maintained semi-annually, with annual nondestructive testing of the crane hook. Testing is performed which meets the intent of the ANSI code thus we would take exception to applying the ANSI criteria to this crane.

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

FRC Comment:

The auxiliary building crane satisfies the criteria of Guideline 7 on the basis of the Licensee's verification that the crane is currently being retrofitted and has been designed to meet ANSI B30.2-1976 and CMAA-70.

The polar crane substantially satisifies the criteria of Guideline 7 on the basis of the Licensee's verification that this crane conforms to the requirements of the industry standards that were applicable when it was built and meets the majority of current CMAA-70 standards. The Licensee's evaluation of existing crane design indicates that the values for hoist speed (less than 6 feet per minute) and b/c ratio (24) are within the limits of, and therefore satisfy, CMAA-70 criteria for impact allowance and compressive stress. However, information supplied by the Licensee is insufficient to allow FRC to determine if the installed polar crane hoisting rope meets the breaking strength requirements of CMAA-70.

FRC has compared the recommendations of CMAA-70 against those of EOCI-61 and has indentified several additional areas where revisions incorporated into CMAA-70 which may affect crane safety have not been specifically addressed by the Licensee. The Licensee should evaluate these areas to determine whether the intent of Guideline 7 of NUREG-0612 is satisifed. The following CMAA-70 issues should be addressed in the Licensee's review.

FRC Comment:

1. Nonsymmetrical girder sections were not used.

2. Any longitudinal stiffeners in use conform to the requirements of CMAA-70 and allowable h/t ratios in box girders using these stiffeners do not exceed those specified in CMAA-70.

3. Fatigue failure was considered in crane design and the number of design loading cycles at or near rated load was less than 20,000.

4. Drum design calculations were based on the combination of crushing and bending loads.

5. Drum groove depth and pitch substantially conform to the recommendations of CMAA-70.

6. A cab-control, cab-on-trolley, configuration was not used.

7. Either a mechanical load brake was used or hoist holding brakes have torque ratings in excess of the hoist motor torque (approximately 125%).

8. Crane operation under load near the end of bridge or trolley travel either is not allowed or is compensated for by bumpers and stops in substantial conformance to the requirements of CMAA-70.

9. Static control systems were not used or substantially conform to the requirements of CMAA-70.

10. Spring-return or momentary-contact pushbutton controllers were used or controllers are equipped with a device which disconnects all motors on power failure and will not permit restart until the controller handle is brought to the OFF position.

11. Maximum crane load weight plus the weight of the bottom block, divided by number of parts of rope, does not exceed 20% of the manufacturer's published breaking strength.

OPPD Response:

The FRC has requested that we address each item as listed above and supply them with verification as to our compliance and noncompliance.

The District has evaluated the polar crane design as per FRC's recommendations, and have concluded that some of these items cannot be addressed for lack of information from our vendor. We have contacted the Polar Crane vendor and have been advised that to supply the equired information would take at least three (3) months. However we can answer most of the FRC's concers. The following items are addressed:

1. Nonsymmetrical girders were not used.

2. Longitudinal Stiffeners

   a) h/t = 240 Complies with CMAA-70, allowable h/t - 286

   b) As shown in attachment 1, Moment of inertia for the polar crane is 8.34 IN^4 which is 5.1% less than the CMAA-70 required moment of inertia of 8.796 IN^4. The moment of inertia required by CMAA-70 is 20% more than required by EOCI-61. The polar crane was designed in accordance with EOCI-61. In our judgement a 5.1% less moment of inertia is considered acceptable.

   Thus the crane design meets the requirements of CMAA-70, Article 3.3.3.1, longitudinal stiffeners. *(See calculation sheets Appendix for justification)

3. Fatigue Failures

   The Polar Crane is used to lift loads less than its design condition on a 2 lifts per refueling basis. Thus the near design loading cycle is not even close to the 20,000 frequency cycles limit for stress evaluation listed in the CMAA 70 code. Thus the requirements of the CMAA-70 code are not of consequence to the design of the Polar Crane.

4. Drum Design:

   The District is not able to adress this item for lack of information from the vendor. However, since this crane was designed to the EOCI code, the drum was designed to withstand maximum load bending and crushing. The combination of the two was not part of the EOCI code, but we feel that the drum design meets the intent of the CMAA-70 code.

5. Drum Design:

   a) Drum groove depth (minimum required: .4688" - actual provided 0.75", this meets the criteria of CMAA-70, Article 4.4.3)
   b) Drum pitch (minimum required: 1.41" actual provided 1.625") this complies with the CMAA-70 criteria, Article 4.4.3.

6. Bridge Brake Design:

Our Polar Crane does not use cab-control, or cab-on-trolley control, thus we meet the criteria set forth.

7. Hoist Brake Design:

We are unable to address this item for lack of information from the vendor. However, since it was designed to EOCI criteria, the hoist holding brake torque rating is not less than 100% of the hoist motor torque. In our opinion the 100% rating provides a sufficient margin of safety and was considered good engineering practice.

8. Bumpers and Stops:

The bridge of the polar crane does not have bumpers such as this polar crane. The trolley however has both bumpers and stops near the end of trolley travel.

9. Static Control System:

Our polar crane uses static control systems, however, for lack of information from vendor, we are unable to address this item in comparison to the CMAA-70 code.

Since the crane was designed to EOCI criteria no specifications were made as to the design of static control systems. However, we believe that good engineering practices were used as indicated by the design factors listed above, they exemplify that the polar crane substantially conforms to most of the CMAA criteria, even though it was designed to EOCI-61 criteria.

10. Restart Protection:

Since our crane is equipped with momentary contact push buttons, no device is necessary that will disconnect all motors upon power failure.

11. Breaking Strength of Rope:

We have verified that the maximum crane load weight plus the weight of the bottom block, divided by the number of parts of rope, does not exceed 20% of the manufacturer's publishing breaking strength.

As shown above in our response to FRC's comments our polar crane design has shown that good engineering practices were used, and though not designed to CMAA-70 that it substantially meets the codes criteria.

We believe that in the cases where FRC comments could not be answered, that this polar crane does meet the intent of the CMAA code. We would like to take exception to answering items 4, 7, 9 due to lack of information, and on the basis that not meeting these criteria does not indicate unsafe practices.

A comparison of EOCI-61 and CMAA-70 for items 4 and 7 shows that only small differences exist between the two codes. However since EOCI-61 does not give guidance for the design of static control systems, we believe that safe engineering was used as in the rest of the crane design.

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 the EOCI-61 criteria. In regard to the design of the monorails, the CMAA-70 and ANSI B30.2 chapter 2.1 codes do not specify any criteria for their design.

As was shown for the Polar Crane, the crane design using the EOCI code substantially conforms to the CMAA code thus meeting the intent of the CMAA code, and therefore we feel that since the Intake Structure Crane was designed to this code, that a point-by-point comparison will not be required.

SECTION 3, FRC Response: "The licensee made no statements or conclusions regarding this (special reviews for heavy loads over the core) interim protection measures.

OPPD Response:

Attached is a copy of our interim protection measures which were implemented May 15, 1981.

TABLE NO. 1
SUMMARY OF STRESS LEVELS & SAFETY FACTORS IN HEAD LIFT RIG COMPONENT PARTS

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

ELEMENT	STRESS CONDITION	NORMAL LOAD STRESS	MIN. YIELD STRESS	MINIMUM ULTIMATE STRENGTH	MATERIAL		RATIO = ULT. STRESS/ NOR. LOAD	RATIO = YLD.STRESS/ NOR. LOAD
TRIPOD	TENSION	5.1	37.5	75.0	A235-E	120°F	14.7	7.4
LIFTING EYE	SHEAR	5.3	21.6	50.0	A235-E	120°F	9.4	4.1
TRIPOD LIFTING EYE SHANK	TENSION	11.7	37.5	75.0	A235-E	120°F	6.4	3.2
LIFTING	SHEAR	6.2	21.5	46.7	SA516-70	120°F	7.5	3.5
FRAME LUG	BEARING	13.1	37.3	70.0	SA516-70	120°F	5.3	2.85*
PIN	SHEAR	7.7	50.5	76.7	SA193	120°F	9.9	6.6
ROD	TENSION	9.3	77.0	100.0	4340	120°F	10.7	8.3
	SHEAR (THD.)	3.5	44.4	66.7	4340	120°F	19.0	12.7
CLEVIS	SHEAR	3.9	20.4	46.7	SA105II	120°F	11.9	5.2
	BEARING	7.8	35.4	70.0	SA105II	120°F	8.9	4.5
	TENSION	2.5	35.4	70.0	SA105II	120°F	28.0	14.2
PIPE AND	COMPRESSION	3.5		60.0	SA106B	120°F	17.1	
PIPE WELD	SHEAR	2.1	29.1	48.0	SA233	E7015	22.8	13.9
TUBING	TENSION	11.3	50.4	72.0	SA233	E7015	6.4	4.5
LIFTING	BEARING	6.4	37.5	75.0	A235-E	120°F	11.7	5.9
EYE AND WELD	SHEAR	3.0	21.6	50.0	A235-E	120°F	16.7	7.2
TUBE AND	TENSION	7.6	36.0	58.0	SA36		7.6	4.7
TUBE SHELL WELD	SHEAR	12.8	29.1	48.0	SA233		3.7*	2.3*
SHELL	TENSION	1.2	36.0	58.0	SA36	120°F	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 the required.

ATTACHMENT 1

GSE B-9-1 Form
Rev. 3/79

GSE CALCULATION SHEET

GSE TASK ES-FC-81-04
CALCULATED BY B. J. Nanda
CHECKED BY Jan Menue
SUBJECT CONTROL OF HEAVY LOADS

DATE 7-5-82
SHEET NO. 1 OF
REFERENCE CMAA-70, HARNISCHFEGER
REVISION

PURPOSE

THE PURPOSE OF THIS ATTACHMENT IS TO SHOW COMPLIANCE OF THE FORT CALHOUN STATION POLAR CRANE TO THE CRANE MANUFACTURERS ASSOCIATION OF AMERICA SPECIFICATION NO. 70 SECTIONS, TORSIONAL FORCES (ART. 3.3.2.1.3) AND LONGITUDINAL STIFFENERS (ART. 3.3.3.1) AS REQUIRED BY NUREG-0612 SECTION 5.1.1. COMPLIANCE IS BASED ON ACTUAL DATA AND CALCULATIONS AS PER ARTICLES 3.3.2.1.3 AND 3.3.3.1.

GSE B-9-1 Form Rev. 3/79	GSE CALCULATION SHEET

GSE TASK ES-FC-81-04
CALCULATED BY B. S. Nanda
CHECKED BY Jan Moore
SUBJECT CONTROL OF HEAVY LOADS

DATE 2-5-82
SHEET NO. 2 OF 11
REFERENCE CMAA-70, HARNISCHFEGER
REVISION

INTRODUCTION

CONTAINMENT POLAR CRANE AT THE FORT CALHOUN STATION WAS DESIGNED, MANUFACTURED AND INSTALLED IN ACCORDANCE WITH THE ELECTRIC OVERHEAD CRANE INSTITUTE SPECIFICATION NO. 61 (EOCI-61). THIS SPECIFICATION WAS REVISED IN 1975 AND IS KNOWN AS THE CRANE MANUFACTURERS ASSOCIATION OF AMERICA SPECIFICATION NO. 70.

TO SATISFY REQUIREMENTS OF NUREG-0612, SECTION 5.1.1, A COMPARISON OF CMAA-70 AND EOCI-61 WAS SUBMITTED AS A PART OF RESPONSE TO NUREG-0612, ENCLOSURE 3, SECTION 2.1 TO SHOW THE ADEQUACY OF THE CONTAINMENT POLAR CRANE AT FORT CALHOUN.

THE TECHNICAL EVALUATION OF THIS RESPONSE WAS PERFORMED BY THE FRANKLIN RESEARCH INSTITUTE AND A DRAFT EVALUATION REPORT WAS ISSUED ON OCTOBER 19, 1981. THIS REPORT HAS MADE RECOMMENDATIONS THAT THE LICENSEE (OPPD) SHOULD PROVIDE

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GSE CALCULATION SHEET

GSE TASK ES-EC-81-04
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DATE 2-5-82
SHEET NO. 3 OF 11
REFERENCE CMAA-70, HARNISCHFEGER
REVISION

JUSTIFICATION BY CALCULATIONS THAT THE REQUIREMENTS OF CMAA-70 ARE SATISFIED.

SUMMARY OF RESULTS

THE CALCULATIONS ON THE FOLLOWING PAGES SHOW THAT THE CRANE DESIGN DOES MEET THE REQUIREMENTS OF CMAA-70 SECTIONS, TORSIONAL FORCES (ART. 3.3.2.1.3) AND LONGITUDINAL STIFFENERS (ART. 3.3.3.1)

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GSE CALCULATION SHEET

GSE TASK ES-FC-81-04
CALCULATED BY B. S. Nanda
CHECKED BY J. Monroe
SUBJECT CONTROL OF HEAVY LOADS

DATE 7-5-82
SHEET NO. 4 OF 11
REFERENCE CMAA-70, HARNISCHFEGER
REVISION

REFERENCES

1. CRANE MANUFACTURERS ASSOCIATION OF AMERICA SPECIFICATION NO. 70 (CMAA-70)
2. ELECTRIC OVERHEAD CRANE INSTITUTE SPEC #61. (EOCI-61)
3. DRAFT TECHNICAL EVALUATION REPORT - CONTROL OF HEAVY LOADS BY FRANKLIN RESEARCH CENTER.
4. HARNISCHFEGER GIRDER DESIGN FOR POLAR CRANE
5. AISC STEEL CONSTRUCTION.

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SUBJECT Control of Heavy Loads

DATE 1-7-82
SHEET NO. 5 OF 11
REFERENCE CMAA-70, Hornischfeger
REVISION

NOMENCLATURE

a = Longitudinal distance between full depth diaphragms or transverse stiffeners in inches.

As = Area of one longitudinal stiffener in square inches.

b = Distance between web plates

c = Thickness of top Cover plate in inches.

C = coefficient for Longitudinal Stiffeners CMAA-70 pg. 13

d = Distance of C.G., of angle from C.G. of stiffener

fc = Maximum compressive stress

ft = Maximum tensile stress

h = Depth of web in inches

I_o = moment of inertia

I_L = moment of inertia

K = ft / fc

l = Span in inches

M = coefficient for Longitudinal Stiffeners CMAA-70 pg. 13

t = Thickness of web in inches.

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GSE TASK ES-81-04	DATE 1-7-82
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VALUES USED

$a = 66''$

$A_s = 1.62\ in^2$ for L3" x 2½" x 5/16"

$b = 30''$ Harnischfeger design girder data

$c = 1.25''$ Harnischfeger design girder data

$C = 162$ CMAA-70 pg. 13 for one stiffener

$d = (3 - .93) = 2.07''$

$f_c = 12.1$ Ksi Girder Design Data

$f_t = 5.6$ Ksi Girder Design Data

$h = 90''$ " " "

$I_o =$ Calculated on sheet $= 8.796\ in.^4$

$I_L =$ Calculated on sheet $= 8.34\ in.^4$

$k = f_t / f_c = .462$

$l = 1272''$ Girder Design Data.

$M = 376$ CMAA-70 pg. 13

$t = 3/8''$ Girder Design Data

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SUBJECT Control of Heavy Loads	REVISION

REQUIREMENTS OF CMAA-70, ARTICLE 3.3.3.1

The CMAA-70 gives guidelines for longitudinal stiffeners. Below is the criteria used to Design the Polar Crane.

3.3.3.1.1 PROPORTIONS

$l = 106'$, $h = 90''$, $b = 30''$, $c = 1.25''$ - (REF. 4)

a) $l/h = \frac{106'' \times 12''}{90''} = 14.1 < 25$ (allowable)

$l/b = \frac{106' \times 12''}{30''} = 42.4 < 60$ (allowable)

$b/c = \frac{30''}{1.25''} = 24 < 60$ (allowable)

l = Span in inches
h = Depth of web in inches
b = Distance between web plates in inches
c = Thickness of top cover plate in inches

Thus we meet the CMAA-70 criteria for proportions

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b) h/t ratio

Requirement: $h/t \le C(K+1)\sqrt{\frac{17.6}{f_c}}$ $\le M$

this is referenced in CMAA-70 pg. 13

For One Longitudinal Stiffener
$C = 162$, $m = 376$ (CMAA-70 pg 13)

from our Girder design data (REF 4) sheet 12 dated April, 69 we derived the f_t and f_c values.

$f_t = 5.6$ Ksi $f_c = 12.1$ Ksi

$K = f_t / f_c = 5.6 / 12.1 = .462$

$$C(K+1)\sqrt{\frac{17.6}{f_c}} = 162(1+.462)\sqrt{\frac{17.6}{12.1}} = 286$$

Our provided $h/t = \frac{90 \times 8}{3} = 240$

$t = 3/8"$

Conclusion: Provided $240 <$ Max. Allow. 286

Therefore meets CMAA-70 criteria
See Figure 1

3.3.1.2 Longitudinal Stiffeners

The Polar Crane was provided with a 3" x 2½" x 5/16" Angle. One stiffener was provided 25" from the top flange.

Below are calculations indicating the stiffener's compliance to the CMAA-70 criteria.

a) Stiffener Replacement:

Requirement: Stiffener spacing from top flange

= .4x(h/2)

Provided = .4x(61.5") = 24.6"

Conclusion: Provided spacing = 25" ≈ 24.6 O.K.

b) Moment of Inertia:

Requirement: $I_o = 1.2\left[.4 + .6\left(\frac{a}{h}\right) + .9\left(\frac{a}{h}\right)^2 + 8\left(\frac{A_{sa}}{h^2 t}\right)\right] h$

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$a = 66''$

$h = 2 \times 61.5'' = 123''$

$t = 3/8''$

$A_s = 1.62\ in^2$ for L 3" x 2½" x 5/16"

$I_o = 1.2[.4 + .6(66/123) + .9(66/123)^2 + 8(\frac{1.62 \times 66}{(123)^2 \times .375})]\ 123 \times .3$

$I_o = 1.2[7.33\ in^4] = 8.796\ in^4$

Provided:

See Figure 2

$I_L = I_o + Ad^2$

$= 1.40 + (1.62)(3 - .93)^2$

$= 8.34\ in.^4$

Conclusion: Provided moment of inertia (8.34 in.⁴) is 5.1% less than required (8.796 in.⁴). The moment of inertia required by CMAA-70 is 20% more than required by EOCI-61. The Polar Crane was designed in accordance with EOCI-61. By engineering judgement a 5.1%. less moment of inertia is considered acceptable.

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GSE CALCULATION SHEET

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DATE 1-7-82
SHEET NO. 11 OF 11
REFERENCE CMAA-70, HARNISCHFEGER
REVISION

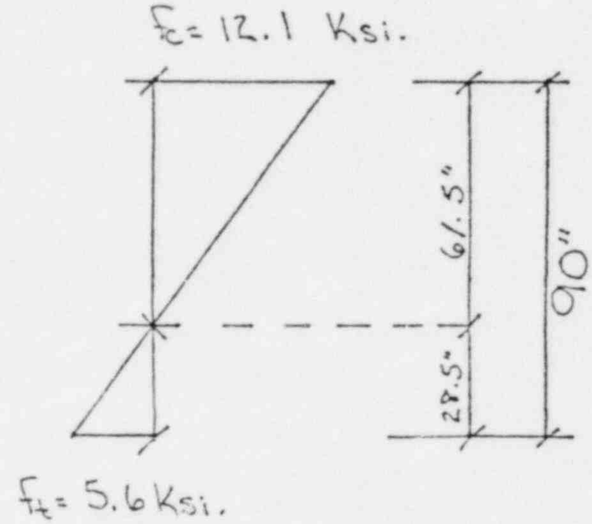


FIGURE 1

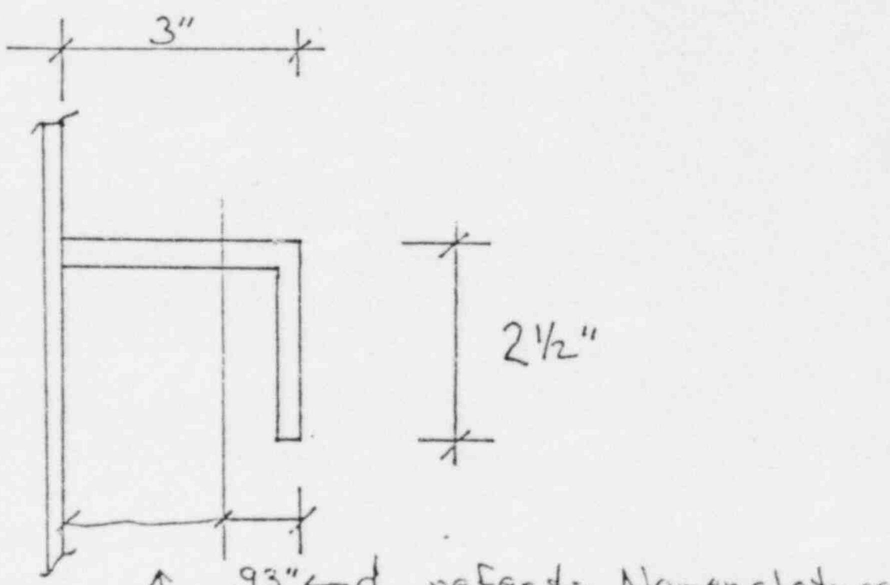


FIGURE 2

LONGITUDINAL STIFFENER

OMAHA PUBLIC POWER DISTRICT'S INTERIM MEASURES FOR CONTROLLING HEAVY LOADS

NRC Position: NUREG-0612

Safe load paths should be defined per the guidelines of Section 5.1.1(1).

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.

Response

The operating instruction for the containment polar crane (OI-HE-1) will provide the following restrictions:

1. The polar crane will not be used to carry loads over the reactor coolant system when the reactor coolant system temperature exceeds 225°F. (Technical Specification 2.11(1)).

2. The polar crane will not be used to transport any load over the core when the reactor vessel head is removed without a Plant Review Committee (PRC) approved procedure.

3. The polar crane will not be used to transport any load over the area bounded by containment columns 10 and 11 and the RC-2B biological shield without a PRC approved procedure pending the results of a load drop analysis.

4. Loads should not be lifted higher than necessary to safely clear obstacles along the load path.

The operating instruction for the auxiliary building crane (OI-HE-5) will provide the following restriction:

1. The auxiliary building crane will not be operated over the spent fuel pool without a qualified crane supervisor present and a PRC approved procedure.

Discussion

The restrictions on the containment polar crane operation given above provide for a safe load path by exclusion. The potential to impact irradiated fuel is minimized by allowing only necessary loads to be transported over the core, using a PRC approved procedure as detailed in Item 2 below. Safe shutdown equipment is defined by NUREG-0612 as "safety related equipment and associated subsystems that would be required to bring the plant to cold shutdown conditions or provide continued decay heat removal following the dropping of (a) heavy load". The above restrictions prohibit use of the polar crane unless the reactor is subcritical (except during low power physics testing below 225°F). Decay heat removal capability is assured by prohibiting transport of a heavy load over locations where a single load drop could remove both HPSI and LPSI as decay heat removal paths unless an alternative decay heat removal path is available. Safe shutdown and decay heat removal capability is therefore assured. Movement of the trolley over the core with no load on the hooks is allowed, since only a spontaneous failure of the cable or sheeves could cause a load drop in this mode. The possibility of this type of failure is minimized by the preoperational inspections performed per Item 4 below.

The restrictions on the auxiliary building crane operation also provide a safe load path by exclusion. The potential to impact irradiated fuel is minimized by not allowing loads to be carried over irradiated fuel (Technical Specification 2.11(2)), and by allowing loads to be carried over the spent fuel pool only according to PRC approved procedure and under the direction of a qualified crane supervisor. There is no safe shutdown equipment below any area accessible to the auxiliary building crane (see definition above). The closest item of safe shutdown equipment is LPSI discharge piping. This piping is 72" north of the northern limit of crane travel. The maximum load dimensions able to be handled are restricted by floor access opening dimensions such that the piping is 16" north of the maximum load extent.

NRC Position: NUREG-0612

Procedures should be developed and implemented per the guidelines of Section 5.1.1(2).

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 this report. 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.

Response

Safe load paths for the polar crane and the auxiliary building crane are included in OI-HE-1 and OI-HE-5, as described in Item 1 above. The PRC approved procedures listed below will provide identification of required equipment, inspections and acceptance criteria required before movement of the load, and steps and proper sequence to be followed in handling of the load:

Procedure	Title
MP-AE-4-1	Missile Shield Removal
MP-AE-4-2	Missile Shield Replacement
MP-FH-16-1	Removal of Spent Fuel Pool Gate
MP-FH-16-2	Installation of Spent Fuel Pool Gate
SP-NFR-2	Fuel Receipt Procedures
MP-RC-6-1	Removal of Reactor Vessel Closure Head
MP-RC-6-2	Inspection and Replacement of Reactor Vessel Closure Head
SP-RC-6-2	Upper Guide Structure Lift Rig and ICI Plate Removal and Installation
MP-RC-7-2-A	Upper Guide Structure and ICI Plate Removal
MP-RC-7-2-B	Upper Guide Structure and ICI Plate Installation

Special precautions are provided where necessary.

Procedures are also available for spent resin and filter disposal, but these do not address load handling since these loads are not carried over or in proximity to irradiated fuel or safe shutdown equipment. Procedures for handling other heavy loads identified in Table 3.1-1 of NUREG-0612 will be written and/or reviewed prior to handling of those heavy loads.

NRC Position: NUREG-0612

Crane operators should be trained, qualified and conduct themselves per the guidelines of Section 5.1.1(3).

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".

Response

Standing Order M-8, "Control of Crane Operations". will require operators, signalmen, and supervisors of the containment polar crane and the auxiliary building crane to be trained and qualified, in accordance with ANSI B30.2-1976. Quality control administers qualification exercises and retains certifications. Currently qualified crane operators, signalmen, and supervisors will be advised of new requirements resulting from NUREG-0612.

NRC Position: NUREG-0612

Cranes should be inspected, tested and maintained in accordance with the guidelines of Section 5.1.1(6).

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 be performed prior to their use.)

Response

The auxiliary building crane and the containment polar crane will be inspected and maintained in accordance with ANSI B30.2-1976. The auxiliary building crane will be inspected daily or prior to each use (whichever is less frequent) according to OI-HE-5, monthly as part of the preventive maintenance program, and annually according to MP-HE-5. The polar crane will be inspected daily and monthly during use (refueling outages) according to MP-HE-1-B and MP-HE-1-A, and at refueling outage frequency according to MP-HE-1. Additional maintenance and inspections are performed as part of the preventive maintenance program and as prerequisites to specific critical lifts.

NRC Position: NUREG-0612

In addition to the above, 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.

Response

The procedures listed below have been specially reviewed and found satisfactory or procedure changes will be made as follows:

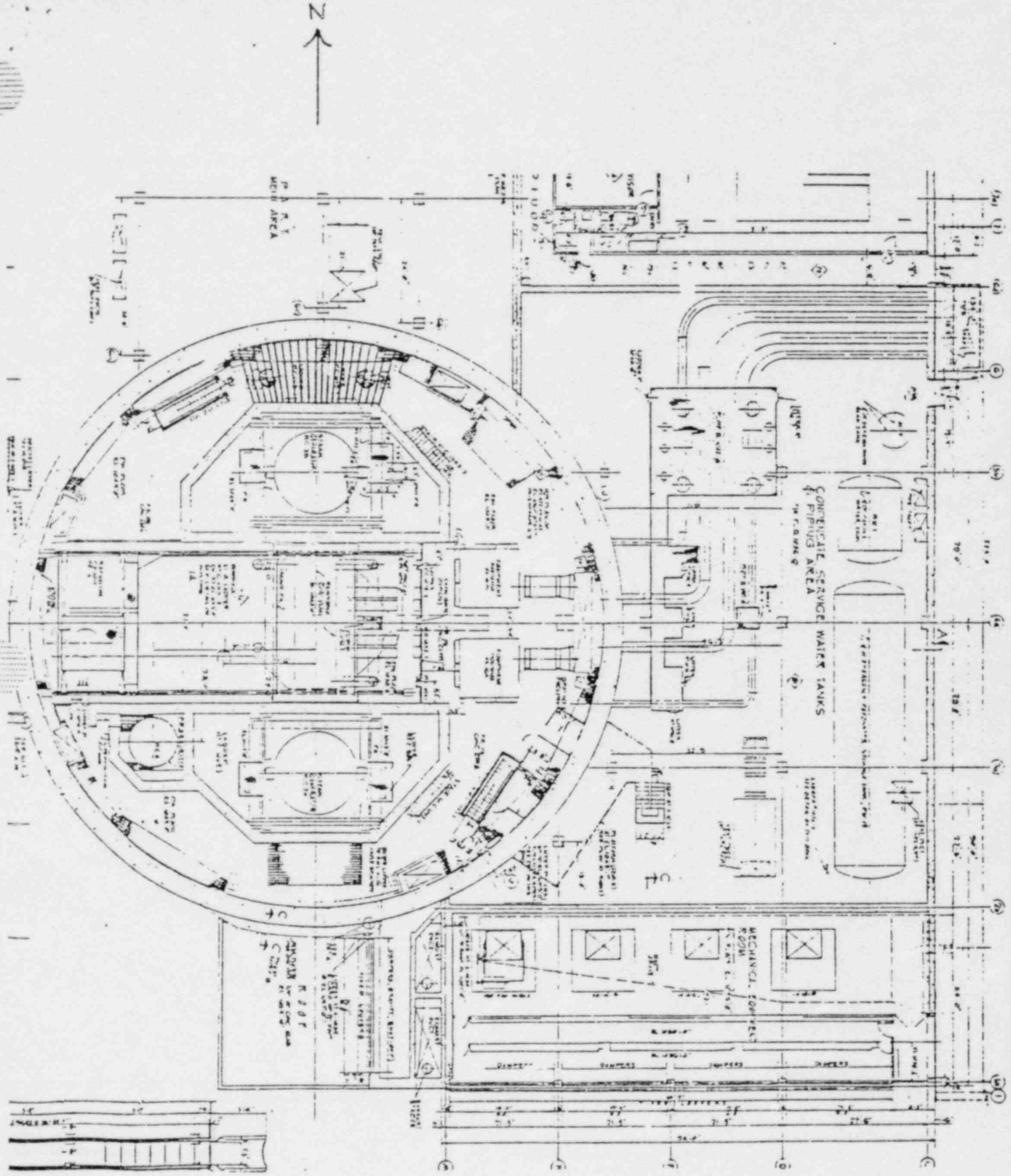
1. Sufficient detail and clear and concise instructions will be provided.

2. Requirements for necessary inspections will be included.

3. Approval of load bearing components inspected per 2 above is required before performance of each procedure; therefore, appropriate repair of defective components will have been completed.

4. Only qualified crane operators are allowed to operate the containment polar crane per OI-HE-1 and Standing Order M-8. Additionally, each of the listed procedures requires a job briefing prior to start of the procedure.

Procedure	Title
MP-AE-4-1	Missile Shield Removal
MP-AE-4-2	Missile Shield Replacement
MP-RC-6-1	Removal of Reactor Vessel Closure Head
MP-RC-6-2	Inspection and Replacement of Reactor Vessel Closure Head
SP-RC-7-2	UGS Lift Rig and ICI Plate Removal and Installation
MP-RC-7-2-A	UGS and ICI Plate Removal
MP-RC-7-2-B	UGS and ICI Plate Installation



= RESTRICTED AREA FOR POLAR CRANE OPERATION