March 16, 2000

Mr. Gregg R. Overbeck
Senior Vice President, Nuclear
Arizona Public Service Company
P. O. Box 52034
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3 - USE OF MECHANICAL NOZZLE SEAL ASSEMBLIES (TAC NOS. MA7737, MA7738, AND MA7740)

Dear Mr. Overbeck:

In a letter dated September 24, 1999, Arizona Public Service Company (APS) submitted a request to use the mechanical nozzle seal assembly (MNSA) as an alternative repair method pursuant to 10 CFR 50.55a(a)(3)(i) for the Palo Verde Nuclear Generating Station, Units 1, 2, and 3. Specifically, APS requested authorization for alternative use of MNSAs for reactor coolant system hot leg instrumentation and sampling nozzles for an installation period not to exceed two operating cycles. The MNSAs would be installed over those nozzles found to exhibit signs of leakage that are not part of the planned replacement activities for the plant outage.

The staff has completed its review of your request, and our findings are contained in the enclosed safety evaluation. The staff concludes that, pursuant to 10 CFR 50.55a(a)(3)(i), the use of MNSAs as an alternate to an ASME Section XI Code repair on any leaking nozzles of the type describe above, is permissible for a period not to exceed two operating cycles, since it is found to provide an acceptable level of quality and safety.

Sincerely,

/***RA/***

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-528, STN 50-529,
and STN 50-530

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE MECHANICAL NOZZLE SEAL ASSEMBLY

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, AND 3

DOCKET NOS. STN 50-528, STN 50-529, AND STN 50-530

1.0 INTRODUCTION

By letter dated September 24, 1999, the Arizona Public Service Company (APS, the licensee) submitted a request to use the mechanical nozzle seal assembly (MNSA) as an alternative repair method pursuant to 10 CFR 50.55a(a)(3)(i) for the Palo Verde Nuclear Generating Station (Palo Verde), Units 1, 2, and 3. Specifically, APS requested authorization for alternative use of MNSAs for reactor coolant system (RCS) hot leg instrumentation and sampling nozzles for an installation period not to exceed two operating cycles. The MNSAs would be installed over those nozzles found to exhibit signs of leakage that are not part of the planned replacement activities for the plant outage.

2.0 DISCUSSION

2.1 Background

The potential exists for leaks to occur in RCS hot leg Alloy 600 instrumentation and sampling nozzles due to primary water stress corrosion cracking. These nozzles are welded to the RCS hot leg piping walls with inner diameter J-groove welds. The typical repair of these nozzles utilizes either an internal or external weld repair, or a half nozzle replacement. As an alternative under the provisions of 10 CFR 50.55a(a)(3)(i), the use of an MNSA is proposed as a repair to restore nozzle integrity and prevent leakage of nozzle assemblies for up to two cycles of operation.

Although there are currently no identified nozzle leaks at Palo Verde, the licensee has undertaken a proactive long-term Alloy 600 nozzle replacement plan. The nozzle replacement plan at Palo Verde calls for replacement of all Alloy 600 RCS hot leg instrumentation and sampling nozzles by the completion of the twelfth cycle unit refueling outages. MNSAs would be used if nozzle leaks are identified that would require full-core offload and drain down to facilitate weld repair and replacement. Unplanned replacement of these nozzles could significantly increase plant outage duration for no significant safety benefit in comparison to the use of MNSAs combined with a well-planned nozzle replacement effort.

An MNSA is a mechanical device consisting of a split gasket/flange assembly that is placed around a leaking instrument nozzle. The gasket is made of Grafoil packing, a graphite compound that is compressed within the assembly to prevent RCS leakage past the nozzle. This assembly is bolted into holes drilled and threaded on the outer surface of the RCS component wall. Another assembly is bolted to the flanges, which serves as the structural attachment of the nozzle to the wall. This assembly serves to carry the loads in lieu of the "J" welds on the Alloy 600 nozzles.

The NRC has approved the use of this MNSA design for similar applications at the San Onofre Nuclear Generating Station, Units 2 and 3 (NRC letters dated February 17, 1998 and January 29, 1999) and at the Waterford Generating Station, Unit 3 (NRC letter dated March 25, 1999).

2.2 Licensing Basis

Section 50.55a to Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a) requires, in part, that all inservice examinations and system pressure tests conducted during the first 10-year interval and subsequent intervals on American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1, 2, and 3 components must comply with the requirements in the latest edition and addenda of Section XI incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 10-year interval. By reference to and implementation of paragraphs IWB-3132 or IWB-3142 to Section XI of the ASME Code, 10 CFR 50.55a also requires that existing flaws in ASME Code Class components be removed by mechanical means, or else that the components be repaired or replaced to the extent necessary to meet the acceptance standards in Article IWB-3000 of Section XI to the code. Detection of leaks in the structural portion of an ASME Code Class 1, 2, or 3 component is direct evidence of a flaw in the component.

Paragraph IWA-4170 of Section XI of the ASME Code requires that repairs and the installation of replacements to the reactor coolant pressure boundary be performed and reconciled in accordance with the Owner's Design Specifications and Original Code of Construction for the component or system. The RCS hot legs of the Palo Verde units were designed and constructed to the rules of ASME Section III, 1974 Edition through and including the Summer 1974 Addenda.

Paragraph NB-3671.7 to Section III of the ASME Code, "Sleeve Coupled and Other Patented Joints," requires that ASME Code Class 1 joints be designed to meet the following criteria:

(1) provisions must be made to prevent separation of the joint under all service loading conditions,

(2) the joint must be designed to be accessible for maintenance, removal, and replacement activities, and

(3) the joint must either be designed in accordance with the rules of Section III to the ASME Code, Subarticle NB-3200, or else be evaluated using a prototype of the joint that will be subjected to additional performance tests in order to determine the safety of the joint under simulated service conditions.

3.0 EVALUATION

Section 50.55a(a)(3) of 10 CFR allows licensees to use alternatives to the requirements of the ASME Code when authorized by the Director of the Office of Nuclear Reactor Regulation. The licensee must demonstrate that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(i), the alternatives would provide an acceptable level of quality and safety in lieu of meeting the requirements, or that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(ii), complying with the requirements of 10 CFR 50.55a would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The licensee requests the use of MNSAs pursuant to 10 CFR 50.55a(a)(3)(i), stating that this alternative provides an acceptable level of quality and safety. In order to determine if the MNSAs provided an acceptable level of quality and safety, the staff compared the MNSA design and operational characteristics to the applicable ASME requirements, reviewed the MNSAs' resistance to corrosion for the intended service period, and evaluated the licensee's commitments associated with the use of the MNSAs. The staff's review is described below.

The MNSAs are designed, fabricated, and constructed using approved ASME Code materials in accordance with the applicable rules of ASME Section III. The MNSAs are designed to prevent separation of the joint under all service loadings. This design is supported by technical analysis and tests that meet the design criteria specified in ASME Section III. Additionally, MNSA installations are accessible for maintenance, removal, and replacement.

The Combustion Engineering (CE) Design Report No. V-PENG-DR- 007, Rev. 1, Addendum to CENC-1500, CENC-1590 and CENC-1642, "Analytical Reports for Arizona Units 1, 2 and 3 Piping," was provided as an attachment to the licensee's September 24, 1999, letter. This addendum demonstrates that stresses under all service conditions do not exceed the code allowables as stated in ASME Section III and that fatigue limits are not exceeded using the conditions in the original Palo Verde design specification.

Modification of the RCS hot leg for MNSA installation has been analyzed in accordance with the Original Construction Code for the Palo Verde Main Loop Piping (ASME Section III, 1974 Edition, Summer 1974 Addenda). The analysis, contained in the addendum referenced above, included the following items and documented the required ASME Section XI reconciliation for the use of a component built to a later edition of the code.

° Fatigue analysis to demonstrate that the code-prescribed cumulative usage factor of 1.0 is not exceeded (NB-3222.4)

° Analysis to demonstrate adequate reinforcement in the wall of the RCS piping for the bolt holes (NB-3643.3)

° Analysis to demonstrate stresses do not exceed the allowables as stated in the code.

The staff concludes that the applicable ASME Code requirements are met by the MNSA design and installation criteria, and that the MNSAs can remain in operation for the period of time requested by the licensee (i.e., not to exceed two cycles).

The licensee provided an evaluation to address potential corrosion of the nozzle bore holes, corrosion of the pipe outside diameter (O.D.) surface, galvanic corrosion, and stress corrosion cracking (SCC) of the MNSA fasteners. The results of this evaluation are summarized as follows:

° Laboratory corrosion data and service experience indicate that any corrosion of the carbon steel in the hot leg Alloy 600 nozzle holes will be minor and will not affect the requested duration of the MNSA repair (i.e., not to exceed two cycles).

° Boric acid corrosion of the materials of construction for the MNSA and the O.D. piping surfaces have been addressed by testing and analysis. With the inspections currently performed, a leaking MNSA would be detected before significant corrosion of the piping occurs.

° There is no history of galvanic corrosion problems in similar applications where carbon steel is in contact with a Grafoil seal. This particular combination is used in other applications where the low alloy (or carbon steel) is frequently inspected (for example, steam generator secondary side manway and hand hole applications). The MNSA application is similar (i.e., Grafoil material is in contact with carbon steel and inspections will be conducted at each refueling outage) and for these reasons significant galvanic corrosion is not expected. In addition, the Grafoil used in the MNSA is Grade GTJ, which has been treated with ammonium phosphate to inhibit corrosion. The corrosion protection provided by this inhibitor is comparable to sacrificial inhibitors such as zinc or aluminum. Testing has shown that GTJ Grafoil significantly reduces the galvanic corrosion process. The licensee also noted that, in the absence of leakage past the Grafoil seal, the annulus will become stagnant and will not allow replenishment of the boric acid or oxygen.

° Testing in pressurized water reactor environments and concentrated boric acid solutions and service experience indicate that A-286 bolts in the MNSA application will operate indefinitely without SCC failures under normal conditions. If the MNSA device leaks, the bolts may be exposed to borated water or steam under conditions in which deposits or slurries will develop. Under these conditions and at stress levels present in the MNSA application, these bolts will operate satisfactorily for more than one fuel cycle. A leaking MNSA will be discovered and repaired as part of the walk-down inspections performed in response to Generic Letter 88-05, *Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants*. These walk-down inspections are performed prior to entering unit outages. Therefore, the existence of leaking MNSA conditions would be limited to one cycle.

Based on the above evaluation of potential corrosion effects, the staff concludes that there are no significant corrosion issues associated with the application of the mechanical nozzle seal assemblies to hot leg piping at Palo Verde. The data indicates that corrosion of the nozzle hole will be acceptable over the requested two-cycle period of use.

The licensee has committed to the following actions should MNSAs need to be utilized in any of the Palo Verde units.

(1) As required by IWA-4820, a VT-1 preservice inspection will be performed on all MNSA installations in accordance with IWB-2200.

(2) During plant startup (Mode 3) after initial MNSA installation and during subsequent plant restarts following outages, the MNSAs will be VT-2 examined (without insulation) for leakage. Additionally, VT-3 exams will be performed to verify general structural and mechanical condition of the MNSAs.

(3) In accordance with ASME Section XI, IWA-4710(b)(5), component connections, piping, and associated valves that are NPS 1 and smaller are exempt from pressure testing. However, to ensure quality of installation and continued operation with the absence of leakage, a pressure test with visual inspection will be performed on each of the installed MNSAs with the insulation removed. The test will be performed as part of plant restart and will be conducted at normal operating pressure with the test temperature determined in accordance with the Palo Verde pressure and temperature limits as stated in the Palo Verde Technical Specifications.

(4) This request for alternative is for up to two cycles of operation. Prior to exceeding two operating cycles, installed MNSAs will be removed and nozzle replacement activities will be implemented as part of the licensee's long-term Alloy 600 nozzle replacement strategy.

(5) APS will verify pipe wall thickness prior to machining MNSA bolt holes to further assure that adequate pipe wall reinforcement exists.

The staff has reviewed the above licensee commitments and conclude that they are sufficient to assure proper installation and operation of the MNSAs for their intended use and duration.

4.0 CONCLUSION

Section 50.55a(a)(3) of Title 10 of the *Code of Federal Regulations* states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if "(i) The proposed alternatives would provide an acceptable level of quality and safety, or (ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without compensating increase in the level of quality and safety." The staff concludes that, pursuant to 10 CFR 50.55a(a)(3)(i), the use of MNSAs as an alternate to an ASME Section XI Code repair on any leaking nozzles of the type describe above, is authorized for a period not to exceed two operating cycles, since it is found to provide an acceptable level of quality and safety.

Principal Contributor: Mel Fields

Date: March 16, 2000