NRC Form 366 (9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Catawba Nuclear Station, Unit 1	0 5 0 0 0 4 1 3	1 OF 0 7

TITLE (4): Unit Shutdowns Due To Design Deficiency With Containment Air Return Fans

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 1	3 0	8 7	8 7	0 0 5	0 2	0 9	0 9	8 7	Catawba, Unit 2	0 5 0 0 0 4 1 4
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

[ ] 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)	[ ] 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 (AREA CODE)
Julio G. Torre, Assistant Engineer - Licensing	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)

[ ] YES (If yes, complete EXPECTED SUBMISSION DATE) [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On January 30, 1987, Units 1 and 2 entered Technical Specification 3.0.3 following the determination that the Containment Air Return and Hydrogen Skimmer Systems were inoperable. It was determined that the systems were inoperable due to the possibility that the Containment Air Return fans (CARF's) could be rendered inoperable in the event of a Containment Spray actuation where the CARF pits would be flooded with collected spray. On both units, deflective curbs were installed on the Reactor Building operating deck to prevent collected spray from funneling into the fan pits. Unit 1 was operating at 100% when Technical Specification 3.0.3 was entered. Unit 2 was in Mode 3, Hot Standby, when Technical Specification 3.0.3 was entered. The systems had been unknowingly inoperable since initial fuel load on both units.

This incident is assigned Cause Code B, Design Manufacturing, Construction/Installation Deficiency. No devices to prevent funneling of collected containment spray into CARF pits were specified on design drawings.

The CARF inoperability did not in any way increase the probability of a Design Basis Accident (DBA), nor would it have affected actual core conditions or created an event that lead to degraded core conditions. The health and safety of the public were not affected by this incident.

This incident is reportable pursuant to: Unit 1 - 10 CFR 50.73, Section (a)(2)(i)(A) and Unit 2 - 10 CFR 50.73, Section (a)(2)(vii)(D).

IE22 1/1

U.S.GPO:1984-0-454-481/18759

BACKGROUND

The purpose of the Containment Air Return Sub-system of the Containment Air Return and Hydrogen Skimmer (VX) System (EIIS:BB) is to assure rapid return of air from upper to lower containment after an initial large break loss-of-coolant (LOCA) blowdown. The subsystem consists of two redundant independent and separately located 100% capacity fans (EIIS:FAN) per unit. Each Containment Air Return fan is located in a pit, approximately 13 feet deep, below the Reactor Building operating deck, at elevation 605' + 10". The fan intake is through grating on the 605' elevation. Fan discharge is directed below to lower containment. Each Containment Air Return fan pit is served by a 6" drain line, which routes liquid to the reactor refueling cavity and then to the containment sump. This function would be necessary in the event of a LOCA and subsequent actuation of the Containment Spray System (EIIS:BE). Some collection of Containment spray in the fan pit is expected and the drain line is provided for that purpose.

The refueling canal and reactor vessel (EIIS:RPV) area are surrounded by a 3" raised curb on 605' elevation, to prevent intrusion of undesired materials to the areas below. The 3" curb around these areas would direct Containment spray collected on the 605' elevation to the Containment Air Return fan pits. However, the sizing of the pit drain would be inadequate to remove all the containment spray which could have been funneled to the pits by the 3" curb surrounding the refueling canal and vessel area. The subsequent flooding of the fan pits following the actuation of containment spray in a LCOA sequence would render the Containment Air Return fans inoperable due to submersion.

Technical Specification 3.6.5.6 requires that two independent Containment Air Return and Hydrogen Skimmer Systems be operable in Modes 1 (Power Operation), 2 (Startup), 3 (Hot Standby), and 4 (Hot Shutdown). With both systems 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, reaching Hot Standby within the next 6 hours, Hot Shutdown within the following 6 hours, and Cold shutdown within the subsequent 24 hours.

DESCRIPTION OF INCIDENT

On January 14, 1987, NRC Region II contacted Duke Power about a TVA problem concerning Containment Air Return fan pit drainage. It was verified that the drains were included for McGuire and Catawba and advised the NRC of this on January 16, 1987. This review identified that valves were installed in the drain lines for both plants. Problem Investigation Reports (PIRs) were initiated to verify sizing of the drain lines to accommodate LOCA conditions and the existence of administrative controls for the drain valves.

On the afternoon of January 29, 1987, during review of McGuire design drawings, a 3" curb was identified around the refueling canal and reactor vessel area of 605' elevation. The purpose of the curb was apparently to prevent any supererogatory materials from falling into the areas below. That afternoon, a McGuire design drawing was found which indicated that a 6" curb device was installed to divert collected containment spray away from the Containment Air Return pit and back to the refueling canal area. Later that afternoon, personnel entered McGuire containment and found that the 6" curb was not in place. At approximately 1500 hours, it was requested that Catawba Health Physics (HP) look for curb devices installed in containment. HP found no curb device installed around the Containment Air Return fan pits.

On the morning of January 30, personnel verified that no curb devices to protect the Containment Air Return fan pits were identified on Catawba design drawings. From approximately 1200 hours to 1500 hours, personnel continued reviews to determine if any differences in McGuire and Catawba design existed to alleviate the necessity for the devices at Catawba. At 1610 hours, Technical Specification 3.0.3 was entered for Units 1 and 2, after discussions indicated that both trains of the Containment Air Return and Hydrogen Skimmer System could not be assured operable during a containment spray actuation. Unit 1 was operating at 100% power initially, and Unit 2 was shutdown and already in Mode 3 for non-related maintenance work.

Discretionary Enforcement was received at approximately 1700 hours. This allowed Unit 1 to remain in Mode 3 for an additional 9 hour period and Unit 2 to remain in Mode 3 for an additional 24 hours. at 1728 hours, notification of Unit 1 Unusual Event was made in accordance with procedure RP/0/B/5000/13, NRC Notification Requirements.

Unit 1 was shutdown at an initial rate of 17%/hour. The unit entered Mode 2 at 2230 hours and Mode 3 at 2235 hours on January 30, 1987.

Efforts to install 6" curb devices were initiated immediately following entry into Technical Specification 3.0.3. Exempt Variation Notices were issued on both units to install 6" steel angle to deflect collected spray away from the Containment Air Return Fan pits. Unit 1 installation was completed by 0915 hours on January 31. Technical Specification 3.0.3 was exited and the Unusual Event was secured at that time. Unit 2 installation was completed by 1625 hours on January 31, and Technical Specification 3.0.3 was exited at that time. Unit 2 entered Mode 1 at 1619 hours on that day, and Unit 2 entered Mode 1 at 1818 hours on February 1.

Unit 1 utilized 3 hours and 5 minutes of the additional 9 hours granted for Mode 3 by Discretionary Enforcement. Unit 2 utilized 10 hours and 15 minutes of the available 24 hours granted for Mode 3 by Discretionary Enforcement.

CONCLUSION

The need for a curb to prevent collected containment spray from entering the Containment Air Return fan pits and rendering the fans inoperable was recognized during the construction phase of the plant. Internal correspondence addressed the need for the curb in September, 1978. The Catawba design drawings were not revised accordingly, although the same correspondence apparently initiated the installation of the curbs at the McGuire plant. This incident is therefore assigned Cause Code B, Design, Manufacturing, Construction/Installation Deficiency.

Duke Power was contacted by TVA personnel in early January, 1987, concerning Duke's design of drain features for the Containment Air Return fan pits. Personnel verified the existence of drains for Catawba and McGuire and were satisfied at the time that the design was satisfactory. Further in-depth evaluation on January 30, 1987, identified the need for curbs as well.

This incident appears to be an isolated occurrence in which failure to install structural elements has led to equipment inoperability.

CORRECTIVE ACTION

IMMEDIATE

Duke Power personnel initiated Exempt Variation Notices to install curbs for Units 1 and 2.

SUBSEQUENT

(1) Curb installation was completed.

(2) Duke Power personnel was requested to identify those containment civil structures that perform passive safety functions.

PLANNED

(1) Based on review of information identified from the preceding corrective action, Duke Power personnel will ensure that appropriate procedures are available to verify that the passive safety structures are in place.

(2) Premode 4 Check Lists will be revised to ensure Containment Air Return Fan curbs are installed.

(3) A Standing Work Request will be originated to remove and reinstall Containment Air Return Fan curbs for refueling outages.

(4) The Standing Work Request concerning Containment Air Return Fan curbs will be placed into refueling schedules.

SAFETY EVALUATION

During the course of this incident, had an initiation of a postulated DBA taken place, containment spray falling anywhere but directly over the canal area would have been diverted into the Containment Air Return Fan (CARF) pit. The CARF pit drains are not sized to accommodate containment spray drainage from the entire operating deck area. Consequently, the CARF pits would have been filled with spray return within three minutes, and made the CARF's inoperable.

It is important to note that the CARF pit discharge isolation dampers would have opened long before the pit fills with spray return to the point of submerging the sampler actuators. The dampers open upon receipt of an Sp signal (after a 10 second time delay) when two permissives are received: (1) containment pressure is equal to 0.25 psig; and (2) differential pressure across the divider barrier is smaller than 0.5 psid. Differential pressure across the divider barrier disappears soon after initiation of a DBA. The LOTIC-1 model used to analyze peak containment pressure is used beginning 10 seconds into a DBA, and assumes that lower and upper containment pressure has been equalized. The opening of the CARF discharge isolation dampers provides a flowpath for natural circulation air flow.

The diverting of spray return from the operating deck to the CARF pit does not significantly affect sump inventory. The capacity of the CARF pit and the operating deck (below the curbs around the refueling canal) is 40,000 gallons. Containment sump capacity is 800,000 gallons. A ratio of these two values yields only a 5% reduction in containment sump capacity due to the missing CARF pit curbs.

CARF inoperability affects the forced air return assumed for the accident analysis, and consequently affects flow rate through the ice condenser, a change in containment peak pressure during a postulated DBA was considered.

Design basis containment analyses can be divided into two categories: 1) Short term (0-10 seconds) analyzed with TMD Computer Model; and 2) Long term (10 + seconds) analyzed with LOTIC-1.

The CARF's are actuated at 9 $\pm$ 1 minutes (10 minutes assumed in analyses) so only the long term analyses with limiting condition after this time are affected.

Long term analyses include: 1) Peak containment temperature; 2) Peak reverse differential pressure (upper greater than lower); 3) Minimum containment pressure; and 4) Peak containment pressure.

The performed analysis yield the following results.

	TIME OF LIMITING CONDITION (seconds)
Peak containment temperature	127
Peak reverse differential pressure	50
Minimum containment pressure	100
Peak containment pressure	6920

The peak containment pressure analysis is in the FSAR Section 6.2.1.1.3.1. Changes from the latest FSAR analyses include: 1) Revised heat sink data; 2) Increased auxiliary containment spray flow; 3) Increased ice mass; 4) Decreased service water temperature; 5) Increased service water flows; and 6) Increased heat exchanger fouling.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Catawba Nuclear Station, Unit 1	0 5 0 0 0 4 1 3	8 7	— 0 0 5	— 0 2	0 6 OF 0 7

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

Change No. 1 is from a recent update of a late 1970's update --- unrelated to CARF inoperability. Change No. 2 is based on McGuire startup tests --- unrelated to CARF inoperability. Changes No. 3-6 are the worst historical observed values during the inoperability period. The results yield a Catawba peak pressure of 13.9 psig.

The acceptance criteria for the integrated leak rate test (Technical Specification 4.6.1.1) is 14.68 psig for Catawba. Therefore, peak pressure is within acceptance criteria.

The analysis used to determine containment peak pressure in a postulated DBA uses a natural circulation air return from upper to lower containment until the CARF is actuated, and then increases air return by a step change equal to the design flow of the CARF's. In the analysis for containment peak pressure without the CARF's. In the analysis for containment peak pressure without the CARF's, the same code was used, but no step change is assumed at the time the CARF's are supposed to be started.

Because the effectiveness of the containment spray system depends on a well-mixed containment atmosphere, the iodine removal capability of the sprays is less efficient without VX flow. However, no credit for iodine removal by containment sprays was taken in the design basis LOCA analysis.

For dose calculation purposes, Standard Review Plan 6.5.4 requires that VX flow be available in order to take credit for iodine scrubbing by the ice beds. Iodine removal credit by the ice condenser was assumed in the design basis LOCA analysis. To address CARF operability concerns, the off-site dose consequences were evaluated assuming no iodine removal by the ice-beds. Calculation results indicate that without the ice condenser credit, off-site doses would still be within acceptable values.

Westinghouse analysis indicates that containment peak pressure would be within the acceptance criteria. Therefore, the assumed leakage rate of 0.2% per day for off-site dose calculations is still valid, as leakage is a function of pressure. The Catawba allowed Technical Specification leakage rate is 0.2% per day, and an action statement is entered when leakage exceeds 75% of this value. With respect to the off-site dose analysis, as stated earlier, no credit was assumed for iodine removal by the ice beds because of the absence of forced circulation. In reality, there will be some iodine removal by the ice bed due to natural circulation air flow. Therefore, the offsite dose analysis is conservative.

10 CFR 50.46 requires, among other things, that the amount of fuel element cladding that chemically reacts with water or steam does not exceed 1% of the total amount of zircaloy in the reactor. In accordance with this requirement, the Catawba design analysis indicates that the total metal/water reaction is less than 0.3% for all breaks. The Standard Review Plan, NUREG-0800, requires that the hydrogen control and mitigation systems be designed for five times the amount of hydrogen yielded by the FSAR analysis of a DBA assuming at least one train of ECCS is operable. Catawba was reviewed against NUREG-0800.

As stated in NUREG-0800, a lower flammability limit of 4 volume percent hydrogen in air or air-steam atmospheres is well established and is adequately conservative. Based on the preceeding mechanistic analysis of hydrogen production in a postulated DBA, with no hydrogen control measures at all, it would be approximately 8 days before the lower flammability limit was exceeded. With only one hydrogen recombiner operable on day 2, the hydrogen concentration never exceeds two percent.

In the hydrogen mixing study performed by Westinghouse, the only flow assumed was from the operation of one hydrogen skimmer fan. The operability of the hydrogen skimmer fans was not affected by this incident. Additional conservatism is provided by the skimmer fan flow rate, which is approximately a factor of 2 greater that the calculated flow requirement. Hence, the operation of one skimmer fan is sufficient to perform the post-LOCA hydrogen mixing function.

The Westinghouse hydrogen mixing study also assumed no credit for blowdown induced turbulence or natural convection. Realistically, it should be noted that results of the EPRI study, "Hydrogen Mixing and Distribution in Containment Atmospheres", EPRI NP-2669, indicate that the jet effect due to a LOCA and natural convection is quite effective at mixing the lower containment volume. The report indicates that the concentration difference between measuring locations was less than one volume percent within 20 minutes after stopping the hydrogen jet for all cases.

Adequate mixing would take place in upper containment due to the following: 1) the hydrogen skimmer fans take suction from the steam generator, pressurizer, accumulator, fan room, and incore instrument room areas, and discharge 4260 CFM each at the hydrogen recombiners in upper containment; and 2) the entire containment air volume would "turn-over" in approximately four hours due to natural circulation.

The following hydrogen control and mitigation measures may be used after a postulated DBA: 1) Hydrogen Recombiners; 2) Glow Plugs; and 3) The Containment Hydrogen Purge System.

While the use of the Containment Hydrogen Purge System would cause a change in off-site dose, the use of this system by the operations group is a last resort, and it is a backup system, not required for hydrogen control in the safety analysis. It also should be noted that this system discharges into the annulus, and the annulus volume is filtered for radioactive particulate matter and iodine prior to release.

In conclusion, the CARF inoperability did not in any way increase the probability of a DBA, nor would it have affected actual core conditions or created an event that lead to degraded core conditions. The CARF design is a defence-in-depth concept for hydrogen control. This incident is reportable pursuant to Unit 1 - 10 CFR 50.73, Section (a)(2)(i)(A) and Unit 2 - 10 CFR 50.73 (a)(2)(vii)(D).

The health and safety of the public were not affected by this incident.

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VICE PRESIDENT
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September 9, 1987

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

Subject: Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413 and 50-414
LER 413/87-05-002 (Revision 2)

Gentlemen:

Pursuant to 10 CFR 50.73 Section (a) (1) and (d), attached is Licensee Event Report 413/87-05-002 concerning Unit shutdowns required due to design deficiency with Containment Air Return and Hydrogen Skimmer System. This event was considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker /mr

Hal B. Tucker

JGT/126/sbn

Attachment

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