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# CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
# WASHINGTON NUCLEAR PROJECT NO. 2 (PHASE I)
# DOCKET NO. 50-397

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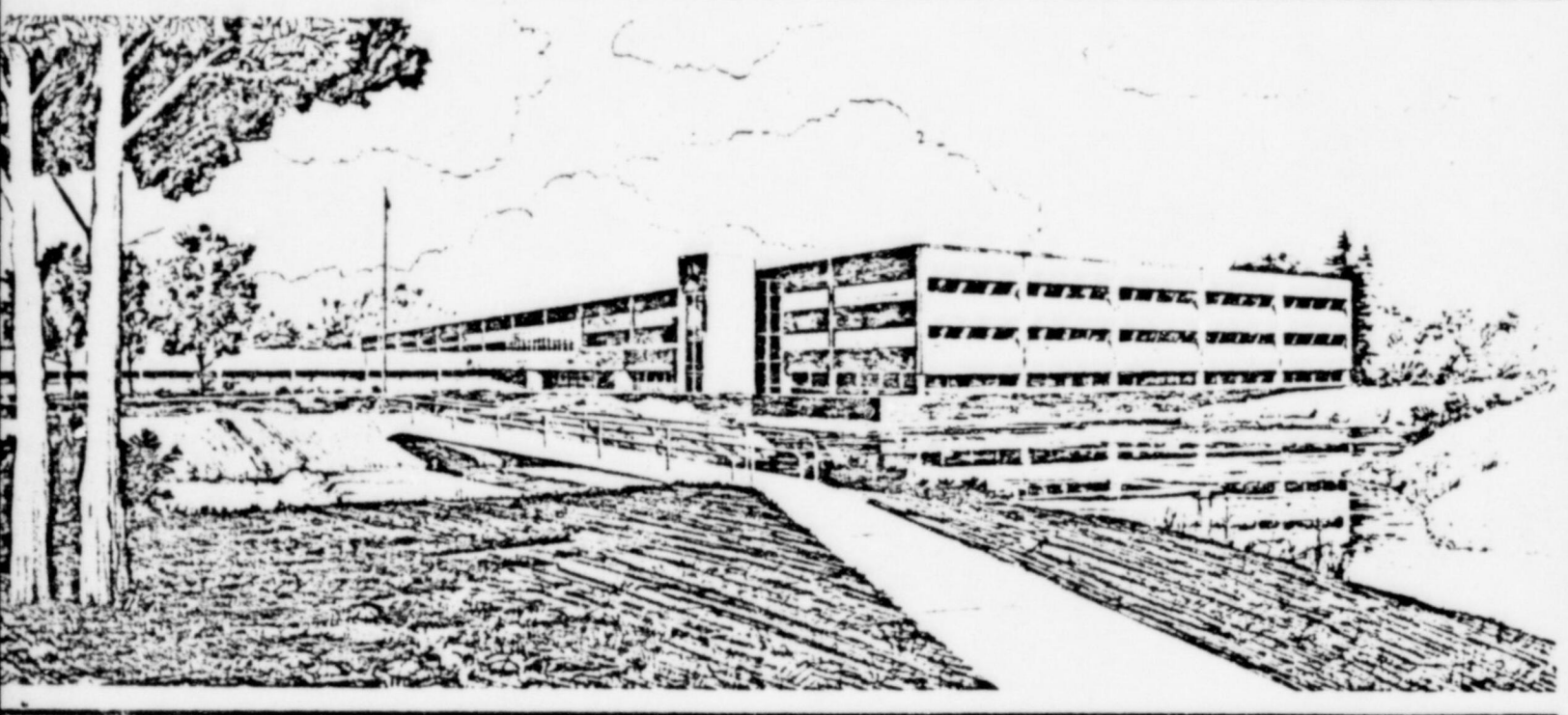

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EG&G Idaho

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## EXECUTIVE SUMMARY

WNP-2 has been found to comply with the seven guidelines of NUREG-0612, Section 5.1.1. All applicant actions necessary for compliance are scheduled for completion prior to plant operation. No interim measures are currently required.

If the applicant finds that the indicated action completion schedule cannot be met, the NRC staff should be notified and interim measures adopted.

# CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
# WASHINGTON NUCLEAR PROJECT NO. 2
# (PHASE I)

## 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" [1], Section 5.1.1. This constitutes Phase I of a two-phase evaluation. Phase II assesses conformance to Sections 5.1.4, 5.1.5, and 5.1.6 of NUREG-0612 and will be documented in a separate report.

### 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 [2], 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.

- Provide mechanical stops or electrical interlocks to prevent movement of heavy loads over irradiated fuel or in proximity to equipment associated with redundant shutdown paths.

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 [3] 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. On January 13, 1982, WPPSS provided the initial response [4] to this request. Additional responses were provided on February 12, 1982 [5], October 4, 1982 [6], February 23, 1983 [7], March 28, 1983 [8], and April 13, 1983 [9]. The October 4 and February 23 responses represent a revision of previous submittals based on WPPSS review of an interim version of this Technical Evaluation Report (TER). The March 28 and April 13 responses are clarifying letters. The present version of this TER is based almost solely on the October 4, February 23, and April 13 responses.

TABLE 2.1 OVERHEAD HANDLING SYSTEM WITH POTENTIAL FOR DAMAGE TO ANY SYSTEM REQUIRED FOR PLANT SHUTDOWN OR HEAT REMOVAL

| Crane | Tag Number | Location | Type | Service | CMAA Class | Tons Capacity | Exemption Status |
|---|---|---|---|---|---|---|---|
| 1 | MT-H01-19A&B | Reactor building inside containment | Trolley hoist manual chain | Main steam relief valves | A-1 | 2 | Exempted--redundant systems |
| 2 | MT-H01-36 | Reactor building inside containment | Trolley hoist manual chain | Recirc flow control valve--(RCC-V-60) | A-1 | 4 | Exempted--sufficient physical separation |
| 3 | MT-H01-6 | Reactor building 489.2 ft | Trolley hoist electric | RHR pumps (A&B) | A-1 | 6 | Nonexempt |
| 4 | MT-H01-7 | Reactor building 492.2 ft | Trolley hoist electric | RCIC pump and turbine | A-1 | 5 | Nonexempt |
| 5 | MT-H01-8 | Reactor building 494.3 ft | Trolley hoist electric | RHR pump C | A-1 | 6 | Nonexempt |
| 6 | MT-H01-9 | Reactor building 493.2 ft | Trolley hoist electric | LPCS pump | A-1 | 7 | Nonexempt |
| 7 | MT-H01-10 | Reactor building 492.4 ft | Trolley hoist electric | HPCS pump | A-1 | 20 | Nonexempt |
| 8 | MT-H01-16 | Reactor building inside containment | Trolley hoist electric | Recirc pump | A-1 | 30 | Exempted--physical separation--redundant systems |
| 9 | MT-H01-19C | Reactor building inside containment | Trolley hoist electric | Main steam relief valves | A-1 | 2 | Exempted--redundant systems |

pass over spent fuel and are physically separated far enough from safe shutdown equipment to preclude damage to such equipment.

"The following cranes listed in [Table 2.1] can be excluded for the following reasons:

MT-HOI-36

"This hoist is a short spur monorail inside containment and is dedicated to handling reactor recirculation flow control valve internals. It can only be used when the reactor is shut down and the containment is open. It does not pass over the RHR return suction lines, the RHR supply lines or other safe shutdown equipment.

MT-HOI-13

"This hoist is inside containment and is used for working on the 4 inboard main steam containment isolation valves. It will only be used when the reactor is shutdown and containment is opened for maintenance work. These monorails and the hoist do not pass over either the RHR system or return lines or other safe shutdown equipment.

MT-HOI-19A, B, C

"Used for removing and reinstalling main steam relief valves (maximum weight 4,000#), crosses over the 14" RHR loop B--return to RPV at Azimuth 170°. The RHR line is approximately 18 feet under the valve passage and is protected by steel grating (1 1/2" deep 3/16 bars spaced 1 1/8" apart) supported on a 4' rectangle of 8" and 14" deep I beams. The RHR line is a 7' Radius bend at this location

RHR Monorails

"The removal of a RHR heat exchanger will be a major and complex job when and if it should ever occur. The existing monorails (20 ton) are not adequate to handle a 34 ton (dry weight) heat exchanger. Significant engineering leading to finalized procedures, including control of the heavy load around the spent fuel pool will be required when the scope of replacement or repair to RHR heat exchangers is determined."

B. EG&G Evaluation

Based on the applicant's response, the exemption of cranes MT-HOI-13 and 36 is reasonable as no irradiated fuel or safe shutdown equipment is endangered.

The exemption of crane MT-HOI-16 is reasonable as the RHR suction line is protected to some extent and an alternate line is available.

The exemptions of cranes MT-HOI-19A, B, and C are reasonable as an alternate RHR cooling line is available and the SLC supply line is not considered "safety related" when the control rods are inserted.

Cranes MT-CRA-9A, 9B, and 11 can be exempted as the maximum loads carried do not qualify as heavy loads for this facility.

The applicant has indicated that the RHR monorails should not presently be considered as heavy-load-handling systems. The only heavy loads indicated to be lifted by these hoists are the RHR heat exchangers. Therefore, these hoists should be considered exempt until such time as the heat exchanger lift (or any other heavy load lift) is required.

- o Guideline 5--Lifting Devices (not specially designed)

- o Guideline 6--Cranes (Inspection, Testing, and Maintenance)

- o 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 succeeding paragraphs address the guidelines individually.

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

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

A. Summary of Applicant's Statements

The applicant included a number of elevation plan drawings with safe load paths clearly marked. The applicant stated that "those load paths will be included in procedures required for maintenance and handling of the equipment listed." The applicant also indicated that additional safe load paths for cranes MT-CRA-1 and MT-CRA-6A, B are being developed.

"The primary control for assuring that load handling operations remain within safe load paths is procedural. The person in charge of lifts shall walk through the load path prior to a lift and insure that proper clearance exists for

independent spotter during lifts provides safety assurances similar to load-path marking. The combination appears reasonable and sufficient.

The applicant's indicated procedure for approval of load path deviations is acceptable.

C. EG&G Conclusions and Recommendations

The WNP-2 facility is in compliance with the criteria of this guideline.

2.3.2 Load-Handling Procedures [Guideline 2, NUREG-0612, Article 5.1.1(2)]

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

A. Summary of Applicant's Statements

"Written procedures will be provided for handling all 'heavy loads' as defined in NUREG-0612 before the equipment is placed in service."

The applicant provided two procedures for review.

B. EG&G Evaluation

Procedure 10.3.5, "Reactor Vessel Head Removal and Replacement" was sufficient for the RPV Head lift but failed

B. EG&G Evaluation

The applicant's statement indicates that WNP-2 is in compliance with the criteria of the guideline.

C. EG&G Conclusions and Recommendations

The WNP-2 facility is in compliance with this guideline.

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

"Special lifting devices should satisfy the guidelines of ANSI N14.6-1978, 'Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials' [11]. This standard should apply to all special lifting devices which carry heavy loads in areas as defined above. For operating plants, certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) or the load and of the intervening components of the special handling device."

A. Summary of Applicant's Statements

"[Table 2.2, this report] is a listing of all special lifting devices.

"The Head Strongback, the Dryer/Separator Sling, the Stud Tensioner Carrousel, and the Service Platform Sling conform to ANSI N14.6-1978 and Section 5.1.1(4) of NUREG-0612. The reference lifting devices are designed to be capable of

lifting five (5) times the static load without exceeding the ultimate strength of the material. Structural members also met the requirements of not exceeding the yield strength with three (3) times the static load applied. The Head Strongback and Dryer/Separator Sling hook boxes will be modified to provide attachment to the eye hook as well as the sister hook. These devices all attach to the load at four (4) points, thus a single failure will not result in an uncontrolled drop. Because of the slow speed of the main hoist and the attendant low acceleration/ deceleration, the dynamic loads are calculated to be less than 2%. This was verified by actual load tests while monitoring load cell readings.

"The RRC Motor Strongback is not a 'single failure' proof lifting device. It was designed with a safety factor of 5 versus static load."

B. EG&G Evaluation

The applicant's statement indicates that four of the special lifting devices listed meet the criteria of the guideline. For these devices, the determination of dynamic loads via testing is acceptable.

The crane used in conjunction with the RRC Motor Strongback (MT-HOI-16) is exempt from the requirements of NUREG-0612 (see Section 2.2.1). Therefore, since this device is of a dedicated type and is not used with any other cranes, it is exempt from the requirements of this guideline.

The applicant has indicated that the fuel cask, when purchased, will meet the guideline criteria.

TABLE 2.3 SLINGS UTILIZED DURING HEAVY LOAD LIFTS

| Hoist | Heavy Load Description | Maximum Weight (Tons) | Slings to be Used |
|---|---|---|---|
| MT-HOI-10 | HPCS Pump | 16.5 | 2-1 1/4" Dia.-6X37 ips |
| MT-HOI-19C | Main Steam Relief Valve | 2 | 2-1/2" Dia.-6X19 ips |
| MT-CRA-6A, 6B | Standby Service Water Pump Motor | 7<br>7.5 | 2-1" Dia.-6X19 ips |
| MT-CRA-2 | Vessel Cavity Shield Plugs | 108 | NSSE-EQ-40:4 chokers rated 39.6 ton safe working load each a 5:1 safety factor |
| | Dryer Separator Storage Plugs Top Plug Dry-Separator | 60 | 2" Dia.-6X36XIPI WRC<br>4-13/4" Dia.-6X37 |
| | Storage Plugs-Bottom 3 | 37 | 2-2" Dia.-6X37 ips |
| | Fueling Slot Plugs | 8 | 2-1" Dia.-6X19 ips |
| | Cattle Chute | 11 | 4-3/4" Dia.-6X19 ips |
| | In-Vessel Stud Rack | 0.3 | 2-3/8" Dia.-6X19 ips |
| MT-CRA-9A, 9B | Fuel-Handling Jib Crane | | Designed for light loads only Load limit 1000 lbs. |
| MT-CRA-11 | Service Platform Channel Handling Boom--Jib Crane | | Designed for light loads only Load Limit 1000 lbs. |
| MT-HOI-18 | Pipe Tunnel Hatch | 7 | 2-1" Dia.-6X19 ips |
| MT-HOI-13 | Inboard Main Steam Isolation Valves | 2 | 2-1/2" Dia.-6X19 ips |
| MT-HOI-19A-19B | Main Steam Relief Valves | 2 | 2-1/2" Dia.-6X19 ips |
| MT-HOI-36 | RRC Flow Control Valve Internals | 2 | 2-1/2" Dia.-6X19 ips |
| MT-HOI-6 | RHR Pumps A and B | 5 | 2-3/4" Dia.-6X19 ips |
| MT-HOI-8 | RHR Pump C | 5 | 2-3/4" Dia.-6X19 ips |
| MT-HOI-7 | RCIC Pump | 3 | 2-5/8" Dia.-6X19 ips |
| MT-HOI-9 | LPCS Pump Motor | 5 | 2-3/4" Dia.-6X19 ips |

2.3.6 Cranes (Inspection, Testing, and Maintenance) [Guideline 6, NUREG-0612, Article 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 Applicant's Statements

"Plant Procedure 10.4.1 lists the inspection, testing, and maintenance requirements for plant cranes. This procedure will be modified as noted to assure full compliance with ANSI B30.2, Chapter 2-2."

B. EG&G Evaluation

EG&G's review of procedure 10.4.1 indicates that after modification, the procedure will generally invoke all pertinent requirements of ANSI B30.2 Chapter 2-2.

C. EG&G Conclusions and Recommendations

The WNP-2 facility is in compliance with the requirements of this guideline.

2.3.7 Crane Design [Guideline 7, NUREG-0612, Article 5.1.1(7)]

"The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' and of CMAA-70, 'Specifications for Electric Overhead Traveling Cranes' [13]. An alternative to a

report prior to operations" [5]. EG&G concurs with this statement and agrees that WNP-2 need not comply with the interim measures at this time. If, however, WPPSS finds that actions required for compliance with the seven guidelines of NUREG-0612 Section 5.1 will not be complete prior to operations at WNP-2, then the interim measures must be addressed.

TABLE 3.1 WNP-2 NUREG-0612 COMPLIANCE MATRIX

| Heavy Loads | Weight or Capacity (tons) | GUIDELINE | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Safe Load Paths | Procedures | Crane Operator Training | Special Lifting Devices | Slings | Crane-Test and Inspection | Crane Design |
| 1. Main steam relief valves manual hoist | 2 | -- | -- | E | -- | -- | E | E |
| Main steam relief valves | 2 | E | E | -- | -- | E | -- | -- |
| 2. Recirc flow control valve hoist | 4 | -- | -- | E | -- | -- | E | E |
| Recirc flow control valve internals | 2 | E | E | -- | -- | E | -- | -- |
| 3. RHR Pumps (A&B) hoist | 6 | -- | -- | C | -- | -- | C | C |
| RHR Pumps A,B | 5 | C | C | -- | -- | C | -- | -- |
| RHR Pump Motor | 3.5 | C | C | -- | -- | C | -- | -- |
| 4. RCIC pump and turbine hoist | 5 | -- | -- | C | -- | -- | C | C |
| RCIC pump | 3 | C | C | -- | -- | C | -- | -- |
| RCIC turbine | 2.5 | C | C | -- | -- | C | -- | -- |
| 5. RHR Pump C hoist | 6 | -- | -- | C | -- | -- | C | C |
| RHR Pump C | 5 | C | C | -- | -- | C | -- | -- |
| RHR Pump Motor | 3.5 | C | C | -- | -- | C | -- | -- |

TABLE 3.1 (continued)

| Heavy Loads | Weight or Capacity (tons) | GUIDELINE | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Safe Load Paths | Procedures | Crane Operator Training | Special Lifting Devices | Slings | Crane-Test and Inspection | Crane Design |
| 11. Reactor building bridge crane | 125/15 | -- | -- | C | -- | -- | C | C |
| Vessel cavity shield plugs | 108 | C | C | -- | -- | C | -- | -- |
| Dryer-separator storage pool plugs | 60 | C | C | -- | -- | C | -- | -- |
| Dryer-Separator Bottom 3 Storage Plugs | 37 | C | C | -- | -- | C | -- | -- |
| Fueling slot plugs | 8 | C | C | -- | -- | C | -- | -- |
| Drywell head | 52 | C | C | -- | C | -- | -- | -- |
| Insulation head | 25 | C | C | -- | C | -- | -- | -- |
| RPV head | 93 | C | C | -- | C | -- | -- | -- |
| "Cattle" chute | 11 | C | C | -- | -- | C | -- | -- |
| Vessel service platform | 6 | C | C | -- | C | -- | -- | -- |
| RPV steam dryer | 40 | C | C | -- | C | -- | -- | -- |
| RPV moisture separator | 73 | C | C | -- | C | -- | -- | -- |
| In-vessel rack | 0.3 | E | E | -- | -- | E | -- | -- |
| Fuel cask | 100 | C | C | -- | C | -- | -- | -- |
| Load Block | 8 | I | C | -- | -- | -- | -- | -- |
| Stud Tensioner and Spreader | 2.5 | C | C | -- | C | -- | -- | -- |

TABLE 3.1 (continued)

| Heavy Loads | Weight or Capacity (tons) | GUIDELINE | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Safe load Paths | Procedures | Crane Operator Training | Special Lifting Devices | Slings | Crane-Test and Inspection | Crane Design |
| 15. Outboard main steam isolation valve hoist | 8 | -- | -- | C | -- | -- | C | C |
| Main steam isolation valve internals | .2 | C | C | -- | -- | C | -- | -- |
| Pipe tunnel hatch covers | 7 | C | C | -- | -- | C | -- | -- |
| 16. Inboard main steam isolation valve hoist | 8 | -- | -- | E | -- | -- | E | E |
| Main steam isolation valve internals | 2 | E | E | -- | -- | E | -- | -- |
| 17. RHR HX monorail | 20 | -- | -- | -- | -- | -- | -- | -- |
| RHR heat exchanger | 34 | -- | -- | -- | -- | -- | -- | -- |

C = Applicant action complies with NUREG-0612 Guideline.
NC = Applicant action does not comply with NUREG-0612 Guideline
I = Insufficient information provided by the Applicant
E = Exempt from the NUREG-0612 Guidelines
-- = Not applicable.

## 4. REFERENCES


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

2. 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.

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

4. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Response to NUREG-0612, Control of Heavy Loads, WPPSS, 13 January 1982.

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

6. 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.

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

8. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Control of Heavy Loads, 28 March 1983.

9. G. D. Bouchey (WPPSS), Letter to NRC. Subject: Nuclear Project No. 2 Control of Heavy Loads, Clarification, 13 April 1983.

10. ANSI B30.2-1976, "Overhead and Gantry Cranes."

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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 (WNP-2) for the requirements of Section 5.1.1 of NUREG-0612 (Phase I). Sections 5.1.4, 5.1.5, and 5.1.6 (Phase II) will be covered in a separate report.

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