April 30, 2004

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 1 - RELAXATION OF THE REQUIREMENTS OF FIRST REVISED ORDER MODIFYING LICENSES EA-03-009 REGARDING REACTOR PRESSURE VESSEL HEAD INSPECTIONS (TAC NO. MC1835)

Dear Mr. Overbeck:

On February 11, 2003, the U.S. Nuclear Regulatory Commission (NRC) issued Order Modifying Licenses (effective immediately) EA-03-009 requiring specific inspections of the reactor pressure vessel (RPV) head and associated penetration nozzles at pressurized water reactors. The NRC issued an errata to the Order on March 14, 2003, to correct an administrative part of the Order related to requests for relaxation of the Order requirements. On February 20, 2004, the NRC issued the First Revised Order Modifying Licenses, which supersedes and revises certain inspection aspects of the original Order.

Section IV.F of the First Revised Order states that requests for relaxation associated with specific penetration nozzles will be evaluated by the staff using its procedure for evaluating proposed alternatives to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code in accordance with Section 50.55a(a)(3) of Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a(a)(3)).

Sections IV.A and IV.B of the First Revised Order provide criteria to categorize each plant's RPV head with respect to its susceptibility to primary water stress corrosion cracking (PWSCC). For plants like Palo Verde Nuclear Generating Station, Unit 1, with an RPV head categorized as highly susceptible to PWSCC, Section IV.C.(1) of the First Revised Order requires that the RPV head penetration nozzles be inspected each refueling outage as prescribed in Sections IV.C.(5)(a) and IV.C.(5)(b).

By letter dated January 14, 2004, and its supplements dated March 11, April 9, and April 23, 2004, Arizona Public Service Company (APS or the licensee) requested relaxation for the RPV head vent nozzles from the requirements of Section IV.C.(1) of the First Revised Order for the Palo Verde Nuclear Generating Station (PVNGS), Units 1, 2, and 3. By letter dated April 23, 2004, the licensee modified their request to be applicable to the PVNGS Unit 1 RPV head vent nozzle only, and only for the next full cycle of operation (approximately 18 months) that begins following the current refueling outage. The relaxation request was made pursuant to the procedure specified in Section IV.F of the First Revised Order. Specifically, APS stated that compliance with the First Revised Order would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The staff has reviewed and evaluated the information provided in support of your request for relaxation as documented in the enclosed safety evaluation (SE). The staff's SE concludes that APS has demonstrated good cause for the requested relaxation and that compliance with this First Revised Order for the PVNGS Unit 1 RPV head vent nozzle would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to Section IV, paragraph F, of the First Revised Order, the staff authorizes the proposed relaxation and alternative inspection for the PVNGS Unit 1 RPV head vent nozzle for one operating cycle.

You should be aware that, when vessel head inspections are performed using ASME Code requirements, acceptance criteria, or qualified personnel, those activities and all related activities fall within the jurisdiction of the ASME Code. Therefore, Order-related inspection activities may be subject to third party review, including those by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

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

Docket No. STN 50-528

Enclosure: Safety Evaluation

cc w/encl: See next page

April 30, 2004

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/RA/

Herbert N. Berkow, Director
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Division of Licensing Project Management
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELAXATION OF THE REQUIREMENTS OF FIRST REVISED ORDER

MODIFYING LICENSES EA-03-009

ARIZONA PUBLIC SERVICE COMPANY, ET AL.

DOCKET NO. STN 50-528

PALO VERDE NUCLEAR GENERATING STATION, UNIT 1

1.0 INTRODUCTION

The First Revised Order Modifying Licenses EA-03-009 (hereinafter referred to as Order), issued on February 20, 2004, requires specific examinations of the reactor pressure vessel (RPV) head and vessel head penetration (VHP) nozzles of all pressurized water reactor (PWR) 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 staff using the procedure for evaluating proposed alternatives to the American Society of Mechanical Engineers (ASME) Code in accordance with 10 CFR 50.55a(a)(3). 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 a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

For Palo Verde Nuclear Generating Station (PVNGS), Unit 1, and similar plants determined to have a high susceptibility to primary water stress corrosion cracking (PWSCC) in accordance with Section IV, paragraphs A and B, of the Order, the following inspections are required to be performed every refueling outage in accordance with Section IV, paragraphs C.(5)(a) and (b) of the Order:

(a) Bare metal visual (BMV) examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle). For RPV heads with the surface obscured by support structure interferences which are located at RPV head elevations downslope from the outermost RPV head penetration, a bare metal visual inspection of no less than 95 percent of the RPV head surface may be performed provided that the examination shall include those areas of the RPV head upslope and downslope from the support structure interference to identify any evidence of boron or corrosive product. Should any evidence of boron or corrosive product be identified, the licensee shall examine the RPV head surface under the support structure to ensure that the RPV head is not degraded.

(b) For each penetration, perform a nonvisual NDE in accordance with either (i), (ii), or (iii):

(i) Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater. In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.

(ii) Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater.

(iii) A combination of (i) and (ii) to cover equivalent volumes, surfaces, and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:

1. On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.

2. On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed.

By letter dated January 14, 2004, as supplemented by letters dated March 11, April 9, and April 23, 2004, Arizona Public Service Company (APS or the licensee) requested relaxation for the RPV head vent nozzles from the requirements of Section IV.C.(1) of the Order for PVNGS Units 1, 2, and 3. In the letter dated April 23, 2004, the licensee modified their request to be applicable to the PVNGS Unit 1 RPV head vent nozzle only, and only for the next full cycle of operation (approximately 18 months) that begins following the current refueling outage. The relaxation request was made pursuant to the procedure specified in Section IV.F of the Order.

Specifically, APS stated that compliance with the Order would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 ORDER RELAXATION REQUEST FOR EXAMINATION COVERAGE FOR RPV HEAD VENT NOZZLE

2.1 Order Requirements for Which Relaxation is Requested

Section IV.C. of the Order requires, in part, that the inspections specified in Section IV.C.(5)(b) of the Order be performed every refueling outage for high susceptibility plants similar to PVNGS Unit 1.

The licensee has requested relaxation from Section IV.C.(5)(b) of the Order. The specific relaxation requested is identified below.

2.2 Licensee's Proposed Relaxation

The licensee seeks relaxation from the Order where inspection coverage is limited by an inaccessible area of the RPV head vent nozzle in PVNGS Unit 1, with respect to nondestructive examination (NDE).

The design of the PVNGS vent line nozzle contains a one-inch long orifice plug welded inside the vent line nozzle and adjacent to the one-fourth inch J-groove weld attaching the vent line nozzle to the reactor pressure vessel head. The position of the welded orifice makes the inside diameter of the vent line nozzle inaccessible to volumetric examinations.

The licensee's proposed relaxation is an alternative inspection consisting of a surface examination of the RPV head vent nozzle J-groove weld including the surface of the nozzle orifice attachment weld.

2.3 Licensee's Basis for Proposed Relaxation

The licensee stated that compliance with the Order would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The hardship argument provided by the licensee is the substantial amount of radiological dose (approximately 80 to 100 man rem) that would be incurred if the PVNGS Unit 1 RPV head vent was inspected during the Spring 2004 refueling outage in accordance with the Order requirements, using equipment and procedures currently available to the licensee. The licensee stated that most of this dose would be averted if sufficient time was available to develop engineering tooling and implementation techniques, with the potential for incurring radiological doses of less that 25 man rem. The licensee committed to develop the special tooling and techniques needed and make the necessary design changes to ensure that future examinations of the reactor vessel head vent nozzle can be performed in accordance with the NRC Order without reliance on a relaxation similar to the one discussed in this safety evaluation.

The licensee stated that there would not be a compensating increase in the level of quality and safety if the inspection requirements of the Order were followed, compared to the alternative examination conducted by the licensee during the Spring 2004 refueling outage for PVNGS Unit 1. The licensee's alternative examination was a surface examination of the RPV head vent nozzle J-groove weld including the surface of the nozzle orifice attachment weld, in conjunction with a bare-metal visual examination of the RPV head vent nozzle annulus area (360° around the nozzle). The licensee claims that the alternative examination would allow detection of leakage from the nozzle base metal or incipient cracking in the J-groove weld area and would demonstrate the structural integrity of the head vent nozzle. The current location of the orifice also provides a level of protection in the unlikely event leakage from this nozzle is undetected and causes a circumferential crack above the weld to develop leading to a nozzle ejection, since the orifice would limit the flow to within the capacity of a single charging pump.

The licensee supported this alternative examination with a postulated flaw analysis, a small break loss-of-coolant accident (LOCA) analysis, additional safety margin for initial high susceptibility inspection, and with an engineering survey of various options to fully meet the Order inspection requirements. Each of these four supporting reasons are discussed more fully below.

2.3.1 Postulated Flaw Analysis

The RPV head vent provides a penetration through the RPV head from which gasses are vented during plant start-up. The head vent line is 3/4-inch Schedule 80 pipe. The vent line nozzle is fabricated from Inconel 600 (SB-166) material. The installation of RPV head vent nozzles with a "slip fit" into the RPV head ensures there would be no obstruction preventing leakage through the RPV head vent nozzle or associated J-groove weld from being observed on the RPV head surface. The nozzle is attached to the carbon steel RPV head with a partial penetration J-groove weld. Inconel 600 weld material is used for the J-groove weld material. The vent line nozzle for each PVNGS Unit contains a one-inch long orifice plug equipped with a 7/32-inch orifice. The orifice plug is welded inside the nozzle, in contour with the inner surface of the RPV head and adjacent to the 1/4-inch J-groove weld attaching the vent line nozzle to the RPV head.

The licensee based the alternate examination's structural integrity assessment on an analysis of a postulated flaw in the uninspected region of the RPV head nozzle. Through this approach the licensee's analysis indicates that an initial flaw in the high stress region would take more than two effective full power years for the crack to grow from the assumed initial surface flaw to a through-wall flaw, and many years longer from the time of crack initiation. The licensee assumed the initial flaw to be an axial inside surface flaw with a flaw length of 0.048" and an initial flaw depth of 0.008". The licensee concluded that this initial flaw size was conservative because approximately 90 head vents in nuclear power reactors worldwide have been inspected since the issue originated in the early 90's, and no flaw indications or leaks requiring repair have been found.

2.3.2 Small Break LOCA Basis

The licensee concluded, in the unlikely event that an undetected flaw in the head vent nozzle resulted in a through-wall crack while the unit was at power, the associated safety concerns

with this possibility are bounded by the PVNGS design basis accidents contained in the Updated Final Safety Analysis Report (UFSAR) . A small break LOCA may be postulated to occur as a result of an RPV head vent nozzle ejection, or due to degradation and rupture of the vent line such that the orifice does not perform its intended safety function. Analysis contained in the PVNGS UFSAR demonstrate that if an RPV head vent nozzle were ejected (with the associated orifice), the break flow from the resulting small break LOCA would exceed the capacity of the normal reactor coolant makeup water system, resulting in the actuation of the emergency core cooling system (ECCS). The licensee stated that the anticipated break size resulting from an RPV head vent nozzle ejection was enveloped by the spectrum of small break LOCA analyzed in the UFSAR.

In the event of an RPV head vent line rupture downstream of the orifice plug, the resulting RCS inventory loss could be successfully mitigated by the normal reactor coolant makeup system, without challenging the ECCS.

2.3.3 Additional Safety Margin for Initial High Susceptibility Inspection

The licensee assessed that additional safety margin would be realized due to the fact that the ongoing inspection outage for PVNGS Unit 1 would be the first inspection period as a high susceptibility plant. High susceptibility plants are defined in the Order as plants which have 12 or more effective degradation years (EDY) or plants that have experienced PWSCC in head penetrations. At the beginning of the Spring 2004 refueling outage for PVNGS Unit 1, the EDY was calculated to be 12.30. None of PVNGS units have experienced PWSCC in any head penetration. The fact that Unit 1 has an EDY value just above the threshold for classification as a "high susceptibility" plant provides additional margin for safety for the proposed relaxation request.

2.3.4 Various Options to Fully Meet the Order Inspection Requirements

The licensee considered several options to provide for the ability to perform a volumetric examination of the vent line nozzle. These options were:

A. Removal of the vent line orifice to conduct the volumetric inspection of the nozzle, followed by re-installation of the vent line orifice. As currently envisioned, removal of the orifice would be accomplished using an electrode discharge machining (EDM) process, followed by a mechanical machining operation to obtain a final surface conducive to the performance of the volumetric examination. The orifice would then be welded back in place. Tooling development and personnel qualifications to allow remote operations for this option cannot be accomplished in a reasonable time frame. Therefore, the radiological dose that would be incurred is substantial (approximately 80 to 100 man rem). In addition, there are several factors which indicate this is not a repeatable (i.e., every refueling outage) process. There is a concern that the orifice removal process could increase the penetration nozzle’s susceptibility to PWSCC and accelerate crack growth rates in the nozzle material.

B. Removal and relocation of the vent line orifice. The tooling development and qualification of the orifice removal process, and the corresponding hardships and concerns regarding increasing the susceptibility of the penetration to PWSCC, are the

same as described above in Option A. The relocation of the orifice would also introduce design and licensing basis issues, including an increase in the probability of a postulated line break of the vent line.

C. Replace the current Alloy 600 vent line and orifice with stainless steel counterparts. The licensee stated that this alternative is extremely complex, the planning and engineering has not been performed, the physical activities are complicated and not prepared for (no training, mockups, qualifications, or procedures have been developed), and is very dose intensive.

The licensee asserts that the hardships associated with implementing any of these options during the current Unit 1 refueling outage are not commensurate with the resulting increase in the level of quality and safety. The alternate inspection proposed, combined with the presence of the flow-limiting orifice at its current location, provide a significant level of protection against the affects of PWSCC of the vent line nozzle. The bare-metal visual inspection of the vent line penetration would readily detect any leakage that might occur from the vent line nozzle due to the affects of PWSCC. Unlike the control element drive mechanism nozzle penetrations that have an interference fit with the reactor vessel head, the RPV head vent line nozzle has a clearance fit arrangement. Through-wall cracks in either the nozzle or the J-groove weld would produce visual evidence of leakage that can be detected by the 360 degree top-of-the-head bare metal visual examination of the nozzle-head annulus.

2.3.5 Licensee's Commitment to Perform Future Inspections of the RPV Head Vent in Accordance with the Order

The licensee committed to develop the special tooling and techniques needed and make the necessary design changes to ensure that future inspections of the reactor vessel head vent nozzle can be performed in accordance with the NRC Order without reliance on a relaxation similar to the one discussed in this safety evaluation.

The licensee performed a review of the steps required to perform an examination of the RPV head vent nozzle using the current radiological condition in PVNGS Unit 1. The inspection would be performed without reliance on the previously submitted relaxation to the Order. The results of the review determined that the radiological dose that would be incurred for the inspection during the Unit 1 Spring 2004 refueling outage, including the manual actions necessary to obtain an acceptable examination, would be approximately 80 to 100 man rem.

The licensee's commitment to pursue the development of engineered tooling and implementation techniques and to plan the necessary activities, will save a significant amount of radiation exposure during future examinations. The licensee anticipated that special tooling and mockups could be developed along with the necessary changes to complete the examination in the 2004 Fall outage for PVNGS Unit 3, and potentially incur a radiological dose of less than an estimated 25 man rem. The savings in dose is estimated to be substantial due to the development of engineered tooling and implementation techniques that would enable some of the tasks to be performed remotely instead of manually in close proximity to the high radiation fields of the reactor vessel head.

2.4 Evaluation

The staff's review of this request was based on criterion (2) of Section IV.F 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 staff agrees that the licensee has presented a convincing discussion regarding the hardships involved if inspections of the RPV head vent nozzle were conducted in accordance with the Order during the Spring 2004 Unit 1 refueling outage. If such inspections were conducted during this outage, the licensee estimated that the radioactive dose to its personnel would be approximately 80 to 100 man rem. The dose estimates provided by the licensee for future inspections of the RPV head vent, based on the commitment by the licensee to develop the special tooling and mockups along with the necessary design changes, are less than 25 man rem. The considerable savings in radiological dose, approximately 55 to 75 man rem, is a valid hardship argument for not conducting inspections of the RPV head vent nozzle during the current refueling outage in accordance with the Order.

The staff reviewed the alternative examinations proposed by the licensee, along with the other analysis and factors presented by the licensee, to determine if compliance with the Order would provide for a compensating increase in the level of quality and safety. Each of the discussions provided by the licensee are evaluated separately below, followed by an overall evaluation by the staff of the licensee's alternative examination compared to the inspections required by the Order.

2.4.1 Evaluation of Postulated Flaw Analysis

The licensee's determination that the initial flaw size present in the head vent nozzle be one which would be larger than the minimum detectable flaw size is a reasonable assumption, but is not completely justifiable without having performed an inside diameter inspection of the RPV head vent nozzle, as no minimum detectable flaw size can be established. The bare-metal visual examination of the RPV head vent nozzle to RPV head surface interface will provide confidence that no through-wall cracking has occurred. However, the BMV examination will not provide sufficient basis to conclude with a high degree of confidence that the reactor pressure boundary integrity will remain intact until the next plant refueling outage. The staff cannot conclude that there will not be flaws greater than that assumed by the licensee in their analysis, and therefore cannot conclude on the acceptability of the licensee's proposed alternative examination based on this factor alone.

The licensee's assessment of post inspection results from other domestic and international facilities which have not identified PWSCC in RPV head vent nozzles is supportive of the licensee's alternative inspection plan. No cracking or leaks have been found in the RPV head vent through non-destructive evaluation of fourteen U.S. PWRs in the high susceptibility category of the Order. However, the applicability of the operating history for foreign power plants is limited. Analysis of the foreign experience of cracking in RPV head vent lines

indicates very few plants were at sufficient EDY to be categorized as high susceptibility plants in accordance with the Order.

2.4.2 Evaluation of Small Break LOCA Basis

The basis upon which the Order provides reasonable assurance of public health and safety is prevention of a situation (i.e., through-wall cracks) that could lead to reactor coolant leakage or a LOCA; the basis for the Order does not include reliance on the performance of ECCS systems to safely mitigate a postulated LOCA. However, with the full performance of the Order's high susceptibility inspection requirements on all other RPV head penetrations, the LOCA analysis could provide some additional assurance of public health and safety in the short term for one RPV head penetration not being volumetrically inspected. Long-term reliance on the ability of ECCS to mitigate LOCAs would not be an effective solution to provide reasonable assurance of public health and safety from a known degradation method of a susceptible material.

2.4.3 Evaluation of Additional Safety Margin for Initial High Susceptibility Inspection

The Order's time-at-temperature model used to determine susceptibility rankings for nickel based alloy penetration nozzles and associated welds in PWR RPV heads is an effective tool, to date, in prioritizing inspection requirements. Of the ten plants which have identified leaking RPV head penetrations, all have been from the High susceptibility category. All plants have performed inspections to effectively identify leakage at least once since the year 2001. Of the fourteen plants which have identified cracks in their RPV head penetrations or associated J-groove welds, all but one were in the high susceptibility category. The one plant in the Moderate susceptibility category had an effective degradation year calculation of 11.6, just below the 12.0 EDY entrance level into the high susceptibility category.

The PVNGS Unit 1 RPV head susceptibility calculation performed in accordance with the requirements of the Order yields an age of 12.3 EDY. The staff estimates the PVNGS Unit 1 RPV head susceptibility will be at a maximum value of 13.6 EDY at the plant's next refueling outage. Cracking has been identified in three RPV head penetration nozzles at 11.6 EDY and twelve more RPV head penetration nozzles at 12.8 EDY in one plant. Additionally in an estimated second operational cycle of susceptibility range (13.6 EDY to 14.9 EDY), two plants have found PWSCC indications at 13.9 EDY and approximately 14 EDY. No leakage indications were reported by these plants during their respective inspections.

While there is limited operational experience that would seem to suggest that the possibility of leakage from nozzles for plants performing their first high susceptibility inspection to meet the requirements of the Order is rather low, there is not convincing data to strongly rely on this factor by itself to approve the licensee's alternative examination.

2.4.4 Evaluation of Licensee's Options to Fully Meet the Order Inspection Requirements

The staff limited its review of the licensee's options to assure that an engineering solution could be developed that would allow the licensee to fully meet the inspection requirements of the Order for the RPV head vent during future refueling outages for all the PVNGS units. The staff concluded that either relocating the orifice plug, or replacing the head vent line and nozzle

(Options B and C in Section 2.3.4 of this safety evaluation) would allow future inspections to be conducted in accordance with the Order. The staff agrees with the licensee that removal and replacement of the orifice plug (Option A in Section 2.3.4) is not practical as a long-term inspection solution, as a substantial portion of the reactor head material would also have to be removed, ultimately resulting in an unacceptable and impractical configuration.

2.4.5 Licensee's Commitment to Perform Future Inspections of the RPV Head Vent in Accordance with the Order

As stated in Section 2.3.5 above, the licensee committed to develop the special tooling and techniques and make the necessary changes to ensure future examinations of the RPV head vent nozzle can be performed in accordance with the NRC Order without reliance on a relaxation similar to that evaluated herein.

The staff limited its review of this commitment to assure that the radiological dose savings reported by the licensee would represent sufficient hardship to warrant approving the alternate inspections proposed by the licensee. The staff requested this commitment by the licensee to ensure a modification of the RPV head vent would be sufficiently conceived to effectively mitigate the exposure hardship through as-low-as-reasonably achievable (ALARA) engineered work procedures versus the licensee's initial modification option to remove and reinstall the orifice plug each refueling outage for the remaining life of the plant.

As stated in Section 2.4 of this safety evaluation, the staff agrees that the licensee has presented a convincing argument regarding the hardships involved if inspections of the RPV head vent nozzle were conducted in accordance with the Order during the Spring 2004 Unit 1 refueling outage. If such inspections were conducted during this outage, the licensee estimated that the radioactive dose to its personnel would be approximately 80 to 100 man rem. The dose estimates provided by the licensee for future inspections of the RPV head vent, based on the commitment by the licensee to develop the special tooling and mockups along with the necessary design changes, are less than 25 man rem. The considerable savings in radiological dose, approximately 55 to 75 man rem, is a valid hardship argument for not conducting inspections of the RPV head vent nozzle in accordance with the Order.

2.4.6 Proposed Alternative Inspections Provide Reasonable Assurance of Safety

While the staff concludes that no single factor presented by the licensee is sufficient to assure the structural integrity of the PVNGS Unit 1 RPV head vent for the life of the unit, the aggregate of the information supplied by the licensee, in conjunction with the staff's evaluation of previous and current inspection results, does provide reasonable assurance of the structural integrity of the PVNGS Unit 1 RPV head vent and associated RPV head area for one operational cycle of 18 months. The inspection conducted during the current refueling outage for PVNGS Unit 1 is its first under the high susceptibility inspection requirements of the Order. No cracking or leaks have been found in the RPV head vent through non-destructive evaluation of fourteen U.S. PWRs in the high susceptibility category of the Order. The alternative inspection performed at PVNGS Unit 1 during the current outage found no indications of leakage through a bare metal visual examination of the RPV head vent to RPV head interface. Due to the "slip fit" configuration of the RPV head vent nozzle into the RPV head, leakage through the reactor

pressure boundary on the RPV head surface should not be obstructed. The alternative inspection also found no flaw indications in the RPV head vent nozzle bottom surface and J-groove weld.

3.0 CONCLUSION

The staff concludes for PVNGS Unit 1 only, that compliance with the Order for the RPV head vent nozzle and associated RPV head area for the current refueling outage would result in a hardship without a compensating increase in the level of quality and safety. The staff concludes that the considerable savings in radiological dose, approximately 55 to 75 man rem, is a valid hardship argument for not conducting inspections of the RPV head vent nozzle in accordance with the Order during the Unit 1 Spring 2004 refueling outage. Requiring the licensee to perform the Order-required examination during this outage, while recognizing that the licensee will be in a position to perform future inspections at Unit 1 at greatly reduced radiological exposure, would result in hardship without a compensating increase in the level of quality and safety. The licensee's proposed alternative examination of the RPV head vent nozzle provides reasonable assurance of the structural integrity of the RPV head vent and associated RPV head area until the next refueling outage, at which time, as committed by the licensee, it will have performed an effective engineering modification which will provide a permanent solution to allow effective inspection of the RPV head vent nozzle for the remaining life of the plant in accordance with the requirements of the Order.

The staff concludes that there is sufficient time available for the licensee to fully investigate and plan for options and effectively mitigate exposure hardships through ALARA engineered work procedures prior to the next refueling outage for any of the three units. Therefore, the hardship argument that is valid for the Spring 2004 refueling outage will not exist during future outages, and no relaxation from the requirements of the Order for any future outages of the PVNGS units is justified.

Therefore, pursuant to Section IV.F of the Order, the staff authorizes the proposed alternative inspection for the PVNGS Unit 1 RPV head vent nozzle for one operating cycle that follows the Spring 2004 refueling outage.

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Date: April 30, 2004