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Millstone Power Station  
Rope Ferry Road  
Waterford, CT 06385



FEB 19 2002

Docket No. 50-336  
B18579

RE: 10 CFR 50.55a(a)(3)(i)

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

Millstone Nuclear Power Station, Unit No. 2  
Request RR-89-35 to Use an Alternative to ASME Code Section XI  
By Employing the Application of Mechanical Nozzle Seal Assemblies -  
Pressurizer Heater Penetration Nozzles

Pursuant to the provisions of 10 CFR 50.55a(a)(3)(i), Dominion Nuclear Connecticut, Inc. (DNC) hereby requests permission to use an alternative to the ASME Boiler and Pressure Vessel Code (B&PV), Section XI, 1989 Edition. Specifically, DNC requests Nuclear Regulatory Commission (NRC) approval to use the Mechanical Nozzle Seal Assembly (MNSA) as an alternative ASME Code replacement for degraded pressurizer heater penetration nozzles at Millstone Unit No. 2. The MNSA was designed and constructed by ASEA Brown Boveri/Combustion Engineering (ABB CE), now part of Westinghouse Electric Company, as a Class 1 component in accordance with the ASME B&PV Code, Section III, 1989 Edition. This alternative request is being submitted because the MNSA is not addressed directly in the ASME Code.

Millstone Unit No. 2 is currently in its refueling outage (RFO14). Based on recent industry operating experience that has been associated with alloy 600 cracking, DNC elected to perform this inspection during the outage. During inservice inspection (visual) of the pressurizer heater penetrations, two (2) penetrations were found to show indication of leakage with the presence of boron encircling the penetration. The MNSA will be applied to those pressurizer heater penetrations. When installed, the MNSA will prevent leakage from the pressurizer heater penetration nozzle. Millstone Unit No. 2 is currently in their 10-Year Inservice Inspection (ISI) Interval which started on April 1, 1999. The 1989 Edition of Section XI applies to the ISI program and is used as the primary Code Edition for Section XI Repair/Replacement activities.

DNC is hereby requesting the NRC Staff to review and approve the proposed alternative to support the startup (MODE 4) of Millstone Unit No. 2, currently scheduled for March 14, 2002, from the current refueling outage.

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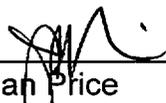
We acknowledge and apologize for the short time available to process our request. We will, of course, promptly provide any additional information the NRC Staff may need to respond to this request. Request RR-89-35 is contained in Attachment 1.

There are no regulatory commitments contained within this letter.

Should there be any questions regarding this submittal, please contact Mr. Ravi G. Joshi at (860) 440-2080.

Very truly yours,

DOMINION NUCLEAR CONECTICUT, INC.

  
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J. Alan Price  
Site Vice President - Millstone

Attachment: Request RR-89-35

cc: H. J. Miller, Region I Administrator  
J. T. Harrison, NRC Project Manager, Millstone Unit No. 2  
NRC Senior Resident Inspector, Millstone Unit No. 2

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Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Request RR-89-35 to Use an Alternative to ASME Code Section XI  
By Employing the Application of Mechanical Nozzle Seal Assemblies -  
Pressurizer Heater Penetration Nozzles

Request RR-89-35 to Use an Alternative to ASME Code Section XI  
By Employing the Application of Mechanical Nozzle Seal Assemblies -  
Pressurizer Heater Penetration Nozzles

Request

RR-89-35

Component Identification

System: Reactor Coolant System (RCS)  
Component: Pressurizer Heater Penetration Nozzles  
Code Class: 1

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).

Proposed Alternative

In accordance with 10 CFR 50.55a(a)(3)(i) the Mechanical Nozzle Seal Assembly (MNSA) has been demonstrated to provide an acceptable level of quality and safety as described in this request and therefore, it is requested that we be provided approval to use the MNSA as an alternative for a Section XI, replacement for degraded or potentially degraded pressurizer heater penetration nozzles.

Basis for Alternative

Application

The 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. Installation of the MNSA will also avoid the need for higher risk plant operations (i.e., reduced inventory for repair/replacement activities of pressurizer nozzles). In addition, the MNSA will shorten the repair/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 1.5 to 3 person-rem per nozzle on the bottom head of the pressurizer.

### Background

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 is an alternative Code replacement to repair leaks or to be installed where there may be susceptibility to leaking such as our pressurizer heater penetration nozzles and the MNSA has been already used in the industry as a Section XI, replacement with NRC approval.

### Details

The pressurizer heater penetration nozzles consist of a sleeve made of SB-167, (Inconel 600) shown on Millstone drawing 25203-29150 Sht.19 and an I.D. J-Groove weld (Inconel) joining the sleeve to the bottom head of the pressurizer made of SA533 - Gr.B CL1 (Alloy Steel) shown on Millstone drawing 25203-29150 Sht.22. The Inconel J-Groove weld provides the primary system pressure boundary. Figure 1 shows the typical concept of the MNSA replacement for a pressurizer heater penetration nozzle.

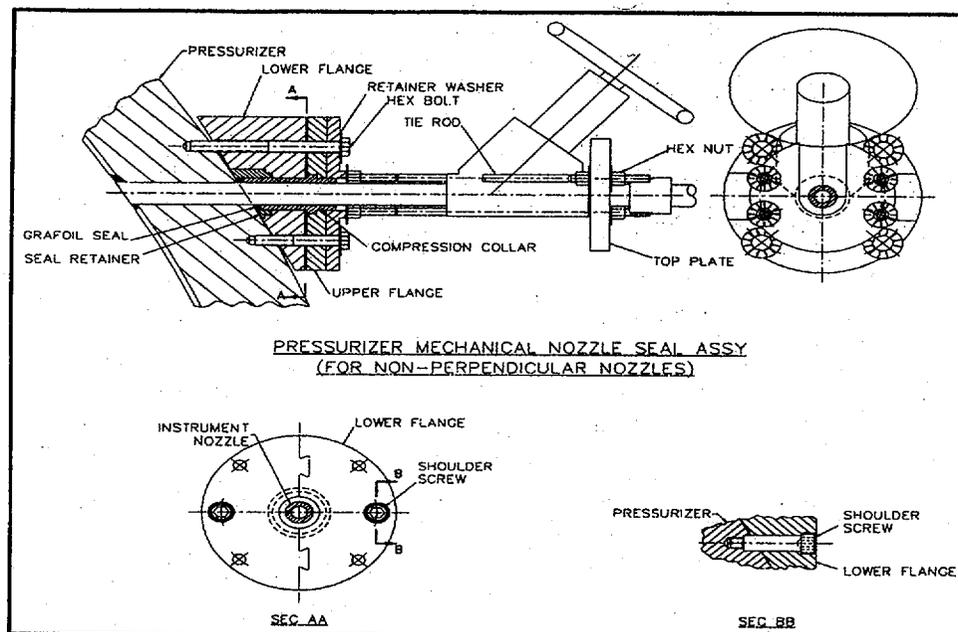


Figure 1: MNSA replacement for a pressurizer heater penetration nozzle.

## Description

The MNSA is a mechanical device that acts as a complete replacement of the "J" weld between an Inconel 600 nozzle and the pressurizer bottom head, to prevent leakage from cracks caused by Stress Corrosion Cracking. It also acts to restrain the instrument nozzle from ejecting if the "J" weld or the heater penetration sleeve 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 head Outside Diameter (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 pressurizer bottom head 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.

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 bottom head 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 Alloy 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 sleeve 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 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, 1968 Edition with Addenda through Summer 1969. Items (material, parts, and components) used for replacement (per Section XI, IWA-7200) shall meet the original Construction Code and existing design requirements or a later edition and addenda of the Construction Code also provided a reconciliation is performed on the differences between the original and current code that affect the design basis of the replacement items.

The three Code activities that need to be addressed as the basis for justification of the MNSA are Design and Fabrication, Installation, and Inspection

1. Design and Fabrication

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. The MNSA complies with all three of these requirements. 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 have been considered to be compatible. Material suitability has been considered under "Degradation Mechanisms" above.

## 1.2 Vessel Application

For design and fabrication of a MNSA for a pressurizer heater penetration 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

Although, we are not requesting use of the MNSA for piping application the 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. These profiles encompass those for Millstone Unit No. 2.

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

1. Bottom Pressurizer MNSA (proposed for use under this request only)
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

1. Prevention of Separation of the Joint Under All Service Loadings.

### 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 component in accordance with the rules of NB-3200. In order to meet these requirements for Millstone Unit No. 2 a Design Stress Report is being prepared for the pressurizer as an "Addendum to the Pressurizer Analytical Stress" and will be completed prior to any application of this request.

#### 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 a 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 the first paragraph of this "Installation" section 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

At the time of installation a preservice examination of the bolting in accordance with Section XI, IWB-2200 shall be performed and then ISI will follow the normal 10-Year ISI schedule requirements. The Section XI requirements applicable to the MNSA during each 10-Year ISI interval include a system leakage test at the end of each refueling outage (Table IWB-2500-1, Examination Category B-P, VT-2 visual examination with acceptance per IWB-3522) and bolting examination (Table IWA-2500-1, Examination Category B-G-2, VT-1 visual examination with acceptance per IWB-3517) based on the schedule of percentages required under (Table IWB 2412-1 Inspection Program B). For the MNSA(s) installed on the pressurizer heater penetration nozzles the Bolting B-G-2 examination requirements would allow the VT-1 examination to be performed as follows: (a) in place under tension; (b) when the connection is disassembled; or when the bolting is removed. This examination is required once each 10-year interval.