APS

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EA-03-009
Bulletin 2003-02
Bulletin 2004-01

102-05207-CDM/SAB/RJR
February 4, 2005

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 3
Docket No. STN 50-530
APS' 60-Day after Plant Restart Letter in Response to First Revised NRC Order EA-03-009, Item IV.E, NRC Bulletin 2003-02, Commitment No. 3 and NRC Bulletin 2004-01, Commitment No. 2 – U3R11

First Revised NRC Order EA-3-009, Item IV.E, NRC Bulletin 2003-02, Item (2) and NRC Bulletin 2004-01, Item 2(a) requested that a report detailing the inspection results of the reactor pressure vessel (RPV) head, the bottom mounted instrumentation (BMI) nozzles and pressurizer Alloy 82/182/600 penetrations be submitted to the NRC within 60 days of returning Unit 3 to operation. On December 7, 2004, Arizona Public Service Company (APS) completed Unit 3's 11th refueling outage.

The enclosure to this letter contains the following requested information.

First Revised NRC Order EA-03-009, Unit 3 Reactor Pressure Vessel Head:

- Inspection results for each inspection required by Paragraph C of the Order.
- Inspection results for each inspection required by Paragraph D of the Order.

Additionally, this section of the enclosure contains a discussion of a leak above the reactor pressure vessel head that occurred during a venting operation of the control element drive mechanisms.

NRC Bulletin 2003-02, Unit 3 BMI inspection:

- A summary of the inspections performed.
- The extent of the inspections.
- The inspection methods used.
- A description of the "as-found" condition of the lower head.

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- Any findings of relevant indications of through-wall leakage.
- A summary of the disposition of any findings of boric acid deposits and any corrective actions taken as a result of indications found.

NRC Bulletin 2004-01, Unit 3 pressurizer Alloy 82/182/600 penetrations and steam space piping connections:

- A statement indicating that the inspections described in the APS response to item (1)(c) of NRC Bulletin 2004-01 was completed.
- A description of the as-found condition of the pressurizer shell.
- A description of any findings of relevant indications of through-wall leakage.
- A description of follow-up NDE performed to characterize flaws in leaking penetrations or steam space piping connections.
- A summary of all relevant indications found by NDE.
- A summary of the disposition of any findings of boric acid.
- A description of any corrective actions taken and/or repairs made as a result of the indications found.

No new commitments are being made to the NRC by this letter. Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

CDM/SAB/RJR/

Enclosure: PVNGS' Unit 3 60-day Report Detailing the Inspection Results of the Reactor Pressure Vessel Head, the Bottom Mounted Instrumentation Nozzles and the Pressurizer Alloy 82/182/600 Penetrations and Steam Space Piping Connections

cc: B. S. Mallett — NRC Region IV Regional Administrator
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G. G. Warnick — NRC Senior Resident Inspector for PVNGS

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Enclosure

PVNGS' Unit 3 60-day Report Detailing the Inspection Results of the Reactor Pressure Vessel Head, the Bottom Mounted Instrumentation Nozzles and the Pressurizer Alloy 82/182/600 Penetrations and Steam Space Piping Connections

First Revised NRC Order EA-03-009

At the start of the Unit 3 11th refueling outage (U3R11) in the fall of 2004, the effective degradation years (EDY) were previously predicted as 12.22 EDY[1]. In accordance with the First Revised NRC Order, this places Unit 3 in the high susceptibility category.

Results of the Inspection Required by the First Revised NRC Order, EA-03-009

First Revised NRC Order EA-03-009 IV.C.(1) states that:

For those plants in the High Susceptibility category, RPV head and head penetration nozzle inspections shall be performed using the techniques of paragraph IV.C.(5)(a) and paragraph IV.C.(5)(b) every refueling outage.

IV.C.(5)(a) Bare metal visual examination of 100 percent 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 down slope 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 down slope 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 [see Figure IV-1]); 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 (see Figure IV-2). In addition, an assessment shall be made to determine if leakage has occurred

1. Letter 102-04968-GRO/SAB/RJR, "Effective Degradation Years for PVNGS Units 1, 2, and 3," dated July 17, 2003.

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 [see Figure IV-3]); 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 (see Figure IV-4).

(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.

IV.C.(5)(a) Bare Metal Visual Examination Results

This examination was conducted in accordance with the requirements of the First Revised Order with no relaxations. During the visual inspection of the RPV head surface, APS identified some staining from Nalco. Nalco is an additive used in the nuclear cooling water system that produces a non-crystalline residue. No cleaning of the RPV head was necessary during U3R11. The visual examination of the "bare-metal" surface of the reactor head found no evidence of boron or corrosion.

IV.C.(5)(b) Nonvisual Nondestructive Examination (NDE) Results:

Nonvisual NDE was performed in accordance with the requirements of the First Revised NRC Order EA-03-009 Section IV.C.(5)(b) and approved relaxations and commitments.

Reactor Head Vent Nozzle:

In preparation for the inspection identified in Section IV.C.(5)(b) of the First Revised NRC Order, APS modified the reactor head vent nozzle. The completed modification of the head vent nozzle removed and permanently relocated the internal orifice. Upon removal of the orifice, APS performed a surface examination (eddy current) of the J-groove weld and inside nozzle surface as required. The head vent nozzle does not protrude below the surface of the RPV head. As a result, there is no material below the J-groove weld to be examined (see Figure 1). No flaws were found during this examination.

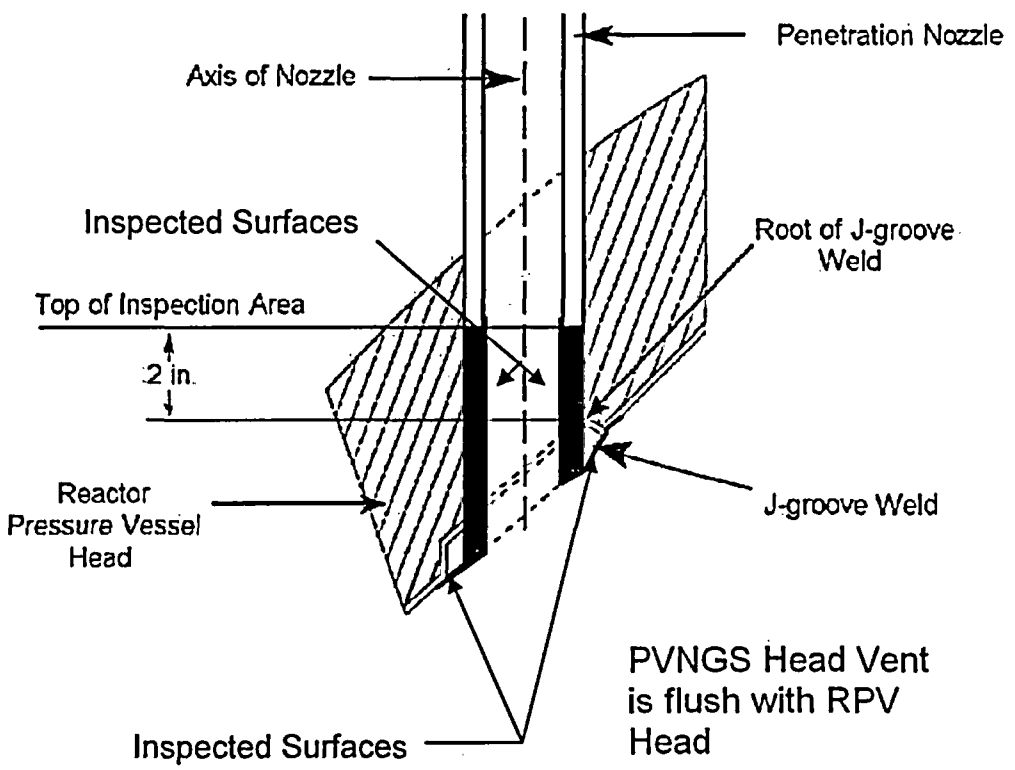

Figure 1

Control Element Drive Mechanism Nozzles:

As previously communicated to the NRC[2], APS stated that nozzles receiving the minimum inspection coverage, but less than 1-inch inspection coverage, will be reported in accordance with First Revised NRC Order Section IV.E. This information is provided in the attachment to this enclosure.

The minimum required inspection coverage described in Reference 1 and revised by Reference 2 was obtained for all nozzles using ultrasonic or eddy current examination. No flaws were identified.

First Revised NRC Order EA-03-009 Section IV.D. states that:

During each refueling outage, visual inspections shall be performed to identify potential boric acid leaks from pressure-retaining components above the RPV head. For any plant with boron deposits on the surface of the RPV head or related insulation, discovered either during the inspections required by this Order or otherwise and regardless of the source of the deposit, before returning the plant to operation the Licensee shall perform inspections of the affected RPV head surface and penetrations appropriate to the conditions found to verify the integrity of the affected area and penetrations.

Results:

APS personnel performed a Boric Acid Walkdown (BAW) for the U3R11 refueling outage using Work Order 2740831. Potential boric acid leak sites from pressure retaining components above the RPV Head were examined using PVNGS procedure 70TI-9ZC01, Boric Acid Corrosion Prevention Program. One leak site above the reactor head was identified (Versa-Vent 29) at the start of the outage. At the end of the outage during the Mode 3 walkdown, an additional leak site above the reactor head was identified (Versa Vent 41). The following describes the findings:

CEDM Versa Vent No. 29

No active leak was identified. The leakage stayed in the area of the vent and did not contact the reactor head or insulation. The boric acid did not affect any carbon steel and there was no non-conforming condition. The dry boric acid residue was cleaned and all of the Versa-Vent assemblies were reworked during U3R11.

CEDM VERSA VENT No. 41

No active leak was identified. The leakage stayed in the area of the vent and did not contact the reactor head or insulation. No carbon steel was affected and

2. Letter 102-05075-CDM/SAB/RJR, "Relief Request No. 25 - Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles," dated March 19, 2004.

there was no non-conforming condition. This leak trail was not cleaned as cleaning would have required a major disassembly of the CEDM main power and position indication cables. This Versa-Vent will be reworked under Work Order 2759048.

During the venting of the Unit 3 CEDM housings on November 30, 2004, the tygon vent hose used for this venting developed a leak. The leak resulted in estimated spillage of 6 to 12 fluid ounces of reactor coolant system water. The leakage was in the southeast quadrant of the reactor head. The region below the leakage was visually examined on December 1, 2004, from the 140 ft. elevation (cable support structure); no evidence of dried boron or other adverse conditions were identified.

NRC Bulletin 2003-02,
Bottom Mounted Instrumentation (BMI) Inspection

Summary of the Inspections Performed

An "as-found" inspection of all 61 penetrations (360° around each nozzle-bottom head interface) was performed by an APS Level III VT-2 qualified examiner using remote operated robotic camera equipment with zoom capabilities. Cleaning of the nozzle-head interface area was started during this outage. However, APS was unable to complete the cleaning process to allow performance of a "bare-metal" visual inspection of all 61 bottom mounted nozzles. A "bare-metal" zone was achieved on 23 of the 61 nozzles before implementation problems developed. Due to the size of the cleaning robot, this robot could not reach the lowest nozzles (center) and because of balance and stability issues, this robot could not clean the tallest nozzles (peripheral).

No boric acid deposits were noted in the area of the nozzle annulus during the "as-found" inspection.

Extent of the Inspections

An initial visual inspection of all 61 penetrations was performed using a robot-mounted camera. The camera included a zoom feature. The maneuverability of the robot allowed the inspection 360° coverage around each nozzle-bottom head interface and was completed prior to any cleaning being attempted. A "bare-metal" zone was achieved on 23 of the 61 nozzles before implementation problems developed. The thirty-eight nozzles that remain to be cleaned are scheduled for the next refueling outage in Unit 3 in the spring of 2006.

Inspection Methods Used

The "as-found" inspection of all 61 penetrations (360° around each nozzle-bottom head interface) was performed by an APS Level III VT-2 qualified examiner using robotic equipment with zoom capabilities. The post cleaning "bare-metal" inspection was also performed by an APS Level III VT-2 qualified examiner using robotic equipment with zoom capabilities.

Description of the "As-found" Condition of the Lower Head

As expected from the previous Unit 3 scoping walkdown performed in the spring of 2003, a residual spray-lat coating, caulking, and other foreign material were found adhered to the Unit 3 BMI nozzles in the area of the nozzle-bottom head interface. Although there was some minor bridging and blockage of the nozzle annulus observed, the bridging/blockage did not restrict the visual inspection. These nozzles are assembled with a clearance fit. This type of fit provides sufficient radial clearance

around the nozzle to perform the required visual inspection. No boric acid deposits were noted in the area of the nozzle annulus during the "as-found" inspection.

Streaks and stains were observed on the outside of the bottom head from previous fuel pool seal leakage. Corrective Action document 2600546 contains the evaluation of this condition and is described below. No corrosion of the carbon steel shell was observed.

Any Findings of Relevant Indications of Through-wall Leakage

There was no indication of through-wall leakage.

Summary of the disposition of any Findings of Boric Acid Deposits and any Corrective Actions Taken as a Result of Indications Found

As stated above, there were no boric acid deposits noted in the area of the nozzle annulus during the "as-found" inspection and there was no evidence of leakage from any bottom-mounted nozzle. Corrective action document CRDR 2600546 evaluated the streaks and stains observed on the outside of the bottom head. The Engineering evaluation performed concluded that the staining observed was from leakage caused by loss of air to the temporary pool seals in 1988 and leakage from a heated junction thermo-couple seal weld in 1987.

Based on the current visual inspection, APS concludes that PVNGS Unit 3 meets applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.

NRC Bulletin 2004-01
Pressurizer Alloy 82/182/600 Penetrations and Steam Space Piping Connection Inspections

During the Unit 3 Refueling Outage 11, APS completed the inspections described in letter 102-05130, APS' 60-Day Response to the Information Requested by NRC Bulletin 2004-01, dated July 22, 2004.

Description of the as-found condition of the pressurizer shell

Normally, PVNGS only visually examines the pressurizer shell exposed by the gap between the insulation and the heater sleeves and other nozzles. However, during the heater sleeve modification project performed in Unit 3, the bottom shell insulation was removed and no corrosion was seen.

Description of any findings of relevant indications of through-wall leakage

The Unit 3 pressurizer had three heater sleeves that were repaired during previous outages, A01, A03 and A15. These were repaired using a mechanical nozzle seal assembly (MNSA) approved by the NRC[3] for this application. There were no relevant indications of through-wall leakage during the inspection of the Unit 3 pressurizer heater sleeves including the 3 sleeves previously repaired.

Description of follow-up NDE performed to characterize flaws in leaking penetrations or steam space piping connections

No additional follow-up NDE was required based on the initial eddy current results.

Summary of all relevant indications found by NDE

- A01 - Seven axial indications with growth.
- A03 - multiple axial indications, one circumferential indication above the weld.
- A15 - no indications.

Summary of the disposition of any findings of boric acid

No boric acid residue was identified during the inspection of the Unit 3 pressurizer.

3. NRC letter to APS, "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Request for Code Alternative for the Use of Mechanical Nozzle Seal Assemblies – Relief Request No. 17 (TAC NOS. MB1618, MB1619, and MB1620)", dated October 10, 2001.

Description of any corrective actions taken and/or repairs made as a result of the indications found

Although there was no visual evidence of boron leakage identified at the start of the outage, APS had previously decided to permanently modify the heater sleeves during 3R11. All 36 heater sleeves, including the three previously repaired using a MNSA, were modified using the ½ nozzle repair technique. The original heater sleeve was cut at a location within the pressurizer lower shell. A weld pad of Alloy 690 was overlaid on the exterior surface of the shell. New Alloy 690 ½ sleeves were inserted and attached to the weld pad. This repair resulted in the relocation of the ASME Pressure boundary weld from the inside surface to the outside surface of the pressurizer shell. The repairs were made using Alloy 690 material. These sleeves were installed using an ambient temperature gas-tungsten arc welding (GTAW) technique that is described in APS Relief Request 23 approved by the NRC on July 30, 2003.[4]

References:

1. Letter 102-05075-CDM/SAB/RJR, "Relief Request No. 25 - Request for Relaxation of First Revised NRC Order EA-03-009, Section IV.C.(5)(b) Requirements for CEDM Nozzles," dated March 19, 2004.

2. Letter 102-05123-CDM/SAB/RMW, "First Revised NRC Order EA-03-009 – Additional Analysis Information for Control Element Drive Mechanism (CEDM) Nozzles," dated July 01, 2004.

3. Letter 102-05000-CDM/SAB/RJR, "APS'30-Day Response to the Information Requested by NRC Bulletin 2003-02,'" dated September 19, 2003.

4. Letter 102-05130-CDM/SAB/RJR, "APS' 60-Day Response to the Information Requested by NRC Bulletin 2004-01," dated July 22, 2004.

4. NRC letter to APS, "Palo Verde Nuclear Generating Station, Units 1, 2, and 3 – Relief Request No. 23 RE: Alternative to Temper Bead Welding Requirements for Inservice Inspection Program (TAC NOS. MB8973, MB8974, and MB8975)."

Attachment

Unit 3 Table of Examination Distances below the J-Groove Weld on the Downhill Side of the CEDM Nozzles

Unit 3 Table of Examination Distances below the J-Groove Weld on the Downhill Side of the CEDM Nozzles

Pen #	Lower Exam Extent	Minimum Required[1]	Pen #	Lower Exam Extent	Minimum Required[1]	Pen #	Lower Exam Extent	Minimum Required[1]	Pen #	Lower Exam Extent	Minimum Required[1]
1	1.24	0.40	26	1.12	0.40	51	1.32	0.35	76	0.80	0.35
2	1.72	0.40	27	1.32	0.40	52	1.12	0.35	77	0.72	0.35
3	1.28	0.40	28	0.95	0.40	53	0.84	0.35	78	0.56	0.35
4	1.40	0.40	29	1.12	0.40	54	0.72	0.35	79	0.92	0.35
5	1.44	0.40	30	1.12	0.35	55	0.80	0.35	80	0.72	0.35
6	1.32	0.40	31	1.12	0.35	56	0.88	0.35	81	0.92	0.35
7	1.40	0.40	32	1.04	0.35	57	1.00	0.35	82	0.92	0.30
8	1.40	0.40	33	1.00	0.35	58	1.04	0.35	83	0.64	0.30
9	1.36	0.40	34	1.12	0.35	59	0.76	0.35	84	0.60	0.30
10	1.20	0.40	35	1.16	0.35	60	0.88	0.35	85	0.48	0.30
11	1.20	0.40	36	1.20	0.35	61	0.88	0.35	86	0.48	0.20
12	1.24	0.40	37	1.24	0.35	62	1.04	0.35	87	0.56	0.20
13	1.44	0.40	38	1.00	0.35	63	1.04	0.35	88	0.76	0.20
14	1.28	0.40	39	1.14	0.35	64	1.08	0.35	89	0.56	0.20
15	1.40	0.40	40	1.08	0.35	65	0.68	0.35	90	0.84	0.30
16	1.32	0.40	41	1.12	0.35	66	0.80	0.35	91	0.60	0.30
17	1.31	0.40	42	1.16	0.35	67	0.88	0.35	92	0.56	0.30
18	1.28	0.40	43	1.20	0.35	68	0.68	0.35	93	0.48	0.30
19	1.12	0.40	44	1.04	0.35	69	0.96	0.35	94	0.48	0.30
20	1.16	0.40	45	1.00	0.35	70	0.86	0.35	95	0.72	0.30
21	1.28	0.40	46	1.20	0.35	71	1.02	0.35	96	0.60	0.30
22	1.04	0.40	47	0.92	0.35	72	0.84	0.35	97	0.88	0.30
23	1.16	0.40	48	1.24	0.35	73	1.28	0.35			
24	1.28	0.40	49	1.12	0.35	74	0.96	0.35			
25	1.16	0.40	50	1.04	0.35	75	0.84	0.35			

1. APS letters 102-0575, dated March 19, 2004 and 102-05123, dated July 01, 2004.