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)
Catawba Nuclear Station, Unit 2	0 5 0 0 0 4 1 4	1 OF 0 7

TITLE (4) Inoperable Containment Air Return Train A Because of Swapped Control Wiring Due to an Inappropriate Action

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 4	0 1	8 8	8 8	0 3 3	0 1	0 3	1 5	8 9		0 5 0 0 0
										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)	1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(a)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(a)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	X 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)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Julio G. Torre, Associate Engineer - Licensing	AREA CODE 7 0 4 3 7 3 - 8 0 2 9

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	

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 31, 1988, at 0400 hours, while performing Auxiliary Safeguards Test Cabinet Periodic Test, 2ARF-D-2, Unit 2 Containment Air Return Fan Damper 2A, failed to open. A work request was written to investigate and repair 2ARF-D-2, and the damper was declared inoperable. While performing the work request, it was discovered that two wires in the damper control circuit were swapped. This wiring error swapped the positive leg of two separate 120 VAC power sources in the damper control circuit and effectively removed the interlocks to open the damper on a safety system actuation. After the wiring was corrected, a functional test was performed on the damper and it was declared operable. This event was discovered on April 1, 1988. The event was determined to be reportable on December 14, 1988. Submittal of this LER was delayed until January 27, 1989 per H. B. Tucker's January 13, 1989 letter to the NRC. Unit 2 had been in all modes of operation while the damper operability was in question. Unit 2 was in Mode 1, Power operation, at 100% Power at the time this event was discovered. This incident has been attributed to an inappropriate action. The wires were apparently incorrectly installed during a Nuclear Station Modification. However, post modification testing verified damper operability. Subsequent testing reverified that the damper would open with the incorrect wiring in place. A work request was completed to further investigate the circuitry. No other wiring discrepancies were found. The damper apparently circled during post modification testing due to a current path created by the wiring error.

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The health and safety of the public were unaffected by this event.

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

BACKGROUND:

The purpose of the Containment Air Return [EIIS:BK] Subsystem of the Containment Air Return and Hydrogen Skimmer [EIIS:BB] (VX) System is to assure rapid return of air from upper to lower Containment after an initial large break LOCA blowdown. The subsystem consists of two redundant independent and separately located 100% capacity fans [EIIS:FAN] per Unit.

The Containment Air Return Fan Damper [EIIS:DMP] 2A, 2ARF-D-2, is designed to open after a 10 second delay upon a Containment High High Pressure (Sp) Signal. When this damper is open, a flow path is provided for the air return fan from upper to lower Containment.

Technical Specification 3.6.5.6 requires that two independent VX Trains be operable in Modes 1, Power Operation, 2, Startup, 3, Hot Standby, and 4, Hot Shutdown. With one train inoperable for more than 72 hours, the plant must be in at least Hot Standby within the next 6 hours, and in Cold Shutdown within the following 30 hours. With both trains inoperable, Technical Specification 3.0.3 requires that action shall be initiated within 1 hour, to place the Unit in a mode in which the Technical Specification does not apply. The Unit is to reach Mode 3 within the next 6 hours, Mode 4 within the following 6 hours, and Mode 5, Cold Shutdown, within the subsequent 24 hours.

DESCRIPTION OF INCIDENT:

On March 31, 1988, while performing PT/2/A/4200/09A, Auxiliary Safeguards Test Cabinet Periodic Test, 2ARF-D-2, Containment Air Return Fan Damper 2A, failed to open. Work Request 6375 PRF was written to investigate and repair 2ARF-D-2. The damper was declared inoperable at this time. While working 6375 PRF, it was discovered that wires on terminals B-32R and C-35R in 2ELMC0020 were swapped. Instrument and Electrical (IAE) personnel initiated Problem Investigation Report (PIR) 2-C88-0151 identifying the swapped wires.

Nuclear Station Modification (NSM) CN-20223, a modification to relocate some Containment Air Return and Hydrogen Skimmer Fan System devices from the Control Room to local panels, was started on August 25, 1987, and wiring changes were completed by approximately January 3, 1988. PT/2/A/4450/05A, Containment Air Return Fan 2A and Hydrogen Skimmer Fan 2A Performance Test, was conducted by Performance to satisfy retest requirements of NSM CN-20223. PT/2/A/4450/05A was not completed due to improper operation of delay timers [EIIS:TMR]. However, 2ARF-D-2 cycled per computer printouts, although not in the required time. Performance wrote work requests on the VX System to investigate the time delay problem. On January 21, 1988, all delay timers were calibrated to their required times. On January 24, 1988, Performance successfully completed PT/2/A/4450/05A. At this time, the Performance post-modification test was performed satisfactorily with damper response being timed with a stop watch by observing damper indicating lights. However, Alarm Summary data does not indicate that the damper cycled.

CORRECTIVE ACTIONS:

Subsequent

(1) Work Request 6375 PRF, which corrected the swapped wires, was completed.

(2) Work Request 314 MES was completed to further check control circuits. The investigation involved verifying Containment Air Return Fan Damper Open Control Circuits which were affected by the implementation of NSM CN-20223. Associated Test switches were also verified for correct contact status.

Planned

(1) Wiring and sleeve installation practices will be reviewed for potential improvements as to requirements for independent verification and continuity checks during installation of new wire markers.

SAFETY ANALYSIS:

Background

For any high-energy line break inside Containment that causes Containment pressure to exceed the high-high Containment pressure setpoint (3.0 psig), the Containment Air Return (VX) fans normally start following a 10 minute delay and circulate air from upper to lower Containment, thereby forcing steam into the ice condenser. The VX System contains two independent trains, each with a 40,000 cfm fan and associated damper, but only one train is required to provide adequate inter-compartment flow. Should an accident occur where the high-high pressure setpoint is reached, the Operators would enter the appropriate emergency procedure and subsequently check 10 minutes later to verify VX System (fan and damper) operation. If the damper was found closed and could not be opened manually from the Control Room, a Priority 1 work request would be issued to open the damper. Instrumentation and Electrical (IAE) personnel would then be immediately dispatched to open the damper. IAE has indicated that the necessary action to open the damper is simply performed by placing a single jumper in a single cabinet. That action would require no more than 30 minutes from notification. Therefore, action to rectify the problem is assumed to be completed within 30 minutes, allowing air flow to be established 40 minutes into the transient. In order to assess the impact of the additional 30 minute delay in establishing air return fan flow from Upper to Lower Containment, a Containment analysis was performed for the double-ended pump suction break loss

A review of the Elementary Diagrams, Wire Tabs, and Connection Diagrams has indicated the damper should not have cycled with the wiring error. Maintenance Engineering Services (MES) has performed Work Request 314 MES to conduct a point to point check per NSM CN-20223 and other drawings to verify the correct wiring exists in control circuits for 2ARF-D-2. No other discrepancies were found. The associated Test switches were also verified for correct contact status.

Both trains of VX are required for Modes 1, Power Operation, through Mode 4, Hot Shutdown. Train B Solid State Protection System [EIIS:JC] was out of service on March 3, 1988, from 1315 hours to 1515 hours. Testing of Train B Containment Pressure Control System was performed on March 7, 1988, for one hour and twenty-two minutes. Diesel Generator 2B Operability Testing was performed on February 29 thru March 1, March 15, March 21 thru March 22, and March 29, 1988. Diesel Generator 2B was inoperable during these tests for approximately four hours due to the controls being placed in Maintenance Mode. Even though Operability Testing was in progress, the Diesel would have responded to a Safety System Actuation when not in Maintenance Mode. Therefore, VX Train B was inoperable due to various reasons for approximately seven hours and twenty-two minutes while VX Train A was unknowingly inoperable due to the swapped wires.

The methods used to align the VX System for testing in the Auxiliary Safeguards Test Cabinet Periodic Test and PT/2/A/4450/05A are slightly different. PT/2/A/4450/05A requires the use of test circuitry which is not used during the Auxiliary Safeguards Test. The different methods in testing should both adequately verify 2ARF-D-2 operability.

The damper's response during PT/2/A/4450/05A on February 24, 1989, in which the damper cycled with the wiring swapped remains unexplained. However, it appears an alternate current path is established with the test switch for 2ARF-D-2 in the Test "A" position which can, at times, cause the damper to cycle. This would explain the damper cycling in the January 19 and 24, 1988 tests as well as the February 28, 1989 test. The damper's response could not be repeated on February 28, 1989, in which the damper did not cycle under the same conditions.

In the previous twelve months, there has been one Technical Specification violation due to inattention to detail (see LER 413/88-10), thereby satisfying the criteria for a recurring problem. During the previous twelve months, there have been problems involving mispositioned control circuit sliding links. LER 413/88-16 was concerned with mispositioned sliding links in control circuits. Formal training of the expected use of procedures, placement of jumpers, repositioning links, independent verification, and documentation was completed in mid 1988 after the installation error described in this incident. The incorrect wiring in the current incident occurred prior to this training. Additiona improvements in the modification program were undertaken in 1988. These included the establishment of a post modification testing task force. Also, the Design Engineering Department was realigned to a project related organizational structure which will provide better support of operability determinations.

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

Station personnel requested that Design Engineering evaluate whether past operability problem existed with the VX controls while the swapped wiring was in place. Design Engineering's response on April 15, 1988, was that the train of VX was operable with the incorrect wiring in place.

In a letter from Performance to Compliance on August 1, 1988, Performance concluded the damper problem and its wiring error occurred after the Performance post-modification test and remained that way until April 1, 1988.

On August 16, 1988, Compliance requested a revised past operability evaluation. On September 14, 1988, Design Engineering concluded that the subject damper, along with its test circuit, would have been inoperable with the circuit wiring error in place.

IAE, Maintenance Engineering Services, and Compliance continued investigation of VX past operability. Based on this investigation, Compliance concluded that PIR 2-C88-0151 was reportable as an LER on December 19, 1988.

The Catawba Safety Review Group (CSRG) investigation revealed that the Alarm Summary data indicates the damper cycled while performing the post modification test, PT/2/A/4450/05A, on January 19, 1988. Alarm Summary data after 4/1/88 show 2ARF-D-2 cycling during appropriate Performance tests. However, there is no explanation for the lack of computer confirmation for the damper changing state on January 24, 1988.

On February 29, 1989, in an effort to better understand the damper's response, VX Train A was declared inoperable and PT/2/A/4450/05A was performed with the wiring error in place. The damper cycled upon demand. PT/2/A/4200/09A was then attempted, but the damper did not cycle. Fuse BA-10 in cabinet ZEATC4 was found blown, and latter replaced. On February 28, 1989, VX Train A was declared inoperable, the wires were again swapped, and PT/2/A/4450/05A was attempted. The damper would not cycle. The wiring was latter corrected and VX Train A returned to operability.

A review of the Nuclear Maintenance Data Base has shown no evidence of other work which would have resulted in the swapping of wires on B-32R and C-35R in 2ELMC0020 following the post modification test on January 24, 1988.

CONCLUSION:

This incident has been attributed to an inappropriate action. A review of NSM CN-20223 indicates that these wires were manipulated during this modification and were apparently installed in error. Also, wiring sleeve markers were found to be consistent with the incorrect wiring. Sleeve markers would have been installed during the NSM. A post-modification test was conducted by Performance which should have been adequate to verify operability. Correct wiring installation during the NSM was independently verified by craft personnel and inspected by Quality Control (QC) personnel. A review of the inspection methods used by QC indicates the wire sleeve markers would be checked for actual wire termination. In this event incorrect sleeving was already in place and the QZ inspection would not detect the installation error.

of coolant accident. A case with establishment of air flow at 10 minutes is used as the baseline and a second case, with damper actuation at 40 minutes, was performed as a sensitivity analysis. It is assumed that VX Train 2B and Containment Spray Train 2B are rendered inoperable by a single failure possibly resulting from a Loss of Offsite Power, and failure of Diesel Generator 2B.

Evaluation of Pressure Effects

Results for the baseline case show that upon fan actuation, the pressure decreases 1.5 psi within 2 minutes and remains almost steady until the end of the analysis (20 minutes). Pressure for the sensitivity case remains essentially constant from 9 minutes until 40 minutes. When the damper opens, pressure drops 1.5 psi by 43 minutes and is steady through the end of the analysis (50 minutes). Therefore, the impact of a 30 minute delay in the establishment of air flow has an insignificant impact on the peak Containment pressure. The time of peak Containment pressure still occurs much later in time following ice meltout.

Evaluation of Temperature

The lower Containment temperature responses are identical until 10 minutes. At 4.7 minutes, substantially superheated steam begins entering lower Containment from the break, forcing the temperature up sharply. When the establishment of air flow occurs in the baseline case, at 10 minutes, the temperature falls 15 degrees F in 2 minutes and remains constant until 15 minutes. At that point, the steam flow from the break decreases over 50%, and the temperature drops another 35 degrees F by 20 minutes. The temperature for the sensitivity case continues to increase until the steam flow reduction at 15 minutes. The peak temperature for the sensitivity case is 6 degrees F higher than the baseline, but falls 20 degrees F by 20 minutes and is constant until air flow is established at 40 minutes. Establishing air flow causes a temperature decrease of 25 degrees F, and the decrease continues through 50 minutes. The additional 30 minute delay in establishing air flow allows lower Containment temperature to increase to 332 degrees F, 5 degrees F higher than the current lower Containment Environmental Qualification (EQ) profile. This result will later be discussed in context of the highest design basis accident temperature (327 degrees F) obtained from the steamline break analysis.

The FSAR also addresses peak Containment temperature, minimum Containment pressure, divider barrier reverse differential pressure, and subcompartment wall differential pressure. The divider barrier reverse differential pressure analysis shows upper and lower compartment pressures equalizing at 70 seconds, well before normal VX air flow is established. Therefore, the additional 30 minute delay would not affect this analysis. For the subcompartment analysis, the maximum pressures within and differential pressures between the various subcompartments tend to decrease and converge within a few seconds. Thus, VX System operation has no effect on this analysis either. The minimum pressure analysis is performed to calculate steam venting during a LOCA and, hence, peak clad temperature. Peak clad temperature occurs before 300 seconds, so VX operation does not affect this transient.

Evaluation of EQ Concerns

Lower Containment temperatures from the steamline break FSAR analysis profile the long-term EQ envelope. The temperatures are higher than that following a LOCA since the steam entering from the break is superheated. The peak temperature of 327 degrees F occurs at 127 seconds into the transient, but decreases to 295 degrees F at 8 minutes, and remains nearly constant until fan actuation at 10 minutes. After fan actuation, the temperature falls to 250 degrees F and continues to decrease. A 30 minute delay would allow lower Containment temperature to remain high until 40 minutes, when establishing air flow would cause a decrease. The mass flow and enthalpy of the steam are decreasing during the time from 10 to 40 minutes, so the temperature would not increase above 295 degrees F. However, since the temperature remains elevated until 40 minutes, the lower Containment EQ profile is exceeded. Thus, the additional delay in establishing air flow presents potential risk to safety related instrumentation and equipment required to function in the accident sequence.

The Large Break LOCA sensitivity case, performed assuming air flow is established at 40 minutes, predicts a peak temperature of 332 degrees F at 15 minutes and a nearly constant temperature of 309 degrees F from 20 to 40 minutes. These temperatures are higher than would be expected from the steamline break assuming air flow is established at 40 minutes. Therefore, lower Containment temperature response for the Large Break LOCA sensitivity case is bounding for all postulated accidents. An evaluation has been conducted concerning the effect of the increase in peak temperature (5 degrees F) and lengthened duration of elevated temperature in lower Containment on instrumentation and equipment required to operate during a LOCA. The result of this evaluation showed that sufficient margin exists in the qualification test profiles of the instrumentation and equipment to adequately account for the degraded environmental conditions.

Summary

The impact of a 30 minute delay in establishing the Containment air return fan flow has been evaluated to determine the impact on pertinent FSAR analyses, structural design considerations, and instrumentation and components located within Containment. Although the lower Containment EQ profile is exceeded by increased peak temperature and longer duration of elevated temperature, the instrumentation and equipment required to operate in the LOCA environment has been tested and qualified to Accident profiles which adequately envelopes the peak temperature for the postulated longer duration. Therefore, the consequences of a 30 minute delay in establishment of Containment Air Return System flow do not present a safety concern. The health and safety of the public were not adversely affected by this incident.
This incident is reportable pursuant to 10CFR 50.73, Section (a) (2) (i) (b).

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March 16, 1989

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

Subject: Catawba Nuclear Station, Unit 2
Docket Nos. 50-414
LER 414/88-33, Revision 1

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Revision 1 to Licensee Event Report 414/88-33 concerning the inoperability of Containment Air Return Train A because of swapped control wiring due to an inappropriate action.

The event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

H. B. Tucker

JGT/2/LER33R

Attachment

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