TECHNICAL EVALUATION REPORT

CONTROL OF HEAVY LOADS (C-10)

SOUTHERN CALIFORNIA EDISON COMPANY

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

NRC DOCKET NO. 50-206

NRC TAC NO. 08082

NRC CONTRACT NO. NRC-03-81-130

FRC PROJECT C5506

FRC ASSIGNMENT 13

FRC TASK 392

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FRC Group Leader: I. H. Sargent

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DIVISION OF ARVIN/CALSPAN
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January 31, 1985

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Date: 1/29/85	Date: 1/31/85	Date: 1-31-85

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FOREWORD

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

Mr. C. R. Bomberger and Mr. I. H. Sargent contributed to the technical preparation of this report through a subcontract with WESTEC Services, Inc.

1. INTRODUCTION

1.1 PURPOSE OF REVIEW

This technical evaluation report documents an independent review of general load handling policy and procedures at Southern California Edison Company's San Onofre Nuclear Generating Station Unit 1. This evaluation was performed with the following objectives:

- o 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
- o to assess conformance to the interim protection measures of NUREG-0612, Section 5.3.

1.2 GENERIC BACKGROUND

Generic Technical Activity Task A-36 was established by the U.S. Nuclear Regulatory Commission (NRC) staff to systematically examine staff licensing criteria and the adequacy of measures in effect at operating nuclear power plants to ensure the safe handling of heavy loads and to recommend necessary changes in these measures. This activity was initiated by a letter issued by the NRC staff on May 17, 1978 [2] to all power reactor licensees, requesting information concerning the control of heavy loads near spent fuel.

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

In order to upgrade measures for the control of heavy loads, the staff developed a series of guidelines designed to achieve a two-part 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 so that their probability of failure is uniformly small and appropriate for the critical tasks in which they are employed. The second portion of the staff's objective, achieved through guidelines identified in NUREG-0612, Sections 5.1.2 through 5.1.5 is to ensure that, for load handling systems in areas where their failure might result in significant consequences, either (1) features are provided, in addition to those required for all load handling systems, to ensure that the potential for a load drop is extremely small (e.g., a single-failure-proof crane) or (2) conservative evaluations of load handling accidents indicate that the potential consequences of any load drop are acceptably small. Acceptability of accident consequences is quantified in NUREG-0612 into four accident analysis evaluation criteria.

A defense-in-depth approach was used to develop the staff guidelines 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:

- 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
- 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 Southern California Edison Company, the Licensee for San Onofre Unit 1, requesting that the Licensee review provisions for handling and control of heavy loads, evaluate these provisions with respect to the guidelines of NUREG-0612, and provide certain additional information to be used for an independent determination of

conformance to these guidelines. On February 5, 1982, Southern California Edison Company provided the initial response [4] to this request. Subsequent information was provided on February 22, 1982 [5], April 1, 1982 [6], April 9, 1982 [7], and May 10, 1982 [8]. Based on this information, a draft technical evaluation report (TER) was prepared and informally transmitted to the Licensee for review and comments. On August 30, 1982, a telephone conference call was held between NRC and Southern California Edison to discuss the draft TER. In response to this telephone call, Southern California Edison, on October 21, 1982 [9] and January 19, 1983 [10], provided additional information which has been incorporated in this final TER.

2. EVALUATION

This section presents a point-by-point evaluation of load handling provisions at San Onofre Nuclear Generating Station Unit 1 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 that 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.

Table 2.1. San Onofre Unit 1/NUREG-0612 Compliance Matrix

Heavy Loads	Weight or Capacity (tons)	Guideline 1 Safe Load Paths	Guideline 2 Procedures	Guideline 3 Crane Operator Training	Guideline 4 Special Lifting Devices	Guideline 5 Slings	Guideline 6 Crane - Test and Inspection	Guideline 7 Crane Design	Interim Measure 1 Technical Specifications	Interim Measure 6 Special Attention
1. Reactor Service Crane	110/20	--	--	C	--	--	C	P	--	--
a. RV Head	65	C	C	--	P	--	--	--	--	C
b. Upper Internals Assembly	30	C	C	--	P	--	--	--	--	C
c. Missile Shields	93	NC	C	--	--	C	--	--	--	--
d. Auxiliary Shield	60	NC	C	--	--	C	--	--	--	--
e. CRDM Ventilation Ducts	2.5	NC	C	--	--	C	--	--	--	--
f. Reactor Cavity Seal Ring	10	NC	C	--	--	C	--	--	--	--
g. Sand Tank	23	NC	C	--	--	C	--	--	--	--
h. Stud Tensioners	2	NC	C	--	--	C	--	--	--	--
i. Stud Rack	20	NC	C	--	--	C	--	--	--	--
j. RCP Motor	31	NC	C	--	R	--	--	--	--	--
k. Inservice Inspection Tool	5	NC	C	--	R	--	--	--	--	C

C = Licensee action complies with NUREG-0612 Guideline.
NC = Licensee action does not comply with NUREG-0612 Guideline.
P = Licensee information indicates partial compliance.
-- = Not applicable.
R = Licensee has proposed revisions/modifications designed to comply 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. Turbine Gantry Crane	100/25	C	C	C	--	--	C	P	C	--
*a. Turbine Spindle	115	--	--	--	--	C	--	--	--	--
b. New Fuel Container	2.5	--	C	--	--	C	--	--	--	--
c. Spent Fuel Cask (NAC 1)	30	C	C	--	--	C	--	--	--	--

*Note: The turbine spindle weight is greater than the rated capacity of the turbine gantry crane.

2.1.1 NUREG-0612, Heavy Load Overhead Handling Systems

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that fixed overhead handling systems of sufficient capacity subject to the criteria of NUREG-0612 at San Onofre Unit 1 include the following:

- o reactor service crane
- o turbine gantry crane.

A review by the Licensee has indicated that the only heavy load handling systems which have the potential to drop a load on spent fuel or equipment required to achieve and maintain the conditions for residual heat removal (RHR) system operation are the reactor service crane and the turbine gantry crane. The spent fuel pit bridge crane is currently prohibited, by technical specification, both from handling loads in excess of 1500 lb and from traveling over fuel assemblies in the storage pool, and is excluded from further consideration. The new fuel bridge crane and the diesel generator building monorail crane were also determined to be free of potential interaction with safe shutdown equipment, and have been excluded from further consideration.

b. Evaluation and Conclusion

The Licensee's exclusion of the spent fuel bridge crane, the new fuel bridge crane, and the diesel generator building monorail crane from compliance with NUREG-0612 is acceptable on the basis of Southern California Edison's justification that the cranes do not endanger safe shutdown equipment or allow movement of heavy loads over irradiated fuel. The Licensee's determination that the reactor service and the turbine gantry cranes are the only two handling systems subject to compliance with the general guidelines is consistent with the guidance of NUREG-0612.

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 safe load paths have been developed for the reactor service crane for movement of the reactor head and the upper internals. These paths are simple direct paths that can easily be followed; use of more circuitous paths does not offer load drop-related advantages. For the remaining loads in the containment, there is little choice as to the path they may follow due to the limited space on the refueling floor. The placement of these loads is dependent upon the maintenance sequence and little preference is given to carrying the load over stronger portions of the floor due to the structural equality of the refueling deck. Therefore, for these remaining loads, restricted areas have been defined to protect cabling on the refueling deck associated with safe shutdown systems and to protect fuel in the reactor vessel when the vessel head is removed, so that interference with maintenance activities is minimized. Residual heat removal (RHR) system components located below the refueling deck are protected by 3 to 5 feet of reinforced concrete. Use of these restricted areas, when combined with additional procedural limitations (i.e., lift height restrictions, use of alternate RHR paths, minimum crane crew size), provides an alternative which the Licensee feels is equivalent to the requirement for safe load paths for the reactor service crane.

For the turbine gantry crane, there are two major areas of concern. One is the area to the west outside of the crane rails which contains some equipment related to safe shutdown; however, a load drop in this area is not of consequence since the equipment is not serviced until periods of shutdown when the equipment has been removed from service. The crane is not allowed to operate in this area unless Mode 5 or 6 is established and, therefore, this

equipment is administratively protected at other times. The other area of concern is the north deck extension which contains such a diverse array of piping and cable runs for systems required for safe shutdown that a load movement cannot avoid all safe shutdown systems in this area. Therefore, the Licensee has established and marked safe load paths which follow structural members to maximize the protection available for these systems. In addition, the Licensee has made a commitment to install steel plating under the north deck to reduce the possibility of spalling damage and to allow the movement of certain loads without the potential to affect those safe shutdown-related systems.

The Licensee states that floor markings are often obscured by protective coverings and maintenance activities. Therefore, as an alternative to these markings, procedures define the safe load paths and restricted areas and a second person is assigned to "walkdown" the path of the lift and guide the crane operator. Floor markings have been provided in the north deck extension area only.

Lastly, the Licensee states that deviations will be made using On-Site Review Committee-approved procedures.

b. Evaluation

Load paths in the containment for the reactor vessel head and the upper internals and in the turbine building's north deck extension area satisfy the requirements of this guideline. Further, it is noted that, although all safe shutdown equipment cannot be avoided on the north deck extension, the Licensee has imposed additional load handling restrictions to reduce potential hazards to this equipment.

However, for remaining loads in the containment, Licensee actions do not appear to be sufficient to satisfy the requirements of this guideline. Use of restricted areas has previously been found acceptable if the restricted areas have been made large enough so that reasonably constrained and well defined load corridors are established for the movement of loads. Such is not the case at San Onofre Unit 1; limited restricted areas have been developed which do not provide defined corridors and which appear to allow the direction of

load movement to be determined at the time of the move by someone who may not be knowledgeable of system functions and locations. In addition, it appears from the Licensee's response that the restricted area over the reactor vessel is enforced only when the reactor vessel head is not installed. This restriction is not consistent with the requirements of this guideline: to avoid at all times all movements of heavy loads over irradiated fuel or safe shutdown equipment regardless of system redundancy, intervening floors, or analyses.

The Licensee has stated that, for remaining loads in the containment, there is little choice as to the path the load may follow. If such is the case, it should be reasonably easy to establish specific load paths for these loads or to establish a general purpose corridor. In choosing these paths, the Licensee should avoid the reactor vessel at all times as well as minimize movements over RHR piping since protection by intervening structures is not an acceptable alternative to compliance with the general guidelines of NUREG-0612, Phase 1.

It should also be recognized that the intent of this guideline is to avoid all movements over fuel and safe shutdown equipment in order to increase plant safety in the event of a load drop; this concept should be the primary basis for selection of load paths, with due consideration for minimizing interference with maintenance activities. The relative importance of these bases should not be reversed.

Licensee use of a signalman to guide the crane operator, and duties clearly delineated in the appropriate procedure, is an alternative to floor markings that has previously been found acceptable. In addition, deviations from procedures are administrated in a manner consistent with this guideline.

c. Conclusion and Recommendation

San Onofre Unit 1 partially complies with Guideline 1. Load paths developed for the reactor vessel head, upper internals, and movements of the turbine gantry crane comply with the requirements of Guideline 1. To comply fully, the Licensee should establish safe load paths/corridors for the

remaining loads in the containment without credit for analyses, system redundancy, or intervening structures (i.e., reactor vessel head or refueling deck).

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 path; and other special precautions."

a. Summary of Licensee Statements and Conclusions

The Licensee stated that newly implemented procedures are in compliance with Section 5.1.1(2) of NUREG-0612.

b. Evaluation and Conclusion

San Onofre Unit 1 complies with Guideline 2.

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' [12]."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that the crane operator and rigging training program at San Onofre Unit 1 satisfies the intent of ANSI B30.2-1976 and NUREG-0612 without exception.

b. Evaluation and Conclusion

San Onofre Unit 1 complies with Guideline 3.

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' [13]. 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 has identified the following to be special lifting devices in use or being procured for use at San Onofre Unit 1:

- reactor vessel head lifting rig
- upper guide structure (UGS) lifting rig
- inservice inspection (ISI) tool lifting device
- core barrel lifting rig
- reactor coolant pump motor lifting rig
- equipment hatch lift rigs.

Of these devices, several were excluded from compliance by the Licensee. The ISI tool is currently under contract from Westinghouse Electric Company. To ensure that the tool is used in accordance with NUREG-0612 guidelines, the Licensee stated that Westinghouse and future ISI contractors will be required to verify that the ISI tool and any associated lifting equipment comply with ANSI N14.6-1978.

The lifting rig for the core barrel has been removed from consideration since the fuel is removed from the core when this lift is performed and therefore no hazard exists as a consequence of any load drop.

Lifting rigs will be constructed for the reactor coolant pump motors and equipment hatches in the containment at some future date. These devices will be designed and built in accordance with ANSI N14.6-1978 (estimated date of purchase - September 1, 1983).

For the remaining lifting rigs (reactor vessel head and upper guide structure), the Licensee states that comparison with ANSI N14.6-1978 has been limited to Sections 3 (3.1, 3.2, 3.3) and 5 for the following reasons:

1. These devices were designed prior to both the adoption of ANSI N14.6-1978 and the NRC's decision (NUREG-0612) to apply the standard to these types of devices. There are a number of sections in the standard that are difficult to apply in retrospect: Fabricator's Responsibilities (Section 4.1), Inspector's Responsibilities (Section 4.2), and Fabrication Considerations (Section 4.3).

2. Section 1.0 (Scope), Section 2.0 (Definitions), Section 3.4 (Design Considerations to Minimize Decontamination Effects in Special Lifting Device Use), Section 3.5 (Coatings), and Section 3.6 (Lubricants) are not pertinent to load handling reliability.

3. Section 6 is applicable to lifting devices used for critical loads. None of the loads lifted using the lifting rigs identified above has as yet been determined to be a critical load.

Regarding Section 3 (Design), the Licensee states that stress analyses have been performed for the vessel head lifting rig which demonstrate that stress design factors for this device are in compliance with the ANSI standard. For the upper guide structure lifting rig, the Licensee states that it was designed with an approximate safety factor of 3 (yield strength) due to conservatisms implicit in the design code (ASME Boiler and Pressure Vessel Code, Section III, Article NA) and due to a design load of twice the operating load. In addition, factors of safety on ultimate strength exceed that required by ANSI N14.6-1978.

Further information has also been provided for the following design-related sections:

- Designer's Responsibilities (3.1) - Review of design documents indicates that sound engineering practices were used in the fabrication of these devices and the Licensee judges these documents to be an acceptable fulfillment of the designer's responsibilities. The vessel head lift rig was redesigned in 1978 and, as a result, all design documentation is available for this device. Although not

originally provided, maintenance and repair procedures have been developed and are available.

- Design Considerations (3.3) - Review of device designs indicates that sound design concepts were originally applied. The materials selected are sound and required inspections (visual prior-to-use and NDE) ensure that potential or actual problems will be detected. In addition, the upper guide structure was redesigned in 1978 to eliminate problems associated with remote engagement and uneven load distribution.

Regarding Section 5, the Licensee states that an inspection program which is in accordance with the ANSI standard has been implemented at San Onofre Unit 1.

b. Evaluation

For those lifting devices identified by the Licensee, it is agreed that the core barrel lifting rig may be excluded from compliance with this guideline. In addition, although the inservice inspection tool lifting device should not be excluded from compliance, actions taken by the Licensee ensure that use of this device will be in accordance with this guideline. Similarly, proposed actions for the reactor coolant pump motor and equipment hatch lifting rigs are consistent with this guideline.

Information provided by the Licensee substantiates the design adequacy of the two remaining lifting rigs (vessel head and UGS). In addition, the Licensee's response that the inspection program at San Onofre Unit 1 provides for inspections in accordance with Section 5 substantially satisfies the requirements of this section; however, no information has been provided to document the performance of required load tests of these devices.

c. Conclusion and Recommendation

Proposed Licensee actions for the inservice inspection tool lifting device and the reactor coolant pump motor and equipment hatch lifting rigs comply with Guideline 4. Present design and use of the reactor vessel head and UGS lifting rigs substantially comply with guideline requirements. To

fully comply, the Licensee should document the performance of initial or periodic load tests in accordance with Section 5 of 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' [14]. However, in selecting the proper sling, the load used should be the sum of the static and maximum dynamic load. The rating identified on the sling should be in terms of the 'static load' which produces the maximum static and dynamic load. Where this restricts slings to use on only certain cranes, the slings should be clearly marked as to the cranes with which they may be used."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that lifts requiring slings will use slings chosen in accordance with ANSI B30.9-1971. Southern California Edison is already in the process of instituting a rigging control program at San Onofre Unit 1. This program will provide procedures that will include the maintenance, inspection, and use requirements of ANSI B30.9-1971.

The Licensee further stated that:

"The load ratings of the slings only include the static load produced by heavy loads handled at San Onofre Unit 1. This is due to the small hook movement induced dynamic loads by the cranes in use at San Onofre Unit 1. Using the criteria of CMAA-70, i.e., 0.5% of the load per foot per minute of hoisting speed, and the low main hook speeds of the reactor service crane and the turbine gantry crane, 5.3 fpm and 7.3 fpm respectively, the dynamic loads will be a maximum of approximately 3.7%. For loads which are carried by the auxiliary hooks of the reactor service crane and the turbine gantry crane, which have maximum hook speeds of 32 fpm and 31 fpm respectively, the maximum dynamic loads would be a maximum of approximately 16%.

The above discussion defines the maximum expected dynamic loads from the use of the cranes at San Onofre Unit 1. The dynamic loads expected from the use of the main hoists for either crane present insufficient loads to be of a safety concern when the 5:1 ultimate strength to weight ratio of slings chosen in accordance with ANSI B30.9-1971, is considered. The dynamic loads expected from the use of the auxiliary hoists should be considered, but the frequency of the use of the auxiliary hook at speeds

anywhere near the maximum hook speed (i.e., the hook speeds are usually 10 fpm or less), removes the need for other consideration. (NOTE: The hook speeds of the auxiliary hook are very slow due to the height restrictions implemented by procedures on October 1, 1982, i.e., for the turbine deck - less than 18 inches, which limit the lift heights and consequently ensure that the loads, if dropped, will not damage the decks over which they are lifted.)

The slings which are used for special applications at San Onofre Unit 1 are restricted in their use to the load which they lift and not to the crane which lifts the load. Consequently, the slings will be marked, if applicable, as to the load they lift and not be restricted to any one crane."

b. Evaluation

Sling installation, use, and maintenance at San Onofre Unit 1 substantially meet the intent of NUREG-0612 on the basis of the Licensee's verification that the procedures and practices comply with ANSI B30.9-1971. It has previously been found acceptable to disregard the dynamic contribution if it can be demonstrated that the dynamic loads are a reasonably small percentage of the overall static load. Considering the nominal allowance for dynamic loading provided in CMAA-70 for crane design (dynamic load = 0.5% x static load per foot per minute of hoist speed), it can be concluded that the maximum dynamic loading in San Onofre Unit 1 slings subject to NUREG-0612 will be relatively small. Since these slings were designed with a safety factor of 5 in accordance with ANSI B30.9-1971, the dynamic loading is not considered significant and may be disregarded in determining the sling's maximum rated load.

c. Conclusion

San Onofre Unit 1 complies with Guideline 5 based on the Licensee's verification.

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

"The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI B30.2-1976, 'Overhead and Gantry Cranes,' with the

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

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that crane inspection, maintenance, and testing requirements of existing procedures were compared to the requirements of ANSI B30.2-1976, Chapter 2-2. Modifications to procedures and inclusion of daily operation and safety checks in the proposed reactor service crane and turbine gantry crane checkout and operation procedures brought overall crane inspection, maintenance, and testing requirements into compliance with ANSI B30.2-1976, Chapter 2-2, with two exceptions:

1. ANSI B30.2-1976, Chapter 2-2 requires full traverse of both the bridge/gantry and the trolley when load-testing cranes. The traverses are intended to test the bridge/gantry rails and spanning girders. However, evidence presented in NUREG-0612 suggests that failures of this nature are not significant contributors to historical crane failure rates. In addition, heavy loads are not usually handled at all extremes of hoist position. Therefore, load tests will not always be conducted for all bridge/gantry and trolley positions. Positions affected by extensive repair and/or alteration, however, will be load-tested.

2. The turbine gantry crane is not tested to 125% of the rated load. The crane was originally rated at 115 tons, but the rating was adjusted to 100 tons when the crane manufacturer did not recommend proof load testing to 125% of 115 tons as required by CAL OSHA standards adopted in the 1970s. The crane is currently certified by the state of California by lifting the heaviest load it is required to lift - the generator rotor, which weighs 108 tons.

The Licensee stated that:

"The reactor service crane is presently tested by lifting the heaviest load in containment, which is the 93 ton missile shield. This test provides a test of the hoist brakes and hoist motor. This test is

performed instead of a 125% proof test, which is unfeasible due to accessiblity and the problem of bringing a 125% test load into containment. This test does not allow the movement of the test load to the position at which the reactor vessel head would be lowered down onto its stand (this is due to lack of space in containment to perform such a movement), but since the crane is rated at 115 tons, the test load is approximately 93 tons, and the reactor vessel head is 65 tons, the test provides adequate assurance that the crane is capable of handling heavy loads safely.

The turbine gantry crane is tested by the performance of a 125% proof test to certify the rated load of 108 tons. This test is performed at more than one trolley position as travel allows and tests the hoisting and braking systems, but in the case of the turbine gantry crane the maximum 'safety-related' heavy load is the 10 ton hot tool box. This provides approximately 10:1 safety factor for lifts involving the use of this crane."

b. Evaluation

San Onofre Unit 1 satisfies the requirements of Section 5.1.1(6) of NUREG-0612 based on the Licensee's certification of compliance to ANSI B30.2-1976 requirements for crane inspection, maintenance, and testing.

In addition, it is apparent from the Licensee's response that the reactor service and turbine gantry cranes substantially satisfy the ANSI B30.2-1976 recommendation to perform a load test to 125% of rated capacity. Therefore, Licensee actions and responses regarding load tests and test requirements are consistent with this guideline.

c. Conclusion

San Onofre Unit 1 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' [15]. An alternative to a specification in ANSI B30.2 or CMAA-70 may be accepted in lieu of specific compliance if the intent of the specification is satisfied."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that the San Onofre Unit 1 turbine gantry and reactor service cranes were built prior to the issuance of ANSI B30.2-1976 and CMAA-70-1975. The cranes were procured, designed, and fabricated by P & H Harnischfeger in accordance with the criteria of Bechtel Power Corporation Specification B30-254 of April 17, 1964. The cranes were designed to the governing criteria in EOCI-61. The Licensee has further stated that a point-by-point comparison has been performed to determine if crane design at San Onofre Unit 1 complies with the requirements of CMAA-70 and ANSI B30.2-1976. As a result of this comparison, the reactor service and turbine gantry cranes were found to be in compliance, with one exception: bridge and trolley stops.

The bridge and trolley bumpers and stops have been further evaluated and it was determined that the guidance of CMAA-70 constitutes the codification of the same engineering practice that would have been used in the design of cranes built to EOCI-61 specifications. Since these cranes are not expected to be operated under load at substantial bridge or trolley speed near the end of travel, the design variation between EOCI-61 and CMAA-70 is not expected to be of significance. Therefore, no modification to the bridge and trolley stops of those cranes is planned.

b. Evaluation

The design of the turbine gantry and reactor service cranes substantially meets the requirements of NUREG-0612, Section 5.1.1(7) on the basis of verification by the Licensee of compliance with CMAA-70 and ANSI B30.2.

However, with regard to the requirements for bumpers and stops, the Licensee's response is an insufficient basis for an independent evaluation of the existing design. Although it can be agreed that the requirements of CMAA-70 are merely a codification of good engineering practices, the Licensee has not provided sufficient information to demonstrate an evaluation that shows the present design to be consistent with CMAA-70, or that adequate

precautions currently exist in administrative procedures to limit travel near the end of bridge or trolley movement.

c. Conclusion and Recommendation

The San Onofre Unit 1 turbine gantry and reactor service cranes substantially comply with Guideline 7; to fully comply, the Licensee should demonstrate either that current design of bumpers and stops is consistent with CMAA-70 or that administrative procedures govern movement near the end of trolley and bridge movement.

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(1)]

"Licenses for all operating reactors not having a single-failure-proof overhead crane in the fuel storage pool area should be revised to include a specification comparable to Standard Technical Specification 3.9.7, 'Crane Travel - Spent Fuel Storage Pool Building,' for PWR's and Standard

Technical Specification 3.9.6.2, 'Crane Travel,' for BWR's, to prohibit handling of heavy loads over fuel in the storage pool until implementation of measures which satisfy the guidelines of Section 5.1."

a. Evaluation

The Licensee has stated that San Onofre Unit 1 Technical Specification 3.8.B.1 currently prohibits loads in excess of 1500 lb from traveling over fuel assemblies in the storage pool.

b. Conclusion

San Onofre Unit 1 complies with Interim Protection Measure 1.

2.2.2 Administrative Controls [Interim Protection Measures 2, 3, 4, and 5, NUREG-0612, Section 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

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

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

"Special attention should be given to procedures, equipment, and personnel for the handling of heavy loads over the core, such as vessel

internals or vessel inspection tools. This special review should include the following for these loads: (1) review of procedures for installation of rigging or lifting devices and movement of the load to assure that sufficient detail is provided and that instructions are clear and concise; (2) visual inspections of load bearing components of cranes, slings, and special lifting devices to identify flaws or deficiencies that could lead to failure of the component; (3) appropriate repair and replacement of defective components; and (4) verify that the crane operators have been properly trained and are familiar with specific procedures used in handling these loads, e.g., hand signals, conduct of operations, and content of procedures."

a. Summary of Licensee Statements and Conclusions

The Licensee has stated that three lifts are routinely scheduled over the open reactor vessel when fuel is in the vessel:

1. reactor vessel head
2. upper internals assembly
3. reactor vessel inservice inspection tool.

Each of the four areas addressed in Interim Action 5 (Interim Protection Measure 6 of NUREG-0612) is addressed below:

1. A draft operating procedure for the reactor service crane and draft changes to each edition of the special procedure for refueling have been prepared and are currently being reviewed. The information contained therein addresses the installation of rigging or lifting devices and movement of the load to ensure that sufficient detail is provided and the instructions are clear and concise.

2. Draft revisions to the maintenance and inspection program for cranes have been prepared and are currently being reviewed. The information contained therein includes visual inspection of load bearing components of cranes, slings, and special lifting devices to identify flaws or deficiencies that could lead to failure of the components.

3. Draft revisions to the maintenance and inspection program for cranes have been proposed and are currently being reviewed. The information contained therein addresses repair and replacement of defective components.

4. Draft administrative changes to the crane operation and rigging training program at San Onofre Unit 1 have been prepared and are currently being reviewed. The information contained therein ensures that crane operators are properly trained and familiar with specific procedures used in handling heavy loads.

The crane inspection program at San Onofre Unit 1, which was instituted prior to NUREG-0612, provided for an annual inspection of the cranes (or inspection at refueling intervals for the reactor service crane) and provided for the repair and replacement of defective components. In addition to this program, the procedures implemented at San Onofre Unit 1 on October 1, 1982 provide for additional inspection of the crane in compliance with ANSI B30.2-1976.

b. Evaluation

The Licensee's special review of heavy load handling over the core is consistent with Section 5.3(1) of NUREG-0612 relative to procedures and operator training. The Licensee has previously stated that crane operators are trained in accordance with ANSI B30.2-1976, which meets the intent of NUREG-0612. Further, operating, maintenance, and inspection procedures have been reviewed and revisions are completed.

Regarding visual inspections of load bearing components, the annual inspection of cranes noted by the Licensee fulfills this requirement since it is assumed to have been performed within the past calendar year or prior to use. Although not specifically addressed by the Licensee, it is also noted that compliance with Section 5 of ANSI N14.6-1978 implies that an annual inspection of special lifting devices has been performed and that the Licensee has similarly satisfied this interim visual inspection requirement for special lifting devices.

c. Conclusion

San Onofre Unit 1 complies 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 San Onofre Nuclear Generating Station Unit 1. 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 so 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 San Onofre Unit 1 can be expected to be conducted in a highly reliable manner consistent with the staff's objectives as expressed in these guidelines. A need for further Licensee action, however, was identified in three areas. The Licensee should:

- establish safe load paths/corridors to control movements of remaining heavy loads in the containment without credit for analyses, system redundancy, or intervening structures
- document the performance of initial or periodic load tests of special lifting devices in accordance with Section 5 of ANSI N14.6-1978
- either provide information which documents the existing design of bridge and trolley stops or demonstrate that adequate provisions exist

in administrative procedures to limit travel near the end of bridge and trolley movement.

3.2 INTERIM PROTECTION

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

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