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AUTH.NAME AUTHOR AFFILIATION
SHRIVER,T.D. Arizona Nuclear Power Project (formerly Arizona Public Serv
HAYNES,J.G. Arizona Nuclear Power Project (formerly Arizona Public Serv
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 88-023-00:on 880324,broken bolting in essential HVAC dampers.

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NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

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)
Broken Bolting in Essential HVAC Dampers

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 NUMBER(S)
0 3	2 4	8 8	8 8	0 2 3	0 0	0 4	2 5	8 9	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)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
6	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)	X 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)	10CFR21
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Timothy D. Shriver, Compliance Manager	AREA CODE 6 0 2 3 9 3 - 2 5 2 1

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	V I	B D M P	R 4 1 1	N					

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 24, 1988 an inspection of two Unit 2 Control Room Essential Heating, Ventilating, and Air Conditioning bubbletight dampers was being conducted. During the inspection, it was noted that some of the bolting which secures the damper blade to the axle shaft was broken. The bolting acts as a shear pin to ensure that the blade will turn with the axle shaft. On one damper, all three bolts which secure the blade to the axle shaft were broken. On the other damper, only one of the three bolts was broken. Only part of one of the four broken bolts had fallen out of position; therefore, both dampers remained functional. Both dampers function to isolate outside air from the Control Room.

An engineering evaluation was performed to determine the cause of the bolting failure. It was determined that the extension shaft between the damper and actuator was rotating, causing a misadjustment between the actuator and damper, and resulting in the damper blade over-rotating. This causes excessive shear forces on the axle to blade bolting which would have eventually resulted in damper failure.

As corrective action, Loctite sealing compound has been applied to the extension shaft/yoke connection in all three units.

This report is also being provided to include information requested by 10CFR21. No previous similar events have been reported.

1/1

NRC Form 366

IE22

The narrative below includes the information requested by 10CFR21(b)(3); however, it is being formatted to report this event in accordance with the requirements of 10CFR50.73.

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

At the time of the initial discovery of the Control Room Essential Heating, Ventilating, and Air Conditioning (HVAC) System (VI) broken damper (BDMP) bolts on approximately March 14, 1988, Palo Verde Unit 2 was in Mode 6 (REFUELING) with the Reactor Coolant System (RCS)(AB) vented to atmosphere.

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

Event Classification: Condition which could have prevented the fulfillment of a safety function.

NOTE: This section includes information requested by 10CFR21 concerning the nature of the defect and dates for which information was obtained/developed.

On March 24, 1988, an inspection of two Control Room Essential HVAC bubbletight dampers (BDMP)(I.D. Nos. 2M-HJB-M02 and 2M-HJA-M03) was being conducted. The inspection was being conducted in accordance with approved work authorization documents which required that the damper blade gap be inspected and, if necessary, rework the damper to correct any blade gap deficiencies. During the inspection, it was noted that the three bolts which attach the damper blade to the axle shaft were broken on damper 2M-HJA-M03 and one of the three bolts which attach the damper blade to the axle shaft was broken on damper 2M-HJB-M02. The failed bolts were replaced and an engineering evaluation was initiated to determine the root cause of failure for the broken bolts.

Both dampers remained functional in their as-found degraded condition. Of the four bolts which failed in both dampers, only one half of one of the three broken bolts on damper 2M-HJA-M03 had fallen out of position. Damper 2M-HJB-M02 had one broken bolt which remained in place as well as two remaining unbroken bolts. Therefore, both dampers would have functioned prior to the discovery of the degraded condition.

Based upon the results of engineering evaluations of the broken bolting, it was determined on March 30, 1989 that the bolting failures described above are reportable pursuant to the provisions of 10CFR21 and 10CFR50.73.

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

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

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

NOTE: This section includes information requested by 10CFR21 concerning the nature of the defect and dates on which information was developed.

The following provides information regarding the actions taken and observations made during ANPP's investigation to determine the cause of the bolting failures:

1. The broken bolts were photographed using an electron microscope. The photographs were then evaluated for mode of failure. As a result of the evaluation, it was determined that the bolts failed due to high cycle fatigue failure.

2. The broken bolts on damper 2M-HJA-M03 were removed and replaced with new bolts. The damper actuator limit switch (33) setting was adjusted in accordance with the manufacturer's instructions. The damper actuator extension shaft (which connects the actuator to the damper yoke assembly) was marked in order to determine if it was rotating. The damper was bench stroked in excess of 300 cycles. During the testing, it was discovered that the damper to actuator extension shaft rotates and screws into or out of the yoke assembly as the damper cycles. The direction and the rate of the shaft rotation varied with the cleanliness of the extension shaft. The magnitude of the force causing the shaft rotation was not significant since rotation could be stopped by holding the shaft between two fingers. The reason for rotation of the extension shaft into or out of the yoke assembly is that the extension shaft is not properly secured to the yoke assembly. The extension shaft rotation results in a misadjustment between the actuator and damper.

   Proper adjustment of a damper requires the actuation of a limit switch to deenergize the actuator as the damper blade contacts a stop pin. Proper adjustment limits exertion of excessive force on the damper blade to axle shaft bolts. However, if the damper extension shaft moves into the yoke as a result of the rotation described above, then contact between the stop pin and the damper blade could occur prior to limit switch actuation, resulting in an increased shear force on the damper blade to axle shaft bolts.

ANPP conducted a test to determine the effects of the actuator "short cycling" on the damper assembly. The manufacturer's instruction manual provided with the damper actuator indicates that the actuator could "short cycle" in its energized position as much as once every 45 seconds. The phenomenon of "short cycling" occurs when hydraulic fluid is internally bypassed in the actuator as a result of spring pressure. The actuator shaft eventually moves 0.10 inch and results in the actuator motor automatically energizing to return the shaft to its original fully stroked position. During the testing, the damper actuator was energized in order to close the damper. The assembly was then allowed to short cycle. It was observed that the actuator extension shaft rotated and moved into or out of the yoke assembly during the short cycling period.

4. Another test was performed wherein the center blade to shaft bolt was removed and a brass shear pin installed in place of the actuator end bolt. The test was conducted with the limit switch setting adjusted deliberately incorrect such that the stop pin would contact the blade and stop the actuator travel before the limit switch deenergized the actuator. The damper was then cycled. In this configuration, the maximum actuator force was exerted on the single shear pin which simulated worst case conditions. Inspection of the brass pin was performed and slight deformation of the surface adjacent to the shear faces was observed.

Based on the investigation described above, one or a combination of the following conditions resulted in the bolting failures.

1. Initial misalignment of the damper/actuator may have resulted in the application of excessive/recurring shear forces in the bolts.

2. Rotation of the actuator lower extension shaft caused misadjustements between the actuators and dampers such that an excessive force was exerted on shaft bolts when the damper cycled.

3. Damper actuator short cycling in the energized position accelerated the rate of bolting failures.

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

The bolting failures described in Section I.B would have eventually resulted in the separation of the damper blade from the axle shaft. This would result in an inability to re-position the damper. Depending upon the required mode of operation for a

postulated accident condition, Control Room (NA) habitability would be compromised. The failure mode and mechanism is discussed in Section I.D.

It should be noted that, of the four bolts which broke, only one half of the center bolt on damper 2M-HJA-M03 had fallen out of position. The remaining bolt pieces remained in place and continued to function as shear pins causing the blade to rotate with the axle shaft.

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

Not applicable - the failed bolts and potentially malfunctioning dampers do not have multiple functions.

G. For 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:

The failures which occurred in Unit 2 did not render a train of a safety system inoperable. The bubbletight damper assemblies had previously been removed from the Control Room Essential HVAC System for the seal inspection.

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

The bolting failures were discovered during a routine inspection of the damper sealing mechanisms. There were no procedural errors.

I. Cause of Event:

See Section I.D above.

J. Safety System Response:

There were no safety system responses and none were necessary.

K. Failed Component Information:

NOTE: This section includes information requested by 10CFR21 concerning the identification of the firm supplying the basic component and the number and location of the dampers at Palo Verde.

There are six (6) dampers in each of the three Palo Verde Units (eighteen total) which utilize a bolted connection between the blade and axle shaft. These are:

UNIT 1	UNIT 2	UNIT 3
1M-HJA-M02	2M-HJA-M02	3M-HJA-M02
1M-HJB-M02	2M-HJB-M02	3M-HJB-M02
1M-HJA-M03	2M-HJA-M03	3M-HJA-M03
1M-HJB-M03	2M-HJB-M03	3M-HJB-M03
1M-CPN-M05A	2M-CPN-M05A	3M-CPN-M05A
1M-CPN-M05B	2M-CPN-M05B	3M-CPN-M05B

The "HJ" dampers are outside air isolation dampers for the Control Room Essential HVAC system. The "CP" dampers (1, 2, and 3M-CPN-M05A and B) are installed in the Containment Purge System (VA). The "CP" dampers are not safety related and are not required for safe shutdown. In addition, the "CP" dampers were procured at a later date and are provided with set screws between the extension shaft and the yoke assembly to prevent the shaft rotation. Therefore, the failure mechanism is considered not to be applicable to the "CP" dampers. All of the dampers are manufactured by the Ruskin Manufacturing Company and are identical in size and application. They are all Model No. CDRB-92.

The following HVAC dampers are designed with the same extension shaft/actuator mechanism which could become misadjusted due to the rotation of the extension shaft. However, the connection between the damper blade and the damper axle shaft are full penetration welded. This provides a stronger connection so the potential for failure is lower.

UNIT 1	UNIT 2	UNIT 3
1M-CPN-M06	2M-CPN-M06	3M-CPN-M06
1M-HCN-M04A	2M-HCN-M04A	3M-HCN-M04A
1M-HCN-M04B	2M-HCN-M04B	3M-HCN-M04B
1M-HFA-M05	2M-HFA-M05	3M-HFA-M05
1M-HFB-M05	2M-HFB-M05	3M-HFB-M05
1M-HFA-M06	2M-HFA-M06	3M-HFA-M06
1M-HFB-M06	2M-HFB-M06	3M-HFB-M06
1M-HPA-M01	2M-HPA-M01	3M-HPA-M01
1M-HPB-M01	2M-HPB-M01	3M-HPB-M01
1M-HPA-M02	2M-HPA-M02	3M-HPA-M02
1M-HPB-M02	2M-HPB-M02	3M-HPB-M02

The "HC" (1, 2, and 3M-HCN-M04A and B) dampers are installed in the non-essential Containment Building HVAC System (VA). The "HF" dampers (1, 2, and 3M-HFA(B)-M05 and 6) are installed in the Fuel Building Essential HVAC System (VG). The "HP" dampers (1, 2, and 3M-HPA(B)-M01 and 2) are installed in the Containment Hydrogen Control System (BB).

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

Note: This section contains information requested by 10CFR21 concerning the nature of the safety hazard which is created or could be created.

As discussed in Section I.B only one half of one of the four bolts discovered broken had fallen out of place. The remaining bolting remained in place and continued to function ensuring that the damper blades would rotate with the axle shaft. Therefore, the dampers were functional prior to discovery of the broken bolts.

If the broken bolts had not been detected, the cycling of the damper would have eventually resulted in the failure of the bolts to the point that the damper blade would no longer respond to the actuator open or close force. These dampers are required to respond to a Control Room Essential Filtration Actuation (CREFAS)(JE) or a Control Room Ventilation Isolation Actuation (CRVIAS)(JE) signal. Failure of the damper to respond to CREFAS signal during an inadvertent radioactive release would prevent the filtration system from pressurizing the Control Room. Failure of the damper to respond to a CRVIAS signal would allow smoke and gases to enter the Control Room. There are no other systems or components which could perform the same function as the bubbletight dampers.

III. CORRECTIVE ACTIONS:

NOTE: This section contains the information requested by 10CFR21 concerning the corrective action which has been, is being, and will be taken; the organizations responsible for the corrective action; and the length of time for accomplishing the corrective action.

A. Immediate:

The broken bolting in dampers 2M-HJA-M03 and 2M-HJB-M02 were replaced.

B. Action to Prevent Recurrence:

As action to prevent recurrence, the manufacturer's instruction for limit switch adjustment was revised to provide additional assurance that the shear forces on the bolts are minimized. In order to prevent rotation of the damper to actuator extension shaft into or out of the damper yoke assembly, an engineering evaluation was performed to determine alternatives for correcting the rotation of the actuator extension shaft. Based upon the engineering evaluation, it was determined that application of LOCTITE formula 277 at the point where the axle shaft threads into the yoke assembly would be the best alternative to stop the rotation. An engineering evaluation was performed to review the impact on the

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Palo Verde Unit 1	0 5 0 0 0 5 2 8	8 8	— 0 2 3	— 0 0	0 8 OF 0 8

TEXT *(If more space is required, use additional NRC Form 366A's)* (17)

equipment qualification of the bubbletight dampers. It was determined that there is no impact on the equipment qualification. Application of LOCTITE formula 277 was field tested and it was observed that application of the LOCTITE compound satisfactory stopped rotation of the extension shaft. The damper manufacturer's concurrence was obtained for the application of the LOCTITE to the various HVAC dampers.

With the exception of two Unit 2 containment hydrogen purge dampers (2M-HPA-M02 and 2M-HPB-M02), work has been completed to adjust the dampers in accordance with the revised procedure for setting the limit switch and to apply LOCTITE compound to the damper assembly extension shaft. No additional broken bolts were discovered as a result of implementing the corrective actions to prevent recurrence. The two Unit 2 containment hydrogen purge dampers are awaiting new actuators for replacement. LOCTITE compound will be applied to the new actuators when they are installed. Based upon an engineering evaluation, it was determined that operability of the Unit 2 Hydrogen Purge System is not compromised with the two dampers unavailable.

No corrective actions are required for the damper actuator short cycling. The short cycling is a normal design feature and, if the damper is properly adjusted, will not result in undue stress on the bolting.

IV. PREVIOUS SIMILAR EVENTS:

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

Arizona Nuclear Power Project
P.O. BOX 52034 • PHOENIX, ARIZONA 85072-2034

192-00474-JGH/TDS/DAJ
April 25, 1989

U. S. Nuclear Regulatory Commission
NRC Document Control Desk
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 1
Docket No. STN 50-528 (License No. NPF-41)
Licensee Event Report 88-023-00
File: 89-020-404

Attached please find Licensee Event Report (LER) No. 88-023-00 prepared and submitted pursuant to 10CFR50.73. In accordance with 10CFR50.73(d), we are herewith forwarding a copy of the LER to the Regional Administrator of the Region V office.

This report is also being submitted to include the information requested by 10CFR21. The initial reporting of the defect was previously performed by the original equipment manufacturer. In accordance with 10CFR21.21(b)(2), three copies of this report are being provided to the Director, Office of Nuclear Reactor Regulation.

If you have any questions, please contact T. D. Shriver, Compliance Manager at (602) 393-2521.

Very truly yours,

J. G. Haynes
Vice President
Nuclear Production

JGH/TDS/DAJ/kj

Attachment

cc: D. B. Karner (all w/a)
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