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DUKE POWER

March 30, 1992

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

Subject: Catawba Nuclear Station
Docket No. 50-414
LER 414/92-003

Gentlemen:

Attached is Licensee Event Report 414/92-003 concerning AUXILIARY FEEDWATER SYSTEM DESIGN DEFICIENCY.

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

Very truly yours,

W. R. McCollum
Station Manager

/lhe

Attachment

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NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
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TITLE (4): AUXILIARY FEEDWATER SYSTEM DESIGN DEFICIENCY

EVENT DATE (5) MONTH	DAY	YEAR	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MONTH	DAY	YEAR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER(S)
0 3	0 2	9 2	9 2	0 0 3	0 0	0 3	3 0	9 2	N/A	0 5 0 0 0
										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)	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)	X 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	
ROBERT FUTRELL, COMPLIANCE MANAGER	8 0 3	8 3 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
				N/A					

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)

ABSTRACT

On March 2, 1992, Units 1 and 2 were in Mode 1, Power Operation, when a design deficiency was discovered. The Auxiliary Feedwater (CA) System motor driven pumps (MDP) were conservatively declared inoperable at 2040 hours. Design Engineering discovered that failure affecting one train the CA System control circuitry would disable control functions of the opposite train. The preliminary conclusion was that under the worst case accident conditions as described by the FSAR, the CA System would not provide the required minimum CA flow to two intact Steam Generators (S/Gs) without operator action. The design intent of the CA Systems is to incorporate physical and electrical separation between trains in order to accommodate a single failure without loss of the intended safety function. The CA MDPs were declared operable on March 2, at 0130 hours upon implementation of temporary compensatory actions which employed the use of operators dedicated to manual operation of CA flow. Subsequent analysis showed that adequate core cooling would have been maintained under the postulated conditions. This incident has been attributed to design oversight. The CA control circuits were modified to ensure control circuit separation. An analysis will be performed to determine if the CA Turbine Driven Pump can be aligned to all four S/Gs.

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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 provides a safety related source of emergency feedwater to the steam generators [EIIS:HX] (S/G) during plant conditions where the Main Feedwater [EIIS:SJ] (CF) System is not available. Loss of CF is defined as rapid reductions in S/G water levels, a turbine [EIIS:TRB] trip, and CA actuation by the protection system logic. During these conditions the CA System is relied upon to remove energy from the primary coolant due to residual core energy in order to prevent overpressurization and expansion of the Reactor Coolant [EIIS:AB] (NC) System which could result in fuel damage. Following a reactor [EIIS:VSL] (Rx) trip from power operation, the power quickly falls to decay heat levels. If CA is not available and no operator action is taken, secondary water levels will continue to decrease as pressure is released from the S/G through the S/G relief valves [EIIS:V].

The CA System for each unit includes two motor driven pumps [EIIS:P] (MDP A & B), powered by separate and redundant safety related power supplies, and a steam powered turbine driven pump (TDP). Normally, MDP A is aligned to S/Gs A and B, and MDP B is aligned to S/G C and D. The TDP is normally aligned to S/Gs B and C.

The CA MDPs auto-start signal is initiated from any one of the following conditions;

1) safety injection
2) loss of off-site power
3) low-low level in any S/G
4) both main feedwater pumps tripped
5) start signal from the Anticipated Transients Without Scram (ATWS) mitigation system actuation circuitry (AMSAC)

The CA TDP is automatically started on Loss Of Off-site Power and Low-Low Level in any two S/Gs.

The preferred sources of water for the CA System are the upper surge tank, the CA condensate storage tanks, and the condenser hot wells. The Nuclear Service Water [EIIS:BI] (RN) System is the assured source of water for the CA System.

A CF line rupture is of particular concern in that the unit not only loses feedwater flow to the S/Gs, but also results in loss of CA flow to the remaining effective S/Gs since the CA System would deliver more flow to the faulted loop because of lower backpressure. CA flow to the faulted loop may be partially ineffective in removing core heat because the water would escape through the break without being converted to steam. The CA System design limits the flow to the faulted loop to ensure that sufficient flow is delivered to the remaining intact S/Gs. The CA System shall provide a minimum flow of 490 GPM to two intact S/Gs following a feedwater line break. For certain combinations of a faulted S/G and one inoperable CA motor [EIIS:MO] driven pump, the operable MDP and the TDP are required to operate at the same time to provide the minimum flow assumed in the design analysis.

The flow optimization circuit for the CA System is used to close motor operated isolation valves on the supply lines to S/G B or C when a motor driven pump has been started manually or automatically, the turbine driven pump is operating, and the motor driven pump on the opposite train has failed to start or the discharge pressure was below 200 PSI. This ensures that the minimum CA flow will be established if the operating motor driven pump is connected to the failed S/G. For example, if motor driven pump B and the turbine driven pump are running, and motor driven pump A is not running 60 seconds after the CA start signal, the C MDP B Discharge Isolation Valve, CA-46B, will automatically close and isolate S/G C from MDP B.

Problem Investigation Report 0-C92-0014 was initiated to resolve concerns with the accident analysis of Final Safety Analysis Report 15.2.8. The concern was the amount of time required to develop full CA System flow after receiving the CA start signal which was assumed to be 60 seconds. It was discovered that in a feedwater line break accident where one CA motor driven pump fails to operate and a faulted S/G exists on the supply line from the operating motor driven pump, up to 35 additional seconds is required to allow for operation of the isolation valves initiated by the flow optimization circuit. Resolution of this question concluded that a total delay of 95 seconds was acceptable. During subsequent analysis of the original question, a design deficiency in the flow optimization circuitry was discovered.

EVENT DESCRIPTION

On January 10, 1992, Unit 1 was in Mode 1, Power Operation and Unit 2 was in Mode 2, Startup. A Problem Investigation Report was initiated concerning Final Safety Analysis Review (FSAR) Accident Analysis Section 15.2.8, Feedwater System Pipe Break.

On March 2, 1992, Unit 1 and Unit 2 were in Mode 1, Power Operation. Design Engineering notified the station of the operability question involving the CA System and its flow optimization circuitry. The flow optimization circuit had been found to be vulnerable to a single failure which could affect the ability of the CA System to provide adequate heat removal during a feedwater line break event.

At 2040 hours, inoperability statements for the motor driven CA pumps were received by Operations. Compensatory actions were developed in order to keep both units conditionally operable. The compensatory actions required dedicated operators to monitor the CA System flow in case of a feedwater line break. The extra operators would then isolate the appropriate S/G to ensure that the minimum required flow was maintained, taking action based upon existing emergency procedure guidance.

On March 3, at 0030 hours, a four hour NRC notification was made due to the potential of loss of heat removal capability under certain postulated accident conditions.

At 0130 hours, the compensatory action was approved and implemented.

On March 15, at 0900 hours, Unit 1 flow optimization circuit modifications were completed. The Technical Specification Action Item Log (TSAIL) was cleared and the compensatory actions were discontinued.

On March 19, at 1400 hours, Unit 2 flow optimization circuit modifications were completed, the TSAIL was cleared, and the compensatory actions were discontinued.

CONCLUSION

During an unrelated design review, analysis of the CA System flow optimization circuit concluded that per the existing FSAR analysis, a single failure could cause an undercooling event under postulated worst case feedwater line break conditions. The CA System MDPs for both units were conservatively declared inoperable, and a four hour NRC notification was made. Compensatory measures were developed and implemented in order to return the MDPs to an operable status until the modifications could be installed on the flow optimization circuitry.

This event has been attributed to a Design Deficiency and is reportable per Section (a)(2)(ii)(B) of 10CFR50.73 because the units were operated under conditions outside the current design basis due to a single failure vulnerability in the flow optimization circuitry. Specifically, the feedwater line break analysis assumes CA flow to the faulted S/G is isolated early in the feedwater line break event. Flow optimization circuitry is provided to automatically accomplish this function. Because of a single failure vulnerability, it is possible that the flow optimization circuitry would not have automatically isolated flow to the faulted S/G.

Although discussed later under Safety Analysis, it is important to note that the existing emergency procedures covering feedwater line break events do include a step to identify and isolate the faulted S/G. This is a manual action that occurs later, within 15 minutes in the feedwater line break event, than assumed in the FSAR analysis (60 seconds). However, further analysis has determined that the delay in isolating the S/G until the manual action would

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be accomplished (within 15 minutes) would still maintain adequate heat removal and establish proper CA flow in an acceptable time frame.

It should also be noted that this conclusion is different from the initial determination that the MDPs for both units were inoperable (4 hour NRC notification). However, the initial determination and subsequent compensatory actions were conservative.

During this period, the analysis of the postulated feedwater line break event continued and ultimately determined that under actual conditions, the heat removal capability of the faulted S/G and operator actions required by emergency procedures to isolate the faulted S/G would maintain adequate heat removal and establish proper CA flow within an acceptable time frame. In addition, the amount of heat removal provided by the unisolated faulted S/G would convert the postulated feedwater line break scenario from an undercooling event, as stated in the current FSAR, into an event bounded by the Main Steamline Break Accident Analysis (FSAR Chapter 15.1).

The design intent of separated redundant trains for the CA System was defeated because components receiving control actions on one train were dependent on power from the other train. The existing circuit required power from one train in order to open the normally closed contacts which initiated the control action on the opposite train. The modified circuit now employs normally open contacts which ensure that the control action takes place regardless of the opposite train power condition. Planned corrective actions include an analysis into the possibility of aligning the TDP to all four S/Gs.

A review of the Operating Experience Program Database for the past 24 months revealed two other incidents attributed to Design Deficiency. Licensee Event Report (LER) 413/91-08 addressed the inability of the Control Room Ventilation [EIIS:VC] System to maintain control room pressure. Loss of non-safety power to non-safety related instruments would have closed control room air intakes which could not have been opened in time to avoid exceeding General Design Criteria 19 requirements. LER 413/91-25 addresses inoperability of the CA sump pump system. Throttling of the CA sump discharge valve created a situation where there was insufficient flowpath from the sumps. Although these events involved design deficiencies, none of these events involved the CA System flow optimization circuits. Therefore, this is not considered to be a recurring problem.

CORRECTIVE ACTION

IMMEDIATE

1) Four hour NRC notification made.

2) Implemented compensatory action.

SUBSEQUENT

1) Developed and implemented modifications for CA control circuits.

PLANNED

1) Perform an analysis to determine if the TDP can be aligned to all four S/Gs.

SAFETY ANALYSIS

The flow optimization circuit automatically isolates a faulted S/G from the operating MDP and the TDP in an event where the opposite MDP is not functioning. This circuit ensures that the minimum required CA flow is delivered to two intact S/Gs from the operable MDP and the TDP. The FSAR Chapter 15 Feedwater line break accident analysis takes credit for heat removal by the two intact S/Gs only. Under this analysis, 490 GPM must be delivered to two intact S/Gs within 60 seconds. No credit was taken for CA flow to the faulted S/G.

Under the new analysis (performed using NRC approved methodology), 190 GPM is required within 60 seconds and 600 GPM is required within 95 seconds; feedwater flow to the faulted S/G is analyzed for an intermediate period of time. In this case, operator action is assumed per emergency procedure guidance to isolate the faulted S/G from the operating MDP. With the operator taking action within 15 minutes to isolate the faulted S/G, CA would provide 839 GPM to two intact S/Gs.

In actuality, a feedwater line break event would result in decreased S/G water level due to blowdown through the break. With the CA System actuated and providing flow to maintain adequate water levels and heat transfer, CA flow to the faulted S/G would remove heat in amounts that result in an overcooling event. The amount of heat removed in a feedwater line break is less than the amount that is removed during the most significant overcooling event which is a steam line break (the limiting overcooling event). Operator action terminates the overcooling event at 15 minutes. The postulated feedwater line break in actuality is an overcooling event and is bounded by the steam line break accident analysis covered in FSAR section 15.2.8.

Thus, the significance of the discovered design deficiency is very low. The analysis ultimately concluded that the consequences of a feedwater line break without automatic flow optimization circuit response was acceptable and consistent with the current design basis analysis. The MDPs were found to

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have been operable per Technical Specifications functional requirements. The CA pumps would have received the appropriate signals to start and perform their intended safety function. Adequate decay heat removal would have been maintained under the postulated scenario. The health and safety of the public were not affected by this event.