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A Duke Energy Company

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December 15, 1999

U. S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Duke Energy Corporation
Catawba Nuclear Station Unit 1
Docket No. 50-413
Licensee Event Report 413/99-008 Revision 2

Attached please find Licensee Event Report 413/99-008 Revision 2, entitled "Operation Prohibited by Technical Specification 3.5.2 Due to an Inoperable Centrifugal Charging Pump and Operation Prohibited by Technical Specification 3.7.12 Due to Inadequate Control of the Auxiliary Building Filtered Ventilation Exhaust System Pressure Boundary".

The only commitments identified in this report are those listed in the "Planned Corrective Actions" section. There are no additional commitments identified in Revision 2. Questions regarding this Licensee Event Report should be directed to J. W. Glenn at (803) 831-3051.

Sincerely,

G. R. Peterson

Attachment

IE22

PDR ADOCK 05000413

xc:

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1. NRC FORM 366
U.S. NUCLEAR REGULATORY COMMISSION
(4-95)

# LICENSEE EVENT REPORT (LER)

APPROVED OMD NO. 3150-0104
EXPIRES: 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE (3) |
|---|---|---|
| Catawba Nuclear Station Unit 1 | 05000413 | 1 of 10 |

TITLE (4)
Operation Prohibited by Technical Specification 3.5.2 Due to an Inoperable Centrifugal Charging Pump and Operation Prohibited by Technical Specification 3.7.12 Due to Inadequate Control of the Auxiliary Building Filtered Ventilation Exhaust System Pressure Boundary

| 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 NAME | DOCKET NUMBER(S) |
| 6 | 10 | 1999 | 1999 | - 008 | - 02 | 12 | 09 | 1999 | | |

| 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) | 100 | | 20.2201(b) | | 20.2203(a)(2)(v) | x | 50.73(a)(2)(i) | | 50.73(a)(2)(viii) |
| | | | 20.2203(a)(1) | | 20.2203(a)(3)(i) | | 50.73(a)(2)(ii) | | 50.73(a)(2)(x) |
| | | | 20.2203(a)(2)(i) | | 20.2203(a)(3)(ii) | | 50.73(a)(2)(iii) | | 73.71 |
| | | | 20.2203(a)(2)(ii) | | 20.2203(a)(4) | | 50.73(a)(2)(iv) | | OTHER (Specify in Abstract below and in Text, NRC Form 366A) |
| | | | 20.2203(a)(2)(iii) | | 50.36(c)(1) | | 50.73(a)(2)(v) | | |
| | | | 20.2203(a)(2)(iv) | x | 50.36(c)(2) | | 50.73(a)(2)(vii) | | |

LICENSEE CONTACT FOR THIS LER (12)

| NAME | TELEPHONE NUMBER |
|---|---|
| | AREA CODE |
| J.W. Glenn, Regulatory Compliance | (803) 831-3051 |

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

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX | | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| Unk | CB | Pump | Pacific | Yes | | | | | | | |

| SUPPLEMENTAL REPORT EXPECTED (14) | | | EXPECTED | MONTH | DAY | YEAR |
|---|---|---|---|---|---|---|
| | YES (If yes, complete EXPECTED SUBMISSION DATE) | x NO | SUBMISSION DATE (15) | | | |


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

On June 8, 1999 at 2350 hours Centrifugal Charging Pump 1B (CCP 1B) failed. On June 11, 1999 at 2350 hours with Unit 1 operating in Mode 1, Power Operation at 100% power, Technical Specification 3.5.2 (ECCS - Operating) was violated when repairs to CCP 1B were not completed within the 72 hour allowable outage time. It had been foreseen that the pump repair could not be completed within 72 hours and a Notice of Enforcement Discretion (NOED) had been obtained to extend the allowable outage time to seven days. On June 10, 1999 at 0000 hours with Unit 1 operating in Mode 1, the doors to the pump room were propped open to allow installation of a temporary ventilation duct. This resulted in operation prohibited by Technical Specification 3.7.12 (Auxiliary Building Filtered Ventilation Exhaust) since the open doors were a breach of the ventilation system pressure boundary. Corrective actions for the pump problem included replacing the pump rotating element. The root cause of the pump failure will be addressed as a long term corrective action. The root cause of the ventilation system breach was that workers were not aware of the significance of opening the pump room door for an extended period due to unclear management expectations. Corrective actions include labeling plant doors to warn workers of the significance of opening the door and communicating the method of identification to plant personnel.

Background

Catawba Nuclear Station Unit 1 is a four loop Westinghouse Pressurized Water Reactor. Unit 1 operated in Mode 1 "Power Operation" during this event.

During normal system operation, the Chemical and Volume Control System [EIIS:CB] provides high pressure charging to the Reactor Coolant System [EIIS:AB]. It also provides seal water to the Reactor Coolant Pump seals [EIIS:SEAL]. The system provides chemical control, purification, and makeup for the Reactor Coolant System.

The accident mitigation function of the system is to provide high pressure injection and recirculation of borated water to the Reactor Coolant System as a part of the Emergency Core Cooling System (ECCS). During a design basis accident the system is isolated except for the Centrifugal Charging Pumps, the injection flowpath to the Reactor Coolant System, and the Reactor Coolant Pump Seal injection flowpath.

The Chemical and Volume Control System includes two train related Centrifugal Charging Pumps [EIIS:P]. These pumps were manufactured by Dresser Pacific Pumps. The pumps are "barrel pumps." They are unique in that the internal element contains both rotating and fixed portions which are pinned to the casing. The pump casing acts as a pressure boundary only, and has a negligible effect on the hydraulic characteristics of the pump. When the internal assembly is built and tested by the vendor in a test casing, it will perform exactly as it performs installed in another casing. The internal element includes the pump shaft, rotating impellers, fixed diffusers and intermediate covers. The main hydraulics are all internal to the pump element and there is no interaction with the volute formed by the pump casing, as there would be in a single stage open impeller pump. Each pump is located in a separate pump room on the 543 foot elevation of the Auxiliary Building with access doors on that elevation and an access hatch above the room.

Technical Specification 3.5.2 (ECCS-Operating) requires two operable ECCS Trains. With one or more trains inoperable and at least 100% of the ECCS flow equivalent to a single operable ECCS train available, the Technical Specification allows 72 hours to restore operability or the Unit must be placed in Mode 3 within 6 hours and in Mode 4 within 12 hours.

Valve [EIIS:FCV] 1NV294 "Centrifugal Charging Pump A and B Discharge Flow Control Valve" controls the amount of high pressure charging flow to the

Reactor Coolant System. Valve 1NV309 "Seal Water Injection Flow" maintains sufficient backpressure on the charging header to ensure adequate seal water injection flow to the Reactor Coolant Pump seals.

The Auxiliary Building Filtered Ventilation Exhaust System [EIIS:VF] normally filters air exhausted from all potentially contaminated areas of the Auxiliary Building [EIIS:NF]. This includes the ECCS Pump Rooms and other parts of the Auxiliary Building. The Auxiliary Building Filtered Ventilation Exhaust System in conjunction with other systems provides ventilation for these areas of the Auxiliary Building. Upon receipt of an Engineered Safety Features Actuation Signal (ESFAS), the Auxiliary Building Filtered Ventilation Exhaust System exhausts air from the ECCS Pump Rooms while the other areas of the Auxiliary Building are isolated.

Technical Specification 3.7.12 (Auxiliary Building Filtered Ventilation Exhaust System) requires two operable trains. Surveillance Requirement 3.7.12.4 verifies that one train of ABFVES can maintain the ECCS Pump Rooms at negative pressure relative to adjacent areas.

The Nuclear Service Water System provides cooling to the Component Cooling System which provides cooling to the CCP Pump Motor Heat Exchanger. The A Train of Nuclear Service Water was inoperable at the beginning of this event. Since the B Train Centrifugal Charging failed, there was confusion which caused an incorrect entry into Technical Specification 3.0.3.

This event is being reported pursuant to 10CFR50.73(a)(2)(i)(B) (Operation prohibited by Technical Specification).

The design of the CCPs as explained above allows for a "single point" pump test as a post maintenance test. Due to the unique design features inherent in the "barrel pump" design, the certified curve is highly reliable in assuring that the repaired pump will perform in the range required to perform within safety analysis limits, and is considered to be bounded in the existing calculation "Safety Injection Flows for Safety Analysis". This ensures that SR 3.5.2.7 is met and that the throttle valve position previously demonstrated acceptable for CCP 1B is also acceptable for the replacement CCP 1B Pump element. Both runout and minimum ECCS injection flows have been demonstrated within acceptable limits specified in the safety analysis. The replacement element is also bounded by existing "strong pump-weak pump interaction" as required by NRC Generic Letter 88-04.

Event Description

6-8-1999 2045 Control Room Operators noticed the 1B Reactor Coolant System Seal Water Injection Filter differential pressure increasing rapidly to 45 psid. Operators swapped seal water injection filters from 1B to 1A. Pressurizer level began decreasing slowly. Valve 1NV294 was full open to restore pressurizer level. Valve 1NV309 did not change position in response to 1NV294 going full open. The expected response would be for 1NV309 to open some amount to ensure that seal injection flow would not increase uncontrollably. 1NV309 and 1NV294 were taken to manual and 1NV309 was opened slightly to stabilize pressurizer level. Pressurizer level was 49%.

6-8-1999 2217 Operators swapped Centrifugal Charging Pumps (CCP) from CCP 1B to CCP 1A because CCP 1B was showing a discharge pressure decrease of approximately 70 psig. Once CCP 1A was placed in service, system parameters (flow, pressure, seal flow, Volume Control Tank level trends, pressurizer level trends) returned to normal. Operations began an investigation to determine why CCP 1B was performing erratically.

6-8-1999 2227 Valve 1NV309 was returned to automatic control.

6-8-1999 2251 Valve 1NV294 was returned to automatic control.

6-8-1999 2320 The CCP 1B was declared inoperable and placed in the Technical Specification Action Item Log. Since Train A of Nuclear Service Water was inoperable, Unit 1 entered Technical Specification 3.0.3. (Later it was determined the entry into Technical Specification 3.0.3 was not required because the applicable Technical Specification was 3.8.1 Action B2 which allows 4 hours to correct the problem).

6-9-1999 0020 Operations commenced Unit 1 shutdown.

6-9-1999 0029 After decreasing power 1.5%, Train A of Nuclear Service Water was declared operable due to the successful completion of the Nuclear Service Water Train "A" flow

balance following replacement of the Nuclear Service Water Pump 1A motor. Unit 1 exited Technical Specification 3.0.3 and entered the 72 hour Action Statement for one inoperable train of Centrifugal Charging.

6-9-1999 0214 Tags were placed on CCP 1B.

6-9-1999 0700 Planners began planning Work Order 98169081-01 for repair of CCP 1B. The planning was done with the understanding that the plant would be shutdown for the repair since it was known that the repair would take longer than 72 hours. Therefore, no compensatory action for opening the pump room door was included in the work plan.

6-9-1999 0800 Since pump repairs were projected to take longer than 72 hours, the decision was made to pursue a Notice of Enforcement Discretion (NOED) from the NRC.

6-9-1999 1900 Repairs to CCP 1B began.

6-10-1999 ~0000 The maintenance work coordinator was concerned about the crews safety since the room was hot (98 degrees F.) and the crew was wearing anti-contamination clothing. A portable cooling unit was brought to the area and a flexible ventilation duct was extended from the cooling unit through the pump room doors and into the room. Unknown to the technicians, this caused a breach in the Auxiliary Building Filtered Ventilation Exhaust System boundary and made both trains of Auxiliary Building Filtered Ventilation Exhaust inoperable.

6-10-1999 0930 During a plant walkdown, the NRC Senior Resident Inspector noted that the pump room door was propped open.

6-10-1999 1430 During a Plant Operations Review Committee Meeting a NOED request/justification was being discussed. The NOED would extend the allowable outage time for Technical Specification 3.5.2 (ECCS Operating) from 72 hours to seven days. It was mentioned that

Technical Specification 3.7.12 (Auxiliary Building Filtered Ventilation Exhaust System) would be included in the NOED since the pump room ventilation boundary would be affected. The NRC Senior Resident who was present at the meeting stated the pump room door was open when he was in the area that morning.

6-10-1999 1455 Maintenance removed the flexible duct and the pump room door was closed.

6-10-1999 2119 The NRC granted the NOED covering Technical Specification 3.5.2 (extending the allowable outage time from 72 hours to seven days). The NOED also covered Technical Specification 3.7.12. It allowed the removal under a Compensatory Action of the CCP 1B Room hatch which is an Auxiliary Building Filtered Ventilation Exhaust System boundary. Per the NOED the hatch could be removed for up to ten hours. A compensatory action associated with the NOED was to station a dedicated individual at the pump room door if the door was secured open. Since a dedicated individual was not available, the door was not opened.

6-11-1999 0106 The CCP 1B Room hatch was removed beginning the ten hour time period.

6-11-1999 0113 Auxiliary Building Ventilation Boundary for CCP 1B Room was entered in TSAIL.

6-11-1999 0645 The CCP 1B Room hatch was replaced.

6-11-1999 Day Shift The doors to the CCP 1B Room were opened and the ventilation duct was reinstalled. The required dedicated individual was in place as required by the compensatory action.

6-11-1999 2320 Technical Specification 3.5.2 was violated when the 72 hour action statement expired.

6-13-1999 0130 Maintenance completed work on CCP 1B.

6-13-1999 0358 Operations completed the fill and vent of CCP 1B.

6-13-1999 1704 Maintenance completed alignment of CCP 1B.

6-14-1999 0005 IWP Testing of the CCP 1B was completed.

6-14-1999 0400 CCP 1B was declared operable. The pump was inoperable for 124 hours 40 minutes which was within the 168 hours allowed by the NOED.

Causal Factors

A failure investigation team was formed to determine the cause of the reduction in charging flow to the Reactor Coolant System. The team concluded that the cause of the problem was failure of CCP 1B. Initial inspection of the pump balance drum (rotating sleeve and stationary bushing) revealed that the sleeve was out of round. This is a result of wear to a condition where the maximum clearance was 35 percent greater than the maximum value allowed (0.020 inches). This geometry would have allowed a significant increase in the balance line flow, directly reducing pump performance.

There have been no similar failures in the previous twenty four months. A failure of CCP 2A occurred in 1988 and a failure of CCP 1B occurred in 1989. Prior to June 8, 1999, there were no indications that CCP 1B was about to fail (either from monitoring of pump vibration data and motor stator temperature, or from evaluation of previous pump tests). Performance data including pump vibration, hydraulic parameters, temperatures and visual inspections all indicate that the other three Centrifugal Charging Pumps (1A, 2A, 2B) are functioning properly with no indications suggesting a problem such as that experienced on CCP 1B. This includes observations during IST testing as well as in-service and standby readiness data collection and Engineering and Maintenance walkdowns.

Operator Aid Computer (OAC) alarms on the motor stator will be significantly tightened from the generic 257 degrees F. to values appropriate to the individual pump.

The wear of the balance drum and other observations from detailed inspection will more specifically identify the failure scenario of this pump. A detailed tear-down inspection will be performed to capture all failure evidence. Descriptions of this process are available in records of other industry failures of these pumps. This pump failure appears to be similar

to others that have occurred, including the previous CCP 1B failure that occurred in 1989.

This failure is EPIX reportable.

A root cause team investigation was conducted to determine why the pump room door was propped open for an extended period. The team concluded that workers were not aware of the effect opening the door would have on the Auxiliary Building Filtered Exhaust System. Workers were found to be generally aware that compensatory actions are necessary for opening doors that serve as fire barriers or security barriers. Workers were also aware that compensatory actions are necessary for removal of hatches. Workers were not generally aware that compensatory actions may also be required when doors serve other design functions such as ventilation boundaries, tornado missile barriers, tornado pressure barriers, environmental qualification zone dividers, and carbon dioxide fire suppression zone barriers.

Workers are not expected to know the effect opening plant doors might have on these various design functions. In the past management expectations have not been clear on how workers should be informed of the need for compensatory actions when doors must be propped open. Although some plant doors are labeled, door labeling has not been adequate to prevent this type problem from occurring. One method of controlling when doors are propped open would be to have workers contact the Work Control Center before propping a door open. This expectation has not been clearly communicated to the work force.

Two factors that contributed to this particular event were:

1. Work on large ECCS pumps is almost exclusively performed during outages when the requirements of Technical Specification 3.7.12 do not apply. When pump work is performed during outages, workers normally use portable cooling units with a flexible ventilation duct routed through both doors leading to the pump rooms. No one realized that the work practice used in outages was not appropriate when the pump work was performed with the plant in Mode 1.
2. During the planning process and work order approval process, planners were not aware that the door would be propped open with the plant in Modes 1-4; therefore, the need for a compensatory action was not identified on the Work Order.

A review of significant events for the past twenty four months shows no similar events, therefore this event is not recurring.

Corrective Actions

Immediate

1. Operators swapped to CCP 1A and system parameters returned to normal.

2. The CCP 1B Pump Room door was closed.

Subsequent

1. Repairs and testing were completed on CCP 1B.

2. A site wide communication was given indicating that Auxiliary Building doors and doors in the Nuclear Service Water Pump Structure are not to be propped open unless the Work Control Center is notified beforehand. A sign was placed at the Single Point Access to the Auxiliary Building stating this expectation.

3. Labels were placed on ECCS Pump Room Doors of both Units stating not to prop the doors open.

Planned

1. A complete flow test of CCP 1B will be performed during the first outage opportunity which facilitates full flow testing.

2. A failure analysis will be performed on the defective pump rotating element and the need for further corrective actions will be evaluated.

3. Appropriate Operator Aid Computer monitoring for the CCPs will be added.

4. Easily noticeable labels will be installed on doors that require compensatory actions. The labels will indicate that action is necessary before securing the doors open.

5. Doors in the Auxiliary Building and Nuclear Service Water Pump Structure that have not been previously evaluated for compensatory actions will be reviewed to determine which ones require compensatory actions. These doors will be labeled as required. Appropriate administrative

controls will be developed and implemented.

6. When door labeling has been completed, station personnel will be trained on the meaning of the labels and the proper actions to take when securing doors open.

Safety Analysis

The inoperability of CCP 1B was evaluated through a probabilistic risk analysis. This analysis shows that for the duration of the CCP 1B inoperability (approximately six days), the increase in Core Damage Frequency (CDF) was approximately 4E-8. This change is considered very small and is below the precursor value. The increase is small due in part to the short duration of the inoperability and the ability to supply reactor coolant pump seal cooling from the Standby Shutdown Facility.

The effect on Large Early Release Frequency (LERF) was also evaluated. The accident sequences associated with a train of Centrifugal Charging in maintenance do not contribute significantly to the plant damage states that are associated with LERF. Therefore, the effect on LERF is very small.

It was determined that the breaching of the CCP 1B Room pressure boundary and the resultant effect on performance of the Auxiliary Building Filtered Ventilation Exhaust System has no effect on either the CDF or the LERF.

During the maintenance activities on CCP 1B when the ventilation system boundary was breached, the CCP 1B was isolated. Therefore the potential of significant leakage of containment sump fluids was eliminated.

All other ECCS Pumps were operable during the time when CCP 1B was inoperable, therefore full flow ECCS capability was available.

This event had no effect on the health and safety of the public.