UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
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ATLANTA, GEORGIA 30303-8931

June 3, 2003

Carolina Power & Light Company
ATTN: Mr. James Scarola
Vice President - Harris Plant
Shearon Harris Nuclear Power Plant
P. O. Box 165, Mail Code: Zone 1
New Hill, NC 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT - NRC SPECIAL INSPECTION REPORT 50-400/03-08

Dear Mr. Scarola:

On May 9, 2003, the Nuclear Regulatory Commission (NRC) completed a special inspection at the Shearon Harris Nuclear Power Plant. The enclosed report documents the inspection findings which were discussed on May 9, 2003 with you and other members of your staff.

On May 1, 2003, a Special Inspection Team (SIT) was established by NRC Region II management using the guidance contained in Management Directive 8.3, NRC Incident Investigation Procedures. The SIT was chartered to inspect and assess the circumstances associated with the loss of shutdown cooling event which occurred on April 28, 2003. The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, conducted field walkdowns, observed activities, and interviewed personnel.

Based on the results of this inspection, we have determined that the cause of the loss of shutdown cooling event was well understood, and that your staff conducted a comprehensive review of the issue. A past operability evaluation concluded that the component cooling water (CCW) system remained operable. Identified problems were appropriately placed into your corrective active program.

This report documents one finding concerning inadequate corrective action involving failure to preclude repetition of CCW system relief valve lifting events and failure to maintain correct relief valve nozzle ring settings. This finding has potential safety significance greater than very low significance. The finding was self-revealing and presented an immediate safety concern. However, adequate compensatory measures were put in place after the event and additional long-term corrective measures are being implemented.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document

Room or from the Publically Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web-site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Loren R. Plisco, Director
Division of Reactor Projects

Docket No.: 50-400
License No.: NPF-63

Enclosure: Inspection Report No. 50-400/03-08
w/Attachments

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No:	50-400
License No:	NPF-63
Report No:	50-400/2003-008
Licensee:	Carolina Power & Light (CP&L)
Facility:	Shearon Harris Nuclear Power Plant, Unit 1
Location:	5413 Shearon Harris Road New Hill, NC 27562
Dates:	May 5 - 9, 2003
Inspectors:	G. MacDonald, Senior Project Engineer (Team Leader) J. Brady, Senior Resident Inspector - Shearon Harris R. Monk, Operator Licensing Examiner
Approved by:	P. Fredrickson, Chief Reactor Projects Branch 4 Division of Reactor Projects

SUMMARY OF FINDINGS

Shearon Harris Nuclear Power Plant, Unit 1
NRC Inspection Report 50-400/03-008

IR 05000400-2003-008; Carolina Power and Light; 05/05-09/2003; Shearon Harris Nuclear Power Plant; special inspection to inspect and assess the circumstances associated with the loss of shutdown cooling event of April 28, 2003. A finding was identified for failing to preclude repetition of component cooling water (CCW) system relief valve lifting events and failing to maintain correct relief valve nozzle ring settings.

The inspection was conducted by a senior project engineer, a senior resident inspector, and an operator licensing examiner. One unresolved item with potential safety significance greater than green was identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using IMC 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

A. Inspector Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems, Initiating Events

- Overall, the licensee conducted a comprehensive review of the loss of shutdown cooling event of April 28, 2003. Task Analysis, Event and Causal Factor Analysis, and Fault Tree Analysis techniques were utilized to determine contributing and root causes for the event. The event review team recognized the potential common cause vulnerability of incorrect relief valve nozzle ring settings and initiated an extent of condition evaluation to address the problem. Past operability reviews adequately addressed system operability considerations.

  The special inspection team concluded that the root cause of the event was inadequate corrective action from previous similar events which allowed the conditions within the CCW system to repeat, causing the relief valve to lift. In addition, past corrective actions for incorrect relief valve nozzle ring setting problems were ineffective which caused the relief valve to remain open for an excessive period of time.

- TBD A failure to prevent repetition of a loss of component cooling water (CCW) resulted in a five minute loss of decay heat removal while in shutdown cooling.

  An Unresolved Item involving a failure to follow 10 CFR 50 Appendix B Criterion XVI, Corrective Action was identified. This finding is unresolved pending completion of the significance determination process (SDP). The finding was more than minor because it affected the initiating event and mitigating systems cornerstones both due to a system alignment that caused lifting of a CCW relief valve (1CC-294) and improper relief valve nozzle ring settings which caused the relief valve to remain open thus affecting CCW reliability. Also, the finding has

potential safety significance greater than Green because it affected at least one train of decay heat removal while shutdown.

B. Licensee Identified Violations

None.

Report Details

Summary of Plant Status

The unit was shutdown for a refueling outage (RFO-11) and was in mode 6 through the end of the special inspection on May 9, 2003.

4. OTHER ACTIVITIES [OA]

4OA3 Event Followup

.1 Special Inspection Team Charter

General Inspection Scope

On May 1, 2003, a Special Inspection Team (SIT) was established by NRC Region II management using the guidance contained in Management Directive 8.3, NRC Incident Investigation Procedures. The SIT was chartered to inspect and assess the circumstances associated with the loss of shutdown cooling event of April 28, 2003. Specific areas of concern included: previous operating experience of component cooling water (CCW) system relief valves lifting during CCW system manipulations; the cause of the failure of the relief valve to reseat; and the risk assessment and planning for CCW isolation valve actuator maintenance and CCW pump testing during a period of high decay heat and reduced rector coolant system (RCS) inventory.

Using Inspection Procedure 93812, Special Inspection, the SIT focused on the activities outlined in the special inspection charter included as Attachment 3. Observations and findings of these areas are outlined below.

.2 Event Description and Chronology

Initial Plant Conditions

On April 28, 2003, Harris Nuclear Plant (HNP) was shutdown for RFO-11 and had been shutdown for approximately three days. The plant was in mode 6 with reactor vessel (RV) head bolts detensioned but with the RV head still installed. The RCS water level was at -12 inches below the RV flange. Initial RCS temperature as measured at the discharge of the operating residual heat removal (RHR) pump was 134.7° Fahrenheit (F) with a calculated time to boil of 31 minutes. The RHR system was in-service in shutdown cooling mode for decay heat removal with the A RHR pump in service and B RHR pump secured. The CCW system trains were split with the A CCW pump supplying the A RHR heat exchanger (HX) and the non-essential CCW header and the B CCW pump supplying the B RHR HX. Containment integrity was not set, and the equipment hatch and several piping penetrations were open with administrative contingency closure controls in place to enable containment to be closed in 25 minutes. The steam generators were not available for decay heat removal. One pressurizer safety valve was removed to ensure feed and bleed capability. The CCW system outlet containment isolation valve (1CC-297) for the reactor coolant pump (RCP) bearing oil coolers was closed and under clearance to remain closed to support maintenance on its motor actuator.

Event Description

At 8:38 p.m. on April 28, 2003, the CCW header was cross-connected by opening the B CCW non-essential header isolation valves to support performance of Operations Surveillance Test (OST) 1813, Remote Shutdown System Operability 18 Month Interval Modes 5, 6 or Defueled. This test transfers control of various components, including the CCW pumps, to the auxiliary control panel (ACP) to verify remote functional capability. In accordance with OST-1813, the B CCW pump was stopped from the ACP. At 10:05 p.m., the B CCW pump was started from the ACP which caused a pressure increase in the isolated RCP bearing oil cooler CCW return line which lifted CCW relief valve 1CC-294. Relief valve 1CC-294 did not reseat as designed and the result was an approximate 200 gallons per minute (gpm) leak into the containment sump. Available operator indications were decreasing CCW surge tank levels, alarms for low CCW surge tank level (alarm light box 5 window 6-1), increasing containment sump levels, and the clearing of the RCP bearing oil cooler low CCW flow alarm (alarm light box 5 window 1-1B). The operators entered Abnormal Operating Procedure (AOP)-14, Loss of Component Cooling Water, initiated CCW surge tank filling and began leak investigation. At 10:08 p.m., the B CCW pump was stopped when level in the B side of the CCW surge tank was less than 4 percent as required by procedure AOP-14 and relief valve 1CC-294 reseated. Level in the B side of the CCW surge tank began increasing and the RCP bearing oil cooler low CCW flow alarm was received. The non-essential header was isolated from the A CCW pump and, at 10:10 p.m., the A CCW pump was stopped when level in the A side of the CCW surge tank was less than 4 percent. No CCW flow to either RHR HX was provided at this time. The operators then aligned CCW flow to the B RHR HX and isolated the B CCW pump from the non-essential header and verified that level in the B side of the CCW surge tank was stable and increasing. At 10:15 p.m., the B CCW pump was started restoring shutdown cooling. RCS temperature had increased from 134.7°F to 139.4°F, and the time to boil was later calculated to have decreased from approximately 31 minutes to approximately 29 minutes. Due to the 5 minute period without CCW flow, RCS temperature as measured at the discharge of the operating RHR pump increased approximately 5° F. A detailed sequence of events is included as Attachment 3.

.3 Licensee Event Response

a. Inspection Scope

The inspectors reviewed available plant event data, control room logs, strip charts for RHR HX inlet and outlet temperatures and interviewed operations personnel to develop a timeline for the event which is included as Attachment 3. The inspectors reviewed plant procedures and discussed event diagnosis and system recovery with the on-shift operations personnel to assess human performance for the event and the adequacy of procedural guidance to respond to loss of CCW during shutdown.

The following procedures were reviewed:

- AOP-14, Loss of Component Cooling Water
- AOP-20, Loss of RCS Inventory or Residual Heat Removal While Shutdown
- APP-ALB-5, Main Control Board

b. Observations and Findings

Operators correctly diagnosed the event from the available alarms and indications, entered the appropriate AOP, initiated CCW surge tank filling as required by the AOP, and began leak isolation activities. Control room operators coordinated with the additional operations staff stationed at the remote ACP and transfer panels to achieve the CCW system pump manipulations necessary to restore the CCW system following the event. The actions taken by the operators were in accordance with plant procedures and appropriate to preserve CCW pump capability. The operators chose to maintain both CCW pumps off for approximately 5 minutes while they confirmed the effectiveness of their leak isolation activities (through monitoring surge tank level) and aligned the B CCW train for restart. However, the inspectors concluded that one CCW pump remained available with adequate net positive suction head for restart at all times, preventing a complete loss of the shutdown cooling safety function.

The inspectors concluded that the limiting condition for operation for Technical Specification (TS) 3.9.8.2, Residual Heat Removal and Coolant Circulation, were met. Throughout the event, forced shutdown cooling flow through the core was maintained with operable RHR pumps, except for a short term period (5 minutes) when the CCW system did not remove the decay heat from the RHR system. One CCW pump remained available during the event and based on no complete loss of the shutdown cooling safety function, the inspectors concluded that the event was not reportable, and did not meet the criteria for declaring any emergency classifications under the licensees emergency action levels.

The inspectors noted that procedure AOP-14 provided minimal detailed guidance for leak isolation and system restoration. Through procedure review and operator interviews, the inspectors found that AOP-14 was written from an at-power perspective and was somewhat challenging to use under shutdown conditions. The licensee had identified this problem in the significant adverse condition investigation for AR 91818, generated as a result of this event, and was planning to take corrective action.

The inspectors noted that operations personnel had been trained on loss of shutdown cooling events but not on the loss of CCW during shutdown. The only training performed on loss of CCW events was during at power alignments. The inspectors also verified that none of the operators on duty or assigned containment closure duties were beyond administrative overtime limits.

.4 Risk Assessment and Planning

a. Inspection Scope

The inspectors reviewed the details surrounding the decision to perform CCW pump testing during a period of high decay heat with the RCS not full. The inspectors reviewed the following to determine the adequacy of the refueling outage work schedule and risk assessment for April 28:

- RFO11 outage risk plan;
- OMP-3 Key Safety Function Availability Checklist for April 28, 2003.
- Procedures OMP-003, SD-145, and OP-145 listed in the attachment
- LERs 50-400/90-018 and 50-400/91-016
- ACFR 94-1408
- PCR 5741
- AR 19212

.

The inspectors interviewed the outage management and scheduling personnel to determine if they were aware that starting a second CCW pump with the RCP oil cooler CCW return line isolated could cause a pressure increase and a lift of CCW relief valve 1CC-294. The inspectors reviewed the licensee's evaluation of the plant configuration at the time of the event and the means used by outage and scheduling personnel to assess risk of planned and emergent work conditions and what measures were utilized for activities considered risk significant.

b. Observations and Findings

The inspectors determined that the outage work management and review process (including risk assessment) did not adequately control the outage work to prevent the loss of CCW event from recurring on April 28. The key activities that contributed to the partial loss of decay heat removal were the performance of OST-1813 and the shutting of valve 1CC-297 to allow preventive maintenance on the motor actuator. The outage and scheduling personnel did not recognize the relief valve lifting vulnerability when CCW system alignment included operating two CCW pumps with the RCP oil cooler CCW return line isolated, despite previous CCW relief valve lifting events. This lack of recognition occurred even in light of the Harris operating experience including two LERs, an NRC information notice with Harris as an example; and caution notes in four test procedures, the system description warning about potential relief valve events, and a recent similar event in 2000 that resulted in a change to the fill and vent section of the operating procedure to prevent such alignments. The licensee's event assessment team and plant staff did not initially appear focused on the outage work management and risk assessment/ management aspects as a cause of the event. The failure to prevent this event through proper use of previous Harris operating experience when developing and implementing the refueling outage schedule was considered part of the inadequate corrective action identified in URI 50-400/03-008-01, Loss of decay heat removal due to loss of CCW, described in Section 4OA3.5 below.

.5 CCW Relief Valve History

a. Inspection Scope

The inspectors reviewed the performance history of CCW relief valve lifting during CCW system alignment configuration changes and the effectiveness of corrective actions for these previous problems to determine whether previous corrective actions were adequate to prevent repetition of previous problems. The inspectors reviewed actions taken at Harris in response to the CCW relief valve event which occurred during 2001 at Robinson Nuclear Plant.

b. Observations and Findings

Introduction

A violation of 10 CFR 50 Appendix B Criterion XVI, Corrective Action, was identified for failure to prevent repetition of a loss of CCW while in shutdown cooling. The finding had potential safety significance greater than Green. This finding is an unresolved item (URI) pending completion of the SDP.

Description

A detailed description of the event is contained in Section 4OA3.2. The inspectors found that multiple similar events had occurred in the past as described in LERs 50-400/90-018 and 50-400/91-016, and licensee corrective action documents ACFR 94-01408, and AR 19212 2000. The 1990 and 1991 events involved other CCW relief valves, while the 1994 and 2000 events involved relief valve 1CC-294. All of the events involved a loss of surge tank level due to relief valves lifting during dual pump operation when header discharge valves were shut. LER 91-016 identified the cause as a system design in which the CCW pump discharge head pressure (with two pumps running) exceeded the relief valve set pressures on several of the individual components in the system. The inspectors noted that corrective actions for the three early 1990s events included a design change to increase the setpoint on the subject relief valves, except for relief valve 1CC-294. For 1CC-294, the licensee had chosen to prevent the problem with administrative controls on system alignment which included revising several test procedures that perform operability valve stroking of non-essential CCW discharge isolation valves including 1CC-297, and revising the fill and vent portion of the operating procedure. The licensee staff believed, based on the conclusions from plant change request 5741 (1992) that this type of event could not happen during normal operation (only during testing), and therefore, general operating procedure precautions were not needed. In addition, LER 91-016 also identified the failure of the relief valve to reseat due to an improper nozzle ring setting. Corrective actions included a procedural change on how to set the nozzle ring; training on how to interpret relief valve data sheets and how to properly set the nozzle rings; and verification that CCW relief valve nozzle rings were set at the correct values. The inspectors concluded that the April 28 event was preventable and that the previous corrective actions were inadequate.

Analysis

The issue was greater than minor because it affected the initiating event and mitigating systems cornerstones due to a system alignment that caused lifting of a relief valve and due to improper relief valve nozzle ring settings that affected CCW system reliability. The finding has potential safety significance greater than Green because it affected at least one train of decay heat removal while shutdown. The safety significance of the issue was yet to be determined.

Enforcement

10 CFR 50 Appendix B Criterion XVI, Corrective Action, requires that for significant conditions adverse to quality, the root cause of the condition be determined and corrective actions taken to preclude repetition. LERs 50-400/90-018 and 50-400/91-016, corrective action document ACFR 94-01408, and corrective action document AR 19212, were associated with lifting of CCW relief valves by shutting a non-essential header discharge isolation valve with both CCW pumps running and identified corrective action to prevent repetition of that problem. In addition, LER 91-016 identified that improper relief valve nozzle ring settings had contributed to the event duration and identified corrective action to prevent repetition of CCW relief valve nozzle ring setting errors.

Contrary to the above, on April 28, the licensee failed to have adequate corrective actions to preclude repetition of system alignment problems that caused CCW relief valves to lift during operation of two CCW pumps, in that, one of the CCW non-essential header discharge isolation valves, 1CC-297, was shut while both CCW pumps were operating. In addition, the licensee failed to take adequate corrective actions to prevent repetition of improper CCW relief valve nozzle ring settings, in that, relief valve 1CC-294 nozzle ring was improperly set. The combination of these two failures resulted in relief valve 1CC-294 lifting and remaining open for an extended period resulting in loss of CCW surge tank level, and requiring operators to secure the CCW pumps. The result was no decay heat removal for approximately five minutes while in mode 6. This issue is in the licensee's corrective action program as AR 91818. This issue is identified as part 1 of URI 50-400/03-08-01, Loss of decay heat removal due to loss of CCW, pending determination of the safety significance. Part 2 of the URI is discussed in Section 4OA3.6.

.6 CCW Relief Valve Failure to Reseat

a. Inspection Scope

The inspectors reviewed the documents listed in Attachment 1 to determine whether relief valve 1CC-294 was properly set in relation to lift pressure and blowdown nozzle ring settings, and whether any potential common cause issues existed. The inspectors examined the valve to verify that valve nameplate data matched what the licensee believed to be the vendor data sheet. The inspectors reviewed system design and operational documents to determine whether the relief valve design setpoints were appropriate in relation to normal system operating parameters. In addition, the inspectors reviewed whether the design change that installed larger CCW pump

impellers for power uprate during the last refueling outage significantly reduced the margin to the relief valve setpoint. The inspectors reviewed the relief valve testing and preventive maintenance performed for the CCW relief valves and the guidance for setting relief valve nozzle rings to determine whether these activities could have had an affect on the performance of relief valve 1CC-294 during this event.

b. Observations and Findings

The inspectors verified that relief valve 1CC-294 had a required nozzle ring setting of -100 notches from level as compared to the as-found setting of +185 notches from level. This improper setting (285 notch difference) led to the valve failing to reseat as designed. The corrective action for LER 91-16 specifically included an effort to inspect and correctly set all CCW relief valves to the design requirements, including procedural enhancements and training. Consequently, the failure to maintain correct CCW relief valve nozzle ring settings was due to inadequate corrective action from previous events where CCW relief valves lifted and failed to reseat due to incorrectly set nozzle rings. This problem is Part 2 of the inadequate corrective action in URI 50-400/03-008-01, Loss of decay heat removal due to loss of CCW, described in Section 4OA3.5 above.

In spite of the previous corrective action, the inspectors noted that there were discrepancies in the guidance for setting relief valve nozzle rings between the Crosby vendor manual, the maintenance procedure (CMM-0192), and the information provided by the vendor representative. Based on discussions with the vendor representative and field observation, the inspectors concluded that performing adjustments of the nozzle rings in the field can lead to incorrect settings as it is difficult to establish correct reference level without viewing the valve internals through the discharge port during adjustment (method used at the vendor's shop to establish reference level). Without viewing through the discharge nozzle, problems with the nozzle ring threads from wear or debris can result in the determination of a false top or bottom nozzle position which would lead to an incorrect reference level position and final nozzle ring setting. Additionally, performing valve maintenance can affect reference level position and merely setting a valve's nozzle ring to the data sheet value following maintenance without visually checking reference level through the discharge port during the adjustment could lead to an incorrect setting. The inspectors also found that the licensee did not track valve serial numbers to specific equipment tag numbers which makes historical maintenance reviews of relief valves difficult. The inspectors could not conclusively determine a reason for the incorrect nozzle ring setting for valve 1CC-294 and concluded that with the conflicting guidance, lack of confidence in the actual maintenance traceability, and the inherent difficulty in counting out the many notches to the desired position in the field that human error was the most likely cause. The licensee recognized that the problem with the incorrectly set nozzle ring for relief valve 1CC-294 represented a potential common cause failure mode and expanded their investigation to other similar relief valves.

.7 Licensee's Problem Investigation Activities

a. Inspection Scope

The inspectors evaluated the licensee's problem investigation activities including determination of root and contributing causes, extent of condition, additional equipment failure mechanisms, risk assessment, and development of corrective actions including corrective actions to prevent recurrence.

b. Observations and Findings

Overall, the licensee conducted a comprehensive review of the loss of shutdown cooling event of April 28, 2003. Task Analysis, Event and Causal Factor Analysis and Fault Tree Analysis techniques were utilized to determine contributing and root causes for the event addressing the initial lifting of the relief valve and the incorrectly set nozzle ring which led to its failure to reseat. The licensee's event review team (ERT) recognized the potential common cause vulnerability of incorrect relief valve nozzle ring settings and initiated an extent of condition evaluation to address all relief valves in the inservice inspection program. Valves that did not have nozzle ring setting capability were excluded. Valves which could have an adverse impact on system operation were inspected (24) and the nozzle rings were verified to be correctly set or were reset (8) to design requirements during RFO11. The inspectors were able to determine, based on discussions with the vendor representative who was on-site, that any nozzle ring discrepancy less than 10 notches from desired would not result in any noticeable change in reseat pressure. The remainder of the valves were planned to be checked by a schedule to be developed following RFO11.

The inspectors concluded that the root cause of the event was inadequate corrective action from previous similar events which led to the conditions within the CCW system that caused the relief valve to lift and to the incorrect relief valve nozzle ring settings on plant relief valves. The inspectors noted that this event was classified as a significant adverse condition which required a detailed root cause investigation and development of corrective actions including corrective actions to prevent recurrence. The 1994 and 2000 CCW relief valve lifting events were not classified as significant adverse conditions and did not receive detailed root cause evaluation or the development of corrective actions to prevent recurrence. The licensee's event review team did not identify this as a potential contributing cause. The inspectors noted that the ERT had not identified that a failure to effectively use operating experience in performing the outage risk assessment represented a missed opportunity to have prevented the event. There was no evidence to show that the Robinson 2001 CCW relief valve event and nozzle ring errors were entered into the licensee's operating experience or corrective action programs.

Both immediate compensatory actions and longer term actions were taken to address this problem and prevent recurrence. The corrective action to prevent recurrence (CAPR) was to implement design modification EC 52488 that increased the setpoint of relief valve 1CC-294 to 190 psi which provided margin above dual pump operating pressure (completed during RFO11). An additional CAPR was to revise procedure CM-M0192 to ensure correct nozzle ring setting instructions. All the corrective actions and the CAPR are detailed in AR 91818.

4OA6 Meetings, Including Exit

The inspectors presented the inspection results to Mr. J. Scarola and other members of licensee management at the conclusion of the inspection on May 9, 2003.

The inspectors confirmed with the licensee that material examined during the inspection was not proprietary.

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee personnel

A. Barbee, Superintendent Operations Training Harris Nuclear Plant (HNP)
D. Barker, HNP Support Services
J. Briggs, Superintendent Chemistry, HNP
J. Caves, Licensing Supervisor, HNP
J. Cook, Supervisor Outage Management, HNP
E. Coffee, Corrective Action Program Administrator
H. Dija, Site Communications, HNP
M. Ellington, Lead Emergency Planning Specialist, HNP
P. Fulford, Superintendent Design Engineering, HNP
W. Gurganious, Nuclear Assessment Manager, HNP
K. Heffner, Lead Engineer, Progress Energy Corporate
T. Hobbs, Operations Manager, HNP
A. Khanpour, Engineering Manager, HNP
E. McCartney, Superintendent Technical Services, HNP
T. Morton, Manager Support Services, HNP
R. Mullis, Plant Evaluation Section Assessor, HNP
J. Scarola, Harris Plant Vice President
D. Tibbitts, Lead Engineer, Self Assessment
R. Varner, Nuclear Assessment Section (NAS), HNP
M. Verrilli, Supervisor Self Evaluation, Progress Energy Corporate
B. Waldrep, Plant General Manager, HNP
M. Wallace, Senior Analyst, Licensing, HNP
M. Weber, Superintendent Operations Support, HNP

NRC personnel

P. Fredrickson, Chief, Branch 4, Division of Reactor Projects

LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

Opened

50-400/03-08-01	URI	Loss of decay heat removal due to loss of CCW (Section 4OA3.4, 4OA3.5, and 4OA3.6)

Closed

None

Discussed

None

LIST OF DOCUMENTS REVIEWED

Sections 4OA3.2 - 4OA3.5 and 4OA3.7

Event Data and Charts

RHR temperatures and flowrates A & B loop
RHR heat exchanger (HX) A outlet temperature
RHR pump A discharge temperature
RHR HX B outlet temperture
RHR pump B discharge temperature
RHR loop A flowrate
RHR loop B flowrate
CCW surge tank levels
Time to boil calculation initial condition
Time to boil calculation post 5°F heatup
Operator logs for the period of 04/28/03 - 05/02/03
Control Room Recorder strip charts for 04/28/03 for A and B loop RHR pump discharge and HX outlet temperatures

Drawings

CPL-2165 S-1319 Simplified flow diagram component cooling water system
CPL-2165 S-1320 Simplified flow diagram component cooling water system
CPL-2165 S-1321 Simplified flow diagram component cooling water system
CPL-2165 S-1322 Simplified flow diagram component cooling water system
CPL-2165 S-1322 S01 Simplified flow diagram component cooling water system
Crosby Drawing No. DS-C-56895 RA (Ebasco No. 364-4413R0)

Procedures

Abnormal Operating Procedure (AOP) - 14, Loss of Component Cooling Water
AOP-20, Loss of RCS Inventory or Residual heat Removal While Shutdown
Outage Management Procedure (OMP) - 003, Outage Shutdown Risk Mangement
Operations Surveillance Test (OST) - 1813, Remote Shutdown System Operability 18 Month Intervals (Modes 5, 6 or Defueled)
OST-1103, Component Cooling Water ISI Valve Test Refueling Interval
Engineering Surveillance Test (EST) - 211, Auxiliary Relief Valve Testing
Corrective Maintenance (CM)-M0192, Crosby Relief Valve Disassembly, Maintenance and Reassembly
Temporary change to procedure CMM0192 revision 11 , Minor Change A
Preventive Maintenance (PM)M-014, Limitorque Inspection and Lubrication
Operating Procedure (OP)-145, Component Cooing Water System
APP-ALB-005, Main Control Board

Corrective Action Documents

AR 91818, Root Cause Investigation for 4/28/03 Loss of CCW
ACFR 94-01408, While Performing OST-1103 CCW Relief Valve 1CC-294 Lifted
AR 19212, 4/3/00 CCW Isolation

Design Documents

Plant Change Request (PCR) 5741, CCW from FPC HX Los Flow Alarm Logic Change
Engineering Service Request (ESR) 00-00301, CCW Impeller Replacement
ESR 00-00322, CCW System Pressure Re-Rate
Shearon Harris Nuclear Power Plant (SHNPP) Final Safety Analysis Report (FSAR) Section 9.2.2 , Component Cooling System

Other Documents

Vendor Manual VM-BJS, Crosby Relief Valves
Crosby Valve Data Sheet for relief valve 1CC-294
System Description, SD-145, Component Cooling Water System
Licensee Event Report (LER) 50-400/91-016-00, Potentially degraded residual heat removal capability due to CCW relief valve lifting and failing to reseat
LER 50-400/90-018-00, Loss of CCW Inventory Due To Lifted Reactor Coolant Drain Tank Heat Exchanger Valve caused by Incorrect Relief Valve Setpoint
NRC Information Notice (IN) 92-64, Nozzle Ring Settings On Low Pressure Water-Relief Valves
NRC Office for Analysis and Evaluation of Operation Data Report AEOD/E90-02, Crosby Low Pressure Relief Valves Nozzle Ring Problems, February 1990
RFOII Containment Closure Contingency Plans
Relief Valve Test Schedule, ISI-802
Periodic System Review Report for CCW dated 2/28/03
HNP Key Safety Function Availability Checklists - Configuration 3 Mode 6 Cavity Not Filled / Loops Not Filled
HNP Memo from John Cook, Supervisor Outage Management, to Outage and Scheduling Personnel, entitled, Outage Risk Assessment and Communication
Progress Energy Mechanical Lesson Plan MEC0023H

Maintenance Work Orders (Wos)

W/O 92-AGJH1
W/O 94-AEWR1
W/O 86-ACQQ1
W/O 234449-01
W/O 403539

Section 4OA3.6

W/O 234449
W/O 403539
Crosby valve data sheet for 1CC-294 (Crosby Serial No. N56895-00-0007)
Crosby Drawing No. DS-C-56895 RA (Ebasco No. 364-4413R0)
Crosby Relief Valve Vendor Manual VM-BJS
AR 91818 Root Cause Investigation for 4/28/03 Loss of CCW
Procedure EST-211, Auxiliary relief Valve Disassembly, Maintenance and Reassembly
Procedure CMM-0192, Crosby Relief Valve Disassembly, Maintenance and Reassembly, including temporary change to procedure CMM0192 revision 11 , Minor Change A
ESR 00-00301, CCW Impeller Replacement
ESR 00-00322, CCW System Pressure Re-Rate
SD-145, CCW System
NRC Information Notice (IN) 92-64, Nozzle Ring Settings On Low Pressure Water-Relief Valves
NRC Office for Analysis and Evaluation of Operation Data Report AEOD/E90-02, Crosby Low Pressure Relief Valves Nozzle Ring Problems, February 1990

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET SW SUITE 23T85
ATLANTA, GEORGIA 30303-8931

May 1, 2003

MEMORANDUM TO: George MacDonald
Team Leader
Special Inspection Team

FROM: Luis A. Reyes **//RA by Bruce S. Mallett for//**
Regional Administrator

SUBJECT: SPECIAL INSPECTION TEAM CHARTER

A Special Inspection Team (SIT) has been established to inspect and assess the April 28, 2003, Shearon Harris Loss of Shutdown Cooling Event including the circumstances associated with the lifting of the component cooling water (CCW) system relief valve which led to operators securing both CCW pumps. In addition, the SIT should assess previous operating experience of relief valve lifting during CCW system manipulations, the cause of the failure of the relief valve to reseat, and the risk assessment and planning for testing which affected CCW pumps during a period of high decay heat and reduced RCS inventory.

The team composition is as follows:

Team Leader:	G. MacDonald (RII)
Team Members:	R. Monk (RII)
	J. Brady (RII)

The objectives of the inspection are to: (1) determine the facts surrounding the decision to perform remote shutdown system testing that cycled the CCW pumps during a period of high decay heat and reduced inventory; (2) evaluate the history of CCW relief valve lifting during CCW system manipulations and any corrective actions implemented to respond to these problems; (3) determine why the relief valve failed to reseat, including a review of any common-cause aspects related to the failure; (4) review relief valve setpoints, system operating parameters and relief valve testing and maintenance used for this and similar valves which could cause a loss of CCW; and (5) review the operator's response to the event including reportability and event classification.

For the period during which you are leading this inspection and documenting the results, you will report directly to me. The guidance of NRC Inspection Procedure 93812, "Special Inspection," and Management Directive 8.3, "NRC Incident Investigation Procedures," apply to your inspection. If you have any questions regarding the objectives of the attached charter, contact me.

Docket No.: 50-400
License No.: NPF-63

Attachment: SIT Charter

Attachment 2

SPECIAL INSPECTION TEAM CHARTER
SHEARON HARRIS NUCLEAR POWER PLANT
LOSS OF SHUTDOWN COOLING EVENT

Basis for the formation of the SIT - On April 28, 2003, while the licensee was performing remote shutdown system testing, a relief valve on the line from the reactor coolant pumps to the CCW non-essential header lifted and failed to reseat. The resulting loss of CCW inventory caused the plant operators to enter the appropriate abnormal operating procedure and, as directed by that procedure, to secure both CCW pumps to prevent pump damage. This initiated a loss of shutdown cooling for approximately 5 minutes, while the operators isolated the subject relief valve, refilled the CCW surge tank, and restarted a CCW pump. This event occurred during a period of reduced inventory and high decay heat with containment integrity not set (containment equipment hatch was open with contingency closure requirements)

These conditions appear to have the characteristics which meet the criteria of Management Directive 8.3, in that a complete loss of the shutdown cooling decay heat removal safety function occurred.

The objectives of the inspection are to: (1) determine the facts surrounding the decision to perform testing that affected decay heat removal functions during a period of high decay heat and reduced inventory; (2) evaluate the history of CCW relief valve lifting during CCW system manipulations, and any corrective actions implemented to respond to these problems; (3) determine why the relief valve failed to reseat, including a review of any common cause aspects related to the failure; (4) review CCW relief valve setpoints, system operating parameters and relief valve testing and maintenance used for this and similar valves which could cause a loss of CCW; and (5) review the licensee's response to the event including reportability and event classification. To achieve these objectives, plan to complete the following activities:

- Develop a timeline for the event and review the licensee's response to the event, including reportability and event classification.

- Determine the circumstances associated with the decision to perform testing which involves CCW pumps during a period of high decay heat and reduced inventory.

- Determine why the relief valve failed to reseat, and review for common-cause aspects. Also, review the CCW relief valve design setpoints and the normal CCW system pressures during various system operating modes, and determine whether the installation of larger CCW pump impellers during the last refueling outage contributed to this event.

- Review the performance history of CCW relief valve lifting during CCW system manipulations, and assess the effectiveness of the licensee's corrective actions for any previous problems with these valves. Also review any actions taken at Harris for the CCW relief valve lift event which occurred at Robinson (5/4/01).

- Review maintenance and testing that is routinely performed for these CCW relief valves to assess their adequacy and any related effects on the material condition of the valves.

- Assess the licensee's activities related to the problem investigation performed to date (e.g., root cause analysis, extent of condition, additional equipment failure mechanisms, risk assessment, etc.).

- Document the inspection findings and conclusions in an inspection report within 30 days of the inspection.

- Conduct an exit meeting.

Harris CCW Event Timeline - April 28, 2003

Time	*Actions*	*Comments*
	Initial system configuration: A and B trains split with the A pump supplying the A RHR Hx and Non-essential header and the B pump supplying the B RHR Hx.	
1439	*RCP oil cooler CCW return line isolated for MOV testing. This line is on the Non-essential header.*	*The relief valve that lifts later in the sequence is upstream of this isolation, but still in hydraulic communication with the pumping portion of the system.*
2038	*The B CCW cross-connect isolation valves were opened and the CCW inlet to the B RHR was shut. This configuration was a pre-requisite for OST-1813 testing of the Auxiliary Control Panel (ACP) start-stop testing of the B CCW pump.*	*Discussion with the licensee indicated that the alignment was necessary because starting the B RHR pump with only the B Essential Header would create a pressure transient that could cause damage to the RHR Hx or Seal Cooler. However, after cross-connecting the trains, the B RHR Hx was required to be isolated due to potential pump run out concerns during the time frames that only one pump was to be running.*
2204	*B CCW pump secured from the ACP*	*No effects on system integrity*
2205	*B CCW pump is started from the ACP*	*CCW Surge Tank level begins to decrease at ~ 200 gpm.*
2206	*CCW low surge tank level annunciator alarms*	*RO refers to the Annunciator Procedure and the SCO commences AOP 14, Loss of Component Cooling Water.*
2207	*SRO directs makeup from Demin Water to the surge tank. The SRO is in the body of AOP 14, Section 3.2, Leakage from CCW with a continuing action step to trip running pumps at < 4% level in their respective tank volumes. Additional activities are begun to make Rx Makeup Water available to the Surge Tank.*	*Levels in the surge tank are below the divider plate at ~28% in A and 22% in B, trending down, even with makeup addition.*
2208	*B side of the Surge Tank trends < 4% and the B CCW pump is secured. A Surge Tank level is ~ 20 % and continues to trend downward.*	*At this point, control of the B CCW pump is at the ACP. Therefore, the Control Room crew is coordinating this activity. The SRO loops back to the continuing action step to trip the B CCW pump and retraces the earlier steps in the procedure to ensure*

		all elements have been covered. These elements are primarily geared from an 'at power' perspective with a philosophy of maintaining cooling flow to the Non-essential header (RCP's) which in this case was the location of the leak.
2209	*The SRO reaches step 14 of AOP 14 which checks VCT level RISING. This is answered 'NO' which sends the operator to the RNO column which sends the operator to step 18 which checks RCDT Leakage. By this point in time, the SRO has received information indicating the problem is in Containment which indicates the Non-essential header is the location of the leak. He shuts the A Train isolation valves to the Non-essential header which isolates the leak from the A train CCW.*	*When the SRO turned the page to go to step 18, he actually executed step 17 which asks is the Surge Tank is STABLE or RISING. He answers 'NO' which sends him to step 87. This turns out to be fortuitous in this case because it is a generic step to take action to isolate the leak. Had he actually gone to step 18, he would have continued checking various components in the system and would have finally been sent to step 87.*
2209+	*Current plant configuration is the A CCW pump running, A Surge Tank level decreasing, A train to Non-essential header valves shutting and the B CCW pump off.*	*This configuration splits the CCW system into two physically separate trains with the B train (not running) still aligned to the Non-essential header. Due to this alignment, as the A Train Non-essential header valves close, water is forced from the A train side of the system to the B train side of the system causing the B train CCW Surge Tank level to recover.*
2210	*A CCW Surge Tank level decreases to <4% and A CCW pump is secured in accordance with the continuing action step of AOP 14.* *The SRO directs the A train to the Non-essential header to be opened.*	*No CCW pumps are running at this point. Discussions with the SRO indicated that he would have preferred to recover the A train CCW, although the A train Surge Tank level was recovering some, B Surge Tank level was recovering faster. He reopened the A train valves to the Non-essential header. This action aligns the A train (not running) to the break.*
2212	*SRO directs the B train RHR Hx to be unisolated and the B train to the Non-essential header isolations to be shut.*	*The SRO elects to use the B train CCW. Shutting the B train valves to the Non-essential header isolates the B train (about to be*

		started) from the break.
2215	*The B train CCW pump is started and the crew begins controlling RCS temperature with the B train of CCW.*	*This activity had to be coordinated with the ACP.*