CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
WASHINGTON NUCLEAR PROJECT NO. 2
(PHASE II--INTERIM)
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ABSTRACT

The Nuclear Regulatory Commission (NRC) has requested that all nuclear plants, either operating or under construction, submit a response of compliancy with NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." EG&G Idaho, Inc., has contracted with the NRC to evaluate the responses of those plants presently under construction. This report contains EG&G's evaluation and recommendations for Washington Nuclear Project No. 2 for the requirements of Sections 5.1.4, 5.1.5, and 5.1.6 of NUREG-0612 (Phase II). Section 5.1.1 (Phase I) was covered in a separate report [1].

EXECUTIVE SUMMARY

WNP-2 does not totally comply with the guidelines of NUREG-0612. In general, compliance is insufficient in the following areas:

- Insufficient information has been provided for review in the areas of lifts over irradiated fuel and lifts by single-failure-proof handling systems.

- Lifts over safe shutdown equipment have not been properly addressed.

The main report contains recommendations which will aid in bringing the above items into compliance with the appropriate guidelines.

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CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
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(PHASE II)

1. INTRODUCTION

1.1 Purpose of Review

This technical evaluation report documents the EG&G Idaho, Inc., review of general load-handling policy and procedures at Washington Nuclear Project No. 2 (WNP-2). This evaluation was performed with the objective of assessing conformance to the general load handling guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" [2], Sections 5.1.4, 5.1.5, and 5.1.6. This constitutes Phase II of a two-phase evaluation. Phase I assesses conformance to Section 5.1.1 of NUREG-0612 and was documented in a separate report [1].

1.2 Generic Background

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to assure the safe handling of heavy loads and to recommend necessary changes to these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [3], to all power reactor applicants, 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 phase of the objective, achieved through a set of general guidelines identified in NUREG-0612, Article 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 phase of the staff's objective, achieved through guidelines identified in NUREG-0612, Articles 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 (a) 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 system) or (b) 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 as follows:

- "Releases of radioactive material that may result from damage to spent fuel based on calculations involving accidental dropping of postulated heavy load produce doses that are well within 10 CFR Part 100 limits of 300 rem thyroid, 25 rem whole body (analyses should show that doses are equal to or less than 1/4 of Part 100 limits);

- "Damage to fuel and fuel storage racks based on calculations involving accidental dropping of postulated heavy load does not result in a configuration of the fuel such that k_{eff} is larger than 0.95;

- "Damage to the reactor vessel or the spent fuel pool based on calculations of damage following accidental dropping of postulated heavy load is limited so as not to result in

water leakage that could uncover the fule, (makeup water provided to overcome leakage should be from a borated source of adequate concentration if the water being lost is borated); and

- "Damage to equipment in redundant or dual safe shutdown paths, based on calculations assuming the accidental dropping of a postulated heavy load, will be limited so as not to result in loss of required safe shutdown functions."

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense in depth. This plan includes proper operator training, equipment design, and maintenance, coupled with safe load paths and crane interlock devices restricting movement over critical areas.

Staff guidelines resulting from the foregoing are tabulated in Section 5 of NUREG-0612.

1.3 Plant-Specific Background

On December 22, 1980, the NRC issued a letter [4] to Washington Public Power Supply System (WPPSS), the applicant for WNP-2 requesting that the applicant review provisions for handling and control of heavy loads at WNP-2, 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. WPPSS provided responses to this request pertinent to Phase II on January 13, February 12, and October 4, 1982 and February 23, 1983 [5,6,7,8].

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize WPPSS's review of heavy load handling at WNP-2 accompanied by EG&G's evaluation, conclusions, and recommendations to the applicant for bringing the facilities more completely into compliance with the intent of NUREG-0612.

2.2 Heavy Load Overhead Handling Systems

Table 2.1 presents the applicant's list of overhead handling systems which are subject to the criteria of NUREG-0612. The applicant has indicated that the weight of a heavy load for the facilities as 1,200 lbs. per the NUREG-0612 definition.

2.3 Guidelines

2.3.1 Reactor Building [NUREG-0612, Article 5.1.4]

(1) "The reactor building crane, and associated lifting devices used for handling the above heavy loads, should satisfy the single-failure-proof guidelines of Section 5.1.6 of this report.

OR

(2) "The effects of heavy load drops in the reactor building should be analyzed to show that the evaluation criteria of Section 5.1 are satisfied. The loads analyzed should include: shield plugs, drywell head, reactor vessel head; steam dryers and separators; refueling canal plugs and gates; shielded spent-fuel shipping casks; vessel inspection platform; and any other heavy loads that may be brought over or near safe shutdown equipment as well as fuel in the reactor vessel or the spent-fuel pool. Credit may be taken in this analysis for operation of the Standby Gas Treatment System if facility technical specifications require its operation during periods when the load being analyzed would be handled. The analysis should also conform to the guidelines of Appendix A."

TABLE 2.1 NONEXEMPT HEAVY LOAD-HANDLING SYSTEMS

Crane	Tag Number	Location	Type	Service	CMAA Class	Tons Capacity
1	MT-H01-6	Reactor building 489.2 ft	Trolley hoist electric	RHR pumps (A&B)	A-1	6
2	MT-H01-7	Reactor building 492.2 ft	Trolley hoist electric	RCIC pump and turbine	A-1	5
3	MT-H01-8	Reactor building 494.3 ft	Trolley hoist electric	RHR pump C	A-1	6
4	MT-H01-9	Reactor building 493.2 ft	Trolley hoist electric	LPCS pump	A-1	7
5	MT-H01-10	Reactor building 492.4 ft	Trolley hoist electric	HPCS pump	A-1	20
6	MT-CRA-6A,6B	Standby service water pump house	Overhead travelling crane (under hung)	Standby service water pumps	A-1	8
7	MT-CRA-2	Reactor building 606 ft	Travelling bridge crane	Reactor refueling floor and vessel	A-1	125
8	MT-CRA-1	Turbine building	Travelling bridge crane	Main turbine and generator		200
9	MT-H01-18	Reactor building	Trolley hoist	Outboard main steam isolation valve work and pipe tunnel hatch removal	A-1	8

A. Summary of Applicant's Statements

The applicant indicated that the Reactor Building Crane is the only crane physically capable of carrying heavy loads over spent fuel in the storage pool or reactor vessel.

"The Reactor Building Crane (MT-CRA-2) main hoist meets the requirements for a 'single failure proof crane' as per NUREG-0612, Appendix C.

"The auxiliary hoist will be derated to 7 1/2 tons maximum versus 15 tons design rating for handling heavy loads over the spent fuel pool or open vessel cavity thus doubling the design safety factor. In addition, travel of the Reactor Building Crane is limited for the main and auxiliary hooks in the area over the spent fuel pool."

B. EG&G Evaluation

The single-failure-proof status of the Reactor Building Crane (MT-CRA-2) is examined in Section 2.3.3 of this report. The entire handling system must be single-failure-proof, including slings and lifting points for this status to be validated.

The applicant indicated on safe load path drawing notes that lifts of the shield plugs would be handled by a non-single-failure-proof sling system. Therefore, these loads fall under the criteria of NUREG-0612 Section 5.1.4(2) and should be so addressed.

Currently the applicant has not indicated compliance to either of NUREG-0612 Sections 5.1.4(1) or 5.1.4(2) for the MT-CRA-2 Auxiliary Hoist. While the increased safety factor for this hoist does provide additional assurances

against a load drop it does not provide single-failure-proof status per NUREG-0612 Appendix C nor does it necessarily meet the load drop probability allowable values outlined in NUREG-0612 Section 5.2.

The applicant should provide more information on the method of travel limitation for the MT-CRA-2 hoists over the Fuel Storage Pool.

C. EG&G Conclusions and Recommendations

WNP-2 is in partial compliance with the requirements of this guideline. The applicant should take the following actions:

(1) Provide an analysis of shield plug lifts per Section (2) of the criteria.

(2) Apply either Section (1) or (2) of the criteria to the Reactor Building Crane Auxiliary Hoist.

(3) Provide information on the limiting method used for the Reactor Building Crane over the Fuel Storage Pool.

2.3.2 Other Areas [NUREG-0612, Article 5.1.5]

(1) "If safe shutdown equipment are beneath or directly adjacent to a potential travel load path of overhead handling systems, (i.e., a path not restricted by limits of crane travel or by mechanical stops or electrical interlocks) one of the following should be satisfied in addition to satisfying the general guidelines of Section 5.1.1:

(a) The crane and associated lifting devices should conform to the single-failure-proof guidelines of Section 5.1.6 of this report;

OR

(b) If the load drop could impair the operation of equipment or cabling associated with redundant or dual safe shutdown paths, mechanical stops or electrical interlocks should be provided to prevent movement of loads in proximity to these redundant or dual safe shutdown equipment. (In this case, credit should not be taken for intervening floors unless justified by analysis.)

OR

(c) The effects of load drops have been analyzed and the results indicate that damage to safe shutdown equipment would not preclude operation of sufficient equipment to achieve safe shutdown. Analyses should conform to the guidelines of Appendix A, as applicable.

(2) "Where the safe shutdown equipment has a ceiling separating it from an overhead handling system, an alternative to Section 5.1.5(1) above would be to show by analysis that the largest postulated load handled by the handling system would not penetrate the ceiling or cause spalling that could cause failure of the safe shutdown equipment."

A. Summary of Applicant's Statements

"The following list of cranes and hoists were installed to permit maintenance of a specific piece of equipment. These lifting devices do not meet the requirements of NUREG-0612 and it is not considered economically practical to modify them to meet these requirements. They will be locked out in a safe position and not placed in use until the equipment they service has been declared inoperable per the Plant Technical Specifications:

MT-HOI-6	Services RHR Pumps A and B
MT-HOI-7	Services RCIC Pump and Turbine
MT-HOI-8	Services RHR Pump C
MT-HOI-9	Services LPCS Pumps
MI-HOI-10	Services HPCS Pumps
MT-CRA-6A and 6B	Services Standby Service Water Pumps, 1A and 1B
MT-HOI-18	Services Outboard Main Steam Isolation Valves"

B. EG&G Evaluation

The applicant should examine the cranes listed in Section A above per the criteria of NUREG-0612 Section 5.1.5(1)(c). A number of these cranes probably meet these criteria without further modification, although an insufficient amount of information has been provided for EG&G to verify this position. Some cranes may require additional analysis or load handling restrictions due to transport of loads from one train over components in the redundant train.

The applicant has not addressed the Turbine Building Traveling Bridge Crane MT-CRA-1.

C. EG&G Conclusions and Recommendations

WNP-2 is not in compliance with the requirements of this guideline. The applicant should take the following actions:

(1) Address the Turbine Building Bridge Crane MT-CRA-1 per the criteria.

(2) Examine the cranes listed in Section A above per Section (1)(c) of the criteria.

2.3.3 Single-Failure-Proof Handling Systems [NUREG-0612, Article 5.1.6]

(1) "Lifting Devices:

(a) Special lifting devices that are used for heavy loads in the area where the crane is to be upgraded should meet ANSI N14.6-1978, "Standard For Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More For Nuclear Materials," as specified in Section 5.1.1(4) of this report except that the handling device should also comply with Section 6 of ANSI N14.6-1978. If only a single lifting device is provided instead of dual devices, the special lifting device should have twice the design safety factor as required to satisfy the guidelines of

Section 5.1.1(4). However, loads that have been evaluated and shown to satisfy the evaluation criteria of Section 5.1 need not have lifting devices that also comply with Section 6 of ANSI N14.6.

(b) Lifting devices that are not specially designed and that are used for handling heavy loads in the area where the crane is to be upgraded should meet ANSI B30.9 - 1971, "Slings" as specified in Section 5.1.1(5) of this report, except that one of the following should also be satisfied unless the effects of a drop of the particular load have been analyzed and shown to satisfy the evaluation criteria of Section 5.1:

(i) Provide dual or redundant slings or lifting devices such that a single component failure or malfunction in the sling will not result in uncontrolled lowering of the load;

OR

(ii) In selecting the proper sling, the load used should be twice what is called for in meeting Section 5.1.1(5) of this report.

(2) "New cranes should be designed to meet NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants." For operating plants or plants under construction, the crane should be upgraded in accordance with the implementation guidelines of Appendix C of this report.

(3) "Interfacing lift points such as lifting lugs or cask trunions should also meet one of the following for heavy loads handled in the area where the crane is to be upgraded unless the effects of a drop of the particular load have been evaluated and shown to satisfy the evaluation criteria of Section 5.1:

(a) Provide redundancy or duality such that a single lift point failure will not result in uncontrolled lowering of the load; lift points should have a design safety factor with respect to ultimate strength of five (5) times the maximum combined concurrent static and dynamic load after taking the single lift point failure.

OR

(b) A non-redundant or non-dual lift point system should have a design safety factor of ten (10) times the maximum combined concurrent static and dynamic load."

A. Summary of Applicant's Statements

The applicant indicated that the Reactor Building Crane is a single-failure-proof crane (see Section 2.3.1A).

Safe load path drawings supplied by the applicant contained the following notes for lifts using the Reactor Building Crane:

"All loads other than shield plugs, lifted with conventional lifting apparatus shall utilize redundant rigging or maintain a safety factor of ten (10). Shield plugs will only be moved when reactor head, RPV space frame and drywell head are in place over the reactor with a lifting apparatus factor of safety of 5 maintained.

"Loads shall be maintained as close to the floor as practical.

The head strong back and stud tensioner and spreader may be moved as necessary, movement shall be governed by appropriate detailed procedure for performance of specific functions."

B. EG&G Evaluation

The applicant has not indicated whether special lifting devices used in conjunction with the Reactor Building Crane meet the requirements of ANSI N14.6 Section 6 as required in NUREG-0612 Section 5.1.6 (1)(a).

The applicant also has not indicated compliance with Section 5.1.6 (3) of NUREG-0612.

(See Section 2.3.1B for discussion on shield plug lifts.)

C. EG&G Conclusions and Recommendations

WNP-2 is not in complete compliance with the requirements for single-failure-proof handling systems. The applicant should take the following actions:

(1) Provide information pertaining to compliance with ANSI N14.6-1978 Section 6 for all special lifting devices used in conjunction with the Reactor Building Crane.

(2) Provide information on interfacing lift points for items lifted by the Reactor Building Crane.

3. CONCLUDING SUMMARY

3.1 Guideline Recommendations

WNP-2 is presently not in complete compliance with the requirements of NUREG-0612 Section 5.1. This conclusion is represented in tabular form as Table 3.1. The following actions should be taken by the applicant:

Guidelines	Action
Section 5.1.4	(a) Provide for review an analysis of shield plug lifts.
	(b) Examine the Reactor Building Crane Auxiliary Hoist per the criteria of this section and provide pertinent material for review.
	(c) Provide information on limiting devices used with the Reactor Building Crane.
Section 5.1.5	(a) Examine the Turbine Building Bridge Crane per the criteria of this section and provide pertinent material for review.
	(b) Analyze the effects of load drops from cranes listed in Section 2.3.2A of this report per the criteria of this section and provide pertinent information for review.
Section 5.1.6	(a) Indicate whether all special lifting devices used in conjunction with the Reactor Building Crane meet the criteria of ANSI N14.6-1978 Section 6.

TABLE 3.1. [Plant]--NUREG-0612 OBJECTIVES COMPLIANCE MATRIX

Handling System	Single-Failure-Proof System	Offsite Radioactive Release	Damaged Fuel Criticality	Fuel Cover Water Inventory Loss	Safe Shutdown Equipment Loss
1. RHR pumps A&B hoist	--	--	--	--	NC
2. RCIC pump hoist	--	--	--	--	NC
3. RHR pump hoist	--	--	--	--	NC
4. LPCS pump hoist	--	--	--	--	NC
5. HPCS pump hoist	--	--	--	--	NC
6. Pump house overhead crane	--	--	--	--	NC
7. Reactor building bridge crane	I	I	I	I	--
8. Turbine building bridge crane	I	--	--	--	I
9. MSIV hoist	--	--	--	--	NC

C = Applicant action complis with NUREG-0612 Risk Reduction Objective.
NC = Applicant action does not comply with NUREG-0612 Risk Reduction Objective.
-- = Risk Reduction Objective is not applicable to this handling system.

(b) Analyze all interfacing lift points on items lifted by the Reactor Building Crane per the criteria of this section and provide pertinent information for review.

3.2 Additional Recommendations

This is an interim report. As WNP-2 is a near term operating license plant the applicant is encouraged to provide information on expected response dates for the items listed in Section 3.1 so as to expedite the issuance of the final report. The applicant should arrange for a telephone conference between the applicant, EG&G Idaho, and the NRC within 6 weeks of receival of this report.

3.3 Summary

The applicant is currently considered to be in partial compliance with each of the guidelines covered in this report.

More information is required to complete the review of compliance with criteria pertaining to lifts over irradiated fuel and single-failure-proof handling systems.

The applicant indicated that for economic reasons the guideline pertaining to lifts over safe shutdown equipment will not be met. However, EG&G feels that full compliance can be achieved for many of these cranes through the use of proper procedures with minimal economic impact. The applicant has been requested to reexamine these cranes.

4. REFERENCES

1. [Phase I Final Report]

2. NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, NRC.

3. V. Stello, Jr. (NRC), Letter to all applicants. Subject: Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 17 May 1978.

4. USNRC, Letter to WPPSS. Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 22 December 1980.

5. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Response to NUREG-0612 Control of Heavy Loads, WPPSS, 3 January 1982

6. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 WNP-2 Response to NUREG-0612, Control of Heavy Loads, WPPSS, 12 February 1982

7. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Response to NUREG-0612, Control of Heavy Loads, Revision 1; Submittal of, WPPSS, 4 October 1982

8. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Control of Heavy Loads, Revision 2, 23 February 1983