Enclosure 2

(DRAFT)

TECHNICAL EVALUATION REPORT

# CONTROL OF HEAVY LOADS (C-10)

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION UNITS 1 AND 2

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# FOREWORD

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

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# 1. INTRODUCTION

## 1.1 PURPOSE OF REVIEW

This technical evaluation report documents the review of general load handling policy and procedures at Virginia Electric and Power Company's (VEPCO) North Anna Power Station 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 to 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.

The approach used to develop the staff guidelines, based on defense-in-depth, was 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 of all operating nuclear power plants perform the following:

- o define safe load travel paths through procedures and operator training so that, to the extent practical, heavy loads are not carried over or near irradiated fuel or safe shutdown equipment
- o provide sufficient operator training, handling system design, load handling instructions, and equipment inspection to ensure reliable operation of the handling system.

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

## 1.3 PLANT-SPECIFIC BACKGROUND

On December 22, 1980, the NRC issued a letter [3] to VEPCO, the Licensee for North Anna Power Station, requesting that the Licensee review provisions for the handling and control of heavy loads, evaluate these provisions with respect to the guidelines of NUREG-0612, and provide additional information to be used for an independent determination of conformance to these guidelines.

On December 22, 1981 [4] and March 22, 1982 [5], VEPCO responded to this request. A draft technical evaluation report (TER) was prepared based on this information and was informally transmitted to the Licensee for review and comment. In response to the draft TER, VEPCO submitted additional information on October 18, 1982 [6]. On October 22, 1982, a telephone conference call was conducted with representatives of NRC, FRC, and VEPCO to discuss unresolved issues. As a result of this call, additional information was forwarded by VEPCO on December 15, 1982 [7] and has been incorporated into this technical evaluation.

# 2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at North Anna 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 to provide the defense-in-depth appropriate for the safe handling of heavy loads. They are identified under the following topics in 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.

### 2.1.1 Overhead Heavy Load Handling Systems

#### a. Summary of Licensee Statements and Conclusions

The Licensee has reviewed all load handling systems capable of carrying a heavy load (approximately 2500 pounds) and classified them into one of two groups:

Table 2.1. North Anna Units 1 and 2/NUREG-0612 Compliance Matrix

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Containment Polar Cranes | 140/50 | -- | -- | R | -- | -- | C | P | -- | -- |
| - Reactor Vessel Lifting Rig | 6.0 | C | R | -- | NC | -- | -- | -- | -- | C |
| - RV Head | 127.2 | C | R | -- | -- | -- | -- | -- | -- | C |
| - RV Internals Lifting Rig | 7.2 | C | R | -- | NC | -- | -- | -- | -- | C |
| - RV Upper Internals | 53.5 | C | R | -- | -- | P | -- | -- | -- | C |
| - RV Lower Internals | 131.5 | C | R | -- | -- | P | -- | -- | -- | C |
| - CRD Missile Shield | 33.3 | C | R | -- | -- | P | -- | -- | -- | C |
| - RV Seal Ring | 7.5 | C | R | -- | -- | P | -- | -- | -- | C |
| - Reactor Coolant Pump Motor | 39.0 | C | R | -- | NC | -- | -- | -- | -- | C |
| - Floor Concrete Hatches | 1-20 | C | R | -- | -- | P | -- | -- | -- | C |
| - RV Inspection Tool | 5.0 | C | R | -- | -- | P | -- | -- | -- | C |
| - Reactor Containment Recirc Fan | 2.8 | C | R | -- | -- | P | -- | -- | -- | C |

C = Licensee action complies with NUREG-0612 Guideline.
NC = Licensee action does not comply with NUREG-0612 Guideline.
P = Licensee action partially complies with NUREG-0612 Guideline.
-- = Not applicable.
R = Licensee has proposed revisions or modifications which, when implemented, will be in compliance with NUREG-0612 Guideline.

Table 2.1 (Cont.)

| Heavy Loads | Weight or Capacity (tons) | Guideline 1 Safe Load Paths | Guideline 2 Procedures | Guideline 3 Crane Operator Training | Guideline 4 Special Lifting Devices | Guideline 5 Slings | Guideline 6 Crane - Test and Inspection | Guideline 7 Crane Design | Interim Measure 1 Technical Specifications | Interim Measure 6 Special Attention |
|---|---|---|---|---|---|---|---|---|---|---|
| 2. Containment Annulus Crane | 5.0 | -- | -- | R | -- | -- | C | C | -- | -- |
| - Various Loads up to Rated Capacity | | C | R | -- | -- | P | -- | -- | -- | -- |
| 3. RHR Pump Monorails | 3.0 | -- | -- | R | -- | -- | C | C | -- | -- |
| - RHR Pump Motors | 3.0 | C | R | -- | -- | P | -- | -- | -- | -- |
| 4. Auxiliary Building Material Handling Monorails | 12.0 | -- | -- | R | -- | -- | C | C | -- | -- |
| - Filter Casks | 4.0 | C | R | -- | -- | P | -- | -- | -- | -- |
| 5. New Fuel Bridge Crane | 5.0 | -- | -- | R | -- | -- | C | C | -- | C |
| - Various Loads up to Rated Capacity | 4.0 | C | R | -- | -- | P | -- | -- | -- | -- |
| 6. Fuel Building Movable Platform | | -- | -- | R | -- | -- | C | C | C | -- |
| - Spent Fuel Cavity Gate | 1.8 | C | R | -- | -- | P | -- | -- | C | -- |

Group I — Heavy load handling systems from which a load drop may result in damage to any system required for plant shutdown or decay heat removal, taking no credit for interlocks, technical specifications, operating procedures, detailed structural analyses, or system redundancy.

Group II — Heavy load handling systems excluded from Group I based on determination by inspection that there is sufficient physical separation between any load-impact point and any system needed for plant shutdown or decay heat removal.

Table 2.1 lists all handling systems the Licensee has classified as Group I, and Table 2.2 lists all handling systems the Licensee has classified as Group II, along with reasons for excluding each system from compliance with NUREG-0612.

Table 2.1. Group I Load Handling Systems

Containment Polar Crane (1-MH-CR-1)

Containment Annulus Crane (1-MH-CR-19)

RHR Pump Monorails

Auxiliary Building Material Handling System Monorails (1-MH-CR-8A & B,-9B)

New Fuel Bridge Crane (1-MH-CR-20)

Fuel Building Movable Platform with Hoists (1-MH-FH-13)

Table 2.2. Group II Load Handling Systems

A. Load handling systems excluded due to physical separation from safety-related or plant shutdown equipment:

Recirculation Spray Pump Hoists (1-MH-CR-39 A & B)

Auxiliary Building Bridge Crane (1-MH-CR-9A)

Auxiliary Building Jib Crane

Fuel Building Trolley (1-MH-CR-15)

Decontamination Building Trolley (1-MH-CR-28)

Solid Waste Crane (1-MH-CR-36)

Solid Fill Area Crane (1-MH-CR-37)

Turbine Building Overhead Crane (1-MH-CR-2)

Table 2.2 (Cont.)

Steam Generator Feed Pump Trolley (1-MH-CR-6)

Condenser Waterbox Hoists (1-MH-CR-10A & B)

Feedwater Heater Hoists (1-MH-CR-17A & B)

Machine Shop Monorails (1-MH-CR-11A & B)

Machine Shop Bridge Crane (1-MH-CR-24)

Machine Shop Monorail (1-MH-CR-38)

Trasn Basket Monorail and Hoist (1-MH-CR-26)

B. Load handling systems excluded because they are sole-purpose systems capable of lifting loads over a single train of components and are used only when the equipment is out of service for maintenence:

Charging Pump Monorails (1-MH-CR-7)

Emergency Diesel Generator Monorails

b. Evaluation, Conclusion, and Recommendation

The Licensee's determination of those cranes and hoists which must comply with NUREG-0612 is consistent with NRC guidelines. The remaining cranes and hoists have been justifiably excluded due to either (1) physical separation from equipment required for plant shutdown or decay heat removal or (2) classification of the handling system as a sole-purpose system used only when the equipment required for plant shutdown or decay heat removal has been placed out of service.

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 load paths have been identified for the Group I overhead handling systems, taking into account the location of plant equipment needed for plant shutdown or decay heat removal, and conservatively adding the effects of possible load swings. Each item of plant equipment was evaluated to determine whether damage from a load drop could prevent achieving and maintaining a safe shutdown condition. For the overhead load handling systems which were inaccessible to walkdown inspection (due to plant operation or high radiation), design drawings were reviewed to determine whether a load drop could potentially damage the equipment required for plant shutdown or decay heat removal.

The Licensee notes that this identification of safe load paths assumes that the structural integrity of the floors is maintained following the postulated load drops. A structural analysis was performed for the floor over which heavy loads travel and maximum lift heights were established to correspond with the floor capacities.

Current plant procedures require that deviations to safe load paths be reviewed by station supervisory personnel with a followup review by the station nuclear safety and operating committee.

The Licensee takes exception to the Guideline 1 requirement to mark safe load paths on the operating floors and notes:

> "Safe load paths will not be marked on the floor in the area where the load is to be handled. Safe load path sketches will be defined in procedures and made available to all crane operators. Since a majority of the reactor containment operating floor consists of removable hatches and mechanical equipment and is covered with herculite during outages, safe load path markings are impractical. Safe load path sketches which are simple, descriptive and readily available to operators will better serve to define safe load paths."

In lieu of marking load paths on floors, supervisory personnel review the load path with the operators prior to a lift being made and a signalman then guides the operator along the load path during the lift operation.

b. Evaluation

Development of load paths in the containment building meets the intent of Guideline 1. The use of floor structural integrity combined with maximum lift heights to determine acceptable safe load paths is consistent with the intent of this guideline.

In the fuel building, use of exclusion areas is acceptable on the basis that the areas of concern are relatively small and the creation of load paths would excessively limit the movement of loads.

Deviations from load paths are acceptably handled on the basis that prior approval is required and that the additional procedures and changes prepared receive at least two levels of supervisory review.

Although safe load paths are not marked at North Anna Units 1 and 2, the object of providing a visual aid for operators is accomplished by having supervisory personnel review the procedure with the operator and providing a signalman to guide the operator. However, the duties of the supervisors and signalman relative to safe load handling should be clearly defined procedures.

c. Conclusion and Recommendation

The Licensee partially complies with Guideline 1 on the basis that safe load paths have been developed for the overhead handling systems subject to compliance with NUREG-0612. However, the Licensee should ensure that the duties of the load handling supervisor and the crane signalman are clearly defined in appropriate procedures.

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 provided a tabulation of heavy loads periodically handled by the containment polar cranes and a summary of loads carried by the other Group I handling systems. Specific sections of M.D. ADM-9.1, "Control of Heavy Loads in the Reactor Containment - 291 Level," are identified for most of the heavy loads in the containment. With the exception of the fuel building movable platform, procedures for the remaining Group I handling systems remain to be developed. The Licensee stated that the procedures will contain the information specified in Guideline 2 and that the procedures will be in place by the next refueling or prior to the movement of individual heavy loads.

c. Evaluation and Conclusion

North Anna Power Station Units 1 and 2 comply with Guideline 2 based on their commitment to implement procedures in accordance with this guideline prior to next refueling or load lift.

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' [6]."

a. Summary of Licensee Statements and Conclusions

Crane operations at North Anna Power Station Units 1 and 2 are handled by either maintenence or operations department personnel. Current maintenance department procedures require that crane operators be trained and qualified according to ANSI B30.2-1976. The Licensee states that crane operators from the operations department are selected by the refueling senior reactor operator/coordinator. Each crane operator receives the following instructions:

1. "He must read, understand and sign the sign off sheet of the master refueling procedure, OP 4.1, covering the manipulator crane and the fuel building bridge and trolley crane.

2. Practice walk-throughs are conducted on all fuel handling equipment. A dummy fuel assembly is used to simulate actual fuel.

3. All equipment is tested and is verified to be in calibration prior to use.

4. Procedures are provided for the following cranes:

   (a) Manipulator Crane
   (b) Fuel Building Bridge and Trolley Crane
   (c) New Fuel Crane
   (d) Spent Fuel Crane.

5. Safe load paths and restricted areas are outlined in the appropriate procedure.

6. Each operator whom the SRO feels operates the equipment in a safe manner will be certified on the crew training check off sheet indicating what equipment he may operate and a copy of which will be in his training record."

The Licensee stated that provisions do not presently exist to monitor operator conduct on a continuing basis but that provisions will be made to do so by the next refueling or the next movement of the individual loads.

b. Evaluation

The crane operator training program at North Anna Power Station Units 1 and 2 satisfies the criteria of Guideline 3 on the basis that operators are trained and qualified in accordance with ANSI B30.2-1976, and that the Licensee has made a commitment to monitor operator conduct on a continuing basis.

c. Conclusion

North Anna Power Station Units 1 and 2 comply 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' [7]. This standard should apply to all special lifting devices which carry heavy

loads in areas as defined above. For operating plants certain inspections and load tests may be accepted in lieu of certain material requirements in the standard. In addition, the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 should be based on the combined maximum static and dynamic loads that could be imparted on the handling device based on characteristics of the crane which will be used. This is in lieu of the guideline in Section 3.2.1.1 of ANSI N14.6 which bases the stress design factor on only the weight (static load) of the load and of the intervening components of the special handling device."

a. Summary of Licensee Statements and Conclusions

The Licensee states that lifting devices used for the reactor vessel heads, reactor internals, and reactor coolant pump motors are standard lifting devices supplied by Westinghouse for these specific functions. The analyses are currently being performed and are expected to be complete by May 1983.

b. Evaluation

Insufficient information has been provided to allow a determination of compliance with respect to Guideline 4. The Licensee should provide an evaluation concerning compliance with ANSI N14.6 for all special lifting devices. In performing their evaluation, the Licensee should address the imposition of static and dynamic loads when assessing design stresses.

Further, the intent of Guideline 4, in addition to determining that special lifting devices have been designed and fabricated in a manner consistent with high reliability, is also to make certain that appropriate steps are taken to have these devices inspected, tested, and maintained so as to ensure continued reliability. Guidance for a program to support the goal is contained in Section 5 of ANSI N14.6. VEPCO has provided no information addressing these issues.

c. Conclusion and Recommendation

North Anna Units 1 and 2 do not satisfy Guideline 4 of NUREG-0612. The Licensee should implement an acceptance and continuing compliance testing

program for special lifting devices in accordance with Section 5.0 of ANSI N14.6-1978 prior to the next use of these devices. Further, the Licensee should provide a design comparison of special lifting designs relative to the criteria in ANSI N14.6-1978.

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' [8]. 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 North Anna maintenance procedure for the reactor containment polar crane (M.M. ADM-4.0) requires that slings comply with ANSI B30.9-1971. Slings used in other plant areas are currently being marked as required by this standard. The Licensee stated that the information concerning the effect of dynamic loads on slings is presently under evaluation and will be provided at a later date.

b. Evaluation

The Licensee's program for non-special lifting devices (slings) is satisfactory on the basis that slings are required to comply with ANSI B30.9-1971. No information has been provided to determine whether dynamic loads are included in the selection and marking of slings, or whether slings restricted in use to only certain cranes are clearly marked to so indicate. As an alternative, the Licensee may demonstrate that crane hook speeds are sufficiently slow that dynamic loads constitute a reasonably small percentage of the static load imposed on the sling.

c. Conclusion and Recommendation

North Anna Power Station partially complies with Guideline 5. To fully comply, the Licensee should verify that (1) slings are selected and marked based upon the maximum static and dynamic load which may be imposed and (2) slings restricted in use to only certain cranes are clearly marked to so indicate.

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

ANSI B30.2-1976 has been invoked by the Licensee in the following maintenance procedures for Group I cranes at the North Anna Power Station:

| | |
|---|---|
| MMP-P-MA-1 | "Reactor Containment Cranes and Associated Lifting Equipment" |
| MMP-P-MH-3 | "Frequent and Periodic Inspection of Bridge Cranes" |
| MMP-P-MH-5 | "Frequent and Periodic Inspection of Gantry Cranes" |
| M.D. ADM-9.1 | "Control of Heavy Loads in Reactor Containment-291 Fuel." |

b. Evaluation

The Licensee has taken no exception with implementing Chapter 2-2 of ANSI B30.2-1976 and it is therefore assumed that procedures in use satisfy ANSI requirements for crane inspection, testing, and maintenance.

c. Conclusion

North Anna Power Station complies with Guideline 6.

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' [9]. 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 states:

"The reactor containment polar crane and turbine room cranes are designed to the Electric Overhead Crane Institute Specification 61 - "Specifications for Electric Overhead Traveling Cranes" (EOCI-61) that was in effect at the time of manufacture of cranes. These specifications are the predecessors of CMAA-70 now in effect and are similar.

The primary difference between the EOCI-61 and CMAA-70 specifications are changes in the design of bridge girders. These changes reflected in the CMAA-70 specification allow the use of higher allowable stresses for the better grade materials available today and also provide new design formulas. These changes are a result of advancements in the state of the art of girder structural design, allowing the use of lighter, more efficient structures and do not increase the conservatism in the design from the older EOCI-61 specification.

The North Anna cranes, hoists, and trolleys are designed in accordance with the requirements of ANSI B30.2-1967, which was the applicable edition for design requirements when the cranes were manufactured."

The Licensee has verified that the polar cranes meet 10 of the 14 revised requirements of CMAA-70. The remaining four items are presently under evaluation: longitudinal stiffeners, hoist rope requirements, drum design, and gear design. Final verification of the remaining four items will be confirmed by March 1, 1983.

b. Evaluation

The cranes at North Anna Units 1 and 2 satisfy, to a considerable extent, the criteria of Guideline 7 on the basis that the cranes were procured to the accepted industrial standard at the time of manufacture; in addition, the Licensee has verified that the current design is in compliance with many of the more restrictive requirements of CMAA-70. The Licensee is currently evaluating the longitudinal stiffeners, hoist rope, drum design, and gear design to determine the extent to which CMAA-70 requirements are met.

c. Conclusion and Recommendation

North Anna Power Station substantially complies with Guideline 7 on the basis of compliance with ECCI-61 criteria and the Licensee's verification that crane design meets the majority of CMAA-70 requirements. The Licensee should complete their verification that the longitudinal stiffeners, hoist rope, drum design, and gear design meet the requirements of CMAA-70.

## 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 general 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]

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

a. Evaluation

Review of North Anna Power Station's Technical Specifications reveals that Technical Specification 3.9.7 for both Units 1 and 2 prohibits loads in excess of 2500 pounds from travel over irradiated fuel in the spent fuel pool.

b. Conclusion

North Anna Power Station complies with this interim protection measure.

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 stated that, prior to each refueling outage, the cranes, slings, and lifting devices are inspected and repaired or replaced in accordance with plant procedures.

In addition, a review of procedures and operator training is under evaluation. Appropriate procedures will be generated or modified as necessary to meet the requirements of the general guidelines of NUREG-0612 prior to the next refueling or movement of individual heavy loads.

b. Evaluation and Conclusion

North Anna 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 North Anna 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 North Anna Units 1 and 2 can be expected to be conducted in a reliable manner consistent with the staff's objectives as expressed in these guidelines.

To ensure that the overall intent of NUREG-0612, Section 5.1.1 is satisfied, the Licensee should perform the following:

- Ensure that the duties of the load handling supervisor and signalman are defined in procedures.
- Develop a program consistent with ANSI N14.6-1978, Section 5.0, to maintain the assurance of reliability of special lifting devices.

- Complete the assessment of the design of special lifting devices in comparison with sections of ANSI N14.6-1978 affecting device load handling reliability. (This work has been contracted; results are expected by May 1983.)

- Complete the evaluation of dynamic loads on slings.

- Complete the design review of electrical overhead traveling cranes within the scope of NUREG-0612 to determine their equivalence regarding longitudinal stiffener design, hoist rope requirements, and drum and gear design to cranes designed and fabricated in accordance with CMAA-70.

## 3.2 INTERIM PROTECTION MEASURES

The NRC staff has established certain measures (NUREG-0612, Section 5.3) that should be initiated to provide reasonable assurance that handling of heavy loads will be performed in a safe manner until final implementation of the general guidelines of NUREG-0612, Section 5.1, is complete. Specified measures include the implementation of a technical specification to prohibit the handling of heavy loads over fuel in the storage pool; compliance with Guidelines 1, 2, 3, and 6 of NUREG-0612, Section 5.1.1; a review of load handling procedures and operator training; and a visual inspection program, including component repair or replacement as necessary of cranes, slings, and special lifting devices to eliminate deficiencies that could lead to component failure. Evaluation of information provided by the Licensee indicates these actions have been satisfactorily implemented at the North Anna Power Station.

## 4. REFERENCES


1. NUREG-0612
   "Control of Heavy Loads at Nuclear Power Plants"
   NRC, July 1980

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

3. NRC
   Letter to VEPCO
   Subject: Request for Review of Heavy Load Handling
   December 22, 1980

4. R. H. Leasburg (VEPCO)
   Letter to H. R. Denton (NRC)
   Subject: Control of Heavy Loads
   December 22, 1981

5. R. H. Leasburg (VEPCO)
   Letter to H. R. Denton (NRC)
   Subject: Control of Heavy Loads
   March 22, 1982

6. ANSI B30.2-1976
   "Overhead and Gantry Cranes"

7. ANSI N14.6-1978
   "Standard for Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More for Nuclear Materials"

8. ANSI B30.9-1971
   "Slings"

9. CMAA-70
   "Specifications for Electric Overhead Traveling Cranes"
   1975

10. R. H. Leasburg (VEPCO)
    Letter to H. R. Denton (NRR)
    Subject: NUREG-0612, Control of Heavy Loads
    October 18, 1982

11. W. L. Stewart (VEPCO)
    Letter to H. R. Denton (NRR)
    Subject: NUREG-0612, Control of Heavy Loads
    December 15, 1982