aps

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102-06799-JJC/RKR/DCE
November 20, 2013

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

References:

1. Arizona Public Service Company (APS) letter number 102-06794, *American Society of Mechanical Engineers (ASME) Code, Section XI, Request for Approval of an Alternative to Flaw Removal and Characterization - Relief Request 51*, dated November 8, 2013
2. APS letter number 102-06797, *Response to Request for Additional Information - American Society of Mechanical Engineers (ASME) Code, Section XI, Request for Approval of an Alternative to Flaw Removal and Characterization - Relief Request 51*, dated November 18, 2013

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Unit 3
Docket No. 50-530
APS Response to Second Request for Additional Information (RAI) Regarding Relief Request 51

Pursuant to 10 CFR 50.55a(a)(3)(i), Arizona Public Service Company (APS) requested the Nuclear Regulatory Commission (NRC) approve Relief Request 51 (Reference 1) and responded to a request for additional information (Reference 2).

By email dated November 20, 2013, the NRC staff provided a second RAI to request clarification of some of the responses provided in Reference 2. The enclosure to this letter contains the APS response to the second NRC RAI.

No commitments are being made to the NRC by this letter.

A047
NRR

Should you need further information regarding this relief request, please contact Robert K. Roehler, Licensing Section Leader at (623) 393-5241.

Sincerely,

JJC/RKR/DCE/hsc

Enclosure: APS Response to the Second Request for Additional Information – Relief Request 51

cc:	M. L. Dapas	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager for PVNGS
	M. A. Brown	NRC Senior Resident Inspector for PVNGS

Enclosure

APS Response to the Second Request for Additional Information – Relief Request 51

Introduction

Pursuant to 10 CFR 50.55a(a)(3)(i) Arizona Public Service Company (APS) requested the Nuclear Regulatory Commission (NRC) approve Relief Request 51, by letter number 102-06794, dated November 8, 2013 [Agencywide Documents Access and Management System (ADAMS) Accession No. ML13317A070]. APS proposed an alternative to the ASME Code requirements of Section XI related to axial flaw indications identified in a Unit 3 reactor vessel bottom mounted instrument (BMI) nozzle. Specifically, APS proposed a half-nozzle repair and a flaw evaluation as alternatives to the requirements for flaw removal of IWA-4421 and flaw characterization of IWA-3300.

By email dated November 15, 2013, the NRC staff provided a request for additional information (RAI). The APS responses to the NRC RAI items were provided in APS letter number 102-06797, *Response to Request for Additional Information - American Society of Mechanical Engineers (ASME) Code, Section XI, Request for Approval of an Alternative to Flaw Removal and Characterization - Relief Request 51*, dated November 18, 2013 [ADAMS Accession No. ML13323A763].

Subsequently, by email dated November 20, 2013, the NRC staff requested clarification of some of the RAI responses. This enclosure contains the APS response to the second NRC RAI.

NRC RAI-1

Your response to RAI-2 dated November 18, 2013, stated that, "The maximum faulted condition, Loss of Secondary Pressure [LSP] stresses, derived in Attachment 1 to this enclosure, occur at about 118 seconds into the transient (at the maximum through-wall temperature gradient) when the cold leg temperature is 344°F and the pressure is less than 300 psia. It is therefore conservative to add the maximum thermal stresses for this transient to the SS [steady state] pressure stresses." Please confirm that by adding the stresses under the SS condition to the stresses under the LSP condition for the SS + LSP condition, you basically assumed that the pressure will be at 2235 psig at any time during the LSP and this is the source of conservatism that you mentioned above in the quote. Please clarify whether there is any other conservatism in the stresses under the SS + LSP condition.

APS Response

Yes, the stresses from SS conditions with a pressure equal to 2235 pounds per square inch absolute (psia) and a temperature equal to 565 degrees Fahrenheit (°F) were added to the LSP transient. There are no other conservatisms regarding applied loads considered in the SS + LSP condition.

NRC RAI-2

Reference 7 of Attachment 2 to Relief Request 51 dated November 8, 2013, was provided as part of your response to RAI-4 dated November 18, 2013. However, it is not clear which stresses in Reference 7 were used in this application. Please indicate the Table number in Reference 7 from which the stresses were used to calculate the stress coefficients under the SS condition in Table 6-1 of Attachment 2 to Relief Request 51.

APS Response

The values were obtained from Table 5-3a, zero degree nozzle nodes, from weld top to weld bottom at a corresponding axial height of 1.11 inches to 2.89 inches, respectively. For axial heights 3.14 inches and 3.35 inches, the head nodes 81310 and 81410 are used and the stresses obtained from the supplemental data provided by Dominion Engineering, Inc. (Attachment 1 – *Supplemental Data Table from PVB-0A*).

NRC RAI–3

Your response to RAI-5 dated November 18, 2013, stated that, "The parameters used to calculate the CD [cooldown] condition used the same total stresses as defined for the SS condition above and included a cooldown transient of 100°F/hour." Considering that the stresses under the CD condition in Table 4-3 of Attachment 2 to Relief Request 51 are much less than the stresses under the SS condition, the NRC staff still thinks that the CD condition are for thermal stresses only. Please confirm that by adding the stresses under the SS condition to the stresses under the CD condition for the SS + CD condition, you basically assumed that the pressure will be at 2235 psig at any time during CD and this is one source of extra conservatism. Please clarify whether there is any other conservatism in the stresses under the SS + CD condition.

APS Response

Yes, the stresses from SS conditions with a pressure equal to 2235 psia and a temperature equal to 565 °F were added to the CD transient. There are no other conservatisms regarding applied loads considered in the SS + CD condition.

NRC RAI-4

Your response to RAI-6 dated November 18, 2013, indicated that the J-R curve based on NUREG-0744, Volume 2, Revision 1, "Resolution of the Task A-11 Reactor Vessel Materials Toughness Safety Issue," is significantly different from that based on Regulatory Guide (RG) 1.161, "Evaluation of Reactor Pressure Vessels with Charpy Upper-Shelf Energy Less Than 50 FT-LB." As a result, you used the safety factors associated with RG 1.161 to perform the elastic plastic fracture mechanics (EPFM) analysis. The required safety factors for detected flaws (ASME Code) are different from those for postulated flaws (RG 1.161). To avoid identifying the causes for the significant difference between the J-R curves based on the two sources, which may be time consuming, please take out the extra conservatism associated with the stresses under the SS + CD condition (RAI-3) and perform the EPFM analysis using the safety factors for detected flaws.

APS Response

An EPFM evaluation for the SS + CD condition was performed removing the 2235 psia pressure stress component for SS conditions and replacing it with 800 psia, which corresponds to the time of the maximum through-wall temperature gradient. This flaw evaluation was done using the J-R curve model presented in Regulatory Guide (RG) 1.161, *Evaluation of Reactor Pressure Vessels with Charpy Upper-Shelf Energy Less Than 50 Ft-Lb*, 1995. In addition, for the J-T based flaw stability analysis, the applied safety factors of 3.0 for primary and 1.5 for secondary (residual plus thermal) were used replacing the RG 1.161 safety factors of 1.5 and 1.0 respectively. Similarly, for the J-integral limited flaw extension of 0.1-inch analysis, the applied safety factors of 1.5 for primary and 1.0 for secondary (residual plus thermal) were used replacing the RG 1.161 safety factors of 1.4 and 1.0, respectively. These results demonstrate that both EPFM acceptance criteria were met.

Regulatory Guide 1.161 J-R Curve used with NUREG-0744 Safety Factors

Ductile Crack Growth Stability Criterion: $T_{app} < T_{mat}$

At instability: $T_{app} = T_{mat}$

Safety Factors		KI^*_p	KI^*_s	$KI^*(a)$	a_e	$KI'(a_e)$	J_{app}	T_{app}	Stable?
Primary	Secondary	(ksi√in)	(ksi√in)	(ksi√in)	(in.)	(ksi√in)	(kips/in)		
1.00	1.00	22.862	91.014	113.876	2.4557	123.942	0.506	1.800	Yes
1.50	1.00	34.293	91.014	125.307	2.5364	138.606	0.633	2.252	Yes
3.00	**1.50**	68.585	136.522	205.107	3.3144	259.350	2.217	7.884	Yes
5.00	1.00	114.309	91.014	205.323	3.3171	259.726	2.223	7.906	Yes
7.00	1.00	160.032	91.014	251.047	3.9328	345.787	3.941	14.014	No

Iterate on safety factor until $T_{app} = T_{mat}$ to determine $J_{instability}$:

							$J_{instability}$	T_{app}	T_{mat}
2.0878	2.0878	47.730	190.018	237.748	3.7410	319.384	3.362	11.956	11.956

at J_{mat} = 2.217 kips/in, T_{mat} = 23.690 ($T_{app} - T_{mat}$ = 0.000)

Applied J-Integral Criterion: $J_{app} < J_{0.1}$

where, $J_{0.1} = J_{mat}$ at Δa = 0.1 in.

Safety Factors		KI^*_p	KI^*_s	$KI^*(a)$	a_e	$KI'(a_e)$	J_{app}	$J_{0.1}$	OK?
Primary	Secondary	(ksi√in)	(ksi√in)	(ksi√in)	(in.)	(ksi√in)	(kips/in)	(kips/in)	
1.50	**1.00**	34.293	91.014	125.307	2.5364	138.606	0.633	1.542	Yes

These results demonstrate that both EPFM acceptance criteria are satisfied using primary/secondary safety factors of 3.0/1.5 for stable flaw extension and 1.5/1.0 for limited flaw extension. The applied tearing modulus of 7.884 is less than the material tearing modulus of 11.956 at instability and the applied J-integral of 0.633 kips/in is less than the material J-integral of 1.542 kips/in at a flaw extension of 0.1 inch.

ATTACHMENT 1

Supplemental Data Table From PVB-0A

Enclosure - Attachment 1
Supplemental Data Table from PVB-0A

PVB-0A results.txt

```
USE MACRO FILE  WELDTAB

SELECT       FOR ITEM=LIVE COMPONENT=
 IN RANGE       1 TO    82309 STEP       1

    3467  ELEMENTS (OF     3467  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

    4311 NODES (OF     4311  DEFINED) SELECTED FROM
    3467 SELECTED ELEMENTS BY NSLE COMMAND.

PRINT S    NODAL SOLUTION PER NODE
1

***** ANSYS - ENGINEERING ANALYSIS SYSTEM  RELEASE 8.0     *****
ANSYS Mechanical U
00206332          VERSION=HPPA 8000-64  15:04:13  MAY 25, 2004 CP=      8.740

PV BMI(0d,CYC SS,3.001/0.75,0,A) - Operating


 ***** POST1 NODAL STRESS LISTING *****

 LOAD STEP=      0  SUBSTEP=      0
  TIME=    7004.0      LOAD CASE=   0

 THE FOLLOWING X,Y,Z VALUES ARE IN ELEMENT COORDINATES
```

NODE	SX	SY	SZ	SXY	SYZ	SXZ
1	1622.3	16457.	-576.34	-2661.9	-238.10	-455.72
2	2937.2	13974.	-3617.6	-2064.9	29.576	102.91
3	4870.3	13191.	-4536.1	-1641.9	307.83	1482.9
4	4326.3	12733.	-4470.5	-1695.4	620.52	3028.0
5	2343.2	12575.	-3393.2	-2062.2	788.01	3881.2
6	19.788	12457.	-2000.3	-2423.1	753.02	3831.2
7	-1732.5	10394.	-882.02	-2297.1	528.11	2611.3
8	-2041.9	8657.6	-643.20	-2065.5	218.45	1187.0
9	-1682.8	7289.2	-1406.2	-1765.8	156.25	486.79
101	-2238.6	1701.4	-749.29	-872.18	-70.323	455.14
102	-2174.4	2469.2	-5364.4	-980.12	257.03	1217.8
103	-2189.7	3271.3	-6712.6	-1126.5	553.95	2730.0
104	-2007.1	3810.6	-6286.8	-1208.0	812.86	4017.5
105	-1419.5	5381.0	-4896.5	-1437.3	979.32	4871.5
106	-928.55	6454.8	-2394.5	-1614.6	1001.3	5001.9
107	-802.72	7100.8	-7.0911	-1774.2	836.27	4260.5
108	-1425.3	6576.0	1493.7	-1729.2	481.85	2338.7
109	-2212.8	5111.3	737.50	-1517.8	274.59	1192.4
201	-4914.7	-13785.	-5035.8	1776.6	220.58	2005.0
202	-5680.6	-10954.	-9118.7	1049.7	595.77	2935.5
203	-7073.4	-8129.1	-10415.	191.71	890.25	4440.3
204	-7314.8	-5627.0	-9249.9	-367.67	1033.7	5188.8
205	-6722.7	-3051.3	-6923.4	-774.53	1093.9	5497.6
206	-5268.3	505.97	-3630.8	-1216.4	1131.5	5649.5
207	-3646.9	4150.2	932.10	-1618.7	1069.6	5391.4
208	-2851.0	5567.1	5340.1	-1743.1	819.60	3849.3
209	-1557.6	4627.1	6616.0	-1331.5	475.70	2331.1
301	-5761.0	-22054.	-11780.	3348.7	342.96	2342.6
302	-7077.4	-17233.	-13289.	2089.4	683.74	3435.6
303	-8813.0	-13228.	-13372.	904.45	1006.0	5075.3
304	-9556.8	-9557.4	-11162.	-14.052	1110.2	5661.6
305	-9712.5	-5605.8	-8149.2	-875.73	1107.2	5672.1

PVB-0A results.txt

81106	17597.	31911.	-24553.	-2965.8	-1812.5	-9015.9
81107	23449.	45464.	-13303.	-4617.4	-2292.8	-11540.
81108	29958.	53076.	-2299.9	-4773.4	-3152.5	-15678.
81109	30827.	56779.	12280.	-5603.7	-4035.9	-18996.
81111	36522.	30210.	-3606.7	1887.1	-4273.2	-22326.
81112	46142.	32226.	-10760.	3176.3	-2945.3	-16041.
81113	36744.	40837.	-9770.5	-1012.0	1049.8	7241.6
81114	47566.	54405.	14083.	-1258.1	4563.0	25429.
81115	40519.	46495.	11435.	-1092.0	5019.1	28191.
81116	57940.	47765.	11012.	2122.4	3276.5	17304.
81117	74980.	49608.	10352.	5265.7	916.36	3895.8
81118	65345.	27615.	3149.2	7851.8	652.40	4334.6
81119	46865.	8913.1	-2561.6	7868.5	753.56	4338.7
81120	32189.	13180.	-1331.8	3980.4	360.58	1736.4
81121	24770.	14811.	-1208.2	2082.1	-5.9303	235.11
81122	21080.	15667.	-1779.0	1126.3	-93.294	-533.11
81123	19886.	16590.	-1621.9	712.69	-294.81	-724.76
81201	1976.4	14733.	-35191.	-2631.1	-448.46	-2535.1
81202	3051.3	12886.	-36030.	-2029.1	-833.62	-4144.3
81203	6829.9	15632.	-32602.	-1828.8	-1402.4	-7022.6
81204	10782.	20663.	-28709.	-2075.0	-1881.0	-9476.7
81205	15464.	27482.	-23744.	-2508.1	-2451.6	-12307.
81206	20808.	34950.	-15472.	-2922.5	-3076.8	-15442.
81207	27707.	45992.	-3072.8	-3769.2	-3728.7	-18611.
81208	33106.	53371.	15477.	-4125.4	-4658.6	-23649.
81209	29328.	24597.	5742.7	1569.4	-4522.3	-22857.
81211	35199.	15338.	-20402.	4712.5	-2469.3	-13638.
81212	25455.	26224.	-30739.	-355.54	-1747.6	-8403.6
81213	31130.	47715.	-8340.3	-3043.5	413.08	6116.3
81214	28101.	54232.	6116.3	-4223.6	3522.8	23326.
81215	39396.	60555.	23612.	-3343.3	3900.9	25912.
81216	55443.	56919.	17404.	178.98	1821.8	8896.7
81217	70956.	52978.	12048.	3742.7	-431.96	-3695.4
81218	62481.	21398.	686.35	8608.1	919.08	5471.3
81219	43655.	10011.	-1171.4	7072.9	1088.8	5700.8
81220	30621.	13299.	-824.18	3636.7	299.10	2212.7
81221	23841.	14676.	-1122.6	1910.9	16.751	126.56
81222	20627.	15602.	-1600.4	1048.5	-154.23	-753.14
81223	19459.	16419.	-1511.1	656.19	-358.69	-1037.8
81301	3097.4	18111.	-22596.	-3160.1	-573.25	-3483.3
81302	3277.3	13216.	-26600.	-2081.2	-1122.8	-5628.5
81303	6467.3	13047.	-24528.	-1350.7	-1871.7	-9346.1
81304	9125.1	16729.	-20272.	-1571.4	-2479.9	-12362.
81305	11412.	23669.	-14063.	-2581.4	-3054.9	-15262.
81306	14010.	34276.	-5637.0	-4296.0	-3637.6	-18171.
81307	14426.	44034.	4313.7	-6162.7	-3830.7	-19311.
81308	9184.4	45219.	25352.	-7949.8	-3611.6	-17296.
81309	-807.55	36848.	40600.	-8692.7	-2285.7	-13327.
81310	15898.	3862.3	-41681.	2528.6	-1121.8	-8119.2
81311	-3379.0	20437.	-38698.	-5471.7	-2231.6	-9558.1
81312	9717.0	33295.	-25931.	-5241.9	-2148.7	-10211.
81313	16358.	45540.	-16398.	-5396.4	-258.70	465.66
81314	27193.	57645.	-1491.2	-4754.6	2047.0	13077.
81315	36828.	67305.	14572.	-4707.1	2564.5	15805.
81316	45750.	57204.	21263.	-1662.7	1711.5	9578.1
81317	51903.	42032.	7931.2	1559.4	-163.49	787.05
81318	52143.	17339.	-1803.5	7283.4	1615.0	6352.1
81319	38843.	10846.	-249.45	5970.1	930.26	6867.7
81320	28174.	12894.	-867.64	3206.4	258.26	2303.6
81321	23137.	14680.	-1089.2	1774.2	-43.567	-9.6570
81322	20031.	15457.	-1495.4	949.10	-220.11	-1009.9
81323	19080.	16255.	-1420.8	597.15	-410.40	-1293.3
81401	1536.3	21795.	-11924.	-4275.3	-523.78	-3021.5

PVB-0A results.txt

81402	2646.6	16689.	-16115.	-2976.8	-1037.1	-5251.1
81403	4692.7	14265.	-15683.	-2040.9	-1841.2	-9228.9
81404	5448.9	15530.	-12149.	-2115.5	-2396.1	-11870.
81405	6092.9	20927.	-7454.8	-3080.2	-2748.7	-13532.
81406	5038.3	29263.	-185.80	-4982.5	-2694.8	-13333.
81407	2951.9	30789.	4707.9	-5829.8	-2288.6	-11366.
81408	277.89	26202.	11358.	-4917.9	-988.78	-3795.9
81409	3745.7	24197.	23859.	-3251.7	742.21	289.82
81410	-809.56	40983.	-18919.	-9248.4	-757.62	-4135.0
81411	-487.77	32201.	-27479.	-7008.9	-1969.8	-8857.3
81412	106.80	35261.	-20992.	-7363.6	-2917.5	-14274.
81413	8863.8	40853.	-17100.	-6056.1	-1265.3	-6505.2
81414	18692.	44478.	-13204.	-4397.7	345.13	1910.6
81415	24400.	48069.	1007.3	-4219.3	840.82	4946.6
81416	30806.	47764.	8412.1	-2964.2	1788.4	11345.
81417	35027.	36256.	1174.7	36.003	2000.5	10069.
81418	33095.	7102.7	-1109.9	5363.1	2181.7	8407.0
81419	27677.	9525.9	236.43	3685.3	1048.0	6782.1
81420	25283.	12989.	-733.66	2564.5	342.60	2220.2
81421	21694.	14504.	-1041.7	1488.6	-83.212	4.1405
81422	19514.	15370.	-1414.5	857.16	-235.78	-1103.1
81423	18679.	16084.	-1349.9	530.80	-421.57	-1339.7
81501	1495.8	20251.	-4278.5	-3856.5	-261.71	-1480.1
81502	2598.5	14544.	-7244.2	-2443.1	-596.05	-3001.1
81503	2906.1	10848.	-7578.5	-1621.0	-1111.9	-5565.2
81504	1233.3	8617.7	-6051.7	-1527.1	-1473.6	-7304.7
81505	-828.36	8892.2	-3838.5	-2022.5	-1532.4	-7537.2
81506	-1889.3	10120.	-1850.9	-2525.8	-1263.8	-6235.8
81507	-3142.6	9234.2	-326.69	-2512.8	-704.61	-3336.7
81508	-1226.0	10745.	5920.7	-2571.5	-251.73	-1769.7
81509	-1648.0	13556.	18201.	-3489.2	-287.89	-1633.8
81510	2523.1	47062.	-5506.0	-9135.0	-572.34	-717.01
81511	5523.8	45566.	-10957.	-8174.7	-420.36	-2730.7
81512	4385.0	41336.	-17369.	-7516.4	-1363.3	-6743.2
81513	1931.2	36969.	-16653.	-6481.5	-790.56	-4088.1
81514	1048.0	34623.	-15828.	-5801.1	52.510	484.45
81515	495.97	36003.	-8934.7	-6182.9	351.71	1807.4
81516	-3218.0	30039.	-2179.2	-5877.2	1285.8	6918.0
81517	4556.1	8683.4	-8528.2	-503.24	1975.1	9155.3
81518	16909.	4625.6	-1217.0	2540.7	1573.2	7625.6
81519	21261.	10505.	1569.0	2203.7	1023.0	5084.5
81520	21547.	12961.	-87.285	1769.5	330.61	2100.6
81521	20291.	14494.	-749.72	1202.9	-34.498	60.156
81522	18834.	15253.	-1269.5	739.94	-217.49	-998.07
81523	18245.	15909.	-1253.5	478.75	-404.45	-1268.0
81601	-207.03	9746.4	-231.85	-2049.3	-49.744	-414.86
81602	169.54	6025.5	-2035.8	-1203.6	-163.98	-820.78
81603	532.03	4425.1	-2765.1	-815.45	-338.35	-1669.2
81604	158.82	3383.4	-2775.3	-666.08	-451.37	-2217.5
81605	-500.20	2515.6	-2783.9	-595.99	-522.35	-2538.5
81606	-938.02	1706.0	-3237.0	-403.49	-479.60	-2329.1
81607	-154.10	2089.8	-1785.8	-347.05	-516.25	-2671.8
81608	115.01	3464.0	4786.1	-560.86	-532.20	-2468.4
81609	918.94	6847.5	11093.	-1064.1	-270.50	-1897.9
81610	1143.7	38556.	-5184.9	-7605.0	39.925	766.78
81611	2110.5	35320.	-6671.5	-6600.4	184.41	846.96
81612	3064.6	22772.	-11516.	-3907.3	294.21	1364.5
81613	-788.17	10194.	-14563.	-1977.7	676.48	3845.8
81614	-5556.8	3964.6	-13882.	-1606.1	889.15	5251.8
81615	-8608.7	899.45	-13031.	-1663.5	836.00	4877.7
81616	-8186.1	-820.72	-11371.	-1360.0	1199.1	6756.7
81617	-1179.0	414.66	-10853.	-429.88	842.69	3736.4
81618	9429.9	7541.2	144.02	239.80	756.33	3055.7