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

Palo Verde Nuclear Generating Station

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102-05424-CDM/SAB/RJR
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Reference APS letter 102-05126, "APS' 60-Day after Plant Restart Letter in Response to NRC Bulletin 2003-02, Commitment No. 3 and First Revised NRC Order EA-03-009, Item IV.E – U1R11," dated July 9, 2004.

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 1
Docket No. STN 50-528
"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 – U1R12"

NRC Bulletin 2003-02, Item 1(c) and First Revised NRC Order EA-03-009, Item IV.E both requested that a 60-day report detailing the inspection results of the bottom mounted instrumentation (BMI) nozzles and the reactor pressure vessel (RPV) head be submitted to the NRC upon returning Unit 1 to operation. On December 24, 2005, Arizona Public Service Company (APS) completed Unit 1's 12th refueling outage.

The enclosure to this letter contains the following requested information.

First Revised NRC Order EA-03-009 Unit 1 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.

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NRC Bulletin 2003-02, BMI inspection:

- A summary of the inspections performed.
- The extent of the inspections.
- The methods used.
- A description of the "as-found" condition of the lower head.
- 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 1 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. The referenced letter contains APS' previous response to these items as a result of Unit 1's 11th refueling outage. Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

James M. Levine
for CDM

CDM/SAB/RJR/ca

Enclosure: PVNGS' Unit 1 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 during the 12th Refueling Outage

cc: B. S. Mallett NRC Region IV Regional Administrator
M. B. Fields NRC NRR Project Manager
G. G. Warnick NRC Senior Resident Inspector for PVNGS

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Enclosure

PVNGS' Unit 1 60-day after Outage Report for the 12th Refueling Outage

First Revised NRC Order EA-03-009

At the start of the Unit 1 12th refueling outage (U1R12) in the fall of 2005, the effective degradation years (EDY) were calculated as 13.29 EDY, which places Unit 1 in the high susceptibility category.

Results of the Inspection Required by Paragraph IV.C

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 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 [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

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 conduced in accordance with the requirements of the First Revised Order with no relaxations. A visual examination of the "bare-metal" surface of the reactor head found no evidence of boron or corrosion. No cleaning of the RPV head was necessary during U1R12.

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 as identified in References 1 and 2.

Reactor Head Vent Nozzle:

In preparation for modifying the head vent nozzle in Unit 1 to remove the flow-restricting orifice, the vent penetration J-weld and orifice J-weld were examined with manual eddy current testing (ET) techniques. 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 nozzles at PVNGS do not protrude below the surface of the RPV head and as a result, there is no material below the J-groove weld to be examined. Although two areas of reduced wall dimension were noted, the results of the examinations were acceptable with no detectable defects.

The head vent orifice was relocated to a downstream flange.

Control Element Drive Mechanisms:

All 97 CEDM penetrations were examined in accordance with Order requirement IV.C (5)(b). Of these 97 penetrations, 84 were acceptable with no detectable defects and 13 had additional examinations performed as a result of areas of interest identified during the manual and rotating probe exams. The additional examinations performed on the 13 penetrations were acceptable with no detectable defects found. The results of these additional examinations were discussed with the NRC inspector reviewing ISI activities during the outage.

In Reference 1, APS stated that nozzles receiving the minimum inspection coverage, but less than 1-inch inspection coverage, will be reported in accordance with Order Section IV.E. The attachment to this enclosure contains a table identifying the lower examination extent and the minimum inspection coverage required from Table 1 of Reference 1.

With the exception of penetrations 87 and 93, the minimum required inspection coverage was obtained for all nozzles from the inside diameter. For penetrations No. 87, and 93, the minimum required inspection coverage described in Table 1 of Reference 1 could not be obtained using ultrasonic or eddy current examination from the inside diameter. The examination of penetrations 87, and 93 did cover the available distance on the inside diameter of each nozzle leaving no additional distance for examination. In accordance with Reference 2 (repeated below), APS performed additional examinations as discussed with the NRC on April 26, 2004 and described in Reference 3.

> "If APS is unable to perform an ultrasonic examination of the CEDM nozzles which meets the minimum required inspection distances identified in Tables 1 and 2 of the referenced letter [Reference 1 of this enclosure], then APS will perform a qualified surface examination on the remaining surface of the inside diameter and a qualified surface examination of the

outside diameter of the CEDM nozzle from below the J-groove weld to as low as practical, prior to plant startup."

The ultrasonic examination of penetrations 87 and 93 did cover the available distance on the inside diameter of each nozzle leaving no additional distance for examination. To meet this commitment, penetrations 87 and 93 were also examined from the outside diameter using a qualified surface exam. Penetration No. 87 was examined an additional 0.885" below the inside diameter chamfer and penetration No. 93 was examined an additional 1.000" below the inside diameter chamfer. Figure 1 in the attachment to this enclosure shows the overlap. No indications were identified.

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

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.

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

APS personnel performed a Boric Acid Walkdown (BAW) for the U1R12 refueling outage. 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. No leaks or evidence of leakage was found.

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

Summary of the Inspections Performed

APS performed a visual examination of all 61 bottom mounted instrumentation (BMI) nozzles at PVNGS Unit 1 during the 12th refueling outage. An APS Level III VT-2 qualified examiner using remote operated robotic camera equipment with zoom capabilities performed the "as-found" examination of all 61 penetrations (360° around each nozzle-bottom head interface). APS personnel did not find any boric acid deposits, but observed minor staining from previous fuel pool seal leakage on the vessel bottom. APS personnel noted some dry red oxide deposits on approximately one third of the BMI nozzles in the area of the annulus. No cleaning of the interface was required.

Extent of the Inspections

APS conducted a visual inspection of all 61 penetrations using a robot-mounted camera. The camera included a zoom and tilt feature calibrated to APS-VT-001 calibration standard. The maneuverability of the robot allowed a complete 360° inspection around each nozzle-bottom head interface. No cleaning of the bottom head was required.

Inspection Methods Used

The visual 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 and tilt capabilities.

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

As expected, there was some minor bridging and blockage of the nozzle annuluses. The bridging/blockage did not restrict the visual inspection. The CEDM 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. The 61 nozzles showed no evidence of leakage.

No cleaning of the nozzle-head interface was required.

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 annuluses during the "as-found" inspection and there was no evidence of leakage from any bottom-mounted nozzle. As previously reported in letter 102-05207, dated February 04, 2005, corrective action document CRDR 2600546 evaluated the streaks and stains observed on the outside of the bottom head. No additional staining or evidence of leakage was identified during this inspection.

Based on the current visual inspection, APS concludes that PVNGS Unit 1 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 1 Refueling Outage 12, 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

Pressurizer bare-metal inspections found no evidence of leakage.

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

No relevant indications of through-wall leakage were identified during this inspection.

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

No additional follow-up NDE was required.

Summary of all relevant indications found by NDE

No relevant indications were observed.

Summary of the disposition of any findings of boric acid

No boric acid residue was identified during the inspection of the Unit 1 pressurizer.

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 1R12. All 36 heater sleeves were modified using the half 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 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.

References:

1. APS 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. NRC letter, "Palo Verde Nuclear Generating Station (Palo Verde), Units 1 and 3 – Relaxation Request from U.S. Nuclear Regulatory Commission (NRC) First Revised Order EA-03-009 RE: Reactor Pressure Vessel Head Inspections (TAC Nos. MC2388 and MC2390)," dated November 8, 2004.

3. APS letter, 102-05099-CDM/SAB/RJR, "APS' Commitment for CEDM Nozzle Inspections for First Revised NRC Order EA-03-009," dated April 28, 2004.

4. APS letter 102-05100-CDM/TNW/RJR, "Additional Information Request for CEDM Nozzle Inspections for First Revised NRC Order EA-03-009," dated April 29, 2004.

Attachment

Unit 1 Table of Examination Distances below the J-groove Weld on the Downhill Side of the Nozzle and Below Weld Coverage of Penetrations 87 and 93

Unit 1 Table of Examination Distances below the J-groove Weld on the Downhill Side of the Nozzle

	Lower Exam Extent	Minimum Required
Pen 01	1.24	0.450
Pen 02	1.28	0.450
Pen 03	1.20	0.450
Pen 04	1.12	0.450
Pen 05	1.28	0.450
Pen 06	1.12	0.450
Pen 07	1.16	0.450
Pen 08	1.00	0.450
Pen 09	1.00	0.450
Pen 10	1.08	0.450
Pen 11	1.24	0.450
Pen 12	1.16	0.450
Pen 13	0.96	0.450
Pen 14	0.84	0.450
Pen 15	0.84	0.450
Pen 16	0.92	0.450
Pen 17	1.12	0.450
Pen 18	0.80	0.450
Pen 19	0.96	0.450
Pen 20	1.00	0.450
Pen 21	0.92	0.450
Pen 22	0.76	0.450
Pen 23	0.68	0.450
Pen 24	0.72	0.450
Pen 25	0.80	0.450
Pen 26	1.08	0.450
Pen 27	0.96	0.450
Pen 28	1.00	0.450
Pen 29	0.96	0.450
Pen 30	0.68	0.450

Unit 1 Table of Examination Distances below the J-groove Weld on the Downhill Side of the Nozzle

	Lower Exam Extent	Minimum Required
Pen 31	0.88	0.450
Pen 32	0.80	0.450
Pen 33	0.92	0.450
Pen 34	0.80	0.450
Pen 35	0.68	0.450
Pen 36	0.88	0.450
Pen 37	0.84	0.450
Pen 38	0.76	0.450
Pen 39	0.56	0.450
Pen 40	1.00	0.450
Pen 41	0.92	0.450
Pen 42	0.84	0.450
Pen 43	0.88	0.450
Pen 44	0.56	0.450
Pen 45	0.88	0.450
Pen 46	0.76	0.400
Pen 47	0.68	0.400
Pen 48	0.80	0.400
Pen 49	0.64	0.400
Pen 50	0.76	0.400
Pen 51	0.76	0.400
Pen 52	0.92	0.400
Pen 53	0.80	0.400
Pen 54	0.84	0.400
Pen 55	0.64	0.400
Pen 56	0.76	0.400
Pen 57	0.72	0.400
Pen 58	0.60	0.400
Pen 59	0.60	0.400
Pen 60	0.52	0.400

Unit 1 Table of Examination Distances below the J-groove Weld on the Downhill Side of the Nozzle

	Lower Exam Extent	Minimum Required
Pen 61	0.88	0.400
Pen 62	0.52	0.400
Pen 63	0.60	0.400
Pen 64	0.88	0.400
Pen 65	0.64	0.400
Pen 66	0.68	0.400
Pen 67	0.56	0.400
Pen 68	0.84	0.400
Pen 69	0.44	0.400
Pen 70	0.48	0.400
Pen 71	0.72	0.400
Pen 72	0.52	0.400
Pen 73	0.88	0.400
Pen 74	0.52	0.400
Pen 75	0.76	0.400
Pen 76	0.60	0.400
Pen 77	0.56	0.400
Pen 78	0.40	0.400
Pen 79	0.40	0.400
Pen 80	0.84	0.400
Pen 81	0.68	0.400
Pen 82	0.68	0.400
Pen 83	0.72	0.400
Pen 84	0.40	0.400
Pen 85	0.40	0.400
Pen 86	0.60	0.350
*Pen 87	0.12*	0.350
Pen 88	0.44	0.350
Pen 89	0.52	0.350
Pen 90	0.68	0.400

Unit 1 Table of Examination Distances below the J-groove Weld on the Downhill Side of the Nozzle

	Lower Exam Extent	Minimum Required
Pen 91	0.48	0.400
Pen 92	0.44	0.400
*Pen 93	0.20*	0.400
Pen 94	0.52	0.400
Pen 95	0.44	0.400
Pen 96	0.44	0.400
Pen 97	0.72	0.400

* Additional examination performed

Figure 1 - Below Weld Coverage for Penetrations 87 and 93