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 9

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
									Palo Verde Unit 2	0 5 0 0 0 5 2 9
0 5	1 2	9 5	9 5	- 0 0 7	- 0 1	0 4	0 6	9 6	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)	X 50.73(a)(2)(vii)	X OTHER (Specify in Abstract		
		20.405(a)(1)(iii)	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)	T.S. 6.9.3		

LICENSEE CONTACT FOR THIS LER (12)

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	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 the bench settings of the air-operated letdown and containment isolation valves adversely affected the ability of the valves to perform their 10CFR50 Appendix R safety function to isolate letdown. APS Engineering 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 effectively isolated in accordance with the existing Pre-Fire Strategies and as required by 10CFR50 Appendix R.

An evaluation of the event revealed that the Palo Verde Nuclear Steam Supply System vendor (ABB-CE) procured valves that had undersized air actuators and bench sets which were too low to provide adequate valve seating force. The evaluation did not reveal whether the procurement of the valves was approved by the Architect Engineer (Bechtel) or the managing owner organization (Arizona Public Service Company). 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.

Letdown isolation valves in Units 1 and 3 have been modified to provide the necessary seating force, and compensatory measures have been implemented in Unit 2 which provide direction for isolating letdown during various fire scenarios.

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

TEXT

1. EVENT CLASSIFICATION

This LER 528/529/530/95-007 is being submitted pursuant to Technical Specification (TS) 6.9.3 which states "Violations to the requirements of the fire protection program described in the Final Safety Analysis Report which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire shall be reported in accordance with 10CFR50.73."

In addition, this event also meets the reporting requirements of 10CFR50.73 (a)(2)(vii), which states: [Licensees shall report] "Any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems of two independent trains or channels to become inoperable in a single system designed to: (A) Shut down the reactor and maintain it in a safe shutdown condition; (B) Remove residual heat; (C) Control the release of radioactive material; or (D) Mitigate the consequences of an accident."

Specifically, it was determined that the bench settings of the air-operated letdown and containment isolation valves (BD)(CB)(ISV) adversely affected the ability of the valves to perform their 10CFR50 Appendix R safety function to isolate letdown.

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 and containment isolation valves adversely affected the ability of the valves to perform their 10CFR50 Appendix R safety function to isolate letdown. APS Engineering 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 effectively isolated in accordance with the existing Pre-Fire Strategies and as required by 10CFR50 Appendix R.

The following Units 1, 2 and 3 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 acceptance criteria is </= 500 sccm. The previous LLRT which had been performed on September 27, 1993, had resulted in a leakage rate of only 22 sccm for this same valve. 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).

TEXT

On April 20, 1995, APS Engineering personnel performed a preliminary calculation to determine whether the bench setting recommended by Fisher Valves for the letdown/containment AOVs was adequate to achieve seat leakage requirements. The preliminary calculation indicated the existing bench set setpoints were too low, and none of these 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 Fisher Valves 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). Fisher Valve'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 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 affect to the operating Units 2 and 3. The APS Engineering team determined through calculations that two valves acting in series are 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, Fisher Controls International (FCI) completed a technical inquiry of the actuator and hand-jack sizing of the AOVs provided to Combustion Engineering 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 November 17, 1995, modifications to the Unit 3 CHB-UV-515, CHA-UV-516, and CHB-UV-523 valve actuators were completed. The modifications included the changing of actuator springs, adjustment of the valve stroke length, replacement limit switches, and removal or modification of the actuator handwheel.

On December 15, 1995, inservice 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.

TEXT

There were no safety system responses 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 containment/letdown 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 provide necessary input for parallel 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 show that a single isolation valve with a bench set of 22 psig will close at a differential pressure of 1878 psig. Therefore, assuming atmospheric conditions immediately downstream of the single isolation valve, RCS pressures above 1878 psig will result in flow through the valve. 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. An evaluation using the conservative mass flow rate determined for attempted single valve isolation at 22 psig bench set resulted in acceptable offsite dose consequences significantly below those required by 10CFR100.

The current design basis HELB analysis assumes ten minutes at the full break blowdown rate prior to the operator remote manually closing the letdown isolation valve. The scenario considered the inadequate isolation provided by the low bench set of the valves and assumes 15 additional minutes at a lower flow rate for the operators to assess the inadequate isolation. At this time, the operators commence cooldown, and 1.93 minutes later the RCS has depressurized to 1878 psig resulting in complete closure of the isolation valve and termination of the letdown line blow down to the Auxiliary Building.

Radiological Consequences:

The radiological consequences of this event are documented in calculation 13-NC-ZY-249, Revision 0. The calculation assumes a total RCS flow for the event prior to complete isolation at 27 minutes following event initiation of 14,700 pounds per minute. The analysis concludes that the total RCS release to the Auxiliary Building during the 27 minutes prior to complete isolation would result in a dose of 7.2 Rem at the exclusion area boundary .

The analysis is based on a specific activity of 1 microcurie per cubic centimeter I-131 equivalent in the RCS. The specific activity is the maximum allowable per TS 3/4.4.7. 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:

In addition, an analysis was conducted to determine the effects of this additional RCS release on the Auxiliary Building environment to ensure no safety related equipment was adversely affected. The results of this analysis indicate that the additional, lower maximum mass flow rate during the 16.93 minutes following the initial 10 minute release currently postulated did not result in a more adverse environment. The flow rate was low enough that the building began to cool following partial isolation at 10 minutes, although at a slower rate than with total line break isolation.

TEXT

Appendix R Fire Hazards Analysis:

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. The current control room fire strategy calls 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.

Compensatory measures, as described in the pre-fire strategies manual, have been implemented which prescribe certain operator actions that must be performed in the event of a fire outside the control room to ensure two letdown isolation valves are closed. Essentially, the action is to open 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.

The analyses and compensatory measures described above demonstrate the vendor recommended low bench set for the letdown and containment isolation valves on the letdown line does not represent a deficiency in design which could result in the loss of a safety function. Calculations have determined that two valves acting in series are capable of closing against the differential pressure associated with a break of the letdown line. Accordingly, all safety functions are capable of being performed except for 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.

Compensatory measures have been implemented in accordance with 10CFR50 Appendix R which prescribe certain operator actions that must be performed in the event of a fire outside the control room. The actions will ensure two letdown isolation valves are closed, thereby ensuring performance of this 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 Palo Verde Nuclear Steam Supply System vendor (ABB-CE) procured valves that had undersized air actuators and bench sets which were too low to provide adequate valve seating

TEXT

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 (Arizona Public Service Co.). 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).

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. There were no personnel errors which 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, and have remained, in service.

The failure mode of the isolation valves is the potential for through-seat leakage at a differential pressure of 2485 psig. The mechanism of the failed component is the bench setup of the valve operator. The effect of through-seat leakage is that the valves cannot be solely relied upon to isolate letdown flow. 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 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

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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 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.

None of the valves' functions were affected by the bench settings except for the isolation of the letdown line during a postulated fire in certain fire zones outside containment where only a single valve may have been available.

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

6. CORRECTIVE ACTIONS TO PREVENT RECURRENCE

Units 1 and 3:

The affected isolation valves in Units 1 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. The new configuration will meet or exceed all requirements for letdown system isolation.

Unit 2:

Compensatory measures, as described in the pre-fire strategies manual, have been implemented which prescribe certain operator actions that must be performed in the event of a fire outside the control room to ensure two letdown isolation valves are closed. Essentially, the action is to open the disconnect switch at the specified auxiliary relay cabinet for the valve whose circuits are potentially affected. This action causes the valve to fail closed. Otherwise the operator can manually close/ensure close the subject letdown valves from the control room for areas where the letdown valve circuits are not affected by fire.

The affected Unit 2 valves will be modified by reducing the stroke length of the actuator, replacing the existing springs with a stiffer 3320 pound per inch spring, modifying the travel stops and limit switches, and increasing the bench settings during the upcoming refueling outage which is scheduled to be complete by May 10, 1996.

Generic:

Evaluations have been performed for all Fisher 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.

TEXT

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

7. PREVIOUS SIMILAR EVENTS

There have been no previous similar events reported pursuant to 10CFR50.73 in the last three years that were attributed to undersized air actuators and bench settings that are too low to provided adequate seating force.