TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT UNITS 1 AND 2

NRC DOCKET NO. 50-282, 50-306

NRC TAC NO. 08075, 08076

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506

FRC ASSIGNMENT 13

FRC TASKS 384, 385

Prepared by

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Prepared for

Nuclear Regulatory Commission
Washington, D.C. 20555

Lead NRC Engineer: F. Clemenson

May 17, 1983

A Copy Has Been Sent to PDR

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

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at Northern States Power Company's (NSP) Prairie Island Nuclear Plant Units 1 and 2. This evaluation was performed with the following objectives:

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

1.2 GENERIC BACKGROUND

Generic Technical Activity Task A-36 was established by the 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 ensure the safe handling of heavy loads and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

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

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-phase 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 such 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 in order to ensure that all load handling systems are designed and operated so that their probability of failure is appropriately small. The intent of the guidelines is to ensure that licensees at 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 NSP, the Licensee for the Prairie Island Nuclear Plant, requesting that the Licensee review provisions for handling and control of heavy loads, 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 April 2, 1981, NSP provided a partial response [4] to this request. Additional information was provided in subsequent reports on July 15, 1981 [5], August 31, 1981 [6], December 9, 1981 [7], and February 3, 1982 [8]. A draft technical evaluation report was prepared based on these submittals and was informally transmitted to the Licensee for review and comment. On August 30, 1982, a telephone conference call was conducted with representatives of NRC, FRC, and NSP to discuss unresolved issues. As a result of this call, additional information was forwarded by NSP on November 8, 1982 [9]. This information was incorporated into the draft TER, which was then reissued as a draft final TER in which several issues remained unresolved. In order to resolve these issues, a meeting was held at NRC headquarters on March 18, 1983. Subsequent to that meeting, NSP submitted additional information in response to these issues in a letter dated April 8, 1983 [10]. This final report is based on the information provided in References 4 through 10.

2. EVALUATION

This section presents a point-by-point evaluation of load-handling provisions at Prairie Island Nuclear Generating Plant Units 1 and 2 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 for 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 evaluation of the extent to which these guidelines have been satisfied and an independent assessment of this evaluation are contained in the succeeding paragraphs.

Table 2.1. Prairie Island Units 1 and 2/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. Containment Polar Cranes(2)	230/20	--	--	C	--	--	C	C	--	--
a. Reactor Missile Shields	28.1	C	C	--	C	--	--	--	--	--
b. PZR Missile Shields	20.25	C	C	--	C	--	--	--	--	--
c. Vessel Head	40.5	C	C	--	C	--	--	--	--	C
d. Upper Internals	25.0	C	C	--	C	--	--	--	--	C
e. Lower Internals	85.7	C	C	--	C	--	--	--	--	C
f. Vessel Studs	3.6	C	R	--	--	C	--	--	--	--
g. ISI Tool	2.0	C	R	--	--	C	--	--	--	--
h. RCP Motor	39.7	R	R	--	--	C	--	--	--	--
i. RCP Pump	27.6	R	R	--	--	C	--	--	--	--
j. RCP Flywheel	6.6	R	R	--	--	C	--	--	--	--

C = Licensee action complies with NUREG-0612 Guideline.
P = Licensee action partially complies with NUREG-0612 Guideline.
R = Licensee has proposed revisions/modifications which comply with NUREG-0612 Guideline.
-- = Not applicable.

Table 2.1 (Cont.)

Heavy Loads	Height 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. Auxiliary Building Crane	125/25	--	--	C	--	--	C	C	--	--
a. New Fuel Shipping Containers	3.3	C	C	--	--	C	--	--	--	C
b. Heat Exchanger Removal Hatches	8.3	C	R	--	--	C	--	--	--	--
c. Heat Exchanger Bundles	0.55-0.95	C	R	--	--	C	--	--	--	--
3. Turbine Building Cranes (2)	120/25	--	--	C	--	--	C	C	--	C
a. HP Cover	42.8	C	R	--	C	--	--	--	--	--
b. LP #1 Outer Casing	61.2	C	R	--	C	--	--	--	--	--
c. LP #2 Outer Casing	61.2	C	R	--	C	--	--	--	--	--
d. LP #1 Inner Cyl. #1	25.0	C	R	--	C	--	--	--	--	--
e. LP #2 Inner Cyl. #1	25.0	C	R	--	C	--	--	--	--	--
f. LP #1 Inner Cyl. #2	45.0	C	R	--	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
g. LP #2 Inner Cyl. #2	45.0	C	R	--	C	C	--	--	--	--
h. HP Rotor	35.0	C	R	--	C	C	--	--	--	--
i. LP Rotor	80.0	C	R	--	C	C	--	--	--	--
j. Condensate Pump	9.3	C	R	--	--	C	--	--	--	--
k. Condensate Pump Motor	6.0	C	R	--	--	C	--	--	--	--
l. Vertical Cooling Water Pump Motor	3.2	C	R	--	--	C	--	--	--	--
m. Vertical Cooling Water Pump	7.3	C	R	--	--	C	--	--	--	--
n. Spare Rotor Stands	6.25	C	R	--	--	C	--	--	--	--
o. Generator Rotor	123.0	C	R	--	C	--	--	--	--	--
4. Spent Fuel Cranes	3.0/3.0	--	--	C	--	--	C	C	C	--
a. Divider Gates	1.3	C	C	--	--	C	--	--	--	--
b. Pool Covers	1.8	C	R	--	--	--	--	--	--	--

2.1.1 NUREG-0612, Heavy Loads Overhead Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee has evaluated the load handling systems at the Prairie Island plant and concluded that the following systems should be subject to the general guidelines of NUREG-0612:

- o containment polar cranes (2)
- o auxiliary building crane
- o turbine building cranes (2)
- o spent fuel pool crane.

Other load handling systems were eliminated from further consideration under NUREG-0612 for the following reasons:

1. Physical separation from safety-related equipment. It was determined by inspection that a load drop could not damage any system or component required for plant shutdown or decay heat removal for the following load-handling systems:

- o filter room crane
- o 3-ton new fuel handling crane
- o manipulator cranes
- o 1-ton trolley above auxiliary building general exhaust fan.

2. Single-purpose system. Each of the following load handling systems is used for maintenance of a single piece of safety-related equipment; consequently, these systems carry heavy loads over safety-related equipment only when plant conditions have been established to allow such equipment to be removed from service:

- o Nos. 11/12 diesel cooling water pump trolleys
- o D-1/D-2 diesel trolleys
- o 1-ton trolley above main steam isolation valve (MSIV) (2)
- o trolley between main steam and feedwater lines
- o 1-ton trolley - 30-inch main steam relief header (MSRH)

- o portable 5-ton trolleys above residual heat removal (RHR) heat exchanger removal hatch (2)
- o 1-ton trolley above relief header in fuel handling and vent fan room
- o 6-ton trolley above RHR pit covers (2).

b. Evaluation

The Licensee's determination that NUREG-0612 is not applicable to those lifting devices identified is consistent with NUREG-0612 guidance for the following reasons: (1) adequate separation from irradiated fuel and safety-related equipment exists or (2) the lifting device is used only when a safety-related component or system that might be damaged by a load drop is placed out of commission (presumably following the establishment of appropriate plant conditions) prior to the lift.

c. Conclusion

NSP's identification of load handling systems subject to compliance with the guidelines of NUREG-0612 is consistent with NRC requirements.

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

> "Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact. These load paths should be defined in procedures, shown on equipment layout drawings, and clearly marked on the floor in the area where the load is to be handled. Deviations from defined load paths should require written alternative procedures approved by the plant safety review committee."

a. Summary of Licensee Statements and Conclusions

The Licensee states that the primary equipment of concern in the turbine building is the 4.16-kV switchgear. Adequate protection is afforded this switchgear in the following manner:

- The switchgear is protected by an 18-inch-thick concrete floor.
- The switchgear is redundant and a single load drop will not cause loss of safeguard switchgear.
- The crane has been modified with redundant limit switches to prevent "two blocking."
- The area covering the switchgear has been marked as an exclusion area for moving heavy loads.
- Any load movement in this area would require preparation of a special procedure.

Safeguard equipment located in the auxiliary building is limited to the boric acid storage tanks (BAST) and the spent fuel pool. An exclusion area has been established above the BASTs similar to that established for the 4.16-kV switchgear in the turbine building. Control of load movements over the spent fuel pool is governed by administrative procedures which prohibit movement of heavy loads in the area as per the technical specifications.

All load handling operations in containment are controlled by procedure D58, "Control of Heavy Loads." This procedure contains general load handling precautions, including the prohibition of carrying heavy loads in the vicinity of spent fuel and certain safety-related equipment. This procedure requires load-specific procedures to provide detailed requirements for handling particular components. Where specific procedures have been prepared (e.g., reactor head, internals, and missile shields), they are referenced. For additional heavy loads that may be identified in the future, D58 provides guidance for the preparation of a specific load handling procedure including the requirements for defining a safe load path consistent with NUREG-0612. The Licensee has provided drawings showing the safe load paths to be used for the reactor vessel head and missile shields.

Any new load handling procedure developed pursuant to the requirements of D58, or any revision to an existing procedure, will be approved by the plant operations committee.

In lieu of marking safe load paths on the containment floor, NSP will assign at least one member of each load handling crew, in addition to the crane operator, the responsibility of ensuring that safe load paths are followed.

In addition, the Licensee has provided the following comments regarding load movement in the containment:

- Dimensions of heavy loads nearly span the distance between floor beams.
- Movements of heavy loads are restricted by where the load is designed to rest when not in use; for example, the upper and lower internals are stored underwater in the refueling pool, and movement of the reactor vessel head, stored on the permanent head stand, is constrained by the refueling pool walls and the steam generator vault walls.
- The physical dimensions of heavy loads and the space available for their laydown on floors to which the crane has access do not allow deviation from procedural load paths.

b. Evaluation

The establishment of exclusion areas for the 4.16-kV switchgear in the turbine building and for the BASTs in the auxiliary building is consistent with Guideline 1 because the exclusion area is relatively small and well defined, and the establishment of individual safe load paths would unnecessarily restrict the handling of loads in the remainder of the building.

The containment load paths currently employed by NSP are consistent with this guideline and indicate that paths to be prepared for additional lifts will also be consistent with this guideline.

The Licensee's commitment to require plant operations committee review/approval for procedural changes affecting safe load paths, deviations from safe load paths, or proposed new safe load paths is also consistent with this guideline.

The Licensee's plan to provide assistance to the crane operator to ensure that load paths are followed through the use of a designated member of the load handling party is also consistent with this guideline.

c. Conclusion and Recommendation

Actions taken at Prairie Island Units 1 and 2 are consistent with this guideline. It is further concluded that this guideline will be satisfied during future operations at Prairie Island Units 1 and 2 based on the Licensee's commitment to provide and implement safe load paths as outlined in Section 2.1.2.a above.

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

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

a. Summary of Licensee Statements and Conclusions

The Licensee has indicated that no specific procedures are in place for handling turbine generator components. However, procedures will be generated if it becomes necessary to carry these heavy loads over the 4.16-kV switchgear.

In the auxiliary building, procedures exist for the handling of the new fuel shipping containers. Procedures to handle heat exchanger removal hatches and heat exchanger bundles will be written prior to handling these loads and will take into consideration circumstances present at that time. Detailed procedures exist for the handling of spent fuel pool divider gates and pool covers.

Loads handled by the containment polar cranes are procedurally controlled as follows:

Load	Procedure
Reactor Vessel (RV) Missile Shield Removal/Replacement	D3 Section 4.28/D7 Section 4.23
Pressurizer Missile Shield Removal/Replacement	D58.3.1

Load	Procedure
RV Head Removal/Replacement	D3 Section 4.26, 4.27/D7 Section 4.7
Upper Internals Removal/Replacement	D4.1 Section 2.0/D6.1 Section 2.0
Lower Internals Removal/Replacement	D4.2 Section 2/Procedure to be written before use
Vessel Studs (in handling box)	Procedure to be written before use
In-Service Inspection Tool	Procedure to be written before use
Reactor Coolant Pump Motor	Procedure to be written before use
Reactor Coolant Pump Internals	Procedure to be written before use

In addition, the Licensee has indicated that existing procedures and those to be prepared will provide the information specified in NUREG-0612, Section 5.1.1(2).

b. Evaluation

The procedures which have been implemented and the Licensee's commitment to develop certain load handling procedures prior to the handling of the specific loads noted satisfy the requirements of this guideline.

c. Conclusion

The Prairie Island Plant complies with Guideline 2 of NUREG-0612.

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

"Crane operators should be trained, qualified and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976 'Overhead and Gantry Cranes' [11]."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that no exceptions are taken to the guidance in ANSI B30.2-1976 with respect to operator training, qualification, and conduct.

b. Evaluation and Conclusion

Crane operator training, qualification, and conduct at Prairie Island Units 1 and 2 are consistent with Guideline 3 of NUREG-0612.

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

"Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, 'Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials' [12]. This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. For operating plants certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device."

a. Summary of Licensee Statements and Conclusions

The special lifting devices used at the Prairie Island plant include:

- o turbine spreader assembly
- o internals lifting rig
- o reactor vessel head lifting rig.

The Licensee has stated that these devices were designed by Westinghouse prior to the existence of ANSI N14.6-1978.

The reactor vessel head lifting rig, internals lifting rig, and turbine spreader assembly were designed and built during 1970-1971. No formal stress report was prepared and no design specifications were written. The devices were designed, fabricated, assembled, and inspected in accordance with Westinghouse requirements specified on detailed manufacturing drawings and purchase order documents. In general, Westinghouse requirements meet the intent of ANSI N14.6-1978, but do not comply with all specific requirements of the standard. The following is a tabulation of those areas not in strict compliance and the associated Licensee commentary:

	Requirement	Remarks
1.	ANSI N14.6 Paragraph 3.2.1.1, requires the design, when using materials with yield strengths above 80% of their ultimate strengths, to be based on the materials fracture toughness and not the listed design factors.	1. High strength materials are used in these devices and the fracture toughness was not determined. However, the stress design factors listed were used in the analysis and the resulting stresses are within those allowable.
2.	ANSI N14.6, Paragraph 5.1, lists owner responsibilities, and 5.1.1 and 5.1.2 require the owner to verify that the special lifting devices meet the performance criteria of the design specification by records and witness of testing.	2. Westinghouse Quality Release is considered to be an acceptable alternate to verify that the criteria for certified material testing reports, nondestructive examination (NDE), and documentation required by Westinghouse drawings and purchasing documents were satisfied.
3.	ANSI N14.6, Sections 5.2 and 5.3, requires that the rigs be initially tested at 150% maximum load followed by NDE of critical load bearing parts and welds and also annual 150% load test or annual NDE and examinations.	3. The devices were originally load tested to only 100% of the load. A load test of 150% of the maximum load is impossible to perform at the Prairie Island plant. The following information is provided relevant to the benefit of an overload test of each special lifting device at the Prairie Island plant. Internals Lifting Rig - This device is designed to lift either the upper or lower internals assembly. The lower internals assembly, which is greater than twice the weight of the upper internals assembly, has been lifted. This lift constitutes an overload test for this device with respect to its use in a lift for which NUREG-0612 is

Requirement		Remarks
		applicable. (The lower internals lift is not subject to NUREG-0612 since it is accomplished only when all fuel is removed from the reactor vessel). Reactor Head Lifting Device - This device is a fairly simple mechanical system assembled from structural members, clevises, lugs, and pins. A stress analysis has been conducted which demonstrates that all stresses are below those allowed by ANSI N14.6-1978. Turbine Component Lifting Assembly - This device is essentially an I-beam spreader assembly which transfers the weight from slings connected to the lifted component via yokes and beam hangers to slings connected to the crane hook. A stress analysis has been conducted and demonstrates that all stresses are below those allowed by ANSI N14.6-1978.
4.	NUREG-0612, Paragraph 5.1.1(4) requires that the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 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 only on the weight (static load) of the load and of the intervening components of the special handling device.	4. The applicable cranes have been investigated to determine the dynamic impact force imparted on a load due to the sudden applications of the brakes of the hoists. The impact factors were computed by first establishing the minimum stopping distance of the load under the maximum braking. A formula given in "Whiting Crane Handbook," 4th Edition,

Requirement	Remarks
	p. 166, was used. The braking distance according to the formula is a function of lowering speed of the load, horsepower for lifting the load, rotational moment of intertia of the motor, gears, drums, etc., the braking torque, and the efficiency of the system. The impact factor does not consider flexibility of ropes and cranes. The maximum impact factor calculated is 3%.

The Licensee has also indicated [6] that these special lifting devices are inspected prior to use in accordance with the requirements of ANSI N14.6-1978. Such inspection will include the nondestructive examination of welds and other critical components [10].

b. Evaluation

Information provided by the Licensee indicates that the design and fabrication of special lifting devices will provide a degree of load handling reliability equivalent to that expected from an initial design in accordance with ANSI N14.6-1978. Although not part of the original design, a complete stress analysis has been completed for these devices. This stress report demonstrates that actual factors of safety on material yield and ultimate stress substantially exceed those specified in ANSI N14.6-1978. Furthermore, the manufacturing controls implemented by Westinghouse are expected to provide a degree of quality assurance equivalent to that inherent in ANSI N14.6-1978. Although no specific 150% overload tests have been conducted on the three special lifting devices subject to NUREG-0612, it can be concluded that the proof of workmanship expected to be demonstrated by such testing can be otherwise determined.

In the case of the internals lift rig, the past use of this rig for lifting the lower internals more than adequately demonstrates its capacity for

handling the upper internals. It should be noted in this case that only the lift of the upper internals is of interest with respect to NUREG-0612 since the plant conditions required prior to lifting the lower intervals eliminates this lift from the jurisdiction of NUREG-0612.

In the case of the reactor vessel head lift rig, a review of the rig design and stress analysis indicates that an additional test is not necessary to provide the high degree of assurance of freedom from errors in fabrication or inadequate material properties expected to be demonstrated by such a test. The device is of fairly simple design. There is little use of welded connections. Almost all load bearing connections are lugs and clevises with large diameter pins. All material used was procured to AISI or ASTM specifications and provides yield strengths in excess of five times calculated stress with margins to ultimate proportionately higher. This substantially exceeds the requirements of ANSI N14.6-1978.

Similarly, the turbine component lifting assembly is made of material with large safety margins. Further, this device is assembled almost entirely with mechanical connections in an extremely simple design consisting essentially of a wide flange beam with two welded beam hangers near the center and yoke assemblies at either end. At five times rated load, the stress calculated in the beam hanger to beam weld is approximately 1/4 of the weld design capacity.

In summary, both the reactor vessel head and turbine component lift rigs are of such simple design and large material safety margins that it is highly unlikely that errors of fabrication or inadequate material properties will render them incapable of lifting 150% of their design load.

The Licensee's commitment to a continuing inspection and examination program is consistent with ANSI N14.6-1978.

c. Conclusion and Recommendations

The special lifting devices subject to NUREG-0612 at Prairie Island Units 1 and 2 will provide a degree of mechanical reliability consistent with that inherent in Guideline 4.

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

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

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that slings used with cranes at the Prairie Island plant comply with the design and inspection requirements of ANSI B30.9-1971. Plant Procedure D58, "Control of Heavy Loads," specifies a minimum factor of safety of 5, and the rated capacities of the slings shall be taken as those listed in Tables 3 through 14 of ANSI B30.9-1971.

Analyses performed show that the design load rating of the slings is based upon the maximum static and dynamic loads. Analysis has shown that the loading due to dynamic loads is very small (approximately 3%). Assuming that the design load for a particular sling is based solely on static loads, the combined dynamic and static load for the cranes at the Prairie Island plant closely approximates the static design load of the slings.

Since the dynamic loads have been shown to be very small, no penalty is required to be assigned to the slings. Therefore, the actual sling load rating is the design load, and no further marking or restrictions are necessary.

Slings shall be visually inspected each day they are used. The condition of their replacement and/or repair will comply with requirements of Section 9.2.8 of ANSI B30.9. Further, the operation of the cranes is controlled by administrative procedures which include inspection for safe operating practices with wire slings compatible with ANSI B30.9-1971.

b. Evaluation and Conclusion

Prairie Island Units 1 and 2 comply with Guideline 5 of NUREG-0612.

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

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

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that procedures for inspection, testing, and maintenance of cranes are in effect that satisfy the criteria of ANSI B30.9-1976, Chapter 2-2.

b. Evaluation and Conclusion

Prairie Island Units 1 and 2 comply with Guideline 6 of NUREG-0712.

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

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

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that the major cranes and hoists at Prairie Island Units 1 and 2 (i.e., 120-ton turbine building cranes, 125-ton auxiliary build-

ing crane, 230-ton polar cranes, and 3-ton spent fuel pool cranes) were manufactured in accordance with EOCI-61 [15] and USAS B30.2-1967. The Licensee performed a point-by-point review of the specifications to which their cranes were built and those required by CMAA-70. The Licensee's review verified that the cranes substantially meet the requirements of CMAA-70.

b. Evaluation

The Licensee has provided verification that CMAA-70 requirements have been satisfied for cranes subject to review or adequate justification that the requirements of CMAA-70 have been satisfied by equivalent means.

c. Conclusion

Prairie Island Units 1 and 2 comply with Guideline 7 of NUREG-0612.

2.2 INTERIM PROTECTION MEASURES

The NRC has established six interim protection measures to be implemented at operating nuclear power plants to provide reasonable assurance that no heavy loads will be handled over the spent fuel pool and that measures exist to reduce the potential for accidental load drops to impact on fuel in the core or spent fuel pool. Four of the six interim measures of the report 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.

The status of the Licensee's implementation and the evaluation of these interim protection measures are summarized in the succeeding paragraphs of this section.

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

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

a. Summary of Licensee Statements and Conclusions

In a previous submittal to the NRC, the Licensee revised the Prairie Island Technical Specifications to meet the requirements of Interim Protection Measure 1 of NUREG-0612. This submittal added Section 3.8 (B.1) to the Prairie Island Technical Specifications prohibiting the handling of heavy loads over spent fuel in the fuel storage pool area.

b. Evaluation and Conclusion

Prairie Island Units 1 and 2 comply 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 2.1.2, 2.1.3, 2.1.4, and 2.1.7.

b. Evaluations, Conclusions, and Recommendations

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

2.2.3 Special Reviews for Heavy Loads Over the Core [Interim Protection Measure 6, NUREG-0612, Section 5.3(1)]

"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

The Licensee has stated in Reference 5 that the interim actions described in Reference 3 were implemented.

b. Evaluation and Conclusion

Prairie Island Units 1 and 2 comply with Interim Protection Measure 6.

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 Prairie Island Nuclear Generating Plant Units 1 and 2. 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 the Prairie Island plant 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 MEASURES

The NRC staff has established (NUREG-0612, Section 5.3) that certain measures should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until final implementation of the general guidelines of NUREG-0612, Section 5.1 is complete. Specified measures include the implementation of a technical specification to prohibit

the handling of heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement as necessary of cranes, slings, and special lifting devices to eliminate deficiencies that could lead to component failure. Evaluation of information provided by the Licensee indicates that such measures have been implemented at Prairie Island Units 1 and 2.

4. REFERENCES

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