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102-04965-SAB/TNW/JAP
July 10, 2003

U. S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Reference: Letter 102-04883-SAB/TNW/JAP, "Unit 1, Cycle 11 Startup Report,"
dated January 28, 2003.

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 3
Docket No. STN 50-530
Unit 3, Cycle 11 Startup Report

In accordance with Technical Requirements Manual requirement T5.0.600.2.a.(2), Arizona Public Service Company (APS) is submitting this startup report for PVNGS Unit 3, Cycle 11. ZIRLO clad fuel manufactured by Westinghouse Electric Company was loaded into Unit 3 for Cycle 11. The manufacturing of the fuel by Westinghouse Electric Company in Columbia, South Carolina, is a change from the previous vendor and location. The previous vendor was Combustion Engineering (CE) and the previous fuel manufacturing location was Hematite, Missouri. PVNGS Technical Specification amendment 140 was issued by the NRC on March 12, 2002 that allowed for the use of ZIRLO clad fuel. This startup report addresses the tests that were performed to demonstrate that the unit operating conditions affected by the addition of ZIRLO clad fuel remain within design predictions and specifications.

Additionally, the reference letter reported that the test acceptance criteria for the "Axial Form AFM Error (absolute value)" was " ≤ 0.010 ". This was incorrect. The actual acceptance criteria for this parameter is " ≤ 0.10 ".

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

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Unit 3, Cycle 11 Startup Report
Page 2

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

Sincerely,

TN WABM... for
SA Bauer

SAB/TNW/JAP/kg

Enclosure

cc: Regional Administrator, NRC Region IV
J. N. Donohew
N. L. Salgado

ENCLOSURE

Unit 3, Cycle 11 Startup Report

Introduction

The Palo Verde Nuclear Generating Station (PVNGS) Unit 3 Cycle 11 core consists of 104 fresh assemblies (ZIRLO) intermixed with 92 once and 45 twice-burned irradiated assemblies. The predicted cycle length is 515 EFPD. Reload Analyses shows that this core is typical of the most recent reload cores designed at PVNGS.

Cycle 11 initial criticality occurred at 2356 on April 29, 2003. Low Power Physics Testing (LPPT) began immediately following criticality and was completed the following day. Additionally, the resumption of commercial operations occurred on April 30, 2003. Power Ascension Testing followed and was completed without issues.

LPPT consisted of:

All Rods Out (ARO), Hot Zero Power (HZP), Critical Boron Concentration
Isothermal Temperature Coefficient (ITC) Measurement
Control Element Assembly (CEA) Worth Measurement
Inverse Boron Worth Measurement

Power Ascension Testing, for model verification, consisted of:

Radial Power Distribution ~ 20% Rated Thermal Power (RTP)
Radial Power Distribution ~ 70% RTP
Axial Power Distribution ~ 70% RTP
Radial Power Distribution ~ 100% RTP
Axial Power Distribution ~ 100% RTP
Verification of the Cycle Independent Shape Annealing Matrix (CISAM)
Hot Full Power (HFP), ARO, Critical Boron Concentration.

Test Acceptance Criteria

The following acceptance criteria apply to each of the tests performed during LPPT and Power Ascension:

| | |
|------------------------------------|---|
| Critical Boron Concentration (HZP) | ± 50 ppm of predicted |
| ITC Measurement | ± 3 pcm/ $^{\circ}$ F of predicted |
| CEA Testing | |
| Reference Group | $\pm 10\%$ of predicted |
| Test Group(s) | $\pm 15\%$ of predicted |
| Total Worth | $\pm 10\%$ of predicted |
| Inverse Boron Worth | $\pm 15\%$ of predicted |
| Radial Power Distribution ~20% RTP | $\pm 10\%$ of predicted for locations with a Relative Power Density (RPD) > 1.0 |

Test Acceptance Criteria (continued)

| | |
|---|--|
| Flux Symmetry ~ 20% RTP | $\leq 10\%$ of symmetric group average for instrumented locations with an RPD ≥ 1.0 and ± 0.1 RPD units for locations with an RPD < 1.0 . |
| Radial Power Distribution ~70% RTP | ± 0.1 RPD and Root Mean Square (RMS) $\leq 5\%$ |
| Axial Power Distribution ~70% RTP | ± 0.1 RPD and RMS $\leq 5\%$ |
| Peaking Factors | $\pm 10\%$ of predicted |
| Radial Power Distribution ~100% RTP | ± 0.1 RPD and RMS $\leq 5\%$ |
| Axial Power Distribution ~ 100% RTP | ± 0.1 RPD and RMS $\leq 5\%$ |
| Peaking Factors | $\pm 10\%$ of predicted |
| CISAM Verification | |
| Axial Shape RMS Error | $\leq 7.5\%$ |
| Core Average Axial Shape Index (ASI) Error (absolute value) | ≤ 0.075 |
| Axial Form AFM Error (absolute value) | ≤ 0.10 |
| Critical Boron Concentration (HFP) | ± 50 ppm of predicted |

Low Power Physics Testing

All Rods Out (ARO) Critical Boron Concentration (CBC)

This test is performed by obtaining a set of reactor coolant system (RCS) boron samples at equilibrium conditions near ARO (CEA Group 5 ~ 125 " W/D) and adjusting this concentration for the Group 5 residual reactivity worth. The measured RCS concentration was 1968 ppm, which was adjusted for an ARO condition to 1973 ppm. The design HZP ARO CBC is 1994 ppm. The difference of 21 ppm is within the acceptance criteria.

Isothermal Temperature Coefficient (ITC)

Raising and lowering the RCS Temperature and measuring the associated changes in core reactivity performs this test. The measured ITC with Group 5 at ~ 125" W/D was -1.72 pcm/°F. The predicted ITC was -1.72 pcm/°F and was corrected to test conditions. The corrected ITC was -2.00 pcm/°F. The measured ITC met the acceptance criteria and satisfied the surveillance requirement of Technical Specification 3.1.4.1.

CEA Rod Worth Measurements

Rod worth was measured using the Rod Swap method. The Reference Group (RG2 + RG3) were diluted into the core. The worth of the reference group was swapped with the worth of the test group. The results are summarized in the following Table:

| CEA Group | Measured Worth (pcm) | Predicted Worth (pcm) | % Difference | Acceptance Criteria |
|-----------------------------|----------------------|-----------------------|--------------|---------------------|
| Reference Group (RG2 + RG3) | -1270.0 | -1286.3 | 1.28 | ≤ 10% |
| | | | | |
| Test Groups: | | | | |
| RG1, SD 'B' #9 | -1248.4 | -1172.5 | -6.08 | ≤ 15% |
| SD 'A' #2 & #20 | -875.6 | -892.5 | 1.94 | ≤ 15% |
| SD 'B' #6 & #9 | -1136.2 | -1150.5 | 1.26 | ≤ 15% |
| RG5, SD 'A' #3 & #19 | -1045.4 | -1078.0 | 3.12 | ≤ 15% |
| RG4, SD 'B' #10 & #16 | -1247.6 | -1186.6 | -4.89 | ≤ 15% |
| | | | | |
| | | | | |
| | | | | |
| Total CEA Worth | -6823.2 | -6766.5 | -0.83 | ≤ 10% |

All test results met the acceptance criteria.

Inverse Boron Worth (IBW)

The IBW was determined by obtaining the measured worth of the CEA Reference Group and the change in the CBC from the dilution of the Reference Group to the lower electrical limit (LEL). The measured IBW was 135.4 ppm/% ΔK/K. The predicted IBW was 135.6 ppm/% ΔK/K. The acceptance criteria were met.

Power Ascension Testing

Flux Symmetry Verification ~ 20% RTP

Obtaining a flux map, by processing a CECOR snapshot and comparing symmetrical Relative Power Densities (RPD) performs this test. All deviations from the average of the instrumented powers were well within 10% or 0.1 RPD units.

Radial Power Distribution and Flux Symmetry ~ 20% RTP

A comparison of predicted and measured RPDs was made using data from ROCS and CECOR at ~ 20% RTP. The maximum difference for assemblies with an RPD greater than or equal to 1.0 was less than the acceptance criteria of 10%. Measured powers in symmetric, instrumented assemblies were within 10% of the symmetric group average for assemblies with RPD's greater than 1.0 and within 0.1 RPD units for assemblies with an RPD less than 1.0.

Radial and Axial Power Distributions ~ 70% RTP

A comparison of predicted and measured RPD's was made using data from ROCS and CECOR at ~ 70% RTP. Measured versus predicted RPD's were within the requirement of ± 0.1 RPD and an RMS of $\leq 5\%$ for both the Radial and Axial comparisons.

Radial and Axial Power Distributions and Peaking Factor Comparisons ~ 100% RTP

A comparison of predicted and measured RPDs was made using data from ROCS and CECOR at ~ 100% RTP. Measured versus predicted RPD's were within the requirement of ± 0.1 RPD and an RMS of $\leq 5\%$ for both the Radial and Axial comparisons. Additionally, CECOR and ROCS comparisons of the Peaking Factors were made. The acceptance criteria of $\pm 10\%$ was also met.

Verification of the Cycle Independent Shape Annealing Matrix (CISAM)

Evaluation of the CEFAS output data was performed to validate the use of the CISAM in the plant Core Protection Calculator (CPC). The requirement that the Axial Shape RMS error be $\leq 7.5\%$ for each CPC channel was met. Additionally, the absolute values of the Core Average ASI Error and the Axial Form AFM Error were ≤ 0.075 and ≤ 0.10 , respectively.

Critical Boron Concentration (Hot Full Power)

The requirement for the measured versus predicted Critical Boron Concentration at HFP is ± 50 ppm. This acceptance criterion was met for the Power Ascension Testing, as the predicted HFP, equilibrium Xenon, CBC was 1443 ppm and the measured value was 1396 ppm.