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 8

TITLE (4)
Containment Electrical Penetration Overcurrent Protective Devices Outside the Design Basis

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
										Palo Verde Unit 2	0 5 0 0 0 5 2 9
0 3	2 9	9 5	9 5	- 0 0 4	- 0 0		0 4		9 5	Palo Verde Unit 3	0 5 0 0 0 5 3 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 5	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		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)(vi)	OTHER (Specify in Abstract
		20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(vii)(A)	below and in Text, NRC Form
		20.405(a)(1)(iv)	X 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		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)

On March 29, 1995, at approximately 1400 MST, Palo Verde Units 1, 2, and 3 were in MODE 1 (POWER OPERATION) when Arizona Public Service Company (APS) Engineering determined that redundant overcurrent protection was not provided on thirty-four (34) electrical containment penetration circuits in each of Units 1, 2, and 3 (a total of one hundred and two) resulting in a condition that was outside the design basis of the plant. Operations declared the thirty-four (34) affected containment penetration overcurrent protective devices inoperable and entered the 72 hour shutdown action statement in accordance with TS 3.8.4.1. The cause of the event was a design error on the part of the original Architect Engineer for using non-conservative assumptions during the initial plant design.

As corrective action, Unit 1 will restore the affected circuits to OPERABLE status during the current refueling outage (1R5). In Units 2 and 3, nine (9) circuits critical to normal power operation were modified to include the required redundant overcurrent protective devices. The remaining affected circuits were deenergized and a seven (7) day surveillance has been implemented to verify the affected circuits remain deenergized until they comply with the design basis.

There have been no previous similar events reported pursuant to 10CFR50.73 in the last three years specific to containment penetration overcurrent protective devices.

TEXT

1. REPORTING REQUIREMENT:

This LER 528/529/530/95-004 is being written to report conditions that resulted in the nuclear plant being in a condition that was outside the design basis of the plant as specified in 10 CFR 50.73(a)(2)(ii)(B) and a condition prohibited by the plant's Technical Specifications as specified in 10 CFR 50.73(a)(2)(i)(B).

Specifically, on March 29, 1995, Palo Verde Units 1, 2, and 3 were in MODE 1 (POWER OPERATION) operating at approximately 85 percent, 9 percent, and 100 percent power respectively, when as a result of a calculation reverification effort, Arizona Public Service Company (APS) Engineering personnel determined that redundant overcurrent protection was not provided on thirty-four (34) electrical containment (NH) penetration (PEN) circuits in each of Units 1, 2, and 3 (a total of one hundred and two).

The design basis for Palo Verde Nuclear Generating Station (PVNGS) requires two (2) protective devices on the electrical circuits outside the containment penetration specifically credited for containment penetration feedthrough protection where calculated maximum fault current exceeds the thermal rating of the penetration feedthrough. As a result of APS Engineering's findings, Units 1, 2, and 3 were in a condition outside the design basis of the plant.

At approximately 1400 MST, on March 29, 1995, APS Management determined that the thirty-four (34) affected containment penetration overcurrent protective devices were not in compliance with plant Technical Specification (TS) 3.8.4.1 (Applicability Modes 1 through 4), which states in part:

> "Primary and backup containment penetration conductor overcurrent protective devices associated with each containment electrical penetration circuit shall be OPERABLE. The scope of these protective devices excludes those circuits for which credible fault currents would not exceed the electrical penetration design rating....
>
> With one or more of the above required containment penetration conductor overcurrent protective devices inoperable:
>
> a. Restore the protective device(s) to OPERABLE status or deenergize the circuit(s) by tripping the associated backup circuit breaker or racking out or removing the inoperable device within 72 hours and

TEXT

declare the affected system or component inoperable and verify the backup circuit breaker racked out at least once per 7 days thereafter..."

Units 1, 2, and 3 Operations personnel (utility, licensed) declared the thirty-four (34) affected containment penetration overcurrent protective devices inoperable and entered the 72 hour action statement for TS Limiting Condition for Operation (LCO) 3.8.4.1 Action (a). This 72 hour action statement expired on April 1, 1995, at 1400 MST.

2. EVENT DESCRIPTION:

On March 10, 1995, APS Engineering personnel identified that during the initial design of PVNGS, the penetration protection calculations (13-EC-PK-160 and 13-EC-PH-240) were performed using non-conservative assumptions. The problems with the calculations were found during a calculation reverification review.

The following problems were found with calculation 13-EC-PK-160:

a. The worst-case short circuit was postulated as a hot-to-neutral fault across the containment penetration. The calculated maximum current was below the penetration conductor long-time rating, thus alleviating the need to credit two protective devices. However, while performing a calculation reverification, APS Engineering discovered that a hot-to-ground fault (which is equally credible) results in a fault current that exceeds the penetration conductor long-time rating. As a result, fifteen (15) electrical circuits, previously designed with only one protective device, now require two protective devices.

b. Seven (7) circuits requiring redundant overcurrent protective devices were not analyzed or included in the original calculation.

The following problems were found with calculation 13-EC-PH-240:

a. Six (6) electrical circuits contained 125 volt DC circuit breakers (72) upstream of their respective inverters (INVT) which were credited as one of the required protection devices. The other protective devices were 480 volt AC circuit breakers (52) located downstream of their respective inverters. The correlation of current through an AC circuit breaker is not linear to that

through a DC circuit breaker. The detailed engineering analysis necessary to coordinate AC and DC circuit breakers was not included in the original calculation.

b. The original calculation contained six (6) 120 volt AC circuits located downstream of voltage regulators (90) that credited the current limitation effect of the regulator plus the impedance of the downstream cables to limit short circuit current to a level below the penetration conductor long-time rating. As a result, primary and back-up overcurrent protective devices were not required. However, considering the current limitation effect of both the voltage regulator and the impedance of the downstream cables concurrently is not a valid assumption. The reverified short circuit levels, based on the full load current limiting effect of the voltage regulators, are above the penetration long-time ratings. As such, redundant overcurrent protective devices coordinated with penetration feedthrough damage curves are required.

APS Engineering personnel, upon discovery of the errors in the original calculations, initiated an investigation in accordance with the APS Corrective Action Program. While preliminary information suggested that a number of circuits were involved, sufficient information on the specific circuits was not confirmed until just prior to the management decision on March 29, 1995.

At approximately 1400 MST on March 29, 1995, APS Management declared the affected containment penetrations inoperable, APS notified the NRC via the Emergency Notification System pursuant to 10CFR50.72(b)(1)(ii)(B).

Unit 1 was preparing to shut down on April 1, 1995, in order to enter a refueling outage. As a result, APS requested enforcement discretion to extend the Allowed Outage Time (AOT) for TS 3.8.4.1 to 1400 MST, April 4, 1995, in order to allow the performance of Steam Generator (AB) high temperature chemical cleaning prior to cooling down to MODE 5 (COLD SHUTDOWN). Discretion was verbally granted by the NRC on March 31, 1995. Unit 1 remained in the extended action statement for TS 3.8.4.1 until at 1008 MST on April 3, 1995, when MODE 5 was achieved, and TS 3.8.4.1 was no longer applicable. The thirty-four (34) containment penetration overcurrent protective devices will be returned to OPERABLE status during the current (fifth) refueling outage (1R5), prior to MODE 4 (HOT SHUTDOWN) entry.

TEXT

In Units 2 and 3, nine (9) of the thirty-four (34) electrical containment penetration circuits were required to be energized for safe plant operations. The remaining circuits could be deenergized without affecting power operation. On March 31, 1995, at 2048 MST and 1706 MST, respectively, Units 2 and 3 complied with the 72 hour action statement for TS LCO 3.8.4.1 Action (a). The affected circuits were either modified to comply with the PVNGS design requirements within their specified TS AOT or left deenergized to be modified at a later date, and an additional seven (7) day surveillance was implemented to verify that the affected circuits not required for normal power operation remain deenergized until they are returned to a configuration in compliance with the design basis.

On March 30, 1995, APS requested two Notices of Discretionary Enforcement (NOED) - one for TS 3.8.4.1 in Unit 1 (as discussed earlier) and the other for TS LCO 3.6.3 Action (1) (Applicability Modes 1 through 4) in Units 2 and 3 which states in part:

> "With one or more of the isolation valve(s) inoperable, maintain at least one isolation valve OPERABLE in each affected penetration that is open and either:
>
> a. Restore the inoperable valve(s) to OPERABLE status within 4 hours, or....
>
> b. Be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours."

The NOED for TS 3.6.3.1 was requested for Units 2 and 3 to extend the AOT for an additional 12 hours to add the required redundant protective device on the circuit for a Nuclear Cooling Water (CC) containment isolation valve (ISV). The 12 hour extension was a precautionary measure to preclude an unnecessary plant transient. The NOED was verbally approved by the NRC on March 31, 1995, but was not needed. The modifications were completed within the 4 hour action statement for TS LCO 3.6.3 Action (1.a).

TEXT

3. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATION OF THIS EVENT:

The OPERABILITY of the containment penetration conductor overcurrent protective devices ensures that the fault current through a containment penetration feedthrough is less than its damage curve. This design feature prevents the circuits from delivering short-circuit currents of a magnitude and duration which could cause thermal damage to the penetrations.

The primary protective devices installed on the thirty-four (34) affected circuits were OPERABLE and capable of performing their safety function. Only the added assurance of the redundant containment protective devices was in question.

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.

4. CAUSE OF THE EVENT:

An investigation is being performed under the APS Corrective Action Program. The investigation to date determined that the cause of the event was a design error on the part of the original Architect Engineer (A/E). When the design documents were transferred from the A/E to APS, only minimal review of their adequacy and completeness was performed by APS. The decision to perform only minimal reviews was based on APS' reliance on the expertise provided by the A/E, who was conducting design activities under the A/E's 10CFR50, Appendix B, Quality Assurance Program.

In 1989, APS discovered that many of the original calculations had not been updated to include the additions and changes made during construction, start-up, and commercial operation. In addition, many of these calculations did not adequately explain the assumptions or rationale used by the original designers. In 1990, APS initiated the Calculation Reverification Program to address and resolve these discrepancies. The findings of this ongoing effort have resulted in the discovery by APS personnel of similar deficient design conditions and the initiation of required corrective actions to restore the plants to their approved design configuration (SALP Cause Code B: Design, Manufacturing, or Installation Error).

TEXT

No unusual characteristics of the work location (e.g., noise, heat, poor lighting) directly contributed to this event. There were no procedural errors which contributed to this event.

5. STRUCTURES, SYSTEMS, OR COMPONENTS INFORMATION:

As discussed in Section 1, the thirty-four (34) affected containment penetration overcurrent protective devices were declared inoperable at the start of the event. There are no indications that other structures, systems, or components were inoperable at the start of the event that contributed to the event. No components with multiple functions were involved. There were no component or system failures involved; therefore, no safety systems were rendered inoperable. There were no safety system actuations and none were required.

6. CORRECTIVE ACTIONS TO PREVENT RECURRENCE:

On March 31, 1995, temporary modifications have been installed in Units 2 and 3 to bring the nine (9) electrical circuits needed for normal power operation back in compliance with the design basis. The remaining affected circuits (those not required for power operation) in Units 2 and 3 have been deenergized and are being modified using permanent design modifications or analytically justified. An approved temporary procedure has been developed to perform a seven (7) day surveillance to verify that the affected circuits not required for normal power operation remain deenergized until they are returned to a configuration in compliance with the design basis. In Units 2 and 3, the thirty-four (34) affected circuits are expected to be returned to service by September 30, 1995.

Five (5) of the original thirty-four (34) affected circuits have been subsequently re-evaluated by APS Design Engineering and found to be configured such that no hardware modifications are needed. Components in the existing circuits could be credited as a protective device or the Electrical Penetration Protection calculation could analytically justify that the circuits are in compliance with the design basis.

The affected circuits in Unit 1 will be corrected using permanent modifications or analytically justified prior to returning to MODE 4 following the current (fifth) refueling outage (1R5). Unit 1 is expected to complete 1R5 by May 16, 1995.

TEXT

The Calculation Reverification Program will continue to review design calculations. The intent of the program is to confirm the adequacy and compliance of the plant design to the plant design basis. Future findings will be addressed in accordance with the APS Corrective Action Program.

7. PREVIOUS SIMILAR EVENTS:

There have been no previous similar events reported pursuant to 10CFR50.73 in the last three years specific to containment penetration overcurrent protective devices. However, findings from the ongoing Calculation Reverification Program has resulted in previously submitted LERs such as LERs 528/93-011-00 and its supplement 528/93-011-01, dated December 25, 1993, and February 6, 1995, respectively. The condition identified in these LERs indicated that it may be possible to have substandard voltages on the Class 1E 480V power system. Previous corrective actions could not have prevented this event because the condition pre-existed the previous corrective actions.