PALO VERDE NUCLEAR GENERATING STATION

UNIT 3 STARTUP REPORT

(DOCKET NO. 50-530)

SUPPLEMENT 2

OCTOBER 1988

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INTRODUCTION

This is the second supplement to the startup report for Unit 3 of the Palo Verde Nuclear Generating Station (PVNGS). The original report, submitted to the NRC on April 6, 1988 (reference 1), addressed the startup test phases of initial fuel loading through power ascension testing. The test results for two areas of testing remained open at the time that this report was submitted. Those areas were the Main and Emergency Feedwater Systems Test (Startup Report Section 6.10) and the CPC and COLSS Verification (Startup Report Section 6.11). The original report was followed in July 1988 by Supplement 1 (reference 2), which updated the status of the CPC and COLSS Verification and closed out the Main and Emergency Feedwater Systems Test. This supplement summarizes the CPC and COLSS Verification, thereby closing out PVNGS Unit 3 Startup Report.

REFERENCES

1. Letter 161-00926-EEVB/PGN, "Palo Verde Nuclear Generating Station (PVNGS) Unit 3 Startup Report", dated April 8, 1988, from E. E. Van Brunt, Jr., (ANPP) to NRC.

2. Letter 161-01148-EEVB/PGN, "Palo Verde Nuclear Generating Station (PVNGS) Unit 3 Startup Report Supplement 1", dated July 1, 1988, from E. E. Van Brunt, Jr. (ANPP) to NRC.

Section 6.11 CPC Verification and COLSS Verification
(Sections 14.2.12.5.18 and 14.2.12.5.20)

TEST OBJECTIVE AND SUMMARY

The objectives of these tests were to verify the calculation of Departure from Nucleate Boiling Ratio (DNBR) and Local Power Density (LPD) performed by the Core Protection Calculators (CPCs) and the Core Operating Limit Supervisory System (COLSS), in addition to evaluating the effect of process instrument noise on the CPC system.

Testing was performed in accordance with the "COLSS/CPC Verification" test which was directed by PVNGS procedures 72PA-3SB02, at 0% full power (FP), 50% FP and 100% FP. The results from each of these tests were satisfactory.

TEST DESCRIPTION

The calculations performed by each CPC channel are verified by comparing the values of Local Power Density (LPD) and Departure from Nucleate Boiling Ratio (DNBR) recorded from each channel with the values calculated by the Combustion Engineering CPC FORTRAN simulator code CEDIPS. When provided with a known variation of input data recorded from each of the CPC channels, the CEDIPS code calculates a range of values for LPD and DNBR which could be expected to bound the actual values observed on each of the CPC operator display devices. The CPC data used as input to CEDIPS is manually gathered from the CPC display devices as maximum and minimum values observed over a specified period of time and consists of: pressurizer pressure, RCP speeds, control rod positions, RCS cold and hot leg temperatures, and excore detector responses. The CEDIPS DNBR and LPD values are compared to those observed and recorded during the test. If the observed DNBR and LPD values are within the range of expected values, the functioning of each CPC channel is considered to be verified and process instrument noise has not affected the CPC operation.

As a further step in evaluating the effect of process instrument noise, input signals to the "nosiest" CPC channel and its analog outputs were recorded on FM tape over a period of approximately two hours. The determination of the "nosiest" CPC channel was accomplished by monitoring the maximum variation in the DNBR value calculated by each CPC channel at 1 minute intervals over a 10 minute period. This data was gathered for evaluation by the NSSS vendor and had no specific test acceptance criteria.

For COLSS calculations, a statistical analysis of different sensor inputs measuring the same parameters was performed to ensure that the instruments were consistent and functioning properly. The statistical analysis is performed automatically on demand by the COLSS Sensor Deviation Statistical Routine which is executed on the Plant Monitoring System (PMS). Additionally, COLSS input and output values were collected via PMS data snapshots.

Following completion of testing at each test plateau, the COLSS statistical data, the COLSS input and output data snapshots, and the FM recorded CPC data were transmitted to the NSSS vendor for evaluation.

TEST RESULTS

The CPC calculated minimum/maximum DNBR and LPD values recorded during the test for the 0%, 50% and 100% power plateaus are provided in Tables 1, 2 and 3 along with the CEDIPS calculated range of expected values. All of the CPC calculated DNBR and LPD values were bounded by the corresponding CEDIPS range of values.

The COLSS data recorded during the testing have been evaluated by the NSSS vendor and the COLSS calculations have been determined to be acceptable.

CONCLUSION

The CPC and COLSS calculations of DNBR and LPD were satisfactorily confirmed at each of the major test plateaus.

TABLE 1
CPC/CEDIPS COMPARISON
FINAL TEST RESULTS
0% POWER PLATEAU

Official Test Copy #01 (0% Power Plateau)

PARA-METER	CPC PID		CHANNEL A CEDIPS[1]	CHANNEL A CPC[2]	CHANNEL B CEDIPS	CHANNEL B CPC	CHANNEL C CEDIPS	CHANNEL C CPC	CHANNEL D CEDIPS	CHANNEL D CPC
LPDDC	179	MAX	5.278	5.264	5.373	5.264	5.275	5.265	6.589	5.750
		MIN	5.252	5.264	5.250	5.263	5.253	5.264	5.253	5.730
		ACC.CRIT.[3]	PASS		PASS		PASS		PASS	
MINDNB	406	MAX	6.434	6.405	6.679	6.401	6.420	6.400	6.436	6.414
		MIN	6.276	6.403	6.003	6.333	6.267	6.335	5.750	6.343
		ACC.CRIT.	PASS		PASS		PASS		PASS	

Reanalysis (OTC #01)

PARA-METER	CPC PID		CHN D ADJUSTED CEDIPS	CHN D ADJUSTED CPC
LPDDC	179	MAX	5.830	5.750
		MIN	5.581	5.730
		ACC.CRIT.	PASS	
MINDNB	406	MAX	6.4352	6.414
		MIN	6.2802	6.343
		ACC.CRIT.	PASS	

Notes:

1 CEDIPS used to calculate the ranges of LPD and DNBR values for each channel using the CPC max/min data recorded from the CPC operator's module as case input.

2 CPC max/min LPD and DNBR values recorded from the operator's module.

3 Acceptance Criteria is that the observed values of LPD and DNBR calculated by the CPC be within the range of values calculated by the CEDIPS computer code.

TABLE 2
CPC/CEDIPS COMPARISON
FINAL TEST RESULTS
50% POWER PLATEAU

Official Test Copy #02 (50% Power Plateau)

PARA-METER	CPC PID		CHANNEL A CEDIPS	CHANNEL A CPC	CHANNEL B CEDIPS	CHANNEL B CPC	CHANNEL C CEDIPS	CHANNEL C CPC	CHANNEL D CEDIPS	CHANNEL D CPC
LPDDC	179	MAX	8.541	8.359	8.465	8.440	8.332	8.218	8.512	8.307
		MIN	8.254	8.340	8.352	8.420	8.095	8.183	8.235	8.287
		ACC.CRIT.	PASS		PASS		PASS		PASS	
MINDNB	406	MAX	3.959	3.901	3.889	3.845	3.980	3.906	3.921	3.877
		MIN	3.739	3.790	3.769	3.799	3.803	3.856	3.717	3.795
		ACC.CRIT.	PASS		PASS		PASS		PASS	

TABLE 3
CPC/CEDIPS COMPARISON
FINAL TEST RESULTS
100% POWER PLATEAU

Official Test Copy #03 (100% Power Plateau)

PARA-METER	CPC PID		CHANNEL A CEDIPS	CHANNEL A CPC	CHANNEL B CEDIPS	CHANNEL B CPC	CHANNEL C CEDIPS	CHANNEL C CPC	CHANNEL D CEDIPS	CHANNEL D CPC
LPDDC	179	MAX	14.320	13.923	14.057	13.755	14.057	13.833	14.173	14.059
		MIN	13.632	13.744	13.681	13.713	13.680	13.753	13.626	13.728
		ACC.CRIT.	PASS		PASS		PASS		PASS	
MINDNB	406	MAX	1.956	1.927	1.924	1.898	1.914	1.8961	1.931	1.871
		MIN	1.739	1.895	1.778	1.873	1.778	1.8631	1.752	1.800
		ACC.CRIT.	PASS		PASS		PASS		PASS	