APS

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Unit 1
Docket No. STN 50-528
Unit 1, Cycle 13 Startup Report

In accordance with Technical Requirements Manual requirement T5.0.600.2.a(1) and (3), Arizona Public Service Company (APS) is submitting this startup report for PVNGS Unit 1, Cycle 13.

TRM T5.0.600.2 requires a startup report when an amendment to the operating license involving a planned increase in rated thermal power and when modifications have been made that may have significantly altered the nuclear, thermal or hydraulic performance of the unit. Prior to the restart for Cycle 13, PVNGS Unit completed modifications to implement a power uprate from 3876 Mwth to 3990 Mwth and replace steam generators.

This startup report addresses the tests that were performed to demonstrate that the unit operating conditions affected by these two changes remain within design predictions and specifications. Testing was stopped at 32% power due equipment problems. Testing at the 70% and 100% plateaus remains to be completed.

APS commits to providing a supplemental report every 90 days from the issuance of this letter until testing is complete.

IE26

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

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

Sincerely,

T/N Weber ... for
SA Bauer

SAB/TNW/JAP/gt

Enclosure

cc:	B. S. Mallett	NRC Region IV Regional Administrator
	M. B. Fields	NRC NRR Project Manager
	G. G. Warnick	NRC Senior Resident Inspector for PV

ENCLOSURE

Unit 1, Cycle 13 Startup Report

Results of Power Uprate Testing

Introduction

The Palo Verde Nuclear Generating Station (PVNGS) Unit 1, Cycle 13 core consists of 108 fresh assemblies intermixed with 96 once and 37 twice-burned irradiated assemblies. The predicted cycle length is 462 EFPD. Reload Analyses shows that this core is typical of the most recent reload cores designed at PVNGS.

Cycle 13 initial criticality occurred at 0114 on December 22, 2005. Low Power Physics Testing (LPPT) began immediately following criticality. The resumption of commercial operations occurred on December 24, 2005. Power Ascension Testing followed but was halted at approximately 32% full power due to high vibrations on safety injection (SI) valve 651. Power Ascension Testing awaits the resolution of the high vibrations on SI-651.

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, consists 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)	$\pm$ 50 ppm of predicted
ITC Measurement	
LPPT	$\pm$ 3 pcm/°F of predicted
At-power (40 EFPD)	$\pm$ 1.517 pcm/°F of predicted

Test Acceptance Criteria (continued)

CEA Testing	
Reference Group	± 10% of predicted
Test Group(s)	± 15% of predicted
Total Worth	± 10% of predicted
Inverse Boron Worth	± 15 ppm/% ΔK/K of predicted
Radial Power Distribution ~20% RTP	± 10% of predicted for locations with a Relative Power Density (RPD) > 1.0
Flux Symmetry ~ 20% RTP	≤ 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) ≤ 5%
Axial Power Distribution ~70% RTP	± 0.1 RPD and RMS ≤ 5%
Peaking Factors	± 10% of predicted
Radial Power Distribution ~100% RTP	± 0.1 RPD and RMS ≤ 5%
Axial Power Distribution ~ 100% RTP	± 0.1 RPD and RMS ≤ 5%
Peaking Factors	± 10% of predicted
CISAM Verification	
Axial Shape RMS Error	≤ 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 " withdrawn) and adjusting this concentration for the Group 5 residual reactivity worth. The measured RCS concentration was 2022 ppm, which was adjusted for an ARO condition to 2026 ppm. The design HZP ARO CBC is 2016 ppm. The difference of 10 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" withdrawn was -1.312 pcm/°F. The predicted ITC was -1.340 pcm/°F and was corrected to test conditions. The corrected ITC was -1.278 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 (RG3 + RG2) 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 (RG3 & RG2)	-1334.3	-1373.4	2.93	≤ 10%
Test Groups:				
SD (B9, B10 & B16)	-1264.2	-1241.4	-1.80	≤ 15%
RG5 & SD (A19 & A20)	-1085.2	-1065.9	-1.78	≤ 15%
SD (B6 & B7)	-1134.4	-1174.9	3.56	≤ 15%
RG4 & SD (A2 & A3)	-858.2	-919.9	7.19	≤ 15%
RG1 & RG4	-1107.5	-1089.1	-1.66	≤ 15%
Total CEA Worth	-6783.9	-6864.6	1.19	≤ 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 control element assembly (CEA) lower electrical limit (LEL). The measured IBW was -133.4 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 relative power density (RPD) units.

Radial Power Distribution and Flux Symmetry ~ 20% RTP

A comparison of predicted and measured RPD's 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.

Further Power Ascension Testing results have not yet been obtained, as power was limited to ~32% because of high vibrations on SI-651. As required, this data will be transmitted once the vibration issue has been resolved.

Results of Steam Generator Replacement Testing

Introduction

The scope and acceptance criteria for the Startup Test Program (SUTP) for the Power Uprate (PUR)/Replacement Steam Generator (RSG) were developed in three stages.

In stage 1, an initial assessment of required tests for initial startup of Chapter 14 (Initial Test Program) to the Updated Final Safety Analysis Report (UFSAR) and Combustion Engineering Standard Safety Analysis Report (CESSAR) was completed in conjunction with industry experience reviews for several plants' post-RSG testing. These assessments provided an initial list of tests to be included in the program.

Stage 2 consisted of a more in-depth screening of the testing and development of preliminary acceptance criteria.

Stage 3 included a detailed, independent engineering assessment of the testing required for the PUR/RSG project. This assessment was accomplished based on an independent review of plant systems relative to PUR/RSG impacts versus UFSAR Chapter 14. The results of the review were then reconciled with the stage 2 reviews to define the final project testing.

Unit 2 was the first Palo Verde Unit to complete the SUTP for the PUR/RSG. The SUTP demonstrated that the unit operating conditions affected by the SGR/PUR are within design expectations and specifications. The following tests which were performed in Unit 2 will not be performed in Unit 1 since testing on the prototype unit is adequate:

- SGRP AFW Water hammer Test
- The Reactor Power Cutback Portion of the SGRP Load Transient Test
- Wet Layup Recirculation Flow Test Portion of the SGRP Steam Generator Blowdown Flow Test

The following specific tests and activities were performed in Unit 1 as part of the SUTP until power ascension was stopped at 32% due to vibration issues with SIA-UV651 :

- Steam Generator Replacement Project (SGRP) Spillover Test
- Hot Gap Program
- SGRP Steam Generator Blowdown Flow Test
- Reactor Coolant System Flow Verification following Steam Generator Replacement
- Reactor Coolant System Heat Loss Measurement following Steam Generator Replacement
- SGRP Steady State Vibration Test

- SGRP Control System Checkout Test

SGRP Spillover Test

The test objective was to obtain and verify the elevations at which the Hot and Cold Legs overflow from their respective legs into the bowls of the Steam Generators to ensure spillover points are acceptable for future midloop operations.

On November 26, 2005, this test was performed. During the initial Reactor Coolant System fill prior to core reload, the level on Train A and Train B gage glasses were both 102 feet 0 inches when flow to the Reactor Coolant System was stopped. Cold Legs 1A and 1B were at the lip of the Steam Generator bowl when flow was stopped. Cold Leg 2A was 1 inch below the lip and Cold Leg 2B was ½ inch below the lip. Both hot legs were 6 inches below the lip. This result was within the expected range of 102′ ± 2″.

Hot Gap Program

The objective of the hot gap program was to validate that thermal movements of components installed or modified by the SGRP are as expected or are otherwise acceptable (by engineering evaluation or by physical changes).

The acceptance criteria varied with component; but, in general:

- No binding
- Bumper gaps not greater that design values
- Snubber strokes within design tolerances

At ambient conditions and at various temperature plateaus (170 -200 °F, 350 - 400 °F, 565 °F) during the Reactor Coolant System heatup, the following activities were performed:

- Look for binding.
- Adjust shims if necessary to preclude binding at elevated temperatures.
- Adjust shims to approach design gaps at normal operating temperature (NOT).
- Address any anomalies with engineering evaluations or physical changes.

Shims were added to the horizontal downcomer feedwater pipe whip restraint on both Steam Generators, a larger bearing plate was added to the vertical downcomer pipe whip restraint on both Steam generators, and a handrail was modified near the Steam Generator 1 west snubber lever plate.

Engineering evaluations were made where Main Steam pipe whip restraint gaps and Feedwater pipe whip restraint gaps were larger than design. The evaluations determined that the larger gaps are acceptable.

SGRP, Steam Generator Blowdown Flow Test

The test objectives were to verify that the revamped blowdown piping and sampling system with the Replacement Steam Generators function as designed. The test was performed in 2 sections:

1. Verify the new downcomer region blowdown flow path.
2. Verify the new blowdown sampling point flow paths.

The following acceptance criteria applied to each of the sections above:

1. Flow through the downcomer region blowdown flow paths shall be within 15% of the measured flow through the hot leg blowdown flow paths (Normal and Abnormal to Condenser).

2. Flow rate through the new sampling lines is at least 1.95 gpm.

On December 21, 2005, under Mode 3 Normal Operating Pressure and Temperature (NOP/NOT) conditions, blowdown flow was measured through the downcomer and hot leg blowdown flow paths to the condenser on both SGs. The following table presents the results of the blowdown flow measurements.

U1 RSG Blowdown Flow Rates (1000 lbm/hr)

Line Up	Hot Leg	Downcomer	% Difference
SG1 – Normal to Condenser	91.4	91.5	0.1
SG1 – Abnormal to Condenser	163.8	174.5	6.5
SG1 – High Rate to Condenser	611.2	N/A	
SG2 – Normal to Condenser	86.5	91.4	5.7
SG2 – Abnormal to Condenser	188.0	187.9	0.05
SG2 – High Rate to Condenser	634.4	N/A	

Downcomer region blowdown in Normal and Abnormal rate on both SGs passed.

On December 21, 2005, under Mode 3 NOP/NOT conditions flow was measured through the new sample lines. The results are listed below:

- SG1 Downcomer sample path: 2.15 gpm
- SG1 Downcomer Blowdown sample path: 2.22 gpm
- SG2 Downcomer sample path: 2.5 gpm
- SG2 Downcomer Blowdown sample path: 2.25 gpm

New sampling line flow rates met the acceptance criteria on both SGs.

Reactor Coolant System Flow Verification Following Steam Generator Replacement

The test objective was to determine the reactor coolant system (RCS) flow rate using the Reactor Coolant Pump (RCP) Delta P method.

The Acceptance Criteria were the following:

1. The actual RCS mass flow rate > 155.8 E6 lbm/hr (Technical Specification 3.4.1).
2. The RCS Volumetric flow rate > 464,357 gpm.
3. The RCS volumetric flow rate < 496,300 gpm (fuel fretting limit).

RCS Flow was determined to be 474,683 gpm (174.6 E6 lbm/hr) on December 21, 2005, under Mode 3 NOP/NOT conditions.

All Acceptance Criteria were met.

Reactor Coolant System Heat Loss Measurement Following Steam Generator Replacement

The objective of this procedure was to measure the Reactor Coolant System (RCS) heat loss at the 565 °F (NOT) and 2250 psia (NOP) test plateau and to determine the Core Operating Limit Supervisory System (COLSS) heat loss constants.

The Acceptance Criteria were the following:

1. The RCS heat loss has been determined to be < 7.1 MBTU/hr.
2. The maximum Containment Air Temperature indication < 117 °F.

The Reactor Coolant System was stabilized and maintained at NOP/NOT conditions. The sources of energy addition, removal and losses from the Reactor Coolant System were measured. To reduce the number of quantities being measured, steam generator blowdown and sampling were secured. To accurately measure pressurizer heater input, backup heaters were operated in MANUAL since the proportional heater output is variable. Containment heat load was measured by determining the heat removed by

Nuclear Cooling Water (NC) to the CEDM Cooling coils and Normal Chilled Water (WC) through the Normal Containment ACU cooling coils.

On December 21, 2005, measured RCS Heat Loss was determined to be 5.54 MBTU/hr. Maximum Containment Air Temperature observed during the test was 96.0 °F.
All Acceptance Criteria were met.

SGRP, Steady State Vibration Test

The test objectives were the following:

- To verify that steady state flow induced piping vibrations values are within the acceptable limits for the Replacement Steam Generators and associated piping systems that were revamped.
- To perform vibration data collection for a representative sample of principal balance of plant high energy systems to evaluate for adverse impact from the RSGs and/or the 2.9% increase in thermal power.
- To perform vibration data collection for the main turbine stop and control valves to evaluate for adverse impact due to the change to turbine full arc admission operation.

The Acceptance Criteria was that the piping vibration velocity was less than 2.5 inches per second (ips).

On December 21, 2005, vibration levels were measured on sixteen representative points on the primary systems under Mode 3 NOP/NOT conditions. All of the points were well below the acceptance criteria of 2.5 ips. The highest value recorded was 0.1490 ips on the RCP 2A instrument root valve.

On December 24, 2005, at the 20% power test plateau, vibration levels were measured on the new downcomer blowdown valve actuators in the normal rate flow alignment. All of the points were well below the acceptance criteria of 2.5 ips. The highest value recorded was 0.22 ips.

Thus, there were no restrictions for the power ascension due to measured vibration data.

SGRP Control System Checkout Test

The test objectives were the following:

- To demonstrate that the feedwater control systems maintains steam generator levels within acceptable bands during steady state conditions and at various plateaus during power ascension.
- To demonstrate that the feedwater control systems maintains steam generator levels within acceptable bands when the setpoint is varied by an increasing or decreasing 5% step change.
- To demonstrate that the Feedwater Control System (FWCS), Steam Bypass Control System (SBCS), Pressurizer Level Control System (PLCS), Reactor Regulating System (RRS)(in auto sequential), and Pressurizer Pressure Control System (PPCS) maintains plant parameters within acceptable tolerances of their program values during power maneuvers.

The Acceptance Criteria were the following:

- The reactor did not trip as a direct result of this test.
- The Main Turbine did not trip as a direct result of this test.
- No Engineered Safety Features Actuation System (ESFAS) actuations occurred as a direct result of this test.
- No Steam Generator safety valves lifted as a direct result of this test.
- No Primary safety valves lifted as a direct result of this test.
- The FWCS controls steam generator levels to within ± 2% narrow range (NR) of the control setpoint when operating at steady state conditions.
- The FWCS controls steam generator levels to within ± 2% NR of control setpoint after stabilization period to both 5% increase and decrease step change.
- RRS maintains/restores RCS average temperature (T_{avg}) to within ±3 °F of RCS reference temperature (T_{ref}).
- SBCS maintains/restores steam header pressure to within ± 15 psia of setpoint.
- PLCS maintains/restores pressurizer level to within ± 2% of setpoint.
- PPCS maintains/restores pressurizer pressure to within ± 15 psia of setpoint or the initial value at test initiation.

On December 24, 2005, the Reactor was stabilized at just under 20% power and the Steam Generator water level was varied in 5% steps, on one steam generator at a time, and then the control systems were evaluated.

All measured control system parameters met acceptance criteria.