

January 27, 2003

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 (PVNGS), UNITS 1, 2,  
AND 3 - RE: REQUEST FOR RELIEF FROM THE REQUIREMENTS OF THE  
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND  
PRESSURE VESSEL CODE (CODE) CONCERNING USE OF ELECTRICAL  
DISCHARGE MACHINING (EDM) (TAC NOS. MB6439, MB6440, AND MB6441)

Dear Mr. Overbeck:

By letter dated September 25, 2002, Arizona Public Service Company (APS), the licensee, submitted a relief request from the requirements of ASME Code Section XI, Subsection IWA-4322, 1992 Edition, 1992 Addenda.

In your relief request, APS requested authorization from the NRC to use an EDM process for repairs of reactor pressure vessel head penetration (VHP) nozzles or J-groove welds. Specifically, you requested authorization to use the requirements of later editions of the ASME Code to qualify the EDM process, should repairs be necessary during VHP inspections at PVNGS, Units 1, 2, and 3 per NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles." You requested to use the qualifying requirements of ASME Code Section XI, IWA-4461.4, 1995 Edition, 1997 Addenda, in lieu of the requirements of IWA-4322 of the 1992 Edition, 1992 Addenda. Per your submittal, APS asserted that this proposed alternative would meet the ASME Code's intent without requiring unnecessary removal of mechanical material during repairs.

The NRC staff's evaluation and conclusions are contained in the enclosed safety evaluation. The staff finds that the proposed alternative using the EDM process provides an acceptable level of quality and safety; therefore, pursuant to 10 CFR 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR), the proposed alternative is authorized for the second 10-Year interval of the Inservice Inspection Program, in the event that inspections for PVNGS, Units 1, 2, and 3 reveal the need for reactor VHP repairs.

Sincerely,

**/RA/**

Stephen Dembek, Chief, Section 2  
Project Directorate IV  
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/encls: See next page

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**ADAMS ACCESSION NUMBER: ML030290212**

**NRR-028**

**\*See previous concurrence**

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
THERMAL REMOVAL TECHNIQUES FOR REACTOR VESSEL HEAD PENETRATION

REQUEST FOR RELIEF (NO. 22)

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

PALO VERDE NUCLEAR GENERATING STATION (PVNGS), UNITS 1, 2, AND 3

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

1.0 INTRODUCTION

By letter dated September 25, 2002, Arizona Public Service Company (APS or the licensee), requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) to use an electrical discharge machining (EDM) process for repairs of reactor pressure vessel (RPV) head penetration nozzles or J-groove welds.

2.0 BACKGROUND

The licensee is required by 10 CFR 50.55a of Title 10 of the *Code of Federal Regulations* (10 CFR) to comply with the ASME Code requirements for inservice inspections. PVNGS, Units 1, 2, and 3, as part of their licensing basis, comply with the 1992 Edition, 1992 Addenda of the ASME Code, Section XI. In this Edition of the Code, Section XI, IWA-4322 states "if thermal removal processes are used on P-No. 8 and P-No. 43 materials, a minimum of 1/16 in. material shall be mechanically removed from the thermally processed area." To propose an alternative to their existing ASME Code requirements a licensee must make a submittal per 10 CFR 50.55a(a)(3). APS specifically applied for this relief based on the provision in 10 CFR 50.55a(a)(3)(i) which states that proposed alternatives must provide an acceptable level of quality and safety.

Per Relief Request Number 22 for PVNGS, Units 1, 2, and 3, the licensee requested authorization from the NRC to use an electrical discharge machining (EDM) process for repairs of reactor pressure vessel (RPV) head penetration nozzles or J-groove welds. Specifically, the licensee requested authorization to use the alternative requirements of later editions of the ASME Code to qualify the EDM process should repairs be necessary. The RPV head penetration nozzles at PVNGS, Units 1, 2, and 3 are considered to be susceptible to primary water stress corrosion cracking (PWSCC). These nozzles are manufactured from Inconel Alloy 600 with material designations of SB-166 or SB-167, which are in base material grouping P-No. 43. The licensee plans to utilize the EDM process to excavate PWSCC cracks or defects and remove weld crown surfaces of repair welds to facilitate performance of final nondestructive examination. The licensee proposed to qualify the EDM process in accordance with IWA-4461.4 of the 1995 Edition, 1997 Addenda of the ASME Code, Section XI to allow the use of thermal methods for metal removal without further mechanical processing.

### 3.0 EVALUATION OF RELIEF REQUEST

Pursuant to 10 CFR 50.55a(a)(3)(i), relief is requested to conduct an alternative thermal removal requirements of IWA-4322 applicable to P-Number 43 materials due to the potentially adverse effects of machining Alloy 600 materials and their associated welds.

#### 3.1 The Items for which Relief is Requested:

Code Class:	1
Examination Category:	B-E
Item Number:	B4.12, B4.11
Description:	Control Element Drive Mechanism (CEDM) nozzle penetration Reactor Head Vent Nozzle penetration

#### 3.2 Code Requirement:

In the 1992 Edition of the ASME Code, Section XI, Subsection IWA-4170(b) states that repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and addenda of the Construction Code or of ASME Section III and Code Cases, either in their entirety or portions thereof, may also be used.

When performing defect removal on P-No. 43 material, Subsection IWA-4322 states that, "If thermal removal processes are used on P-No. 8 and P-No. 43 materials, a minimum of 1/16 in. material shall be mechanically removed from the thermally processed area."

#### 3.3 Licencee's Proposed Alternative:

In lieu of the Code requirement of mechanically removing 1/16" of material from all thermally processed areas as required by IWA-4322, APS proposes to qualify the EDM process in accordance with the qualification requirements from IWA-4461.4 of the 1995 Edition, 1997 Addenda of ASME Section XI. In addition to the requirements of IWA-4461.4, APS states that it will perform the following:

1. Determine the thickness of the resultant oxide layer on the cut surface by metallographic examination during the EDM process qualification.
2. Based upon the oxide thickness measurements obtained during the EDM qualification process, remove the oxide layer from cut or excavated surfaces when performing repair activities on RPV head penetration nozzles or J-welds.

Based on this proposal, the licensee concluded that their alternative process would provide for an acceptable level of quality and safety with respect to the repair of the RPV head penetration nozzles and welds.

#### 3.4 Licensee's Basis for Relief (as stated):

"IWA-4322 of the 1992 Edition of ASME Section XI requires the removal of a minimum of 1/16" of material from all thermally processed areas of P-Number 43 materials. The apparent basis of this requirement is to ensure that thermally cut or excavated surfaces are free of

unacceptable surface irregularities, oxides and fissures that were created by the thermal removal process.

Suitability of IWA4461.4 of ASME Section XI, 1995 Edition, 1997 Addenda:

The qualification requirements of IWA-4461.4 ensure that the proposed thermal process is capable of producing a surface finish that is free of cracks or fissures and meets the required surface roughness criteria of the owner. Where the cut surface is exposed to a corrosive medium, then corrosion testing or evaluations must also be performed. The qualification requirements of IWA-4461.4 are summarized below.

- (a) The qualification test shall consist of two coupons of the same P-Number material to be cut in production.
- (b) The qualification coupons shall be cut using the maximum heat input to be used in production.
- (c) The thermally cut surface of each coupon shall be visually examined at 10X and shall be free of cracks. The Owner shall specify surface roughness acceptable for the application and shall verify that the qualification coupon meets the criterion.
- (d) Each qualification test coupon shall be cross-sectioned, and the exposed surfaces shall be polished, etched with a suitable etchant, and visually examined at 10X. All sectioned surfaces shall be free of cracks.
- (e) Corrosion testing of the thermally cut surface and heat affected zone shall be performed if the cut surface is to be exposed to a corrosive media. Alternatively, corrosion resistance of the thermally cut surface may be evaluated. The Owner shall specify the acceptance criteria.

In addition to the qualification testing requirements of IWA-4461.4 of ASME Section XI, 1995 Edition, 1997 Addenda, APS will determine the thickness of the resultant oxide layer on the cut surfaces as part of the EDM qualification. The thickness of the resultant oxide layer will be determined by metallographic examination. Based on the oxide thickness measurements obtained during the EDM process qualification, post-EDM polishing operations will be performed to ensure that the oxide surface layer is removed. The method described above for qualification of this process is consistent with the previously approved ENTERGY request (Section VII, Precedents).”

3.5 Evaluation:

Although considered a thermal process for removing metal, since it uses an electrical arc, EDM leaves an extremely small oxide layer on the cut surface of the metal remaining after the removal process. The licensee has committed to removing that oxide layer by mechanical means (polishing) after metal removal by the EDM process. The amount of metal removed will be determined by the qualification requirements of IWA-4461.4 of the ASME Code, Section XI, 1995 Edition, 1997 Addenda, with the additional requirement for APS to determine the thickness of the resultant oxide layer on the cut surfaces by metallographic examination, and as part of the EDM qualification. Based on the oxide thickness measurements obtained during

this qualification, post-EDM polishing operations will be performed to ensure that the oxide surface layer is removed. The NRC staff concludes that this proposed alternative provides an acceptable method of weld removal.

#### 4.0 CONCLUSION

The NRC staff concludes that the licensee's proposed alternative using the EDM process provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the second 10-Year interval of the Inservice Inspection Program, in the event that inspections for PVNGS, Units 1, 2, and 3 reveal the need for reactor VHP repairs.

Principal Contributor: R. Kuntz

Date: January 27, 2003