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 1 0

TITLE (4)

Adverse Affect of Low Bench Set on Fisher Air Operated Letdown/Containment Isolation Valves

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
0 5	1 2	9 5	9 5	- 0 0 7	- 0 2	0 2	2 0	9 7	Palo Verde Unit 2	0 5 0 0 0 5 2 9
									Palo Verde Unit 3	0 5 0 0 0 5 3 0

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL(10)	0 0 0	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)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	Voluntary

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Daniel G. Marks, 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
B	C B	I S V	F 1 3 0	Y					

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 May 12, 1995, Unit 1 was in Mode 5 (COLD SHUTDOWN) during a scheduled refueling outage and Units 2 and 3 were in Mode 1 (POWER OPERATION) operating at approximately 100 percent power, when APS Engineering personnel determined that low bench settings of the air-operated letdown/containment isolation valves adversely affected the ability of the valves to perform their 10CFR50 Appendix R safety function to isolate letdown. APS Engineering initially determined that during postulated fires in fire zones outside of the control room, a condition could exist in which the letdown line would not be efficiently isolated in accordance with the existing Pre-Fire Strategies and as required by 10CFR50 Appendix R.

Subsequent evaluations have shown that the valves would have been able to perform their safety function even though they had undersized air actuators and bench sets which were too low to provide desired valve seating force. The root cause of the design deficiency was attributed to the absence of a detailed design basis evaluation for air operated valves. Additionally, routine maintenance activities performed during the operational life of the valves caused some air operators to have lower than design bench set pressures.

Modifications which included the installation of stiffer actuator springs, new limit switches, adjustment of the valve stroke length, and revised bench set pressures have been completed for all affected letdown/containment isolation valves.

Voluntary LER 50-528/94-009-00 initially reported the Unit 1 CHB-UV-515 through seat leakage.

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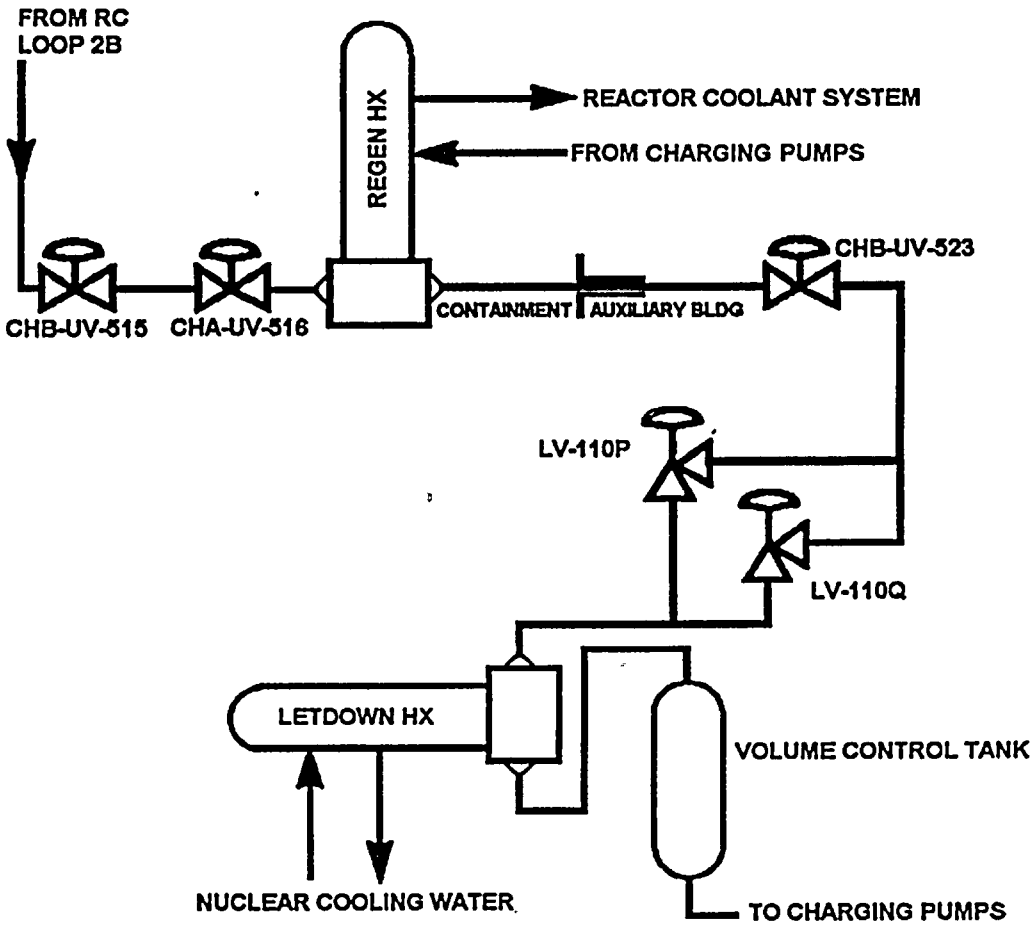

FIGURE 1 - LETDOWN LINE CONFIGURATION THROUGH THE LETDOWN HEAT EXCHANGER

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1. EVENT CLASSIFICATION

This LER (50-528/529/530/95-007) was previously submitted pursuant to Technical Specification (TS) 6.9.3 (Violations to the requirements of the fire protection program) and 10CFR50.73 (a)(2)(vii) (Any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems...). However, upon further review it has been determined that the condition did not meet these reporting requirements and is now being reported voluntarily, because it is likely that other plants may have made, but not discovered, the same errors.

2. EVENT DESCRIPTION

On May 12, 1995, Unit 1 was in Mode 5 (COLD SHUTDOWN) with reactor coolant system (RCS)(AB) temperature at 95 degrees Fahrenheit (F) and at atmospheric pressure, and Units 2 and 3 were in Mode 1 (POWER OPERATION), operating at approximately 100 percent power, when APS Engineering personnel (utility non-licensed) determined that the bench settings of the air-operated letdown/containment isolation valves adversely affected the ability of the valves to perform their 10CFR50 Appendix R safety function to isolate letdown. APS Engineering initially determined that during postulated fires in fire zones outside of the control room (NA) a condition could exist in which the letdown line would not be efficiently isolated in accordance with the existing Pre-Fire Strategies and as required by 10CFR50 Appendix R.

Figure 1, page 10, illustrates the letdown system. The following Unit 1, 2, and 3 letdown line isolation valves were affected by this event: CHB-UV-515 Upstream Containment Isolation Valve, CHA-UV-516 Downstream Containment Isolation Valve, and CHB-UV-523 Outside of Containment Letdown Isolation Valve.

Prior to the event, on April 14, 1995, during Local Leak Rate Testing (LLRT) the as-found leakage rate for Unit 1 air-operated valve (AOV) CHB-UV-523 was quantified at 24,631 standard cubic centimeters per minute (sccm) while the administrative acceptance criteria is </= 500 sccm. The previous LLRT which had been performed on September 27, 1993, resulted in a leakage rate of only 22 sccm for this same valve. Diagnostic testing results revealed the bench set (the lower and upper pressure range required to stroke the actuator) was low at 18-34 pounds per square inch gauge (psig).Subsequent diagnostic testing using a Fisher "Flow Scanner" indicated the valve could not achieve the desired seating force with the vendor recommended bench setting of 22-38 psig.

On April 19, 1995, as-found testing of Unit 1 CHB-UV-515 was performed and it was revealed that the as-found lower bench set was 10 psig. The bench set was raised to the Fisher Controls International (FCI) recommended 22-38 psig, but diagnostic software indicated the valve would not seat under full system pressure. The bench set was raised to 24-40 psig to achieve an indicated positive seating load.

On April 20, 1995, APS Engineering personnel performed a preliminary calculation to determine whether the bench setting recommended by FCI for the letdown/containment AOVs was adequate to achieve seat leakage requirements. The preliminary calculation indicated the existing bench set values were too

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low, and none of the valves could meet seat leakage requirements at full system pressure of 2485 psig. Another preliminary calculation was performed to determine the bench set pressure required to achieve shutoff at 2485 psig system pressure. The calculation revealed the low bench setpoint would have to be 38 psig, and the upper setpoint would have to be 58 psig to achieve shutoff at 2485 psig.

APS Engineering personnel contacted FCI and requested a preliminary calculation to determine if the 667 DBQ/60 actuator could be set up to the 38-58 psig bench set without compromising the valve spring (in terms of coil interference). FCI's evaluation indicated the model 667 DBQ/60 actuator could not withstand a 38-58 psig bench set without compromising the associated spring.

On May 6, 1995, modifications which included stiffer actuator springs, new limit switches, adjustment of the valve stroke length, and revised bench set pressures were completed for the affected Unit 1 valves.

On May 11, 1995, APS Engineering personnel met to determine the possible consequences of the 667 DBQ/60 actuators' inability to achieve shutoff at a system pressure of 2485 psig and the impact to the operating Units 2 and 3. The APS Engineering team determined through calculations that two valves acting in series were capable of closing against the differential pressure associated with a break of the letdown line. Further, the APS Engineering team determined that all safety functions for these valves were capable of being performed except for the isolation of the letdown line during a postulated fire in certain fire zones outside containment where only a single valve may be available, assuming worst case single active failures.

On June 30, 1995, FCI completed a technical inquiry of the actuator and hand-jack sizing of the AOVs provided to ABB-CE for use at Palo Verde Nuclear Generating Station (PVNGS). The evaluation concluded that although the original actuator selection probably did not account for packing friction, a sizing review which did account for packing friction was performed after the order for the valves was placed. FCI's evaluation did not reveal any information to indicate that the January 1, 1977 ship date for actuators, sized to account for graphite packing (reference NRC IN 88-94), was in error. In addition, FCI provided documentation that sizing reviews indicated larger actuators were needed for some applications and stated "Fisher believes the actuators were not changed because of equipment availability and the results of [size 60] operability testing."

On or about October 15, 1995, during the Unit 3 refueling outage, Unit 3 letdown line valve testing revealed that CHB-UV-515 had a bench set lower range pressure of 14.4 psig. By November 17, 1995, modifications to the Unit 3 CHB-UV-515, CHA-UV-516, and CHB-UV-523 valve actuators had been completed. The modifications included stiffer actuator springs, new limit switches, adjustment of the valve stroke length, and revised bench set pressures.

On December 15, 1995, dynamic testing of the Unit 2 CHA-UV-516 valve was performed. The test results demonstrated that the valve would perform as required to mitigate design basis events.

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There were no safety system actuations as a result of this event and none were necessary.

3. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS EVENT

APS Engineering personnel determined the following safety functions are performed by the affected letdown/containment isolation valves: 1) Containment Isolation (CHA-UV-516 and CHB-UV-523); 2) Mitigation of UFSAR Chapter 15 Letdown Line Break Outside Containment (NH) Event (CHB-UV-515 and CHA-UV-516); 3) Isolation of a high energy line break (HELB) of the letdown line in the Auxiliary Building (NF)(CHB-UV-515 and CHA-UV-516); 4) Isolation of the letdown line for Reactor Coolant inventory control for 10CFR50 Appendix R fire scenarios (CHB-UV-515, CHA-UV-516 and CHB-UV-523); and 5) Isolation of the letdown line upon receipt of a Safety Injection Actuation Signal (BP/BQ)(JE) (CHB-UV-515 and CHA-UV-516).

Based upon the safety functions performed by the valves, APS Engineering personnel assessed the impact of low bench set and determined isolation could be provided by a series combination of the isolation valves. The net system leak rate was then determined as a function of RCS pressure, based upon the two valve isolation. These analyses assumed that for a letdown line break discharging to the Auxiliary Building atmosphere, two of the three valves in series were operable to provide isolation.

Additional evaluations were completed to assess the consequences of single valve isolation, considering low bench set. These analyses provided necessary input for Auxiliary Building HELB and 10CFR100 evaluations.

Two Valve Isolation Evaluation:

Two valves in series will function to provide isolation at a higher relative pressure differential than that achieved by a single valve. The effect of the downstream valve of the two valve pair is to impose a higher back-pressure on the upstream valve. The corresponding reduced pressure differential across the first valve results in the valve closing and a larger seat force after the valve plug is engaged in the seat. The analyses show that series isolation valves will provide adequate seat force to restrict the net leakage through the letdown line to less than 1 gpm under pressure differential conditions consistent with the design rating of the letdown line.

Single Valve Isolation Evaluation:

This condition is applicable for a postulated letdown line break upstream of the outboard containment isolation valve with concurrent single failure of either of the other two inboard isolation valves. The analyses demonstrate that a single isolation valve with the worst as-found case 10 psig lower bench set will close at a differential pressure of 1120 psia. A conservative mass flow rate was established for this condition and subsequently used as input in the 10CFR100 and HELB analyses.

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Consequences of a HELB at the Containment Penetration:

A terminal end break at the containment penetration upstream of CHB-UV-523 in conjunction with a single failure of CHB-UV-515 to close results in the single valve isolation scenario described above. An evaluation using the conservative mass flow rate determined for attempted single valve isolation at 10 psig bench set resulted in acceptable offsite dose consequences below those required by 10CFR100. Likewise, the effect of single valve isolation on the Auxiliary Building environment was evaluated and the results are summarized below.

Radiological Consequences:

APS performed a configuration calculation, based upon the lowest as-found bench set pressures, and actual RCS activity levels to determine the 2 hour thyroid dose at the exclusion area boundary (EAB) resulting from a letdown line break outside of containment. The calculation concludes that the RCS release to the Auxiliary Building would result in a 2 hour exclusion area boundary thyroid dose of 22.49 Rem.

Standard Review Plan 15.6.2 states that the consequences of this event are acceptable if the resulting dose does not exceed a small fraction (10 percent) of 10CFR100 guidelines. The 10CFR100 guideline is 300 Rem. Ten percent of this is 30 Rem. Therefore, the additional leakage would not result in exceeding the applicable criteria.

Auxiliary Building Environment:

APS performed an evaluation to determine the consequences of a delayed isolation during a letdown line break scenario due to low bench set pressures of valves CHB-UV-515, CHA-UV-516 and CHB-UV-523. The evaluation assumed breaks at two separate building elevations and considered larger mass releases to the auxiliary building as a result of delayed isolation. The consequences of these larger mass releases is that a Safety Injection Actuation Signal (BP/BQ) will be initiated within approximately 21 minutes of initiation of the event.

The effect of transient pressures, temperatures and relative humidities created in the auxiliary building as a result of a postulated line break would not affect the current qualification of safe shutdown equipment.

Appendix R Fire Hazards Analysis:

APS engineering determined through analysis that the effect of this condition did not impact the ability to achieve and maintain safe shutdown in the event of a fire either inside or outside the control room.

To ensure letdown isolation as assumed in the fire hazards analysis, two valves must be shown to be available for a fire in any analysis area. Control room fire strategy guidelines for fires inside the control room call for closing CHB-UV-515 and securing the nuclear cooling water pumps, which will cause CHB-UV-523 to close, from outside the control room. Therefore, two valves are closed and the isolation function can be performed with the current bench sets. The fire strategy for fires outside the control room calls for closing either CHB-UV-515 or CHA-UV-516, dependent on the analysis area and corresponding A or B train circuits potentially affected. Therefore, only one valve can be currently assumed to close for analysis areas outside the control room.

For fires outside of the control room, wherein the fire is located in Train B analysis areas, the Train A Charging Pump(CB) and High Pressure Safety Injection system (BQ) are available to provide make-up for resultant losses to RCS inventory. Similarly, if a fire occurs outside the control room in Train A analysis areas, the Train B Charging Pumps and High Pressure Safety Injection system are available to provide make-up for any losses to RCS inventory. In addition, the third charging pump is available and can be used with additional operator actions. Therefore, safe shutdown would have been achievable.

Compensatory measures, as described in the pre-fire strategies manual, were implemented which prescribed certain operator actions that were required until the valve modifications could be completed. The measures ensured that in the event of a fire outside the control room two letdown isolation valves were closed. Essentially, the action opens the disconnect switch which fails the valve closed at the specified auxiliary relay cabinet for the valve whose circuits are potentially affected. Otherwise the operator can manually close/ensure close the subject letdown valves from the control room for analysis areas where the letdown valve circuits are not affected by fire. Although these measures are no longer required, they have been left in place as a conservative measure to ensure letdown line isolation.

The analyses described above demonstrate the low bench set for the letdown/containment isolation valves on a letdown line break scenario does not represent a deficiency in design which could result in the loss of a safety function.

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 the 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 evaluation of the event was performed in accordance with the APS corrective action program. The results of the investigation revealed that the cause of the valve actuators being undersized was that the Palo Verde Nuclear Steam Supply

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System vendor (ABB-CE) procured valves that had undersized air actuators and bench sets which were too low to provide desired valve seating force for the differential pressure which would be present across the valves during a letdown line break. The evaluation did not reveal whether the procurement of the valves was approved by the Architect Engineer (Bechtel) or the managing owner organization (APS). The root cause of the design deficiency was attributed to the absence of a detailed design basis evaluation for air operated valves as part of an AOV program (SALP Cause Code B: Design, Manufacturing, Construction/Installation Error).

The cause of the as-found bench set pressures being lower than the original FCI recommended bench sets is believed to be the result of certain routine maintenance activities. APS determined that instructions for restoring bench set pressures were adequately described within the Fisher technical manuals, however, these instructions may not have been performed after some maintenance activities. A review of the maintenance history of the valves revealed instances where some of the air operators were de-coupled and/or removed from the valve to perform packing or bonnet gasket replacements. It is believed the vendor technical manual instructions may not have been explicitly followed when the operators were returned, which resulted in changes to the stroke length of the valves and subsequently the bench set pressures.

No unusual characteristics of the work location (e.g., noise, heat, poor lighting) directly contributed to this event.

5. STRUCTURES SYSTEMS AND COMPONENTS

The three Unit 1 isolation valves were not required to be operable when the condition was identified. Unit 2 and 3 isolation valves were not declared inoperable as a result of this event.

The potential failure mode of the isolation valves is through-seat leakage at a differential pressure of 2485 psig. The mechanism of the potential failure of the component is the sizing and bench setup of the valve operator. The effect of through-seat leakage is that the valves may not isolate letdown flow as efficiently as desired. No failures that rendered a train of a safety system inoperable were involved.

The low bench settings were discovered after the LLRT of Unit 1 CHB-UV-523 was quantified at 24,631 sccm. Subsequent diagnostic testing using a Fisher "Flow Scanner" indicated the valve could not achieve adequate seating force with the vendor recommended bench setting of 22-38 pounds per square inch gauge (psig).

All of the valves affected by this event are 2" globe valves with Fisher model 667 DBQ/60 actuators. The following is a brief description of the valves' functions.

CHB-UV-515 Upstream Containment Isolation Valve

This air diaphragm open, spring-closed globe valve provides for letdown isolation, system protection, and emergency safety features. It may be

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closed manually in the control room or on the remote shutdown panel, or, upon receipt of a high-high regenerative heat exchanger (CB) outlet temperature of 450°F or a Safety Injection Actuation Signal (SIAS), this valve is closed automatically. The valve fails closed on loss of electrical power or air. It also has a disconnect switch on the remote shutdown panel (IU).

CHA-UV-516 Downstream Containment Isolation Valve

This air diaphragm open, spring-closed globe isolation valve provides for letdown isolation and emergency safety features. It may be closed manually in the control room or on the remote shutdown panel, or, upon receipt of a Containment Isolation Actuation Signal (CIAS) (BD) (JE) or SIAS, this valve is closed automatically. The valve fails closed on loss of electrical power or air.

CHB-UV-523 Outside Containment Letdown Isolation Valve

This air diaphragm open, spring-closed globe valve provides letdown isolation and emergency safety features. It may be closed manually, or, upon receipt of a CIAS or a low nuclear cooling water (CC) flow of 39 gpm from the letdown heat exchanger, it is closed automatically. The valve fails closed on loss of electrical power or air.

No safety systems were declared inoperable as a result of the event.

6. CORRECTIVE ACTIONS TO PREVENT RECURRENCE

The affected isolation valves in Units 1, 2, and 3 were modified by reducing the stroke length of the actuator, replacing the existing spring with a stiffer 3320 pound per inch spring, modifying the travel stops and limit switches, and increasing the bench settings to 24-40 psig. The new configuration will meet or exceed all requirements for letdown system isolation.

Compensatory measures, as described in the pre-fire strategies manual, were implemented which prescribed certain operator actions that were required until the valve modifications could be completed. Although these measures are no longer required, they have been left in place as a conservative measure to ensure letdown line isolation.

Evaluations have been performed for active safety related AOVs suspected of having sizing problems. Valves which were identified as having low or marginal seating force for their application have been addressed through the APS corrective action program.

A departmental procedure has been written to provide guidance for the implementation of the AOV program at PVNGS.

Mechanical and Instrument & Control teams who perform maintenance on spring and diaphragm AOVs were briefed on valve maintenance activities that effect proper bench set, how to obtain proper bench set and on when post maintenance testing is required.

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7. PREVIOUS SIMILAR EVENTS

Voluntary LER 50-528/94-09-00 initially reported the Unit 1 CHB-UV-515 through seat leakage.