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Calvert Cliffs
Nuclear Power Plant

A Member of the
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November 17, 2000

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
Use of Mechanical Nozzle Seal Assemblies at Calvert Cliffs Nuclear Power Plant

The reactor coolant system (RCS) at Calvert Cliffs Nuclear Power Plant (CCNPP) contains numerous small-bore (≤1 inch) nozzles that are used for instrumentation and sampling purposes. These nozzles are attached to the parent RCS component via a partial penetration weld. These nozzles and their weld material are Alloy 600. Due to relatively high residual stresses at the weld interface from fabrication and high service temperatures (approximately 600°F), this type of material has been susceptible to primary water stress corrosion cracking throughout the industry. The effect of this cracking is a pressure boundary leak from the RCS.

Historically, there have been two methods of repairing leaking nozzles. Both entail replacement of the nozzle by welding. The first replaces the entire nozzle and weld with Alloy 690, which is less susceptible to primary water stress corrosion cracking. This repair utilizes a similar geometry to the original design. The second method is similar in that the nozzle is replaced with Alloy 690; however, the attachment is made from the outside using a weld pad. Both of these repair methods are time consuming and costly. Furthermore, because the nozzle must be removed and replaced, these methods require complete depressurization and draining of the affected component. For hot leg installations, this could mean that the entire RCS must be drained below the hot leg nozzles.

As an alternative, Westinghouse – CE Nuclear Power, LLC has developed a mechanical nozzle seal assembly (MNSA) device that can be used to repair these nozzles. The MNSA device offers several advantages because it is faster to install, no welding is required, and it can be installed without draining or depressurizing the affected component. As a result, nuclear safety is enhanced because of the elimination of a fuel offload/reduced inventory requirement, and the occupational exposure to radiation associated with MNSA device installation is lower than that accrued during more traditional repairs.

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Consistent with station procedures, CCNPP performs specific inspections of Alloy 600 components of the RCS pressure boundary at the start of each outage. Based on the results of these inspections, there are currently no identified nozzle leaks at CCNPP. However, ongoing review of industry experience indicates that a reasonable potential exists for nozzle leakage in the future. Consequently, CCNPP has taken a proactive approach to management of Alloy 600 RCS nozzle corrosion cracking at CCNPP. Although Alloy 600 cracking is not considered a significant threat to the structural integrity of the components (reference Information Notice 90-10), CCNPP has implemented a plan that calls for preemptively placing MNSA devices on those nozzle locations most susceptible to leakage. Calvert Cliffs intends to prevent potential RCS leakage by the installation of MNSA devices over non-leaking Alloy 600 nozzles.

The MNSA device is designed and fabricated in accordance with the 1989 Edition of American Society of Mechanical Engineers (ASME) Section III. These items are classified as an *appurtenance* under article NCA-9000. This means that the MNSA device is an NPT-stamped item that requires the development of a design report (article NCA-3200) and a hydrostatic test (article NB-6000). These devices have been classified as Class 1 (i.e., reactor coolant pressure boundary) in accordance with the criteria in 10 CFR 50.55a and 50.2. Consequently, the provisions of ASME Section III, Subsections NCA and NB are applicable. Article NB-3000 allows two options for the design phase of an item. These two options are design-by-analysis and design-by-rule. We chose to design the MNSA devices to the design-by-analysis provisions of article NB-3200. Therefore, the specific design configuration requirements in the design-by-rule provisions of article NB-3300, which restrict nozzles to welded only joints, do not apply per paragraph NB-3331(c).

An overview of the design and inspection program is given in Attachment (1). Enclosures to Attachment (1) provide the design information required for the design-by-analysis option used for the MNSA devices currently installed at CCNPP. Enclosures (4) through (10), (12), and (13) are identified as proprietary. The proprietary affidavit for these enclosures appears in Attachment (2). We request the NRC to withhold these documents from public disclosure and afford them protection in accordance with 10 CFR 2.790.

We understand that the Nuclear Regulatory Commission has taken exception to an inquiry (NI97-015) approved by the Section III code committee that addresses bolted connections. We are submitting this request to obtain your approval to utilize the MNSA devices on leaking partial penetration welded nozzles. We do not believe that installing a MNSA device on a non-leaking nozzle represents an issue that is required to be reviewed by the Nuclear Regulatory Commission.

Calvert Cliffs Nuclear Power Plant requests the Staff review this request and respond by March 1, 2001, to support the CCNPP Unit 2 refueling outage in the event that nozzle leakage is identified during the outage. If a leaking nozzle was discovered and this repair method was not available to us as part of the planned replacement scope for the outage, the replacement of a leaking nozzle using traditional methods would adversely impact outage duration and occupational exposure to radiation.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

CHC/PSF/bjd

Attachment: (1) Mechanical Nozzle Seal Assembly Design and Inspection Program Overview

cc: **(Without Enclosures to Attachment 1)**

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Director, Project Directorate I-1, NRC
A. W. Dromerick, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

MECHANICAL NOZZLE SEAL ASSEMBLY

DESIGN & INSPECTION PROGRAM OVERVIEW

Calvert Cliffs Nuclear Power Plant, Inc.
November 17, 2000

ATTACHMENT (1)

MECHANICAL NOZZLE SEAL ASSEMBLY DESIGN & INSPECTION PROGRAM OVERVIEW

DESIGN

The mechanical nozzle seal assembly (MNSA) is a device that is designed to mechanically attach and seal small nozzles to the reactor coolant system (RCS) piping or pressure vessels. There are two primary functions the MNSA device must accomplish to achieve this design goal. The first is to seal the annular opening between the nozzle and the component. The second is to maintain the geometry of the nozzle in a fixed configuration during all anticipated loadings.

The seal is created by compressing Grafoil split packing against the nozzle, at the nozzle to component interface. This is accomplished by torquing four hex head bolts that engage into the component and compress the upper flange/load ring. The load is transmitted through the upper flange to the compression collar/ring that in turn compresses the Grafoil. (See Figure 1)

The geometric configuration of the nozzle is maintained using tie rods and Belleville washers. The tie rods are used to ensure that the nozzle is fixed in place, and the Belleville washers provide for the thermal expansion of the nozzle. Lateral loads are resisted by the existing portion of the nozzle that is inserted into the component and the MNSA device. Since these nozzles are classified as "no load nozzles" by the Construction Code, the external loads due to deadweight, thermal, and seismic are limited.

With the MNSA device installed and an assumed failure of the internal weld, the annular region between the nozzle and the RCS component will now be exposed to reactor coolant. The pressure boundary material is carbon steel. The boric acid in the reactor coolant will attack this material. An assessment of the worst corrosion that could be seen until the end of the current license plus an additional 20 years showed a total of 0.0882 inches. In reality, the small crevice of exposed low alloy steel will fill completely with corrosion products, and greatly reduce the rate of corrosion. This was found insignificant with regard to the RCS pressure boundary function.

The MNSA device is designed as a fully qualified Code nozzle. The nozzle and the MNSA device must withstand the effects of pressure, weight, thermal expansion, seismic loads, and faulted conditions such as loss-of-coolant accident. The failure modes of the MNSA device are leakage past the mechanical seals, or a loss of structural integrity from a rupture or ejection of the nozzle due to failure of the MNSA structural bolting. The current welded configuration has similar failure modes (i.e., leakage past the welded joint, or a loss of structural integrity from a rupture or ejection of the nozzle due to failure of the welded joint). However, the leakage mode of the welded configuration is more significant in that it had to have developed a through-wall flaw, which may affect the structural integrity of the nozzle. With the MNSA device, leakage is a maintenance issue that does not have the same potential to evolve into the same type of structural concern. If a MNSA device began to leak at the beginning of a cycle, the leak would be detected by visual inspection during the next refueling outage before structurally significant corrosion could develop.

The boric acid inspection program would normally identify leakage through the weld. This would allow for the implementation of a repair, and an analysis of the crack in the j-groove weld. With the MNSA device installed, leakage would not occur and provide indication that the j-groove weld has cracked. However, the weld is no longer part of the pressure boundary of the item. Instead, it is being re-classified as cladding. Consequently, there are no Code implications regarding the cracked material.

General Design Criteria-14 requires that the reactor coolant system be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, rapidly propagating failure, and of gross rupture. To this end, a fracture mechanics analysis of the cracked material that assumes bounding conditions was performed to demonstrate that if a crack were to develop in the weld, it could not challenge the integrity of the component as described by General Design Criteria-14. This analysis has been completed for all instrument nozzles and pressurizer heater nozzles. The analysis is underway for nozzles on the reactor coolant system piping.

Calculations, design reports, and drawings are enclosed with this letter (Enclosures 1-22).

INSPECTIONS

Mechanical nozzle seal assembly devices have been installed as a preventive measure on nozzles where there is no evidence of leakage or of a crack. We intend to leave the MNSA devices in place to provide structural integrity in the case of a leaking nozzle. An inspection program is required to provide assurance that the MNSA device will continue to perform its function. The proposed program therefore is intended to apply to either a preventively installed MNSA device or a MNSA device installed on a leaking nozzle.

Proposed Inspection Plan - Visual Inspections

1. Perform examinations as required under the plant's ASME Section XI program. Documentation and reporting of the examinations will be as required under the plant's ASME Section XI program.

2. Perform visual inspections as required under the boric acid inspection program on every installed MNSA device. Any evidence of degradation, including leakage or corrosion, of the installed MNSA device or the surrounding area, will be recorded. Evidence of leakage from the interface of the vessel wall and the MNSA device lower flange, or along the axis of the nozzle, would be cause for disassembly of the MNSA device for further investigation.

3. As part of the visual inspection described in Item 3 above, inspect the condition of the retaining washers and associated fasteners. Satisfactory condition is an indication that there has been no loss of preload or load relaxation on the seal.

Proposed Inspection Plan - Disassembly and Inspection

1. *This step applies to a MNSA device installed on a leaking nozzle.* At the first outage after MNSA device installation, completely disassemble the MNSA device and inspect for corrosion and degradation. The structural bolting will be examined for evidence of stress corrosion cracking. Any degradation of the Grafoil seal or corrosion of the bolts and MNSA components would be cause for further investigation. Should significant degradation (i.e., degradation that challenges the ability of the MNSA device to perform its design function) of the Grafoil seal, bolts, or MNSA components be identified, this would be cause for notifying the NRC in a timely manner. If the MNSA device, nozzle, and attachment surfaces show no degradation of significance then the affected MNSA device will be inspected per the visual inspection plan detailed above.

2. *This step applies to a MNSA device installed preventively on a non-leaking nozzle.* This assumes multiple MNSA devices have been installed preventively and that none show any outward signs of

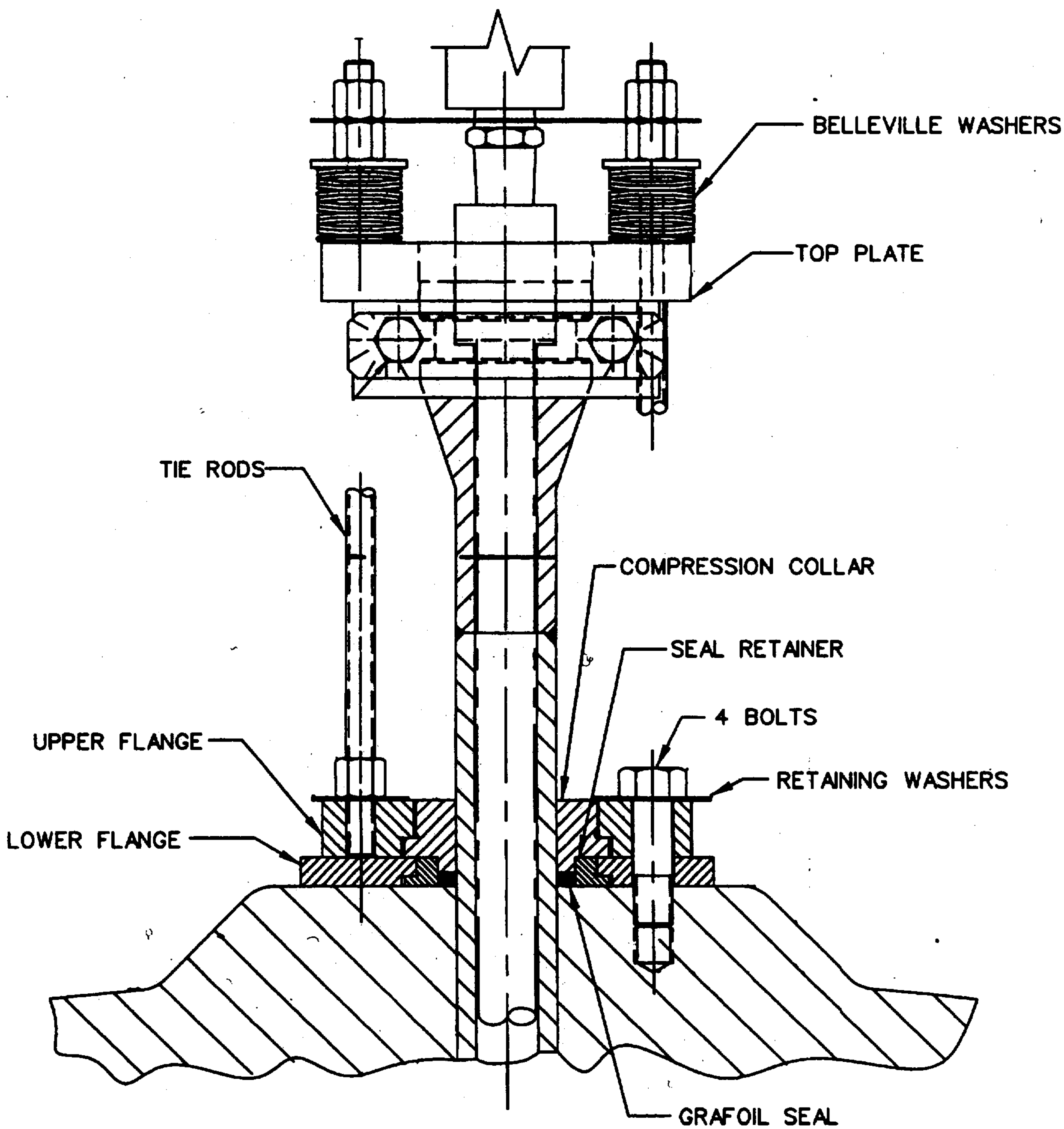
leakage or degradation during the outage inspections described above. After five cycles, one MNSA device will be selected for complete disassembly and inspection. The purpose of this inspection is to determine if the nozzle had leaked, and to monitor the long-term condition of the MNSA components and the surrounding area of the vessel for both galvanic corrosion and boric acid corrosion. The structural bolting will be examined for evidence of stress corrosion cracking. Any degradation of the Grafoil seal or corrosion of the bolts and MNSA components would be cause for further investigation. Should significant degradation (i.e., degradation that challenges the ability of the MNSA device to perform its design function) of the Grafoil seals, bolts, or MNSA components be identified, this would be cause for notifying the NRC in a timely manner. If the MNSA device, nozzle, and attachment surfaces show no degradation of significance then the affected MNSA device will be inspected per the visual inspection plan detailed above.

Concerns regarding long-term use of MNSA devices that have not been addressed by previous testing or analysis can be adequately addressed by a targeted inspection program. The inspection program outlined above would be sufficient to identify any problems with MNSA devices in-service before failure would take place. We believe adequate safeguards exist to allow the use of MNSA devices indefinitely with regular inspections.

Figure 1

Representative Mechanical Nozzle Seal Assembly

(Actual configuration will vary depending on location)



CE NUCLEAR POWER LLC PROPRIETARY

AFFIDAVIT FOR ATTACHMENT (1)

ENCLOSURES (4) THROUGH (10), (12), AND (13)

I, Norton L. Shapiro, depose and say that I am the Chief Engineer, CE Engineering Technology of CE Nuclear Power LLC (CENP), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below.

I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information. I have personal knowledge of the criteria and procedures utilized by CENP in designating information as a trade secret, privileged, or as confidential commercial or financial information.

The information for which proprietary treatment is sought, and which documents have been appropriately designated as proprietary, is contained in the following:

1. *Calculation No. CA04893, Revision No. 0, "Design Evaluation of MNSA for Various Applications at Calvert Cliffs Units 1 and 2"*
2. *Calculation No. CA04894, Revision No. 0, "Calculation of Vertical Bolt Pull-out Loads Due to Horizontal Seismic Loading of 1G for Calvert Cliffs Units 1 and 2"*
3. *Calculation No. CA04895, Revision No. 0, "Analysis of Hot Leg and Pressurizer MNSA Seismic Acceleration"*
4. *Calculation No. CA04803, Revision No. 0, "Flaw Growth Evaluation For CCNPP Unit 2 Pressurizer Upper Level Tap Leak"*
5. *Calculation No. CA04945, Revision No. 0, "Pressurizer Mid and Lower Level (Nozzle) Crack Analysis"*
6. *Vendor Report TR-PENG-042, "Test Report for MNSA Hydrostatic and Thermal Tests"*
7. *Vendor Report S-PENG-CALC-008, "Nozzle Loads for which SONGS Bottom Mounted PRZ MNSA was Qualified"*
8. *Design Report No. B-PENG-DR-005, Revision 01, "Addendum to CENC-1179 Analytical Report for BGE CCNPP Units 1 and 2 - Piping"*
9. *Design Report No. B-PENG-DR-006, Revision 02, "Addendum to CENC-1187 Analytical Report for BGE CCNPP Units 1 & 2 - Pressurizers"*

Pursuant to the provisions of Section 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information included in the documents listed above should be withheld from public disclosure.

i. The information sought to be withheld from public disclosure is owned and has been held in confidence by CENP. It consists of information concerning application, qualification and evaluation details for mechanical nozzle seal assemblies.

ii. The information consists of stress reports and calculations or other similar data for the design, evaluation or application of mechanical nozzle seal assemblies, the application of which results in substantial competitive advantage to CENP.

iii. The information is of a type customarily held in confidence by CENP and not customarily disclosed to the public.

iv. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

v. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence.

vi. Public disclosure of the information is likely to cause substantial harm to the competitive position of CENP because:

a. A similar product is believed under development by major competitors of CENP.

b. Development of this information by CENP required hundreds of thousands of dollars and thousands of manhours of effort. A competitor would have to undergo similar expense in generating equivalent information.

c. The information consists of technical data and qualification information for mechanical nozzle seal assemblies, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to design their product to better compete with CENP, take marketing or other actions to improve their product's position or impair the position of CENP's product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.

d. In pricing CENP's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of CENP's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

e. Use of the information by competitors in the international marketplace would increase their ability to market competing systems by reducing the costs associated with their technology development.

Sworn to before me this
1st day of November 2000

Norton L. Shapiro

Norton L. Shapiro
Chief Engineer
CE Engineering Technology

Catherine P. McCarthy

Notary Public

My commission expires: 1/31/03

ENCLOSURE (14)

ABB Drawing No. E-MNSABGE-228-001, Revision 02,

"Hot Leg RTD MNSA"

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

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NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

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ENCLOSURE (15)

ABB Drawing No. E-MNSABGE-228-002, Revision 02,

"Hot Leg PDT/Sampling MNSA"

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ENCLOSURE (16)

ABB Drawing No. E-MNSABGE-228-005, Revision 02,

"Upper Pressurizer MNSA"

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ENCLOSURE (17)

ABB Drawing No. E-MNSABGE-228-006, Revision 02,

"Side Pressurizer RTD MNSA"

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ENCLOSURE (18)

ABB Drawing No. E-MNSABGE-228-007, Revision 02,

"Bottom Pressurizer MNSA"

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ENCLOSURE (19)

BGE Drawing No. 12019-0077, Revision 0A,

"Name Plates"

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ENCLOSURE (20)

BGE Drawing No. 12019-0078, Revision 0C,

"Upper Pressurizer MNSA"

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ENCLOSURE (21)

BGE Drawing No. 12019-0079 Revision 0D,

"Side Pressurizer RTD MNSA"

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ENCLOSURE (22)

BGE Drawing No. 12019-0080 Revision 0B,

"Bottom Pressurizer MNSA"

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