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

May 10, 2002

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 50-400/02-06

Dear Mr. Scarola:

On April 12, 2002, 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 April 12, 2002 and on May 8, 2002 via teleconference, with Mr. R. Duncan and other members of your staff.

On April 8, 2002, 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 gas accumulation in the Shearon Harris safety injection system as identified by your staff on April 3, 2002. 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 gas accumulation in the suction of the emergency core cooling system (ECCS) piping was well understood, and that your staff conducted a comprehensive review of the issue. A past operability evaluation concluded that the ECCS system remained operable. Identified problems were appropriately placed in your corrective active program.

The inspectors identified one issue of very low safety significance (Green) with two examples. This issue was determined to involve a violation of NRC requirements. However, because of its very low safety significance and because the examples have been entered into your corrective action program, the NRC is treating this issue as a non-cited violation, in accordance with Section VI.A.1 of the NRC's Enforcement Policy. If you deny this non-cited violation, you should provide a response with the basis for your denial, within 30 days of the date of this inspection report to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001, with copies to the Regional Administrator, Region II; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector at the Shearon Harris facility.

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/NRC/ADAMS/index.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. 50-400/02-06
w/Attachments

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No:	50-400
License No:	NPF-63
Report No:	50-400/2002-06
Licensee:	Carolina Power & Light (CP&L)
Facility:	Shearon Harris Nuclear Power Plant, Unit 1
Location:	5413 Shearon Harris Road New Hill, NC 27562
Dates:	April 9 - 12, 2002
Inspectors:	S. Shaeffer, Senior Resident Inspector - McGuire (Team Leader) A. Hutto, Resident Inspector - Robinson
Approved by:	L. Plisco, Director Division of Reactor Projects

SUMMARY OF FINDINGS

Shearon Harris Nuclear Power Plant, Unit 1
NRC Inspection Report 50-400/02-06

IR 05000400-02-06; Carolina Power and Light; on 04/9-12/2002, Shearon Harris Nuclear Power Plant; special inspection to inspect and assess the circumstances associated with gas accumulation in the safety injection system. A non-cited violation (Green Finding) was identified for inadequate procedures for venting emergency core cooling systems.

The inspection was conducted by a senior resident and a resident inspector. One Green finding of very low safety significance was identified during this inspection and was classified as a non-cited violation. The finding was evaluated using the Significance Determination Process.

A. Inspector Identified Findings

Cornerstone: Mitigating Systems

- Overall, the licensee conducted a comprehensive review of the gas accumulation issue. Fault tree development appeared to be broad based and reviewed known gas generation/accumulation root causes. Past operability reviews were detailed and adequately addressed system operability considerations.

  The probable root cause of gas identified in the emergency core cooling system (ECCS) suction supply piping at the 1CS-294 check valve was degassing of residual heat removal (RHR) loop piping without appropriate elimination of the gas from the RHR system or adequate system venting. A contributing cause was operation of the volume control tank (VCT) at higher than normal pressures. This exacerbated the rate of degassing in the RHR system. In addition, the Special Inspection Team (SIT) concluded that the licensee's methods and system design for monitoring and venting the ECCS suction piping did not ensure gas voids remain undetected.

- (Green) A non-cited violation of TS 6.8.1, with two examples of inadequate operations procedures for the venting of safety-related systems was identified. The first example resulted in operation of Shearon Harris with a significant quantity of gas in the common refueling water storage tank suction supply line to the ECCS high head injection pumps. This condition adverse to quality existed for approximately 45 days beginning in February 2002. Operating Procedure OP-111, Residual Heat Removal System, failed to provide adequate instructions such that the timing of ECCS filling and venting, specifically for the RHR system and heat exchangers, was not performed when system conditions warranted sweeping and venting of gas due to changing plant conditions. The licensee's procedures and risk assessments for returning the RHR system to operable status did not incorporate the potential for gas accumulation in the RHR system once the system was depressurized.

The finding was more than minor because it could have had a credible impact on safety by reducing the reliability of the ECCS system by the ingestion of gas through the ECCS pumps. If left uncorrected, a slightly higher gas accumulation than identified on April 3, could result in redundant trains of the ECCS being inoperable. The finding was of very low safety significance because mitigation systems were concluded to be operable based on the engineering analysis performed. Further, the gas accumulation did not result in any adverse consequences. (Section 04.01)

The second example of the above non-cited violation was identified for an inadequate maintenance restoration procedure, which resulted in the potential movement of an unknown quantity of gas into the suction flowpath of an operating charging/safety injection pump (CSIP) in February 2002 and on other occasions during previous on-line CSIP maintenance restoration activities. Operating Procedure OP-107, Chemical Volume Control System, used to perform venting of the C CSIP, incorrectly assumed that gas vented from the CSIP casing and suction supply piping would be vented from the system through the VCT supply line. The SIT determined that there was a probability that the licensee's on-line process of venting the pump would result in all or a portion of the gas being swept to the operating CSIP due to flow out of the VCT supply line, location of the operating CSIP, and the buoyancy effects of the gas.

The finding was more than minor because it could have had a credible impact on safety by reducing the reliability of the ECCS system by the ingestion of gas through the ECCS pumps. Additionally, the finding was of very low safety significance because mitigation systems, specifically the CSIPs, have not currently exhibited a known adverse effect from this condition. Ingestion of gas through operating CSIP has been indicated through industry operating experience to initiate cracking of pump shafts, which propagate over time into a shaft failure. (Section 05.04)

B. <u>Licensee Identified Violations</u>

None.

Report Details

Summary of Plant Status

The unit operated at 100 percent power from the time of identification of the gas accumulation on April 3, through the end of the special inspection on April 12.

01 Special Inspection Team Charter

General Inspection Scope

On April 8, 2002, 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 gas accumulation in the Shearon Harris safety injection system as identified by the licensee on April 3, 2002. Specific areas of concern included the current operability of the changing/safety injection pumps (CSIP) and their ability to perform their safety function with gas in the common suction line from the refueling water storage tank (RWST). The objectives of the inspection were to: (1) determine the facts surrounding the gas accumulation in the CSIP common suction line; (2) review the licensee's response to this condition and their operability evaluation(s); (3) review the maintenance history and, (4) assess the generic aspects of the degraded condition and any operational issues.

Utilizing Inspection Procedure 93812, Special Inspection, the SIT focused on the activities outlined in the attached special inspection charter. Observations and findings of these areas are outlined below.

02 Initial Risk Significance of the Identified Adverse Condition

Following initial identification of the gas accumulation in the RWST suction piping, an initial risk significance assessment by the Region II senior reactor analysts indicated that there was sufficient potential risk increase to consider the event for more than the baseline inspection program. The major contributor to risk increase was the introduction of a potential common-mode failure mechanism (i.e., gas binding of multiple CSIPs) which could impact the ability of the system to mitigate the consequences of a design basis accident. Outstanding questions with regard to the status of current operability, in conjunction with an identified increase in risk, led to NRC Region II management's decision to conduct a Special Inspection.

Once on-site, the SIT confirmed the need for continuation of the Special Inspection without upgraded NRC involvement. The basis for this was an initial understanding that the source of the gas accumulation was not due to an ongoing operational issue which could result in the reformation of a gas pocket. However, the SIT identified that future RHR quarterly pump runs could move additional amounts of gas to monitored locations. The licensee was made aware of this possibility by the SIT and appropriate precautions were taken. The SIT confirmed that activities which could lead to development or migration of gas in the subject areas were not in progress or planned until the licensee fully understood the potential impact of such activities. In addition, the inspectors reviewed the current operability

evaluations for the small amounts of known gas remaining in the system as well as the results of daily ultrasonic testing (UT) piping examinations and concluded the licensee was taking appropriate measures to address the problem.

03 Event Description, Immediate Corrective Actions, and Current Operability Analysis

03.01 Condition Summary and Immediate Corrective actions

On April 3, 2002, while performing quarterly preventative maintenance UT examinations of the chemical and volume control system (CVCS) piping, gas was detected in the 8 inch CSIP suction line from the RWST in an inverted U-bend near check valve 1CS-294. This piping is located on the mezzanine just above the three CSIPs, upstream of the normally closed RWST injection flow path supply valves. On a safety injection (SI) signal, these supply valves open the suction of the CSIPs to the RWST. The primary concern for the accumulation of gas in this piping is the potential to air bind or degrade the CSIPs and diminish their capability to mitigate a design basis accident. Following identification of gas, the licensee entered Technical Specification (TS) 3.0.3, took actions to vent the majority of the gas by loosening the bonnet bolts on check valve 1CS-294, and performed follow-up UT to assure venting. The licensee estimated the amount of gas at the 1CS-294 location to be approximately 3.5 cubic feet. The licensee declared the pumps operable when the venting was complete and exited the applicable TS action statement. Post venting UT showed that two small pockets of gas totaling approximately 0.02 cubic feet remained adjacent to 1CS-294. The licensee initiated daily UT examinations of suspect piping which, throughout the inspection, did not indicate reformation of the gas at the 1CS-294 location. An expanded extent of condition UT was also initiated by the licensee.

On April 6, the licensee identified an additional pocket of gas estimated at 0.3 cubic feet in the same line beneath the 1CS-294 location in a horizontal run of piping. Venting of this location was not performed due to a lack of high point vent.

03.02 Current Operability

The SIT reviewed Action Requests (AR) 58670-8 and 58835 which addressed system operability with respect to the small amount of gas left in system at the location of 1CS-294 and in the piping just beneath this location. The licensee's CSIP vendor does not provide an allowable limit for any amount of slug flow of gas through operating pumps but does provide for a limit of 5 percent void fraction for an unspecified period of time for bubble flow. The inspectors verified that the licensee's analyses showed non-slug flow parameters (breakup of the gas pocket) and void fractions less than 5 percent which supported system operability per the CSIP vendor recommendations. Based on adequacy of daily UT, initial venting of gas at 1CS-294, and the licensee's operability determination, the SIT determined that the licensee's current operability assessment of the CSIPs was adequate.

03.03 System Walkdown

The SIT also performed a review of the SI system configuration from the RWST and connecting systems by walking down these systems and reviewing drawings to obtain an understanding of the system design. The SIT reviewed the ECCS suction lines for high

point configurations, evaluated as-constructed line slopes, and made direct observations of the licensee's UT methods. During the walkdown, the SIT identified a CSIP common suction pipe high point which was not being evaluated for gas accumulation from a gravity feed boration line. The licensee subsequently indicated this area would be incorporated into their UT evaluation plan. The line, used during a loss of offsite power scenario, represented a small accumulation area and was normally isolated; however, it could be used as an additional high point UT monitoring location.

03.05 Sequence of Events Related to Gas Accumulation

The inspectors developed the following sequence of events for the gas accumulation based on the most probable root cause determination discussed in Section 04.01:

Date	Condition/Event
11/19/01	ECCS Systems were filled and vented following RHR outage maintenance. Confirmed filled by UT.
12/25/01	Due to a conoseal leak, the licensee had to cool down from mode 3 to mode 5 utilizing Train A RHR.
12/29/01	During shutdown cooling, VCT pressure was maintained higher than normal range (40+ psig) to expedite adjustment of reactor coolant system (RCS) hydrogen concentration. Normal VCT pressure is 20-30 psig as required by procedure the OP-107.
12/30/01	A RHR was depressurized and cooled down. ECCS low head safety injection (LHSI) restoration complete. This potentially allowed dissolved gases in RHR system to come out of solution and accumulate in the A RHR heat exchanger (HX).
12/31/01	Unit entered mode 2.
01/6/02	Monthly ECCS venting performed (OST-1107).
01/9/02	Licensee performed quarterly A RHR full flow surveillance test. This potentially moved a portion of the gas from the A RHR HX to the RHR discharge test line (this line is common to both trains).
01/9/02	Quarterly UT preventive maintenance (PM) for monitoring of CSIP suction piping showed pipe section at check valve 1CS-294 full of water.
02/19/02	Licensee performed quarterly B RHR full flow surveillance. Due to the configuration of the B RHR suction tap and discharge test line tap on the RWST supply header, the gas potentially migrated to the CSIP ECCS suction piping. This pipe taps vertically off the top of the RWST supply header between the above mentioned RHR taps.

04/3/02 Quarterly UT showed a gas bubble at 1CS-294. 1CS-294 bonnet was loosened and gas in piping was vented and mostly removed. During venting an explosive meter registered positive indicating some hydrogen.

04/6/02 An additional gas pocket discovered in CSIP piping upstream (lower elevation) of 1CS-294.

04/3-10/02 Daily UT has not indicated further accumulation of gas.

04 Review of Root Cause Analysis

04.01 Independent Root Cause Determination

The inspectors performed a detailed, independent review of the licensee's information, and conducted interviews with numerous personnel, to confirm the sequence of events both before and after the identification of the gas accumulation, to assess the established basis for current operability, and establish a probable root cause for the gas accumulation.

The SIT determined that the probable root cause of gas identified at 1CS-294 check valve was degassing of RHR loop piping without appropriate elimination of the gas from the RHR heat exchangers or adequate system venting. Specifically, following RHR sweep and vents during the refueling outage (RFO) 10, the unit was taken to Mode 3 operation. However, the unit was subsequently taken to Mode 5 to facilitate repairs to a leaking conoseal. Following these activities, the RHR system was cooled and depressurized, which allowed degassing to occur in the RHR loop piping. Subsequent sweeping and venting of the RHR system was not performed to remove the gas, as degassing was not anticipated by the licensee or incorporated into system operating procedures. Based on the aforementioned root cause and the past operability reviews discussed in Section 06, the inspectors identified the following finding.

A Green Finding dispositioned as a non-cited violation (NCV) of TS 6.8.1 was identified for an inadequate operations procedure, which resulted in the operation of Shearon Harris with a significant quantity of gas in the common RWST suction supply line to the ECCS CSIPs.

This condition adverse to quality existed for approximately 45 days beginning February 19, 2002 when the B train full flow RHR surveillance test was performed. It was during this evolution that the team concluded that the gas was transported to the CSIP suction piping. Operations Procedure OP-111, Residual Heat Removal System, failed to provide adequate instructions such that ECCS filling and venting, for the RHR system and HXs, was not performed when system conditions warranted sweeping and venting of gas due to changing plant conditions. The licensee's procedures and risk assessments for returning the RHR system to operable status did not incorporate the potential for gas accumulating in the RHR system once the system was depressurized.

The finding was more than minor because it had a credible impact on safety by reducing the reliability of the ECCS system due to ingestion of gas. Additionally, if left uncorrected, a slightly higher gas accumulation could result in redundant trains of the

ECCS being inoperable. The finding was of very low safety significance because mitigation systems were concluded to be past operable based on an engineering analysis performed by the licensee. This issue is captured in the licensee's corrective action program as AR 58670-8. Because the finding is of very low safety significance and the finding was captured in the licensee's corrective action program, this finding is being treated as an NVC, consistent with Section VI.A.1 of the NRC Enforcement Policy and identified as NCV 50-400/02-06-01: Inadequate ECCS Venting Procedures. A second example of this finding is discussed in Section 05.04.

The SIT also identified a contributing cause to the problem. Specifically, during the later stages of the shutdown cooling operation, the VCT pressure was maintained at higher pressure (approximately 42 psig) than the specified normal operating range of 20 - 30 psig. This was done to expedite establishing the appropriate RCS hydrogen concentration prior to mode 2. This also put higher dissolved gases (hydrogen and nitrogen) in the RHR system. When shutdown cooling was subsequently secured and the RHR system cooled down and depressurized, these gases came out of solution and collected in the A RHR piping and HX. The licensee did not recognize the potential for this degassing scenario and did not perform the venting portions of operating procedure OP-111, Residual Heat Removal System, to sweep and vent gas from the A RHR HX. The SIT concluded that the failure of the licensee to perform adequate sweeping and venting of the RHR system following a return to Mode 5 was the probable cause of the identified gas. The operation of the higher than normal VCT pressures exacerbated the ultimate volume/rate of degas in the RHR system during this period. The licensee captured this problem in AR 58670 for resolution.

The SIT additionally concluded that during non-routine evolutions; RHR operations, plant conditions changes, and chemistry requirements be coordinated and prioritized by the licensee such that the potential for gas accumulation in ECCS piping be minimized. The licensee should consider the need for sweeping and venting the RHR system per OP-111 as part of system restoration based on plant conditions while the system was in service.

04.02 Overall Root Cause Evaluation

The SIT reviewed licensee investigations conducted for the root cause, extent of condition, and past operability of this issue. The SIT concluded that, overall, the licensee conducted a comprehensive review of the gas accumulation issue. Fault tree development appeared to be broad based and considered known gas generation/accumulation root causes. The team identified one potential area for gas ingestion into operating CSIPs that the licensee had not considered, which is discussed in Section 05.04.

05 Historical Review of Gas Accumulation Issue at Harris

05.01 Review of Maintenance and Testing Activities for the Potential to Accumulate Gas

The inspectors reviewed and assessed the licensee's maintenance work orders (WO) and restoration procedures performed on the RHR system during refueling outage RFO-10 for the potential for introducing air into the CSIP suction piping. The licensee isolated

and drained the RHR suction piping to perform work orders WO 88578 and 88579 to remove foreign material from the system. Subsequently, the isolation boundary was expanded utilizing freeze seals to perform WO 88481 and 88483 to install bonnet relief lines on the RWST to RHR pump isolation valves. Upon completion of the maintenance, the freeze seals were removed and the RHR system and CSIP suction piping filled and vented per OP-111 from the RWST. The licensee recognized the potential for air being trapped at 1CS-294 following these procedures as this piping is above and taps into the RWST supply header. This was confirmed by the licensee during post filling UT of the pipe. The licensee performed a series of flushes until all CSIP suction piping sections vulnerable to gas accumulation were verified full by UT, including the piping at 1CS-294. The SIT concluded that restoration procedures following RHR maintenance were adequate in filling and venting the systems and was not the source of the gas found at 1CS-294 on April 3, 2002.

05.02 Review of Previous Indications of Gas Accumulation

The SIT reviewed and assessed previous operating and maintenance history of the CSIPs for indications of previous air intrusion problems.

Historical reviews of CSIP equipment failures identified a shaft failure in 1993 and a thrust bearing failure in 2000. The root cause for the shaft failure was attributed to high cycle fatigue failure. Although no direct link was made to ingestion of gas through the CSIP, ingestion of gas quantities in excess of vendor recommended limits through operating CSIPs has been indicated through industry operating experience to initiate cracking of pump shafts, which could propagate over time into a premature shaft failure. Regarding the thrust bearing failure, the licensee determined that the root cause was either a gas ingestion transient or a momentary loss of the forced lube oil to the bearing. The SIT did not have sufficient evidence to determine if these failures were related to the current issue.

The SIT conducted a search of related problem identification reports, reviewed completed performances of OST-1107, ECCS Flow Path and Piping Filled Verification, interviewed operations and engineering personnel, and walked down various components on related systems. The inspectors also reviewed current CSIP response curves and other plant data which would reflect the ability of the pumps to meet their intended safety function. The reviews did not identify any significant evidence of identified or unaddressed waterhammer, damage to RHR/CSIP pumps and piping supports, or other physical evidence of a long term issue of gas accumulation problems. In addition, the SIT noted that operators were generally stationed at the pumps during routine starting evolutions to monitor for adverse conditions. Based on the above, no significant performance anomalies were identified indicative of current degradation from gas related issues.

05.03 Current System Monitoring, Venting, and Ability to Identify and Eliminate Gas Accumulation

The SIT reviewed and discussed the results of periodic venting that was being performed on the ECCS system with the licensee. Shearon Harris TS require a monthly periodic vent of the ECCS pump discharge piping. The purpose of this requirement is to

ensure the piping is full of water to minimize water hammer during the injection phase of a design basis accident. The TS do not require venting of the suction piping to ensure ECCS pumps are not subjected to gas binding or gas degradation issues. However, the licensee had taken several steps to address NRC Information Notices 88-23, Revisions 1 through 5, which discuss concerns with gas accumulation monitoring and elimination. Prior to this event, the licensee had concluded they were susceptible to VCT side gas issues, in that, their design utilized 11 stage CSIP mini-flow orifices which returned flow to the CSIP suctions. These orifices have been identified in industry to strip a substantial amount of gas and allow for gas accumulation to occur in various parts of the ECCS. Modifications were made in 2001 to redirect the CSIP mini-flow return to the VCT vapor space and eliminate this historical problem first identified in IN 88-23. Additionally, in 2001, the licensee began a quarterly PM to UT suspect areas (suction and discharge) for gas.

However, the SIT concluded that the Harris design had not incorporated sufficient high point vents in appropriate locations to effectively ensure suction piping is full of water. As an example, the location of the gas identified around 1CS-294 was a system high point without an installed vent. The SIT also concluded that the licensee's current process of using existing suction vents with supplemental quarterly UT provides adequate assurance that gas accumulation in the ECCS suction piping would be identified.

The inspectors identified that the licensee was not fully utilizing or maximizing a number of standard industry performance monitoring techniques which could allow for early detection of gas accumulation/generation within the ECCS system. These included:

- Monitoring CSIP balance drum flow as an indicator of pump performance. Historically, this parameter is used to evaluate whether pump transients (sweeping of gas through an operating pump) has degraded the performance of the pump.

- Monitoring ECCS pressure response hydraulic curves as an indicator of residual gas accumulation in the system. This method is useful in determining whether the RHR heat exchangers are void free.

- The frequency of venting was being performed on a monthly basis while the UT inspections were being performed only quarterly.

- High point venting techniques may not allow for thorough venting, in that, the venting is performed into a portable 5 gallon container instead of a hard pipe vent to a drain location which would allow for increased flow to ensure all gas is removed.

At the end of the inspection, the licensee was considering modifications for additional suction piping vents and considering a number of long term corrective actions and enhancements to improve their ability to eliminate gas accumulation.

05.04 Potential for On-line Gas Ingestion During CSIP Fill and Vent Following Maintenance

A second example of the NCV discussed in Section 04.01 of this report was identified by the NRC regarding an inadequate procedure related to restoration of an unvented CSIP to service following maintenance.

During the inspection, the inspectors reviewed the venting methods utilized by the license to fill and vent the CSIPs following certain on-line maintenance activities. The inspectors identified that the refill/venting of the C CSIP in February 2002, could have resulted in the release of an unknown quantity of gas to the suction supply for the operating CSIP. Unplanned ingestion of gas through an operating CSIP could cause significant damage or reduce the reliability of the CSIP. Ingestion of gas quantities in excess of vendor recommended limits through operating CSIPs has been indicated through industry operating experience to initiate cracking of pump shafts, which could propagate over time into a premature shaft failure.

Operating procedure OP-107, Chemical and Volume Control System, allows filling a CSIP while another is operating. The procedure instructs the throttling open of the suction valve for the unvented pump to vent the air in the pump casing to the CSIP suction header with the assumption that the air would eventually vent up through the VCT. The licensee was performing the venting of the CSIPs via the opening of the suction valve due to the lack of pump casing and suction high point vents.

The inspectors identified that, depending on which of the other two pumps is operating, system flow could pull some of the vented gas away from the VCT tap and to the suction of the operating pump. The licensee initiated AR 59194 to address this issue for future maintenance activities. The SIT concluded that the restoration of the C CSIP in February 2002 and other CSIP on-line restoration activities would not result in a gas accumulation in the location identified around 1CS-294. However, it could result in the unplanned ingestion of gas though an operating CSIP.

A Green finding that was dispositioned as a second example of NCV 50-400/02-06-01, was identified for an inadequate maintenance restoration procedure which could allow the potential movement of an unknown quantity of gas into the suction flow-path of an operating CSIP, following CSIP maintenance restoration activities. The volume of gas within the pump casing and applicable suction piping was estimated at 3.14 cubic feet at atmospheric pressure. OP-107, Chemical Volume Control System, used to perform venting of the C CSIP, incorrectly assumed that gas vented from the CSIP casing and suction supply piping would be vented from the system through the VCT supply line. The NRC determined that there was a probability that the licensee's on-line process of venting the pump would result in all or a portion of the gas being swept to the operating CSIP due to the existence of flow out of the VCT supply line, location of the operating pump, and the buoyancy effects of the gas.

The finding was more than minor because it could have had a credible impact on safety by reducing the reliability of the ECCS system by the ingestion of gas through the ECCS pumps. The finding was of very low safety significance because mitigation systems, specifically the CSIPs, have not currently exhibited a known adverse effect from this condition. This issue is captured in the licensee's corrective action program as AR 59194.

Because the finding is of very low safety significance and the finding was captured in the licensee's corrective action program, this finding is being treated as a second example of an NCV, consistent with Section VI.A.I of the NRC Enforcement Policy and identified as the second example of NCV 50-400/02-06-01: Inadequate ECCS Venting Procedure.

05.05 Recovery Ability of the Standby CSIP

The SIT reviewed and assessed the licensee's procedures for recovering the standby CSIP, if the operable CSIPs were to become air bound or failed. OP-107 provides instructions for replacing the A or B CSIP with the C CSIP. With both pumps air bound, the operators would select the procedure section for the electrical bus to which the C CSIP was already aligned. The SIT concluded that if operators were aware that A and B pumps were gas bound, venting could be initiated. However, the operators would have to evaluate and select the appropriate venting instructions provided in OP-107 prior to starting the C CSIP. The inspectors did note that the operation of the C CSIP requires the breaker to be racked in and the installed pump breaker racked out at the bus. Therefore, there was a low probability that operators would gas bind the standby pump via an immediate operator action. The SIT also concluded that procedural guidance for recovery of air binding/degradation of the operable CSIPs may not result in timely restoration of a CSIP. The licensee indicated that they would review current procedural guidance to enhance recovery of the standby pump if the other two pumps were unavailable.

06 Past Operability Reviews and Regulatory Significance

Subsequent to the end of the onsite inspection, the licensee completed their past operability review (AR 58670-10) for the gas identified in the system on April 3 and 6, 2002. The licensee contracted an independent engineering firm (Numerical Applications, Inc.) that specialized in two phase fluid flow to perform flow analysis calculations as part of the basis for the determination of past operability. A computer model of the applicable HHSI piping was developed to assess the transport of the gas into the CSIPs for various design-basis cases. This modeling showed that some cases would have resulted in a gas void fraction at the pump suction in excess of the vendor-recommended upper limit of five percent void fraction. For these cases, the pump vendor (Flowserve) evaluated the results of the modeling and concluded that at least one CSIP would remain functional in each case. Regardless of the pump configuration, type of accident, and single failure considered, at least one CSIP would continue to operate following ingestion of the gas found in the CSIP suction piping. Based on review of the licensee's evaluation, the SIT concluded past operability of the RHR and HHSI systems was not affected by the gas voids found in the ECCS piping.

07 Management Meetings

The inspectors presented the inspection results to Mr. R. Duncan and other members of licensee management at the conclusion of the inspection on April 12, 2002 and May 8, 2002.

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

PARTIAL LIST OF PERSONS CONTACTED

Licensee

D. Alexander, Nuclear Assessment Manager
G. Attarian, Engineering Support Services Manager
J. Caves, Licensing Supervisor
R. Duncan, Director of Site Operations
B. Waldrep, Plant General Manager
T. Hobbs, Operations Manager
C. Kamilaris, Self Evaluation Unit Supervisor
M. Munroe, Training Manager
T. Natale, Outage and Scheduling Manager
J. Scarola, Harris Plant Vice President
P. Summers, Environmental & Radiation Control Manager
M. Wallace, Senior Analyst, Licensing

NRC

J. Brady, Senior Resident Inspector, Harris
B. Bonser, Chief, Branch 4, Division of Reactor Projects

ITEMS OPENED, CLOSED AND DISCUSSED

Opened and Closed During this Inspection

50-400/02-06-01	NCV	Inadequate ECCS Venting Procedures. (Sections 04.01, 05.04)

LIST OF DOCUMENTS REVIEWED

Condition Reports/ Action Requests

CR/AR No.	Description/Title
17895-11	Evaluate Potential Gas Binding of CSIPs
20822, 20823	Revise CM-0019, Maintenance Procedures for Charging Safety Injection Pumps
24123	Reviews for three significant equipment issues failed to bound the problems.
58670-8, 58670-10	Gas Found in the CSIP Suction Piping From RWST
58700	Technical Specifications 3.0.3 Entry
58835	Gas Found in the CVCS Suction Piping From RWST
59140	Potential Procedural Problem - RHR Venting

Procedures

CM-M0019, Charging Safety Injection Pump Disassembly and Maintenance

CM-M0169, Freeze Seal Procedure

GP-002, Normal Plant Heatup from Solid to Hot Subcritical Mode 5 to Mode 3

OST-1107, ECCS Flow Path and Piping Filled, Verification Monthly Interval

OP-107, Chemical and Volume Control System

OP-111, Residual Heat Removal System

OP-156.02, AC Electrical Distribution

NDEP-0408, Ultrasonic Thickness Measurement (A-Scan)

Drawings

CPL-2165/S-1304, Chemical & Volume Control System

CPL-2165/S-1305, Chemical & Volume Control System

CPL-2165/S-1310, Safety Injection System

CPL-2165/S-1324, Residual Heat Removal System

CPL-2165/S-0550, Containment Spray System

Westinghouse 8378024, Swing Check Valve

Engineering Documents

Calculation HNP-F/PSA-0021, Impact of Degraded Charging Safety Injection Pump on Overall Risk Profile, dated 6/22/01

AR 29272, SOER Implementation

Operating Experience Issue Documents/ NRC Information Notices/ NRC Generic Letters

NRC Information Notice 88-23, Potential for Gas Binding of High pressure Safety Injection Pumps During a Loss-Of-Coolant Accident

SOER 97-01, Potential Loss of High Pressure Injection and Charging Capability from Gas Intrusion

Previously Identified NRC Findings

Item ID No.	AR No.	Title
50-400/2000-04	24123	Problem Identification and Resolution Errors (Cross-Cutting Issue)
50/400-00-03-03	22287	Technical Specification Violation Due to Inoperable Emergency Core Cooling System Flowpath
50/400-00-06-01	27038 & 30360	Inadequate Operability Evaluation For ECCS Throttle Valve

Licensee Event Reports

2001-003-00 1A-SA Residual Heat Removal Suction Line Debris - Nonconforming Condition

2000-007-02 Technical Specification Violation Due to Inoperable Charging Safety Injection Pump

Other Documents

Operations Night Order issued April 12, 2002 regarding precautions to preclude additional gas void generation/accumulation.
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