10 CFR 50.90

Palo Verde Nuclear Generating Station

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102-05285-CDM/TNW/RAB
June 3, 2005

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

Reference: Letter No. 102-05116-CDM/TNW/RAB, dated July 9, 2004, from C. D. Mauldin, APS, to U. S. Nuclear Regulatory Commission, "Request for a License Amendment to Support Replacement of Steam Generators and Uprated Power Operations in Units 1 and 3, and Associated Administrative Changes for Unit 2"

Dear Sirs:

**Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1 and 3, Docket Nos. STN 50-528 and STN 50-530
Response to Request for Additional Information Regarding Steam Generator Replacement and Power Uprate License Amendment Request**

In the referenced letter, Arizona Public Service Company (APS) submitted a license amendment request to support steam generator replacement and uprated power operations for PVNGS Units 1 and 3.

The enclosure to this letter provides written responses to the questions provided by the NRC in electronic mail and discussed in telephone conversations. The response to NRC Question 3 contains the following statement in which APS commits to a degradation management program for reactor vessel internals:

> Arizona Public Service Company (APS) is currently an active participant in the Electric Power Research Institute (EPRI) Materials Reliability Program research initiatives on aging related degradation of reactor vessel internals components. APS commits to:
>
> - Continue its active participation in the MRP initiative to determine appropriate reactor vessel internals degradation management programs,

- Evaluate the recommendations resulting from this initiative and implement a reactor vessel internals degradation management program applicable to Palo Verde Units 1 and 3,

- Incorporate the resulting reactor vessel internals inspections into the Palo Verde 1 and 3 augmented inspection program as appropriate.

In addition, as requested by the NRC, a description of the program, including the inspection plan, will be submitted to the NRC for review and approval. The submittal date will be within 24 months of the EPRI MRP final recommendations or within five years from the date of issuance of the uprated license, whichever comes first.

Should you have any questions, please contact Thomas N. Weber at 623-393-5764.

Sincerely,

CDM/TNW/RAB/ca

Enclosures:
1. Notarized Affidavit
2. Materials and Chemical Engineering Branch Questions and APS Responses

cc: B. S. Mallet — NRC Region IV
M. B. Fields — NRC Project Manager
G. G. Warnick — NRC Senior Resident Inspector for PVNGS
A. V. Godwin — Arizona Radiation Regulatory Agency (ARRA)

ENCLOSURE 1

NOTARIZED AFFIDAVIT

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, David Mauldin, represent that I am Vice President Nuclear Engineering and Support, Arizona Public Service Company (APS), that the foregoing document has been signed by me on behalf of APS with full authority to do so, and that to the best of my knowledge and belief, the statements made therein are true and correct.

David Mauldin

Sworn To Before Me This 3rd Day Of June, 2005.

Notary Public

SUSIE LYNN ERGISH
Notary Public - Arizona
Maricopa County
My Comm. Expires Jul 14, 2007

Notary Commission Stamp

Enclosure 2

Materials and Chemical Engineering Branch
Questions and APS Responses

The Attachment to this Enclosure contains excerpts from the referenced letters as identified below. The Attachment also contains excerpts from the NRC Reactor Vessel Integrity Database for Palo Verde highlighting the requested information.

NRC Question
1.I.- The projected neutron fluence (E>1.0 Mev) for each vessel beltline material at EOL including the impact of the proposed UPO.

APS Response
As cited in the references below, the projected neutron fluence for PUR (3990 MW_t) given that the projected fluence at end-of-license, 3.29E+19 n/cm^2, E>I MeV, is bounded by the Analysis of Record (AOR).

References
1) Letter 102-03448, dated August 17, 1995 from APS to USNRC, Response to NRC Generic Letter 92-01, Rev.1, Supplement 1 reported fluence values for Palo Verde Units 1, 2 and 3.
2) USNRC Reactor Vessel Integrity Database contains the EOL fluence values for Palo Verde Units 1, 2, and 3. See the database summary in The Attachment to this Enclosure.
3) Letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6, Sections 5.1.2 & 7.5 discuss the impact of the proposed UPO. Excerpts from 102-04641 are provided in The Attachment to this Enclosure.
4) Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, NRC question 7 response provides discussion on the impact of the proposed UPO for Unit 2. These results are summarized for Units 1, 2, and 3 in The Attachment to this Enclosure.
5) Letter 102-04847 from APS to USNRC, dated October 11, 2002, Attachment 2, NRC Question 17 response provides further discussion on the impact of the proposed UPO.

NRC Question
1.II.- Reactor vessel beltline material properties including initial RT_{NDT}, Cu and Ni contents and the source of the information (generic or plant specific).

APS Response
As cited in the references below, for Palo Verde Units 1, 2, and 3, the reactor vessel beltline plate and as deposited weld chemistries were controlled to low weight percentages for the following elements: copper < 0.1 wt.%, phosphorus < 0.012 wt.%, vanadium < 0.01 wt.%, and sulfur _<0.022 wt.%. The initial RT_{NDT} is ≤ 40 °F. The source of this information is plant specific.

References

1) Letter 102-03448 from APS to USNRC, dated August 17, 1995, Response to NRC Generic Letter 92-01, Rev. 1, Supplement 1 reported values for RT_{NDT}, Cu and Ni.
2) USNRC Reactor Vessel Integrity Database contains the initial RT_{NDT}, Cu and Ni values for Palo Verde Units 1,2 and 3. See the database summary in The Attachment to this Enclosure.
3) Letter 102-04139 from APS to USNRC, dated June 24, 1998 provides responses to NRC questions that updates information provided in the APS response to GL 92-01, Rev. 1, Supplement 1.

NRC Question

1.III.- RT_{PTS} values at end of current licensed life including the impact of UPO for all vessel beltline materials. Also, provide the basis of RT_{PTS} values.

APS Response

Pressurized Thermal Shock (PTS) - The screening criteria in 10 CFR Part 50.61 is 270 °F for plates, forgings, and axial weld materials, and 300 °F for circumferential weld materials. The highest RT_{PTS} value for a plate from the intermediate shell course of the RV for Palo Verde at the end of the current license was determined to be as follows:

Unit 1	122.5°F
Unit 2	78 °F
Unit 3	68.1°F

The projected RT_{PTS} value at the end of the current license for the beltline materials are summarized in Figure 7-2 (from the NRC Reactor Vessel Integrity Database (RVID). These values represent conditions for PUR (3990 MW_t) given that the projected fluence at end-of-license, 3.29E+19 n/cm^2, E>I MeV, is bounded by the Analysis of Record (AOR) and the method for predicting RT_{PTS} unchanged.

References

1) Letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6, Sections 5.1.2 & 7.5 discuss the impact of the proposed UPO on the reactor vessel. These results are summarized for Units 1, 2, and 3 in The Attachment to this Enclosure.
2) Letter 102-04847 from APS to USNRC, dated October 11, 2002, Attachment 2, NRC Question 17 response provides further discussion on the impact of the proposed UPO.
3) Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, NRC question 7 response provides discussion on the impact of the proposed UPO. These results are summarized for Units 1, 2, and 3 in The Attachment to this Enclosure.
4) Letter 102-04899 from APS to NRC, dated March 11, 2003, Attachment 2, NRC question 15 response also provides further discussion on the impact of the proposed UPO.

NRC Question

1.IV.- For each beltline material, provide the USE values at the end of the current licensed life including the impact of UPO. Also, provide the basis of the calculation including beltline material copper percentage, the unirradiated USE, the projected neutron fluence (E>1.0 Mev) ¼ thickness. If surveillance data was used, provide the surveillance data.

APS Response

Upper Shelf Energy (USE) - 10 CFR Part 50 Appendix G requires that the upper shelf energy throughout the life of the vessel be no less than 50 ft-lb. For Palo Verde, based on surveillance data, the lowest USE value at the end of the current license was determined to be as follows:

Unit 1	65.20 ft-lb
Unit 2	74 ft-lb
Unit 3	70.70 ft-lb

The projected USE value at the end of the current license for the beltline materials is summarized in Figure 7-1 (from the NRC RVID). These values represent conditions for PUR (3990 MW_t) given the projected fluence at end-of-life, 3.29E+19 n/cm^2, E>I MeV. The RPV copper content is less than 0.1 wt.%.

The lowest unirradiated USE value was:

Unit 1	83 ft-lb
Unit 2	95 ft-lb
Unit 3	90 ft-lb

References

1) Letter 102-03448 from APS to USNRC, dated August 17, 1995, Response to NRC Generic Letter 92-01, Rev. 1, Supplement 1 reported the requested data.
2) USNRC Reactor Vessel Integrity Data contains USE values at the end of the current licensed life.
3) Letter 102-04139 from APS to USNRC, dated June 24, 1998 provides responses to NRC questions that updates information provided in the APS response to GL 92-01, Rev. 1, Supplement 1.
4) Letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6, Sections 5.1.2 & 7.5 discuss the impact of the proposed UPO. Excerpts from 102-04641 are provided in the Attachment to this Enclosure.
5) Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, NRC question 7 response provides further discussion on the impact of the proposed UPO. These results are summarized for Units 1, 2, and 3 in the Attachment to this Enclosure.

NRC Question
1.V.- Basis for current P-T limits (applicability in EFPY, 1/4T, and 3/4T ART values).

APS Response
Current P-T limits are based on using Peak-end-of-life (i.e. 32 EFPY) fluence of 3.29E+19 n/cm^2. Adjusted reference temperatures (ART) for all beltline materials at the 1/4T, and 3/4T locations were calculated using this end-of-life fluence and the methods in Regulatory Guide 1.99 Revision 02.

There are approximately 14 effective full power years (EFPY) of operation in each of the Palo Verde units, therefore the current P-T curves are more conservative since they were determined using peak end-of-life fluence.

References
1) Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, NRC question 7 response discusses the basis for P-T limits and the impact of the proposed UPO. These results are summarized for Units 1, 2, and 3 in The Attachment to this Enclosure.
2) Letter 102-04847 from APS to USNRC, dated October 11, 2002, Attachment 2, NRC Question 17 response provides further discussion on the impact of the proposed UPO.

NRC Question
1.VI.- Projected ART values for the proposed period of applicability using the UPO fluence.

APS Response
The calculated ART values for Palo Verde Unit 1, 2 & 3 are based on the peak end-of-life fluence of 3.29E+19 n/cm^2. The results and conclusions of the assessment of the impact of the proposed UPO on the Analysis of Record (AOR) fluences are that the AOR values will continue to be bounded for current and future operation of Palo Verde including the uprated power condition of 3990 MW_t. Therefore, the calculated ART values is applicable for the proposed period using the UPO fluence.

References
1) Letter 102-03448, dated August 17, 1995 from APS to USNRC, Response to NRC Generic Letter 92-01, Rev.1, Supplement 1 reported the requested data for Palo Verde Units 1, 2 and 3.
2) Letter 102-04139, dated June 24, 1998 from APS to USNRC provides responses to NRC questions that updates information provided in the APS response to GL 92-01, Rev. 1, Supplement 1.
3) Letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6, Sections 5.1.2 & 7.5 discuss the impact of the proposed UPO. Excerpts from 102-04641 are provided in the Attachment to this Enclosure.

4) Letter 102-04847, dated October 11, 2002 from APS to USNRC, Attachment 2, NRC Question 17 response provides further discussion on the impact of the proposed UPO.

NRC Question
2.- Discuss the impact of uprated power operations on surveillance capsule program developed in accordance with 10 CFR 50, Appendix H criteria.

APS Response
Surveillance Capsule Withdrawal Schedule - 10 CFR Part 50, Appendix H defines the RV surveillance program that is to be used by the licensee to monitor the neutron radiation induced changes in fracture toughness of the vessel during the life of the plant. It includes requirements to establish a surveillance capsule withdrawal schedule. The schedule was established based on the original calculation of fluence that was shown to bound conditions for PUR (3990 MW_t). The detailed surveillance schedule is discussed in UFSAR Section 5.3.1.6.6 and Table 5.3-19. Therefore, the existing surveillance capsule withdrawal schedule remains applicable under conditions for PUR.

References
1) Letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6, Sections 5.1.2 & 7.5 discuss the impact of the proposed UPO on the reactor vessel. APS has determined that no change to the surveillance capsule program is required. Excerpts from 102-04641 are provided in The Attachment to this Enclosure.
2) Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, NRC question 7 response provides discussion on the impact of the proposed UPO. These results are summarized for Units 1, 2, and 3 in The Attachment to this Enclosure.
3) Letter 102-04847 from APS to USNRC, dated October 11, 2002, Attachment 2, NRC Question 17 response provides further discussion on the impact of the proposed UPO on the reactor vessel.

NRC Question
3.- Table Matrix-1 of NRC Review Standard RS-001, Revision 0, provides the staff's basis for evaluating the potential impacts for uprated power operations and the subsequent aging effects. In Table Matrix-1, the staff states that, in addition to the Standard Review Plan (SRP), guidance on the neutron irradiation-related threshold levels inducing irradiation assisted stress corrosion cracking (IASCC) in reactor vessel (RV) internal components are given in Westinghouse document, License Renewal Evaluation, Aging Management for Reactor Internals, WCAP-14577, Revision 1-A. WCAP-14577, Revision 1-A establishes, a threshold of 1×10^{21} n/cm^2 ($E \geq 0.1$ MeV) for the initiation of IASCC, loss of fracture toughness, and/or void swelling in pressurized water reactor (PWR) RV internal components made from stainless steel (including cast austenitic stainless steels) or Alloy 600/82/182 materials. In Table Matrix-1 of NRC

Report RS-001, the staff established guidance that plants exceeding this threshold of neutron irradiation would either have to establish plant-specific degradation management programs for managing the aging effects associated with their RV internals or else indicate that the licensees would participate in industry programs designed for investigating and managing age-related degradation in the RV internal components. Please provide the threshold fluence values for the internals (E > 0.1 MeV) due to UPO. Also, discuss the inspection program that will be implemented by Palo Verde Nuclear Generating Station if the threshold values exceed 1 X 10^{21} n/cm^2 (E ≥ 0.1 MeV).

APS Response

Arizona Public Service Company (APS) is currently an active participant in the Electric Power Research Institute (EPRI) Materials Reliability Program research initiatives on aging related degradation of reactor vessel internals components. APS commits to:

- Continue its active participation in the MRP initiative to determine appropriate reactor vessel internals degradation management programs,
- Evaluate the recommendations resulting from this initiative and implement a reactor vessel internals degradation management program applicable to Palo Verde 1 and 3,
- Incorporate the resulting reactor vessel internals inspections into the Palo Verde 1 and 3 augmented inspection program as appropriate and provide the internals inspection plan to the NRC staff for information.

In addition, as requested by the NRC, a description of the program, including the inspection plan, will be submitted to the NRC for review and approval. The submittal date will be within 24 months of the EPRI MRP final recommendations or within five years from the date of issuance of the uprated license, whichever comes first.

Attachment

Excerpts from letter 102-04641 from APS to USNRC, dated December 21, 2001, Attachment 6

Section 5.1.2 Reactor Vessel Integrity
RV integrity is impacted by any changes in plant parameters including the effects of neutron fluence levels (see Section 7.5), RCS temperature, or pressure/temperature transients. The most critical area, in terms of RV integrity, is the beltline region of the RV. Therefore, the changes in neutron fluence resulting from the PUR were evaluated to determine the impact on RV integrity.
The evaluation shows that the heating rates, pressure/temperature transients, and neutron fluence estimates that were used to represent operation at 3800 MWt bound the values at the PUR power level of 3990 MW_t. The neutron fluence projections on the RV for the PUR power level will not adversely affect RV integrity AOR (i.e., pressure/temperature limits and Pressurized Thermal Shock (PTS) screening limits) for operation at 3990 MWt. Therefore, operation at PUR condition will have no detrimental impact on the RV integrity.

Section 7.5 Neutron Fluence
The calculated fluences for the existing AOR assume a core power level of 4200 MWt and an out-in type fuel-loading pattern typical of first cycle operation. The PUR level of 3990 MWt and the low-leakage fuel patterns (used since PVNGS Unit 2 Cycle 2) yield a neutron flux to the shroud and vessel that is lower than considered in the existing AOR (see Section 5.1.2). Therefore, the reactor vessel integrity AOR (i.e., pressure/temperature limits and Pressurized Thermal Shock (PTS) screening limits) are not affected by PUR operation at 3990 MW_t. In addition, fuel management guidelines for PUR cycles are set to ensure that the vessel fluence is bounded by the AOR.

Letter 102-04834 from APS to USNRC, dated August 29, 2002, Attachment 2, modified for PVNGS Units 1, 2, and 3.

NRC Question 7:
The PURLR does not discuss the power-uprate-related effects on RV integrity. Discuss the effect of the PUR on the following for Unit 2: pressurized thermal shock, fluence evaluation, heat-up and cooldown pressure temperature limit curves, low temperature overpressure protection, upper shelf energy, and surveillance capsule withdrawal schedule.

APS Response:
The factors influencing Reactor Vessel (RV) integrity are the initial properties of the materials and the neutron fluence incident on the materials. PUR does not affect the initial material properties, but the neutron fluence can change. The effect of neutron fluence changes on vessel integrity is assessed below using 10 CFR Part 50, Appendices G and H, and 10 CFR Part 50.61.

a) Pressurized Thermal Shock (PTS) - The screening criteria in 10 CFR Part 50.61 is 270 °F for plates, forgings, and axial weld materials, and 300 °F for circumferential weld materials. The highest RT_{PTS} value for a plate from the intermediate shell course of the RV for Palo Verde at the end of the current license was determined to be as follows:

Unit 1	122.5°F
Unit 2	78 °F
Unit 3	68.1°F

The projected RT_{PTS} value at the end of the current license for the beltline materials are summarized in Figure 7-2 (from the NRC Reactor Vessel Integrity Database (RVID). These values represent conditions for PUR (3990 MW_t) given that the projected fluence at end-of-license, 3.29E+19 n/cm^2, E>I MeV, is bounded by the Analysis of Record (AOR) and the method for predicting RT_{PTS} unchanged.

b) Vessel Fluence Evaluation - The AOR end-of-life fluence is 3.29E+19 n/cm^2 for the vessel inside surface. The AOR is based on a core power level of 4200 MW_t. The analyses for Palo Verde were issued as follows:

Unit 1 Letter 102-04500 from APS to USNRC, dated October 20, 2000 transmitted WCAP-15589 (Analysis of 38 Degree Capsule from the Arizona Public Service Company Palo Verde Unit No. 1 Reactor Vessel Radiation Surveillance Program)

Unit 2 Letter 102-02919 from APS to the USNRC, dated April 15, 1994 transmitted WCAP-13935 (Analysis of 137 Degree Capsule from the Arizona Public Service Company Palo Verde Unit No. 2 Reactor Vessel Radiation Surveillance Program).

Unit 3 Letter 102-03340 from APS to USNRC, dated April 26, 1995 transmitted WCAP-14208 (Analysis of 137 Degree Capsule from the Arizona Public Service Company Palo Verde Unit No. 3 Reactor Vessel Radiation Surveillance Program)

Based on those analyses, the 32 EFPY peak azimuthal fluence for the vessel inside surface is as follows:

Unit 1	1.725E+19 n/cm^2
Unit 2	2.047E+19 n/cm^2
Unit 3	2.047E+19 n/cm^2

The WCAP's analyses showed that the projected end-of-life (32 EFPY) fluence was approximately one-third lower than the value in the AOR (i.e., one-third more conservative than the assessment done for the PUR submittal). The large difference between the AOR and the WCAP's analyses is based on the fact that the latter did account for actual plant operation, and much of the difference is a reflection of the low leakage fuel management program employed. The PUR submittal concerning vessel fluence was based on the AOR and showed that value to be bounding.

c) Heat-up and Cool-down Pressure Temperature Limit Curves and Low Temperature Overpressure Protection - 10 CFR Part 50 Appendix G addresses the limits on pressure and temperature that are placed on heatup and cool-down during normal operation. There are no changes to the values used to establish the Appendix G normal operating limits. The limits represent conditions for PUR (3990 MW_t) given that the projected fluence at end-of-license, 3.29E+19 n/cm^2, E>I MeV, is bounded by the AOR such that the predicted vessel material properties used to establish the heat-up and cool-down limits are unchanged. The low temperature overpressure protection limits for PUR conditions are unchanged for those same reasons.

d) Upper Shelf Energy (USE) - 10 CFR Part 50 Appendix G requires that the upper shelf energy throughout the life of the vessel be no less than 50 ft-lb. For Palo Verde, the lowest USE value at the end of the current license was determined to be as follows:

Unit 1	65.20 ft-lb
Unit 2	74 ft-lb
Unit 3	70.70 ft-lb

The projected USE value at the end of the current license for the beltline materials is summarized in Figure 7-1 (from the NRC RVID). These values represent conditions for PUR (3990 MW_t) given the projected fluence at end-of-life, 3.29E+19 n/cm^2, E>I MeV.

e) Surveillance Capsule Withdrawal Schedule - 10 CFR Part 50 Appendix H defines the RV surveillance program that is to be used by the licensee to monitor the neutron radiation induced changes in fracture toughness of the vessel during the life of the plant. It includes requirements to establish a surveillance capsule withdrawal schedule. The schedule was established based on the original calculation of fluence that was shown to bound conditions for PUR (3990 MW_t). The detailed surveillance schedule is discussed in UFSAR Section 5.3.1.6.6 and Table 5.3-19. Therefore, the existing surveillance capsule withdrawal schedule remains applicable under conditions for PUR.

NRC - Reactor Vessel Integrity Database

PTS Summary Report

PALO VERDE 1

Printed 10/20/2004 12:56:2
Page 1

Docket No: 50-528
EOL Date: 12/31/2024

Beltline Identification		RTpts @ EOL	Neutron Fluence @ EOL	RTndt(u)	RTndt(u) METHOD	ΔRTndt(u) @ EOL	Fluence Factor @ EOL	Chem Factor	Chemistry Factor Method	Margin	Margin Method	Cu %	Ni %	P %	S %
Type	Heat ID														
LOWER SHELL M-4311-1		58.1	3.290	-10.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.650	0.004	0.003
PLATE	62467-1														
LOWER SHELL M-4311-3		32.5	3.290	-20.0	PLANT SPECIFIC	26.2	1.312	20.00	TABLE	26.2	OVERRIDE	0.030	0.640	0.004	0.005
PLATE	62722-1														
LOWER SHELL M-4311-2		12.5	3.290	-40.0	PLANT SPECIFIC	26.2	1.312	20.00	TABLE	26.2	OVERRIDE	0.030	0.620	0.005	0.007
PLATE	62817-1														
INTERMEDIATE SHELL M-6701-1		121.7	3.290	30.0	PLANT SPECIFIC	57.7	1.312	44.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.070	0.660	0.005	0.018
PLATE	C4142-1														
INTERMEDIATE SHELL M-6701-3		122.5	3.290	40.0	PLANT SPECIFIC	48.5	1.312	37.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.060	0.610	0.004	0.016
PLATE	C4188-1														
INTERMEDIATE SHELL M-6701-2		122.5	3.290	40.0	PLANT SPECIFIC	48.5	1.312	37.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.060	0.610	0.004	0.017
PLATE	C4188-2														
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		30.6	3.290	-50.0	PLANT SPECIFIC	40.3	1.312	30.74	TABLE	40.3	OVERRIDE	0.047	0.049	0.010	0.008
WELD	4P6052														
CIRC. WELD 101-171		5.4	3.290	-70.0	PLANT SPECIFIC	37.7	1.312	28.73	TABLE	37.7	OVERRIDE	0.031	0.096	0.013	0.009
WELD	4P7869														
LOWER SHELL AXIAL WELDS 101-142A,B,C		-3.0	3.290	-80.0	PLANT SPECIFIC	38.5	1.312	29.32	TABLE	38.5	OVERRIDE	0.035	0.079	0.005	0.006
WELD	90071														

Plant References and Beltline Material Notes

NOTE: Margin method for all welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01. Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of the FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.

Margin method for plate M-4311-3 (heat number 62722-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate M-4311-2 (heat number 62817-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

UUSE value for intermediate shell axial welds 101-124A,B,C (heat number 4P6052) is the average of three (3) Charpy impact tests for Palo Verde 1 weld wire/flux (Linde 0091) data from weld certified material test report (CMTR).

Certified material test report (CMTR) USE data for heat 4P6052 is from letter dated July 25, 1994.

NRC - Reactor Vessel Integrity Database

Upper Shelf Energy Summary Report

PALO VERDE 1

Docket No: 50-528
EOL Date: 12/31/2024

Beltline Identification		Material Type	USE @ EOL @ 1/4T	1/4 T NeutronFluence @ EOL	Unirradiated USE	Unirradiated USE Method	%Drop in USE @ EOL @ 1/4T	%Drop in USE Method	Cu %
Type	Heat ID								
LOWER SHELL M-4311-1		A 533B	105.27	1.681	134.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	62467-1								
LOWER SHELL M-4311-3		A 533B	111.56	1.681	142.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.030
PLATE	62722-1								
LOWER SHELL M-4311-2		A 533B	99.77	1.681	127.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.030
PLATE	62817-1								
INTERMEDIATE SHELL M-6701-1		A 533B	65.20	1.681	83.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.070
PLATE	C4142-1								
INTERMEDIATE SHELL M-6701-3		A 533B	78.56	1.681	100.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.060
PLATE	C4188-1								
INTERMEDIATE SHELL M-6701-2		A 533B	75.42	1.681	96.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.060
PLATE	C4188-2								
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		LINDE 0091	157.12	1.681	200.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.047
WELD	4P6052								
CIRC. WELD 101-171		LINDE 124	70.70	1.681	90.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.031
WELD	4P7869								
LOWER SHELL AXIAL WELDS 101-142A,B,C		LINDE 0091	109.98	1.681	140.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.035
WELD	90071								

Plant References and Beltline Material Notes

NOTE: Margin method for all welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of the FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.

Margin method for plate M-4311-3 (heat number 62722-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate M-4311-2 (heat number 62817-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

UUSE value for intermediate shell axial welds 101-124A,B,C (heat number 4P6052) is the average of three (3) Charpy impact tests for Palo Verde 1 weld wire/flux (Linde 0091) data from weld certified material test report (CMTR).

Certified material test report (CMTR) USE data for heat 4P6052 is from letter dated July 25, 1994.

NRC - Reactor Vessel Integrity Database

PTS Summary Report

PALO VERDE 2

Docket No: 50-529
EOL Date: 12/09/2025

Beltline Identification		RTpts @EOL	Neutron Fluence @ EOL	RTndt(u)	RTndt(u) METHOD	ΔRTndt(u) @ EOL	Fluence Factor @ EOL	Chem Factor	Chemistry Factor Method	Margin	Margin Method	Cu %	Ni %	P %	S %
Type	Heat ID														
INTERMEDIATE SHELL F-765-4		32.5	3.290	-20.0	PLANT SPECIFIC	26.2	1.312	20.00	TABLE	26.2	OVERRIDE	0.030	0.670	0.003	0.005
PLATE	63427-1														
INTERMEDIATE SHELL F-765-5		62.5	3.290	10.0	PLANT SPECIFIC	26.2	1.312	20.00	TABLE	26.2	OVERRIDE	0.030	0.650	0.004	0.007
PLATE	63464-1														
INTERMEDIATE SHELL F-765-6		78.1	3.290	10.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.670	0.002	0.004
PLATE	63716-1														
LOWER SHELL F-773-3		14.7	3.290	-60.0	PLANT SPECIFIC	40.7	1.312	31.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.050	0.660	0.004	0.009
PLATE	63987-1														
LOWER SHELL F-773-2		68.1	3.290	0.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.640	0.003	0.008
PLATE	64065-1														
LOWER SHELL F-773-1		62.5	3.290	10.0	PLANT SPECIFIC	26.2	1.312	20.00	TABLE	26.2	OVERRIDE	0.030	0.670	0.003	0.008
PLATE	64071-1														
LOWER SHELL AXIAL WELDS 101-142A,B,C		28.0	3.290	-80.0	PLANT SPECIFIC	54.0	1.312	41.17	TABLE	54.0	OVERRIDE	0.074	0.067	0.009	0.011
WELD	3P7317														
CIRC WELD 101-171		45.4	3.290	-30.0	PLANT SPECIFIC	37.7	1.312	28.73	TABLE	37.7	OVERRIDE	0.031	0.096	0.012	0.009
WELD	4P7869														
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		22.6	3.290	-60.0	PLANT SPECIFIC	41.3	1.312	31.51	TABLE	41.3	OVERRIDE	0.046	0.059	0.008	0.012
WELD	89833														

Plant References and Beltline Material Notes

NOTE: Margin method for all beltline welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01. Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.

Margin method for plate F-765-4 (heat number 63427-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate F-765-5 (heat number 63464-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate F-773-1 (heat number 64071-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

NRC - Reactor Vessel Integrity Database

Upper Shelf Energy Summary Report

PALO VERDE 2

Docket No: 50-529
EOL Date: 12/09/2025

Beltline Identification		Material Type	USE @ EOL @ 1/4T	1/4 T Neutron Fluence @ EOL	Unirradiated USE	Unirradiated USE Method	%Drop in USE @ EOL @ 1/4T	%Drop in USE Method	Cu %
Type	Heat ID								
INTERMEDIATE SHELL F-765-4		A 533B	89.56	1.681	114.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.030
PLATE	63427-1								
INTERMEDIATE SHELL F-765-5		A 533B	95.06	1.681	121.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.030
PLATE	63464-1								
INTERMEDIATE SHELL F-765-6		A 533B	98.99	1.681	126.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	63716-1								
LOWER SHELL F-773-3		A 533B	101.34	1.681	129.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.050
PLATE	63987-1								
LOWER SHELL F-773-2		A 533B	99.77	1.681	127.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	64065-1								
LOWER SHELL F-773-1		A 533B	82.49	1.681	105.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.030
PLATE	64071-1								
LOWER SHELL AXIAL WELDS 101-142A,B,C		LINDE 124	76.06	1.681	100.00	DIRECT	23.94	POSITION 1.2 (NO S DATA)	0.074
WELD	3P7317								
CIRC WELD 101-171		LINDE 124	74.63	1.681	95.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.031
WELD	4P7869								
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		LINDE 124	78.56	1.681	100.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.046
WELD	89833								

Plant References and Beltline Material Notes

NOTE: Margin method for all beltline welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.

Margin method for plate F-765-4 (heat number 63427-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate F-765-5 (heat number 63464-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Margin method for plate F-773-1 (heat number 64071-1) is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

NRC - Reactor Vessel Integrity Database

PTS Summary Report

PALO VERDE 3

Docket No: 50-530
EOL Date: 03/25/2027

Beltline Identification		RTpts @ EOL	Neutron Fluence @ EOL	RTndt(u)	RTndt(u) METHOD	ΔRTndt(u) @ EOL	Fluence Factor @ EOL	Chem Factor	Chemistry Factor Method	Margin	Margin Method	Cu %	Ni %	P %	S %
Type	Heat ID														
INTERMEDIATE SHELL F-6407-4		38.1	3.290	-30.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.620	0.002	0.005
PLATE	65202-1														
INTERMEDIATE SHELL F-6407-5		54.7	3.290	-20.0	PLANT SPECIFIC	40.7	1.312	31.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.050	0.610	0.002	0.005
PLATE	65219-1														
INTERMEDIATE SHELL F-6407-6		48.1	3.290	-20.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.610	0.002	0.004
PLATE	79011-1														
LOWER SHELL F-6411-1		28.1	3.290	-40.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.640	0.004	0.007
PLATE	79545-1														
LOWER SHELL F-6411-3		8.1	3.290	-60.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.660	0.007	0.018
PLATE	79659-1														
LOWER SHELL F-6411-2		68.1	3.290	0.0	PLANT SPECIFIC	34.1	1.312	26.00	TABLE	34.0	POSITION 1.1 (NO S DATA)	0.040	0.650	0.004	0.013
PLATE	79745-1														
CIRC. WELD 101-171		5.4	3.290	-70.0	PLANT SPECIFIC	37.7	1.312	28.73	TABLE	37.7	OVERRIDE	0.031	0.096	0.008	0.011
WELD	4P7869														
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		25.4	3.290	-50.0	PLANT SPECIFIC	37.7	1.312	28.73	TABLE	37.7	OVERRIDE	0.031	0.096	0.010	0.008
WELD	4P7869														
LOWER SHELL AXIAL WELDS 101-142A,B,C		25.4	3.290	-50.0	PLANT SPECIFIC	37.7	1.312	28.73	TABLE	37.7	OVERRIDE	0.031	0.096	0.008	0.012
WELD	4P7869														

Plant References and Beltline Material Notes

NOTE: Margin method for all beltline welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.

NRC - Reactor Vessel Integrity Database

Upper Shelf Energy Summary Report

PALO VERDE 3

Docket No: 50-530
EOL Date: 03/25/2027

Beltline Identification		Material Type	USE @ EOL @ 1/4T	1/4 T NeutronFluence @ EOL	Unirradiated USE	Unirradiated USE Method	%Drop in USE @ EOL @ 1/4T	%Drop in USE Method	Cu %
Type	Heat ID								
INTERMEDIATE SHELL F-6407-4		A 533B	101.34	1.681	129.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	65202-1								
INTERMEDIATE SHELL F-6407-5		A 533B	89.56	1.681	114.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.050
PLATE	65219-1								
INTERMEDIATE SHELL F-6407-6		A 533B	104.48	1.681	133.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	79011-1								
LOWER SHELL F-6411-1		A 533B	122.55	1.681	156.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	79545-1								
LOWER SHELL F-6411-3		A 533B	84.06	1.681	107.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	79659-1								
LOWER SHELL F-6411-2		A 533B	87.20	1.681	111.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.040
PLATE	79745-1								
CIRC. WELD 101-171		LINDE 124 SAW	70.70	1.681	90.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.031
WELD	4P7869								
INTERMEDIATE SHELL AXIAL WELDS 101-124A,B,C		LINDE 124 SAW	78.56	1.681	100.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.031
WELD	4P7869								
LOWER SHELL AXIAL WELDS 101-142A,B,C		LINDE 124 SAW	78.56	1.681	100.00	DIRECT	21.44	POSITION 1.2 (NO S DATA)	0.031
WELD	4P7869								

Plant References and Beltline Material Notes

NOTE: Margin method for all beltline welds is "override" since sigma delta need not be greater than 1/2 delta RTndt per RG 1.99, Rev. 2.

Chemical composition data are from the June 24, 1998 letter from J.M. Levine (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2,3 Response to Request for Additional Information Regarding RPV Integrity at PVNGS.

Information on the beltline plate heat numbers, and weld wire heat numbers are from the August 17, 1995 letter from W.L. Stewart (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1,2 and 3, Response to NRC Generic Letter 92-01, Revision 1, Supplement 1.

Plate UUSE data are from Table 5.2-5A of FSAR, and weld UUSE values are from Charpy Curves of FSAR.

Fluence and RTndt(u) data are from the January 31, 1989, letter from D. B. Karner (APS) to the USNRC Document Control Desk, subject: Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3, Generic Letter 88-11, Radiation Embrittlement of Reactor Vessel Materials.