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Washington, D. C. 20555

Subject: Catawba Nuclear Station
Docket No. 50-413
PIR 0-C90-0079; IIR C90-024-0

Gentlemen:

Attached is our Problem Investigation Report 0-C90-0079, submitted concerning IDENTIFICATION OF THE INABILITY OF AUXILIARY FEEDWATER PUMPS TO TAKE SUCTION FROM THE CONDENSER HOTWELL. This incident was determined to be NRC non-reportable but has been investigated and documented as a Special Report.

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

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DUKE POWER COMPANY
CATAWBA NUCLEAR STATION
PROBLEM INVESTIGATION REPORT NO. 0-C90-0079

IDENTIFICATION OF THE INABILITY OF AUXILIARY FEEDWATER PUMPS TO TAKE SUCTION FROM THE CONDENSER HOTWELL

ABSTRACT

On March 7, 1990 at approximately 1800 hours, with Unit 1 in Mode 5, Cold Shutdown, and Unit 2 in Mode 1, Power Operation, Auxiliary Feedwater (CA) Pump 1A tripped on low suction pressure during a functional test of check valve 1CA-1 (CA Pumps Suction Check From Hotwell). The functional test involved a pump suction lineup from the Condenser Hotwell with the CA pump operating in the manual mode. The cause of the event is attributed to a functional design deficiency due to an inadequate margin between existing Hotwell head pressure and the low suction pressure pump trip setpoint. The Unit 1 event, in which a Technical Specification requirement is non-applicable for the Condensate Storage System (CS), provided evidence that the similar condition existed on Unit 2, where the requirement is specified. The Unit 2 CS System was declared inoperable. The low suction pressure pump trip was bypassed by appropriate procedure changes in order to complete the Unit 1 functional test. Procedure changes and compensatory measures were incorporated into abnormal procedure AP/1&2/A/5500/06, Loss of Steam Generator Feedwater, to allow utilization of the Hotwell as a direct suction source for the CA pumps. This incident was determined to be NRC non-reportable but has been investigated and documented as a Special Report.

BACKGROUND

The Auxiliary Feedwater [EIIS:BA] (CA) System is a safety-related system which is designed to assure sufficient feedwater supply to the steam generators [EIIS:HX] in the event of loss of the Condensate/Feedwater [EIIS:SD/SJ] (CM/CF) System, to cooldown the Unit to allow initiation of Residual Heat Removal [EIIS:BP] (ND) System operation.

The CA System operates in either the automatic or manual mode of operation. The automatic mode is initiated in response to any of the following signals: loss of offsite power, safety injection, 1/4 and 2/4 low-low steam generator level logic, loss of both main feedwater pumps [EIIS:P], and AMSAC (ATWS Mitigation System Actuation Circuit). Manual mode is initiated by the Operator, either by manually starting the pumps or by resetting the CA System controls following an automatic start.

The CA pumps can take suction from three sources; the Condensate Storage [EIIS:KA] (CS) System, the Nuclear Service Water [EIIS:BI] (RN) System, and the Condenser Circulating Water [EIIS:SG] (RC) System. The CS System is the normal source, RN the assured source, and RC is reserved for Standby Shutdown Facility Events. Within the CS System, the Auxiliary Feedwater Condensate Storage Tank (CACST) and the Upper Surge Tanks (UST) are the only condensate grade sources suitable for direct supply to the CA pumps suction without having to manually defeat re-alignment interlocks to RN and RC, and breaking condenser vacuum. The CACST and the UST have a volume capacity of 42,500 and 85,000 gallons, repectively. The Condenser Hotwell provides an additional 170,000 gallons of condensate grade feedwater supply. The CACST and the UST are available to the CA pumps in all modes of operation, with adequate net positive suction head available due to the elevation differences between the tanks and the pumps. For a postulated event requiring prolonged operation of the CA System, the contents of the Hotwell would be used to supply CA pump suction following depletion of the CACST and the UST, rather than utilizing the raw water quality of the assured RN source. With a Hotwell pump available, the contents of the Hotwell when needed would be transferred to the UST. Otherwise, as in the case of a Loss of Offsite Power (LOOP), CA pump suction can be aligned directly to the Hotwell.

Low suction pressure protection is provided for the CA pumps according to the following:

During an auto-start of the CA System coincident with low suction pressure, a swap to RN will occur when the auto-swap valve position switches are in their normal "AUTO" position.

During a manual start, or following reset of an automatic start, low suction pressure will initiate a trip of the running CA pumps at the same setpoint as the RN swap.

During any mode of operation if the suction pressure drops below the RC pressure switch setpoints, the RC supply will align to the CA suction.

It is assumed that these condensate grade water sources would be available for short term (7-8 hour) response to non-seimic events, however this event showed that premature swapover to RN could occur or that upon CA reset a CA pump trip occur when a large volume of condensate inventory remained.

Technical Specification 3.7.1.5 requires that a minimum of 225,000 gallons of water be available in Modes 1, Power Operation, 2, Startup, and 3, Hot Standby, for Unit 2 only. A comparable specification is not applicable for Unit 1. With the CS System inoperable, an action statement option includes demonstration of the operability of the RN backup supply and restoration of the CS System to operable status within seven days.

EVENT DESCRIPTION

On March 7, 1990, modified periodic test PT/1/A/4250/03A, CA Pump 1A Performance Test, was performed in order to conduct a functional/retest on check valve [EIIS:V] 1CA-1 following corrective maintenance. Restricted Change #27 to the PT was issued to allow the realignment of CA pump suction from the UST to the Condenser Hotwell, with condenser vacuum broken, in order to full stroke 1CA-1. As the suction source was realigned to the Hotwell, operating CA Pump 1A tripped on low suction pressure, contrary to the intended functional design of operation with adequate net positive suction head (NPSH) provided by the Hotwell.

In order to complete the functional test of 1CA-1, it was necessary to disable the pump trip circuitry for low suction pressure. Restricted Change #28 to PT/1/A/4250/03A specifies the opening of sliding link F-1 in control panel 1AFWPTCP in order to block the CA Pump 1A trip on low suction pressure on a manual pump start. Additionally as part of the test change, instructions were included for defeating the automatic swap of CA pump suction to the RC System makeup source. (Automatic swap to RN is effectively defeated by the manual start.) Guidance on low pressure protection for the CA pumps in the Hotwell alignment was obtained from Design Engineering. To ensure that CA pump suction pressure does not reach a specified minimum value of 3.5 psig, the test procedure change also included cautionary guidance to maintain suction pressure greater than 4.0 psig. The swap to RN on low suction pressure interlock, coincident with a pump auto-start, is unaffected by the temporary circuit modification.

With the test procedure modified, the test was repeated and successfully completed on March 8. Test data of CA flow, suction pressure, and Hotwell level was collected at the request of Design Engineering for the purpose of further evaluation. The data was compiled as Design calculation CNC-1223.42-00-0022 and was used to generate the graph entitled 'CA Pump Suction Pressure Based on

Hotwell Level and Flowrate.' The graph provides specific guidance for the purpose of ensuring that suction pressures are maintained above 3.5 psig. The graph became an enclosure of abnormal procedure AP/1(2)/A/5500/06, Loss of Steam Generator Feedwater.

Following the test, the Unit 2 Condensate Storage System was declared inoperable at 0200 hours due to the failure to meet the requirements of Technical Specification 3.7.1.5. The corrective actions necessary to restore operability were identified, initiated, and completed in compliance with the ACTION statement of the Technical Specification. The corrective actions involved various additions to AP/2/A/5500/06 to provide guidance to Operators for aligning the CA Pump suction sources when the Hotwell pumps are not available for transferring water from the Hotwell to the UST. Statements were also added to caution Operators of the automatic actions which could occur when the CA pumps are aligned to the Hotwell. The Unit 2 CS System was declared operable on March 14 at 1753 hours.

CONCLUSION

The cause of this incident is attributed to a functional design deficiency due to an inadequate operating margin between existing Hotwell head pressure and the low suction pressure pump trip setpoint. The type of evolution that was conducted to functionally retest check valve 1CA-1, was intended to be possible even with the Condenser under normal vacuum. The actual condition would have prevented the use of the Hotwell as a CA pump suction source if appropriate compensatory measures were not employed. The CA pumps were verified during pre-operational testing to be functionally capable of receiving adequate suction directly from the Hotwell; however, this activity was not required as part of the initial test program. Since the pre-operational system check-out was performed with the low suction pressure trip interlock intentionally blocked, the system limitation was not evident. The initial system check-out's were performed with the Condenser under vacuum, in which possible interference from the low suction pressure interlock was expected and therefore blocked. It was known that in a situation of actual necessity for CA pump suction on the Hotwell, that condenser vacuum would be previously broken as a result of the event or by associated mitigative actions, and would thereby provide adequate suction margin above the pump trip setpoint.

Although numerous design deficiencies in general have been identified, there have been no similar previous occurrences to the discovered condition in this incident; therefore, this event is not considered a recurring event or problem.

CORRECTIVE ACTION

SUBSEQUENT

1) Restricted Change #28 to PT/1/A/4250/03A was issued to provide instructions for blocking the low suction pressure trip of CA Pump 1A for manual operation. Also included were cautionary statements regarding a minimum suction pressure of 4.0 psig.

2) The functional/retest of check valve 1CA-1 using PT/1/A/4250/03A was repeated and successfully completed.

3) CA flow, pump suction pressure, and Hotwell level test data was gathered and provided to Design Engineering.

4) The Unit 2 Condensate Storage System was declared inoperable.

5) Abnormal procedure AP/1(2)/A/5500/06 was revised to provide guidance to Operators for aligning the CA Pump suction sources when the Hotwell pumps are not available for transferring water from the Hotwell to the UST. Statements were also added to caution Operators of the automatic actions which could occur when the CA pumps are aligned to the Hotwell.

PLANNED

1) Performance, Operations, and Maintenance Engineering Services personnel will evaluate a recommendation from Design Engineering of installing a duplicate set of pressure switches to those existing, which will monitor CA pump suction pressure in relation to a lower setpoint for the purpose of net positive suction head (NPSH) protection during modes of manual pump operation. The existing switches [EIIS:XIS] would function for pipe [EIIS:PSP] break protection in cases of automatic operation.

SAFETY ANALYSIS

The vital safety-related function served by the CA System during all postulated occurrences requires the assurance of two trains supplied by a safety grade, seismically designed water source for pump suction to assure pump operability and function. The safety-related suction function is accomplished via an automatic re-alignment feature to the RN System. In view of the consequences of unnecessary alignment of RN to the steam generators, maintaining a minimum condensate inventory is an important operational consideration. For chemistry concerns in events such as a blackout or loss of normal feedwater, the CA pumps are normally aligned to utilize the condensate quality water of the non-seismic

CACST, UST, and if necessary, the Condenser Hotwell. A combined water volume of 225,000 gallons is to be available in Modes 1, 2, and 3, contained in the said non-seismic sources, according to Unit 2 Technical Specification 3.7.1.5. This value is based on a safe and orderly shutdown/cooldown with natural Reactor Coolant [EIIS:AB] System circulation.

For the purpose of this safety analysis, it is assumed that the contents of the Condenser Hotwell would not have been available as a non-safety CA pump suction source during a postulated loss of feedwater/offsite power event. Since an automatic or manual start of the CA System is assumed in the FSAR Accident Analysis in conjunction with the LOOP, the LOSS OF NON-EMERGENCY AC POWER TO THE STATION AUXILIARIES event, described in FSAR Section 15.2.6, is considered the bounding analysis for the subject condition.

The exclusion of the Hotwell storage capacity results in only the combined 127,500 gallons of the CA CST and UST being available to "maintain the Reactor Coolant System at Hot Standby conditions for 2 hours followed by approximately 5 hours cooldown with steam discharge to the atmosphere concurrent with total loss-of-offsite power." This condition appears to have existed since initial Unit licensing.

Prior to discovering the described functional discrepancy and since initial Unit licensing, alternative means of avoiding an unanalyzed situation are considered to have been available. CA pump operability is maintained by compliance with the surveillance requirement to verify the automatic availability of the seismically assured RN suction source, limited only by the volume of the Standby Nuclear Service Water Pond (SNSWP) and RN water chemistry.

Since it was recognized during pre-operational testing that blocking of the pump suction pressure interlock permitted "safe-if-monitored" operation of the CA pumps while aligned to the Hotwell, it is considered to have been a viable option at any time that it became necessary to preclude the undesired swap to RN.

To reiterate, the postulated unusable contents of the Hotwell are a result of a loss of power to the Hotwell pumps, which would normally be used to pump the Hotwell contents to the UST. Depending on the circumstances surrounding the initiating LOOP, methods are available by procedure for realigning offsite electrical power from the opposite unit, thereby restoring available power to the Hotwell pumps.

Present operability of the Unit 2 Condensate Storage System has been addressed in the 10CFR50.59 evaluation which accompanied a necessary procedure retype for abnormal procedure AP/2/A/5500/06. Procedure revisions included provisions for aligning the Hotwell to the CA Pump suction when the Hotwell pumps are not available for transferring water from the Hotwell to the UST. Instructions were

outlined for blocking the low pump suction pressure interlock as well as the automatic swap capability to the RC System piping. Cautionary statements pertaining to pump protection and the remaining automatic interlocks were also added. (Similar changes were made to the equivalent Unit 1 procedure even though a similar Technical Specification requirement does not apply.) These actions and demonstration of the operability of the SNSWP as a backup supply to the CA pumps, constitute full compliance with the Unit 2 Technical Specification action statement.

The health and safety of the public were unaffected by this incident. The incident was determined to be of no nuclear safety significance.