TRANSSHIPMENT OF

SAN ONOFRE UNIT 1

SPENT FUEL

SAN ONOFRE NUCLEAR GENERATING STATION

UNITS 1, 2 AND 3

APRIL 1988

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A. INTRODUCTION

The Spent Fuel Pool at San Onofre Unit 1 is designed to store 216 spent fuel assemblies. Currently there are 67 spaces available for future storage. During each refueling, 52 assemblies are removed from the core and placed in the spent fuel pool. The next refueling outage for San Onofre Unit 1 is in August 1988 (Cycle X refueling).

Following the Cycle X refueling outage, only 15 unfilled spaces will remain. Therefore, the plant will not be capable of refueling at the following refueling outage which is scheduled in 1990 unless additional space is made available by transshipment. In addition, In-Service Inspection of the reactor vessel which requires unloading the entire core is necessary during the 1990 refueling outage. If the spent fuel is not removed from the spent fuel pool prior to the 1990 refueling outage, operation of San Onofre Unit 1 would cease.

SCE is planning to rerack the San Onofre Units 2 and 3 Spent Fuel Pools. Following the reracking there will be sufficient space in the Units 2 and 3 Spent Fuel Pools for the San Onofre Unit 1 spent fuel until the expiration of the Unit 1 license in 2004. During the licensing of San Onofre Units 2 and 3, it was recognized that the new units would be used to store Unit 1 spent fuel. Therefore, Units 2 and 3 were analyzed for storage of Unit 1 spent fuel.

In the following sections of this report, the previously approved method for shipping spent fuel will be briefly described. This will provide some historical background and obvious reasons why this method is considered inefficient and undesirable. The proposed method of transshipping spent fuel from Unit 1 to Units 2 and 3 will be described. In contrast to the previous method, this is more efficient and reliable. In order to proceed with the transshipment process the relevant issues regarding movement of a spent fuel cask at Unit 1 must be discussed. This report addresses the cask to be used, the Unit 1 turbine gantry crane and its use on the turbine building, the effects of the cask on the decontamination pad and the spent fuel pool and movement of the loaded cask from Unit 1 to Units 2 and 3. Finally, a discussion of the approvals associated with the storage of Unit 1 fuel in the Units 2 and 3 spent fuel pools is also provided.

B. EXISTING SPENT FUEL SHIPPING

San Onofre Unit 1 was approved by the NRC to ship spent fuel utilizing an air pallet system in conjunction with the turbine gantry crane. The air pallet is a low profile load movement device consisting of a steel superstructure, air bearings, air distribution manifold and a control and instrumentation system, conservatively designed to accommodate casks weighing up to 100 tons (See Figure 1). Overall length, width and height of the pallet are 100 inches, 82 inches and 8 inches, respectively. The air pallet weighs approximately 2-1/2 tons. Tie-down anchors and a shear ring are located in a circle centered around the base of the cask. When not in the energized mode (i.e., not riding on an air film), the pallet rests on structural load bars. This system was designed and approved by the NRC to carry a 30 ton single element spent fuel cask including lifting rig at San Onofre Unit 1. The steps involved in the spent fuel shipment were as follows (See Figure 2):

1. At the south end of the turbine building, the turbine gantry crane lifts the spent fuel cask and places it on the air pallet. (Points A and B on Figure 2.)

2. The turbine gantry crane then lifts and places the cask and air pallet as a unit onto the south extension of the turbine building. (Point C on Figure 2.)

3. The air pallet travels down the west side of the turbine deck to the spent fuel building at the north extension of the turbine building.

4. The air pallet is moved into the decontamination area and the turbine gantry crane lifts the cask from the air pallet. (Point D on Figure 2.)

5. The air pallet is moved out of the decontamination area and the cask is placed on the decontamination pad.

6. The turbine gantry crane lifts and places the cask in the cask handling area of the spent fuel pool. (Point E on Figure 2.)

7. A spent fuel element is loaded into the cask and the cask is returned to the decontamination pad.

8. Once decontaminated, the cask is placed on the air pallet for transport to the south extension of the turbine building.

The details of this method of shipping spent fuel are described in SCE's March 21, 1975 submittal. This submittal indicates that certain structural modifications would be necessary for the south and north extensions of the turbine building. In addition, a turbine deck load bearing test would be performed every four years to ensure the structural integrity of the turbine deck on the west side. The NRC's January 15, 1976 Safety Evaluation approved the use of the air pallet for shipping spent fuel. It also approved the technical specification for performing the turbine deck load bearing test, and as part of the San Onofre Unit 1 license, required that shipments of spent fuel should not resume until the modifications had been completed and the initial turbine deck load bearing test was performed. The license amendment did allow spent fuel shipments during cold shutdown without these modifications.

AIR PALLET

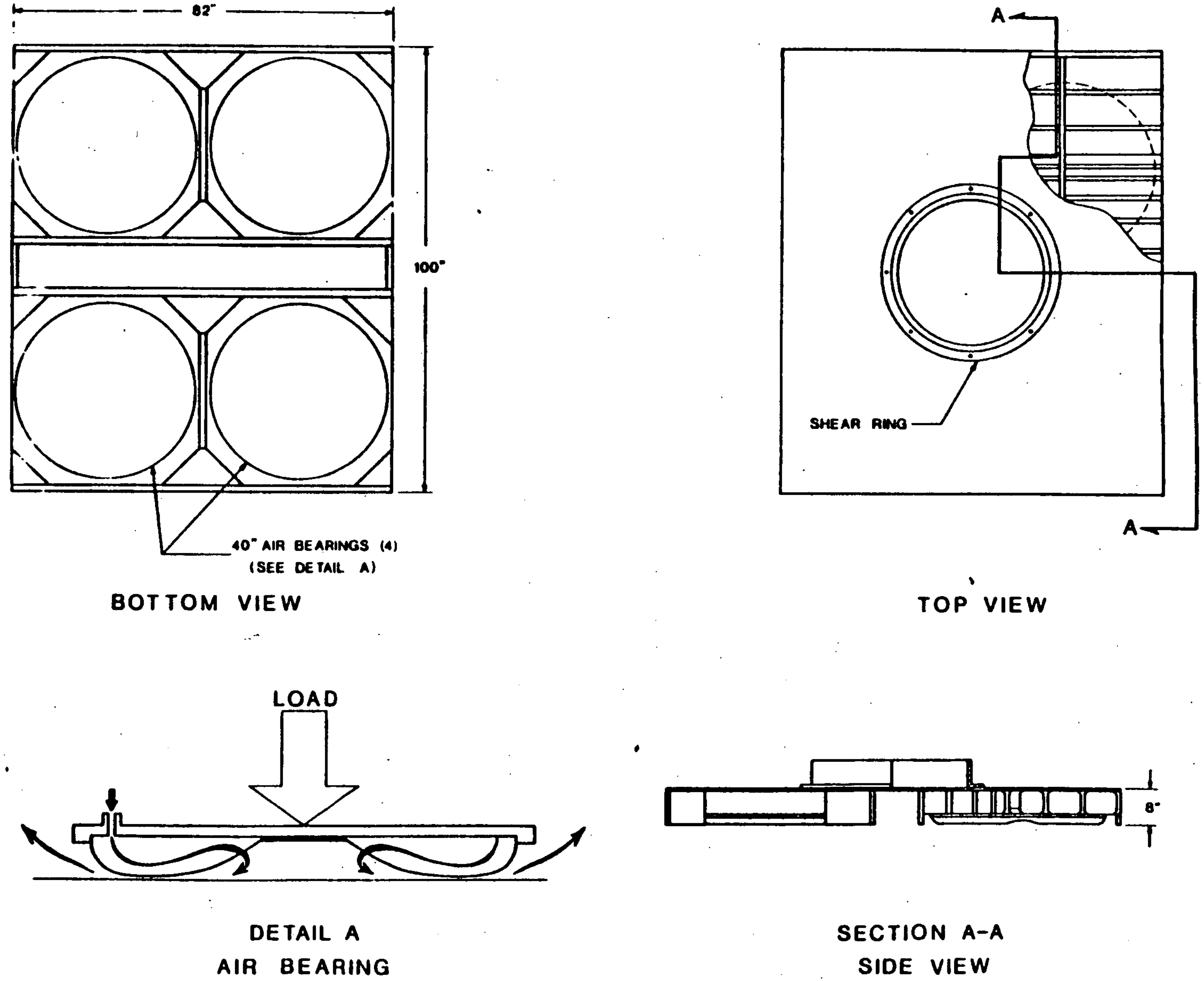
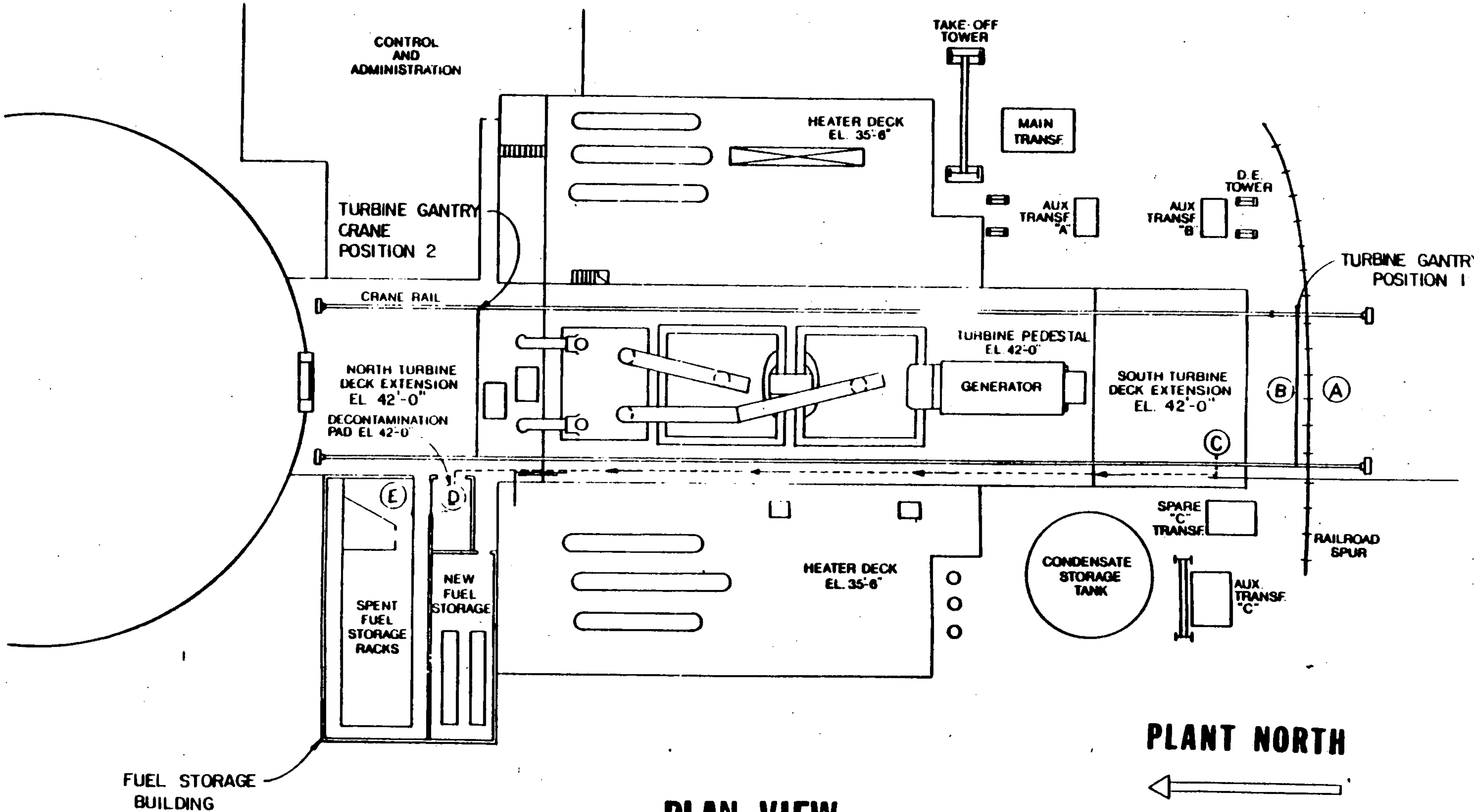


Figure 1

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1



PLAN VIEW

Figure 2

C. PROPOSED METHOD OF SPENT FUEL SHIPMENT

The proposed method of shipping spent fuel elements from San Onofre Unit 1 to Units 2 and 3 will involve the use of the San Onofre Unit 1 turbine gantry crane. The air pallet system will not be used. The spent fuel shipping cask will be restrained on the horizontal beam of the west A-frame leg of the turbine gantry crane for travel along the turbine deck. In addition, a multi-element cask on the order of 70 tons will be used. All transshipment will be performed only during Unit 1 plant shutdowns (Modes 5 and 6).

The steps involved in the transshipment process would be as follows (these steps can be followed on Figures 3, 4 and 5):

1. An empty spent fuel cask will be on either a tractor trailer or a railroad car parked under the turbine gantry crane at Unit 1 (Point A on Figure 3). (For purposes of this discussion, it is assumed that a tractor trailer is the transport method of choice, as the railroad path is very similar.)

2. The turbine gantry crane will lift the cask from the tractor trailer and place it on the horizontal beam of the west A-frame leg of the turbine gantry crane (Point B on Figure 3). Once in place, the cask will be secured from lateral movements and tipping (the method of securing the cask is discussed in the section on the Turbine Gantry Crane). The crane hook will remain attached to the cask.

3. The turbine gantry crane will travel to the north extension of the turbine building alongside the decontamination (decon) pad. Once the cask is released from the A-frame, the turbine gantry crane will place the cask on the decon pad and unhook while preparations are made to lower the cask into the spent fuel pool (Point C on Figure 3). An impact limiter will be used during the lift of the cask. The crane is able to reach into the Fuel Storage Building through a sliding panel on the roof.

4. The cask will be lifted by the turbine gantry crane and placed in the cask handling area of the pool. Once lowered, the crane will be unhooked (Point D on Figure 3).

5. After the designated spent fuel assemblies have been placed in the cask, the turbine gantry crane will return the cask to the decon pad. The cask will be decontaminated and prepared for transshipment.

6. The cask will be lifted by the turbine gantry crane, placed on the horizontal beam of the west A-frame leg and secured again. During the lift, an impact limiter will be used under the cask. The crane will move to the south end of the turbine building.

7. The cask will be placed on the tractor trailer by the turbine gantry crane and secured. Once the tractor trailer exits the Unit 1 protected area it will be escorted by armed security officers while

it is in transit outside the protected area. The tractor trailer will reenter the protected area through the Units 2 and 3 gate (Figure 4).

8. The tractor trailer will then proceed to the Unit 2 or Unit 3 Fuel Handling Building truck bay (Figure 4).

9. The Unit 2 or 3 cask handling crane will lift and transport the cask to the decon area, where the cask will be prepared to be placed in the cask pool. The cask crane will then move the cask to the cask pool for unloading (Figure 5).

10. After unloading, the cask crane will return the empty cask to the decon area for decontamination and preparation for transport back to Unit 1 where the process is repeated.

The transshipment process will be controlled by one procedure, SO123-X-9, Transshipment of Spent Fuel, that ties in the Maintenance activities of cask handling, the Health Physics responsibilities of decontamination and operational radiation surveys, the administrative and technical responsibilities for control of the fuel movement and the Quality Assurance and Quality Control responsibilities for overseeing the evolution. The activities will be supervised by a Maintenance Supervisor. The project will be coordinated by a Refueling Engineer. The lifts of the cask will be controlled by SO123-I-1.13, "Turbine Gantry Crane Checkout and Operation" and SO1-I-7.27, "Cranes, Rigging, and Lifting Controls".

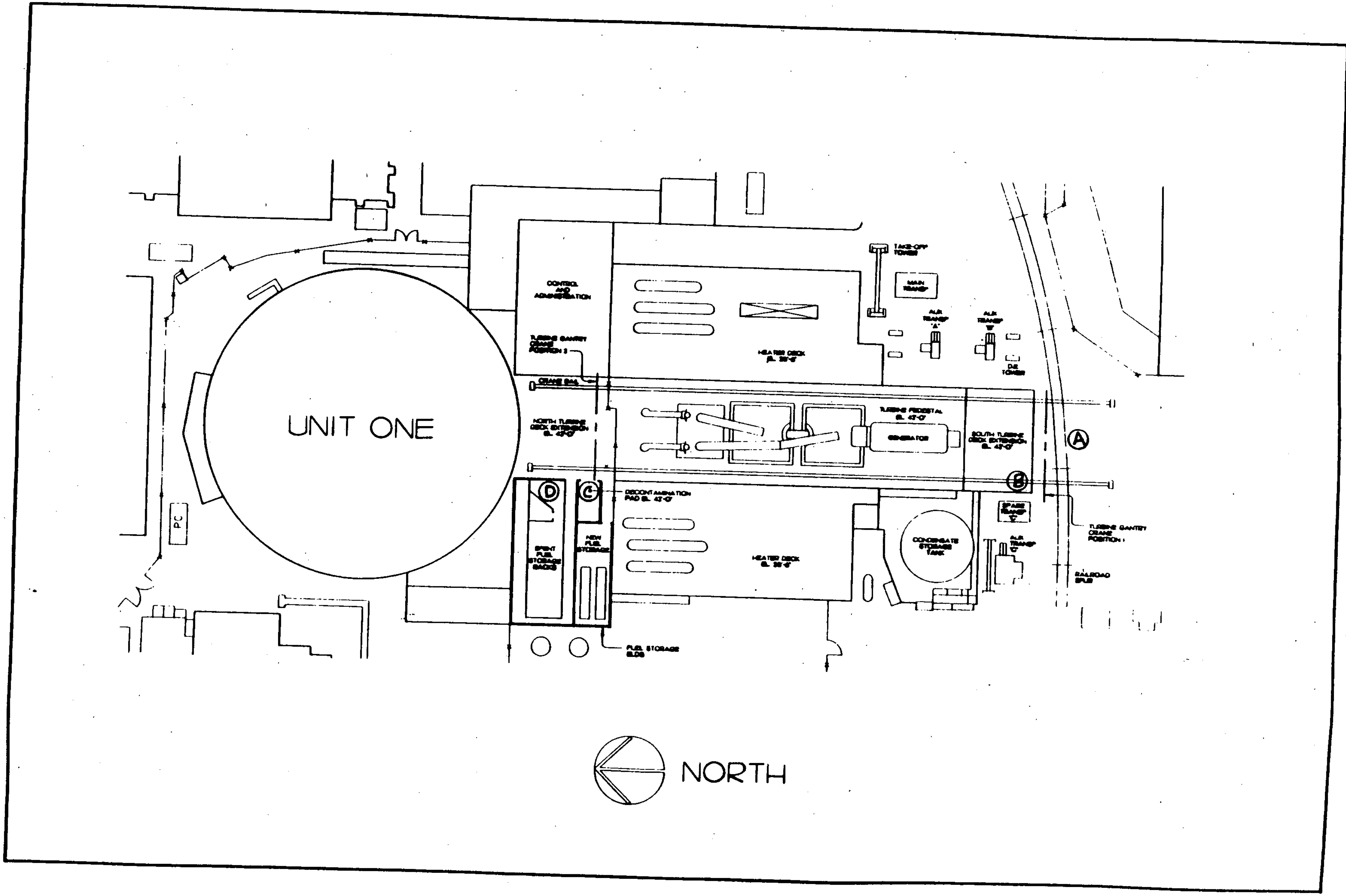

UNIT ONE
CONTROL AND ADMINISTRATION
TURBINE GANTRY CRANE POSITION 2
CRANE RAIL
NORTH TURBINE DECK EXTENSION
HEATER DECK
TAKE-OFF TOWER
MAIN TRANSF
AUX TRANSF "A"
AUX TRANSF
TURBINE PEDESTAL
GENERATOR
SOUTH TURBINE DECK EXTENSION
A
B
C
D
DECONTAMINATION PAD
SPENT FUEL STORAGE RACKS
NEW FUEL STORAGE
FUEL STORAGE BLDG
CONDENSATE STORAGE TANK
SPARE TRANSF
AUX TRANSF
TURBINE GANTRY CRANE POSITION 1
RAILROAD SPUR
PC
NORTH

Figure 3

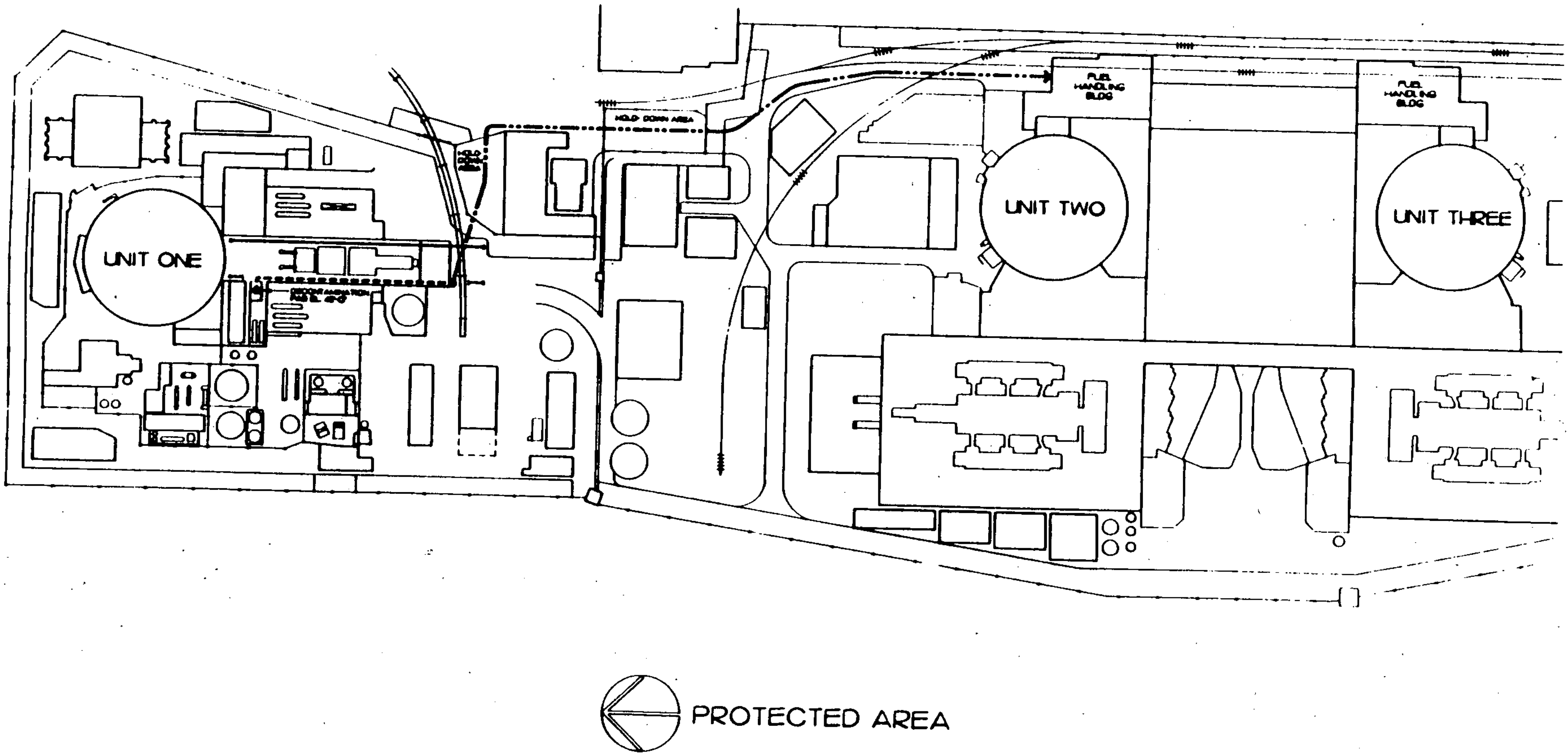

HOLD DOWN AREA
HOLD DOWN AREA
FUEL HANDLING BLDG
FUEL HANDLING BLDG
UNIT ONE
UNIT TWO
UNIT THREE
PROTECTED AREA

Figure 4

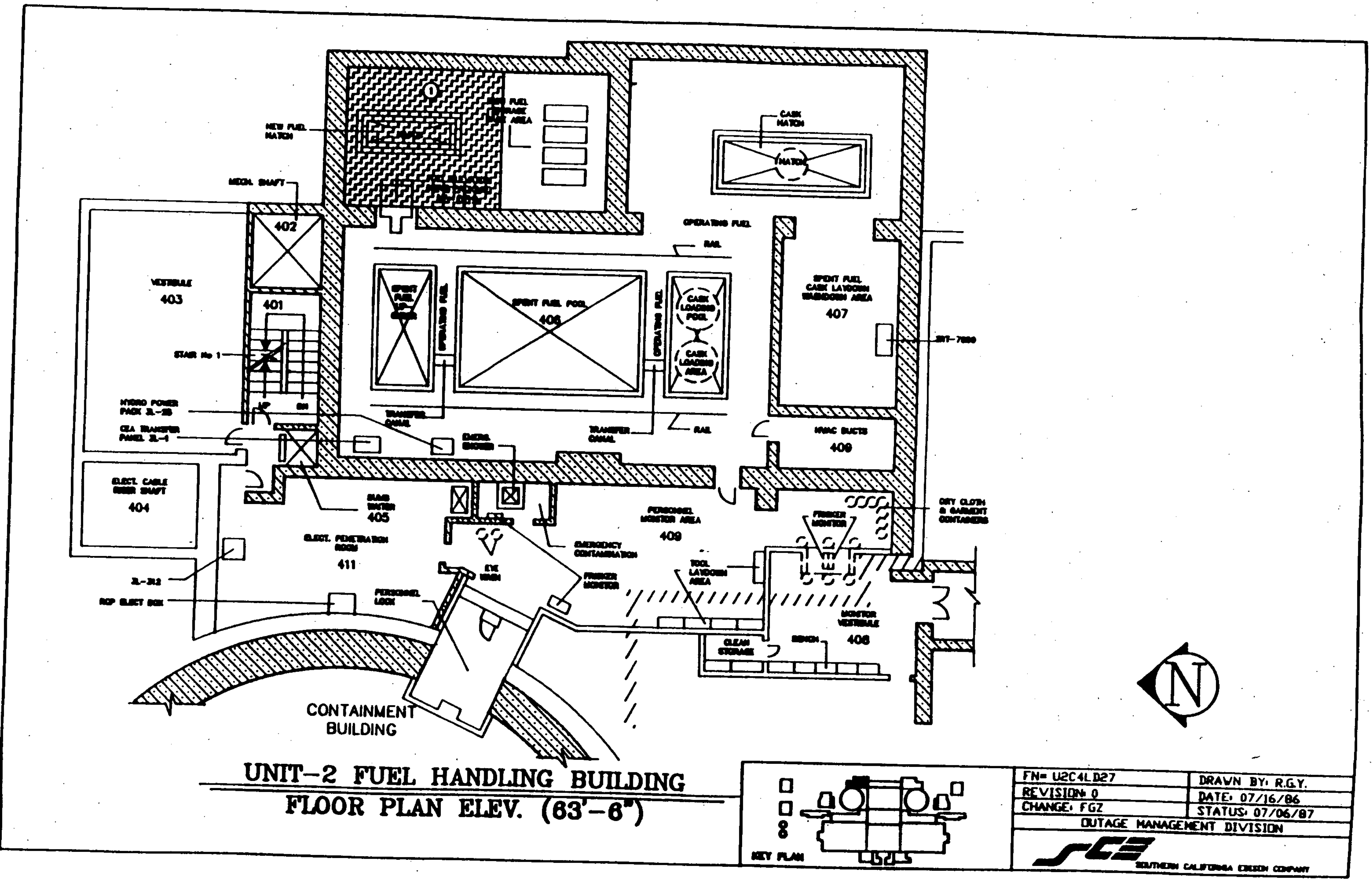

402
403
401
404
405
406
407
408
409
411
CONTAINMENT
BUILDING
UNIT-2 FUEL HANDLING BUILDING
FLOOR PLAN ELEV. (63'-6")
FN= U2C4LD27
REVISION: 0
CHANGE: FGZ
DRAWN BY: R.G.Y.
DATE: 07/16/86
STATUS: 07/06/87
OUTAGE MANAGEMENT DIVISION
KEY PLAN
SOUTHERN CALIFORNIA EDISON COMPANY
N

Figure 5

D. CASK

The spent fuel cask to be used for the transshipment is the GE IF-300 (Figure 6). The cask carries seven spent fuel assemblies and weighs 70 tons which includes the rigging, spent fuel assemblies and water. It has a Certificate of Compliance for Radioactive Material Packages which means it is licensed by the NRC for use on public roadways. The cask will be used entirely within the San Onofre site for the transshipment. The cask will not be transported over any highways or public roads during the transshipment evolution or while it is located at San Onofre.

The Unit 1 spent fuel being shipped is bounded by the GE IF-300 Consolidated Safety Analysis Report (CSAR) NEDO-10084-3 (see Table 1). The CSAR contains the structural analysis, thermal analysis, criticality analysis, shielding analysis, fission product release, fuels and contents acceptability.

Cask drops are addressed in the areas where lifts of the cask are discussed. Transport accidents with the cask are precluded by shipping entirely onsite and by the fact that the tractor trailer will not travel at speeds greater than 5 mph onsite. The transport path is such that the cask will be outside the protected area in the owner controlled area for a very short distance (approximately 200 yards). It is anticipated that the travel time from the Unit 1 Turbine Building area to the Unit 2 or Unit 3 Fuel Handling Building will be less than 1/2 hour. The transport speed of the cask will be less than five miles per hour, and other traffic in the area will be less than ten miles per hour. Station security will accompany the cask during transport between units. Health Physics will be monitoring the operation throughout the

Table 1

GE IF-300

7-Element/70-Ton Cask

Certificate of Compliance - Number 9001, expires May 30, 1990

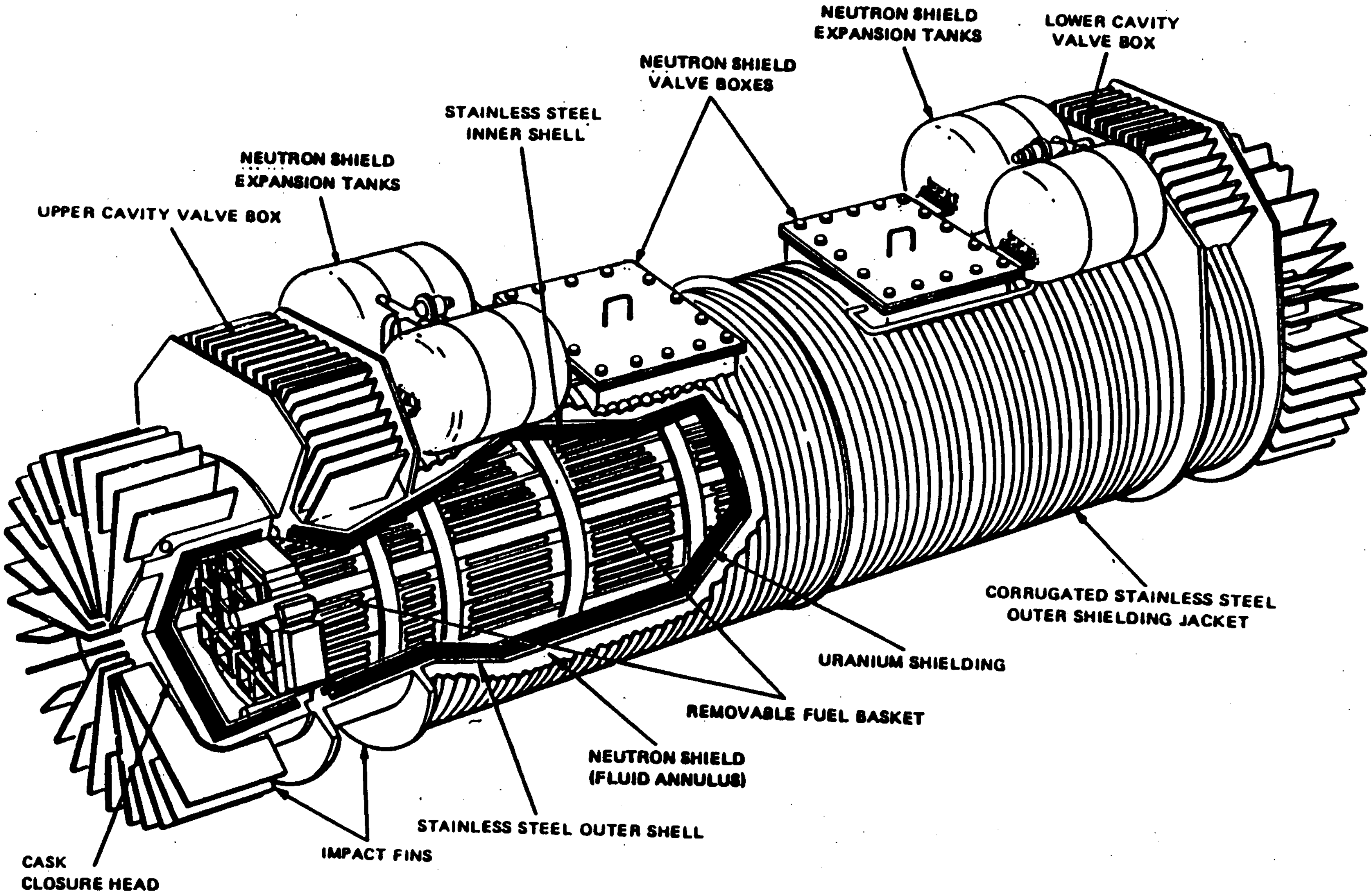
Currently being used to ship BWR fuel to the GE facility in Morris, Illinois.

	PWR Boundaries	SONGS 1 Fuel
Fuel form	Clad U02 pellets	Clad U02 pellets
Cladding material	Zr or SS	SS
Maximum initial U content/assembly, kg	465	425
Maximum initial U-235 enrichment, w/o	4.0	4.0
Maximum bundle cross section, in	8.75	7.63
Fuel pin array	14x14/15x15	14x14
Fuel diameter, in	0.380-0.460	.422
Fuel pin pitch range, in	0.502-0.582	.556
Maximum active fuel length, in	145	120
Maximum decay heat per package for dry shipment	40,000 BTU/hr	40,000 BTU/hr
Maximum decay heat per assembly for dry shipment	5,725 BTU/hr	5,725 BTU/hr
Maximum burnup per assembly for dry shipment	35,000 MWD/MTU	34,777 MWD/MTU

procedure to maintain ALARA considerations. This monitoring will ensure that neutron, beta and gamma radiation are within the limits ALARA Engineering has set for this program. Accidents which would result in exposure of the fuel in the cask to the environment are not considered credible. This is due to the fact the cask is licensed in accordance with 10 CFR 71 which requires qualification of the cask to design basis accident testing. This testing will ensure the cask will not be breached in the event of an accident during handling and shipment.

The Unit 1 FSA and March 21, 1975 submittal do not discuss spent fuel shipping casks, nor associated accidents. There were no discussions of cask handling accidents other than drop analysis.

The GE IF-300 cask is designed to sustain a 30' vertical drop onto an unyielding surface and maintain its integrity and protect the fuel. During the evolution of raising and lowering the cask between the vertical and horizontal position, the cask is positioned so the valve boxes are on top when horizontal, and the trunnions are on either side. Therefore, a drop during this evolution would be bounded by existing cask accident scenarios and the cask and contents would remain safe.



IF-300 Irradiated Fuel Shipping Cask

Figure 6

E. TURBINE GANTRY CRANE

The turbine gantry crane (Figure 7) will be used for the transshipment process at San Onofre Unit 1. The spent fuel cask will be lifted at the south end and the north end of the Turbine Building by the crane. The cask will travel between the north and south ends of the Turbine Building on the horizontal beam of the west A-frame leg of the turbine gantry crane. The west A-frame has been modified to securely hold the cask in place. The crane structure has been evaluated for Seismic Category B criteria while transporting the spent fuel cask because cask movement will only occur during a plant outage. Modifications to the crane structure are not required to support the 70 ton load.

The cask will be positioned on a platform built onto the horizontal beam of the turbine gantry crane west A-frame leg. A 6 foot square plate has been welded on top of the beam. The platform has a raised ring that will prevent the cask from sliding off the platform during crane movement. The top of the cask will also be restrained by cables attached to 1 1/4 inch thick lugs welded to the crane legs (Figure 8). The lugs will be used for attachment of the cask cable restraints between the crane and cask to prevent the lateral movement of the cask while on the support platform. The other end of the cables will be attached to the cask. A ladder has been installed on each leg of the A-frame to provide access to the lugs. The crane main hook will not be released during the cask movement along the turbine deck. Since the platform and lateral restraints are redundant to the crane hoist and hook, the spent fuel cask will be supported by two independent systems during its movement along the turbine deck. Therefore, failure of the crane hoisting mechanism will not result in a cask drop since the cask is restrained on the horizontal beam.

The crane modifications (platform and cable restraints) were evaluated for Seismic Category B requirements with a 100 ton cask load. The modifications are designed specifically to accommodate the 70 ton GE IF-300 cask. Since the modifications will become a permanent installation, they were also designed for Seismic Interaction B/A criteria (no cask load). Thus, this change will not impact any safety related equipment located in the vicinity of the crane travel path.

The turbine gantry crane type is a double leg, through-leg design manufactured by Harnischfeger. It is designed for a maximum load of 125 tons and is load tested for 100 tons. During the construction of the crane, all applicable regulations and codes were observed including the Specification and General Information for Standard Industrial Service, Electric Overhead Traveling Cranes of the Electric Overhead Crane Institute and the standards of the AISC. The crane support members are made of structural steel which conform to the Standard Specifications for Structural Steel for Bridges and Buildings, Serial Designation A36 of the American Society for Testing Materials.

The designed safety factor for the mechanical and structural components of the crane is 5 to 1 based on ultimate strength. The crane as a whole is designed so that for the design conditions of loading, the ratio of the righting moment to the overturning moment is not less than 2:1. The east leg is counter weighted so as to allow a 100-ton lift on the west cantilever and maintain this factor of safety against overturning. The wire ropes used on the main hoist are extra high strength steel ropes with wire cores. Their designed safety factor based on ultimate strength at their rated load is 5 to 1. The above factors apply at the rated 100-ton load on the main hoist.

The turbine gantry crane maintains two limit switches for lift heights. A discussion of the lift heights and the use of the impact limiter is provided in Section H, Decontamination Pad. The limit switches will be set for a maximum lift of the 70 ton cask above the decontamination pad of 27 inches and a maximum lift of 10 feet 6 inches above the turbine deck while placing the cask on the turbine gantry crane horizontal beam.

TURBINE GANTRY CRANE

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1

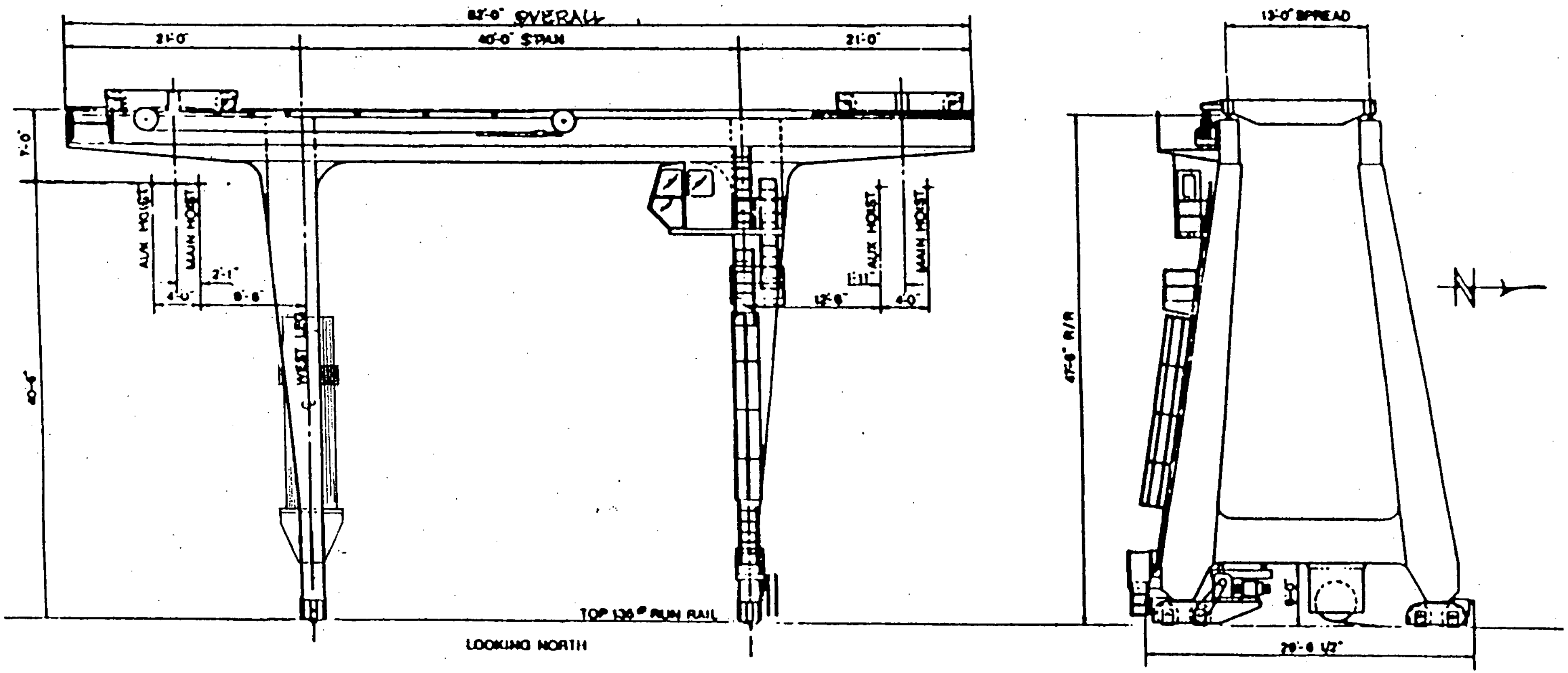
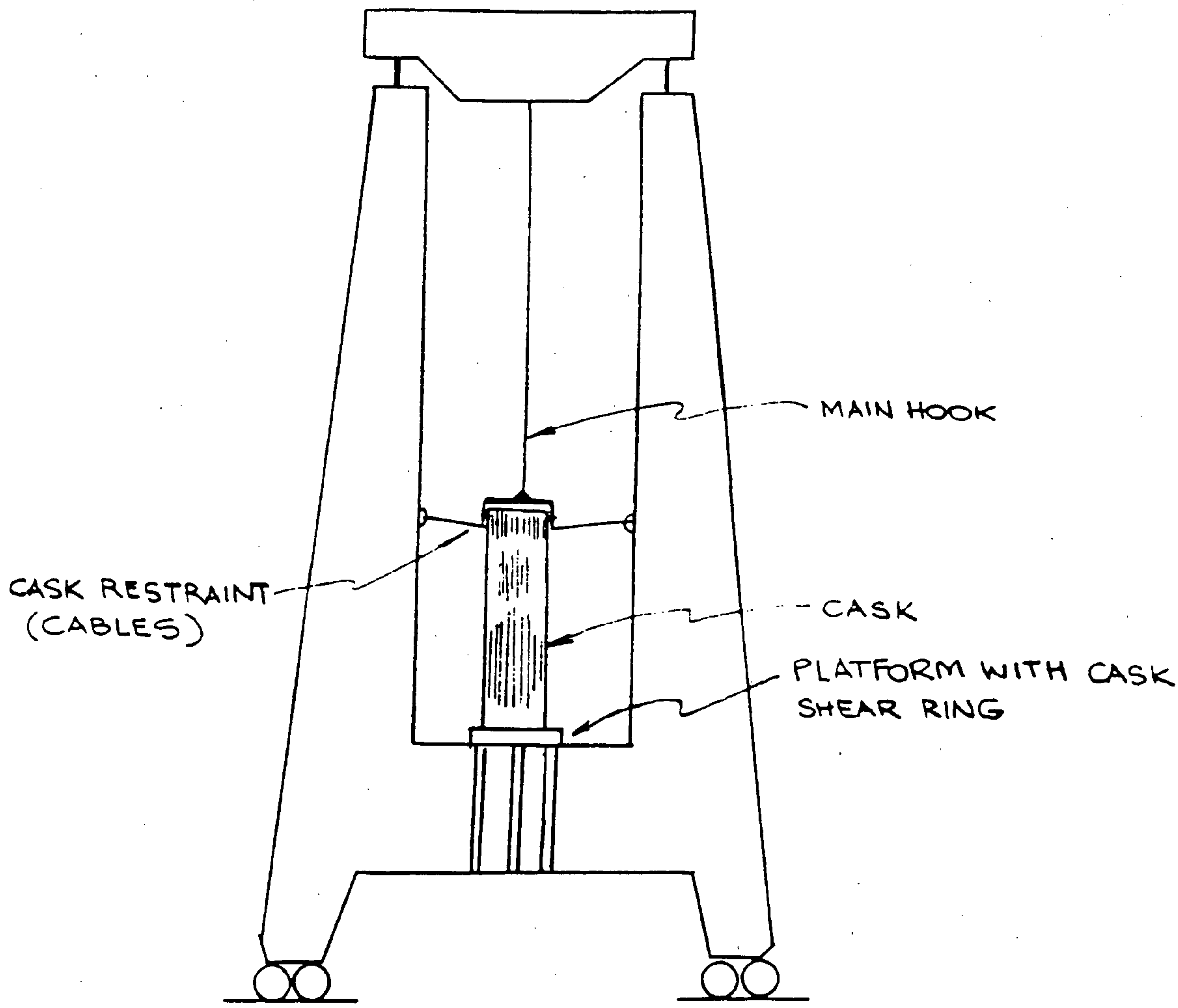


Figure 7



PROPOSED CASK PLATFORM ON SHEAR LEG

Figure 8

F. HEAVY LOADS HANDLING ISSUES

The NRC and SCE reviewed the "Heavy Loads" issues for San Onofre Unit 1 under the guidance of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The guidance contained in NUREG-0612 identified seven general guidelines to provide the defense-in-depth appropriate for the safe handling of heavy loads at nuclear power plants. The heavy load handling guidelines have been reviewed for San Onofre Unit 1, and the details of this review are documented in the Technical Evaluation Report (TER) and Safety Evaluation (SE) enclosed with the NRC letter dated November 5, 1985. The San Onofre Unit 1 spent fuel cask handling methodology was not reviewed in detail as part of this NRC evaluation due to the fact that spent fuel cask handling had previously been reviewed in 1975. Since that time, SCE has opted to use a larger spent fuel cask and has reevaluated the seven NUREG-0612 heavy load handling guidelines to assure that the larger spent fuel cask is handled in a manner consistent with the NUREG-0612 guidance.

The seven general NUREG-0612 guidelines are:

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 Specifically Designed)
Guideline 6 - Cranes (Inspection, Testing and Maintenance)
Guideline 7 - Crane Design

NUREG-0612 states that the 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. Spent fuel cask handling at San Onofre Unit 1 falls into the latter two categories. The review of the spent fuel cask handling methodology as it relates to the seven guidelines is as follows.

Guideline No. 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."

SCE Evaluation

The chosen load path for the new spent fuel cask will be the same as for the old cask, that is, directly out of the spent fuel pool, onto the decon pad, directly out of the Fuel Storage Building to the turbine gantry crane and down the turbine deck. This load path is chosen due to its direct nature, accessibility, and to follow, to the extent practical, structural members. Along the load path, equipment required for maintaining shutdown is located in the area of the decontamination pad. Between the crane West A-frame leg and the decontamination pad, cable trays containing circuits for equipment which may be used during shutdown are located below the turbine deck in the turbine building. The shutdown equipment which has circuits located in these cable trays include a residual heat removal pump, component cooling water pumps and a salt water cooling pump. It has been determined that without this equipment safe shutdown can be maintained with redundant equipment. This is discussed in Section H, Decontamination Pad. Spent fuel assemblies are not located within the load path for the spent fuel cask. The illustration of this load path will be included in the spent fuel cask handling procedure. Since any floor markings of the load path would be obscured by the cask during the lifting process, it is not appropriate to have any deck or floor markings, but consistent with the SE, TER and SCE's procedures, as a minimum a second person will be assigned to walk down the lifts and be in contact with the crane operator.

Guideline No. 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."

SCE Evaluation

As indicated in past SCE correspondence, there exists a heavy load handling program at San Onofre Unit 1 that addresses the general prerequisites, precautions, inspections and acceptance criteria required before movement of a heavy load. The procedure S0123-X-9, "Transshipment of Spent Fuel", covers the handling of spent fuel casks at San Onofre Unit 1 and this procedure will be developed to account for the new cask, the revised cask handling process, the safe load path, additional or different inspection requirements for the cask lift rig, and any other special precautions.

Guideline No. 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]."

SCE Evaluation

The crane operator training was reviewed as part of the TER and SE, therefore an additional review for the purposes of determining the acceptability of the spent fuel cask handling methodology is not necessary. The crane operators will be trained on any special requirements of the new spent fuel cask handling methodology.

Guideline No. 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 (4500kg) 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."

SCE Evaluation

The new spent fuel cask lifting device will meet the guidelines of ANSI N14.6-1978, "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500kg) or More for Nuclear Materials." As previously stated in SCE's August 29, 1985 letter to the NRC, after the initial 150% proof load test, SCE may opt to perform NDE in lieu of periodic (every 5 years) load testing. The choice will be dependent upon SCE's availability of test options. It is noted that the initial proof load test of the lifting device will be a 150% proof load test.

Regarding the Guideline No. 4 discussion of the stress design factor stated in Section 3.2.1.1 of ANSI N14.6 being based upon the combined maximum static and dynamic loads that could be imparted on the handling device based upon the characteristics of the crane which will be used, refer to the information discussed under the NRC review of Guideline No. 5 in the TER. The TER indicates that the dynamic load induced by the San Onofre Unit 1 turbine gantry crane is sufficiently small so as to remove it from consideration. This is based upon the already required 3 to 1 maximum yield strength to weight ratio and 5 to 1 ultimate strength to weight ratio required by Section 3.2.1 1 of ANSI N14.6-1978, and the consideration that the maximum expected dynamic load induced by the turbine gantry crane is only 3.7% of the static load. Therefore, only the weight (static load) of the load and intervening components of the spent fuel cask lift rig need be considered.

Guideline No. 5

"Lifting devices that are not specifically 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."

SCE Evaluation

Since Guideline No. 4 relating to specifically designed lifting devices applies to the new spent fuel cask handling methodology, this guideline does not apply and no additional review is required.

Guideline No. 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)."

SCE Evaluation

The crane inspection, testing and maintenance was reviewed as part of the TER and SE and an additional review for the purposes of determining the acceptability of the spent fuel cask handling methodology is not necessary. The new spent fuel cask is a lesser weight (70 tons) than the existing largest load (108 tons), so the existing proof load tests of the turbine gantry crane are acceptable. All other inspection, testing and maintenance issues associated with the turbine gantry crane remain applicable to the new spent fuel cask handling methodology. Handling of the cask and use of the turbine gantry crane at San Onofre Unit 1 and the cask handling crane at San Onofre Units 2 and 3 will be controlled by SO1-I-7.27, "Turbine Gantry Crane Checkout and Operation", and SO123-I-1.13, "Cranes, Rigging, and Lifting Controls."

Guideline No. 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."

SCE Evaluation

The turbine gantry crane design issues were addressed in SCE's submittals of April 1, 1982 and October 21, 1982. These submittals provided a point by point comparison of the applicable ANSI B 30.2-1976 and CMAA-70 design criteria to the turbine gantry crane design. The information in these submittals was reviewed by the NRC in the TER and SER, and found to be acceptable. Since the design allowables and strength ratings are based upon the maximum design load of 108 tons, they remain applicable to handling a spent fuel cask of 100 tons or less, and therefore no further review of the turbine gantry crane is necessary.

The above evaluations of each of the seven NUREG-0612 guidelines as they relate to the new spent fuel cask handling methodology provide sufficient assurance that the heavy loads issues will be appropriately addressed. Accordingly, as a result of heavy load handling issues relating to the new spent fuel cask handling methodology, appropriate revisions will be made to existing San Onofre Unit 1 crane and cask handling procedures.

G. TURBINE BUILDING

The turbine building is located immediately south of the containment. It is composed of five distinct structures, the north turbine deck extension, south turbine deck extension, the west and east reheater decks and the turbine pedestal (See Figure 3 and Figure 9).

The San Onofre Unit 1 Turbine Building has been reevaluated and upgraded to withstand a .67g modified Housner seismic event as part of the Systematic Evaluation Program. This reevaluation included the effects of the turbine gantry crane on the dynamic response of the structure. The turbine gantry crane was included in the reevaluation analysis. No lifted loads were assumed in the analyses because the crane is not normally or regularly used during plant operation. Additionally, the Turbine Building and the safety related systems within the structure were qualified for the condition of the crane parked on the south extension during plant operation. The air pallet system was specifically not included in the scope of the seismic reevaluation of the turbine building. This was agreed to with the NRC since the movement of spent fuel with the air pallet system was not considered a normal operating load. (The Seismic Reevaluation Program reanalyzed structures, systems and components for seismic loads in combination with "normal operating loads.") As part of the use of the air pallet system, the turbine gantry crane was used to make lifts of the spent fuel cask at the south and north ends of the turbine building, therefore, this use of the turbine gantry crane was also not included in the scope of the seismic reevaluation of the turbine building. Although this agreement with the NRC regarding the turbine gantry crane was not explicitly documented, it is understood that the crane is required when using the air pallet. The turbine gantry crane is also used for performing other maintenance activities which require the crane, such as work on the turbine, that are not considered normal plant loads.

Additional evaluations were performed to determine the load on the crane that would be seismically acceptable. These evaluations concluded that acceptable seismic response for structure and piping would occur with the turbine gantry crane located on the turbine pedestal or the south turbine deck extension with a load up to 35 tons, and that unacceptable seismic response would occur with the turbine gantry crane located on the north turbine deck extension (with or without a load) due to the potential affects of seismic induced loads on safety-related piping systems located under the north turbine deck extension. The turbine gantry crane can be located on the north turbine deck extension with a 10 ton load when there is not a concern about piping functionality in this area (e.g. during Modes 5 and 6).

Since the seismic design of the turbine building limits the location and load use of the turbine gantry crane for continuous use (i.e., as a normal operating load), deviations from these conditions are permitted for only very limited time periods. To ensure this, the turbine gantry crane will be allowed on the turbine building with loads in excess of the seismic evaluated loads for a total accumulated time of no more than 1% per year. This comes to approximately 87 hours for a year.

The 1% time is recorded when:

A. The crane is on the north extension with or without a load during plant operation (Modes 1-4).

B. The crane is on the north extension during a plant outage (Modes 5&6), with a load exceeding 10 tons.

C. The crane is south of the north extension with a load greater than 35 tons during plant operation (Modes 1-4).

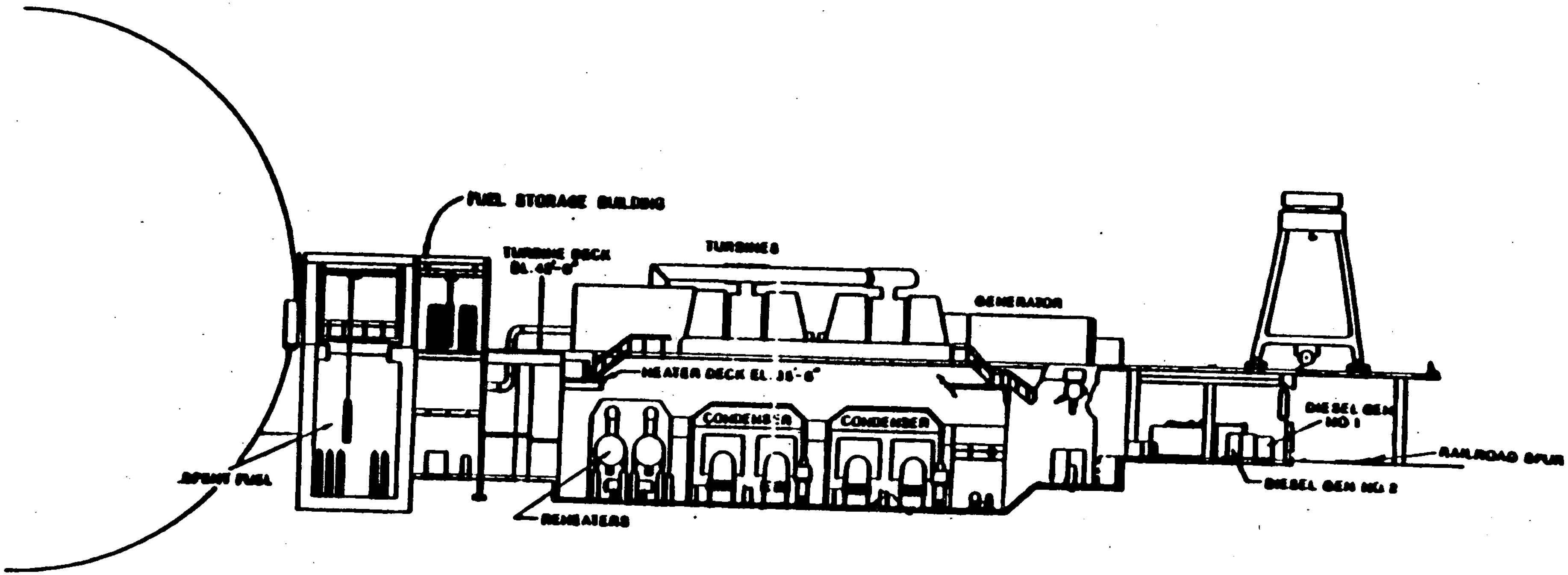
The purpose of using a 1% time limit is to minimize the possibility of having a seismic event concurrent with the turbine gantry crane being located in a position other than that found acceptable in the seismic evaluation.

During plant operation the turbine gantry crane is not normally used. During shutdowns and refuelings the turbine gantry crane is used in support of the outage. Thus the 87 hour limit will be used almost entirely during plant shutdown. Beginning with the next scheduled plant shutdown, transshipment of spent fuel will be performed on a regular basis during scheduled shutdowns such as refueling and midcycle outages. Therefore it is expected that the majority of the crane use will be associated with spent fuel transshipment during plant shutdown (Modes 5 and 6).

The spent fuel cask will be transported on the turbine gantry crane between the north and south ends of the Turbine Building. Movement of the spent fuel cask along the Turbine Building was previously done using the air pallet. This system was approved for use by the NRC and documented in their January 15, 1976 SER. Experience with the air pallet at Unit 1 has demonstrated that it is inefficient and unreliable.

Since the cask is restrained on the turbine gantry crane west A-frame horizontal beam and simultaneously supported by the crane hoist and hook, a drop of the cask during this movement is not considered credible. The cask will be lifted by the crane beyond the south end of the turbine building. The height from plant grade onto the crane leg will be approximately 33 feet. Since the tractor trailer and cask skid will be under the cask during this lift, the lift height will be less than 30 feet which is the design basis for the cask. The height of the trailer is a minimum of 3 feet 1 inch and the cask skid is located on the trailer above this height. They provide a yielding surface that is less critical than the cask drop onto an unyielding surface. There is no safety-related equipment located in this area or underground. On the north end, the spent fuel cask will be lifted in the area of the decontamination pad. Precautions associated with that lift are discussed in Section H, Decontamination Pad.

SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1



SECTION VIEW

Figure 9

H. DECONTAMINATION PAD

The decontamination pad is located inside the Fuel Storage Building adjacent to the spent fuel pool. The turbine gantry crane will be moved directly opposite the decontamination pad with the cask located in the west A-frame leg. The crane will remove the cask and place it on the decontamination pad. Following loading of the cask in the spent fuel pool area and decontamination, the cask will be lifted from the decontamination pad and placed on the west A-frame.

The decontamination pad consists of a 9" thick reinforced concrete slab with approximately 9" concrete topping over the existing liner plate. The pad is supported by steel beams. The spent fuel cask will be placed on the decontamination pad during cask handling and for decontamination. The decontamination pad can withstand a DBE event with a 70 ton cask on it, provided that the cask is placed on the pad directly over the location of two W 24x94 beams. When the cask is on the decon pad, it will be over two W 24x94 beams in accordance with the procedures. With the cask on the decon pad, the entire structure can withstand the .67g modified Housner seismic event without failure.

As part of the lifting procedure for the spent fuel cask over the decon pad area, an impact limiter will be used. The impact limiter will be located under the cask as it is removed and lowered from the cask platform on the crane leg. The purpose of using the impact limiter is to ensure the structural integrity of the north turbine deck extension and decon pad and preclude damage to cables located below the lift area in the unlikely event of a spent fuel cask drop. Calculations were performed to check that the ductility ratios are less than 10, the impact forces are less than the plastic resisting forces of structural elements and the slab thickness will preclude perforation and spalling.

Four vertical cask drops were postulated on the decontamination pad and on the north turbine deck extension.

A. The cask is postulated to drop from a height of 10'-6" on the north turbine deck extension and the decontamination pad when lifted on and off the shear beam of the turbine gantry crane west leg. During this lift, the four foot high section of the impact limiter is directly under the cask. The impact limiter will reduce the impact force on the structures.

B. The cask is postulated to drop from a height of 4'-6" on the decontamination pad with the two foot high section of the impact limiter under the cask.

C. The cask is postulated to drop from a height of 2'-3" on the decontamination pad (over two W 24x94 beams) when the impact limiter is completely removed.

D. The cask is postulated to drop from a height of 6 inches when the cask is moved by the gantry crane between the cask laydown area of the pool and the decontamination pad.

The 70 ton cask will not perforate the north turbine deck extension or the decontamination pad, or cause spalling if dropped for all postulated heights. In case C, the concrete slab of the decontamination pad will crack, but cracking will not cause concrete spalling. The ductility of the steel beams supporting the pad is within acceptable limits. The impact limiter, made out of polyurethane foam, will be installed on the north turbine deck extension and the decontamination pad to reduce the impact load on the structural members to an acceptable level (the ductility of steel beams is within allowable limits).

The impact limiter configuration will be a two-tiered box that has heights of 4 feet and 2 feet. The width of the box is 6 feet and the length is 12 feet. The box will be constructed with stainless steel and filled with polyurethane foam. The foam density is approximately 5 pounds per cubic foot and has an average crush strength of 150 psi. Angles will be welded to the sides of the box for stiffening and handling. Four wheels will be provided to facilitate the movement of the box on the turbine deck. The 4 foot high section of the impact limiter will be located under the cask during the maximum lift height of 10 feet 6 inches. The 2 foot high section of the impact limiter will be located under the cask for lifts up to 4 feet 6 inches. The maximum lift height over the decon pad without an impact limiter is 2 feet 3 inches when the 70 ton cask is placed directly over the location of two floor beams. The crane limit switch will be used to prevent lifting the cask above the 2 feet 3 inch height over the decon pad when the impact limiter is not in place. Since the polyurethane foam is completely encapsulated with stainless steel plates, there will be no change in fire load in any area due to the impact limiter.

The procedure for removing the spent fuel cask from the crane leg will be to place the 4 foot high section of the box adjacent to the crane leg. The cask is lifted off the crane leg and positioned directly over the 4 foot high section of the box. The cask is lowered to within 6 inches of the top of the box. The box is then pulled east under the crane leg so that the 2 foot high section is over the decon pad. The cask is moved horizontally west and lowered over the 2 foot high section of the box. The box is pulled east again under the crane leg to remove the box from under the cask. The cask is then lowered to the decon pad. Placing the cask onto the crane leg will be done in the reverse order.

The surrounding areas of the decon pad during transshipment are as follow:

A. North - The south wall of the cask handling area of the spent fuel storage pool.

B. South - Exterior reinforced masonry wall and decon scaffolding.

C. East - The turbine gantry crane leg.

D. West - Reinforced masonry wall of new fuel storage and decon scaffolding.

Significant damage in the event of a cask drop into these areas is only expected on the masonry walls and decon scaffolding. Local damage to the masonry walls would not have an adverse impact on the Fuel Storage Building because the roof is supported by an independent steel framing. Loose concrete blocks will not impact the new fuel racks or any other safety related components because these items are far enough away from the potentially impacted walls.

I. SPENT FUEL POOL

The spent fuel pool is located in the Fuel Storage Building and has a rectangular geometry which is divided by interior walls into three areas. The three areas are the spent fuel storage area, the fuel transfer area, and the spent fuel cask handling area. The side walls, bottom slab, and interior walls are reinforced concrete of thickness 4 feet 0 inches (min.), 4 feet 9 inches (min.), and 2 feet 6 inches, respectively. There is a 0.120 inch stainless steel membrane liner on the pool bottom and a 0.06 inch stainless steel membrane liner on all sides of the pool. A 2 foot 6 inch thick partition separates the spent fuel storage area and the fuel transfer and cask handling areas.

Nominal pool water depth is 39 feet in the cask handling area with the pool surface at plant elevation 41 feet. The water depth is monitored with high level (plant elevation 41 feet) and low level (plant elevation 40 feet 6 inches) control room annunciation. Minimum water shielding above the stored fuel is 25 feet 3 inches.

Makeup water for the spent fuel pool can be provided via the spent fuel cooling water return line by either the refueling water filter pump (80 gpm) from the refueling water storage tank (240,000 gallons) or the primary plant makeup pumps (2 at 100 gpm each) from the primary plant makeup tank (150,000 gallons). In addition, the fire protection water system could also be utilized to provide makeup water to the spent fuel pool. The fire protection water pumps (2 at 1000 gpm each) could provide makeup water from the service water reservoir (3,000,000 gallons) or the circulating water system (through the 1000 gpm screen wash pumps) via hydrants located at strategic points in the plant and fire hoses (100 gpm each). Makeup water to the spent fuel pool could also be provided by gravity flow from the condensate storage tank (240,000 gallons) through the fill/drain connection with fire hoses. Plant personnel operate makeup and drainage equipment as necessary to maintain the pool water level within annunciation limits. Any leakage from the spent fuel pool can be detected by accumulation of water in the leak detection monitor sump located at plant grade, outside and adjacent to the north wall of the Fuel Storage Building.

There is no change in the method for handling the spent fuel cask, fuel assemblies or pool water level in the spent fuel pool at Unit 1. Spent fuel cask handling in the spent fuel pool is performed by the turbine gantry crane. This load handling is limited to the east end of the spent fuel pool away from the spent fuel racks. The spent fuel pool area and the cask handling area are separated by a 2 foot 6 inch thick concrete wall. Due to the turbine gantry crane travel limitations, the crane cannot access the spent fuel pool area. Fuel element handling is performed by the fuel handling crane. The spent fuel cask head which weighs approximately 5,000 pounds will be lifted over spent fuel in the cask when it is placed on the cask. This load path is necessary in order to place the cask head back on the cask. This is the same as lifting the reactor vessel head over the fuel in the reactor vessel when it is necessary to remove the head or place it on the vessel. Furthermore, as indicated in the discussion on the spent fuel cask, the geometry of the cask and head will prevent the head from damaging the fuel in the cask in the event the head was dropped.

In order to prevent damage to the liner in the cask handling area, a 2 1/4 inch stainless steel plate has been installed at the bottom of the cask handling area. The steel plate will minimize the potential for damage to the liner due to cask handling and evenly distributes the load of the cask over the liner. The plate has been sized to provide protection to the liner and concrete basemat in the unlikely event of a vertical cask drop in the cask handling area. As a result of the postulated cask drop, it is expected that the concrete basemat will crack under the installed plate and liner. However, no leakage to the environment will occur even in the presence of existing liner leakage because there is a waterproof membrane between the concrete and soil. There will be local yielding of the concrete but this does not affect the overall structural capacity of the spent fuel pool and Fuel Storage Building because the cracking of concrete is localized only to the cask handling pool, which is a small percentage of the total basemat area.

Although the cask drop into the pool is greater than 30 feet (distance is 40 feet 3 3/4 inches maximum), the water will retard the cask velocity such that the drop is equivalent to a 30 foot drop. Since the plate will be a permanent installation, it was verified that the plate will not slide during a DBE and there is no adverse impact on the existing liner plate. The trapezoidal plate has been fabricated with four lifting lugs that are designed to rotate. The lugs are to be flush with the plate when installed in the cask handling area of the pool. The plate was brought into the Fuel Storage Building in the vertical position with the turbine gantry crane and then after rerigging, lowered into the cask handling area of the spent fuel pool. The plate clears the wall liner plate by at least 6 inches on all sides to prevent any damage to the pool liner. The sides and the corners of the plate have been chamfered for the liner protection.

J. TRANSPORT BETWEEN UNIT 1 AND UNITS 2 AND 3

The spent fuel cask will be moved on a tractor trailer from the Unit 1 south turbine deck extension to the Units 2 and 3 Fuel Handling Buildings. The tractor trailer will exit the Protected Area at the Unit 1 railroad gate. It will be escorted by Security and Health Physics while in the Owner Controlled Area. The vehicle and cask will travel at a speed of 5 miles per hour. It will reenter the Protected Area through the railroad gate at Unit 2 east of the Diesel Generator Building. It will then move south towards the Unit 2 or 3 Fuel Handling Building loading bay (see Figure 4).

When moving from the Unit 1 south turbine deck extension through the protected area the tractor trailer does not travel over any underground safety-related equipment, components or systems. When traversing the Owner Controlled Area the trailer passes over a communication duct bank. The top of the concrete duct bank which carries cable for the Public Address system is located 7'-5" below grade. The duct bank is buried sufficiently to be safe from the tractor trailer load. At Units 2 and 3 there is no safety related equipment, component or system located underground in the path of the tractor trailer. The tractor trailer will travel over the underground fire water system which is important to safety. The fire water piping will not be adversely affected because the tractor trailer wheel loads are less than the design loads.

K. SAN ONOFRE UNITS 2 AND 3

The San Onofre Units 2 and 3 Spent Fuel Pools have been evaluated for storage of the San Onofre Unit 1 spent fuel. This is described in Section 9.1.2, Spent Fuel Storage, of the San Onofre Units 2 and 3 FSAR where it is stated:

> "The Unit 1 fuel assembly will be stored without the use of any spacers or adapters in any of the spent fuel rack locations. The weight of the Unit 1 fuel assembly is less and its center of gravity is located at a lower elevation than that of a Unit 2 or 3 fuel assembly. These effects will decrease the rack stresses imposed by Unit 1 fuel when compared with Unit 2 or 3 fuel."

During the evaluation of the reracking of San Onofre Units 2 and 3, the storage of Unit 1 spent fuel will be included.

L. CONCLUSION

The San Onofre Unit 1 spent fuel pool will be essentially full following the Cycle X refueling outage in late 1988. Unless the spent fuel is shipped to the adjacent San Onofre Units 2 and 3 spent fuel pools, operation of the unit will cease in 1990. It is proposed that transshipping of the spent fuel should begin as soon as possible.

In order to transship the spent fuel the turbine gantry crane at San Onofre Unit 1 will be used to lift and transport the spent fuel shipping cask. A procedure has been developed for the transshipment methodology, SO123-X, Transshipment of Spent Fuel. Procedures SO123-I-1.13, Turbine Gantry Crane Checkout and Operation, and SO1-I-7.27, Cranes, Rigging, and Lifting Controls will be used to control the cask, lift rigs, lifts and inspections. With all the necessary procedural precautions taken, the movement and lift of the spent fuel cask will be conducted in a safe manner.

The seismic design of the turbine building did not include the turbine gantry crane with a spent fuel cask located on the north turbine deck extension. In order to minimize the possibility of a seismic event concurrent with the crane on the turbine building, the use of the turbine gantry crane with a load in excess of the turbine building design is being limited to 1% (or 87 hours) per year. This limit provides assurance that the cask will be on the crane for a minimum amount of time while the crane is on the north turbine building extension. In addition all transshipments will only be performed during Unit 1 plant shutdowns (Modes 5 or 6).

Lifts of the cask will occur in the Fuel Storage Building over the north and south turbine deck extensions, decontamination pad and the cask handling pool. These lifts were evaluated and a drop during these lifts is not considered probable due to the procedural controls that will be implemented. In the unlikely event that a cask is dropped lift height restrictions and an impact limiter will be used to ensure the cask will not penetrate the decon pad and a stainless steel plate has been installed in the spent fuel pool to ensure its integrity is maintained.

Therefore, it can be concluded that the transshipment of spent fuel from San Onofre Unit 1 will be conducted in a safe and reliable manner. With the NRC approval of this methodology transshipment of spent fuel will begin as soon as possible.

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