April 25, 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, UNIT 3 - RELAXATIONS FROM ORDER ESTABLISHING INTERIM INSPECTION REQUIREMENTS FOR REACTOR PRESSURE VESSEL HEADS (TAC NO. MB7855)

Dear Mr. Overbeck:

In your letter of February 28, 2003 (102-04894), you provided the 20-day response to NRC Order EA-03-009, issued on February 11, 2003, that established interim inspection requirements for reactor pressure vessel (RPV) heads. In the letter, you stated that Arizona Public Service Company (APS) did not request a hearing on the Order and consented to the Order modifying the operating licenses for the Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. You further stated that the consent to the Order supersedes the previous APS commitments made to the NRC as a result of Bulletins 2001-01, 2002-01, and 2002-02.

In the letter of February 28, 2003, as directed in the Order and pursuant to the procedures in Order Section IV.F, you also submitted two requests for relaxation to the requirements of the Order for PVNGS, Unit 3. You requested relaxations to the Order in that you would (1) implement the requirements of the Order by performing a Section IV.C.2(a) examination of the RPV head vent nozzle and a Section IV.C.2(b) examination of the control element drive mechanism (CEDM) nozzles and (2) perform ultrasonic testing of the CEDM nozzles to approximately six-tenths of an inch above the top of the nozzles' chamfer face. The Order required that the vessel head be inspected in accordance with either Section IV.C.2(a) or Section IV.C.2(b), and the examination in accordance with Section IV.C.2(b)(i) be by ultrasonic testing of each vessel head penetration nozzle to the bottom of the nozzle. Your relaxation request was supplemented in letters dated March 21 (102-04910), April 2 (102-04916), April 4 (102-04918), and April 24 (102-04929), 2003.

The NRC staff has evaluated your two relaxation requests and supporting information, and has concluded, subject to certain conditions, that you have demonstrated good cause for the proposed relaxations of the Order. Therefore, pursuant to Section IV, paragraph F, of Order EA-03-009, the NRC staff authorizes the proposed (1) alternative inspection for the head vent line nozzle and (2) relaxation and alternative inspection of CEDM nozzles at Palo Verde, Unit 3 for the current spring 2003 outage inspection. The authorization for the CEDM nozzles is conditioned by the following: If the NRC staff finds that the crack growth formula in industry report MRP-55 is unacceptable, APS shall revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs the licensee of an NRC-approved crack growth

formula. If the revised analysis shows that the crack growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation is rescinded and APS shall, within 72 hours, submit to the NRC written justification for continued operation. If revised analysis shows that the crack growth acceptance criteria are exceeded during the subsequent operating cycle, APS shall, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, APS shall, within 30 days, submit a letter to the NRC confirming that its analysis has been revised. Any future crack growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack growth rate formula.

The details of the staff review are in the enclosed Safety Evaluation. If you have any questions concerning this letter, please contact Jack Donohew at 301-415-1307, or via the Internet at jnd@nrc.gov.

Sincerely,

/RA/

Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. STN 50-530

Enclosure: Safety Evaluation

cc w/encl: See next page

formula. If the revised analysis shows that the crack growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation is rescinded and APS shall, within 72 hours, submit to the NRC written justification for continued operation. If revised analysis shows that the crack growth acceptance criteria are exceeded during the subsequent operating cycle, APS shall, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, APS shall, within 30 days, submit a letter to the NRC confirming that its analysis has been revised. Any future crack growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack growth rate formula.

The details of the staff review are in the enclosed Safety Evaluation. If you have any questions concerning this letter, please contact Jack Donohew at 301-415-1307, or via the Internet at jnd@nrc.gov.

Sincerely,
/RA/
Herbert N. Berkow, Director
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. STN 50-530

Enclosure: Safety Evaluation

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*** See EMCB memorandum dated April 17 and 23, 2003**

ADAMS Accession No.: ML031150603 **NRR-106**

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELAXATION REQUESTS TO RPV HEAD INSPECTION ORDER EA-03-009

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

PALO VERDE NUCLEAR GENERATING STATION, UNIT 3

DOCKET NO. STN 50-530

1.0 INTRODUCTION

Nuclear Regulatory Commission (NRC) Order EA-03-009 (Order), issued on February 11, 2003, requires specific examinations of the reactor pressure vessel (RPV) head and vessel head penetration nozzles (VHP) of all pressurized water reactor plants. Section IV, paragraph F, of the Order states that requests for relaxation of the Order associated with specific penetration nozzles will be evaluated by the NRC staff using the procedure for evaluating proposed alternatives to the American Society of Mechanical Engineers Code in accordance with 10 CFR 50.55a(a)(3) of Title 10 of the *Code of Federal Regulations* (10 CFR). Section IV, paragraph F, of the Order states that a request for relaxation regarding inspection of specific nozzles shall address the following criteria: (1) the proposed alternative(s) for inspection of specific nozzles will provide an acceptable level of quality and safety, or (2) compliance with this Order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

For Palo Verde, Unit 3, and similar plants determined to have a moderate susceptibility to primary water stress corrosion cracking (PWSCC) in accordance with Section IV, paragraphs A and B, of the Order, require the following inspections to be performed during every refueling outage in accordance with Section IV, paragraph C.(2) of the Order:

(a) Bare metal visual examination of 100% of the RPV head surface (Including 360^{o} around each RPV head penetration nozzle).

OR

(b) Either:

(i) Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two (2) inches above the J-groove weld to the bottom of the nozzle and an assessment to determine if leakage has occurred into the interference fit zone, OR

(ii) Eddy current testing or dye penetrant testing of the wetted surface of each J-Groove weld and RPV head penetration nozzle base material to at least two (2) inches above the J-groove weld.

In addition, the requirements of (a) and (b) shall be performed at least once over the course of every two (2) refueling outages.

By letter dated February 28, 2003, as supplemented March 21, 2003, and April 2, 4, and 24, 2003, Arizona Public Service Company (the licensee), requested relaxation to implement alternatives to the requirements: (1) Order Section IV.C.(2)(b) for the RPV head vent line nozzle for Unit 3 where the remaining reactor head penetrations (RHPs), the 97 Control Element Drive Mechanism (CEDM) nozzles, will be examined in accordance with the requirements of Order Section IV.C.(2)(b); and (2) Section IV, paragraph C.(2)(b)(i) for the 97 CEDM nozzles for Unit 3. Unit 3 is in its spring 2003 refueling outage.

2.0 ORDER EA-03-009 RELAXATION REQUESTS FOR PROPOSED ALTERNATIVE INSPECTIONS OF CEDM NOZZLES

2.1 Order Requirements for which Relaxation is Requested

Section IV.C.(2)(a) and IV.C.(2)(b) of Order EA-03-009 requires, in part, that at least the requirements of 2(a) or 2(b) are performed every refueling outage and the requirements of 2(a) and 2(b) shall each be performed at least once over the course of every two (2) refueling outages. The required inspections for moderate susceptibility plants similar to Unit 3 are:

(a) Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle).

OR

(b) Either:

(i) Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two (2) inches above the J-groove weld to the bottom of the nozzle and an assessment to determine if leakage has occurred into the interference fit zone, OR

(ii) Eddy current testing or dye penetrant testing of the wetted surface of each J-Groove weld and RPV head penetration nozzle base material to at least two (2) inches above the J-groove weld.

Therefore, compliance with Order EA-03-009 is achieved through implementation of a 100 percent bare metal visual examination, ultrasonic testing of each nozzle, or eddy current (or dye penetrant) testing of each J-groove weld and nozzle.

The licensee has requested two relaxations from part IV.C.(2)(b) of the Order for the CEDM nozzles in Unit 3 as follows:

1. To perform testing of the one RPV head vent line nozzle in accordance with Section IV.C.(2)(a) and testing of the remaining RHPs in accordance with Section IV.C.(2)(b); and

2. Not to perform ultrasonic testing of each CEDM nozzle (i.e., nozzle base material) from two (2) inches above the J-groove weld to the bottom of the nozzle.

2.2 Licensee's Proposed Alternative

The first proposed alternative examination is to perform bare metal visual inspection 360^{O} around the one (1) RPV head vent line nozzle in accordance with Order Section IV C.(2)(a). The remaining 97 CEDM nozzles will be examined in accordance with the requirements of Order Section IV.C.(2)(b).

The second proposed alternative examination is to perform ultrasonic testing (UT) of each RPV head penetration nozzle (i.e., nozzle base material) per Order Section IV.C.(2)(b)(ii) from 2 inches above the J-groove weld to approximately 0.6 inches above the top of the nozzle's chamfer face.

2.3 Licensee's Basis for Relaxation

2.3.1 First Relaxation

The VHPs are one head vent line nozzle and 97 CED nozzles. The licensee stated that due to the design of the RPV head vent line nozzle, internal volumetric or surface examination of the RPV head vent line would be difficult and would require the removal of the welded orifice. The licensee also stated that it is currently unable to perform 100 percent bare metal visual of the RPV head surface due to the reflective contoured vessel head insulation that is currently installed. Therefore, the licensee is stating there is a hardship to examine all the VHPs by either Order Section IV.C.(2)(a), a surface examination, or Order Section IV.C.(2)(b), a volumetric examination. The licensee has proposed to do the one head vent line nozzle by Section IV.C.(2)(a) and the 97 CEDM nozzles by Section IV.C.(2)(b), which without a relaxation of the requirements of the Order is not allowed. The reasons for this proposal were provided by the licensee in its submittals.

The licensee submitted this proposed relaxation request since all of the VHP nozzles are not being inspected by the same method (i.e., Order Section IV.C.(2)(a) or Section IV.C.(2)(b)) during the current Unit 3 refueling outage. This relaxation request would allow the licensee to inspect the RPV head vent line nozzle in accordance with Order Section IV.C.(2)(a) and perform an inspection of the 97 CEDM nozzles in accordance with Order Section IV.C.(2)(b). The licensee stated that this relaxation does not change the criteria of the inspection requirements of Order Section IV.C.2(a) and Order Section IV.C.2(b) for the nozzles being inspected. The licensee considers the relaxation request would allow an administrative change to the Order to allow one nozzle to be inspected by one method as identified in the Order and the remaining nozzles to be inspected by the other method identified in the Order. All of the RPV nozzles would receive an inspection by an approved method described in the Order. The licensee stated that the requirement to perform a bare metal visual examination of 100 percent of the RPV head surface described in Order Section IV.C.(2)(a) will be performed at the next refueling outage of Unit 3.

Therefore, this relaxation of Order Section IV.C.(2)(b) is for the one head vent line nozzle so that this nozzle is examined in accordance with Order Section IV.C.(2)(a), whereas all the remaining RHP nozzles are examined in accordance with Order Section IV.C.(2)(b).

As an alternative to the bare metal visual examination of Order Section IV.C(2)(a), for moderate susceptibility plants like Unit 3, compliance with Order EA-03-009 can be achieved through ultrasonic testing (UT), in accordance with Order Section IV.C.(2)(b)(i), or eddy current testing (ET) or penetrant testing (PT), in accordance with Order Section IV.C.(2)(b)(ii), of the wetted surface of each J-groove weld and RPV head penetration nozzle base material at least (2) inches above the J-groove weld. The licensee stated that unlike the CEDM nozzle penetrations that have an interference fit with the reactor vessel head, the RPV head vent line nozzle has a slip fit arrangement. Therefore, through-wall cracks in either the nozzle or the J-groove weld would produce leakage that can be detected by a bare metal visual examination of 360^{O} around the vent line nozzle.

The RPV head vent line nozzles at each PVNGS unit contain a 0.19 inch orifice plug welded inside the nozzle in-line with the RPV head and adjacent to the J-groove weld attaching the vent line nozzle. The licensee stated that any volumetric or surface examination of the nozzle's inside diameter base material performed in accordance with Order Sections IV.C.(2)(b)(i) or IV.C.(2)(b)(ii) would require either mechanical grinding or electrical discharge machining (EDM) to remove the orifice. As a result, the licensee concluded that the removal processes would inherently cause distortion or obliteration of any indications of surface cracking of the nozzle base material. Additionally, the licensee noted that Order Section IV.C.(2)(b)(i) requires an assessment to determine if leakage has occurred in the interference fit zone. The licensee contends that this option cannot be performed, since the RPV vent line does not have an interference fit zone. The licensee also stated that the Unit 3 refueling outage started March 29, 2003, limiting the licensee's ability to plan an examination of the RPV vent line in accordance with Order Section IV.C.(2)(b). Therefore, based upon the above, the licensee concluded that there was not sufficient time to implement an examination of the RPV head vent line in accordance with Order Section IV.C.(2)(b), and it is not practical to perform volumetric or surface examinations in accordance with Order Section IV.C.(2)(b)(i) or Order Section IV.C.(2)(b)(ii) on the head vent line nozzle.

As an alternative to the UT or ET/PT examinations identified in Order Sections IV.C(2)(b)(i) and IV.C.(2)(b)(ii), respectively, compliance with Order EA-03-009 can be achieved through a bare metal visual examination of 100 percent of the RPV head surface (including 360^{O} around each RPV head penetration nozzle) in accordance with Order Section IV.C.(2)(a). The licensee identified that the PVNGS Units have reflective contoured vessel head insulation, this type of insulation configuration cannot be readily removed without significant modification to allow complete inspection access and the 97 CEDM nozzles cannot be inspected in accordance with Order Section IV.C.(2)(a) without this modification.

The licensee explained that an extensive insulation modification is currently being planned for the Unit 3 refueling outage scheduled for the fall of 2004. The modification is being performed to allow complete access for the bare metal visual examination of the RPV head outer surface, which includes the 97 CEDM nozzles. The licensee stated that the modification is very complex, requiring a re-design of the insulation, taking as-built measurements for access and clearances, development of specific tooling and mockups and detailed training to implement the modification. The licensee estimates the dose for the planned modification to be approximately

30 man-rem. The modification has a lead time of a minimum of 20 weeks. Therefore, the licensee considers the option to perform a bare metal visual examination of all RPV head nozzles impractical during the current outage of Unit 3 since the necessary plant modification will not be in place at that time.

The licensee concluded in its April 4, 2003, letter that the proposed inspection that combines elements of Order Sections IV.C.(2)(a) and IV.C.(2)(b) and which uses previously approved and accepted methods will provide an acceptable level of quality and safety since the proposed examination covers each VHP nozzle on the RPV head.

2.3.2 Second Relaxation

The licensee stated that due to the design of the funnel attachment to the CEDM nozzles (which includes a threaded connection with a plug weld), it is unable to fully comply with the requirement to perform UT to the bottom of the nozzles.

The licensee states that experience gained from the previous two UT examinations completed at PVNGS (Unit 2 Refueling outage 10 and Unit 1 Refueling Outage 10 in the spring and fall of 2002, respectively) has shown that scanning becomes impractical and ineffective from approximately 0.6 inches above the top of the nozzle's chamfer face to the bottom of the nozzle. Ultrasonic scans in this area do not yield useful data because of the geometry of the nozzle and funnel, and the multiple signals reflected back by threaded surfaces.

The licensee proposes a UT examination of each RPV head CEDM penetration nozzle (i.e., nozzle base material) from 2 inches above the J-groove weld to approximately 0.6 inches above the top of the nozzle's chamfer face. The CEDM nozzle inspection includes multiple inspections from the nozzle inner surface. The primary inspection, which was demonstrated through the Materials Reliability Program/Electric Power Research Institute (MRP/EPRI) protocol, uses a dual element ultrasonic tip diffraction technique. The examination inspects from 2 inches above the J-groove weld to the lowest possible point on the nozzle. The probe design has a transmitter and receiver that are in close proximity to each other. In order to operate, both crystals must be in contact with the inner surface. There is approximately 0.6 inches above the nozzle to funnel threaded joint interface that cannot be inspected due to the configuration of the equipment. In addition to the UT inspections required in the Order, the licensee performs an ET examination on the inside diameter (ID) of the CEDM nozzle as part of the CEDM inspection program. This examination is capable of detecting ID-initiated flaws. This examination operates beyond the range of the UT examination almost down to the chamfer edge between the nozzle and funnel (approximately 0.06 inches above the chamfer). This examination was also demonstrated through the MRP/EPRI protocol.

The UT examination proposed by the licensee includes the entire heat-affected zone on either side of the J-groove weld. A dimensional study was performed for the CEDM nozzles to determine the limits of coverage relative to the bottom of the J-groove weld. The inspection method employed at PVNGS provides coverage from 2 inches above the J-groove weld to at least 1.3 inches below the J-groove weld. The licensee stated that indications outside of this area, by themselves, cannot result in an unacceptable condition resulting in reactor coolant leakage into the interference fit zone, reactor coolant leakage onto the RPV head, or ejection of a CEDM nozzle.

The licensee's request to limit the examination of the nozzle base material from 2 inches above the J-groove weld to approximately 1.3 inches below the J-groove weld is supported by its analysis which demonstrated that no flaw below that portion of the nozzle would propagate to a level adjacent to the J-groove weld within an 18-month operating period. The licensee concluded that the area not covered by the examination has been determined to be a low stress zone and a non-pressure boundary portion of the nozzle as demonstrated by the hoop stress distribution charts provided by the licensee.

The licensee's evaluation used plant specific flaw analysis data contained in Westinghouse document, WCAP-16044-P, "Structural Integrity Evaluation of Reactor Vessel Head Penetrations to Support Continued Operation: Palo Verde Unit 3," which determined that it would take an axial crack with a crack tip 0.5 inch below the weld, approximately 5.8 EFPY to extend to an elevation adjacent to the pressure boundary J-groove weld. This evaluation uses plant specific stress, operating temperature, and the MRP-55, "Materials Reliability Program Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Thick Wall Alloy 600 Material (MRP), Revision 1," crack growth rate predictions. Since the area not examined is below this point, the licensee concluded that no flaw located within the unexamined portion of the nozzles would propagate to a level adjacent to the J-groove weld within an 18-month operating period. As a result, the licensee concluded that indications in the unexamined area, by themselves, cannot result in an unacceptable safety condition resulting in reactor coolant leakage in the interference fit zone, reactor coolant leakage on the RPV head, or ejection of a CEDM nozzle due to circumferential cracking of the nozzle above the J-groove weld.

As an alternative to the UT examination of Order Section IV.C(2)(b)(i), Section IV.C(2)(b)(ii) permits use of ET or dye PT of the wetted surface of each J-groove weld and RPV head penetration nozzle base material at least two (2) inches above the J-groove weld. Due to the location and the proximity of the funnels to each other, the licensee stated that they are unable to fully comply with the requirements to perform ET or PT of the wetted surfaces near the bottom of the nozzle. The licensee stated that it would need to develop new remote tooling or remove and reinstall a large number of funnels in order to comply with this requirement. The licensee cited insufficient time to plan the PT examination and estimated the exposure for this examination method to be at least 30 times the dose of the proposed UT/ET examination. Therefore, the licensee does not consider it practical to perform ET or PT of the unexamined area of each nozzle.

As an alternative to the inspection requirements of Order Section IV.C.(2)(b), compliance can be achieved with a bare metal visual examination of 100 percent of the RPV head surface (including 360^{o} around each RPV head penetration nozzle), in accordance with Order Section IV.C(2)(a). The licensee identified that the PVNGS Units are provided with reflective contoured vessel head insulation. This type of insulation configuration cannot be readily removed without significant modification to allow complete inspection access. The licensee has previously performed successful bare metal visual inspection of the reactor vent line nozzle and 24 CEDM nozzles on the outer perimeter of the RPV head.

An extensive insulation modification is currently being planned for the Unit 2 refueling outage scheduled for the fall of 2003. The modification will allow complete access for bare metal visual examinations of the upper head. The licensee states that the modification is complex and estimates the dose for the planned modification to be approximately 30 man-rem. The

modification has a lead time of a minimum of 20 weeks. The insulation modification is planned to be implemented for Units 1 and 3 in 2004. However, the licensee stated it is not practical to perform a 100 percent bare metal visual examination for the current spring 2003 Unit 3 refueling, since the necessary plant modification will not be in place at that time.

The CEDM nozzles at PVNGS are all installed into the RPV head with an interference fit. The licensee considers the proposed alternative examination to be sufficient to reliably detect cracking of RPV head nozzles which could cause corrosion of the RPV head or pose a safety concern because of the possibility of a nozzle ejection or loss of coolant accident. The licensee considers the proposed alternative provides an acceptable level of quality and safety.

2.4 Evaluation

2.4.1 First Relaxation

The NRC staff's review of this relaxation request was based on criterion (2) of paragraph F of Section IV of the Order which states:

> Compliance with this order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality or safety.

The licensee has proposed to inspect the head vent line nozzle in accordance with Order section IV.C.(2)(a) and the 97 CEDM nozzles in accordance with Order section IV.C.(2)(b). The relaxation of the Order is that one RHP, the head vent line nozzle, out of 98 RHPs would be done in accordance with the bare metal visual examination of Order section IV.C.(2)(a). The proposed bare metal visual examination of the RPV head vent line is based upon (1) the Section IV.C.(2)(a) examination is the only possible, meaningful examination allowed by the Order to detect leakage as a result of through-wall cracks in either the nozzle base material or the J-groove weld, and (2) the hardship to modify the insulation on the head to allow the 97 CEDM nozzles to be examined in the same manner. The RPV head vent line nozzle contains a 0.19 inch orifice plug welded inside the nozzle in-line with the RPV head and adjacent to the J-groove weld attaching the vent line nozzle to the RPV head. Volumetric or surface examination of the nozzle's inside diameter base material, performed in accordance with Order Sections IV.C.(2)(b)(i) or IV.C.(2)(b)(ii) would require either mechanical grinding or EDM to remove the orifice, causing distortion or obliteration of any indications of surface cracking or the nozzle base material. Therefore, Order Section IV.C.(2)(b) will not provide for an effective examination of this surface.

To inspect the 97 CEDM nozzles in accordance with Order Section IV.C.(2)(a), the licensee would have to have modified the RPV head because it currently has reflective contoured insulation which can not be readily removed. Although the licensee is planning such a modification, it could not be performed in the current Unit 3 refueling outage because the modification is complex, requiring a re-design of the insulation, taking as-built measurements for access and clearances, development of specific tooling and mockups and detailed training to implement the modification, with a lead time of a minimum of 20 weeks. Therefore, it would have been a hardship for the licensee to have done the modification for the current refueling outage without any benefit because there is an inspection method for the CEDM nozzles that meets the requirements of the Order (i.e., Order Section IV.C.(2)(b)).

This relaxation is considered to be acceptable because each VHP nozzle will be inspected by a method that is acceptable to Order EA-03-009, and, therefore, there would be no increase in the level of quality or safety by examination of the RPV head vent line with the UT method used to examine the CEDM nozzles. Requiring an examination of the RPV head vent line in accordance with Order Section IV.C.(2)(b) would result in hardship without a compensating increase in the level of quality or safety. Therefore, the licensee has shown good cause for relaxation of the Order.

2.4.2 Second relaxation

The NRC staff's review of this request was based on criterion (2) of paragraph F of Section IV of the Order, which states:

> Compliance with this order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The proposed UT examination of each RPV head CEDM penetration nozzle would inspect from 2 inches above the J-groove weld to at least 1.3 inches below the J-groove weld. Inherently, there is approximately 0.6 inches above the nozzle to funnel threaded joint interface that cannot be inspected. This is an area that cannot be inspected with current UT technology due to the configuration of the equipment. The licensee identified that in addition to the UT inspection required by the Order, the licensee also performs an ET examination on the inside diameter of the CEDM as part of its own CEDM inspection program. This examination operates beyond the range of the UT examination almost down to the chamfer edge between the nozzle and the funnel (approximately 0.06 inches above the chamfer). Both of these examinations were demonstrated through the MRP/EPRI protocol.

The licensee cited that the area not covered by the examination has been evaluated and determined to be a low stress zone and a non-pressure boundary portion of the nozzle. This was demonstrated by the hoop stress distribution curves provided by the licensee. The NRC staff reviewed the stress evaluations and determined that the stress levels at least 1.3 inches below the J-groove weld were very low. The highest stress level was just less than 10,000 psi at 0 degrees (uphill and downhill). Thus, the area covered by this relaxation request is a low stress zone and would be less likely to crack.

The licensee provided crack growth evaluations using plant-specific flaw analysis data contained in Westinghouse document WCAP-16044-P which determined that it would take a crack with a crack tip of 0.5 inches below the weld, approximately 5.8 EFPY to extend to an elevation adjacent to the pressure boundary J-groove weld. This analysis used the approach described in footnote 1 of the Order as the criteria to set the necessary height of the examination, including plant-specific stress and operating temperature. However, this analysis incorporates a crack growth formula different from that described in footnote 1, as provided in the Electric Power Institute's (EPRI) Material Reliability Program (MRP) report MRP-55. The NRC staff has performed a preliminary review of the report but has not yet made a final assessment regarding the acceptability of the crack growth formula. Because the NRC staff has not approved MRP-55, it will place conditions on this relaxation request as stated in Section 3.0, "Conclusion," of this safety evaluation.

Subject to certain conditions, the licensee's crack growth analysis provides assurance that hypothetical cracks in the uninspected portion of the nozzle will not exceed the flaw acceptance criteria prior to the next inspection. Due to the low stresses and additional ET examination of the uninspected portion of the nozzles, the required inspection of the remaining portions of the CEDM nozzles would provide little or no increase in the level of quality and safety.

As an alternative to the inspection requirements of Order Section IV.C.(2)(b), compliance with the Order can be achieved with a bare metal visual examination of the RPV head surface in accordance with Order Section IV.C(2)(a). In order to perform the bare metal visual examination of the RPV head surface on Unit 3, the licensee would need to perform an extensive insulation modification. The modification would not be practical and would cause a delay in the Unit 3 refueling outage. In addition the licensee estimates the occupational exposure dose to be significant. Subject to certain conditions, the licensee's crack growth analysis provides assurance that hypothetical cracks in the uninspected portion of the nozzle will not exceed the flaw acceptance criteria prior to the next inspection. Due to the low stresses and additional ET examination of the uninspected portion of the nozzles, the required inspection of the remaining portions of the CEDM nozzles would provide little or no increase in the level of quality and safety. Because the proposed UT coverage and the licensee's analysis, as conditioned below, provide reasonable assurance of structural integrity, compliance with this Order would result in hardship without a compensating increase in the level of quality and safety.

As an alternative to the UT examination of Order Section IV.C(2)(b)(i), Section IV.C(2)(b)(ii) permits use of ET or PT of the wetted surface of each J-groove weld and RPV head penetration nozzle base material at least two (2) inches above the J-groove weld. In order to perform the ET/PT of the wetted surface, the licensee cited insufficient time to prepare for the examination, and the need to develop new remote tooling for removing and reinstalling a large number of funnels as hardships. The licensee estimated the dose to be much greater than that of the proposed UT/ET. Because the proposed alternative provides reasonable assurance of structural integrity, compliance with this Order would result in hardship without a compensating increase in the level of quality and safety. Therefore, the licensee has shown good cause for relaxation of the Order.

3.0 CONCLUSION

For the first relaxation, the NRC staff concludes that the licensee has shown good cause for relaxation of the Order in that the proposed alternative to perform bare metal visual examination on one RPV head vent line nozzle in accordance with Order Section IV.C(2)(a) and perform a volumetric/surface examination on the remaining 97 CEDM nozzles in accordance with Order Section IV.C(2)(b) as modified by the authorized Order relaxation dated April 4, 2003, is sufficient to reliably detect cracking of VHP nozzles and provides reasonable assurance of the structural integrity of the VHP nozzles and RPV head. Therefore, pursuant to Section IV, paragraph F, of Order EA-03-009, the NRC staff authorizes the proposed relaxation and alternative inspection of the RPV head vent line nozzle at Unit 3 for the spring 2003 outage. Although the proposed alternative authorized for Unit 3 for the current spring 2003 outage, Order Section IV.C.(2) requires that Order Sections IV.C.(2)(a) and IV.C.(2)(b) be performed at least once over the course of every two refueling outages. Therefore, the licensee must perform the required Section IV.C.(2)(b) examination of the RPV head vent line at Unit 3 at the

next refueling outage of Unit 3, unless relaxation from such a requirement is requested by the licensee and authorized by the NRC.

For the second relaxation, the NRC staff concludes that the licensee has shown good cause for relaxation of the Order in that the proposed alternative to perform ultrasonic testing of each RPV head CEDM penetration nozzle (i.e., nozzle base material) from 2 inches above the J-groove weld to approximately 0.6 inches above the top of the nozzles' chamfer face (i.e., a minimum of 1.3 inches below the J-groove weld) and an eddy current examination to approximately within 0.06 inches above the chamfer face is sufficient to reliably detect cracking of RPV head nozzles, subject to certain conditions stated below, and, thus, provides reasonable assurance of structural integrity. Further, performing inspections in accordance with Section IV.C.(2)(a) or Section IV.C(2)(b)(ii), of Order EA-03-009 would result in hardship without a compensating increase in the level of quality and safety. Therefore, pursuant to Section IV, paragraph F, of Order EA-03-009, the NRC staff authorizes the proposed relaxation and alternative inspection for RPV head CEDM penetration nozzles at Unit 3 for the spring 2003 outage inspection, subject to the following conditions:

If the NRC staff finds that the crack growth formula in industry report MRP-55 is unacceptable, the licensee shall revise its analysis that justifies relaxation of the Order within 30 days after the NRC informs the licensee of an NRC-approved crack growth formula. If the licensee's revised analysis shows that the crack growth acceptance criteria are exceeded prior to the end of the current operating cycle, this relaxation is rescinded and the licensee shall, within 72 hours, submit to the NRC written justification for continued operation. If revised analysis shows that the crack growth acceptance criteria are exceeded during the subsequent operating cycle, the licensee shall, within 30 days, submit the revised analysis for NRC review. If the revised analysis shows that the crack growth acceptance criteria are not exceeded during either the current operating cycle or the subsequent operating cycle, the licensee shall, within 30 days, submit a letter to the NRC confirming that its analysis has been revised. Any future crack growth analyses performed for this and future cycles for RPV head penetrations must be based on an acceptable crack growth rate formula.

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