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April 14, 1993

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

Subject: Catawba Nuclear Station
Docket No. 50-413
LER 413/93-007

Gentlemen:

Attached is Licensee Event Report 413/93-007, concerning ENGINEERED SAFETY FEATURE ACTUATION DUE TO AN UNEXPECTED SYSTEM INTERACTION.

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

Very truly yours,

M. S. Tuckman /by William R. McCollum, Jr.

M. S. Tuckman

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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

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.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Catawba Nuclear Station, Unit 1	05000413	1 OF 06

TITLE (4)
Engineered Safety Feature Actuation Due To An Unexpected System Interaction

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									N/A	05000
03	15	93	93	-- 007 --	00	04	14	93	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	100	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
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		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 (Include Area Code)
R. C. Futrell, Compliance Manager	(803) 831-3665

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 15 single-spaced typewritten lines) (16)

On March 15, 1993, at 1501 hours, an unexpected Engineered Safety Feature (ESF) Actuation occurred on Unit 1 while in Mode 1, Power Operation. Upon receipt of a spurious signal, Auxiliary Feedwater (CA) System Motor Driven Pumps (MDP) 1A and 1B started simultaneously. The Steam Generator Blowdown (BB) system and the Steam Generator sampling portion of the Nuclear Sampling (NM) system isolated as designed. Component Engineering (CE) investigated this incident and determined that the spurious signal originated in the final output relays of the Anticipated Transient Without Scram (ATWS) Mitigation System Actuation Circuitry (AMSAC). Corrective action included securing the CA Motor Driven Pumps, realigning BB and NM valves, and the replacement of the two final output relays of the AMSAC system in Unit 2. Planned corrective action includes the replacement of the two final output relays in the Unit 1 AMSAC system during the next unit outage and a review to determine if Struthers-Dunn 219 type relays are used in other areas of the station which may be susceptible to high vibration.

BACKGROUND

The Main Feedwater [EIIS:SJ] (CF) system supplies feedwater to the four Steam Generators (S/Gs) [EIIS:HX] at the temperature, pressure, and flow required to maintain proper S/G water levels commensurate with reactor power output and turbine [EIIS:TRB] steam requirements. The CF system contains two 50% capacity variable speed turbine driven pumps [EIIS:P].

The Auxiliary Feedwater [EIIS:BA] (CA) system provides an assured source of emergency feedwater to the S/Gs during plant conditions when the CF system is not available. The CA system for each unit includes two motor driven pumps (MDP A and B), powered by separate and redundant safety related power supplies, and a steam powered turbine driven pump (TDP).

The CA MDP autostart signal is initiated from any one of the following conditions:

1) safety injection
2) loss of emergency bus power
3) low-low level in any S/G
4) both main feedwater pumps tripped
5) start signal from the Anticipated Transient Without Scram (ATWS) Mitigation System Actuation Circuitry (AMSAC)

During a CA autostart, the CA MDPs start, the CA discharge valves [EIIS:V] for each train fully open, and the S/G Blowdown [EIIS:WI] (BB) and Nuclear Sampling [EIIS:KN] (NM) systems isolate from the S/Gs.

AMSAC is a non-safety related control logic in addition to and separate from the Reactor Protection System [EIIS:JC] (RPS), used to ensure reactor cooling via the CA system in the event of an ATWS. An ATWS event is any condition causing an interruption of main feedwater to the S/Gs without the appropriate reactor scram. The AMSAC system is comprised of the necessary control components to detect an ATWS event and then provide the necessary actions to mitigate the event. AMSAC actuation occurs when either of two conditions exists. These conditions are both main feedwater pumps tripped or blockage of CF flow to the S/Gs due to inadvertent valve closure(s). Either event constitutes an interruption of normal feedwater flow to the S/Gs. On actuation, the AMSAC circuitry will perform the following:

1) trip the main turbine
2) start both CA MDPs
3) isolate the BB and NM systems from the S/Gs

Technical Specification (T/S) 3/4.3.2 states the instrumentation and interlock requirements for the Engineered Safety Features Actuation System (ESFAS). Per this T/S, the loss of CF main feedwater CA autostart circuitry during Mode 1 or Mode 2, Startup, requires that the unit be in at least Mode 3, Hot Shutdown, within six hours.

EVENT DESCRIPTION

On March 15, 1993, Unit 1 was operating in Mode 1, Power Operation, at 100% reactor power level. At approximately 1501 hours, a CA autostart signal was received. Both CA motor driven pumps started simultaneously and the BB and NM systems automatically isolated from the S/Gs.

At 1504 hours, Operations personnel reset the CA system valve control trains A and B and secured the A and B CA motor driven pumps after verifying that the CA autostart was inadvertent.

At 1506 hours, tempering flow to all S/Gs was realigned.

At 1532 hours, NM valves were realigned for S/G sampling.

At 1550 hours, the BB system was returned to normal operation.

The Station Compliance Manager, Duty Engineer, Duty Station Manager, and the Nuclear Regulatory Commission (NRC) were notified of the event. System Engineering (SE) and Component Engineering (CE) were notified to investigate the event. More Significant Event (MSE) 1-C93-0189 was written to document the CA autostart.

CONCLUSION

A CA autostart signal is initiated from any of the following conditions: safety injection, loss of emergency bus power, low-low level in any S/G, both main feedwater pumps tripped, or start signal from the AMSAC circuitry. Each of these initiating conditions, except for the AMSAC signal, are train related. A review of the Operator Aid Computer (OAC) data and the Events Recorder revealed no indication of an initiating event. By reviewing this information and station

drawings, CE determined that to receive a simultaneous autostart of both trains of the CA motor driven pumps that the autostart signal was initiated from the AMSAC circuitry.

CE also determined that no work activities were in progress which could have caused an actuation of the AMSAC circuitry.

An ATWS signal will energize the coils of the AMSAC final output relays and cause all contacts to close. This will cause a main turbine trip, annunciator alarms in the Control Room, and a simultaneous autostart of both trains of the CA motor driven pumps. The lack of an ATWS signal indicates that the MDP start was isolated to the CA autostart final output relay contacts and was of a spurious nature.

The final output relay contacts are suspected to be susceptible to contact chatter in a high vibration environment. The AMSAC cabinet is in a high vibration area adjacent to the CF main feedwater pumps. Work Order 92028220 was completed during 1992 to upgrade the AMSAC cabinet by performing several wiring changes and adding stiffeners to the cabinet to reduce vibration within the cabinet. This work was performed as a corrective action to Licensee Event Report (LER) 414/91-012, which involved a Design Deficiency in the AMSAC circuitry. Satisfactory results were obtained during post modification testing.

The final output relays are Struthers-Dunn, Part Number 219BBXP. Testing by CE on Struthers-Dunn relays using an accelerometer indicated that an induced force, specifically from a vertical orientation, can cause contact chatter. Due to a physical difference in the contacts, the CA autostart contacts are more prone to chatter than the annunciator or turbine trip contacts.

Bench testing was also performed on Cutler-Hammer, Part Number D26MRD70A1, relays. This testing indicated that these relays are significantly less prone to contact chatter than the Struthers-Dunn relays.

The root cause of this event has been attributed to an unanticipated interaction of systems or components. No evidence exists that the AMSAC cabinet may have been struck with a force which would have caused the CA contacts to chatter. One theory is that a transient through the Turbine Building [EIIS:NM] floor could have created a vertically oriented vibration which could have caused contact chatter. During the time frame of this event, Maintenance personnel were moving Unit 2 Condenser Circulating Water [EIIS:SG] System (RC) pump motors [EIIS:MO] with an overhead crane on the turbine deck directly above the AMSAC panels. These motors were being moved into this area to perform outage related maintenance. Movement or dropping

of heavy equipment creates the potential for a floor transient which may have caused a vertical force on the CA autostart contacts.

Corrective action to prevent recurrence involves the replacement of the Struthers-Dunn AMSAC final output relays with Cutler-Hammer relays. Testing has indicated that the Cutler-Hammer relays are significantly less susceptible to vibration or resonant frequency induced contact chatter. The relays in the Unit 2 AMSAC cabinet were replaced by Minor Modification CNCE-4060 while the unit was in Mode 5. Minor Modification CNCE-4061 has been initiated to replace the final output relays in the Unit 1 AMSAC cabinet. Since replacement of the relays will take longer than 6 hours to perform, which will place the Unit in an Action Statement per T/S 3/4.3.2 due to declaring the loss of CF main feedwater pump CA autostart circuitry inoperable, the Unit 1 modification will be performed at the next unscheduled outage of appropriate length or during the next refueling outage. Electrical Engineering will also perform a review to determine if Struthers-Dunn 219 type relays are used in other areas of the station which are susceptible to high vibration.

A review of the Operating Experience Program (OEP) database for the 24 months prior to this incident identified one other incident in which an unexpected AMSAC ESF actuation occurred. This incident was documented in LER 414/91-012 and was attributed to a functional Design Deficiency of the AMSAC circuitry and a Design Deficiency due to unanticipated environmental interaction. As stated previously, corrective action included changes in the AMSAC wiring and the addition of stiffeners to the cabinet. This incident involved a design deficiency which was internal to the cabinet in which a relay had excessive chatter when the Control Room AMSAC bypass pushbutton was depressed thus causing the final output relays to chatter and spuriously close. ESF actuation due to a spurious actuation of the AMSAC circuitry due to contact chatter is a recurring problem.

CORRECTIVE ACTION

SUBSEQUENT

1) Operations personnel reset the CA system valve control trains and secured the A and B CA motor driven pumps.

2) Operations personnel realigned the tempering flow to all S/Gs and realigned the BB and NM systems.

3) Minor Modification CNCE-4060 was performed to replace the two final output relays of the Unit 2 AMSAC system with Cutler-Hammer Part Number D26MRD70A1 relays.

PLANNED

1) Minor Modification CNCE-4061 will be scheduled and performed to replace the two final output relays of the Unit 1 AMSAC system with Cutler-Hammer Part Number D26MRD70A1 relays.

2) The Electrical Engineering Group will perform a review to determine if Struthers-Dunn 219 type relays are used in other areas of the station which are susceptible to high vibration.

SAFETY ANALYSIS

The inadvertent ESF actuation which caused the Unit 1 CA motor driven pumps to autostart was due to a spurious signal which affected the CA final output relays within the AMSAC circuitry. Upon receipt of the CA autostart signal, all systems operated as designed.

Control Room Operator response was proper. All systems were returned to their normal alignment after verification that the CA autostart was not due to an abnormal plant condition. Reactor response was as expected with only a slight decrease (approximately .2 degrees F) in Reactor Coolant [EIIS:AB] System (NC) average temperature.

The replacement of the Struthers-Dunn relays with Cutler-Hammer relays does not change any operating parameters, safety limits, or setpoints. No unreviewed safety questions are created by this change. The Cutler-Hammer relay is believed to be more reliable in a high vibration environment. There is no reason to suspect that the Struthers-Dunn relay would have failed to actuate in an actual ATWS situation. The outputs of AMSAC (downstream of these particular relays) are latched such that an AMSAC actuation, if received, could not be erroneously reset by contact chatter. This relay replacement only reduces the possibility of a spurious AMSAC actuation.

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