SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

J. L. Rainsberry
Manager, Plant Licensing

July 11, 1997

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Gentlemen:

SUBJECT: **Docket Nos. 50-361 and 50-362**
Mechanical Nozzle Seal Assembly Code Replacement
Request for Relief from 10 CFR 50.55a
San Onofre Nuclear Generating Station, Units 2 & 3

By this letter, in accordance with 10 CFR 50.55a(g)(5)(iii), Southern California Edison (Edison) submits the enclosed request for relief from ASME Code, Section III requirements in 10 CFR 50.55(a)(3) to use the Mechanical Nozzle Seal Assembly (MNSA) as an Alternate ASME Code Replacement at the San Onofre Nuclear Generating Station Units 2 and 3. The MNSA was designed and constructed by Asea Brown Boveri/Combustion Engineering (ABB CE) as a Class 1 component in accordance with the ASME Boiler & Pressure Vessel Code, Section III. Relief is requested because use of the MNSA is not addressed directly in the ASME Code. San Onofre Units 2 and 3 began their second ten-year interval on April 1, 1994, under the 1989 Edition of the ASME Code, Section XI, with no Addenda.

NRC approval is requested to allow for use of the MNSA at San Onofre Units 2 and 3 for pressurizer and reactor coolant system piping instrument nozzle penetrations which have an active leak or may be susceptible to future leaking. When installed, the MNSA will prevent leakage from the instrument nozzle penetration. Although there are no active leaks currently identified where the MNSA would be used, if such leaks should develop Edison may be requesting expedited NRC approval of this relief request. Based on this, we are requesting NRC review of this request as soon as practical.

A047

San Onofre Nuclear Generating Station
P. O. Box 128
San Clemente, CA 92674-0128
714-368-7420

If you have any questions, please call me.

Sincerely,

Enclosure

cc: E. W. Merschoff, Regional Administrator, NRC Region IV
K. E. Perkins, Jr., Director, Walnut Creek Field Office, NRC Region IV
J. A. Sloan, NRC Senior Resident Inspector, San Onofre Units 2 & 3
M. B. Fields, NRC Project Manager, San Onofre Units 2 and 3

Enclosure

RELIEF REQUEST 3.4.2
San Onofre Nuclear Generating Station
Unit 2 (Docket 50-361) and Unit 3 (Docket 50-362)

SYSTEM: Reactor Coolant System (RCS)

COMPONENT/AREA: Instrument Nozzles, Piping, Pressurizer

CODE CLASS: 1

CODE APPLICABILITY: ASME Code Section XI, IWA-7000 Replacement, 1989 Edition with no Addenda

DESCRIPTION Use of the Mechanical Nozzle Seal Assembly (MNSA) Alternate Method for Replacing Reactor Coolant System Instrument Nozzles

CODE REQUIREMENTS Per Section XI, IWA 7200, any items used for replacement shall meet the original Construction Code requirements. Use of a later edition of the Construction Code is allowed provided that a Code date reconciliation is performed to show that the replacement item meets the design requirements.

Components which are part of the reactor coolant pressure boundary must meet the requirements for Class 1 components in Section III of the ASME Boiler and Pressure Vessel Code as stated in 10 CFR 50.55a(c)(1).

REQUESTED RELIEF Stress Corrosion Cracking has been experienced in the Inconel 600 nozzles at many nuclear plants. The typical repair of these nozzles involves external weld repairs or half nozzle replacements. The MNSA would be used as an alternative replacement to repair leaks or where there may be susceptibility to leaking in RCS nozzles and piping.

BASIS FOR RELIEF

APPLICATION

The Mechanical Nozzle Seal Assembly (MNSA) provides the leakage sealing function plus structural integrity of a nozzle attachment weld in locations (e.g., bottom of the pressurizer) where the typical repair and replacement techniques may be difficult or impractical (proposed installation locations are shown on Figure 1). Installation of the MNSA will also avoid the need for higher risk plant operations (i.e., reduced inventory or core offloads for repair or replacement of RCS nozzles). In addition, the MNSA will shorten the repair or replacement time significantly and thereby reduce radiation exposure to workers.

A radiation exposure savings from use of the MNSA instead of the present nozzle repair/replacement method is expected to be about 1.0 to 1.8 person-rem per nozzle on the RCS hot and cold legs and about 3 to 4 person-rem per nozzle on the pressurizer.

BACKGROUND

Depending on the intended function, the initial Reactor Coolant System (RCS) instrument nozzles were designed and installed as either a one piece nozzle made of 100% Inconel 600 or Inconel 600 with a SA-479, type 316L stainless steel material safe end when welded end connections were intended. Both nozzle types are welded with a J-Groove weld (Inconel to Inconel) on the inside of the RCS piping. An identical weld configuration is also provided for instrument nozzles located on the pressurizer. The Inconel 600 J-Groove weld provides the primary system pressure boundary. Details of existing nozzles are shown in Figures 2-4.

DESCRIPTION

The MNSA is a mechanical device that acts as a complete replacement of the "J" weld between an Inconel 600 instrument nozzle and the pressurizer/RCS pipe, to prevent leakage from cracks caused by Stress Corrosion Cracking. It also acts to restrain the instrument nozzle from ejecting if the "J" weld completely fails (360 degree circumferential crack). Therefore, the MNSA replaces both the sealing and structural integrity functions of the existing weld. The MNSA is designed to seal against a pressure of 2500 psi at a temperature of 700°F.

The seal is created by compressing the Grafoil Split Packing against the nozzles at the nozzle to RCS OD interface. The compression collar transmits the load to the Grafoil split packing, while the packing is retained within the seal retainer and compression collar. The compressive load is generated when the hex head bolts are threaded into the RCS piping or pressurizer and torqued. The installation of the hex head bolts does not violate the primary system pressure boundary. The compressive load is then transmitted to the compression collar through the upper flange. No additional load is imparted on the existing J-weld by application of the MNSA. (See Figures 5 - 7).

The nozzle is held from ejecting by the top plate which is anchored to the upper flanges through tie rods, and secured in place by hex nuts. The top plate is installed with a small gap between the nozzle and its bottom surface. Only if the nozzle to RCS weld completely fails will the top plate act as a restraint; otherwise, it is subject to no load during operating conditions.

DEGRADATION MECHANISMS CONSIDERED

Degradation mechanisms were considered and addressed in the design of the MNSA as follows:

a. Erosion/Corrosion of Low Allow Steel Components

A through-wall crack in the nozzle could be a source of erosion/corrosion. However, the borated water will stagnate in the annulus between the Inconel 600 nozzle and the low alloy steel component. In the absence of a replenishment mechanism, the boric acid will be consumed and the pH level will decrease the corrosion rate, and eventually the process will be stopped.

b. "J"-Weld Cracking

"J"-Weld cracking is fully addressed by the MNSA design, since the MNSA takes over the sealing and anti-ejection functions if the weld fails. The MNSA design qualification test runs included simulated partial cracks and complete 360° cracks in the nozzles.

c. Grafoil Seal Corrosion

The Grafoil seal material, Grade GTJ, used in nuclear applications is composed of 99.5% graphite, with the remaining 0.5% made up of ash, halides, and sulfur (concerns for corrosion of low alloy steel). The Grafoil seal itself is chemically resistant to attack from nearly all organic and inorganic fluids, and is very resistant to borated water.

Galvanic corrosion occurs as the result of an electrochemical reaction between the graphite (Grafoil Seal, cathodic material) and metal (Low Alloy Steel, anodic material), in the presence of an electrically conductive fluid (water). The combination of Grafoil and the pipe or pressurizer material has a high potential for galvanic corrosion in the presence of water. However, the borated water is stopped by the seal. Since further leakage is prevented from entering the annulus, the Grafoil Seal will not continue to be wetted. Therefore, the corrosive effect will not continue and the seal will maintain its integrity.

d. Hardware Corrosion

All the components of the MNSA are fabricated from corrosion resistant materials. Most components are 300 series stainless steel. Fasteners and tie rods are made from SA-453 Grade 660 (a high temperature, high alloy bolting material).

CONFORMANCE TO ASME CODE

The original construction code for the pressurizer is Section III, 1971 Edition with Summer 1971 Addenda and Code Case 1361-2 and for piping is Section III, 1971 Edition, Summer 1972 Addenda.

Items (material, parts, and components) used for replacement (per Section IWA-7200) shall meet the original Construction Code and existing design requirements. The original Construction Code also allows replacement items to be constructed or fabricated to a later Code edition provided a reconciliation is performed on the differences between the original and current code that affect the design basis of the replacement items.

There are 3 Code activities that need to be addressed as the basis for justification of the MNSA:

1. Design and Fabrication
2. Installation
3. Inspection

<u>1. Design and Fabrication</u>

Section XI, IWA-7210 (Code Applicability) provides for the design and fabrication of a replacement item to the requirements of Section III.

1.1 IWA-7210 Compliance

IWA-7210(a) requires replacement of items in accordance with the Edition and Addenda of Section XI as stated in the Owner's Program. The 1989 Edition with no Addenda is specified, and the installation and inspection of the MNSA complies, as described in 1.2 and 1.3 below. IWA-7210(c) permits construction of the replacement item to editions of the Construction Code later than that used for original construction, provided (1) the requirements affecting design, fabrication, and examination are reconciled with the original requirements, (2) mechanical interfaces are compatible, and 3) materials are suitable. MNSA complies with 1) above. The MNSA is built to a later edition of the ASME Code: Section III, 1989 Edition, no Addenda. The ABB CE design report for the MNSA includes a Construction Code date reconciliation to show compliance. Mechanical interfaces (2) have been considered as shown by Figures 5-7. Material suitability (3) has been considered under "Degradation Mechanisms" above.

1.2 Vessel Application

For design and fabrication of an MNSA for a pressurizer instrument nozzle, the rules of Section III, NB-3300 (Vessel Design) are followed. The reasoning is because the MNSA acts in much the same way as the Reactor Vessel (RV) Head. The RV Head seals against the RCS pressure using a gasket, and the force required to seat that gasket is provided by preloading threaded fasteners (RV studs). Similarly, the MNSA seals against RCS pressure using the Grafoil packing, and the hex bolts generate the sealing load. It was determined by analysis that the requirements of the Code (NB-3200) were satisfied by the design of the MNSA.

1.3 Piping Application

Section III, NB-3600 (Piping Design) rules were followed for the design and fabrication of the MNSA for an RCS Pipe instrument nozzle. Specifically, NB-3670 (Special Piping Requirements) permits the use of Sleeve Coupled and Other Patented Joints (NB-3671.7) and gives requirements for mechanical joints "... for which no standards exist". NB-3600 specifies the design of this mechanical joint must: a) prevent separation of the joint under all Service Loadings; b) be accessible for maintenance, removal, and replacement after service; c) a prototype must be subjected to performance tests to determine the safety of the joint under simulated service conditions, or the joint design shall be in accordance with the rules of NB-3200.

1.4 NB-3600 Compliance: NB-3671.1 Qualification Program

Test Program

Enveloping temperature, pressure, and seismic profiles applicable to San Onofre were used in the testing qualification of the device.

Three MNSA designs were subjected to a qualification test program. These were:

1. Bottom Pressurizer MNSA
2. Side Pressurizer RTD MNSA
3. Hot Leg RTD MNSA

Each design uses the same sealing principle; however, they are different in the size and shape of components to ensure the seal interfaces properly with the specific nozzle and shell geometry. A prototype of each of the three configurations was manufactured and installed on nozzles simulating the as-built San Onofre configuration.

The qualification test program for each MNSA design consisted of:

1. A single hydrostatic test to 3175 (± 50) psi at ambient temperature.

2. Three thermal cycle tests to 650°F while pressurized to 2500 psi.

3. Seismic testing for five Operating Basis Earthquake events and one Safe Shutdown Earthquake event. The test spectra enveloped the San Onofre seismic spectra. During seismic testing, all specimens were maintained at a pressure of 3175 ± 50 psi.

4. As part of the thermal cycle testing (at 650°F and 2500 psi) a special effects test was performed in which a MNSA was installed around a nozzle with a simulated 360° crack. The system was pressurized until the nozzle slipped and contacted the anti-ejection device.

Test Program Results

<u>1. Prevention of Separation of the Joint Under All Service Loadings.</u>

1.1 Summary of Results

The MNSA is fastened to the pressurizer/pipe with bolts which are torqued to generate a preload value higher than the load created by both the system pressure and the impact load which would be imposed if the existing nozzle weld should fail completely.

1.2 Conclusion Concerning Joint Separation

Testing demonstrated that the joint maintained both mechanical and seal integrity under all service conditions. All specimens remained leak tight and no mechanical damage occurred to any of the components.

2. Accessibility for Maintenance, Removal and Replacement

2.1 Description

Each MNSA is designed to be installed onto the external surface of the pressurizer/pipe, around the existing instrument nozzle, in accordance with installation procedures. In some of these locations, the insulation must be removed to permit access. Special tools are required for the one-time thread machining in the component. The MNSA can be installed without completely depressurizing or draining below the nozzle in question. Once installed, no maintenance of the MNSA is planned unless leakage is observed during the course of routine inspections.

2.2 Conclusion, Accessibility, Removal and Replacement

MNSA is accessible for maintenance, removal, and replacement as required.

3. Demonstration of Safety of the Joint Under Service Conditions

3.1 Testing

A prototype of each MNSA design was fabricated, installed on simulated leaking nozzles, and subjected to plant conditions simulating the operating temperature and pressure. The prototypes were also subjected to seismic testing while pressurized.

3.2 Analytical Verification

Although the MNSA design was qualified by testing, all the components were analyzed to verify adequate margins. All components are within allowable stresses.

3.3 Conclusion, Safety of Joint Under Service Loadings

Test results demonstrated that each prototype maintained both mechanical and seal integrity under all service conditions. All specimens remained leak tight and no mechanical damage occurred to any of the components.

4. Joint Design Compliance with NB-3200

4.1 Description

MNSA becomes a primary pressure boundary if the instrument nozzle weld cracks. It, therefore, must be designed to the rules of NB-3200.

4.2 Conclusion, Safety of Joint

MNSA is designed as a "safety-related" primary pressure boundary in accordance with the rules of NB-3200. A Design Stress Report for the hot leg MNSA has been prepared as an "Addendum to the Piping Analytical Stress Report for SCE SONGS Units 2 and 3," ABB Document Number S-PENG-DR-003. Similarly, a Design Stress Report has been prepared as an "Addendum to the Pressurizer Analytical Stress Report for SCE SONGS Units 2 and 3," ABB Document Number S-PENG-DR-002.

2. Installation

Installation of the MNSA is categorized as a Replacement activity under the rules of Section XI of the Code. Under IWB-7300 (Installation Not Requiring Welding), IWB-7310 allows installation of Mechanical Joints. The MNSA is a specially designed mechanical joint which meets the requirements of IWB-7310.

IWB-7311 permits flanged joints. The MNSA is considered a flanged joint. The MNSA consists of an Upper Flange, Lower Flange, Compression Collar and Grafoil Seal. Bolts pass through the Upper and Lower Flanges and are threaded into the pressurizer or piping. Tightening the bolts applies a load to the Compression Collar through the Upper Flange which compresses the seal against the nozzle and the pressurizer/pipe surface.

IWB-7312 prohibits expanded joints. No expansion type joints are used in the MNSA.

IWB-7313 prohibits threaded joints in which threads provide the only seal. Although threads are machined into the primary pressure boundary to attach the MNSA, the threads do not in any way form the seal. Seal welding is not part of the MNSA installation.

IWB-7314 provides for the use of flared, flareless, and compression joints subject to specific limitations. The MNSA does not use these joint types.

For the reasons stated above, the MNSA complies with IWB-7310.

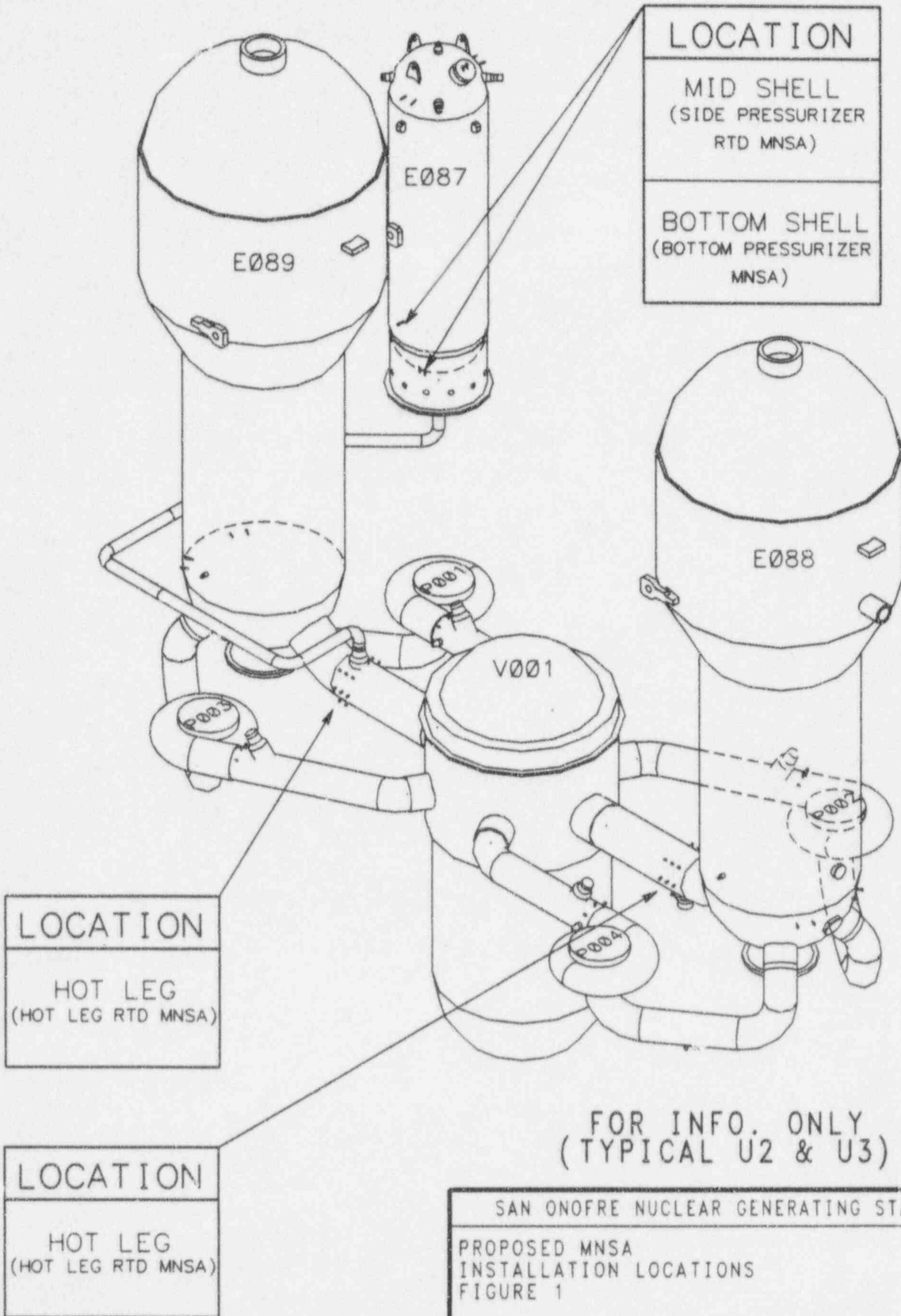
There are two installation cases for the MNSA:

a. For installation of an MNSA on a leaking nozzle, Flaw Removal is not required for continued plant operation. Section XI, IWA-4300 Defect Removal requirements are applicable only where a defect is repaired by welding. In addition, since the MNSA replaces both the sealing and structural integrity of the original "J" weld, the Section III weld repair provisions are not applicable. There is no other Section III requirement that would address flaw removal.

b. For installation of an MNSA as a preventive measure, since the MNSA replaces both the sealing and structural integrity of the original "J" weld, Flaw Removal is not required (refer to paragraph 1. above). Once the MNSA is installed, it would be visually inspected for leakage during the normal system leak checks made each outage. As long as no leakage occurs, no maintenance is required.

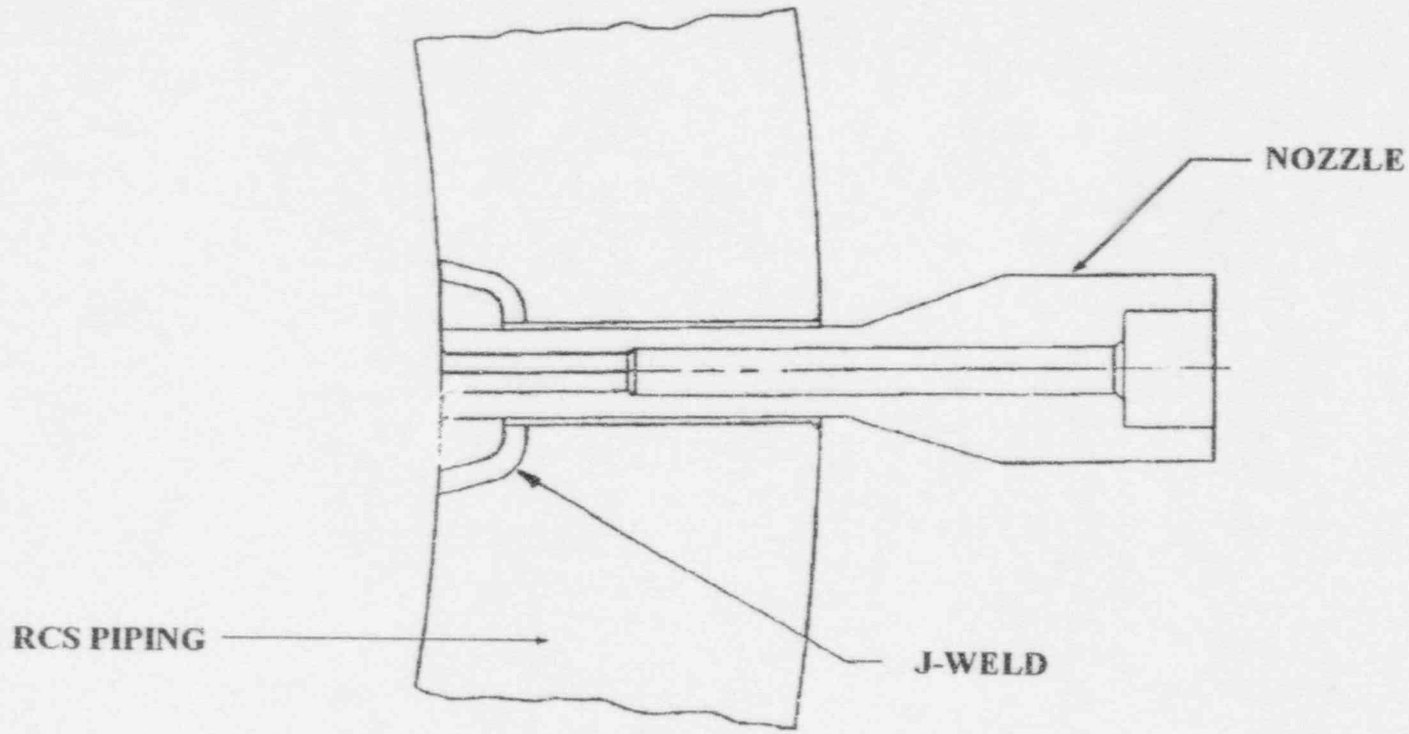
3. Inspection

Section XI requirements applicable to the MNSA are the system leakage test at the end of each refueling outage (Table IWB-2500-1, Category B-P, VT-2 visual examination with acceptance per IWB-3522) and the bolting examination at the end of each 10-year examination cycle (Table IWA-2500-1, Category B-G-2, VT-1 visual examination with acceptance per IWB-3517). Bolting examination rules mean that the MNSA bolted connections will be disassembled for the 10-year examinations if they are located on the pressurizer; however, the MNSA's located on the pipes would only be disassembled for inspection of the bolts if the section of pipe containing the MNSA is scheduled for examination during the particular 10-year inspection. Because the "J" weld would no longer be the pressure boundary, the "J" weld would no longer be included in the ISI program.



FOR INFO. ONLY
(TYPICAL U2 & U3)

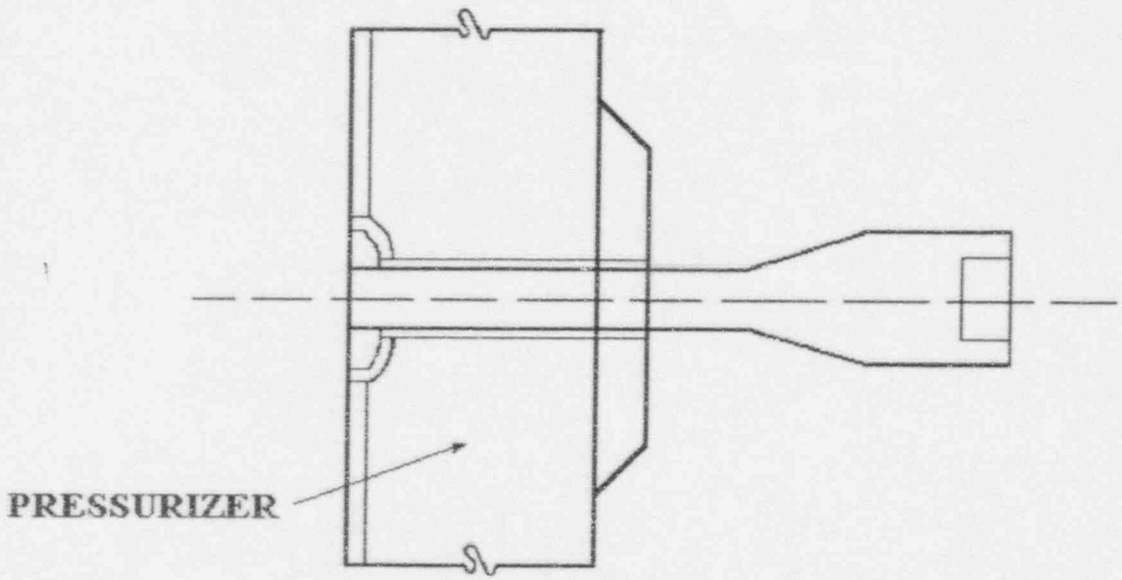
SAN ONOFRE NUCLEAR GENERATING STATION	
PROPOSED MNSA INSTALLATION LOCATIONS FIGURE 1	
SCE	SOUTHERN CALIFORNIA EDISON
	Scale: NONE DRAWN BY: J. LEYVA



EXISTING HOT LEG RTD NOZZLE

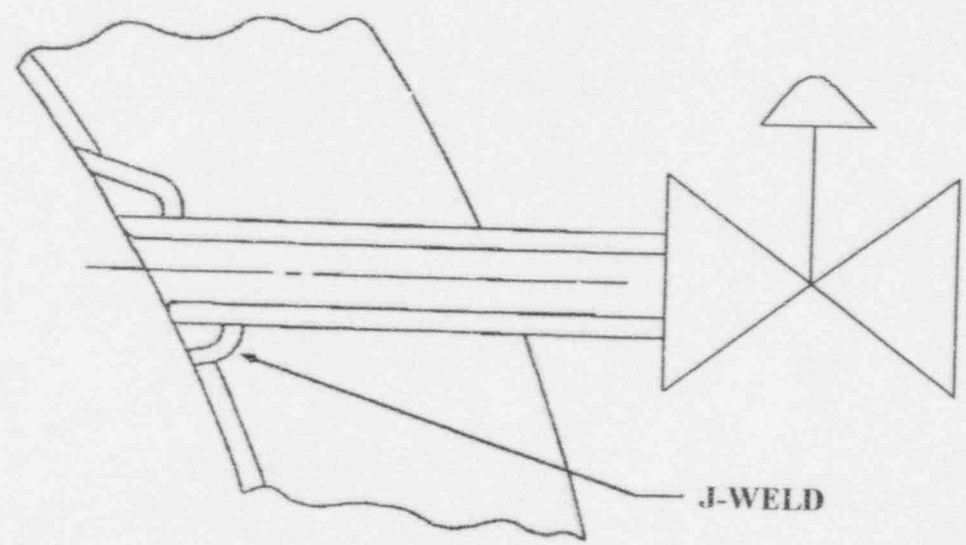
TYPICAL 12 PLACES

FIGURE 2



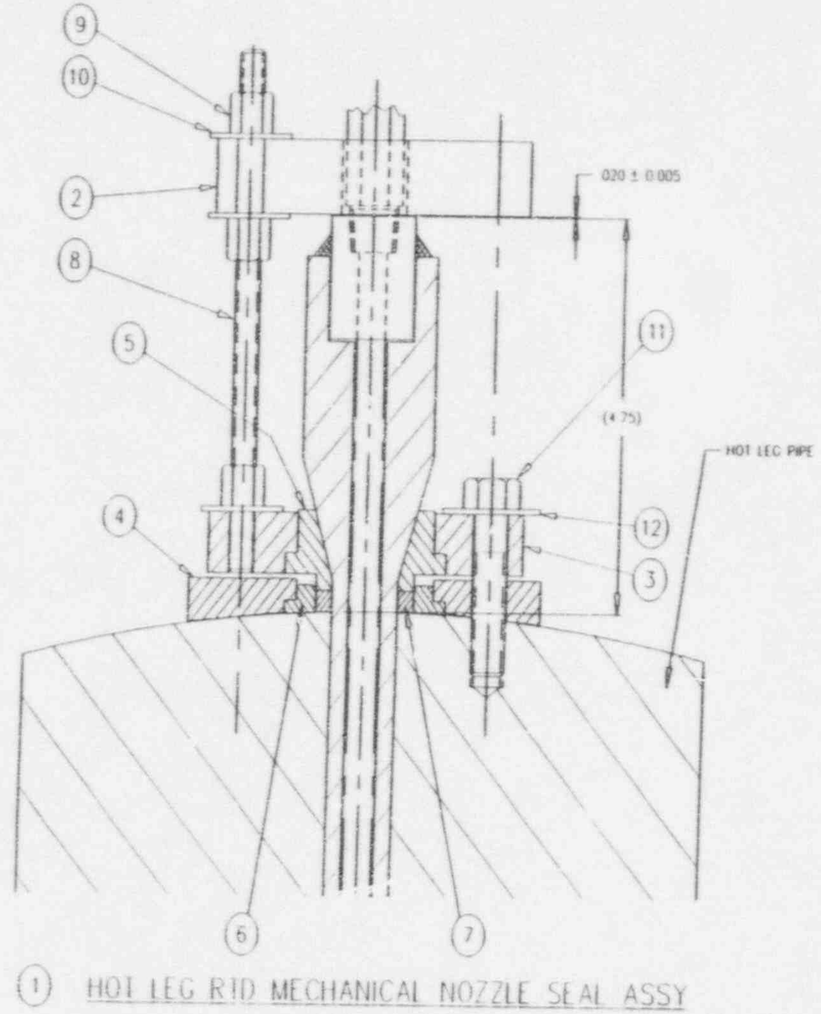
EXISTING SIDE PRESSURIZER RTD NOZZLE

FIGURE 3



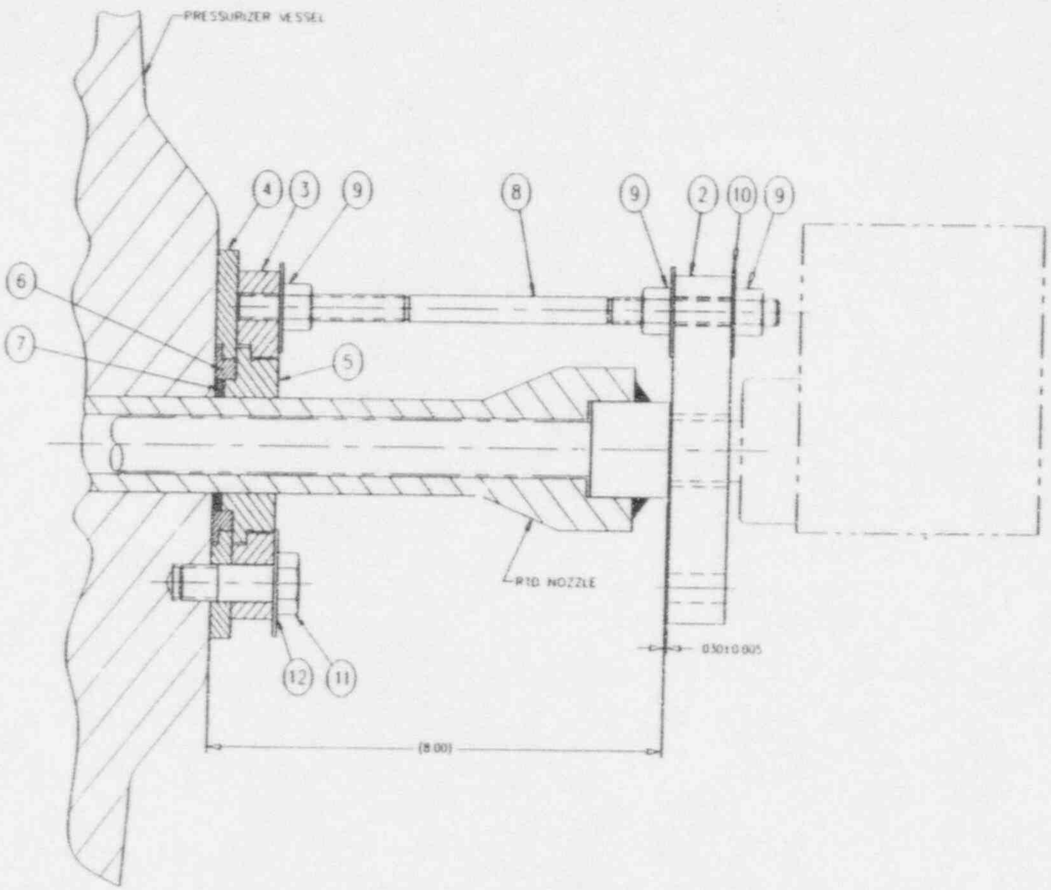
EXISTING BOTTOM PRESSURIZER RTD NOZZLE

FIGURE 4



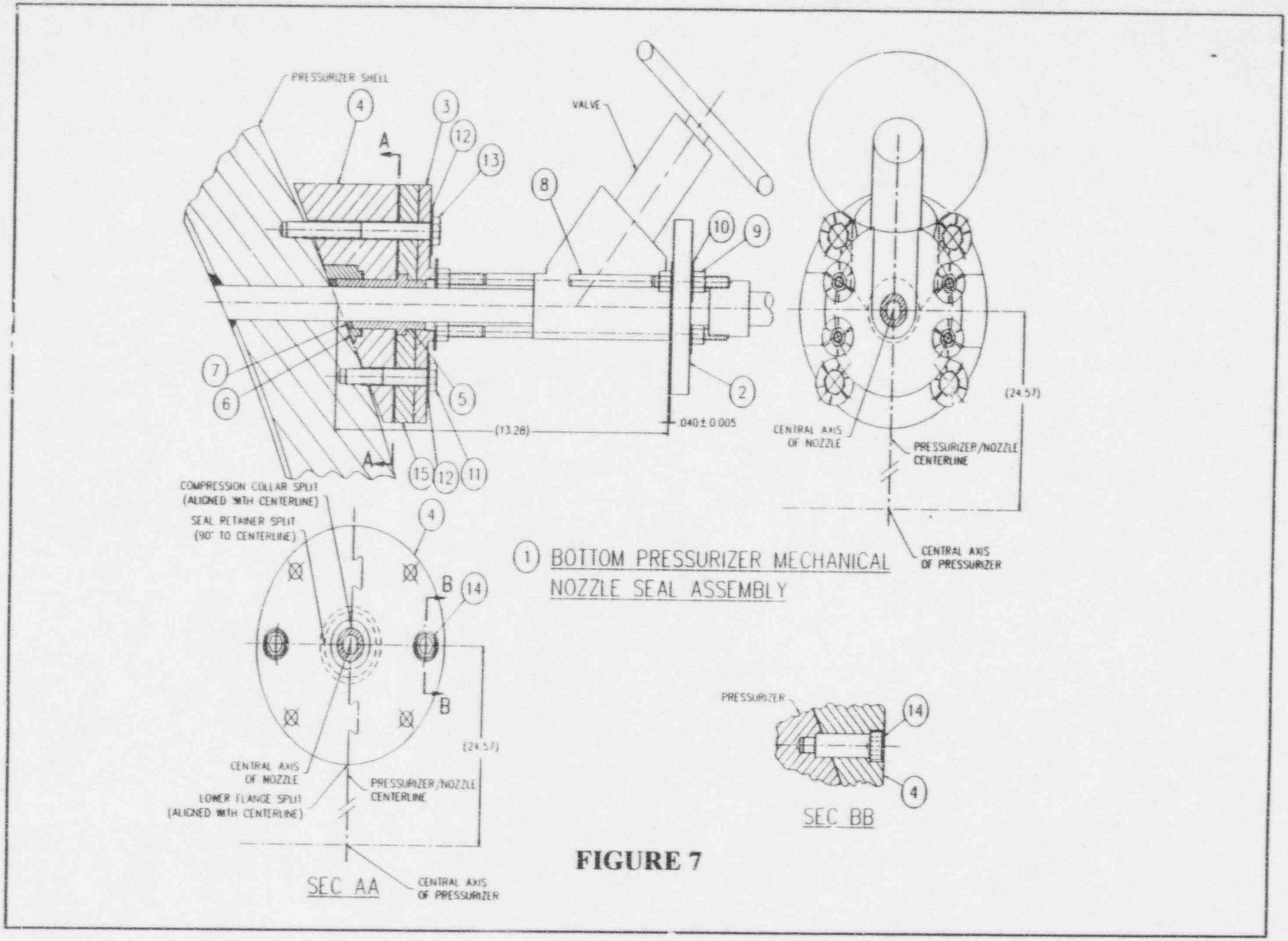
9
10
2
8
5
4
020 ± 0.005
11
(4.75)
HOT LEG PIPE
12
3
6
7
1
HOT LEG RTD MECHANICAL NOZZLE SEAL ASSY

FIGURE 5



(1) SIDE PRESSURIZER RTD MECHANICAL NOZZLE SEAL ASSY

FIGURE 6



PRESSURIZER SHELL
VALVE
A
A
(13.28)
.040 ± 0.005
(24.57)
CENTRAL AXIS OF NOZZLE
PRESSURIZER/NOZZLE CENTERLINE
CENTRAL AXIS OF PRESSURIZER
COMPRESSION COLLAR SPLIT (ALIGNED WITH CENTERLINE)
SEAL RETAINER SPLIT (90° TO CENTERLINE)
B
B
(24.57)
CENTRAL AXIS OF NOZZLE
LOWER FLANGE SPLIT (ALIGNED WITH CENTERLINE)
PRESSURIZER/NOZZLE CENTERLINE
SEC AA
CENTRAL AXIS OF PRESSURIZER
(1) BOTTOM PRESSURIZER MECHANICAL NOZZLE SEAL ASSEMBLY
PRESSURIZER
SEC BB

FIGURE 7