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Palo Verde Nuclear
Generating Station

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10CFR50.55a

102-04430–CDM/SAB/RKB
April 14, 2000

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2 and 3
Docket Nos. STN 50-528/529/530
Implementation of American Society of Mechanical Engineers (ASME), Subsection IWL of Section XI for Containment Inservice Inspection – Relief Request Nos. RR-L1 through RR-L4

Pursuant to 10 CFR 50.55a(b) and (g), inservice inspection of containment must meet the requirements of the 1992 Edition, 1992 Addenda (or 1995 Edition, 1996 Addenda) of ASME Code, Section XI, Subsection IWE and IWL.

In accordance with the provisions of 10 CFR 50.55a(a)(3)(i), Arizona Public Service Company (APS) hereby submits Relief Request Nos. RR-L1 through RR-L4. These requests for relief, provided in the enclosure, seek alternatives to some of the requirements of 10 CFR 50.55a and ASME Code, Section XI, Subsection IWL for PVNGS Units 1, 2 and 3 based on the proposed alternatives providing an acceptable level of quality and safety.

In addition, pursuant to 10 CFR 50.55a(g)(6)(ii)(B), the first interval, first period containment examinations are required to be completed by September 9, 2001. To facilitate implementation for the three Unit PVNGS site, APS requests NRC Staff approval of the enclosed relief requests by September 30, 2000.

A047

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

Should you have any questions, please contact Scott A. Bauer at (623) 393-5978.

Sincerely,

David Mauldin

CDM/SAB/RKB/

Enclosure

cc:	E. W. Merschoff	[Region IV Administrator]
	M. B. Fields	[NRR Project Manager]
	J. H. Moorman	[Senior Resident Inspector]

ENCLOSURE

CONTAINMENT INSERVICE INSPECTION

ASME SECTION XI, SUBSECTION IWL

RELIEF REQUEST NOS. RR-L1 THROUGH RR-L4

FOR THE PALO VERDE NUCLEAR GENERATING STATION

UNITS 1, 2 AND 3

TABLE OF CONTENTS

CONCRETE CONTAINMENT REMOTE EXAMINATION

Code Class	CC (IWL)
Code Reference	ASME Section XI, Division 1, 1992 Edition, 1992 Addenda, IWA-2210, IWL-2310
Examination Category	L-A, CONCRETE
Item Numbers	L1.11, All Areas
Component Description	Exterior Concrete Portion of the Containment Building
PVNGS Units	1, 2, 3

Requirement

ASME Section XI, 1992 Edition, 1992 Addenda, IWA-2210, Table IWA-2210-1 and IWL-2310 require specific minimum illumination levels and maximum direct examination distances for examination of all concrete surfaces.

Alternate Testing

Apply the provisions of 10CFR50.55a(b)(2)(ix)(B) for deviating from the examination distance and illumination requirements of Table IWA-2210-1 to the examination of the concrete portion of the containment.

Basis For Relief

Pursuant to 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements stated above on the basis that the proposed alternative would provide an acceptable level of quality and safety. Inspecting the concrete surfaces using increased distances and decreased illumination, when approved by the Responsible Engineer, and demonstrated to the satisfaction of the Authorized Nuclear Inservice Inspector, will still allow the detection of flaws of a size sufficient to distinguish a structural problem with the concrete.

10CFR50.55a was amended in the Federal Register (61FR41303) to require the use of the 1992 Edition, 1992 Addenda of ASME Code, Section XI, when performing containment examination.

IWL-2310(a) and IWL-2310(b) impose the IWA-2210 minimum illumination, maximum examination distance, and maximum procedure demonstration lower case character height (resolution demonstration) requirements for VT-1 and VT-3, that were written for the examination of metal, on VT-1C and VT-3C for the examination of concrete.

Basis For Relief (continued)

IWA-2210, which also serves as the reference for Subsection IWE for the examination of the metal portion of containment, allows remote examination to be substituted for direct examination provided that the remote examination procedure be demonstrated capable of meeting the prescribed resolution requirements. Thus, extending the maximum direct examination distance specified in Table IWA-2210-1, is permitted.

For examinations performed under Subsection IWE, 10CFR50.55a(b)(2)(ix)(B) permits both an increase in maximum distance and a decrease in minimum allowable illumination requirements of Table IWA-2210-1 "...provided that the conditions or indications for which the visual examination is performed can be detected at the chosen distance and illumination."

The relief being sought is for the application of the rules of 10CFR50.55a(b)(2)(ix)(B) to the examination of concrete under Subsection IWL.

When IWL-2310(a) and IWL-2310(b) refer to the IWA-2210 requirements for examination distance, illumination, and resolution, the effect is to impose criteria intended for the examination of metal surfaces on the examination of concrete surfaces. The VT-1 and VT-3 examinations in Subsection IWA were designed for use on metal surfaces. Flaw detection on metal surfaces requires the ability to resolve much smaller indications than those required on concrete due to the small grain size of metal in comparison to poured concrete.

The IWA-2210, IWL-2310(a), and IWL-2310(b) visual examination requirements for examination distances, illumination levels and resolution do not allow licensees the ability to demonstrate that the remote visual examination is equivalent to direct visual examination when performing examination of concrete surfaces.

In lieu of using the Table IWA-2210-1 test chart characters, APS proposes that the Responsible Engineer use a combination of character- and workmanship-based samples to determine the resolution required to ensure that indications of interest are detectable. The Responsible Engineer would also identify the minimum size for indications of interest. For remote visual examination, the procedure and equipment to be used would be demonstrated capable of resolving these minimum indications to the satisfaction of the Responsible Engineer and the Authorized Nuclear Inservice Inspector. The record of demonstration would be available to the regulatory authorities.

Additional Information

The 1998 Edition of the ASME Code, Section XI, Subsection IWL has removed the reference to IWA for examination distance, illumination, and resolution. In addition, the terms VT-1C examination and VT-3C examination have been replaced by "Detailed Visual Examination" and "General Visual Examination," respectively. The General Visual Examination of a concrete surface is performed under the direction of the Responsible Engineer to indicate the general structural condition of the containment. If any deterioration or distress is detected in the performance of the General Visual Examination, the Detailed Visual Examination is performed under the direction of the Responsible Engineer to determine the magnitude and extent of the deterioration.

Approval

In accordance with 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements on the basis that the proposed alternative would provide an acceptable level of quality and safety.

References

1. ASME Section XI, Division 1, 1992 Edition, 1992 Addenda.

2. ASME Section XI, 1998 Edition

3. 10CFR50.55a

4. Letter from R. A. Gramm, USNRC, to C. L. Terry, TU Electric, dated July 23, 1999, "Commanche Peak Steam Electric Station (CPSES), Units 1 and 2 – Evaluation of Relief Requests: Use of the 1998 Edition of Subsections IWE and IWL of the ASME Code for Containment Inspections (TAC Nos. MA 2038 and MA 2039)."

CHEMICAL ANALYSIS OF POST-TENSIONING TENDON CORROSION PROTECTION MEDIUM (GREASE)

Code Class	CC (Concrete Containment)
Code Reference	ASME Section XI, 1992 Edition, 1992 Addenda, IWL-2525, Table IWL-2525-1
Examination Category	L-B
Item Numbers	L2.40
Component Description	Corrosion Protection Medium
PVNGS Units	1, 2, 3

Requirement

ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1, requires the use of specific American Society for Testing and Material (ASTM) and American Public Health Association (APHA) procedures for determining the chemical characteristics of the post-tensioning tendon corrosion protection medium. Analysis is required to determine the reserve alkalinity, water content, and the concentration of water-soluble chlorides, nitrates, and sulfides.

Alternate Testing

PVNGS proposes the use of alternate procedures for performing these analyses as follows:

ASTM D-6304-98, *"Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fisher Titration,"* in lieu of ASTM D-95, *"Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation,"* for the analysis of water content of the corrosion protection medium.

"Standard Method" 4500- CL^- F, *"Ion Chromatography Method for Chlorides,"* in lieu of ASTM D-512, *"Standard Test Method for Chloride Ion in Water,"* for the analysis of water-soluble chlorides.

"Standard Method" 4500-NO_3-C, *"Ion Chromatography Method for Nitrates,"* in lieu of ASTM D-992, *"Standard Test Method for Nitrate Ion in Water,"* for the analysis of water soluble nitrates.

"Standard Method" 4500-S^2-E, *"Iodometric Method for Sulfides,"* in lieu of APHA 427, *"Standard Methylene Blue Test Method for Water Soluble Sulfides,"* for the analysis of water soluble sulfides.

Alternate Testing (Continued)

ASTM D-974 MODIFIED, *"Standard Test Method for Acid and Base Number by Color Indicator Titration,"* using Table 1 of ASTM D-974 to determine sample size in lieu of the 10-gram sample specified by Table IWL-2525-1 for the analysis of reserve alkalinity.

Basis For Relief

Pursuant to 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements stated above on the basis that the proposed alternative would provide an acceptable level of quality and safety.

Water Content

ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1 of the Code requires the use of test method ASTM D-95 for the measurement of water content. The Acceptance Limit is not specified in the 1992 Edition, 1992 Addenda, but 10CFR50.55a(b)(2)(viii)(D)(1) specifies the acceptance criteria as 10% (maximum) chemically combined water by weight or the presence of free water. In the 1993 Addenda and later, the acceptance criterion is 10% (maximum). The PVNGS dedication acceptance criterion for new grease is 0.4% (maximum) by weight.

The detection limit of ASTM D-95 is 0.05% by weight. This method requires the use of chemicals not approved for use on site due to their environmentally hazardous nature. This method also generates a large amount of hazardous waste.

PVNGS proposes to determine Water Content per ASTM D-6304-98. This test method has a detection limit of 0.0005% by weight, well within the required dedication acceptance criteria for new grease. The chemicals used in this method are approved for use on site and generate a comparatively small amount of hazardous waste.

Relief is requested to use procedure ASTM D-6304-98 in lieu of ASTM D-95 for the analysis of water content of the corrosion protection medium.

Water Soluble Chlorides

ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1 of the Code requires the use of test method ASTM D-512 for the measurement of soluble chlorides. Table IWL-2525-1, specifies the acceptance criterion as 10 parts per million (PPM) maximum. The PVNGS dedication acceptance criterion for new grease is 2 PPM (maximum).

Basis For Relief (Continued)

There are three methods shown in ASTM D-512. Methods A & B have a detection limit of 8 to 250 PPM and use environmentally hazardous chemicals that are not approved for use on site. Method C has a detection limit equal to the acceptance criteria for new grease (2 PPM), however it requires the use of equipment which is not currently approved for use on site and which APS considers less reliable and its results inconsistent.

PVNGS proposes to determine chlorides per "Standard Method" 4500-CL^- F. This test method uses an ion chromatograph. In addition, the chemicals used to perform this test method are environmentally safe and are approved for use on site. The detection limit is 1 PPM.

Relief is requested to perform analysis for soluble chlorides using "Standard Method" 4500-CL^- F in lieu of ASTM D-512.

Water Soluble Nitrates

ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1 of the Code requires the use of test method ASTM D-992 for the measurement of water soluble nitrates. Table IWL-2525-1, specifies the acceptance criterion as 10 PPM maximum. The PVNGS dedication acceptance criterion for new grease is 4 PPM (maximum).

The detection limit of ASTM D-992 is 1 to 50 PPM. This method requires the use of chemicals not approved for use on site due to their environmentally hazardous nature. This method also generates a large amount of hazardous waste.

PVNGS proposes to determine nitrates per "Standard Method" 4500-NO_3-C. This test method uses an ion chromatograph. In addition, the chemicals used to perform this test method are environmentally safe and are approved for use on site. The detection limit is 0.1 PPM.

Relief is requested to perform analysis for soluble nitrates using “Standard Method” 4500-NO_3-C in lieu of ASTM D-992.

Water Soluble Sulfides

ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1 of the Code requires the use of test method APHA 427 for the measurement of water soluble sulfides. Table IWL-2525-1, specifies the acceptance criterion as 10 PPM maximum. The PVNGS dedication acceptance criterion for new grease is 2 PPM (maximum).

Basis For Relief (Continued)

The detection limit of APHA 427 is 0.1 PPM. This method requires the use of chemicals not approved for use on site due to their environmentally hazardous nature. This method also generates hazardous waste.

PVNGS proposes to determine sulfides per "Standard Method" 4500-S^2-E. This test method is done by titration. The chemicals used to perform this test method are environmentally safe and are approved for use on site. The detection limit is 0.2 PPM.

Relief is requested to perform analysis for soluble sulfides using "Standard Method" 4500-S^2-E in lieu of APHA 427.

Reserve Alkalinity (Base Number)

In accordance with ASME Section XI, 1992 Edition, 1992 Addenda, Table IWL-2525-1 requires the Reserve Alkalinity (Base Number) to be determined using ASTM D-974 Modified (in accordance with Note 2 of Table IWL-2525-1). The acceptance criteria are specified in Note 3 to the table as a minimum of 50 percent of the installed value. The Reserve Alkalinity (Base Number) for new and inservice grease at PVNGS ranges between 35 and 80 mg KOH/g.

Per ASME Section XI, Table IWL-2525-1, Base Number is to be determined per ASTM D-974 Standard Test Method for Acid and Base Number Color-Indicator Titration MODIFIED. This modified test method requires 10 grams of sample to be used. Table 1 of ASTM D-974 indicates that a 10-gram sample should be used if the anticipated (expected) Base Number will be between 0.0 and 3.0 mg KOH/g. Due to the large sample size (10 grams), a substantial amount of titration is required to reach the anticipated Base Numbers for the new and inservice grease at PVNGS. This process creates unnecessary hazardous waste.

PVNGS proposes to follow the guidelines shown in Table 1 of ASTM D-974. In general, for the existing anticipated Base Numbers for the new and inservice grease at PVNGS, Table 1 would require a sample size of 0.2 grams plus/minus 0.02 grams. Following the guidelines in Table 1 of the standard would greatly reduce the quantity of generated hazardous waste.

Relief is requested to perform ASTM D-974 MODIFIED using Table 1 of ASTM D-974 to determine sample size in lieu of the 10 gram sample size specified by ASME Section XI, Subsection IWL, Table IWL-2525-1, note 2.

Basis For Relief (Continued)

Summary

The above alternatives will result in meeting the acceptance criteria specified, result in the generation of less hazardous waste and provide an acceptable level of quality and safety.

Notes:

1. PVNGS is not requesting any relief from notes 1 and 3 of Table IWL-2525-1. PVNGS proposes relief from the sample size prescribed in note 2 of Table IWL-2525-1 (see above discussion for Reserve Alkalinity (Base Number)).

2. "Standard Method" procedures are industry standards used for chemical analysis. "Standard Method" procedures are issued jointly by the American Public Health Association, American Water Works Association and the Water Environment Federation. Refer to Library of Congress catalogue no. ISBN 0-87553-207-1.

Additional Information

Tables comparing the specified and the proposed procedures are attached to this request.

Approval

In accordance with 10CFR50.55a(a)(3)(i), relief is requested from the code requirements on the basis that the proposed alternatives would provide an acceptable level of quality and safety.

References

1. ASME Section XI, 1992 Edition, 1992 Addenda
2. Standard Methods for the Examination of Water and Waste Water, 18^{th} Ed
3. ASTM D-95
4. ASTM D-6304-98, Water by Karl Fisher
5. ASTM D-512
6. "Standard Method" 4500-CL^- F
7. ASTM D-992
8. "Standard Method" 4500-NO_3-C
9. APHA 427
10. "Standard Method" 4500-S^2-E
11. ASTM D-974, Standard Test Method for acid and Base Number Color-Indicator Titration

ATTACHMENTS:

Table RR-L2-1

WATER CONTENT

Test Method	Detection Limit	Environmental Hazards/ Special Concerns	PVNGS Acceptance Limit, New Grease	TABLE IWL-2525-1 and 10CFR50.55 a Acceptance Limit, Inservice Grease
ASTM D-95	0.05% by wt.	Uses hazardous chemicals not approved for site use. Creates hazardous waste.	Less than or equal to 0.4% by wt.	Less than or equal to 10% by wt.
ASTM D-6304-98 (proposed)	0.0005% by wt.	Uses environmentally safe chemicals and creates very little hazardous waste.		

Table RR-L2-2

CHLORIDES

Test Method	Detection Limit	Environmental Hazards/ Special Concerns	PVNGS Acceptance Limit, New Grease	TABLE IWL-2525-1 Acceptance Limit, Inservice Grease
ASTM D-512 Method "A"	8 to 250 PPM	Uses hazardous chemicals not approved for site use.	Less than or equal to 2PPM	Less than or equal to 10 PPM
ASTM D-512 Method "B"	8 to 250 PPM	Uses hazardous chemicals not approved for site use.		
ASTM D-512 Method "C"	2 PPM	Uses unapproved equipment.		
Standard Method 4500-CL^- F (proposed)	1 PPM	Uses environmentally safe chemicals.		

Table RR-L2-3

NITRATES

Test Method	Detection Limit	Environmental Hazards/ Special Concerns	PVNGS Acceptance Limit, New Grease	TABLE IWL-2525-1 Acceptance Limit, Inservice Grease
ASTM D-992	1.0 to 50.0 PPM	Use of hazardous chemicals not approved for site use. Creates hazardous waste.	Less than or equal to 4 PPM	Less than or equal to 10 PPM
Standard Method 4500-NO_3-C (proposed)	0.1 PPM	Uses environmentally safe Chemicals.		

Table RR-L2-4

SULFIDES

Test Method	Detection Limit	Environmental Hazards/ Special Concerns	PVNGS Acceptance Limit, New Grease	TABLE IWL-2525-1 Acceptance Limit, Inservice Grease
APHA 427	0.1 PPM	Uses hazardous chemicals not approved for site use. Creates hazardous waste.	Less than or equal to 2 PPM	Less than or equal to 10 PPM
Standard Method 4500-S^2-E (proposed)	0.2 PPM	Uses environmentally safe chemicals		

Table RR-L2-5

RESERVE ALKALINITY (BASE NUMBER)

	Detection Limit(s)	Environmental Hazards/ Special Concerns	PVNGS Acceptance Limit, New Grease	TABLE IWL-2525-1 Acceptance Limit, Inservice Grease
ASTM D-974 Modified, Sample Size 10 Grams (per IWL)	0.0 to 3.0 mg. KOH/g	Creates a considerable amount of Hazardous Waste.	Greater than or equal to 35.0 mg KOH/g	Minimum 50% of installed value
ASTM D-974 MODIFIED, Sample Size Per direction shown in Table 1 of ASTM D-974 (proposed)	3.0 to 25.0 and 25.0 to 250.0 mg KOH/g	Creates comparatively little Hazardous Waste.		

Containment Concrete Examination

Code Class	CC (IWL)
Code Reference	ASME Section XI, Division 1, 1992 Edition, 1992 Addenda, IWL-2410
Examination Category	L-A, CONCRETE
Item Numbers	1.11, All Areas
Component Description	Concrete Containment Exposed Exterior Surface
PVNGS Units	1, 2, and 3

Requirement

10CFR50.55a, as amended effective November 22, 1999, requires that every concrete containment be examined per the requirements of ASME Section XI, Subsection IWL, IWL-2510 (and per additional requirements as stipulated in 10CFR50.55a) by September 9, 2001 and at 5 year intervals following this initial examination.

Alternate Testing

Baseline examinations are to be performed per the requirements of 10 CFR 50.55a, as amended and IWL-2510. All subsequent exams will be performed per the following schedule and in accordance with the requirements of IWL-2510 and IWL-2410(c).

Unit 1:
- By September 9, 2001 (Baseline Examination)
- 5 years following the completion of the baseline examination.
- 15 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

Unit 2:
- By September 9, 2001 (Baseline Examination)
- 10 years following the completion of the baseline examination.
- 20 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

Unit 3:
- By September 9, 2001 (Baseline Examination)
- 10 years following the completion of the baseline examination.
- 20 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

Basis For Relief

Pursuant to 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements stated above on the basis that the proposed alternate testing would provide an acceptable level of quality and safety. Justification for relief is provided below.

1. Containment Design, Construction Dates, and Operating Environment

A single design and material specification applies to all three PVNGS containment structures. These were constructed in a continuous sequence. The completion dates for the structures are relatively close together so that all three units are similar in age. Key construction dates are listed in Table RR-L3-1.

Table RR-L3-1

Key Construction Dates

Unit	Start Post-Tensioning	Complete Post-Tensioning	Structural Integrity Test
1	February 24, 1981	January 26, 1982	December 20, 1982
2	May 3, 1982	April 18, 1983	February 5, 1985
3	October 14, 1983	April 11, 1984	September 13, 1986

All three containment structures are subject to the same environmental conditions. The water table is well below the reactor cavity floor (the lowest part of the containment structure) elevation. The climate is warm and arid throughout most of the year.

2. Results of Examinations Performed to Date

All three containment structures have been examined on a regular basis under the post-tensioning system surveillance program and the Appendix J (leakage rate testing) program. These examinations have uncovered no evidence of containment degradation. Examination results are summarized in the following Tables:

Unit 1	Tables RR-L3-2 and RR-L3-3
Unit 2	Tables RR-L3-4 and RR-L3-5
Unit 3	Tables RR-L3-6 and RR-L3-7

Table RR-L3-2

Examination Results - Unit 1

Unit 1 Post-Tensioning System Surveillance Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1984)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
3 (1986)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
5 (1988)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
10 (1992)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
15 (1999)	All forces above predicted lower limit Trend - Forces in common tendons following predicted trend	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits

Table RR-L3-3

Appendix J Examinations - Unit 1

Unit 1 Appendix J (Leakage Rate Testing) Examinations	
Date	**Examination Result**
December 1982	No evidence of degradation observed
May 1986	No evidence of degradation observed
February 1990	No evidence of degradation observed

Table RR-L3-4

Examination Results - Unit 2

Unit 2 Post-Tensioning System Surveillance Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1986)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	N/A (no sample wire extracted)
3 (1988)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	N/A (no sample wire extracted)
5 (1991)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	N/A (no sample wire extracted)
10 (1994)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	N/A (no sample wire extracted)

Table RR-L3-5

Appendix J Examinations - Unit 2

Unit 2 Appendix J (Leakage Rate Testing) Examinations	
Date	**Examination Result**
February 1985	No evidence of degradation observed
June 1988	No evidence of degradation observed
December 1991	No evidence of degradation observed

Table RR-L3-6

Examination Results - Unit 3

Unit 3 Post-Tensioning System Surveillance Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1987)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
3 (1990)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
5 (1991)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits
10 (1997)	All forces above predicted lower limit Trend - Forces in common tendons following predicted trend	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit	Strength and elongation above acceptance (lower) limits

Table RR-L3-7

Appendix J Examinations - Unit 3

Unit 3 Appendix J (Leakage Rate Testing) Examinations	
Date	**Examination Result**
September 1986	No evidence of degradation observed
May 1991	No evidence of degradation observed

Basis For Relief (Continued)

3. Causes of Containment Concrete Degradation

The principal potential causes of post-tensioned concrete containment degradation are excessive loss of pre-stressing force, high humidity, high rainfall, high ground water, severe winter conditions, and high concentrations of corrosive chemicals in the atmosphere. The resulting degradation is generally age-related.

A post-tensioned containment is essentially a passive structure. The concrete is maintained in compression by the pre-stressing tendons. It is, therefore, not subject to the destructive mechanisms associated with the tensile stresses (static and cyclic) that result from live loading and temperature fluctuations. The only significant live load applied to a containment structure under normal operating conditions is the internal pressure associated with the Structural Integrity Test and the periodic Integrated Leakage Rate Tests (ILRT).

Excessive loss of pre-stressing force may eventually result in significant cracking of the concrete surface when the containment is pressurized for periodic leakage rate testing. This is not a concern at PVNGS since, as is shown above, pre-stressing forces are above the predicted lower limits and are not decreasing at excessive rates.

High humidity, high rainfall, and high ground water may result in corrosion of steel items embedded in the concrete with consequent loss of strength and possible spalling due to corrosion product volume. Also, rainfall and ground water that enter the concrete through cracks and other openings may leach cement paste and/or, possibly, aggregate from the concrete mass. PVNGS is located in a very arid area with low humidity prevailing throughout most of the year. Rainfall is very low (averaging just 7 inches per year) and the water table is well below the reactor cavity bottom slab (the containment low point).

Basis For Relief (Continued)

Also, the concrete (with the exception of the base mat) is maintained in compression and is, consequently, relatively impervious to water percolation. Therefore, concrete degradation resulting from high humidity, rainfall, and ground water is not a concern at PVNGS.

Freezing and thawing in conjunction with precipitation can result in progressive cracking and ultimate spalling of concrete. PVNGS is located in a mild winter area. Freezes occur but these are light, of relatively short duration, and do not cause concrete temperatures to fall below the ice point at any significant distance below the surface.

Also, the freezes that do occur are generally associated with clear and dry conditions. Therefore, degradation due to freeze/thaw cycles is not a concern at PVNGS.

A corrosive atmosphere, in conjunction with rainfall or high humidity condensing conditions, may result in corrosive chemicals entering the concrete. This can result in disintegration of the concrete and corrosion of embedded steel items. The atmosphere at PVNGS is free of corrosive vapors and, as previously discussed, humidity and rainfall are low. Therefore, atmospherically induced degradation of concrete is not a concern at PVNGS.

4. Summary and Conclusions Regarding Examination Requirements

Since degradation resulting from excessive loss of pre-stressing forces, climatic conditions, other environmental conditions and ground water is not a concern at PVNGS, no benefit is gained by overly frequent detailed examinations of containment concrete surfaces. The 10CFR50.55a and Subsection IWL requirement to perform a detailed examination of each containment structure every 5 years may be reasonable for structures subject to the degradation conditions discussed, however, these requirements are excessive for PVNGS.

All three containment structures are effectively identical in design, materials of construction, and environmental exposure. Also, since construction progressed rapidly at PVNGS, there is little difference in the relative ages of the three structures; the concrete surface of each has been exposed to the PVNGS environment for close to 20 years. As the environmental conditions are benign, age related degradation is not expected to be an issue during the design lifetime (currently 40 years of reactor operation) of the structures. In fact, neither age-related nor other degradation has been observed during the regular post-tensioning system and Appendix J (leakage rate testing) examinations performed to date. Since the relative ages of the containment structures are similar, indications of age-related

Basis For Relief (Continued)

degradation, if and when these develop, are expected to be about the same on all three PVNGS containment structures at any point in time.

There is, therefore, a sound basis for concluding that an examination performed on any one containment will provide the information necessary to assess the age related condition of all three. As a result, it is concluded that safety concerns relating to the condition of containment concrete are well satisfied by examining each containment every 10 years according to a schedule that provides a reasonable nominal interval between examinations on different structures.

5. <u>Proposed Examination Schedule</u>

An examination schedule satisfying the conditions stated above is summarized under the Alternate Testing heading on Page 1 and described in detail below.

A. Baseline Examinations During The Expedited Implementation Period (by September 9, 2001)

   1. Complete examinations of Units 1, 2, and 3 are to be performed in accordance with Subsection IWL (1992 Edition with 1992 Addenda) and additional requirements identified in the November 22, 1999 (effective date) amendments to 10CFR50.55a. All noted requirements apply to these examinations except:

      (a) The IWL-2410 requirements relating to examination schedule and performance time window.

      (b) Requirements revised by approved relief requests.

   2. Each of these examinations serves the same purpose as the pre-service examination identified in IWL –2220.

B. Examinations Subsequent to September 9, 2001

   1. Subsequent examinations are to be performed in accordance with Subsection IWL (1992 Edition with 1992 Addenda) and additional requirements identified in the November 22,1999 (effective date) amendments to 10CFR50.55a per the following schedule.

Basis For Relief (Continued)

(a) Unit 1

- 5 years following the completion of the baseline examination.
- 15 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

(b) Unit 2

- 10 years following the completion of the baseline examination.
- 20 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

(c) Unit 3

- 10 years following the completion of the baseline examination.
- 20 years following the completion of the baseline examination.
- As required following evaluation of observed degradation on any unit.

2. Per the requirements of IWL-2410(c), examinations subsequent to the baseline examination would be started no sooner than 1 year prior to the baseline examination completion anniversary date and will be finished no later than 1 year after that date. All noted requirements apply to these examinations except those revised by approved relief requests.

The current condition of all three structures would be established by the baseline IWL examinations performed by September 9, 2001, as required by 10CFR50.55a (g)(6)(ii)(B)(2). These examinations will determine the condition of the Units 1, 2, and 3 containment structures after almost two decades of service under the principal loading (the pre-stressing forces).

Based on the results of other examinations (as discussed above) performed to date, it is expected that the initial Subsection IWL examinations will show the concrete to be in sound condition and free of any significant indications of degradation. This would support the conclusion that concrete does not degrade (at least over a decades

Basis For Relief (Continued)

long time frame) in the PVNGS environment.

The Unit 1 containment (the oldest) would be examined again 5 (± 1) years and 15 (± 1) years following the completion of baseline examination. The Units 2 and 3 containment structures would each be examined again 10 (± 1) years and 20 (± 1) years following the completion of the baseline examinations. Further examinations are not scheduled since they would be after the expiration of the current operating licenses.

This program provides for baseline Subsection IWL examinations of the three containment structures. This is followed by a cycle of examinations (three per 10 year interval) timed to provide early detection of any unexpected changes in concrete condition.

The above schedule would be reassessed if evidence of degradation is found during any examination. At a minimum, an engineering evaluation would be performed and the other two units may be examined for evidence of similar conditions in similar locations, if applicable. Additional examinations would be performed in accordance with the findings of the evaluation.

6. Other Considerations

Unlikely (but possible) instances of damage to a single structure resulting from unique incidents such as vehicle contact or equipment missile impacts would be evaluated on a plant specific basis when these occur.

7. Related Examinations

Added assurance about concrete condition is provided by the general visual examinations performed under the Appendix J (leakage testing) program. The Appendix J program requires a general visual examination of each containment prior to an ILRT and at least twice between ILRTs if these are performed at intervals greater than four years. Currently, APS plans to perform an ILRT on each containment every nine years and must, therefore, examine each containment at mean intervals of three years. These closely spaced examinations are expected to uncover any damage or degradation resulting from a unique incident if this has not already been evaluated and documented.

Approval

In accordance with 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements on the basis that the proposed alternatives would provide an acceptable level of quality and safety.

References

1. ASME Section XI, 1992 Edition, 1992 Addenda
2. Federal Register, August 8, 1996, Volume 61, Number 41303, Nuclear Regulatory Commission, 10CFR50, RIN 3150-AC93, Amendment to 10CFR50.55a
3. Federal Register, September 22, 1999, Volume 183, Nuclear Regulatory Commission, 10CFR50, RIN 3150-AE26, Amendment to 10CFR50.55a
4. PVNGS 10CFR50 Appendix J (Leak Rate Testing) Programs
5. PVNGS Post-Tensioning Surveillance Procedure 73ST-XZC01, Tendon Integrity

Containment Post-Tensioning System Examination

Code Class	CC (IWL)
Code Reference	ASME Section XI, Division 1, 1992 Edition, 1992 Addenda, IWL-2420 and IWL-2421
Examination Category	L-B, UNBONDED POST-TENSIONING SYSTEM
Item Numbers	L2.10, Tendon L2.20, Wire or Strand L2.30, Anchorage Hardware and Surrounding Concrete L2.40, Corrosion Protection Medium L2.50, Free Water
Component Description	Concrete Containment Post-tensioning System
PVNGS Units	1, 2, and 3

Requirement

The ASME Boiler and Pressure Vessel Code (1992 Edition with 1992 Addenda), Section XI, Division 1, IWL-2420(a) requires that each containment post-tensioning system be examined per the requirements of IWL-2520 at 1, 3, and 5 years after the Structural Integrity Test (SIT) and every 5 years thereafter. IWL-2421 provides for a reduction in the scope of alternate consecutive examinations if a site has two identical containment structures. IWL-2421 does not address sites with three identical containment structures.

Alternate Testing

10CFR50.55a, as amended effective September 9, 1996, requires performance of containment post-tensioning system examinations during a five year expedited implementation period commencing on September 9, 1996 and ending on September 9, 2001. Per the amendment, these examinations may be done under plant programs that were in effect prior to September 9, 1996.

PVNGS completed Units 1 and 3 containment post-tensioning system examinations in 1999 and 1997, respectively. These examinations were performed under the program that was in place prior to September 9, 1996 and conformed to USNRC Regulatory Guide 1.35, Revision 1 and Draft Revision 3. The Unit 2 examination, currently scheduled for early 2000, will be

Alternate Testing (Continued)

performed under the same program. Subsequent examinations will be performed in accordance with the requirements of the November 22, 1999 (effective date) amendment to 10CFR50.55a. In addition, IWL concrete containment post-tensioning system examinations performed in accordance with the alternative schedule proposed in Relief Request RR-L4 will be full physical exams conducted in accordance with all the examination requirements of IWL-2520. These exams are to be performed in accordance with the following schedule and IWL-2420(c) in lieu of the schedule and performance time window requirements of IWL-2420(a) and (b):

Unit 1:

- Between December 20, 2006 and December 20, 2008 (SIT + 25 Years), 25 year surveillance test.
- Between December 20, 2016 and December 20, 2018 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Unit 2:

- Between February 5, 2004 and February 5, 2006 (SIT + 20 Years), 20 year surveillance test.
- Between February 5, 2009 and February 9, 2011 (SIT + 25 Years), 25 year surveillance test.
- Between February 5, 2019 and February 5, 2021 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Unit 3:

- Between September 17, 2000 and September 17, 2002 (SIT + 15 Years), 15 year surveillance test.
- Between September 17, 2010 and September 17, 2012 (SIT + 25 Years), 25 year surveillance test.
- Between September 17, 2020 and September 17, 2022 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Further examinations are not scheduled since these would be after the expiration of the current Units 1, 2, and 3 operating licenses.

Basis for Relief

Pursuant to 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements stated above on the basis that the proposed alternative would provide an acceptable level of quality and safety. Justification for relief is provided below.

1. Containment Design, Construction Dates and Operating Environment

A single design and material specification applies to all three PVNGS containment structures. These were constructed in a continuous sequence. The completion dates for the structures are relatively close together so that, at the present point in time, all three are similar in age.

Key construction dates are listed in Table RR-L4-1.

Table RR-L4-1

Key Construction Dates

Unit	Start Post-Tensioning	Complete Post-Tensioning	Structural Integrity Test
1	February 24, 1981	January 26, 1982	December 20, 1982
2	May 3, 1982	April 18, 1983	February 5, 1985
3	October 14, 1983	April 11, 1984	September 13, 1986

All three structures are subject to the same environmental conditions. The climate is warm and arid throughout most of the year and the ground water table is well below the reactor cavity bottom slab (the low point of the containment). The surrounding atmosphere is free of corrosive aerosols and vapors.

2. Results of Examinations Performed to Date

The Units 1 and 3 containment post-tensioning systems have received regular and complete examinations that effectively comply with the requirements of IWL-2520. The Unit 2 containment post-tensioning system has received regular visual examinations that effectively comply with the requirements of IWL-2524. The Unit 2 system corrosion protection medium has been regularly sampled and analyzed. Sampling and analysis

Basis for Relief (Continued)

effectively complied with the requirements of IWL-2525. These examinations have uncovered no evidence of post-tensioning system degradation.

Examination results are summarized below.

Unit 1	Table RR-L4-2
Unit 2	Table RR-L4-3
Unit 3	Table RR-L4-4

Table RR-L4-2

Unit 1 Post Tensioning System Examination Results

Unit 1 Post-Tensioning System Examination Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1984)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
3 (1986)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
5 (1988)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits

Table RR-L4-2

Unit 1 Post Tensioning System Examination Results (Continued)

Unit 1 Post-Tensioning System Examination Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
10 (1992)	All forces above predicted lower limit Trend (see trend at 15 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
15 (1999)	All forces above predicted lower limit Trend - Forces in common tendons following predicted trend	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits

Table RR-L4-3

Unit 2 Post Tensioning System Examination Results

Unit 2 Post-Tensioning System Examination Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1986)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	N/A (no sample wire extracted)
3 (1988)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	N/A (no sample wire extracted)
5 (1991)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	N/A (no sample wire extracted)
10 (1994)	N/A (forces not measured)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	N/A (no sample wire extracted)	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	N/A (no sample wire extracted)

Table RR-L4-4

Unit 3 Post Tensioning System Examination Results

Unit 3 Post-Tensioning System Examination Results					
Surveillance (Year)	**Tendon Force & Trend**	**Anchorage Concrete & Hardware Condition**	**Wire Corrosion**	**Corrosion Protection Medium Composition**	**Wire Strength & Elongation**
1 (1987)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
3 (1990)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
5 (1991)	All forces above predicted lower limit Trend (see trend at 10 years)	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits
10 (1997)	All forces above predicted lower limit Trend - Forces in common tendons following predicted trend	No evidence of damage, degradation or significant (deep, extensive or ongoing) corrosion	No evidence of significant (deep, extensive or ongoing) corrosion	Contaminants & water content below acceptance (upper) limits; reserve alkalinity above acceptance (lower) limit; no free water observed	Strength and elongation above acceptance (lower) limits

Basis for Relief (Continued)

3. Causes of Post-Tensioning System Degradation

a. Corrosion

The principal cause of post-tensioning system degradation is intrusion of water into tendon ducts and end caps. This can result in corrosion of tendon wires and anchorage hardware and eventual breakage of wires and anchor heads. Deleterious corrosion of post-tensioning system components is not common, but it does occur in regions that have relatively heavy rainfall and/or high water tables.

Shallow dome containment structures account for almost all recorded instances of deleterious corrosion. This is a consequence of design and, possibly age (shallow dome containment structures are generally older than those with

Basis for Relief (Continued)

hemispherical domes; corrosion has had more time to progress). The top of the ring girder, which supports the shallow dome, must be well drained to prevent ponding of rainwater. If drainage is not properly maintained, these structures can be vulnerable to intrusion of accumulated rainwater into the upper ends of vertical tendons and percolation into dome tendon ducts and end caps. Corrosion of the vertical and dome tendons can result.

If the water table is high and the containment is deeply embedded, ground water percolating through the concrete and into the tendon gallery can enter tendon ducts and end caps. This can lead to corrosion of the lower hoop tendons and the lower ends of vertical tendons.

The PVNGS containment structures are not subject to the normal causes of post-tensioning system corrosion. The area is arid, with rainfall averaging approximately 7 inches per year. The water table is well below the containment low point. The containment structures have hemispherical domes. Therefore, the rain water quickly drains from the concrete surface. And, neither free water, significant (deep, extensive or ongoing) corrosion, nor significant concentrations of absorbed water (in the corrosion protection medium) have been found during examinations conducted at regular intervals since 1984. The containment structures are not deeply embedded and tendon galleries are dry. Thus, there is no propensity for, and no evidence of, water percolation through the lower wall. Therefore, the potential for corrosion of the PVNGS containment post-tensioning systems is minimal.

b. Excessive Loss of Pre-stressing Force

Pre-stressing force decreases with time as a consequence of concrete shrinkage, concrete creep and tendon stress relaxation. The rates of shrinkage, creep and relaxation are determined by tests conducted under specific temperature and humidity (shrinkage and creep tests) conditions. The test results provide the basis for predicting the loss of pre-stressing force. The containment is designed to retain a safe margin (after all predicted losses) of pre-stressing force at the end of design life. If actual service conditions are close to test conditions, the pre-stressing forces measured during periodic post-tensioning system examinations should be close to predicted values.

Basis for Relief (Continued)

Some older containment structures have experienced losses of pre-stressing forces well in excess of those predicted by the design calculations. This has generally been found to result from the differences between test and actual service temperatures, with the latter being significantly higher than the former. Tests performed in support of the designs of newer containment structures are generally conducted under more realistic conditions. As a result, actual losses are typically close to those predicted.

Forces in the PVNGS Units 1 and 3 containment tendons were measured during each of the periodic examinations. Results of these measurements, as summarized in the Tables RR-L4-2 and RR-L4-4 and detailed in the examination reports, show that the pre-stressing forces are decreasing in accordance with predictions. Since pre-stressing force trends are as expected based on design calculations, excessive loss of force is not a concern at PVNGS.

c. Other Indications of Potential System Degradation

Any of the following conditions may be indicative of post-tensioning system degradation. Visual inspections and laboratory tests to detect and evaluate the severity of such conditions are a part of the overall examination program.

- Cracking/spalling of concrete in the highly stressed end anchorage zones.
- Deformation and / or cracking of anchorage components.
- Button head detachment and wire breakage.
- Loss of wire strength / ductility
- Contamination of corrosion protection medium.
- Loss of corrosion protection medium

None of the above conditions has been a cause for concern at PVNGS. Tables RR-L4-2, RR-L4-3, and RR-L4-4 the results of system examinations performed to date. The examinations and results are discussed in more detail below.

The surface of the concrete adjacent to the bearing plates is examined for evidence of cracking, spalling and other indications of overloading resulting from the high bearing loads transferred by the tendons. No evidence of damage or deterioration has been found.

Basis for Relief (Continued)

Bearing plates, anchor heads, shims, and wire button heads are examined for evidence of cracking, deformation, detachment (button heads) and other indications of damage resulting from high stress levels. No evidence of damage or degradation has been found.

Wires are extracted from selected tendons, visually examined for evidence of damage and tested to determine ultimate strength and elongation at failure. No wire damage or degradation has been found. Measured wire strength and elongation have always exceeded the specified minimum required values.

The quantity of corrosion protection medium removed from (prior to examination) and replaced into (subsequent to examination) tendon ducts is measured. The difference, which provides an estimate of as-found or as-left under fill, has always been below the acceptance limit.

Corrosion protection medium is sampled and analyzed to determine the concentration of absorbed water, concentration of corrosive ions and level of reserve alkalinity. Analysis results have always met acceptance criteria.

Tendon end caps and the containment concrete surfaces are examined for evidence of corrosion protection medium leakage. No significant leakage, either from end cap seals or through the concrete, has ever been observed.

4. <u>Summary and Conclusions Regarding Examination Requirements</u>

Installation of the Unit 1 containment post-tensioning system commenced in early 1981 (see Table RR-L4-1). This was followed by installation of the Units 2 and 3 systems commencing in mid-1982 and late 1983, respectively. Since this time, thirteen examinations have been performed, five on the Unit 1 system and four on each of the other systems (see Tables RR-L4-2, RR-L4-3, and RR-L4-4). The most recent examination was that performed on the Unit 1 system in 1999. This examination was performed 18 years after system installation.

No degradation of the PVNGS Units 1, 2, and 3 containment post-tensioning systems has been found during these thirteen examinations. The forces in the Units 1 and 3 tendons are decreasing in accordance with design calculations (forces in the Unit 2 tendons are not measured under the current program). No

Basis for Relief (Continued)

evidence of significant corrosion, water intrusion (into the tendon ducts/end caps) or other potentially deleterious condition has been found. As previously noted, water intrusion and consequent corrosion are not expected at PVNGS since the climate is arid, the containment structures have hemispherical domes, and the water table is well below the low points of the structures.

Therefore, it is concluded that no benefit is gained by overly frequent examination of the PVNGS containment post-tensioning systems.

Subsection IWL requires that each containment post-tensioning system be examined 1, 3, and 5 years after the Structural Integrity Test and every 5 years thereafter. The IWL Editions and Addenda referenced in 10CFR50.55a amendments issued to date permit some reduction in examination requirements at a two-unit site (if the units meet certain criteria). Three unit sites are not addressed. The requirements for a two unit site are:

- First Unit
  - All examinations required by IWL-2520 at 1, 3, 10, 20, and 30 years following the SIT.
  - Examinations required by IWL-2524 (visual examination of anchorages) and IWL-2525 (analysis of corrosion protection medium and free water) at 5, 15, 25, and 35 years following the SIT.
- Second Unit
  - All examinations required by IWL-2520 at 1, 5, 15, 25, and 35 years following the SIT.
  - Examinations required by IWL-2524 (visual examination of anchorages) and IWL-2525 (analysis of corrosion protection medium and free water) at 3, 10, 20, and 30 years following the SIT.

The third unit at a three unit site (only PVNGS and Oconee have three identical post-tensioned concrete containment structures) may be considered as the second unit of a site that includes only Units 2 and 3. If this is done, the examination requirements for Unit 3 can be made the same as those listed above for Unit 1.

The Subsection IWL requirement (as extended above to a three unit site) to examine each containment post-tensioning system every five

Basis for Relief (Continued)

years may be reasonable if systems have shown evidence of degradation or are subject to water intrusion and corrosion. However, these requirements are excessive for PVNGS.

All three containment structures are effectively identical in design, materials of construction and environmental exposure. Also, since construction progressed rapidly at PVNGS, there is little difference in the relative ages of the three structures; only 27 months elapsed between completion of post-tensioning work on Unit 1 and the completion of the same on Unit 3. The work on Unit 3 was completed more than 15 years ago. Therefore, at any point in time, there should be little difference in age related post-tensioning system degradation among the three units. As a result, examination of any one system should provide the information needed to assess the condition of all three.

As previously noted, the most common type of age related degradation is that resulting from water intrusion (into tendon ducts and end caps) and consequent corrosion. For the reasons discussed, this type of degradation is not expected at PVNGS.

Tendon force levels typically decrease in a log-linear fashion, at least over a decades long time frame. As a result, force-time relationships are well defined by measurements made relatively frequently just after post-tensioning is completed and with decreasing frequency as time progresses. Measurements documented to date show that the Units 1 and 3 tendon forces are decreasing in accordance with design calculations. Future adherence to this trend can be assured by measurements that are relatively widely spaced in time.

Breakdown and contamination (other than that due to water intrusion) of corrosion protection medium, loss of wire strength and ductility, overloading of end anchorage zone concrete and cracking/ deformation of anchorage components have not been identified as problems in the industry. None of these has been identified as a problem at PVNGS.

Other (non age-related) degradation mechanisms are usually those associated with isolated material and construction flaws. Degradation of this nature is generally limited to a single broken wire or single detached button head in one or a few tendons. These tendons may be in any unit and, since there are typically so few, have a very low likelihood of being included in the Subsection IWL examination samples. This is not a concern since industry experience has shown that the number, if any, of wires affected is a very small percentage of the total number of wires installed.

Basis for Relief (Continued)

Therefore, it is concluded that a program requiring a complete examination (per the requirements of Subsection IWL and the added requirements identified in 10CFR50.55a) of each containment post-tensioning system at overlapping ten year intervals will represent a conservative approach to ensuring continuing system quality.

5. Proposed Examination Schedule

An examination schedule satisfying the conditions stated above is summarized under the Section of this Relief Request titled "Alternate Testing" and is described in detail below.

PVNGS completed Units 1 and 3 containment post-tensioning system examinations in 1999 and 1997, respectively. These examinations were performed under the program that was in place prior to September 9, 1996 and conformed to USNRC Regulatory Guide 1.35, Revision 1 and Draft Revision 3.

The Unit 2 examination, currently scheduled for early 2000, will be performed under the same program. Subsequent examinations will be performed in accordance with the requirements of the November 22, 1999 (effective date) amendment to 10CFR50.55a. In addition, IWL concrete containment post-tensioning system examinations performed in accordance with the alternative schedule proposed in Relief Request RR-L4 will be full physical exams conducted in accordance with all the examination requirements of IWL-2520. These exams are to be performed in accordance with the following schedule and IWL-2420(c) in lieu of the schedule and performance time window requirements of IWL-2420(a) and (b):

Unit 1:

- Between December 20, 2006 and December 20, 2008 (SIT + 25 Years), 25 year surveillance test.
- Between December 20, 2016 and December 20, 2018 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Basis for Relief (Continued)

Unit 2:

- Between February 5, 2004 and February 5, 2006 (SIT + 20 Years), 20 year surveillance test.
- Between February 5, 2009 and February 5, 2011 (SIT + 25 Years), 25 year surveillance test.
- Between February 5, 2019 and February 5, 2021 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Unit 3:

- Between September 17, 2000 and September 17, 2002 (SIT + 15 Years), 15 year surveillance test.
- Between September 17, 2010 and September 17, 2012 (SIT + 25 Years), 25 year surveillance test.
- Between September 17, 2020 and September 17, 2022 (SIT + 35 Years), 35 year surveillance test.
- As required following evaluation of observed degradation on any unit.

Additional examinations are not scheduled since these would be after the expiration of the current Units 1, 2, and 3 operating licenses.

All noted requirements of IWL-2520 and 10CFR50.55a will apply to these examinations except those revised by approved relief requests.

The examinations of the Units 1 and 3 post-tensioning systems are spaced at intervals of ten years as discussed. The Unit 2 tendon forces are not measured under the program (based on USNRC Regulatory Guide 1.35, Revision 1 and Draft Revision 3) currently in place at PVNGS. However, under the schedule proposed above, full physical examinations per IWL-2520 (that include tendon force measurements) would be performed on the Unit 2 post-tensioning system at both 20 and 25 years following the SIT. The subsequent Unit 2 system examination would be ten years later (35 years following the SIT). Each examination listed above may be performed at any time within the indicated 2-year window per IWL-2420(c).

The above schedule would be reassessed if evidence of degradation is found during any examination. At a minimum, an engineering evaluation would be performed and the other two units may be examined for evidence of similar conditions, if applicable. Additional examinations would be performed in accordance with the findings of the evaluation.

Approval

In accordance with 10CFR50.55a(a)(3)(i), relief is requested from the Code requirements on the basis that the proposed alternatives would provide an acceptable level of quality and safety.

References

1. ASME Section XI, 1992 Edition, 1992 Addenda
2. Federal Register, August 8, 1996, Volume 61, Number 41303, Nuclear Regulatory Commission, 10CFR50, RIN 3150-AC93, Amendment to 10CFR50.55a
3. Federal Register, September 22, 1999, Volume 183, Nuclear Regulatory Commission, 10CFR50, RIN 3150-AE26, Amendment to 10CFR50.55a
4. USNRC Regulatory Guide 1.35, Revision 1 and Draft Revision 3.
5. PVNGS Post-Tensioning Surveillance Procedure 73ST-XZC01, Tendon Integrity