CONTROL OF HEAVY LOADS AT NUCLEAR POWER PLANTS
MILLSTONE UNIT 3
Docket No. [50-0423]
(Phase I)

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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 Millstone Unit 3.

EXECUTIVE SUMMARY

Millstone Unit 3 does not totally comply with the guidelines of NUREG-0612. In general, compliance is insufficient in the following areas:

- o It appears that three cranes that should have been evaluated to NUREG-0612 criteria have not been evaluated.

- o Compliance with NUREG-0612 with regard to load-handling procedures has not been shown.

- o More information regarding compliance with NUREG-0612 is needed for special lifting devices.

- o No information was provided regarding compliance with NUREG-0612 in regard to standard lifting devices.

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

MILLSTONE UNIT 3

(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 Millstone Unit 3. 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.

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 applicant 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.

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, 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 portion 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 crane) 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.

The approach used to develop the staff guidelines for minimizing the potential for a load drop was based on defense in depth and is summarized as follows:

- o Provide sufficient operator training, handling system design, load-handling instructions, and equipment inspection to assure reliable operation of the handling system

- 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 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 Northeast Nuclear Energy Company (NNECO), the applicant for Millstone Unit 3 requesting that the applicant review provisions for handling and control of heavy loads at Millstone Unit 3, 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 May 15, 1984, NNECO provided the initial response [4] to this request.

2. EVALUATION AND RECOMMENDATIONS

2.1 Overview

The following sections summarize NNECO's review of heavy load handling at Millstone Unit 3 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. The applicant has indicated the weight of a heavy load for this facility (as defined in NUREG-0612, Article 1.2) as 1800 lb.

2.2 Heavy Load Overhead Handling Systems

This section reviews the applicant's list of overhead handling systems which are subject to the criteria of NUREG-0612 and a review of the justification for excluding overhead handling systems from the above mentioned list.

2.2.1 Scope

"Report the results of your review of plant arrangements to identify all overhead 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 any interlocks, technical specifications, operating procedures, or detailed structural analysis) and justify the exclusion of any overhead handling system from your list by verifying that there is sufficient physical separation from any load-impact point and any safety-related component to permit a determination by inspection that no heavy load drop can result in damage to any system or component required for plant shutdown or decay heat removal."

A. Summary of Applicant's Statements

The applicant's review of overhead handling systems identified the cranes and hoists shown in Table 2.1 as those which handle heavy loads in the vicinity of irradiated fuel or safe shutdown equipment.

TABLE 2.1 APPLICABLE OVERHEAD LOAD HANDLING SYSTEMS

Equipment No.	Identification	Location
3MHR-CRN1	Polar Crane	Containment
3MHF-CRN1	Spent Fuel Shipping Cask Trolley	Fuel Building
3MHF-CRN2	New Fuel Handling Crane	Fuel Building
3MHF-CRN3	New Fuel Receiving Crane	Fuel Building
3MHF-CRN4	Fuel Building Decontamination Crane	Fuel Building
3MHP-CRN1	Auxiliary Building Filter Handling Crane/Monorail	Auxiliary Building
3MHP-CRN2A,B,C	Auxiliary Building Charging Pump Trolley	Auxiliary Building
(-)	Reactor Plant Component Cooling Water Heat Exchanger Monorail	Auxiliary Building

The applicant has also identified numerous other cranes that have been excluded from satisfying the criteria of the general guidelines of NUREG-0612.

B. EG&G Evaluation

The Steam Generator Access Platform Jib Crane Mark No. 3MHR-CRN-4, 5 was excluded from compliance with NUREG-0612 on the basis that limit switches and a load cell limit the load over the refueling cavity area to 1800 lb. Exclusion does not seem to be consistent with Phase I criteria of not taking credit for interlocks and operating procedures.

The Spent Fuel Bridge and Hoist Mark No. 3MHS-CRN-B1 and the Sigma Refueling Machine Mark No. 3MHR-CRN-2 were excluded because the maximum load they will carry is a fuel element. However, it is not clear whether it is possible to lift loads heavier than a fuel element with these hoists. If heavier loads are eliminated only by administrative procedures then these hoists should be included.

C. EG&G Conclusions and Recommendations

EG&G concludes that the applicant has not included all applicable hoists and cranes in their list of handling systems which must comply with the requirements of the general guidelines of NUREG-0612.

The three cranes or hoists mentioned in our evaluation should either be included as applicable cranes or a more adequate justification for their exclusion should be given.

2.3 General Guidelines

This section addresses the extent to which the applicable handling systems comply with the general guidelines of NUREG-0612, Article 5.1.1. EG&G's conclusions and recommendations are provided in summaries for each guideline.

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 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

NNECO provided figures which "identify, as much as practical, the location of safe load paths, spent fuel, and safe shutdown equipment in the areas of concern.

The safe load paths shown on these figures will not be permanently marked on the plant flooring. This is due to the possibility that when loads are being moved, the flooring may be covered with disposable polyvinyl sheeting. In lieu of the permanent markings a supervising load director will be available to verify the load path and help direct the crane operator."

NNECO also stated that deviation from procedures will require an approved procedural change.

B. EG&G Evaluation

NNECO's response to this guideline is brief but seems to meet the intent of the guideline. Load paths are defined and a load director will verify and direct the load handling operation to ensure that load paths are followed. It is not clear if deviations from load paths require a written approval.

C. EG&G Conclusions and Recommendations

Millstone Unit 3 appears to meet the intent of this guideline. However, clarification of items as mentioned in the above evaluation is necessary.

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

Administrative procedures will include the general guidelines and evaluation requirements of NUREG-0612. Load-handling operational procedures will be written as necessary to ensure compliance with the NNECO submittal to NUREG-0612. The safe load paths shown in this report will be used as the load-handling paths. Any deviation from these operational procedures will require an approved procedural change.

B. EG&G Evaluation

NNECO states that "load-handling operational procedures will be written as necessary to ensure compliance with the NNECO submittal to NUREG-0612." Compliance should be to NUREG-0612 not the NNECO submittal.

It is also not clear if all heavy loads will have written procedures for their handling.

C. EG&G Conclusions and Recommendations

EG&G concludes that the information provided concerning this guideline is inadequate. NNECO should provide more information as indicated by the evaluation.

2.3.3 Crane Operator Training [Guideline 3, NUREG-0612, Article 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' [5]."

A. Summary of Applicant's Statements

An operator training program is currently being developed and, along with operator qualification and conduct, will be consistent with the intent of ANSI B30.2-1976.

B. EG&G Evaluation

NNECO has committed to compliance with Guideline 3.

C. EG&G Conclusions and Recommendations

Millstone Unit 3 meets the intent of 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' [6]. 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

The two special lifting devices, the reactor vessel head lifting device and the upper internals lifting rig assembly, were both designed prior to the publishing of ANSI N14.6-1978.

The ANSI N14.6 document has been reviewed in detail and compared to the requirements used to design and manufacture the reactor vessel head lift rig, the reactor vessel internals lift rig, load cell, and the load cell linkage.

ANSI N14.6 contains the requirements for use of stress design factors of 3 and 5 for allowable yield and ultimate stresses respectively for maximum shear and tensile stresses. Westinghouse is currently performing a detailed stress report to document the degree of compliance of the Millstone 3 lift rigs listed above to these requirements. This analysis is identical in nature to numerous other analyses completed by Westinghouse on lift rigs of similar design. Based on the results of those analyses previously performed, the following results are expected:

1. The reactor vessel head lift rig, load cell and load cell linkage at Millstone 3 are nearly identical to those previously analyzed. In all cases, those previously analyzed met the requirements of ANSI N14.6, Section 3.2. Therefore, the requirements for Millstone 3 are expected to conform to these requirements.

2. The reactor vessel internals lift rig at Millstone 3 is not identical in design to those previously analyzed, but many similarities exist. Based on these similarities and past analyses, most but not all of the requirements of ANSI N14.6, Section 3.2 are expected to be met. However, as pointed out in past analyses, the stress calculations will be based on lifting the lower internals. The lower internals are only removed when a periodic inservice inspection is required. Before lifting the lower internals all fuel is removed. As a result, the concern for handling over fuel is nonexistent. Normal use of the rig is for handling the upper internals only. The upper internals are approximately one-half the weight of the lower internals. Thus, the stress induced while handling the upper internals would be approximately one-half of that to be analyzed handling the lower internals. Therefore, the handling of the upper internals is expected to comply with ANSI N14.6, Section 3.2.

B. <u>EG&G Evaluation</u>

A stress report on the two special lifting devices identified is being done by Westinghouse but is not yet available. Based on the information given in the response the intent of the guideline should be met but the stress report or a summary of its conclusions should be provided before final acceptance. Information on how dynamic loads were accounted for should also be provided. The response to the requirements of Section 5.3 of ANSI N 14.6 is not in sufficient detail.

C. EG&G Conclusions and Recommendations

This response should include the results of the on going Westinghouse analysis as well as the details of the response to Section 5.3 of ANSI N 14.6.

2.3.5 Lifting Devices (Not Specially Designed) [Guideline 5, NUREG-0612, Article 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' [7]. 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 Applicant's Statements

No information was provided.

B. EG&G Evaluation

Since no information was provided an evaluation is impossible.

C. EG&G Conclusions and Recommendations

Since no information was provided EG&G must conclude that Millstone Unit 3 does not meet the intent of this guideline. NNECO should provide information regarding the use of standard lifting devices.

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

Crane inspection, testing, and maintenance procedures will comply with the intent of the guidelines of ANSI B30.2-1976, Chapter 2-2. Should any deviations from this standard be required, they will be equivalent to the requirements of ANSI B30.2-1976.

B. EG&G Evaluation

NNECO's response is brief but adequate.

C. EG&G Conclusions and Recommendations

Millstone Unit 3 complies with the intent 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' [8]. 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 Applicant's Statements

The containment polar crane (3MHR-CRN1), the spent fuel shipping cask trolley (3MHF-CRN1), the new fuel receiving crane (3MHF-CRN3), and the decontamination area crane (3MHF-CRN4) have been designed to meet the criteria and guidelines of CMAA-70, Specification for Electrical Overhead Traveling Cranes, and ANSI B30.2-1967. Although these cranes have been designed to the 1967 ANSI standard, they have been reviewed for compliance with the 1976 standard and there are no significant differences between the two ANSI standards which would affect the operation of the cranes. The new fuel handling crane (3MHF-CRN2) has been designed to comply with the guidelines of CMAA-70 and ANSI B30.2-1976.

The balance of the load-handling devices are not cranes, so CMAA-70 and ANSI B30.2-1976 were not used in their design. Instead, ANSI B30.11, Standard Monorail System and Underhung Cranes, and ANSI B30.16, Standard Overhead Hoists, were used.

B. EG&G Evaluation

The above statements are brief but indicate that the applicable cranes and hoists were designed in accordance with standards equivalent to those specified in the guideline.

C. EG&G Conclusions and Recommendations

Millstone Unit 3 complies with the intent of this guideline.

3. CONCLUDING SUMMARY

3.1 Applicable Load-Handling Systems

The list of cranes and hoists supplied by the applicant as being subject to the provisions of NUREG-0612 is not complete (see Section 2.2.1).

3.2 Guideline Recommendations

Compliance with the seven NRC guidelines for heavy load handling (Section 2.3) are partially satisfied at Millstone Unit 3. This conclusion is represented in tabular form as Table 3.1. Specific recommendations to aid in compliance with the intent of these guidelines are provided as follows:

Guideline	Recommendation
1. Section 2.3.1 Guideline 1	a. Clarification of requirements for deviations from load paths is recommended.
2. Section 2.3.2 Guideline 2	a. NMECO should provide more information on this guideline.

Guideline	Recommendation
3. Section 2.3.3	a. Millstone Unit 3 complies with the intent of this guideline.
4. Section 2.3.4 Guideline 4	a. NNECO should supply more information on this guideline.
5. Section 2.3.5 Guideline 5	a. NNECO should supply information on this guideline.
6. Section 2.3.6 Guideline 6	a. Millstone Unit 3 complies with the intent of this guideline.
7. Section 2.3.7 Guideline 7	a. Millstone Unit 3 complies with the intent of this guideline.

Page left for TABLE 3.1 COMPLIANCE MATRIX

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 NNECO. Subject: NRC Request for Additional Information on Control of Heavy Loads Near Spent Fuel, NRC, 22, December 1980.

4. W. G. Council (NNECO), Letter to B. J. Yougblood (NRC). Subject: Response to Auxiliary Systems Branch Draft SER Open Items, 15, May 1984.

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

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

7. ANSI B30.9-1971, "Slings".

8. CMAA-70, "Specifications for Electric Overhead Traveling Cranes".

ENCLOSURE 2

SYNOPSIS OF ISSUES ASSOCIATED WITH NUREG-0612

CONTROL OF HEAVY LOADS AT

MILLSTONE UNIT 3

DOCKET NO. 50-423

ENCLOSURE 2

SYNOPSIS OF ISSUES ASSOCIATED WITH NUREG 0612

The following information is provided to identify exceptions or interpretations related to verbatim compliance with NUREG 0612 Guidelines that have occurred during the course of this review. For each of the major Guidelines specific exceptions are identified, a discussion concerning the underlying objective of that Guideline is provided, and approaches felt to be consistent and inconsistent with that guideline are identified. While each such exception has been handled on a case by case basis, and has been considered in light of overall compliance with NUREG 0612 at a particular plant, the topics are of a nature general enough to be of interest to other plants.

GUIDELINE 1 SAFE LOAD PATHS

Exception 1

In the opinion of the licensee, development of individual load paths is impractical since there are a significant number of loads for which the pickup and laydown areas vary from outage to outage. Further, in some cases the location of safety related equipment combined with the design of the floor over which heavy loads are carried indicates that for a number of lifts there is no preferred load path.

Discussion

The purpose of this portion of Guideline 1 is to ensure that the paths over which heavy loads are carried have been developed and approved in advance of the lift and are based on considerations of safety. In particular it is provided to avoid the ad hoc selection of load paths by maintenance personnel since such a situation could result in the use of a load path which has been established by a process wherein considerations other than safety have taken precedence.

It is recognized that there are a class of loads which, although in excess of the weight specified for classification as a heavy load, are actually miscellaneous or maintenance related loads for which it is impractical to identify a specific laydown area which can be fixed from outage to outage. Conversely there are a number of loads for which specific laydown areas have been allocated in the original plant design and which should reasonably be expected to be carried over the same load paths during every outage. A tabulation of loads in this latter category, generally applicable to PWR's and BWR's, was provided in NUREG 0612 as Table 3-1.

A fundamental principal of NUREG 0612 is protection through defense in depth. Specifically, the first line of protection from an accident which could result in damage to spent fuel or equipment required for safe shutdown or decay heat removal is to avoid or minimize the exposure of such equipment to crane borne loads overhead. Where such exposure is minimized, rather than avoided, a second line of defense can then be provided by intervening barriers such as floors or the provision of additional lifting device redundancy or safety factors. Considering the foregoing, the use of exclusion areas, rather than safe load paths, is consistent with this guideline only under circumstances where there is no safety related equipment located beneath the area accessible to the crane hook but outside of the exclusion area. This situation has been found in buildings such as the turbine hall or screen house where safety related equipment is concentrated in a specific area within the crane path. It is unlikely to occur within containment due to the numerous safety related piping and electrical systems provided to support decay heat removal.

Approaches Consistent With This Guideline

Specific safe load paths are prepared an approved for major components for which hazardous areas are well established. For miscellaneous lifts load corridors are established such that any movement within that corridor cannot result in carrying a heavy load over spent fuel or systems required for safe shutdown or decay heat removal (regardless of intervening floors). Movement within these corridors is at the discretion of the load handling party.

Specific safe load paths are prepared and approved for major components for which hazardous areas are well established. For miscellaneous lifts detailed directions are prepared and approved for developing safe load paths which include floor plans showing the location of safety related equipment and instructions to avoid such equipment. Specific safe load paths are then prepared each time a miscellaneous lift qualifying as a heavy load is made. These individual load paths are temporary and may change from outage to outage.

Approaches Inconsistent With this Guideline.

Use of limited exclusion areas in containment which merely prohibited the carrying of heavy loads directly over the core or specific components and allow full load handling party discretion in other areas.

Exception 2

In the opinion of the licensee marking of load paths on the floor is impractical. This may be caused by the general use of temporary floor coverings which would cover the load path markings, or, due to the number of loads involved, a requirement for multiple markings which could confuse the crane operator.

Discussion

The purpose of this feature of Guideline 1 is to provide visual aids to assist the operator and supervisor in ensuring that designated safe load paths are actually followed. In the case of the operator it has the additional function of avoiding undesirable distractions while handling suspended loads (e.g., trying to read procedural steps or drawings while controlling the crane). This feature should also be seen as a provision necessary to complete a plan for the implementation of safe load paths. Specifically it provides some additional assurance that, having spent the time and effort to develop safe load paths, those paths will be followed.

Approaches Consistent With this Guideline

Rather than mark load paths a second member of the load handling party (that is, other than the crane operator) is made responsible for assuring that the designated safe load path is followed. This second person, a signalman is typically used on cab operated cranes, checks out the safe load path prior to the lift to ensure that it is clear, refers to the safe load path guidance during the lift and provides direction to the operator and that the load path is followed. To support this approach the duties and responsibilities of each member of the load handling party should be clearly defined.

Prior to a lift the appropriate load path is temporarily marked (rope, pylons, etc.) to provide a visual reference for the crane operator. In cases where the load path cannot be marked (e.g., transfer of the upper internals in a PWR) temporary or permanent match marks can be employed to assist in positioning the bridge and/or trolley during the lift.

In either case reasonable engineering judgement would indicate that in certain specific lifts marking of safe load paths is unnecessary due to physical constraints on the load handling operation (e.g., simple hoists, monorails, or very short lifts where movement is limited to one coordinate axis in addition to the vertical).

Approaches Inconsistent With this Guideline

Positions which in effect do not recognize the need for realistically providing visual aids to the crane operator and imply that, for all lifts, the operator will remember the load path from review of procedures or by reference to a drawing.

Exception 3

Obtaining written alternative procedures approved by the plant safety review committee for any deviations from a safe load path is considered too cumbersome to accommodate the handling of maintenance loads where laydown areas may have to change or load paths altered as a result of unanticipated maintenance requirements.

Discussion

The purpose of this portion of this guideline is to ensure that deviations from established safe load paths receive a level of review appropriate to their safety significance. In general it is highly desirable that once safe load paths are established they are retained and kept clear of interference rather than routinely deviated from. It is recognized, however, that issues associated with plant safety are the responsibility of an individual licensee plant safety review committee (or equivalent) and the details of their excercizing this responsibility should be within their jurisdiction.

Approach Consistent With this Guideline

A plant safety review committee (or equivalent) delegates the responsibility for approving temporary changes to safe load paths to a person, who may or may not be a member of that committee, with appropriate training and education in the area of plant safety. Such changes are reviewed by the safety review committee in the normal course of events. Any permanent alteration to a safe load path is approved by the plant safety review committee.

Approach Inconsistent With this Guideline

Activities which in effect allow decisions as to deviations from safe load paths to be made by persons not specifically designated by the plant safety review committee.

GUIDELINE 2 LOAD HANDLING PROCEDURES

No significant exceptions to this guideline have been encountered. Occasionally a question arises concerning the need for individual procedures for each lift. In general, it was not the purpose of this guideline to require separate procedures for each lift. A reasonable approach is to provide separate procedures for each major lift (e.g., RV head, core internals, fuel cask) and use a general procedure for handling other heavy loads as long as load specific details (e.g., load paths, equipment requirements) are provided in an attachments or enclosures.

GUIDELINE 3 CRANE OPERATOR TRAINING

Exception

The only exception occassionally encountered with respect to this Guideline other than fairly minor, site unique, exceptions has been a desire to deviate from the requirement of ANSI B30.2-3.1.7.o for testing of all controls before beginning a new shift. In some cases a licensee has qualified a commitment in this area by noting that only crane controls "necessary for crane operation" will be tested at the start of a shift.

Discussion

This requirement (ie. not a recommendation) of ANSI B30.2 is important since crane control system failures are relatively significant contributors to load handling incidents. The only reason that can be seen for an exception in this area is a general aversion to the word "all". Specifically, it appears that some licensees fear that a commitment to this requirement will force them to test all control type devices (eg. motor overloads, load cells, emergency brakes) rather than just those features generally known as controls (ie. hoist, bridge, and trolley motion controllers).

Approaches Consistent With this Guideline

Exceptions that clearly indicate that all normal controls (hoist, bridge, and trolley motion controllers) will be tested at the start of each shift and that the purpose of not committing to "all" controls is to avoid a misunderstanding concerning other control devices.

Approaches Inconsistent With This Guideline

A response that implies that a decision to test or not test a normal control will be made by the crane operator on the basis of what type of lift or direction of motion he expects for the forthcoming shift.

GUIDELINE 4 SPECIAL LIFTING DEVICES

Exception 1

Some licensees have indicated that their special lifting devices were designed and procured prior to the publication of ANSI N14.6 and therefore are not designed in accordance with that standard. This fact is sometimes combined with a reference to the title of that standard to reach a conclusion that the standard is not applicable.

Discussion

The purpose of this section is to ensure that special lifting devices were designed and constructed under controlled conditions and that sufficient documentation is available to establish existing design stress margins and support future maintenance and repair requirements. ANSI N14.6 is an existing standard that provides requirements supporting this goal for lifting device applications where the consequence of a failure could be similar to that which could be expected in the event of the failure of a special lifting device carrying a load within the jurisdiction of NUREG 0612. Consequently it seems appropriate that for special lifting devices subject to NUREG 0612 it should be able to be demonstrated that, from a design standpoint, they are as reliable as a device for which ANSI N14.6 was developed.

Approaches Consistent With This Guideline

Although not originally specified to be designed in accordance with ANSI N14.6 the special lifting device in question was provided by a reactor vendor, in accordance with appropriate quality assurance and quality control procedures, for a specific application associated with power plant components provided by that vendor. Based on either the review of the original stress report or, if such a stress report is unavailable, the preparation of a new stress report, the licensee has determined that margins to material yield and ultimate strength are comparable to those specified in ANSI N14.6. Although not required of the lifting device vendor, the licensee has reviewed the design of the lifting device and prepared a list of critical components whose repair or replacement should be performed under controlled conditions.

Approaches Inconsistent With This Guideline

No information is available concerning the original design but it is probably allright because the device has been used for ten years and never failed.

The device was built before the publication of ANSI N14.6, does not carry shipping containers of nuclear material weighing more than 10,000 pounds, and thus need not comply with ANSI N14.6.

Exception 2

No 150% overload test has been performed and, in the opinion of the licensee, such a test is impractical.

Discussion

The performance of a load test in excess of the load subject to NUREG 0612 is an important contributor to the ability to assess the overall reliability of a device. Such a test supplements design reliability by demonstrating that the device was properly fabricated or assembled and that a portion of the design safety margin has been demonstrated. Such proof of workmanship is particularly important for a fairly complicated device. It is recognized, however, that the specification of a 150% overload test is somewhat arbitrary and that, in some cases, the nature of the device is such that the liklihood of workmanship shortcomings is remote.

Approaches Consistent With This Guideline

The licensee has evaluated the lifting device in question and has determined that design stress margins are substantial. Further it has been established that the device itself is uncomplicated and principally put together with mechanical joints such that an assembly error is highly unlikely. The use of welded joints is severly limited and where employed were performed in accordance with substantial quality controls (eg AWS D1.1) including NDE. The device has been tested to 100% of rated load.

Although a 150% overload test has not been performed the lifting device has been subjected to a manufacturer recommended overload to demonstrate proof of workmanship (typically 120-125%).

Approaches Inconsistent With This Guideline

See this topic for Exception 1 above.

Exception 3

The requirement of ANSI N14.6 for an annual 150% load test or full NDE is excessive. Both the load test (due to the inability to make the test lift within containment) and the NDE (due to the need to remove protective coatings) are impractical and not justified by the infrequent use of these devices.

Discussion

A continuing inspection program to assure the continued maintenance of safety margins incorporated in the original design of the device is important to demonstrate the reliability of special lifting devices. It is recognized, however, that some devices employed in a nuclear power plant, particularly those associated with refueling, are used under conditions of control and at frequencies of use that are substantially less severe than that possible for the type of lifting device for which ANSI N14.6 was originally prepared. Consequently a reasonable relaxation of the inspection interval seems appropriate.

Approaches Consistent With This Guideline

Overload tests will be conducted but at a longer interval, 5 years, between tests to be consistent with the number of operational lifts required.

NDE of load bearing welds will be conducted at 5 year intervals or, alternatively, load bearing welds will be examined through a program that ensures that all welds will be examined over a normal inservice inspection interval of 10 years in a manner similar to that specified in the B&PV Code for Class 2 Component Supports.

Approach Inconsistent With This Guideline

Continuing inspection will be limited to an annual visual examination of the device.

Exception

Licensees have taken exception to the requirement to select slings in accordance with the maximum working load tables of ANSI B30.9 considering the sum of static and dynamic loads. Most commonly it is the licensees position that the approximate factor of safety of five on rope breaking strength inherent in these tables adequately accomodates dynamic loading.

Discussion

The intent of this portion of this Guideline, which also applies to special lifting devices under Guideline 4, is to reserve the ANSI B30.9 safety factors for accomodating sling wear and unanticipated overloads and avoid a reduction of this safety factor as a result of the routine dynamic loads inherent in hook/load acceleration and deceleration. While it is acknowledged that, for operating characteristics typical of cranes employed at nuclear power plants, these dynamic loads are unlikely to be substantial, such a determination cannot be made generically. Typically the actual dynamic load due to hook/load acceleration or deceleration is a function of design hook speeds and the type of hoist control system employed. It should also be recalled that ANSI B30.9 is a general industrial standard which applies to all load handling devices and does not in itself provide for any additional conservatism in consideration of the potential consequences of a load handling accident at a nuclear power plant. Based on this, it is considered reasonable that individual licensees evaluate the potential contribution of dynamic loading in their operations and if such dynamic loading is indeed significant accomodate it in their procedures for sling selection.

Approach Consistent With This Guideline

The licensee has evaluated the potential routine dynamic loading for lifting devices not specially designed and found them to be a relatively small fraction (typically 5-15%) of static load. This estimate has been made on the basis of either calculated acceleration and deceleration rates or through use of the industrial standard for impact loading of cranes specified in CMAA-70. In either case having verified that routine dynamic loading of a specific hoist is indeed small the licensee has drawn the conclusion that revised selection criteria to accomodate such minor additional loads will not have a substantial effect on overall load handling reliability.

Approach Inconsistent With This Guideline

Statement to the effect that dynamic loads are accomodated in the tables of ANSI B30.9 with no indication that the licensee has assessed the actual dynamic loading imposed on cranes subject to NUREG 0612.

Exception

The only exception occasionally encountered with respect to this Guideline other than fairly minor and site-unique exceptions has been a desire to deviate from the requirement of ANSI B30.2-1.1.2.a.2 and 3.2.4 for testing of hoist limit devices before beginning a new shift. In some cases a licensee has qualified a commitment in this area by noting that this limit switch will be tested only if operations in the vicinity of the limit switch are anticipated.

Discussion

While this issue is treated somewhat ambigously in ANSI B30.2 (it is a recommendation in article 1.1.2 and a requirement in article 3.2.4) it is important since two-blocking incidents are relatively significant contributors to load handling incidents. Further it should be noted that this test has been incorporated as a requirement of OSHA in 29 CFR 1910.179.(n).(4).(i). It is recognized, however, that there may be circumstances where such a test is not prudent. First, such a test clearly should not be made with the hook under load. Consequently if a shift change is made with the hook loaded (this, by the way, is not a desireable practice and could be precluded through strict compliance with ANSI B30.2-3.2.3.j) a hoist limit switch test should not be performed. Second, there may be circumstances where the nature of forthcoming load handling operations indicates that the time (and minor risk) associated with this test is not justified. In particular if it is known that a hoist will not be used or used only in an area substantially removed from the upper travel limit, it would seem reasonable to defer the limit switch test until the start of the next shift. If such an approach is taken, however, it should be approached with care. Requirements for deferring an upper limit switch test should accomodate the uncertainty associated with maintenance plans and establish unambiguous criteria concerning what operations can be determined to be remote from upper travel limits. Such criteria should recognize that the need for upper travel limit switch protection may be preceeded by a control system failure and consequently should conservatively allow for operater response time and potential delays associated with emergency shutdown of the crane.

Approach Consistent With This Guideline

General compliance with this requirement. Certain specific provisions made for deferring upper limit switch testing under conditions that are not subject to operater interpretation.

Approaches Inconsistent With This Guideline

An approach that implies that a decision to test or not is left to the discretion of the operator or implies that such a test will be required only if operations are planned in close proximity to the hook upper travel limit.

Exception

Occasionally a licensee has indicated that the overhead electric travelling cranes employed at a site were purchased prior to the publication of CMAA-70 or ANSI B30.2-1976 and thus these standards should not be applied.

Discussion

The purpose of this Guideline is to ensure that all cranes carrying heavy loads in nuclear power plants meet certain minimum criteria in their design and, consequently, can be assumed to provide an acceptable standard of mechanical, electrical, and structural reliability. It is also recognized, however, that cranes in operating plants may have been designed and procured prior to the publication of current standards and, thus, not strictly comply with some details of these standards. In general, though, current standards have evolved from predecesor standards in existence at the time of crane procurement (EOCI 61, ANSI B30.2-1967) and, since the later standards are not revolutionary, it is likely that cranes at nuclear power plants will provide a degree of reliability equivalent to that provided by the current standards. Such a general determination canot be made, however, by the staff since nuclear power plant cranes are usually unique and provided with site specific design features. It is up to the licensee then to make a systematic comparison of their crane design with the requirements of current standards and determine if additional design features are appropriate.

Approach Consistent With This Guideline

The licensee has compared original crane procurement specifications or existing crane designs with the requirements of the referenced standards in areas effecting load handling reliability. In instances where the current standard provides additional protection against the consequences of operater error or component failure the licensee has proposed modifications which will result in a degree of load handling reliability similar to that provided in the current standard.

Approach Inconsistent With This Guideline

Positions to the effect that the cranes satisfied standards in existence at the time of procurement and what was good enough then is good enough now.