A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear Generating Station

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102-06233-JHH/GAM
July 30, 2010

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

Dear Sirs:

**Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528, 50-529 and 50-530
Responses to Follow-up Request for Additional Information Regarding Small Bore Piping Socket Welds and Other Items for the Review of the PVNGS License Renewal Application, and License Renewal Application Amendment No. 21**

By letter no. 102-06134, dated February 19, 2010, Arizona Public Service Company (APS) submitted a response to request for additional information (RAI) B2.1.19-3 regarding small bore piping socket welds, for the review of the PVNGS license renewal application (LRA). The NRC staff has requested follow-up information regarding this RAI response. In addition, the NRC staff has requested additional information regarding insulation (LRA 4.3), steam generator feedrings (LRA 3.1.2.2.14), elastomer and thermoplastic components (LRA 3.3.1 and 3.3.2), and cavitation erosion (LRA B2.1.6).

Enclosure 1 contains responses to the follow-up RAIs. Enclosure 2 contains PVNGS LRA Amendment No. 21 to reflect changes made as a result of the follow-up RAI responses.

Commitment No. 21 for One-time Inspection of ASME Code Class 1 Small-Bore Piping (LRA A1.19, B2.1.19) has been revised to reflect the commitment in the RAI B2.1.19-3 supplemental response to inspect small bore piping socket welds, as shown in Table A4-1 in LRA Amendment No. 21 in Enclosure 2. In addition, Commitment No. 59 to complete the inspections of safety injection piping locations potentially susceptible to cavitation as described in cavitation erosion RAI response (LRA B2.1.6) has been added to LRA Table A4-1 as shown in Amendment No. 21 in Enclosure 2.

A138
NRR

Should you need further information regarding this submittal, please contact Russell A. Stroud, Licensing Section Leader, at (623) 393-5111.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on July 30, 2010
(date)

Sincerely,

JHH/RAS/GAM

Enclosures:

1. Responses to Follow-up Request for Additional Information Regarding Small Bore Piping Socket Welds and Other Item for the Review of the PVNGS License Renewal Application

2. Palo Verde Nuclear Generating Station License Renewal Application Amendment No. 21

cc:	E. E. Collins Jr.	NRC Region IV Regional Administrator
	J. R. Hall	NRC NRR Senior Project Manager
	L. K. Gibson	NRC NRR Project Manager
	R. I. Treadway	NRC Senior Resident Inspector for PVNGS
	L. M. Regner	NRC License Renewal Project Manager
	G. A. Pick	NRC Region IV (electronic)

ENCLOSURE 1

Responses to Follow-up Request for Additional Information Regarding Small Bore Piping Socket Welds and Other Items for the Review of the PVNGS License Renewal Application

Small Bore Piping Socket Welds Follow-up RAI B2.1.19-3
Cavitation Erosion (LRA B2.1.6)
Steam Generator Feedrings (LRA 3.1.2.2.14)
Elastomer and Thermoplastic Components (LRA 3.3.1 and 3.3.2)
Insulation (LRA 4.3)

NRC Follow-up RAI B2.1.19-3

Background:

The LRA small bore piping AMP states that the program is consistent with the program elements in the GALL Report AMP XI.M35, "One-Time Inspection of ASME Code Class 1 Small Bore Piping." It also states that PVNGS has experienced cracking of ASME Code Class 1 small-bore piping.

Issue:

Based on GALL Report Section XI.M35 recommendation, periodic inspection of the subject piping is needed as managed by a plant-specific AMP.

Request:

Either provide a plant-specific AMP that includes periodic inspections to manage aging, or provide justification why a plant-specific AMP is not necessary for ASME Code Class 1 small-bore piping.

APS Response to Follow-up RAI B2.1.19-3

(This response replaces the RAI B2.1.19-3 response, and modifies the RAI B2.1.19-2 response provided in APS letter no. 102-06134, dated February 19, 2010)

GALL Report AMP XI.M35 states "This program is applicable only to plants that have not experienced cracking of ASME Code Class 1 small-bore piping resulting from stress corrosion or thermal and mechanical loading. Should evidence of significant aging be revealed by a one-time inspection or previous operating experience, periodic inspection will be proposed, as managed by a plant-specific AMP."

Palo Verde has experienced two related instances where failures have occurred in ASME Code Class 1 small-bore piping with socket welds. The failures were reported in the following LERs:

- Unit 1 LER 87-018-00 for a socket weld on the upstream side of the isolation valve for the flanged refueling water level indication (NRC Agencywide Document Access and Management System [ADAMS] Accession No. 8803080078; APS letter no. 192-00342, February 19, 1988).
- Unit 1 LER 2004-001-00 for a cracked socket weld on a high pressure safety injection line (ADAMS Accession No. ML041040027; APS letter no. 192-01135, April4, 2004).

Evaluations were performed to determine the cause of each of the failures. In each case, the failure cause was the same, and was determined not to be cracking due to stress corrosion or thermal and mechanical loading, and was not aging related. The cause of the 1987 LER failure was determined to be high cycle fatigue and the piping configuration, and was mitigated with the installation of a design modification for six similar locations. The 2004 LER failure was due to the incorrect installation of this modification for one of the other locations. The correct support configuration was installed on the line associated with the 2004 failure and there have been no subsequent failures of the ASME Code Class 1 small-bore piping socket welds.

In order to provide assurance that the ASME Code Class 1 small-bore piping socket welds are not experiencing aging degradation, at least 10% of the socket welds in ASME Code Class 1 piping that is less than four inches nominal pipe size and greater than or equal to one inch nominal pipe size will be selected per unit for ultrasonic testing examination. The sample will be selected based on risk insights and those welds with the potential for aging degradation.

LRA Sections A1.19, B2.1.19, and Commitment No. 21 in Table A4-1 have been revised, as shown in Amendment No. 21 in Enclosure 2, to reflect this response.

NRC RAI: Cavitation Erosion (B2.1.6)

Background:

In its discussion of aging effects for cavitation erosion for treated water, EPRI 1010639, "Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools," Appendix A, Section 4.1, "Assumptions," states, in part, that it is assumed cavitation erosion problems are a design deficiency, which will be detected and corrected during current operation, except when the cavitation occurs in infrequently operated systems. In these cases, it states that plant specific consideration may need to be addressed in the aging management review. In addition, the GALL Report, Table IX.E, Aging Effects notes that "loss of material" may be due to several causes and erosion is specifically included. Also, the GALL Report, Table IX.F, "Significant Aging Mechanisms," defines both cavitation, and erosion.

Issue:

During a review of operating experience at PVNGS, the NRC identified CRDR 2932507, which documents a through-wall leak in piping immediately downstream of a valve in the HPSI RWT recirculation line "due to erosion by damaging cavitation." The apparent cause evaluation for this issue indicated that the Flow-Accelerated Corrosion (FAC) Program was to ultrasonically inspect these potentially susceptible components, and that the FAC program was to be revised to examine portions of all three units' HPSI train "B" recirculation piping every 18 months in order to assess cavitation erosion. Subsequent information, made available to the NRC, indicated that the affected sections of the HPSI system are to be replaced on a conservative interval of every 7.5 years. While this will preclude further need of aging management for those specific locations, the extent of condition performed in the above apparent cause evaluation indicated that components and locations in other safety-related systems were potentially susceptible to the same degradation mechanism.

Based on PVNGS' operating experience, the exception noted above in EPRI 1010639, regarding infrequently operated systems, appears to apply, and plant-specific consideration needs to be addressed in the aging management review.

In addition, the extent of condition section in PVNGS' Apparent Cause Evaluation for CRDR 2932507 indicates that it only addressed stainless piping and components in systems associated with heat removal and implied that the FAC Program would address the cavitation erosion issue in carbon steel piping systems. The staff notes that although the FAC program monitors carbon steel piping, the implementing computer program, CHECWORKS, specifically excludes cavitation considerations, and that the scope of the FAC program only includes a limited number of systems (condensate, feedwater, etc.) that are operate within specific parameters (temperatures, pressures, oxygen content, etc.) associated with FAC.

Request:

1) For all in-scope piping and components that have been identified, either directly or as a result of the extent of condition evaluation, as being susceptible to cavitation erosion:

   a) provide the currently established time-based replacement frequency and the basis for this frequency, or

   b) if a time-based replacement frequency will not be established, prior to the period of extended operation, provide the proposed aging management program for these segments or components until such time as a time-based replacement frequency is established, or

   c) provide the proposed aging management program that will be used to manage this age related degradation during the period of extended operation.

2) For any other in-scope stainless steel piping and components in infrequently operated water systems, which were excluded from the extent of condition evaluation discussed above, provide the basis to show that a cavitation erosion degradation mechanism, similar to that identified in the above plant-specific

operating experience, is not applicable, or provide appropriate aging management programs.

<u>APS Response to RAI: Cavitation Erosion (B2.1.6)</u>

<u>Response 1(a)</u>

As documented in CRAI 3337611, Engineering Study 13-MS-B089, "Cavitation in Safety Injection System," APS identified 26 components and associated piping in each PVNGS unit potentially susceptible to cavitation under design basis maximum flow conditions. All locations potentially subject to cavitation have been identified regardless of whether the potential for cavitation results from high flow, valve throttling, or flow area reduction.

One location in each unit, the HPSI recirculation piping downstream of throttle valve JSIBUV0667, has been confirmed to be susceptible to cavitation erosion, and a 7.5-year time-based replacement schedule described below has been established.

All of the remaining 25 locations identified as potentially susceptible to cavitation in Unit 2, 20 of the locations in Unit 1, and 15 of the locations in Unit 3 have been inspected by ultrasonic testing (UT) and demonstrated no degradation. The remaining five locations in Unit 1 are scheduled to be inspected in the Unit 1 fall 2011 refueling outage. Of the remaining ten locations in Unit 3, five will be inspected in the Unit 3 fall 2010 outage and five will be inspected in the Unit 3 spring 2012 outage. Therefore, the inspections in all three units will be completed no later than June 30, 2012. If any of the remaining components and associated piping is found to be susceptible to cavitation or a form of flow-related degradation, it will be incorporated into a replacement plan similar to that for the HPSI recirculation piping downstream of throttle valve JSIBUV0667.

The time-based replacement frequency for the HPSI recirculation piping downstream of throttle valve JSIBUV0667 is replacement every 7.5 years (five operating cycles) based on the assessment described below. As recorded/stated in the Prompt Operability Determination and Extent of Condition Review for CRDR No. 2932507, the following numbers describe the piping and the erosion damage:

(1) HPSI B Recirc pipe (SI-112-2") is nominal 2", schedule 160 pipe and pipe thickness = 0.343 inches

(2) HPSI B Recirc pipe (SI-112-2") min-wall thickness = 0.141 inches

(3) HPSI B Recirc pipe (SI-112-2") elbow min-wall thickness = 0.141 inches

(4) HPSI B Recirc run time per average year = 30 to 35 hours (assumed normal operation)

(5) Depth of erosion damage = 0.343 inches (most conservative value to utilize, since pipe failed)

A review of the installation data for this specific piping and associated valves revealed that the piping was installed during original construction, prior to January 1986. No specific date could be determined. As such, it is assumed that at the time of the failure in October 2006, that the piping had seen approximately 20 years of service. Therefore, considering 20 years of normal operation, the erosion rate was:

Pipe (SI-112-2") erosion rate = 0.343 inches ÷ 20 years = 0.01715 inches per year

Applying this erosion rate, along with the piping's min-wall thickness, to determine an overall replacement timeframe:

Pipe (SI-112-2") replacement timeframe = (pipe thickness - min-wall thickness) ÷ erosion rate

= (0.341 inches - 0.141 inches) ÷ 0.01715 inches per year

= 11.66 years

Since a normal operating cycle is 18 months or 1.5 years, then the replacement timeframe is equal to:

= 11.66 years ÷ 1.5 years/cycle

= 7.8 cycles

Therefore, applying additional conservatism, a further reduction in this calculated timeframe is needed and the HPSI B Recirc piping (and valve) should be preventatively replaced every 5th operating cycle.

<u>Response 1(b)</u>

No aging management program is required because the piping susceptible to cavitation erosion will be replaced on a conservative time-based frequency.

<u>Response 1(c)</u>

No aging management program is required because the piping susceptible to cavitation erosion will be replaced on a conservative time-based frequency.

<u>Response 2</u>

The Palo Verde Apparent Cause Evaluation for CRDR No. 2932507 and the associated Engineering Study 13-MS-B089 evaluated the high pressure safety injection, low pressure safety injection, containment spray, and shutdown cooling systems for damaging cavitation erosion to identify the potential for damaging cavitation erosion. A review of stainless steel in-scope piping and components in infrequently operated systems which were not included in the extent of condition evaluation discussed above identified no piping or components in systems within the scope of license renewal with the potential for damaging cavitation erosion.

This cavitation erosion review was based on evaluation of:

- stainless steel water filled piping and components,
- infrequently operated systems (normally operating or frequently operating systems were excluded), and
- the potential for cavitation based on high/maximum flow, valve throttling, or flow area reduction.

NRC RAI: Steam Generator Feedrings (LRA 3.1.2.2.14)

Please provide the material of the steam generator feedrings, and the susceptibility to flow accelerated corrosion.

APS Response to RAI: Steam Generator Feedrings (LRA 3.1.2.2.14)

The steam generator feedrings are constructed of P11 chrome-moly steel. P11 steel is resistant to wall thinning due to flow-accelerated corrosion, and, therefore, wall thinning of the feedrings is not an aging effect that requires management. The Steam Generator Tubing Integrity program (B2.1.2) conservatively considers wall thinning of steam generator feedrings and applicable operating experience as part of the secondary side degradation assessment.

NRC RAI: Elastomer and Thermoplastic Components (LRA 3.3.1 and 3.3.2)

Background

SRP-LR Table 3.3.1, item 75 indicates that elastomer components exposed to raw water may undergo hardening and loss of strength due to elastomer degradation, and loss of material due to erosion. The GALL Report recommends that this aging effect be managed by the Open-Cycle Cooling Water System.

Issue

The PVNGS LRA Table 3.3.1 item 3.3.1.75 indicates that aging of elastomer components exposed to raw water is not applicable because PVNGS has no in-scope elastomer components exposed to raw water in the open-cycle cooling water systems. Staff examination of the LRA identified the following items which could be classified as elastomeric components exposed to raw water:

1. Table 3.3.2-7 identifies PVC components and Table 3.3.2-22 identifies polyethylene components. In both cases, the tables cite generic note F indicating that the materials are not in the GALL Report, and also state that there are no aging effects requiring management. Although the LRA stated that PVC is relatively unaffected by water, there were no further bases provided to justify that there were no aging effects requiring management for PVC or polyethylene. The staff was specifically concerned about the loss of material due to erosion.

2. Tables 3.3.2-22 and 3.3.2-30 indicate that the loss of material for carbon steel pipe with elastomer linings in raw water are to be managed through the Fire Water System Program and the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Program, respectively. Since the item numbers cited in the LRA do not specifically address the loss of material for the elastomer, it was not clear to the staff that the AMPs being proposed would adequately manage the loss of material for the elastomer lining. Although the cited AMPs addressed pressure boundary and leakage boundary, the potential consequences of the degraded elastomer lining material in the associated systems was not addressed.

Request

Provide a basis for why these components, or other elastomer components exposed to raw water in the auxiliary system are appropriately being managed for aging during the period of extended operation for the issues discussed above.

APS Response to RAI: Elastomer and Thermoplastic Components (LRA 3.3.1 and 3.3.2)

Response 1: Table 3.3.2-7, Essential Spray Ponds PVC Component Erosion, and Table 3.3.2-22, Domestic Water polyethylene component erosion.

LRA Table 3.3.1 item 3.3.1.75 identifies elastomer components that are typically flexible materials such as rubber, neoprene, and silicon. PVC and polyethylene are thermoplastics. Thermoplastic materials are not evaluated in the GALL Report. PVC and polyethylene are thermoplastics that are rigid and have good resistance to abrasion and erosion. Loss of material due to erosion is possible only if the fluid contains particulates in the fluid stream that impinge on the surface of the thermoplastic. When particulates are present in the fluid, regions that are susceptible to erosion are flow discontinuities where fluid velocities are high. Essential Spray Pond PVC components are located in the corrosion test rack portion of the system and are not subject to high fluid velocities. Domestic Water polyethylene components are located in the well water portion of the system that provides make-up to the fire water storage tanks. This portion of the domestic water system contains minimal particulates and is not subject to high flow velocities.

Response 2: Table 3.3.2-22, Domestic Water, and Table 3.3.2-30, Oily and Non-Radioactive Waste: Loss of Material for Carbon Steel Pipe With Elastomer Linings In Raw Water

Loss of material for Domestic Water carbon steel pipe with elastomer linings evaluated with a raw water environment is managed by the Fire Water System AMP (B2.1.13). The Domestic Water carbon steel pipe with elastomer linings supports a fire protection system intended function by providing make-up water to the fire protection tanks. The Fire Water System AMP (B2.1.13) manages loss of material and potential consequences of the degraded elastomer liner material with internal visual inspections performed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP (B2.1.22). Potential consequences are also addressed by the Fire Water System AMP (B2.1.13) that demonstrates the effectiveness of the fire protection water supply by conducting periodic flow testing of the fire water loops and in addition conducts flow testing of the fire suppression water system.

Loss of material for Oily and Non-Radioactive Waste System carbon steel pipe with elastomer linings used for waste water drainage from the battery rooms is evaluated with a raw water environment and is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP (B2.1.22). The Oily and Non-Radioactive Waste System carbon steel pipe with elastomer linings supports a Criterion (a)(2) spatial interactions function for drainage from the battery rooms to waste/neutralization sumps. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components AMP (B2.1.22) manages loss of material and potential consequences of the degraded elastomer liner material with internal visual inspections.

NRC RAI: Insulation (LRA 4.3)

Please confirm that all the in-scope calcium silicate and mineral wool insulation is jacketed with overlapping seams such that moisture intrusion is not an issue.

APS Response to RAI: Insulation (LRA 4.3)

The Palo Verde insulation specification confirms the use of overlapping seams to prevent moisture intrusion.

ENCLOSURE 2

Palo Verde Nuclear Generating Station
License Renewal Application Amendment No. 21

LRA Section	Page Nos.	RAI No.
A1.19*	A-11	B2.1.19-3
Table A4-1, Item 19	A-48	B2.1.19-3
Table A4-1, Item 59	A-65	B2.1.6
B2.1.19*	B-62, 63, 63A	B2.1.19-3

* The complete Appendix A and B aging management program sections are provided for reviewer convenience when there is any change to the sections.

A1.19 ONE-TIME INSPECTION OF ASME CODE CLASS 1 SMALL-BORE PIPING

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program manages cracking of stainless steel ASME Code Class 1 piping less than or equal to 4 inches.

For ASME Code Class 1 small-bore piping, volumetric examinations on selected butt weld locations will be performed to detect cracking. Butt weld volumetric examinations will be conducted in accordance with ASME Section XI with acceptance criteria from Paragraph IWB-3000 and IWB-2430. Weld locations subject to volumetric examination will be selected based on the guidelines provided in EPRI TR-112657. Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. ~~If no socket welds are in the sample population, then at least one weld per unit will be selected.~~ ~~A different socket weld location will be selected for each unit.~~ At least 10% of the socket welds in ASME Code Class 1 piping that is less than four inches nominal pipe size and greater than or equal to one inch nominal pipe size will be selected per unit for ultrasonic testing examination. The sample will be selected based on risk insights and those welds with the potential for aging degradation.

Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. If a qualified volumetric examination procedure for socket welds endorsed by the industry and the NRC is available and incorporated into the ASME Section XI Code at the time of PVNGS small-bore socket weld inspections then this will be used for the volumetric examinations. If no volumetric examination procedure for ASME Code Class 1 small bore socket welds has been endorsed by the industry and the NRC and incorporated into ASME Section XI at the time PVNGS performs inspections of small-bore piping, a plant procedure for volumetric examination of ASME Code Class 1 small-bore piping with socket welds will be used.

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program that will be implemented prior to the period of extended operation. Industry and plant-specific operating experience will be evaluated in the development and implementation of this program.

Table A4-1 License Renewal Commitments

Item No.	Commitment	LRA Section	Implementation Schedule
21	The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program that will be implemented prior to the period of extended operation. Industry and plant-specific operating experience will be evaluated in the development and implementation of this program. For ASME Code Class 1 small-bore piping, volumetric examinations on selected butt weld locations will be performed to detect cracking. Butt weld volumetric examinations will be conducted in accordance with ASME Section XI with acceptance criteria from Paragraph IWB-3000 and IWB-2430. Weld locations subject to volumetric examination will be selected based on the guidelines provided in EPRI TR-112657. Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. At least 10% of the socket welds in ASME Code Class 1 piping that is less than four inches nominal pipe size and greater than or equal to one inch nominal pipe size will be selected per unit for ultrasonic testing examination. The sample will be selected based on risk insights and those welds with the potential for aging degradation. (RCTSAIs 3246910 [U1]; 3247265 [U2]; 3247266 [U3])	A1.19 B2.1.19 One-Time Inspection of ASME Code Class 1 Small-Bore Piping	Prior to the period of extended operation[1].

Table A4-1 License Renewal Commitments

Item No.	Commitment	LRA Section	Implementation Schedule
59	As documented in CRAI 3337611, Engineering Study 13-MS-B089, "Cavitation in Safety Injection System," APS identified 26 components and associated piping in each PVNGS unit potentially susceptible to cavitation under design basis maximum flow conditions. One location in each unit, the HPSI recirculation piping downstream of throttle valve JSIBUV0667, has been confirmed to be susceptible to cavitation erosion, and a 7.5-year time-based replacement schedule described below has been established. In Unit 1, All of the remaining 25 locations identified as potentially susceptible to cavitation in Unit 2, 20 of the locations in Unit 1, and 15 of the locations in Unit 3 have been inspected by ultrasonic testing (UT) and demonstrated no degradation. The remaining five locations in Unit 1 are scheduled to be inspected in the Unit 1 fall 2011 refueling outage. Of the remaining ten locations in Unit 3, five will be inspected in the Unit 3 fall 2010 outage and five will be inspected in the Unit 3 spring 2012 outage. Therefore, the inspections in all three units will be completed no later than June 30, 2012. If any of the remaining components and associated piping is found to be susceptible to cavitation or a form of flow-related degradation, it will be incorporated into a replacement plan similar to that for the HPSI recirculation piping downstream of throttle valve JSIBUV0667. (RCTSAI 3497597)	Supplemental Response to RAI B2.1.19-3 (letter no. 102-06233, dated 07/30/2010)	06/30/2012

B2.1.19 One-Time Inspection of ASME Code Class 1 Small-Bore Piping

Program Description

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program manages cracking of stainless steel ASME Code Class 1 piping less than or equal to 4 inches.

For ASME Code Class 1 small-bore piping, volumetric examinations (by ultrasonic testing) will be performed on selected butt weld locations to detect cracking. Small-bore weld locations are selected for examination based on the guidelines provided in EPRI TR-112657. Volumetric examinations are conducted in accordance with ASME Section XI with acceptance criteria from Paragraph IWB-3131 and IWB-2430 for butt welds. If no socket welds are in the sample population, then at least one weld per unit will be selected. A different socket weld location will be selected for each unit. At least 10% of the socket welds in ASME Code Class 1 piping that is less than four inches nominal pipe size and greater than or equal to one inch nominal pipe size will be selected per unit for ultrasonic testing examination. The sample will be selected based on risk insights and those welds with the potential for aging degradation.

Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. If a qualified volumetric examination procedure for socket welds endorsed by the industry and the NRC is available and incorporated into the ASME Section XI Code at the time of PVNGS small-bore socket weld inspections then this will be used for the volumetric examinations. If no volumetric examination procedure for ASME Code Class 1 small bore socket welds has been endorsed by the industry and the NRC and incorporated into ASME Section XI at the time PVNGS performs inspections of small-bore piping, a plant procedure for volumetric examination of ASME Code Class 1 small-bore piping with socket welds will be used.

If evidence of an aging effect is revealed by a one-time inspection, evaluation of the inspection results will identify appropriate corrective actions.

This Program will be implemented and inspections completed and evaluated prior to the period of extended operation.

NUREG-1801 Consistency

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program that, when implemented, will be consistent, with NUREG-1801, Section XI.M35, "One-Time Inspection of ASME Code Class 1 Small-Bore Piping," with an exception.

Exceptions to NUREG-1801

Program Elements Affected

Scope of Program - Element 1

Guidelines from EPRI TR-112657, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," Rev. B-A, were used for identifying susceptible piping instead of EPRI Report 1000701, "Internal Thermal Fatigue Management" Guidance (MRP-24). Guidelines for identifying piping susceptible to potential effects of thermal stratification or turbulent penetration that are provided in EPRI Report 1000701 are also provided in EPRI TR-112657. The recommended inspection volume for welds in EPRI Report 1000701 are identical to those for inspection of thermal fatigue in RI-ISI programs; thus, the PVNGS risk-informed process examination requirements meet the requirements of NUREG-1801 and no enhancements are required.

Enhancements

None.

Operating Experience

In order to estimate the extent of the problem of cracking in Class 1 piping socket welds, NEI conducted a review of LERs available in the NRC ADAMS database. Of 141 LERs reviewed, 48 were determined to be associated with failures of Class 1 socket welds. For the 46 LERs where a cause was identified, 42 of the failures were due to either vibration-induced high cycle fatigue or improper installation and are not age-related. Of the four remaining failures, one was due to randomly applied loads during maintenance and not age-related, and three were related to aging: two due to insulation contamination on the outside surface, and one associated with IGSCC, although there were other contributing factors not associated with aging (poor weld fit up, weld repair, nearby missing support, etc.).

The NEI review indicates that there have been a relatively small number of Class 1 socket weld failures of which only three were related to aging.

PVNGS has experienced ~~three~~ two related instances where failures have occurred in ASME Code Class 1 small-bore piping with socket welds. The failures were reported in the following LERs:

> 87-018 for a socket weld on the upstream side of the isolation valve for the flanged refueling water level indication;
>
> ~~96-006 for a cracked weld in the minimum flow recirculation line for the Train B High Pressure Safety Injection pump; and~~
>
> 04-001 for a cracked socket weld on a high pressure safety injection line.

Evaluations were performed to determine the cause of each of the failures. In each case, the failure cause was the same, and was determined not to be cracking due to stress corrosion or thermal and mechanical loading and was not aging related. The cause of the 1987 failure was determined to be high cycle fatigue and the piping configuration, and was mitigated with the installation of a design modification for six similar locations. The 2004 failure was due to the incorrect installation of this modification for one of the other locations. The correct support configuration was installed on the line associated with the 2004 failure and there have been no subsequent failures of the ASME Code Class 1 small-bore piping socket welds.

A review of the second 10-year ISI Interval Summary Reports for Units 1, 2 and 3 indicates there were no code repairs or code replacements required for continued service of ASME IWB Code components during the second 10-year ISI Interval.

Conclusion

The implementation of the One-Time Inspection of ASME Code Class 1 Small-Bore Piping program will provide reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.