10 CFR 50.55a

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station Unit 1**
Docket No. STN 50-528
Relief Request 57 - Request for Alternative to American Society of Mechanical Engineers Code Case N-729-4 for Replacement Reactor Vessel Closure Head Penetration Nozzles

Pursuant to 10 CFR 50.55a(z)(2), Arizona Public Service Company (APS) requests Nuclear Regulatory Commission (NRC) approval of the enclosed request for an alternative for the Palo Verde Nuclear Generating Station (PVNGS) Unit 1, based upon the specified Code Case requirements representing a hardship or unusual difficulty without a compensating increase in the level of quality and safety. The enclosure identifies the affected components, applicable American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Case requirements, reason for request, proposed alternative and basis for use. The alternative is proposed to be applied during the next operating cycle and will conclude in the Spring of 2019 refueling outage.

APS scheduled visual examinations (VE) of the replacement reactor vessel closure head (RRVCH) nozzle penetrations during the current Unit 1 refueling outage (1R20) because a spill emanating from the RRVCH vent valves had occurred on the RRVCH during the previous refueling outage (1R19) just prior to startup. In 1R20, the RRVCH nozzle penetrations were examined and 14 penetrations were determined to have relevant conditions pursuant to Code Case N-729-4, paragraph 3141(c).

The relevant conditions were not initially considered to be indicative of possible nozzle leakage based upon the combined factors of the analysis of the VE results, streak markings on the RRVCH and nozzles that were in the spill zone, nondestructive VE training for ASME Code Case N-729-4, primary water stress corrosion cracking resistant material used in the RRVCH, crack growth and crack initiation studies of Alloy 690 material, and radioisotope analysis of the residue. However, it could not absolutely be refuted that the relevant conditions are indicative of possible nozzle leakage. Code Case N-729-4, paragraph 3142.2, requires nozzles with relevant conditions indicative of possible nozzle leakage to have a supplemental examination consisting of a volumetric examination of the nozzle tube and a corresponding weld surface examination in accordance with paragraph 3200(b).

As described in the enclosure, APS is requesting an alternative to the specified requirements of Code Case N-729-4, paragraph 3142.2, pursuant to 10 CFR 50.55a(z)(2), as the provisions that require a supplemental examination represent a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

APS requests approval of this relief request by November 2, 2017, to support restart (Mode 2) from the current Unit 1 refueling outage.

No new commitments are being made in this submittal.

If you have any questions about this request, please contact Matthew Cox, Licensing Section Leader, at (623) 393-5753.

Sincerely,

Lacal, Maria L(Z06149)

Digitally signed by Lacal, Maria L(Z06149)
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Date: 2017.10.26 15:45:52 -07'00'

MLL/MDD/MSC

Enclosure: Relief Request 57 - Request for an Alternative to ASME Code Case N-729-4 for Replacement Reactor Vessel Closure Head Penetration Nozzles

cc:	K. M. Kennedy	NRC Region IV Regional Administrator
	S. P. Lingam	NRC NRR Project Manager for PVNGS
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Enclosure

Relief Request 57

Request for an Alternative to ASME Code Case N-729-4 for Replacement Reactor Vessel Closure Head Penetration Nozzles

Arizona Public Service Company
Palo Verde Nuclear Generating Station – Unit 1
Proposed Alternative in Accordance with 10 CFR 50.55a(z)(2)
Request for an Alternative to ASME Code Case N-729-4
for Replacement Reactor Vessel Closure Head Penetration Nozzles

1. ASME CODE COMPONENTS AFFECTED

Component:	Replacement Reactor Vessel Closure Head (RRVCH) Nozzles
Code Class:	Class 1
Examination Category:	American Society of Mechanical Engineers (ASME) Code Case N-729-4, *Alternative Examination Requirements for PWR Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1*
Code Item Number:	B4.40
Description:	Control Element Drive Mechanism (CEDM) Nozzles – Specifically, nozzles 22, 41, 46, 54, 55, 64, 73, 74, 81, 82, 86, 89, 90 and 97
Size:	4.275 Inch (Nominal Outside Diameter)
Material:	RRVCH - SA-508 Grade 3 Class 1 Nozzles - SB-166 N06690 (Alloy 690) Buttering and Weld Material - ERNiCrFe-7 / ERNiCrFe-7A / ENiCrFe-7 (Alloy 52/152)

There are 97 CEDM nozzles and 1 vent nozzle welded to the inside surface of the RRVCH with partial penetration J-groove welds.

2. APPLICABLE CODE EDITION AND ADDENDA

The third 10-year ISI interval Code for Palo Verde Nuclear Generating Station (PVNGS) is the 2001 Edition through and including the 2003 Addenda of ASME Code, Section XI, *Rules for Inservice Inspection of Nuclear Power Plant Components*. Examinations of the RRVCH penetrations are performed in accordance with ASME Code Case N-729-4 (Reference 1), as conditioned by Title 10 of the Code of Federal Regulations (10 CFR) 50.55a(g)(6)(ii)(D).

Manufacturing Code for PVNGS Unit 1 RRVCH: 1998 Edition through and including the 2000 Addenda of ASME Boiler and Pressure Vessel (BPV) Code, Section III, *Rules for Construction of Nuclear Power Plant Components*

3. APPLICABLE CODE REQUIREMENT

10 CFR 50.55a(g)(6)(ii)(D)(1) requires:

> *(D) Augmented ISI requirements: Reactor vessel head inspections—(1) Implementation. Holders of operating licenses or combined licenses for pressurized-water reactors as of or*

after August 17, 2017 shall implement the requirements of ASME BPV Code Case N–729–4 instead of ASME BPV Code Case N–729–1, subject to the conditions specified in paragraphs (g)(6)(ii)(D)(2) through (4) of this section, by the first refueling outage starting after August 17, 2017.

Paragraph 3141 of Code Case N-729-4 states, regarding inservice visual examinations (VE):

(a) The VE required by -2500 and performed in accordance with IWA-2200 and the additional requirements of this Case shall be evaluated by comparing the examination results with the acceptance standards specified in -3142.1.

(b) Acceptance of components for continued service shall be in accordance with -3142.

(c) Relevant conditions for the purposes of the VE shall include evidence of reactor coolant leakage, such as corrosion, boric acid deposits, and discoloration.

Paragraph 3142.1 *Acceptance by VE* of Code Case N-729-4 states:

(a) A component whose VE confirms the absence of relevant conditions shall be acceptable for continued service.

(b) A component whose VE detects a relevant condition shall be unacceptable for continued service until the requirements of (1),(2), and (c) below are met.

(1) Components with relevant conditions require further evaluation. This evaluation shall include determination of the source of the leakage and correction of the source of leakage in accordance with -3142.3.

(2) All relevant conditions shall be evaluated to determine the extent, if any, of degradation. The boric acid crystals and residue shall be removed to the extent necessary to allow adequate examinations and evaluation of degradation, and a subsequent VE of the previously obscured surfaces shall be performed, prior to return to service, and again in the subsequent refueling outage. Any degradation detected shall be evaluated to determine if any corrosion has impacted the structural integrity of the component. Corrosion that has reduced component wall thickness below design limits shall be resolved through repair/replacement activity in accordance with IWA-4000.

(c) A nozzle whose VE indicates relevant conditions indicative of possible nozzle leakage shall be unacceptable for continued service unless it meets the requirements of -3142.2 or -3142.3.

Paragraph 3142.2 *Acceptance of Supplemental Examination* of Code Case N-729-4 states:

A nozzle with relevant <u>conditions indicative of possible nozzle leakage</u> shall be acceptable for continued service if the results of supplemental examinations [-3200(b)] meet the requirements of -3130. (Emphasis added)

Paragraph 3142.3 *Acceptance by Corrective Measures or Repair/Replacement Activity* of Code Case N-729-4 states:

> *(a) A component with relevant conditions not indicative of possible nozzle leakage is acceptable for continued service if the source of the relevant condition is corrected by a repair/replacement activity or by corrective measures necessary to preclude degradation.*
>
> *(b) A component with relevant conditions indicative of possible nozzle leakage shall be acceptable for continued service if a repair/replacement activity corrects the defect in accordance with IWA-4000.*

Paragraph 3200(b) *Supplemental Examinations* of Code Case N-729-4 states:

> *(b) The supplemental examination performed to satisfy -3142.2 shall include volumetric examination of the nozzle tube and surface examination of the partial-penetration weld, or surface examination of the nozzle tube inside surface, the partial penetration weld, and nozzle tube outside surface below the weld, in accordance with Fig. 2, or the alternative examination area or volume shall be analyzed to be acceptable in accordance with Mandatory Appendix I. The supplemental examinations shall be used to determine the extent of the unacceptable conditions and the need for corrective measures, analytical evaluation, or repair /replacement activity.*

4. REASON FOR REQUEST

APS scheduled visual examinations (VE) of the RRVCH nozzle penetrations during the current Unit 1 refueling outage (1R20) because a spill emanating from the RRVCH vent valves had occurred on the RRVCH during the previous refueling outage (1R19) just prior to startup. The spill occurred due to a RRVCH vent valve misalignment and was terminated when the vent valves were closed. During 1R20, the RRVCH head nozzle penetrations were examined in the as-found condition using ASME Code Case N-729-4 and 14 penetrations were determined to have relevant conditions pursuant to Code Case N-729-4, paragraph 3141(c). See Attachment 1 of this enclosure for nozzle and vent valve locations.

The APS qualified examiner concluded that the relevant conditions were the result of the previous spill as the condition did not have active leakage characteristics (a part of the VE-729 qualification process). Therefore, APS pursued cleaning these nozzles with a carbon dioxide (CO_2) spray in preparation for the final VE prior to return to service and again in the subsequent refueling outage as required by paragraph 3142.1(b)(2). The final VE results were acceptable as no relevant conditions remained.

During interaction with the NRC ISI inspector, APS was questioned as to how they were able to discern whether the residue in the annulus of the relevant 14 nozzles could not possibly have originated from a leak in the nozzle as opposed to resulting from the overhead spill from the RRVCH vent valves that had occurred in the previous outage. Although the pattern of residue on the nozzles was not consistent with the traditional patterns seen in CEDM nozzle leaks and there were visible streak marks on the RRVCH and nozzles indicative of an overhead spill, it could not absolutely be refuted that the relevant conditions are indicative of possible nozzle leakage.

Once it is determined that the possibility of nozzle leakage exists, Code Case N-729-4, paragraph 3142.2, requires nozzles with relevant conditions indicative of possible nozzle leakage undergo supplemental examinations consisting of a volumetric examination of the nozzle tube and a corresponding surface examination in accordance with paragraph 3200(b). In order to perform the examinations in accordance with Code Case N-729-4, paragraph 3200(b), it will be necessary

to mobilize qualified personnel to the site on an emergent basis. It is estimated that mobilization of personnel and completion of the required supplemental examinations will take approximately five weeks depending upon availability of resources.

In addition, the supplemental examination requires access to the underside of the highly contaminated RRVCH which would expose personnel to elevated dose rates. The additional dose is estimated to be approximately 0.75 to 1.0 person-rem for this work.

Adding this extra time duration to the outage and increasing the personnel dose for performing these supplemental examinations represents a hardship or unusual difficulty without a compensating increase in the level of quality and safety, pursuant to 10 CFR 50.55a(z)(2).

The specific CEDM nozzles that are within the scope of this relief request are:

Nozzles 22, 41, 46, 54, 55, 64, 73, 74, 81, 82, 86, 89, 90 and 97

Each of these nozzles was deemed a relevant condition pursuant to Code Case N-729-4, paragraph 3141(c). The initial disposition of these nozzles was that the conditions were deemed relevant, but not indicative of nozzle leakage. This conclusion was reached due to the streaking from above, the pooling in the annulus region, as well as the location of the vent valve (RCNV007 and RCNV212, see Attachment 1) spill which occurred at the end of 1R19. Each nozzle was cleaned with CO_2 to perform an adequate examination of the base metal and to ensure there were no indications of degradation or corrosion.

Attachment 2 of this enclosure, entitled, *Nozzles Identified with Debris Removed After Cleaning Efforts,* itemizes nozzles that were determined to have no relevant conditions and are not within the scope of this relief request. This additional information is provided based upon a conference call with NRC staff on October 24, 2017.

An effort was made to determine the source of the identified debris. A review of the baseline images that were taken of the RRVCH, prior to being installed in the unit, indicates that the debris noted in the current as-found images during 1R20 is similar to that noted in the May 2010 baseline which would indicate the source of the debris is from the RRVCH prior to installation in the unit. The configuration of the head ventilation system is another potential source of debris as air is drawn in from the surrounding containment atmosphere, across the RRVCH and expelled above. This circulation of air has a potential to draw in dust/debris and deposit it on the RRVCH.

Attachment 3 of this enclosure, entitled, *Nozzles Identified with Debris Remaining After Cleaning Efforts*, itemizes nozzles that were determined to not have relevant conditions but were not able to be fully cleaned so that all debris was removed. This additional information is provided based upon a conference call with NRC staff on October 24, 2017.

Nozzles 27, 39, 62 and 84 show white debris in their noted quadrants but is not relevant and cannot be removed by using the industry accepted CO_2 cleaning methodology (dry ice). The foreign material (nozzle 16) and remaining debris do not obscure the examination area and adequate VE can still be performed in the future. This information is provided independent of the scope of the relief request.

5. PROPOSED ALTERNATIVE AND BASIS FOR USE

APS proposes an alternative of performing a bare metal VE of the 14 applicable RRVCH nozzles within the scope of this relief request at the next refueling outage in accordance with Code Case N-729-4.

Previous Examinations

The replacement partial-penetration welded nozzles of the Unit 1 RRVCH were examined prior to service. During fabrication, there were no indications detected by dye penetrant examination (PT), i.e. PT white. Ultrasonic examination (UT) and eddy current examination (ET) of 100% of the nozzles was performed following hydrostatic testing with no unacceptable indications.

The Unit 1 RRVCH was installed in refueling outage 1R15, in May 2010.

A VE was performed on the PVNGS RRVCH for Unit 1 in 2014 in accordance with ASME Code Case N-729-1, Table 1, item B4.40. This VE was performed by qualified examiners on the outer surface of the RRVCH including the annulus area of the penetration nozzles. This examination did not reveal any relevant conditions that would be indicative of nozzle leakage.

MRP-375 Information Regarding the Structural Adequacy of the RRVCH Alloy 690 Nozzles

Evaluations were performed and documented in MRP-375 (Reference 2) to demonstrate the acceptability of extending the inspection intervals for ASME Code Case N-729-1, item B4.40 components. Based on plant service experience, factor of improvement (FOI) studies using laboratory data, deterministic study results, and probabilistic study results, MRP-375 documented extended inspection intervals. This information documents the structural suitability of the RRVCH for extended periods of time.

Per MRP-375, much of the laboratory data indicated an FOI of 100 for Alloy 690/52/152 versus Alloy 600/182/82 (for equivalent temperature and stress conditions) in terms of crack growth rates (CGR). In addition, laboratory and plant data demonstrate an FOI in excess of 20 in terms of the time to primary water stress corrosion cracking (PWSCC) initiation. This reduced susceptibility to PWSCC initiation and growth supports elimination of all volumetric examinations throughout the plant service period, and by extension, supports not performing volumetric examinations this refueling outage.

Deterministic calculations demonstrate that the alternative volumetric re-examination schedule of MRP-375 (15 years) is sufficient to detect any PWSCC before it could develop into a safety significant circumferential flaw that approaches the large size (i.e., more than 300 degrees of circumferential extent) necessary to produce a nozzle ejection. The deterministic calculations also demonstrate that any base metal PWSCC would likely be detected prior to a through-wall flaw occurring. Probabilistic calculations based on a Monte Carlo simulation model of the PWSCC process, including PWSCC initiation, crack growth, and flaw detection via ultrasonic testing, show a substantially reduced effect on nuclear safety compared to a RRVCH with Alloy 600 nozzles examined per current requirements.

As documented in MRP-375, the resistance of Alloy 690 and corresponding weld metals Alloy 52 and 152 is demonstrated by the lack of PWSCC indications reported in these materials, in up to 24 consecutive years of service for thousands of Alloy 690 steam generator tubes, and more than 22 consecutive years of service for thick-wall and thin-wall Alloy 690 applications. This operating experience includes service at pressurizer and hot-leg temperatures higher than those on the

RRVCH and includes Alloy 690 wrought base metal and Alloy 52/152 weld metal. This experience includes ISI volumetric or surface examinations performed in accordance with ASME Code Case N-729-1 on 13 of the 41 replacement reactor vessel heads currently operating in the United States nuclear power plant fleet. This data supports a factor of improvement in time to detectable PWSCC flaw initiation of at least five to 20 when compared to service experience of Alloy 600 in similar applications worldwide.

The PVNGS Unit 1 RRVCH was fabricated by Doosan Heavy Industries using Alloy 690 nozzle material produced by Doosan Heavy Industries per ASME SB-166. The nozzle J-groove welds were produced using Alloy 52 (ASME SFA-5.14 ERNiCrFe-7), Alloy 52 (ERNiCrFe-7A to ASME Code Case 2142-2 requirements), and Alloy 152 (ASME SFA-5.11 ENiCrFe-7) weld material. There are no similarities that indicate any specific concern for elevated PWSCC susceptibility of the RRVCH nozzles at PVNGS in comparison to other RRVCHs with Alloy 690 nozzles.

Recent RCS Operational Leakage Performance

From the operational data for Unit 1 cycle 20, the following information provides support for the conclusion that there is no evidence of an active nozzle leak:

- The surveillance test data from procedure 40ST-9RC02, *ERFDADS (Preferred) Calculation of RCS Water Inventory,* shows Reactor Coolant System (RCS) unidentified leakage rates were nominal.
- The containment atmosphere radiation monitor particulate channel RU-1 was nominal and constant.
- Containment tritium levels were nominal and constant.
- There was an increase in the containment east sump in-leakage levels which were attributed to secondary system leaks from the steam generator wet-layup pump seals.
- Chemistry samples taken of the residue in several locations on the RRVCH during 1R20 show that there is no evidence of short-lived radionuclides that must be present if there were a recent RCS leak.
- The ISI and boric acid program examinations, evaluations, and reports do not show evidence of a recent RCS leak.

The PVNGS Technical Specifications (TS) require monitoring of operational leakage. TS 3.4.14, *RCS Operational Leakage,* contains the following limits for RCS leakage:

a) No pressure boundary leakage
b) 1 gallon per minute (gpm) unidentified leakage
c) 10 gpm identified leakage; and
d) 150 gallons per day primary to secondary leakage through any one steam generator

This specification is applicable in operating Modes 1, 2, 3, and 4.

APS implements these requirements with station operating procedures; specifically, procedure 40ST-9RC02, *ERFDADS (Preferred) Calculation of RCS Water Inventory,* which is used to determine the leakage rates on a routine basis.

RCS leak rate results are used to implement specific operational actions based on action level criteria or leakage trend data. Procedure 40OP-9RC03, *RCS Leakage Source Determination,* specifies the RCS unidentified leakage action levels and their required actions as follows:

> Action Level 1 is reached when the rolling average of the last seven performances of the unidentified RCS leak rate exceeds 0.1 gpm, or the last nine consecutive unidentified RCS leak rates are greater than the baseline mean. Required actions are to document the event in a condition report, establish increased monitoring frequency of leakage indicators by daily performance of RCS water inventory performance, or as designated by the Shift Manager/Control Room Supervisor, and request assistance from the reactor coolant system engineer.
>
> Action Level 2 is reached when the last two consecutive unidentified RCS leakage rates are greater than 0.15 gpm, or two of three consecutive unidentified RCS leak rates are greater than the mean unidentified RCS leakage plus two standard deviations. Required actions are to ensure action level one response is completed, review recent plant evaluations to determine any suspect sources, evaluate changes in leakage detection indications, check any components or flowpaths whose condition has recently changed and check for recent maintenance activities.
>
> Action Level 3 is reached when the unidentified RCS leak rate is greater than 0.3 gpm, or greater than the mean plus three standard deviations. Required actions are to ensure action level one and two responses are completed, initiate planning for a containment entry per plant procedure 40DP-9ZZ01, *Containment Entry in MODE 1 thru MODE 4*, obtain a containment sump sample, chemistry to analyze the containment sump sample, evaluate other systems for indications of leakage, obtain a containment atmosphere sample for indications of RCS leakage, monitor containment sump east and west level, monitor reactor cavity sump level, monitor area radiation monitors, other containment parameters, identify the source of the leakage, determine the leakage rate, and initiate a plan to correct the leak.

Based upon the VE performed on the RRVCH and the operating time of the RRVCH, it has been determined that there is no leakage from any of the nozzles or partial penetration welds. The nozzle penetrations with relevant conditions were known to have been subjected to a prior spill emanating from the RRVCH vent valves, that radiochemistry results indicated no short half-life radioisotopes present (which indicates no active nozzle leak), and there was no evidence of carbon steel oxidation in the annulus of the nozzle penetrations with relevant conditions. Therefore, performing the stipulated emergent supplemental examinations of the nozzles would represent a hardship or unusual difficulty without a compensating increase in the level of quality and safety. APS proposes an alternative of performing a bare metal VE of the 14 applicable RRVCH nozzles within the scope of this relief request at the next refueling outage in accordance with Code Case N-729-4.

6. DURATION OF PROPOSED ALTERNATIVE

The proposed alternative will be utilized until the end of operating cycle 21.

7. PRECEDENT

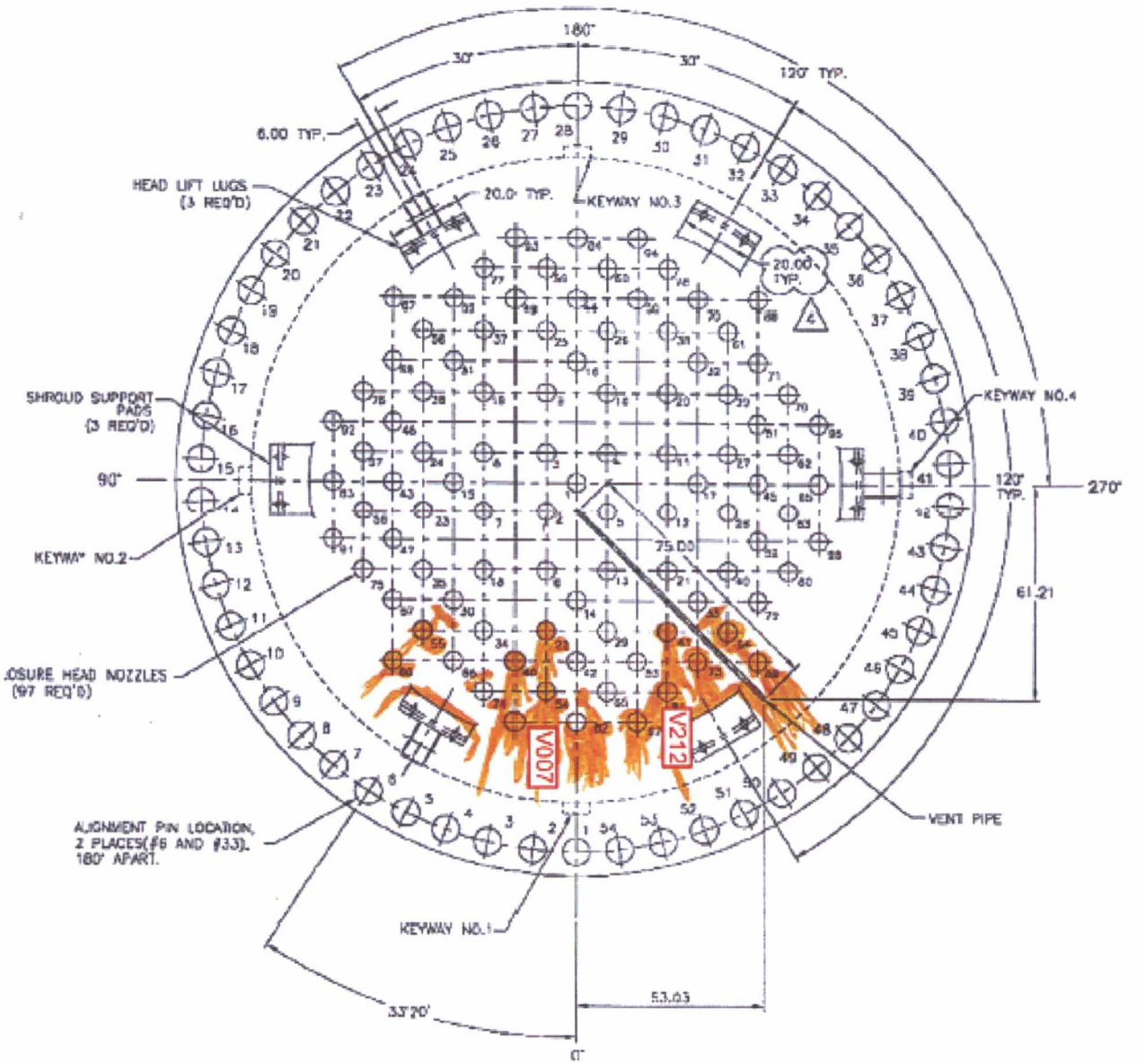
NRC letter regarding approval of Relief Request (RR) 14 for Fort Calhoun Station, Unit No. 1, Subject: *Fort Calhoun Station, Unit No. 1 - Request for Relief RR-14, From Certain Requirements of ASME Code Case N-729-1 for Reactor Vessel Head Penetration Nozzle Welds*, dated August 21, 2015 (ADAMS Accession number ML15232A003)

8. REFERENCES

1. ASME Boiler and Pressure Vessel Code Case N-729-4, *Alternative Examination Requirements for PWR Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1*
2. Materials Reliability Program: *Technical Basis for Reexamination Interval Extension for Alloy 690 PWR Reactor Vessel Top Head Penetration Nozzles* (MRP-375), EPRI, Palo Alto, CA: 2014

Attachment 1

Area of Identified RRVCH Vent Valve Spill



Attachment 2

Nozzles Identified with Debris Removed After Cleaning Efforts

Item	Nozzle	Comment	Disposition	Debris Disposition Method
1	12	Slight debris on bare metal of the head in 0-90 image	Debris was removed during 60 psig air blowing on 10/21/17.	Air
2	13	Debris noted in 0-90 and 270-360 images	Debris was removed during 60 psig air blowing on 10/21/17.	Air
3	17	Debris noted in 270-360 image	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
4	25	0-90 image shows indications of residual debris after 60 psig air on 10/21/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
5	29	Slight debris noted in the images	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
6	35	Debris noted in the 270-360 images on 10/13/17	Debris was removed during 60 psig air blowing on 10/21/17.	Air
7	36	Debris was noted in 0-90 and 270-360 images on 10/13/17	Debris was removed during 60 psig air blowing on 10/21/17. Non-relevant adjacent vessel stain with no accumulation was removed with CO_2 on 10/23/17.	Air
8	40	Debris noted in 0-90 and 270-360 images on 10/13/17	Debris was removed during 60 psig air blowing on 10/21/17. Non-relevant adjacent vessel stain with no accumulation was removed with CO_2 on 10/23/17.	Air
9	45	Debris noted in 0-90 and 270-360 images on 10/13/17	Debris was removed during 60 psig air blowing on 10/21/17.	Air
10	47	Debris noted in 0-90 and 270-360 on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
11	48	Debris noted in 180-270 and 270-360 on 10/13/17	Debris was removed during 60 psig air blowing on 10/20/17.	Air

Attachment 2

Nozzles Identified with Debris Removed After Cleaning Efforts

Item	Nozzle	Comment	Disposition	Debris Disposition Method
12	49	Debris noted in 0-90 and 270-360 on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
13	52	Debris noted in 0-90 and 270-360 on 10/13/17	As-left image from 10/17 of 0-90 does not show indication of debris. debris on 270-360 was removed with 60 psig air on 10/20/17.	Air
14	53	Debris noted in all images on 10/13/17	Debris was removed inadvertently during the CO_2 cleaning on 10/17/17. The nozzle was not directly blown on by CO_2; however, it is near the vicinity of the locations that were cleaned, and the deposits were removed.	Air
15	57	Debris noted in 90-180, 180-270 and 270-360 on 10/13/17	The debris was removed from the 90-180 and 180-270 locations utilizing 60 psig air. The debris that was in the 270-360 area was deemed non-relevant through visual examination after 60 psig air because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
16	58	Debris noted in 270-360 image on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
17	59	Debris noted in 0-90 and 270-360 images on 10/13/17	As-left image from 10/17/17 of 0-90 does not show indication of debris. Debris on 270-360 was not removed with air, but deemed non-relevant through further visual evaluation. The non-relevant condition was removed using CO_2 on 10/23/17.	Air, visual examination, CO_2
18	63	Debris noted in the 0-90 image on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2

Attachment 2

Nozzles Identified with Debris Removed After Cleaning Efforts

Item	Nozzle	Comment	Disposition	Debris Disposition Method
19	65	Debris noted in 0-90 and 270-360 images on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
20	69	Debris noted in 0-90 and 270-360 images on 10/13/17	Debris was removed during 60 psig air blowing on 10/20/17	Air
21	72	Debris noted in 0-90 and 270-360 images on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
22	77	Debris noted in 0-90 image on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
23	80	Debris noted in 270-360 image on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
24	93	Debris noted in 270-360 image on 10/13/17	After 60 psig air blow, the debris was deemed non-relevant through visual examination because it does not have an apparent path below. A successful attempt was made to remove the debris utilizing CO_2 on 10/23/17.	Air, visual examination, CO_2
25	96	Nozzle staining from above noted in 1R18, still present in 1R20	Cleaned non-relevant indications with CO_2.	Visual examination, CO_2

Attachment 3

Nozzles Identified with Debris Remaining After Cleaning Efforts

Item	Nozzle	Comment	Disposition	Debris Disposition Method
1	16	Slight debris in annulus in the 0-90 image. The debris is at the top of the annulus with no apparent path down below.	After 60 psig air, debris was deemed non-relevant and an attempt was made to remove it utilizing CO_2 on 10/23/17. In the process a piece of foreign material was pushed up from the annulus below. It appears to be a bristle from a wire brush.	Air, visual examination, CO_2 - foreign material remains
2	27	Debris noted in 0-90 and 90-180 as-found images. Vessel stain noted on 270-360 image from 10/20/17	At 0-90 and 90-180 debris blew away with 60 psig air, but the adjacent vessel staining with no accumulation of depth was still present after 10/21/17 attempt. Vessel stain was deemed non-relevant and removed with CO_2 on 10/23/17. At the conclusion of the CO_2 cleaning, a non-relevant condition was noted in the 270-360 image and an unsuccessful attempt to remove it was made. A small, non-relevant white debris remains in the annulus of the 270-360 image.	Air, visual examination, CO_2 - slight non-relevant debris remains
3	39	Debris noted in 0-90 image on 10/13/17	Debris was not removed with air and further evaluated visually to determine that it is not relevant. An attempt was made to remove the non-relevant condition with CO_2 on 10/23/17, but was unsuccessful. A non-relevant condition is still present in 0-90 after CO_2 on 10/23/17.	Air, visual examination, CO_2 - slight non-relevant debris remains
4	62	Debris noted in 0-90 image on 10/13/17	Debris was not removed with air and further evaluated visually to determine that it is not relevant. An attempt was made to remove the non-relevant condition with CO_2 on 10/23/17, but was unsuccessful. A non-relevant condition is still present in 0-90 after CO_2 on 10/23/17.	Air, visual examination, CO_2 - slight non-relevant debris remains
5	84	Nothing noted in 1R20 inspection, slight debris in 1R18 inspection	Debris was not removed with air and further evaluated visually to determine that it is not relevant. An attempt was made to remove the non-relevant condition with CO_2 on 10/24/17, but was unsuccessful. A non-relevant condition is still present in 90-180 after CO_2 on 10/23/17.	Air, visual examination, CO_2