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August 30, 1989

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

Subject: Catawba Nuclear Station
Docket No. 50-414
LER 414/89-17

Gentlemen:

Attached is Licensee Event Report 414/89-17, concerning Technical Specification violation due to turbine driven auxiliary feedwater pump control valve stem corrosion.

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

Very truly yours,

Tony B. Owen
Station Manager

KEB\LER-NRC.TBO

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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)
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TITLE (4) Potential Technical Specification Violation Due to Inoperability of the Turbine Driven Auxiliary Feedwater Pump Due to Control Valve Stem Corrosion

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)
									N/A	0 5 0 0 0
0 7	3 1	8 9	8 9	0 1 7	0 0	0 8	3 0	8 9		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 1 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)	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
R.M. Glover, Compliance Manager	8 0 3 — 8 3 1 — 3 2 3 6

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	
X	B A	V	T 1 4 7	Y							
B	S A	V	K 0 8 5	Y							

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

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

On July 31, 1989, at 1310 hours, with Unit 2 in Mode 1, Power Operation, during monthly surveillance testing on the Unit 2 Turbine Driven Auxiliary Feedwater (CA) Pump (CAPT), the turbine repetitively tripped on mechanical overspeed. The turbine control valve linkage was manually exercised, and the subsequent pump start was successful. On August 7, 1989, at 0950 hours, with Unit 2 in Mode 1, the Unit 2 CAPT tripped on electrical overspeed during a pre-maintenance test start at maximum speed. Disassembly and inspection of the control valve and linkage revealed that pitting and corrosion on the control valve stem and packing washers were causing excessive friction during movement. The valve stem, packing, and washers were replaced and the control linkage was cleaned and relubricated. Post-maintenance testing of the Unit 2 CAPT at maximum speed was successful. Between July 31, when the turbine was returned to service after initially tripping on mechanical overspeed, and August 7, when the root cause of the trips was identified, the ability of the Unit 2 CAPT to respond to an automatic start signal without operator action is questionable. Since the pump was capable of performing its intended safety function on July 31, 1989, (as evidenced by successfully completing the performance test) and tripped a week later in a pre-maintenance test, the actual date of inoperability cannot be determined. However, the work done on the CAPT was outside of the station's programs for ensuring operability. Thus, this report is submitted as a potential Technical Specification violation under 10CFR50.73, Section (a)(2)(i)(b).

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

BACKGROUND

The Auxiliary Feedwater [EIIS:BA] (CA) System assures a reliable source of feedwater tc the Steam Generators [EIIS:HX] (S/G) for decay heat removal. The CA System is independent on each Unit. There are two motor driven pumps [EIIS:P] and one turbine driven pump on each Unit. Each pump is capable of supplying 100% of the required feedwater flow to return the plant to a stable condition following a Reactor trip. Normal alignment is for the CA pumps to take suction from the Auxiliary Feedwater Condensate Storage Tank [EIIS:ACC] (CACST) and the Upper Surge Tank (UST) and discharge to the S/Gs.

The Turbine Driven CA Pump (CAPT) has a variable speed control [EIIS:65] with mechanical and electrical overspeed protection. Normal operating speed at the maximum speed control setting is 3650 rpm. The overspeed protection will trip the turbine [EIIS:TRB] at 4150 rpm at the electrical trip setpoint, and at 4500 rpm at the mechanical trip setpoint.

Technical Specification 3.7.1.2, Auxiliary Feedwater System, requires that all three pumps in the CA System be operable in Mode 1, Power Operation, Mode 2, Startup, and Mode 3, Hot Standby. If the Limiting Condition of Operation cannot be met, with one pump out of service, that pump must be returned to service within 72 hours. If one pump is out of service for more than 72 hours or if a second pump is removed from service, the Unit must be in at least Mode 3, Hct Standby, within the next six hours, and in Mode 4, Hot Shutdown, within the following six hours.

The Motor Driven CA Pumps are Bingham type MSD-E, Ten Stage Single Suction Double Volute Pumps. The Turbine Driven CA Pump is a Bingham type MSD-D, Seven Stage Double Suction Double Volute Pump. The CA Pump Turbine is a Terry Corporation type GS-2N turbine. The Speed Control Governor is a Woodward type PG-PL Mechanical Hydraulic governor.

EVENT DESCRIPTION

On July 31, 1989, at 1230 hours, with Unit 2 in Mode 1, PT/2/A/4250/06, CA Pump Head and Valve Verification, was initiated for monthly surveillance testing of the Unit 2 CAPT. The CA System was aligned for the Unit 2 CAPT to take suction from the UST and discharge to the UST Dome. The CAPT Speed Control was set to minimum speed per the procedure. At 1310 hours, the Unit 2 CAPT tripped on mechanical overspeed on an attempted start. An immediate attempt at a second start of the Unit 2 CAPT was also unsuccessful. A Maintenance Engineering Services (MES) Engineer was contacted, and, at 1320 hours, a third start attempt was made with an MES Engineer, an Operations Engineer, and a Maintenance Planner observing the pump. Again, the pump tripped on mechanical overspeed and it was observed that the linkage did not move. The CAPT control valve linkage was then manually exercised to check the freedom of movement. At 1325 hours, the Unit 2 CAPT was started, the linkage responded to control turbine speed, and

successfully met the requirements of the monthly surveillance test. A work request was not initiated when the turbine trip occurred, and was not used in investigating the problem.

On August 1, 1989, at 0450 hours, the Unit 2 Motor Driven CA Pump 2B was removed from service to repair an oil leak on the bearing housing drain plugs. Repairs were complete and the pump was returned to service at 1500 hours.

On August 1, 1989, the MES Engineer met with an MES Engineering Supervisor and the MES Manager to evaluate the situation with the Unit 2 CAPT and determine what additional actions were necessary. Operability of the Unit 2 CAPT was discussed. It was the view of those individuals that the Unit 2 CAPT continued to be operable at this time. Past problems were reviewed taking into consideration present design, repair methods, procedures, and types of lubricants used. Of these aspects, the lubricant used on the control valve linkage was considered to be the major cause of the July 31 overspeed trips. It was determined that input from the equipment manufacturer would be beneficial. Attempts to contact the manufacturer at that time were unsuccessful.

On August 2, 1989, at 0300 hours, Nuclear Service Water [EIIS:BI] (RN) System Train B was removed from service for repairs. With RN Train B inoperable, both Unit 1 and Unit 2 Train B Diesel Generators [EIIS:GEN] were inoperable due to loss of RN cooling water. With the Diesel Generators inoperable, essential power could not be provided to the Unit 1 or Unit 2 CA Pump B, which were also considered to be inoperable. On August 4, 1989, at 2000 hours, RN repair work was complete and the CA Train B Pumps were returned to operable status.

On August 2, 1989, a Manufacturers Representative was contacted and recommended that a dry film lubricant be used on the control valve linkage instead of the paste lubricant presently used. The vendor concluded that this control valve and linkage were of the latest design. Work Requests 1514 MES and 1515 MES were written to disassemble and clean the linkage and to inspect the control valve stem for freedom of movement in both the Unit 1 and Unit 2 CAPTs, respectively.

On August 3, 1989, with RN Train B repairs still in progress and both Units' CA Pump B inoperable, inspection of the Unit 1 CAPT was scheduled for August 6, and the Unit 2 CAPT was scheduled for August 7. It was felt appropriate to wait and not take the CAPT out of service immediately since the lubricant was not a short term concern for operability. On August 4, restricted changes were made to OP/1,2/A/6150/02, Auxiliary Feedwater System, to perform starts on the CAPTs with the CAPT Speed Control set on maximum. Plans were made to perform test runs prior to working on the control valve linkage. Operations, Planning, Performance, and MES personnel met to insure all groups understood the inspection process.

On August 5, 1989, the Unit 1 CAPT successfully started with the speed control set on maximum. On August 6, 1989, the Unit 1 CAPT control valve linkage was disassembled, cleaned, relubricated with a dry film lubricant, and reassembled. The valve stem was manually stroked and moved freely without any signs of drag. On August 6, 1989, at 2300 hours, the post maintenance maximum speed start of the Unit 1 CAPT was successful.

On August 7, 1989, at 0950 hours, with Unit 2 in Mode 1, the Unit 2 CAPT tripped on electrical overspeed when started with the speed control set on maximum. During this start attempt, an MES Engineer observed that the control valve linkage did respond to the turbine start, but binding slowed the response causing the electrical overspeed trip. The electrical overspeed trip was reset and, at 1000 hours, a second start of the Unit 2 CAPT was successful. After securing the pump, linkage disassembly began and the control valve stem was observed to have excessive drag in the valve [EIIS:V] assembly. Work was expanded to include rebuilding the control valve. Reassembly was completed using a dry film lubricant and a high temperature grease on the control valve linkage.

On August 8, 1989, at 2140 hours, the Unit 2 CAPT was started to vent air from the servo valve. With the servo vented at 2200 hours, the Unit 2 CAPT successfully started at the maximum speed control setting. On August 9, 1989, at 1030 hours, after being at ambient condition for more than 12 hours, the Unit 2 CAPT was again successfully started with the speed control set on maximum.

CONCLUSION

This event is classified as an equipment failure based on the findings during the disassembly of the the Unit 2 CAPT control valve on August 8, 1989. During disassembly with the servo valve disconnected, more than 30 pounds of force was required to move the control valve and linkage to the closed position. With the linkage removed, the parts used to guide the valve stem movement were found to be worn and the valve stem did not travel smoothly within the valve assembly. After disassembly of the control valve, it was found that corrosion and pitting on the valve stem were preventing smooth travel through the packing area. The wear in the linkage is the result of excessive force required to move the stem. Valves 2SA2 and 2SA5, Main Steam Supply to the CAPT, have experienced seat leakage problems and condensate has collected in the CAPT control valve. Valve 2SA16 (CAPT Control Valve Stem Leakoff Drain) is a Kerotest Series 1500 Y-Type Globe valve that can easily become clogged and not allow adequate draining of the condensate from the control valve stem. The control valve bonnet is oriented with the stem leakoff drain connection horizontal and is not allowing condensate to drain from the lower half of the stem. The leaking steam supply valves, the drain orientation, and the drain valve have contributed to the corrosion and pitting of the control valve stem. With the stem replaced and the control valve and linkage reassembled, the force required to move the assembly was 7 pounds.

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

The mechanical overspeed trip of the Unit 2 CAPT on July 31, 1989, is a direct result of the control valve stem condition discovered on August 7, 1989, although it was not recognized at the time of occurrence. After three mechanical overspeed trips on July 31, the control valve linkage was mechanically exercised. The control valve stem then moved freely enough to achieve a successful start with the CAPT speed control set on minimum. On August 7, 1989, the turbine tripped on electrical overspeed when started with the speed control set on maximum, and then was successfully started with only a reset of the electrical trip mechanism. At the initial start of the CAPT with the control valve full open, the turbine speed increases rapidly until the control valve shuts sufficiently to control speed. The rate of speed increase and the rate of control valve closure is considered to be the same with the speed control set on minimum or maximum. Once the control valve is closed sufficiently, the speed of the turbine decreases and then adjusts to the control setting. All of the CAPT trips were on the initial speed increase of the turbine. The initial movement of the turbine and the increased temperature from the inlet steam during the first attempted start on August 7, 1989, decreased the friction between the control valve stem and packing enough for the second start attempt to be successful. The friction between the stem and packing was too great during the July 31, 1989, starts and the manual exercising of the linkage enhanced its movement.

The July 31, 1989, trips of the CAPT occurred during the monthly surveillance testing in accordance with PT/2/A/4250/06. The control valve linkage was manually exercised and the Unit 2 CAPT was successfully started, completing the surveillance test. A work request was not initiated to identify and document the action taken. Without a work request, consideration for root cause of the binding was not adequately evaluated. Reviewing the requirements with the Performance Engineer, PT/2/A/4250/03C, Turbine Driven Auxiliary Feedwater Pump #2 Performance Test, is used to verify the Turbine Driven CA Pump operating parameters on a quarterly basis and would not have been required for work on the control valve or linkage. Completion of PT/2/A/4250/06, used to verify the CAPT discharge pressure at the rated flow rate and speed, met the post maintenance testing requirements.

A contributing cause of this event was the failure to initiate a work request when the Unit 2 CAPT tripped during surveillance test on July 31, 1989. Station Directive 3.2.2, Development and Conduct of the Periodic Testing Program, requires that a work request be generated to resolve discrepancies encountered during surveillance testing. Without a work request, the normal process of evaluating equipment operability was not performed. Catawba Management philosophy expects that problem resolution be performed under the appropriate programs to ensure that underlying problems are identified and resolved and that an operationally reliable component is returned to service. In actuality, the Unit 2 CAPT operability was dependent on the rate of stem corrosion and the impact this corrosion would have on the control valve stem. With this consideration, the actual operability of the Unit 2 CAPT between July 31 and

August 7, 1989, cannot be determined. Had the Unit 2 CAPT become inoperable between August 1 and August 4, a Technical Specification violation would have occurred due to the Unit 2 CA Pump B being removed from service for repairs. If the corrosion developed such that a turbine trip would not have occurred until August 5 through August 6, a violation would not have resulted even with the CAPT being unknowingly inoperable. Since the actual date of operability is indeterminate, NUREG-1022 guidance would not require a report. However, since the work was performed outside of the work request program, the pump is considered potentially inoperable during the period and this report is submitted as a potential violation of Technical Specifications.

The CAPT control valve and linkage is an integral part of the Terry Steam Turbine, Model GS-2N, with a cam crank linkage. Review of the history of failures on both the Unit 1 and Unit 2 CAPTs revealed two prior occurrences of excessive control valve stem drag problems. Stem drag was corrected by Work Request 12931 OPS on the Unit 1 CAPT in November, 1984, and by Work Request 5257 MNT on the Unit 2 CAPT in February, 1988. The Unit 2 CAPT control valve was rebuilt in March, 1989, during the refueling outage at which time the stem was replaced. Valves 2SA2 and 2SA5 have been repaired for seat leakage during the past two refueling outages, with work requests presently outstanding for seat leakage. Valve 2SA2 has been replaced with a valve of the same design during this period in an attempt to correct the seat leakage problem. Review of the NPRDS data base for overspeed trips of CAPT control valve drag revealed only one other occurrence at other locations. LER 413/89-007, Failure of Turbine Driven Auxiliary Feedwater Pump Due to Stress Corrosion Cracking of the Final Stage Shaft Sleeve, addresses overspeed trips of the Unit 1 CAPT during post-maintenance testing. Turbine trips were due to steam leakage from the control valve packing onto the control valve linkage causing the linkage lubrication to be washed away and affecting the ability of the valve to control. Leakage from the packing was a result of a blocked valve stem leakoff drain valve, 1SA16. Although similar, the root cause of the Unit 1 CAPT overspeed trips are not the same as the recent Unit 2 CAPT problems. The incident described in this report is not considered to be a recurring event.

CORRECTIVE ACTION

SUBSEQUENT

1) MES Engineer and Operations Engineer observed CAPT start and manually exercised control linkage.

2) A Group meeting was held and a Manufacturers Representative was contacted.

3) The Unit 1 CAPT linkage was disassembled, cleaned, relubricated and rebuilt under Work Request 1514 MES. No problems with the control linkage or valve were observed.

4) The Unit 2 CAPT control valve and linkage were rebuilt under Work Request 1515 MES. The control valve stem and packing was replaced. The linkage was cleaned and relubricated.

5) Catawba Station Manager Staff Notes of August 17, 1989, emphasized to all Station employees the need to thoroughly evaluate root cause of failure, and provided a philsophy for performing root cause analysis.

PLANNED

1) The Control Valve Standing Work Requests and Maintenance Procedures are to be revised as follows:

   * Change the lubricant used on the control valve linkage from a paste lubricant to a high temperature grease.

   * Add a requirement to properly clean the linkage prior to applying the grease.

   * Add steps to disconnect the servo valve from the valve linkage and check for freedom of movement in the valve stem. Lack of movement will require action to determine cause.

2) The Unit 2 CAPT control valve will be disassembled and inspected to determine the rate at which pitting is occurring.

3) A Standing Work Request will be initiated to disassemble the control valve and linkage to inspect parts for wear during each refueling outage on Units 1 and 2.

4) The CAPTs control valve bonnets will be rotated and valve SA-16 will be removed to allow better drainage of the condensate from the control valve packing area.

5) A low point drain will be evaluated for addition to the steam supply line to the CAPTs.

6) The material used in construction of the control valve stem and packing will be evaluated to determine if more corrosive resistant material is available.

7) Unit 1 and Unit 2 valves SA2 and SA5 will be replaced to prevent excessive steam leakage from the Main Steam Header.

8) PT/1,2/A/4250/06 and OP/1,2/A/6250/02 will be revised to allow starts of the CAPTs from the cold condition at maximum speed during post-maintenance testing.

9) The Unit 1 CAPT governor valve will be disassembled to verify condition of the stem.

10) The need to be cautious in performing troubleshooting activities without a work request on equipment that may have followup retest requirements will be discussed with all appropriate personnel.

SAFETY ANALYSIS

Each Unit is equipped with three Auxiliary Feedwater pumps, each of which is capable of supplying more than 491 gpm condensate flow to any two Steam Generators. From the pre-maintenance testing and the disassembly inspection on August 7, the ability of the Unit 2 CAPT to start on an automatic actuation signal without Operator action is questionable. During the August 1 through 4 time period, CA Pump 2B was removed from service for about 75 hours. The action required by Technical Specification 3.7.1.2 for two CA pumps out of service was not taken because the condition of the Unit 2 CAPT was not realized until the August 7 inspection. FSAR Section 15.2.7, Loss of Normal Feedwater Flow, assumes only one operable CA pump is available to provide at least 492 gpm for a heat sink for the Reactor Coolant [EIIS:AB] System to attain Hot Shutdown condition with the Reactor Coolant System in natural recirculation. If the CAPT was operable during the entire July 31 through August 7 time period, a single failure rendering either the CAPT or CA Pump 2A inoperable would not have prevented adequate flow from reaching the Steam Generators to meet the CA System design basis. If the corrosion rate of the valve stem had been such as to have made the CAPT inoperable when CA Pump 2B was also out of service on August 1 through August 4, a single failure during an accident condition could render CA Pump 2A inoperable. If the CAPT then tripped on electrical overspeed, Operator action would have been required to initiate flow to the Steam Generators. However, since the CAPT tripped on electrical overspeed and could be reset and restarted from the Control Room (without dispatching an Operator directly to the pump), the time to reinitiate flow is minimal. Immediately following the August 7th trip, the second start attempt was made in ten minutes and was successful. It would be expected from a review of the Station Emergency Procedures that more expedient action would be taken in an actual emergency. The health and safety of the public were unaffected by this incident.