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February 7, 1991

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

Subject: Catawba Nuclear Station
Docket No. 50-414
LER 414/91-03

Gentlemen:

Attached is Licensee Event Report 414/91-03, concerning ESF ACTUATION DUE TO IMPROPER ISOLATION OF CONTROL FUNCTION DURING CORRECTIVE MAINTENANCE.

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

Very truly yours,

J. W. Hampton
Station Manager

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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)

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TITLE (4) ESF Actuation Due to Improper Isolation of Control Function During Corrective Maintenance

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 1 0	8 9	1 9 1	—	0 0 3	— 0 0	0 2	0 6	9 1		0 5 0 0 0

OPERATING MODE (9)	3	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0	20.402(b)	20.405(c)	X 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)	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
C. L. Hartzell, Compliance Manager	8 0 3 8 3 1 1 - 1 3 6 6 5

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 January 8, 1991, at 1626 hours, with Unit 2 in Mode 3, Hot Standby, Instrument and Electrical (IAE) technicians were performing corrective maintenance within the Unit 2 Main Feedwater pump (MFWP) control cabinets under direction of a Maintenance Engineering Services (MES) work plan. IAE technicians were placing a jumper to allow elimination of wiring that was not removed during a 1989 modification. An inadvertent initiation of the Auxiliary Feedwater System (CA) occurred when the technicians placed a jumper across terminals causing Train 'A' of the CA system logic to react as if both MFWP's had tripped. After determining the nature of the actuation, Operations terminated the event and returned the plant to normal Mode 3 conditions. Corrective maintenance was resumed and successfully completed after the mistake in circuit isolation was discovered. This event has been attributed to an Iappropriate Action due to a lack of attention to detail. Corrective actions for this event include a review/revision of the existing Independent Ve ification programs along with training for any revisions made.

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

BACKGROUND

The Anticipated Transients Without Scram (ATWS) requirement for light water nuclear plants was introduced to prevent over-pressurizing the Reactor Coolant [EIIS:AB] System in the event that an ATWS event occurs (loss of main feedwater pumps [EIIS:P], along with a Reactor Protection System [EIIS:JC] failure. The ATWS Mitigation System and Actuation System (AMSAC) circuit design for Catawba Nuclear Station is based on conditions that indicate a loss of main feedwater event. Inputs to AMSAC circuitry originate from pressure switches [EIIS:XIS] that monitor hydraulic control oil pressure to the main feedwater pumps (MFWP's) valves [EIIS:V] along with limit switches on feedwater regulating and control valves. Upon initiation of this circuit, 2 of 3 pressure switches < 75 PSI, or valves less than 25% open, will initiate auxiliary feedwater pump start, and isolation of steam generator [EIIS:HX] blowdown and sampling valves. AMSAC related pressure switches monitor MFWP conditions only and do not interface with the Reactor Protection System. The AMSAC circuitry is connected to a non-safety related DC power source and uses optical isolators [EIIS:XS] when interfacing with safety related circuits. This represents the desired separation of AMSAC and Reactor Protection System circuitry.

The Main Feedwater (CF) System supplies feedwater to the four Steam Generators (S/Gs) 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 (MFWP). The MFWP speed may be manually or automatically controlled. The MFWP's discharge through two stages of high pressure CF heaters [EIIS:HTR]. Then the feedwater divides into four CF lines, each supplying one of the four S/Gs. Each of the four CF lines contains a CF Control valve, a CF Control Bypass valve, two CF Check valves, and a CF Isolation valve. The CF Isolation valves function to terminate CF flow in either direction following a CF Isolation signal and also function to prevent or allow admission of feedwater to the S/Gs CF nozzles during various modes of operation. The CF Control Bypass valves normally are utilized to control CF flow up to approximately 15% load, and the CF Control valves are utilized to control CF flow from approximately 15% to 100% load. The CF Control valves are normally automatically controlled by the S/G Level Control system to maintain proper S/G levels.

The Auxiliary Feedwater [EIIS:BA] (CA) System provides an independent means of supplying feedwater to the S/Gs in addition to the CF System. The CA System functions to maintain secondary side water inventory sufficient to permit an orderly plant cooldown and to remove residual heat stored in the Reactor Coolant [EIIS:AB] (NC) System for the duration of all Design Basis Events. The CA System also provides condensate grade feedwater during normal Unit start-up and shutdown operations when use of the CF System at such low flow rates would be undesirable. The CA System contains two full capacity Motor [EIIS:MO] Driven Pumps and one full capacity Steam Turbine Driven Pump. Any of these pumps may be started manually or automatically. The Motor Driven Pumps are designed to start automatically when both CFPTs trip.

EVENT DESCRIPTION

On May 13, 1989, Nuclear Station Modification (NSM) CN-20346, which installed the AMSAC modification on Unit 2, was completed by the Construction Maintenance Department (CMD). Post modification testing was satisfactorily performed on the AMSAC circuitry.

On September 18, 1990, a ground fault was detected on auxiliary battery [EIIS:BTRY] bank 2CDA. Work request 11690IAE was initiated to investigate the problem.

On December 17, 1990, Unit 2 was in Mode 1, Power Operation, while the search for the 2CDA ground was in progress. I/AE found possible wiring discrepancies within 2TBOX0105 (CFPT2A), 2TBOX0108 (CFPT2B), and 2ELCP0093 (AMSAC) that could possibly be the source of the 2CDA ground problem. Maintenance Engineering Services (MES) was notified.

On December 18 and 19, 1990, MES research was underway to verify the problem and to determine if the problem was a design or installation error.

On December 26, 1990, after reviewing what had been discovered, MES determined that the wiring in question should have been removed during the NSM and that the MFWP control power sources, 2CDA and 2CDB, were inadvertently tied together when the AMSAC modification was installed.

On December 27, 1990, MES discussed the development of a work execution plan to remove the improper wiring. It was determined that both MFWP's would have to be tripped and control power for both MFWP's would then be de-energized prior to this task. It was noted that tripping both MFWP's would cause a CA Auto Start. The effect of this condition on other plant equipment was also determined and a complete list of systems and components was prepared by MES.

On January 2, 1991, MES informed OPS of the problem and the recommended solution. It was agreed that MES would initiate a work request and that the wire removal would be performed when both MFWP's could be tripped. MES determined that a step by step work execution plan should be developed and provided as an attachment to the work request.

On January 4, 1991, Work request 3848MES was initiated to remove the improper wiring from the AMSAC circuit.

On January 5, 1991, Unit 2 was reduced to Mode 3 to perform ice basket inspections due to findings on Unit 1. Work request 3848MES was taken to Integrated Scheduling and scheduled to be worked on January 7, 1991. The delay was due to the work load on both units.

On January 6, 1991, MES had completed the development of the work execution plan.

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On January 7, 1991, a second MES Staff member independently verified the work execution plan provided for work request 3848MES. MES reviewed the work plan with the IAE technicians who would perform the wire removal. During the early stages of the work process, IAE informed MES that OPS could not trip both MFWP's while in Mode 3 because the OPS procedures did not support this condition. MES discussed the AMSAC system requirements with OPS. It was decided to wait until Unit 2 was in Mode 4. After further discussion, OPS decided that the work would not be performed at this time since Unit 2 would not drop below Mode 3 during the current outage. OPS stated that the work should be performed the next time Unit 2 was in Mode 4. After MES voiced concerns about the possible problems that could occur and the questionable reliability of the circuit during Unit 2 operation, it was determined that a Problem Investigation Report (PIR) should be initiated for Design Engineering (DE) to determine operability of the AMSAC circuitry. MES agreed to initiate the PIR.

On January 8, 1991, MES initiated PIR 2-C91-0008 and forwarded it to Compliance. At midmorning, MES was informed by I/S that the operability statement requested by the PIR was needed so that start-up would not be delayed. Again, MES discussed the possible problems of starting up with the wiring problems remaining in the circuit. MES and OPS discussed the possibility of performing the repair with one MFWP reset. MES was concerned about the consequences of an event caused by the circuit problem, even if Design determined that the circuit was operable. MES informed OPS that the CA Auto Start signal could be defeated which would allow MFWP'B' to be tripped. OPS agreed to allow the work to be continued if the work plan was revised to block this signal. This would have less impact on the start up schedule since the OPS procedures would have to be changed to allow tripping the second MFWP. MES reviewed the original work execution plan and determined that the work execution plan could be modified for MFWP'A' tripped and MFWP'B' reset. While MES was revising the work plan, it was determined that to keep MFWP'B' reset, MFWP'B' sliding links should be opened instead of placing a jumper across them. Since MFWP'A' was already tripped, MES determined that changes to the work request attachment steps specific to MFWP'A' were not necessary. However, this determination was in error. This determination was made by the two MES Staff members who wrote and reviewed the original instructions.

On January 8, 1991, at 1626 hours, the IAE technicians were in the process of placing the first jumper per the revised work execution plan. When the jumper was placed across terminals F-12 and F-13 in 2EATC4 as specified by the attachment, the A Train CA Auto Start signal initiated as if both MFWP's had tripped. CA motor driven feed water pump 'A' was providing Steam Generator flow and maintained satisfactory flow throughout this event. The system isolations that occur with the Train 'A' automatic CA system initiation initiated properly. MFWP'B', CA Pump 'B', and 'B' Train isolations remained in their normal conditions throughout this event. The CA Auto start was immediately acknowledged by OPS and the affected systems were realigned.

After the mistake in the work plan was discovered, MES revised the work execution plan to include a block on the CA Auto Start signal. The revised work plan section associated with blocking the CA Auto Start signal was then independently reviewed by the MES Engineering Supervisor. IAE completed the corrective maintenance using the revised plan blocking the signal and then removed the jumpers which allowed them to correct the 2CDA ground problem.

CONCLUSION

The inadvertent CA auto start has been attributed to an Inappropriate Action due to lack of attention to detail. A mistake was made when the work request attachment was revised by MES to allow the the work to be performed with one MFWP reset. The jumper placed across terminals F-12 and F-13 in cabinet 2EATC4 initiated 'A' Train CA flow and system isolations as if MFWP's 'A'&'B' had tripped. Electrical drawings were not reviewed adequately to detect the presence of the 'B' Train contact in the 'A' Train circuit. The original attachment, which assumed that both MFWP's would be tripped, was correct. Jumpers would have been placed across 'A' and 'B' Train contacts after the pumps were tripped by OPS. When the work plan required revision because the OPS procedures did not specifically allow both MFWP's to be tripped in Mode 3, MES changed the 'B' Train portion of the attachment only. This change would allow the 'B' Train MFWP to remain reset until after the CA Auto start signal was blocked. Then MFWP'B' would be tripped and the work would proceed as planned. A mind-set existed when MES revised the attachment assuming that jumpers placed on Train 'A' circuits could not affect Train 'B' circuits. This led to the mistake made in the first revision of the attachment. A closer review of the circuit functions by MES, could have prevented this event. After the CA Auto Start functions were cleared, Unit 2 was returned to normal Mode 3 conditions. MFWP'A' was still tripped and MFWP'B' remained reset. The work request attachment was revised again to include isolation of the 'A' Train CA Auto start signal prior to tripping MFWP'B'. The corrective maintenance work was resumed and was completed without further incident. The 2CDA ground problem was solved after the AMSAC wiring was corrected.

It was concluded that the presence of the jumpers inadvertently left in the AMSAC circuit after the NSM did not affect operability. The post modification testing was adequate to confirm proper circuit functions but did not detect the presence of the jumpers. The DE operability evaluation stated that although the AMSAC circuitry was not constructed to the desired design per the design drawings, the nature of the wiring errors allowed for continued effective operation of the system and therefore the system was operable.

During the implementation of the AMSAC NSM, CMD used as built and limited edition prints which illustrate a before and after diagram of conductors. These prints clearly reflect the wiring changes to be implemented by the NSM. The Unit 1 AMSAC NSM successfully employed the same method to implement these changes. Complex NSM's which involve numerous conductors use an implementation procedure which may include specific terminations. The NSM designer or the NSM reviewer determines if an NSM is considered to be complex. The PMT for this NSM did not provide steps to ensure that the proper power circuit connections were made to AMSAC. The PMT program has been enhanced since the implementation of this NSM to include a verification of proper power circuit separation. An inspection is now required after the implementation of non-safety modifications per IP/0/A/3890/02, Controlling Procedure For Changes On Systems And Components.

An Operational Experience Program Data Base search revealed two CA Auto Starts in the last 24 months due to defective or inadequate procedures. Seven reportable events attributed to inappropriate action due to lack of attention to detail also occurred during this period but were unrelated to this event. Therefore this event has not been determined to be recurring.

CORRECTIVE ACTIONS

IMMEDIATE

1) The Control Room Operators reset CA and throttled the CA control valves to maintain Steam Generator level.

SUBSEQUENT

1) MES corrected the work execution plan.

2) IAE removed the jumpers within the AMSAC circuit and corrected the battery ground problem.

PLANNED

1) Review and revisions of maintenance programs (e.g. Maintenance Management Procedure and the Procedure For Corrective Maintenance And Generic Troubleshooting, IP/0/A/3890/01) will be performed to ensure that proper guidance is provided for independent verification of actions during corrective maintenance.

2) Appropriate maintenance personnel will be trained on the changes made to the maintenance independent verification process

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SAFETY ANALYSIS

This incident occurred during the performance of corrective maintenance on AMSAC system with Unit 2 in Mode 3 and steam generator level being maintained by the CA motor driven pumps. The placement of the jumper simulated that both MFWP's had tripped which caused the 'A' Train CA Auto Start to occur. The Train 'A' NM and BB containment isolations actuated as designed and the Control Room Operators responded properly by resetting the CA system and throttling the CA control valves to maintain the proper steam generator levels. The CA System maintained its safety function to provide decay heat removal for the Reactor Coolant System. Therefore, the health and safety of the public were not affected by this incident.