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April 1, 1982

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Director, Office of Nuclear Reactor Regulation
Attention: D. M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-206
NUREG-0612, Control of Heavy Loads at Nuclear Power Plants
San Onofre Nuclear Generating Station
Unit 1

References:

1. Letter, K. P. Baskin, SCE, to D. M. Crutchfield, NRC, Control of Heavy Loads, NUREG-0612, February 5, 1982

2. Letter, K. P. Baskin, SCE, to D. M. Crutchfield, NRC, NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, February 22, 1982

3. Letter, D. G. Eisenhut, NRC, to All Licensees, Control of Heavy Loads, December 22, 1981

Reference 1 provided you with the current status of our actions in response to the subject requirement and a schedule for submittal of the additional information necessary for your evaluation of the load handling systems at San Onofre Unit 1. This schedule included the submittal of the general information report by April 1, 1982. Reference 2 provided you with the load handling restrictions placed on the reactor service crane and turbine gantry crane to ensure the responsible handling of heavy loads at San Onofre Unit 1. As noted in Reference 2 the long-term crane operating procedures will be completed by April 2, 1982 and we will advise you of the implementation schedule on April 9, 1982.

The purpose of this correpondence is to transmit the six month general information report. This report, as prepared for us by TERA Corporation, addresses the Section 2.1 information requested in Reference 3. The report provides all of the required information applicable to San Onofre Unit 1 with the exception of the response to Section 2.1, Item 3d, which requests information on the lifting devices identified in Item 3c. As noted in the report, when the necessary design information becomes available it will be compared to ANSI N14.6-1978. It is anticipated that the design information will be available and the response to Section 2.1, Item 3d, will be completed in time for inclusion in the nine month specific information report to be submitted by May 1, 1982.

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It should be noted that a sentence was inadvertently omitted from the first paragraph in Section (1) of the response to Item 3 on page 5 of the enclosed report. The sentence that should be inserted as the last sentence in paragraph one reads:

> These load handling areas are not restricted because the three to five foot thick concrete decks will function as a safe load path and will minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel or to impact safe shutdown equipment.

If you have any questions, please let me know.

Very truly yours,

R W Krieger for KPBaskin

Enclosures

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) letter of December 22, 1980 requested that the Southern California Edison Company evaluate heavy load handling capabilities at San Onofre Unit 1. The letter requested a three-part evaluation:

(1) Interim measures

(2) Six-month report

(3) Nine-month report.

This report is responsive to the six-month requirement for San Onofre Unit 1.

CONTROL OF HEAVY LOADS
RESPONSE TO NUREG-0612

ITEM I: 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).

RESPONSE: Fixed overhead handling systems of sufficient capacity to be of interest at SONGS I are listed in Table I (page 3) along with their locations and capacities. Plant arrangement drawings were reviewed to determine if any of the handling systems listed above could carry a heavy load over components in systems required for plant shutdown or decay heat removal. The location of components of interest with respect to the handling systems was determined by review of these plant arrangement drawings and review of the fire zone descriptions previously submitted to the NRC as part of the "Fire Protection Program Review, BTP APCSB 9.5-1" for SONGS I. The fire zone descriptions identify the safety-related components within fire zones and the location of the fire zones within the plant.

This review revealed that two of the handling systems listed in Table I could carry heavy loads over components in systems required for plant shutdown or decay heat removal. A brief description of each of the two cranes is provided below. The remaining cranes in Table I were determined to be free of interaction potential with safe shutdown equipment.

(1) Reactor Service Crane: The reactor service crane is located in the containment at elevation 78 feet 2 inches. The crane is a traveling bridge crane spanning rail structures supported by the secondary shield walls. Harnischfeger Corporation designed and manufactured the crane. The crane has a main hoist rated at 110 tons and an auxiliary hoist rated at 20 tons. The crane is used for lifts involving the reactor vessel head and the upper internals assembly and for other maintenance related lifts. The reactor service crane handles loads over Residual Heat Removal System

pumps, heat exchangers and associated piping. In normal situations, these components are protected from dropped loads by 3 to 5 feet of reinforced concrete.

(2) Turbine Gantry Crane: The turbine gantry crane travels on rails spanning the operating deck of the turbine generator building at elevation 42 feet. Harnischfeger Corporation designed and manufactured the crane. A trolley with a main hoist rated at 100 tons and an auxiliary hoist rated at 25 tons traverse the upper bridge structure. The upper bridge structure has cantilever extensions which permit run-out of both the main and the auxiliary hooks beyond the gantry rail centerline. The principal heavy loads handled by this crane are components of the turbine generator unit and the spent fuel shipping cask. Load handling activities by this crane constitute a potential interaction per the NRC guidelines because loads can be handled over safe shutdown equipment located under the turbine deck.

TABLE I

HEAVY LOADS HANDLING SYSTEMS
SONGS I

Handling System	Rated Capacity (tons)	Location
Reactor Service Crane	110 (20)	Containment
Turbine Gantry Crane	100 (25)	Turbine Building
Spent Fuel Bridge Crane	2½	Fuel Storage Building
New Fuel Bridge Crane	3	Fuel Storage Building
Diesel Generator Building Monorail Crane	3	Diesel Generator Building
Aeroball Monorail Crane	*	Containment

*The Aeroball Monorail Crane is no longer in service and does not have a hoist installed. It was listed to reduce confusion because it is seen on some plant layout drawings.

ITEM 2: Justify the exclusion of any overhead handling system from the above category 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 core decay heat removal.

RESPONSE: None.

ITEM 3: With respect to the design and operation of heavy load-handling systems in the containment and spent-fuel-pool area and those load-handling systems identified in Item 1 above, provide your evaluation concerning compliance with the guidelines of NUREG-0612, Section 5.1.1. The following specific information should be included in your reply:

a. Drawings or sketches sufficient to clearly identify the location of safe load paths, spent fuel, and safety-related equipment.

b. A discussion of measures taken to ensure that load-handling operations remain within safe load paths, including procedures, if any, for deviation from these paths.

RESPONSE:

(1) <u>Reactor Service Crane</u>: The reactor service crane is designed to provide coverage of the containment for lifting operations. Figure 1 shows a general arrangement of the containment at the reactor refueling deck (elevation 42 feet). Also included are outlines of Residual Heat Removal System heat exchangers and pumps below the refueling deck. These components and associated piping are protected by 3 to 5 feet of reinforced concrete.

Figure 2 is a diagram of the restricted area of operation with the reactor vessel head installed. This restricted area protects cabling for safe shutdown equipment from potential load drop damage. Figure 3 is a diagram of restricted areas of operation with the reactor vessel head removed. These restricted areas protect cabling and fuel in the reactor vessel from potential load drop damage. These restricted operation areas are included in the Reactor Service Crane Checkout and Operation Procedure. The procedure is now undergoing review in preparation for inclusion in the San Onofre Nuclear Generating Station Unit 1 (SONGS 1) procedure set.

Safe load paths for the reactor vessel head and for the upper internals assembly are included as Figure 4. This figure will be included in the special procedure for refueling.

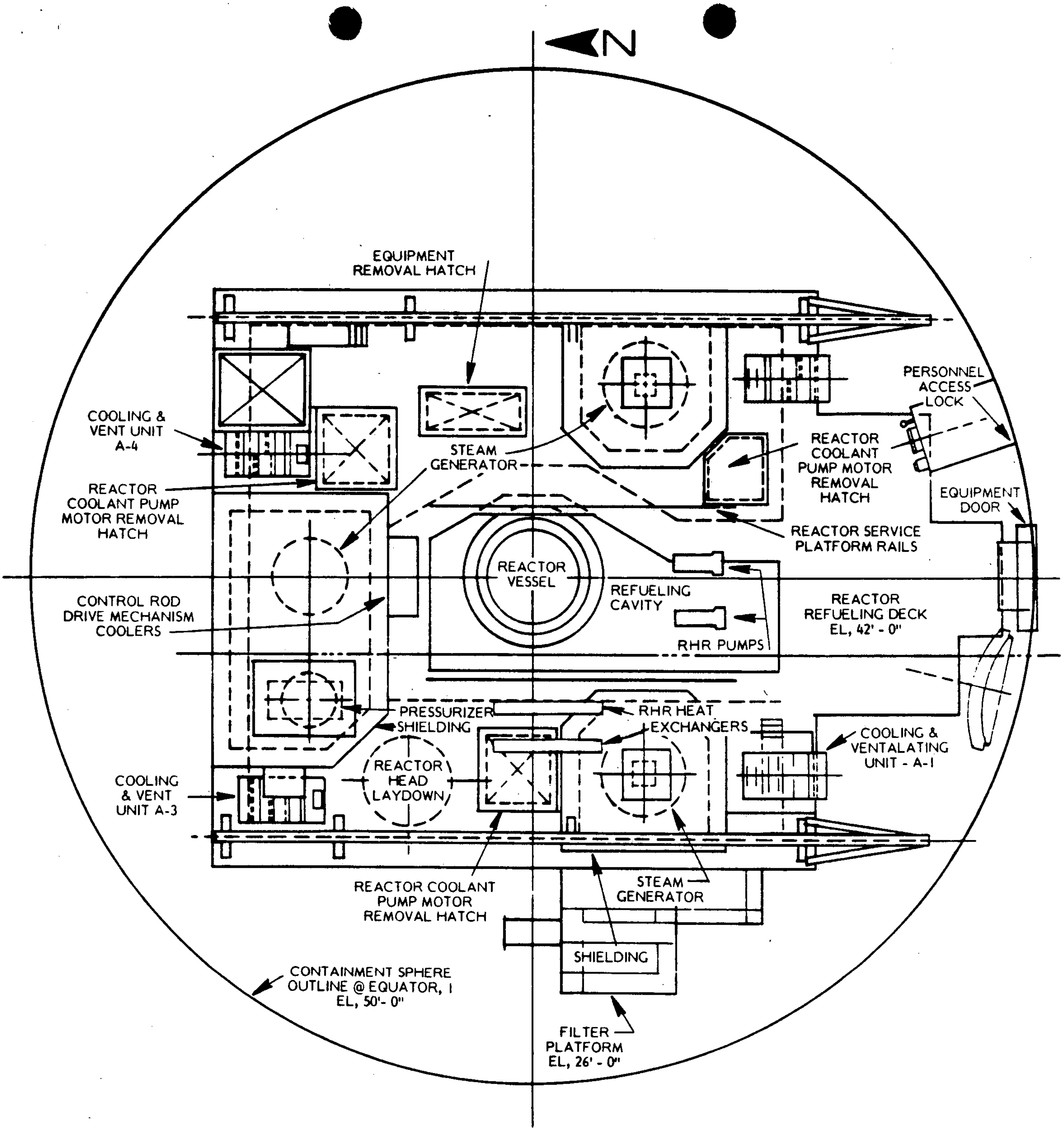

FIGURE I

CONTAINMENT GENERAL
ARRANGEMENT AT REFUELING DECK
(Elevation 42 feet)

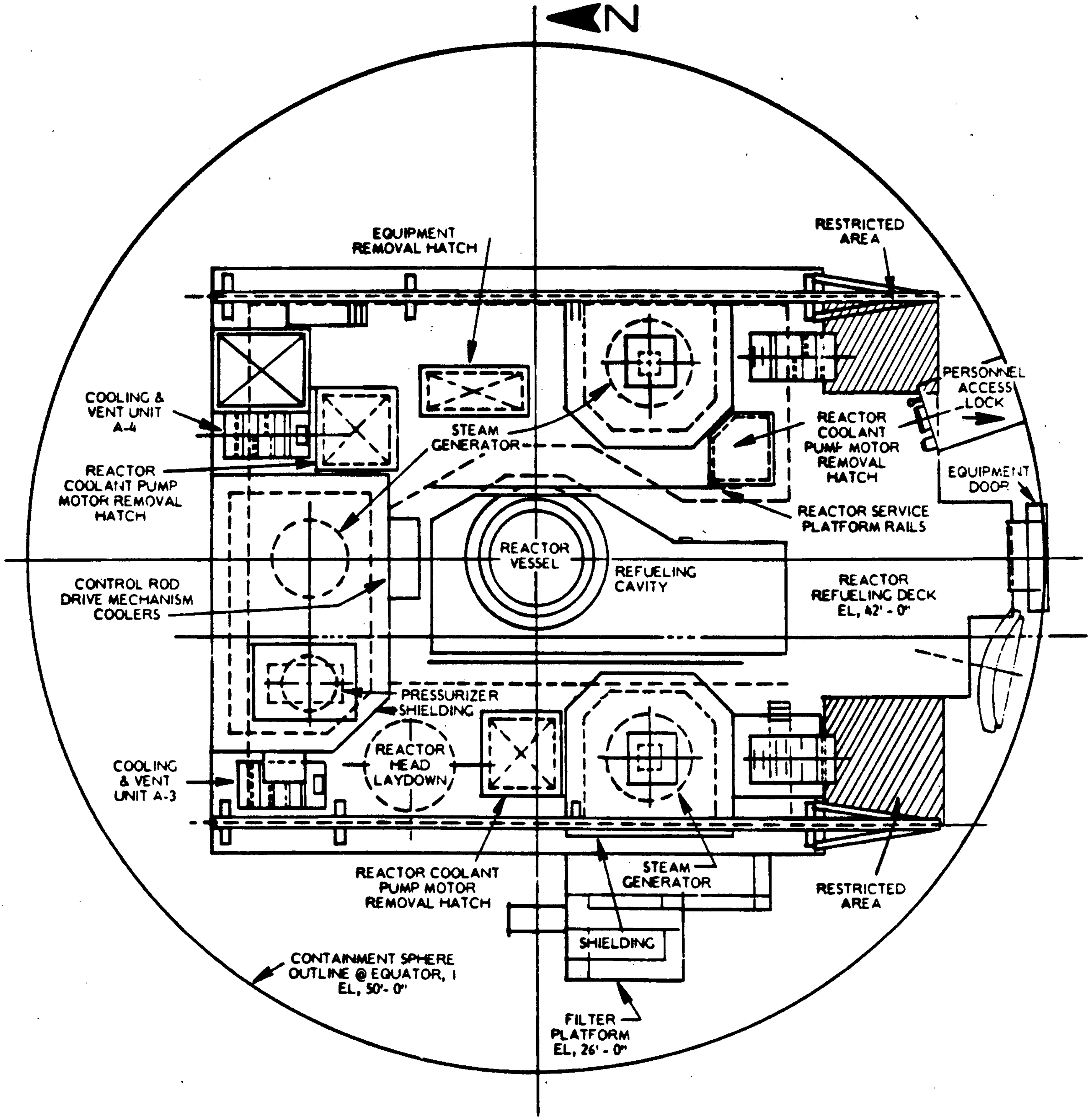

FIGURE 2

RESTRICTED LOAD HANDLING AREA-
REACTOR VESSEL HEAD INSTALLED
(Elevation 42 feet)

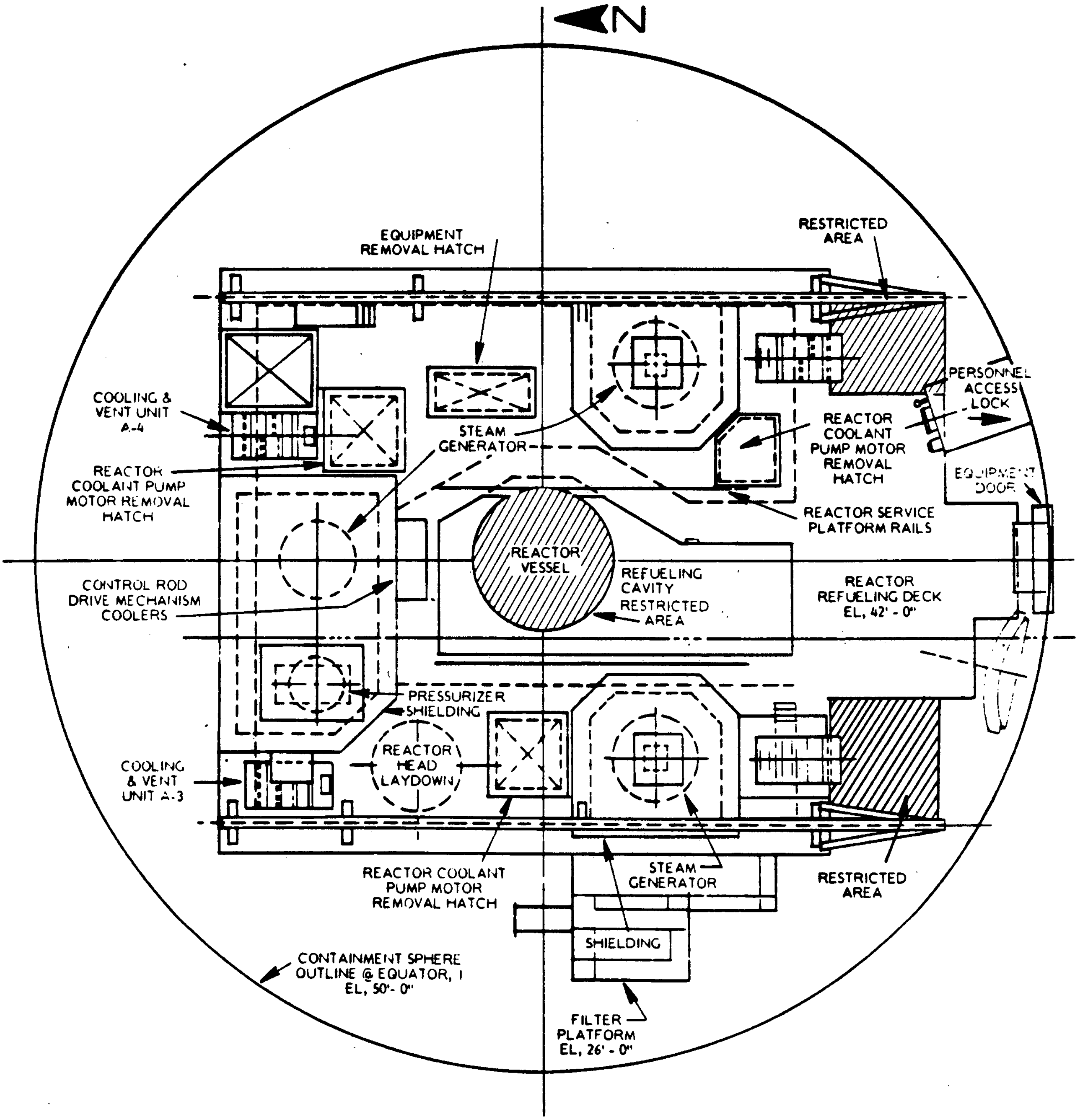

FIGURE 3

RESTRICTED LOAD HANDLING AREA-
REACTOR VESSEL HEAD REMOVED
(Elevation 42 feet)

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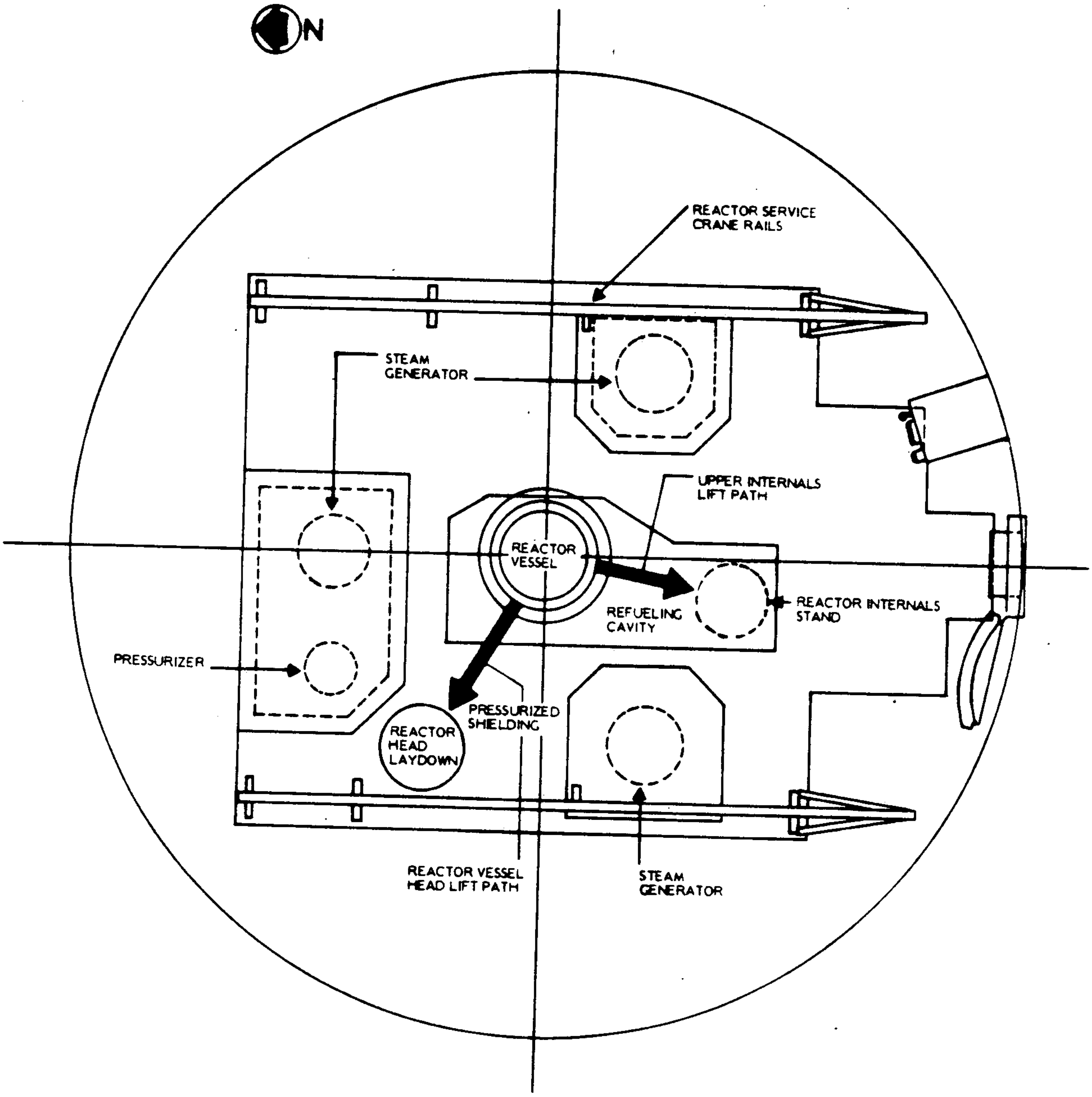

FIGURE 4

LOAD PATHS FOR MOVEMENT OF REACTOR VESSEL HEAD AND UPPER INTERNALS ASSEMBLY

Restricted areas rather than safe load paths were chosen where possible to minimize interference with maintenance activities. Easily discernible physical boundaries rather than floor markings were chosen because floor markings are often obscured by protective coverings and maintenance activities. In addition, because the reactor service crane is pendant operated, crane grid positions may not be as easily usable as in cab controlled cranes.

When safe load paths were defined for the reactor vessel head and the upper internals assembly, simple direct paths were chosen because they can be easily followed by the crane operator and because more circuitous paths do not offer load drop related advantages.

Deviation from the load paths and the restricted areas described above will only be made using On-Site Review Committee approved procedures.

(2) <u>Turbine Gantry Crane:</u> The turbine gantry crane provides lifting services for turbine generator maintenance, for the new fuel shipping container, for spent fuel shipping cask handling and for lifting in the area between the containment sphere and the turbine generator. Figure 5 shows the general arrangement of the turbine gantry crane service area.

The area just to the west of the western rail, roughly bounded on the north and south by the ends of the generator, contains some piping and cabling associated with shutdown systems. However, the turbine deck is very sound in this area. The crane rail rests on a beam which is 7 feet thick and 8 feet 2 inches wide. Drops inside of the rail are unlikely to cause interaction with systems required for shutdown.

The area under the turbine deck to the south of the turbine generator (the south turbine deck extension) contains no equipment or cabling which are required for normal plant shutdown and cooldown.

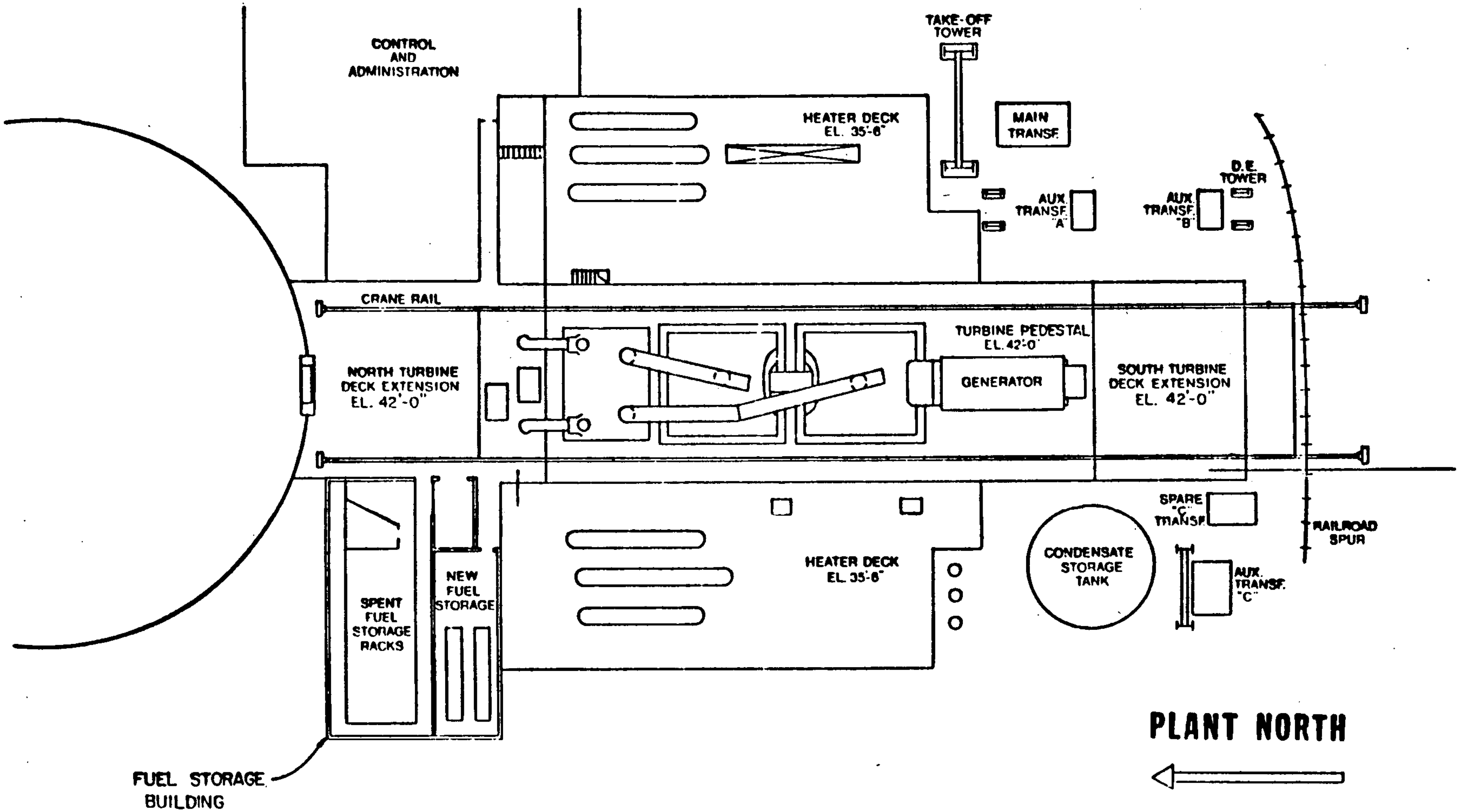

FIGURE 5

TURBINE GANTRY CRANE SERVICE AREA

The area under the turbine deck between the containment sphere and the high pressure turbine (the north turbine deck extension) contains many piping and cabling runs associated with systems required for shutdown. Included are auxiliary and main feedwater piping, main steam lines, RHR cabling and charging pump cabling.

To ensure that equipment required for shutdown of the plant is not damaged by accidental load drops, turbine gantry crane load handling will be restricted to the safeload path area and load paths as shown in Figures 6 and 7, respectively. These restricted areas of operation are included in a proposed Turbine Gantry Crane Checkout and Operation Procedure now being reviewed in preparation for addition to the SONGS 1 procedure set.

Turbine gantry crane loading handling restrictions and safeload paths will be revised based upon the results of load drop and crane reliability analyses prepared for the nine-month report. The nine-month report will address any recommended modifications to the crane or north turbine deck extension.

Deviation from the load paths and restricted areas described above will only be made using On-Site Review Committee approved procedures.

(3) **Spent Fuel Pit Bridge Crane:** The spent fuel pit bridge crane is intended to move spent fuel in the spent fuel building. It is also generally used once per refueling to withdraw and replace the gate which isolates the fuel transfer system from the remainder of the spent fuel pit and to change spent fuel pit lights. The spent fuel pit bridge crane service area is shown in Figure 8.

SONGS 1 Technical Specification 3.8.B.1 currently prohibits loads in excess of 1,500 pounds from traveling over fuel assemblies in the storage pool. The Technical Specification provides assurance that heavy loads will not interact with spent fuel.

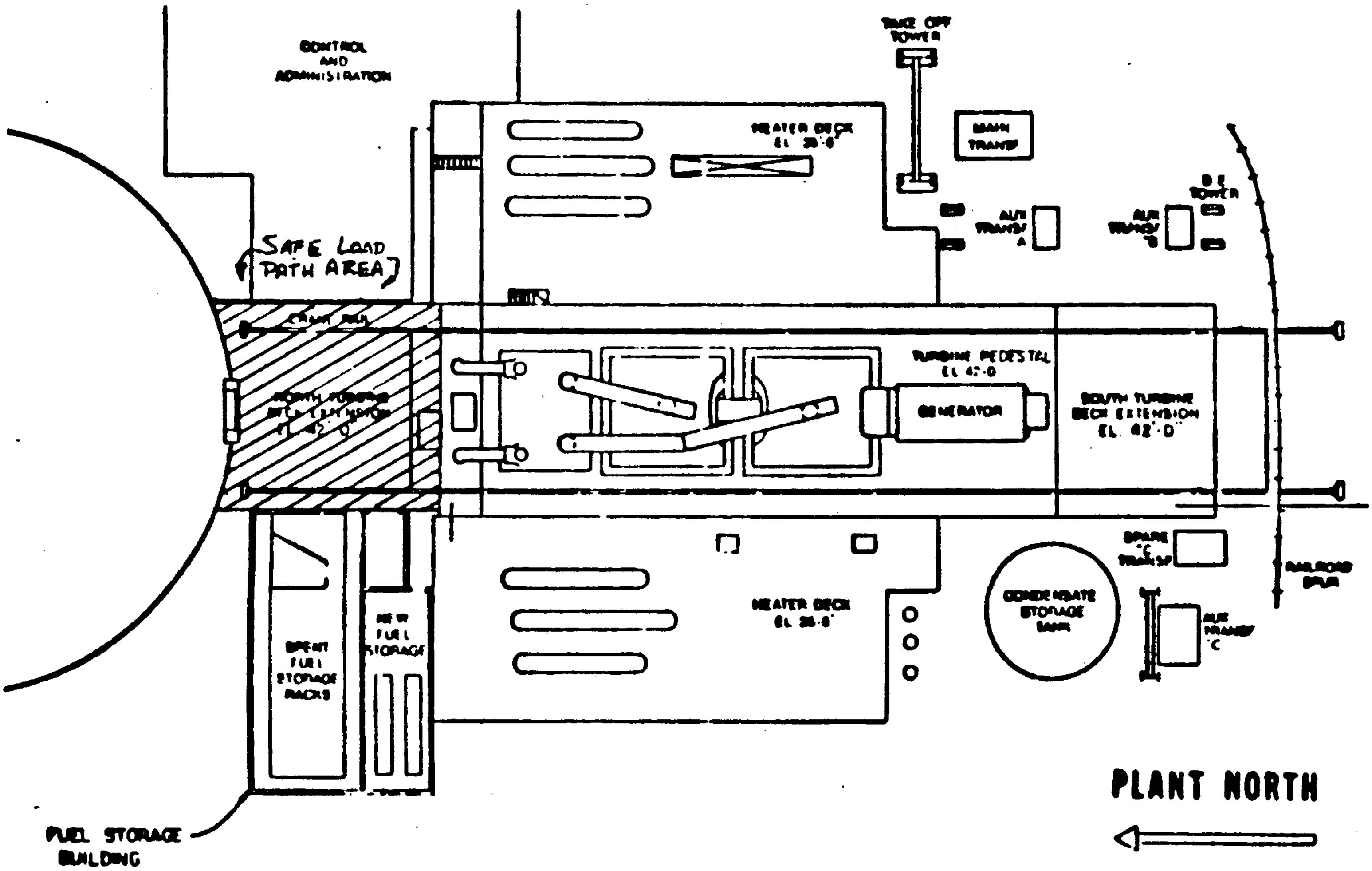

FIGURE 6

TURBINE GANTRY CRANE
SAFELOAD AREA

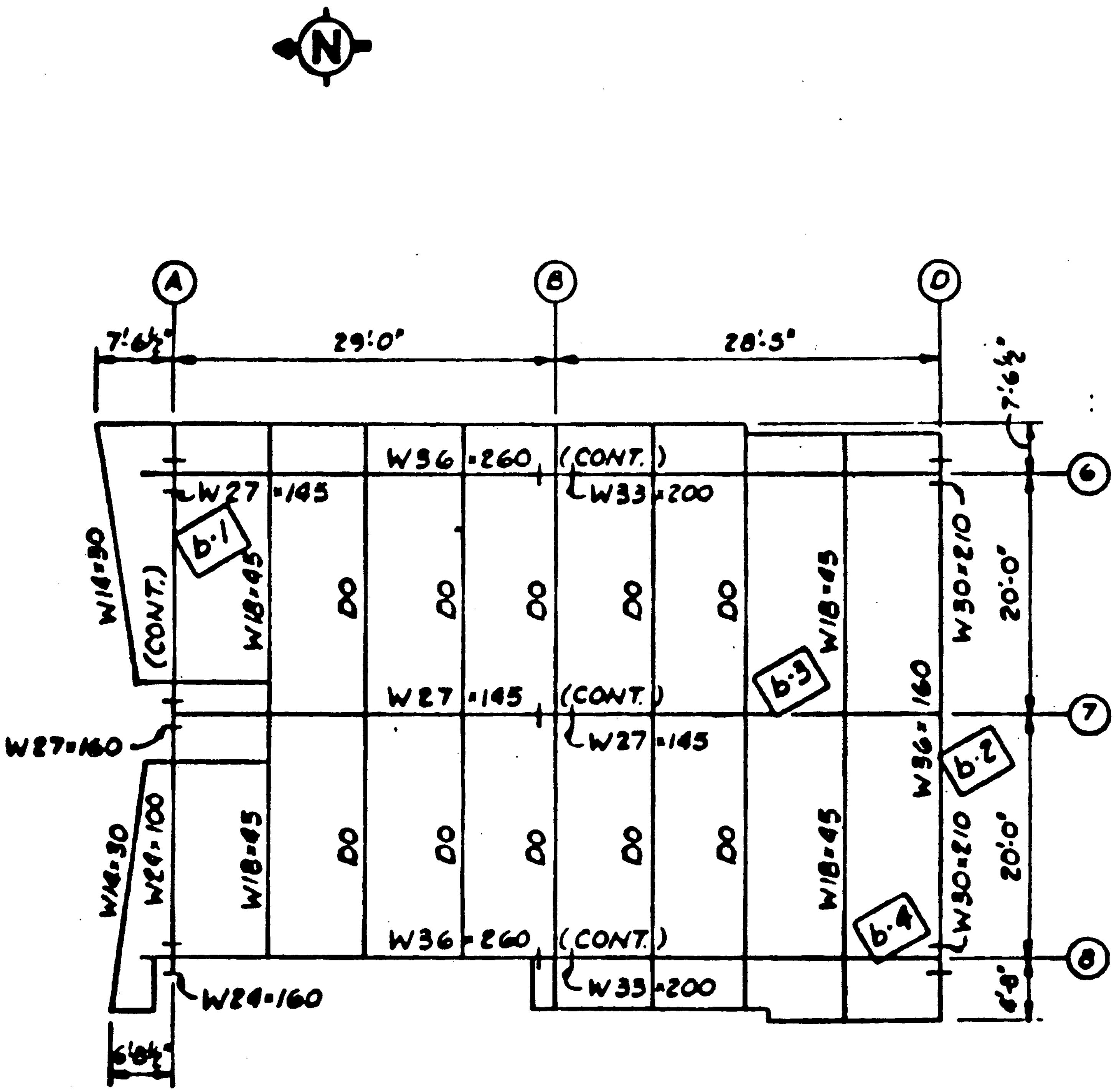

FIGURE 7

TURBINE DECK NORTH EXTENSION
SAFELOAD PATHS

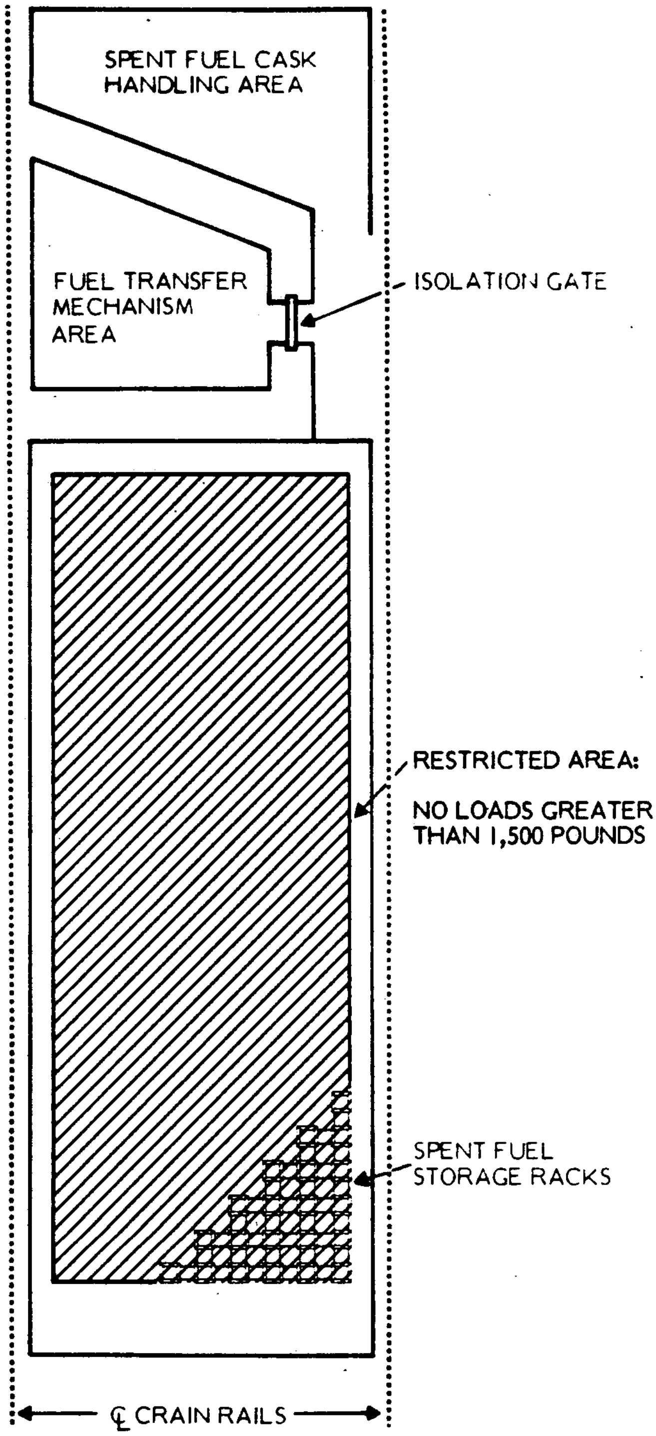

FIGURE 8

SPENT FUEL PIT BRIDGE CRANE
SERVICE AREA

ITEM 3c: A tabulation of heavy loads to be handled by each crane which includes the load identification, load weights, designated lifting device, and verification that the handling of such loads is governed by a written procedure containing, as a minimum, the information identified in NUREG-0612, Section 5.1.1(2).

RESPONSE: The requested information is provided below.

Safety classes define when the lifts are made with respect to the vessel head being in place or removed, fueled or defueled. They are defined as follows:

Class 1 - Loads of greater than the weight of a single fuel assembly (about 1,500 lb) that must be carried over fuel in an open reactor vessel.

Class 2 - Loads of greater than about 1,500 lb that could be lifted and moved by the containment crane when the head is off and the fuel is in the reactor vessel but are not required to be moved over the reactor vessel.

Class 3 - Loads of greater than about 1,500 lb that are normally lifted only when the reactor vessel head is in place or the reactor is defueled.

TURBINE GANTRY CRANE*

Load	Approximate Weight	Lifting Device	Applicable Procedure
Turbine Spindle	115 tons	Lifting Beam	NA
New Fuel Container	2½ tons	Multiple Leg Sling	S-1-3.1
Spent Fuel Cask (NAC-1)	30 tons (includes lifting gear)	Yoke	S-1-3.6

*The turbine gantry crane will be used to lift a wide variety of loads. The loads listed are the heaviest load associated with turbine repair, new fuel handling and spent fuel shipment. Most of the loads lifted by the crane are not covered by specific procedures. Guidance for general lifting using the crane is contained within a proposed procedure, now under review, titled Turbine Gantry Crane Checkout and Operation. The procedures in turn reference appropriate maintenance and inspection procedures for lifting devices and slings.

SPENT FUEL BRIDGE CRANE

Load	Approximate Weight (lb)	Lifting Device	Applicable Procedure
Upender Pit Gate	2,000	Slings	S-1-1.2 and Technical Specification 3.8.B.1

REACTOR SERVICE CRANE

Load	Safety Class	Approximate Weight (tons)	Required Equipment	Applicable Procedure
Reactor Vessel Head	1	65	RV Head Lift Tripod	SPE[1] for Refueling
Upper Internals Assembly	1	30	Upper Internals Lift Rig	SPE[1] for Refueling
Missile Shields	3	93	Slings	SPE[1] for Refueling
Auxiliary Shield	3	60	Slings	SPE[1] for Refueling
Core Barrel	3	72	Core Barrel Lifting Device	SPE[1] for Refueling
CRDM Ventilation Ducts	3	2.5	Slings	SPE[1] for Refueling
Reactor Cavity Seal Ring	3	10	Slings	SPE[1] for Refueling
Sand Tank	3	23	Slings	SPE[1] for Refueling
Stud Tensioners	3	2	Slings	SPE[1] for Refueling
Stud Rack	3	20	Slings	SPE[1] for Refueling
Reactor Coolant Pump Motor	2	31	Slings	SO1-1-5.1
Westinghouse ISI Tool	1	5	ISI Tool Lifting Device	SPE[1]

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[1] Special Procedure Engineering

ITEM 3d: Verification that lifting devices identified in Item 3c, above, comply with the requirements of ANSI N14.6-1978 or ANSI B30.9-1971 as appropriate. For lifting devices where these standards, as supplemented by NUREG-0612, Section 5.1.1(4) or 5.1.1(5), are not met, describe any proposed alternatives and demonstrate their equivalency in terms of load-handling reliability.

RESPONSE: Those lifts requiring slings which were identified in Item 3c above will utilize slings chosen in accordance with ANSI B30.9-1971.

With regard to special lifting devices, there are four identified in response to Item 3c above that are used in lifts over an open reactor vessel. These lift the reactor vessel head, upper internals assembly core barrel and ISI Tool.

Detailed information concerning these lifting devices has been requested but is not yet available. When the information does become available, comparison to ANSI N14.6-1978 will be limited to Sections 3.2 and 5 for the following reasons:

(1) The devices listed above were designed prior to both the adoption of ANSI N14.6-1978 and the NRC's decision (in 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. The sections are those entitled Designer's Responsibilities (Section 3.1); Design Considerations (Section 3.3); Fabricator's Responsibilities (Section 4.1); Inspector's Responsibilities (Section 4.2); and Fabrication Considerations (Section 4.3). Because documentation is not available to assure that all of the subparts of these sections were met, they will not be addressed item by item for the purpose of identifying and justifying exceptions. The review will include information provided by the designer including drawings and procurement specifications where available.

(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 the load handling reliability of the devices and therefore will not be addressed for the purpose of identifying and justifying exceptions.

(3) Section 6 is applicable to lifting devices used for critical loads. A critical load is defined in the standard as:

> "Any lifted load whose uncontrolled movement or release could adversely affect any safety related system when such system is required for unit safety or could result in potential offsite exposures comparable to the guideline exposures outlined in Code of Federal Regulations, Title 10, Part 100."

Neither of the loads lifted using the two lifting rigs identified above has as yet been determined to be a critical load. Such a determination would require an analysis of the consequences of various load drop scenarios. Since such analyses are not required to be performed until the nine-month report to the NRC, it is premature to designate certain loads as critical loads and accordingly to apply Section 6 of ANSI N14.6-1978 to their designated lifting devices.

ITEM 3e: Verification that ANSI B30.2-1976, Chapter 2-2, has been invoked with respect to crane inspection, testing, and maintenance. Where any exception is taken to this standard, sufficient information should be provided to demonstrate the equivalency of proposed alternatives.

RESPONSE: The 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. These are:

(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 percent of 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.

ITEM 3f: Verification that crane design complies with the guidelines of CMAA Specification 70 and Chapter 2-1 of ANSI B30.2-1976, including the demonstration of equivalency of actual design requirements for instances where specific compliance with these standards is not provided.

RESPONSE: The discussion which follows is applicable to both the reactor service crane and the turbine gantry crane. They were both built at the same time in the same facility.

The SONGS 1 turbine gantry and reactor service cranes were built prior to the issuance of ANSI B30-2-1976 and CMAA 70-1975. The crane was procured, designed and fabricated by P&H Harnischfeger in Norwalk, California in accordance with the criteria of Bechtel Corporation Specification BSO-254 of April 17, 1964.

In evaluating the cranes for conformance with ANSI B30.2-1976, as required by NUREG-0612, point-by-point comparisons of the crane design were performed with the ANSI criteria using information contained in the Bechtel specification, in engineering drawings and instructions for the crane supplied by P&H Harnischfeger, and by direct consultation with P&H engineers.

The SONGS 1 turbine gantry crane was designed to the governing criteria in "Specifications for Electric Overhead Traveling Cranes," EOCI #61, predecessor to CMAA-70. In general, structural design requirements specified in EOCI #61 were more conservative than those delineated in the later standards. For this reason, the crane is, in many respects, structurally over-designed. However, numerous criteria in the later standards differ in detail from the corresponding criteria in EOCI #61. In some cases, criteria have been added that were entirely absent in EOCI #61. The paragraphs below address the differences between the cranes and the criteria of ANSI B30.2-1976 that could be pertinent to the prevention of heavy load drops.

Current standards specify that structural steel "shall conform to ASTM-A36 specifications or shall be an accepted type for the purpose for which the steel is to be used" (CMAA-70, paragraph 3.1). The structural steel in the reactor service and turbine gantry crane structure is A36. The structural steel in the trolley and trolley trucks is A7, which has yield and ultimate strengths of 33,000 psi and 60,000-75,000 psi, respectively. In comparison, the yield and ultimate strengths of A36 are 36,000 psi and 58,000-80,000 psi. The more conservative low figure for yield strength of 60,000 psi was used in the design of the trolley trucks, and the design maintained a safety factor of 5:1. Thus, the structural materials used in these cranes comply with the requirements of NUREG-0612.

ANSI B30.2-1976 required that welding procedures conform to the standards of the American Welding Society as embodied in AWS-D1.1 and AWS-D14.1. However, D14.1 did not exist at the time these cranes were constructed, and changes were made in D1.1 between that time and the issuance of ANSI B30.2-1976. The changes in requirements most important to load drop prevention appear to be those related to control of the hydrogen content of the welding rod for prevention of hydrogen embrittlement of welds. The procedure recommended for this control is preheating of the rod in on-site ovens. Although this provision may not have been detailed in the AWS standards of the mid-1960s as fully as at present, the manufacturer nevertheless stated that preheating in on-site ovens was practiced during the construction of this crane. Based on our evaluation, it is concluded that the quality of the welding in this crane is equivalent to that required by current standards.

CMAA-70-1975 specifies the position of longitudinal stiffeners on the web plates of box girders of the type used in these cranes. The actual position of the stiffeners on these cranes differs by less than 10 percent from the specified position. The ability of these cranes to perform at rated capacity is not affected because of the overall conservatism of the design of the girder.

Shear analysis records for vertical stresses in the bridge (gantry leg) end trucks (CMAA-70-1975, Section 3.4.3) were normally not retained by P&H after crane delivery in the mid-1960s. However, ASTM-A7 steel was used in the end trucks, and 60,000 psi was used as the ultimate strength of this steel in the design. Since the design specified a 5:1 safety factor for structural members, the maximum vertical tension or compression would be 12 ksi, which is below the allowable limit of 14.4 ksi set by CMAA-70. Ultimate strength in shear used for the design was approximately 35 ksi, giving a maximum design shear stress of 7 ksi. This stress level is within the 10.8 ksi limit in CMAA-70. The same reasoning holds for the trolley frames, which are also A7 steel. Thus, with respect to vertical stress, the cranes comply with current standards.

These cranes have a single hoist holding brake, whereas CMAA-70-1975 and ANSI B30.2 (1976) require that "each independent hoisting crane unit of a . . . nuclear reactor and fuel handling crane, having power control braking, shall have at least two holding brakes."

CMAA-70-1975 and ANSI B30.2-1976 specify deceleration and stopping criteria for bridge and trolley bumpers and stops. According to P&H engineers, bumpers and stops for these cranes were probably not designed to rigid quantitative deceleration and stopping criteria because such criteria had not been developed by the mid-1960s. Instead, bumpers and stops were chosen on the basis of experience. The P&H engineers also stated that bumpers and stops built in the mid-1960s typically do not meet the quantitative criteria set out in CMAA-70.

In summary, the SONGS I reactor service crane and turbine gantry crane meet the requirements of CMAA-70 and ANSI B30.2-1976 except that they do not have a second holding brake and their bridge and trolley stops may not meet current requirements.

ITEM 3g: Exceptions, if any, taken to ANSI B30.2-1976 with respect to operator training, qualification, and conduct.

RESPONSE: Current information indicates that no deviation from ANSI B30.2-1976 will be required. Should deviation be required, the NRC will be informed.