LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Palo Verde Unit 1	0 5 0 0 0 5 2 8	1 OF 0 6

TITLE (4)

Core Protection Calculator, Delta-T Power Fluctuations

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBERS
									NA	0 5 0 0 0
0 6	1 9	9 4	9 4	- 0 0 5	- 0 2	0 6	2 8	9 5	NA	0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL(10)	8 6	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
[redacted]		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract
		20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	below and in Text, NRC Form
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	366A)
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Burton A. Grabo, Section Leader, Nuclear Regulatory Affairs	AREA CODE 6 0 2 3 9 3 - 6 4 9 2

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	[redacted]	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

At approximately 2258 MST on June 19, 1994, Control Room personnel determined that the Core Protection Calculator (CPC) Channel D, Delta-T Power signal could no longer be adjusted to within +/- 2 percent of actual power as determined by secondary plant calorimetric and required by Technical Specification (TS) 3.3.1, Table 4.3-1, Notation (2). CPC Channel D was declared inoperable. This condition was caused by loop 2 Hot leg temperature (T-h) Resistance Temperature Detector (RTD) fluctuations. Fluctuations in T-h RTDs have been identified at other plants and attributed to temperature stratification. On June 29, 1994, after reviewing plant logs, the condition was determined to be reportable. The loop 2 (T-h) Resistance Temperature Detector (RTD) creating the Delta-T power fluctuations was electronically switched with the T-h RTD used in the Core Operating Limits Supervisory System. At approximately 1812 MST on July 2, 1994, CPC Channel D was calibrated and declared OPERABLE. The event did not adversely affect safe operation of the plant.

No previous similar events have been reported pursuant to 10CFR50.73.

TEXT

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

At approximately 2258 MST on June 19, 1994, Palo Verde Unit 1 was in Mode 1 (POWER OPERATION) at normal operating temperature and pressure.

B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classification: Operation prohibited by the plant's Technical Specifications (TS)

At approximately 2258 MST on June 19, 1994, Unit 1 Control Room personnel (utility, licensed) determined that, due to frequent fluctuations of approximately 5 percent in Core Protection Computer (CPC)(JC) Channel D, Delta-T Power signal, Delta-T power could no longer be adjusted to within +/- 2 percent of actual power as determined by secondary plant calorimetric and required by TS 3.3.1 Table 4.3-1 Notation (2). CPC Channel D was declared inoperable and placed in by-pass.

TS Limiting Condition for Operation (LCO) 3.3.1 Action 2 states that STARTUP and/or POWER OPERATION may continue with the number of channels OPERABLE 1 less than the total number of channels, provided the inoperable channel is placed in the bypassed or tripped condition within 1 hour. This TS LCO Action also requires that the desirability of maintaining the channel in bypass be reviewed in accordance with TS 6.5.1.6.g and returned to OPERABLE status no later than during the next COLD SHUTDOWN.

During the performance of the calibration of CPC Channel D Delta-T Power on June 19, 1994, questions were raised as to the validity of the calibration by a Control Room operator (utility, licensed). Prior to June 19, 1994, the CPC Delta-T Power signals had been averaged by Control Room personnel for determining agreement with the calorimetric. The averaging of this fluctuating signal was not proceduralized or a subject of formal operator training. The initial investigation identified that the method of determining an average for this signal varied between operators.

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The validity of the calibration was questioned because the Control Room operator felt the fluctuations had become larger than before; and even after adjusting the average signal to within +/- 2 percent of actual power, the fluctuations would still cause the Delta-T Power signal on CPC Channel D to periodically swing outside its allowable band of +/- 2 percent power. Because of this and the lack of written guidance on how to obtain an average signal, it was determined by the Control Room staff that the fluctuations should not be averaged. Thus, CPC Channel D Delta-T Power could not be calibrated as required and the channel was declared inoperable. During the investigation a review of past data on CPC Channel D Delta-T power showed that fluctuations of the same magnitude have existed for several fuel cycles.

To calculate Delta-T power, the CPCs monitor several primary plant parameters. One of those parameters is Hot Leg temperature (T-h). T-h data is received from 8 Resistance Temperature Detectors (RTD). The RTDs are arranged with 4 in each hot leg. Each hot leg is a 42 inch diameter pipe. The RTDs are inside of thermal wells which protrude approximately 3 inches into the process stream. The thermal wells are located radially around the hot leg in approximately the same plane. An additional thermal well and RTD exists 10 inches closer to the steam generator (AB) inlet and is used as an input to the Core Operating Limits Supervisory System (COLSS).

Each CPC channel receives one T-h signal from each Hot Leg. For example, CPC Channel D receives T-h inputs from 1 Loop 1 RTD and 1 Loop 2 RTD. These signals are combined with signals from cold leg temperature, mass flow rate, and Reactor Coolant System (RCS)(AB) pressure to produce the Delta-T Power calculation. The Delta-T Power calculation is one input to the Maximum Power Calculation auctioneering algorithm.

The Maximum Power Calculation auctioneering algorithm also receives two other power signals (Neutron Flux and a 20 percent minimum signal) and auctioneers the highest of the 3 powers. The output of the Maximum Power Calculation is used in calculating Departure from Nucleate Boiling Ratios (DNBR) and Local Power Density (LPD). The same T-h signals are also used as an input to the Auxiliary Trip logic for the generation of an auxiliary Hot Leg Saturation Trip. The auxiliary trip is provided when the highest T-h,

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including uncertainties, reaches or exceeds the saturation temperature.

Prior to declaring CPC Channel D inoperable, Unit 1 was operating a 86.08 percent actual power as determined by secondary plant calorimetric. The CPC Channel D thermal power indications were observed to be between approximately 81.6 and 86.6 percent power even though Unit power was not varying. This was attributed to fluctuations in one of the T-h RTDs (loop 2) which supply a signal to CPC Channel D Delta-T Power, a condition that has existed for several fuel cycles.

Prior to this event, APS Engineering had been investigating these fluctuations since January, 1991, when ABB Combustion Engineering (ABB-CE) responded to a request by APS for an explanation of a T-h anomaly which had been observed in Unit 1, Loop 1. The response described the normal coolant temperature stratification effects which occur in reactor hot legs and the effects and postulated cause for the phenomenon known as the Hot Leg Temperature Anomaly.

Hot Leg Temperature Anomaly is a phenomenon observed in the RCS hot legs where temperatures measured at the same distance from the core exit, but at different radial locations, may differ by several degrees. Although flow at the core exit is highly turbulent and mixing is expected to be complete, hotter water from the center of the core and colder water from the periphery do not always mix completely. This shows as varying temperature readings.

ABB-CE's response concluded that the T-h trends in PVNGS Unit 1 were consistent with trends observed in other ABB-CE reactors. This caused APS Engineering to follow the changes in T-h RTD fluctuations and conduct several reviews to verify that the RTDs were accurately responding to temperature changes. At no time during these investigations did the results identify problems specific to the instrumentation.

On February 18, 1994, the investigation team concluded that:

The RTDs were functioning correctly,

There was no safety concern since the fluctuations did not cause the CPC system to perform its safety function in a non-conservative manner, and

Based on the available industry information and plant observations, the temperature variations seen in the hot legs were being caused by thermal-hydraulic effects of the phenomenon known as "Hot Leg Anomaly" or "Hot Leg Stratification."

When CPC Channel D was declared inoperable on June 19, 1994, a temporary modification, which substituted the COLSS Loop 2 T-h RTD with the CPC Channel D T-h RTD, was initiated. The loop 2 T-h RTD creating the Delta-T power fluctuations was electronically switched with the COLSS T-h RTD. CPC Channel D was successfully calibrated and was declared OPERABLE at approximately 1812 MST on July 2, 1994.

C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

Not applicable - no structures, systems, or components were inoperable at the start of the event which contributed to this event.

D. Cause of each component or system failure, if known:

Based on extensive testing and analysis of the T-h RTDs, the RTDs are functioning correctly. The variance seen in T-h temperature by CPC Channel D is due to thermal stratification anomalies occurring at the location of this T-h RTD.

E. Failure mode, mechanism, and effect of each failed component, if known:

There were no component failures.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - no failures of components with multiple functions were involved.

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G. For a failure that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

Not applicable - there were no failures that rendered a train of a safety system inoperable were involved.

H. Method of discovery of each component or system failure or procedural error:

Not applicable - there have been no component or system failures or procedural errors identified. There were no procedural errors which contributed to this event.

I. Cause of Event:

When the condition of fluctuating T-h RTD signals was first identified in 1991, APS determined that fluctuations were not safety significant in that the trips provided by the CPCs were not negatively effected. APS continued to investigate and review the condition and based on the best available industry and plant information, the cause of the T-h fluctuations is attributed to a phenomenon known as Hot Leg Temperature Anomaly (SALP Cause Code X: Other). An investigation of this event is continuing. If information is developed which would affect the reader's understanding or perception of this event, a supplement will be submitted.

J. Safety System Response:

Not applicable - there were no safety system responses and none were necessary.

K. Failed Component Information:

Not applicable - no component failures were involved.

II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS EVENT:

The CPC uses T-h indications for calculating the Hot Leg Saturation Trip, Thermal Power, and RCS Flow.

The Hot leg Saturation Trip includes a 13 degree uncertainty which is sufficient to offset the observed abnormal behavior

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and prevent hot leg saturation even with a large temperature difference among RTDs.

The T-h signals used by the CPCs to calculate thermal power are first averaged. The calculated thermal power is then compared to a calculated reactor power based on neutron flux density (when above 20 percent power). The higher of the two calculated signals is used in the calculation of DNBR and LPD. Because of this, the likelihood that the averaging techniques used by the Control Room operators would have had an adverse affect on DNBR and LPD is significantly reduced.

The CPC RCS flow related constants have been optimized to provide a good match of CPC flow to actual RCS flow as power is varied. The constants selected provide a weak dependance of flow on T-h. Because of this weak dependance, a large temperature difference among RTDs will not adversely effect the flow calibration of an affected CPC channel.

This event did not result in any challenges to the fission product barriers or result in any releases of radioactive materials. There were no adverse safety consequences or implications as a result of this event. This event did not adversely affect the safe operation of the plant or the health and safety of the public.

III. CORRECTIVE ACTION:

A. Immediate:

CPC Channel D was declared inoperable and bypassed.

A temporary modification substituting the COLSS Loop 2 T-h RTD (121X) for the CPC Channel D T-h RDT (122HD) was implemented on July 2, 1994, and CPC Channel D was successfully calibrated and declared OPERABLE.

B. Action to Prevent Recurrence:

A task force, lead by Safety Analysis, was established to continue to investigate the cause of the T-h oscillations and identify possible solutions to provide a more reliable measurement of core thermal power. Options on possible actions are expected to be presented to Management on September 15, 1994.

TEXT

Operations Standards has investigated how to accommodate for oscillating/fluctuating instruments during various plant operations. An administrative procedure providing direction on the use of fluctuating instruments is expected to be approved by September 15, 1994.

IV. PREVIOUS SIMILAR EVENTS:

No other previous similar events have been reported pursuant to 10CFR50.73.