UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

January 2, 2014

Mr. Thomas D. Gatlin
Vice President - Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
P.O. Box 88
Jenkinsville, SC 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - NRC EVALUATION OF CHANGES, TESTS, AND EXPERIMENTS AND PERMANENT PLANT MODIFICATIONS INSPECTION REPORT 05000395/2013008

Dear Mr. Gatlin:

On November 22, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at your V.C. Summer Nuclear Station Unit 1. On December 17, 2013, the NRC inspectors discussed the results of this inspection with Mr. Robin Haselden and other members of your staff. Inspectors documented the results of this inspection in the enclosed inspection report.

NRC inspectors documented two findings of very low safety significance (Green) in this report. Both of these findings involved violations of NRC requirements. The NRC is treating these violations as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the violations or significance of these NCVs, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. 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 V.C. Summer plant.

If you disagree with a cross-cutting aspect assignment in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region II; and the NRC resident inspector at the V.C. Summer plant.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response, if any, will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Agencywide Documents Access and

Management 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

Rebecca L. Nease, Chief
Engineering Branch 1
Division of Reactor Safety

Docket No.: 50-395
License No.: NPF-12

Enclosure:
Inspection Report 05000395/2013008
w/Attachment: Supplementary Information

cc: Distribution via Listserv

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ADAMS: x Yes ACCESSION NUMBER:_____ x SUNSI REVIEW COMPLETE x FORM 665 ATTACHED

OFFICE	DRS RII	DRS RII	DRS RII	DRS RII	DRS RII	DRP RII	
SIGNATURE	**RA**	**RA**	**Via email**	**Via email**	**RA**	**RA**	
NAME	**E. Stamm**	**N. Coovert**	**A. Alen**	**T. Fanelli**	**R. Nease**	**M. King**	
DATE	**12/17/2013**	**12/17/2013**	**12/17/2013**	**12/17/2013**	**12/26/2013**	**12/26/2013**	
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

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Management 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

Rebecca L. Nease, Chief
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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No.:	50-395
License No.:	NPF-12
Report No.:	05000395/2013008
Licensee:	South Carolina Electric & Gas (SCE&G) Company
Facility:	Virgil C. Summer Nuclear Station
Location:	P.O. Box 88 Jenkinsville, SC 29065
Dates:	November 4 – November 22, 2013
Inspectors:	E. Stamm, Senior Reactor Inspector (Team Leader) N. Coovert, Reactor Inspector A. Alen, Reactor Inspector T. Fanelli, Reactor Inspector
Approved by:	Rebecca L. Nease, Chief Engineering Branch 1 Division of Reactor Safety

Enclosure

SUMMARY

IR 05000395/2013008; 11/04/2013-11/22/2013; Virgil C. Summer Nuclear Plant, Unit 1; Evaluations of Changes, Tests, and Experiments and Permanent Plant Modifications.

This report covers a two-week, on-site inspection by one senior reactor inspector and three reactor inspectors. Two Green non-cited violations (NCVs) were identified. The significance of inspection findings are indicated by their color (Green, White, Yellow, Red) using the NRC Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," dated June 2, 2011. Cross-cutting aspects are determined using IMC 0310, "Components Within the Cross Cutting Areas," dated October 28, 2011. All violations of NRC requirements are dispositioned in accordance with the NRC's Enforcement Policy, revised July 9, 2013. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

NRC-Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

Green: The team identified a non-cited violation of 10 CFR 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to review the application of design processes prescribed for the heating, ventilation, and air conditioning (HVAC) system chillers for suitability, to assure that appropriate quality standards were specified and included in design documents, and to ensure that deviations from such standards were controlled. This was a performance deficiency. The licensee entered this issue into their corrective action program as condition reports 13-04803, 13-04804, and 13-04665. The licensee performed an operability evaluation and determined the 'A' chiller was inoperable with the two remaining operable chillers providing compliance with technical specifications.

The performance deficiency was more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the failure to establish adequate design control measures that required the review of applicable design processes for suitability resulted in a failure to meet specified quality objectives, which decreased the availability and reliability of the 'A' chiller. The team determined the finding to be of very low safety significance (Green) because although the finding was a deficiency affecting the design of a mitigating system, structure, or component which failed to maintain its operability, it did not represent a loss of the system function or a single train for greater than its technical specification allowed outage time. The HVAC system remains operable with the two remaining chillers, 'B' and 'C', in operation. The team determined the finding involved the cross-cutting aspect of supervisory and management oversight, within the Work Practices component of Human Performance area which states that, "the licensee ensures supervisory and management oversight of work activities, including contractors, such that nuclear safety is supported." Specifically, V. C. Summer management did not ensure management oversight of work activities that provided for the administration of quality assurance necessary to support nuclear safety. [H.4(c)] (Section 1R17.b.i)

Cornerstone: Barrier Integrity

Green: The team identified a non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of design to prevent water hammer on the reactor building cooling unit (RBCU) service water (SW) return lines following a potential design basis accident and a delayed closure of SW valves 3107A/B. This was a performance deficiency. The licensee entered this issue into their corrective action program as condition reports 13-04877 and 13-05139. The licensee restricted the alignment of SW to the RBCUs during normal plant operation until changes to procedures or additional control circuit interlocks between 3107A/B and the service water booster pump (SWBP) could be implemented to mitigate the consequences of a delayed closure of the valves.

The performance deficiency was more than minor because it was associated with the Structures, Systems and Components and Barrier Performance attribute of the Barrier Integrity cornerstone and affected the cornerstone objective to provide reasonable assurance that physical design barriers (i.e. containment) protect the public from radionuclide releases caused by accident or events. Specifically, startup of the SWBP following a delayed closure of 3107A/B would cause a water hammer event on the RBCU SW return lines inside containment. The water hammer loads would challenge SW piping and/or valve integrity and could compromise containment isolation. The team determined the finding to be of very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment, containment isolation system, or heat removal components, and it did not involve a reduction in function of hydrogen igniters in the reactor containment. No cross-cutting aspect was assigned to this finding because the team determined that the cause of the finding was not indicative of current licensee performance. (Section 1R17.b.ii)

Licensee-Identified Violations

None

REPORT DETAILS

1. REACTOR SAFETY

Cornerstones: Initiating Events, Mitigating Systems, and Barrier Integrity

1R17 Evaluations of Changes, Tests, Experiments and Permanent Plant Modifications (71111.17T)

a. Inspection Scope

Evaluations of Changes, Tests, and Experiments: From November 4 – 22, 2013, the team reviewed eight safety evaluations performed pursuant to Title 10, *Code of Federal Regulations* (CFR) 50.59 to determine if the evaluations were adequate and that prior NRC approval was obtained as appropriate. The team also reviewed 17 screenings where licensee personnel had determined that a 10 CFR 50.59 evaluation was not necessary. The team reviewed these documents to determine if:

- the changes, tests, or experiments performed were evaluated in accordance with 10 CFR 50.59 and that sufficient documentation existed to confirm that a license amendment was not required;
- the safety issues requiring the changes, tests or experiments were resolved;
- the licensee conclusions for evaluations of changes, tests, or experiments were correct and consistent with 10 CFR 50.59; and
- the design and licensing basis documentation used to support the change was updated to reflect the change.

The team used, in part, Nuclear Energy Institute (NEI) 96-07, "Guidelines for 10 CFR 50.59 Implementation," Revision 1, to determine acceptability of the completed evaluations, and screenings. The NEI document was endorsed by the NRC in Regulatory Guide 1.187, "Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments," dated November 2000. The team also consulted Part 9900 of the NRC Inspection Manual, "10 CFR Guidance for 10 CFR 50.59, Changes, Tests, and Experiments," dated March 2001.

This inspection constituted eight samples of evaluations and 17 samples of screenings as defined in Inspection Procedure (IP) 71111.17-04.

Permanent Plant Modifications: From November 4 - 22, 2013, the team reviewed 11 permanent plant modifications that had been installed in the plant during the last three years. The 11 modifications reviewed are listed below:

- Engineering Change Request (ECR) 50466/50466A/50466B, Diesel Generator Governor Replacement
- ECR 50567O, Major Revision - Addition of Service Water Vacuum Relief Valves and Replacement of XVG03107A/B-SW
- ECR 50577, Diesel Air Compressor Auto-Start Addition
- ECR 50585K/50585M/50585Q, Major Revision - Chiller Replacement
- ECR 50592D, Major Revision - Main Control Board/Simulator
- ECR 50677, RCS Leak Detection Improvements
- ECR 50725, XVC08411-CS Volume Control Tank Inlet Header Check Valve

- ECR 50746, Switchyard - Upgrade 230kV Breaker Monitoring Main Control Board
- ECR 50747, Bus 1 Upgrades
- ECR 50768/50768B, Major Revision - Power Operated Relief Valve Qualification for Inadvertent Safety Injection
- ECR 50772A, Upgrades to Bus 2 (Electrical)

The modifications were selected based upon risk significance, safety significance, and complexity. The team reviewed the modifications selected to determine if:

- the supporting design and licensing basis documentation was updated;
- the changes were in accordance with the specified design requirements;
- the procedures and training plans affected by the modification had been adequately updated;
- the test documentation as required by the applicable test programs had been updated; and
- post-modification testing adequately verified system operability and/or functionality.

The team also used applicable industry standards to evaluate acceptability of the modifications and performed walkdowns of accessible portions of the modifications. Documents reviewed are listed in the Attachment.

This inspection constituted 11 permanent plant modification samples as defined in IP 71111.17-04.

b. Findings

i Design the Safety-related Chiller Modification to Appropriate Quality Standards

Introduction: The team identified a Green non-cited violation (NCV) of 10 CFR 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to review the application of design processes prescribed for the HVAC system chillers for suitability, to assure that appropriate quality standards were specified and included in design documents, and to ensure that deviations from such standards were controlled. This was a performance deficiency.

Description: Plant technical specifications (TS) require two of three HVAC system chillers to meet the plant's limiting conditions for operation (LCO). The licensee re-designed the three HVAC system chillers to improve the reduced reliability caused by aging, and in addition, the licensee incorporated automation that would increase the versatility of the HVAC system. The team determined that the licensee installed the 'A' chiller first in 2011, but deferred the 'B' and 'C' chiller installations indefinitely. On August 21, 2013, the licensee submitted a licensee event report (LER), which described the 'A' chiller's failure to perform a fast transfer to an alternate power source on June 25, 2013. The team evaluated this LER and additional samples of condition reports (CRs); 11-05225, 12-05003, and 13-03124, which described design deficiencies that have challenged the 'A' chiller performance since its installation. The team noted that the software design deficiencies described in CR-12-05003 were caused from the field changes implemented to correct previous software design flaws found after the 'A' chiller

installation. The team noted that the licensee implemented field changes that created new, self-revealing design flaws. The team determined that the chiller's design process and implementation history increased the likelihood of automation flaws and the possibility that these flaws could generate software common cause failures (CCF). The licensee's 10 CFR 50.59 process for implementing this modification without a license amendment relied on compliance with and application of the design processes specified in the quality standards that were referenced in NEI 01-01/EPRI TR-102348, "Guideline on Licensing Digital Upgrades," Revision (Rev.) 1, Section 5.3, Assessing Digital System Dependability. NEI 01-01 indicated that compliance with Section 5.3 should provide adequate quality assurance such that automation flaws and CCFs were minimized. Additionally, NEI 01-01, Section 5.2, Defense in Depth and Diversity Analysis, indicated that a diverse means of operation could mitigate any additional risk of CCFs. Thus, the licensee engineering specification SP-951 and purchase order (PO) NU-02SR726683 required compliance with the quality standards specified in NEI 01-01, Section 5.3 and included requirements to provide a diverse means of operating the chillers.

The team determined that the plant's licensing basis did not provide for the automation of structures, systems, and components (SSCs). However, because of the specific direction in the PO to comply with the specific Regulatory Guides (RGs) and Institute of Electrical and Electronics Engineers (IEEE) standards (quality standards) referenced in NEI 01-01, Section 5.3, the team used those standards for their assessment. The team reviewed the design processes used and determined that they deviated from the design processes specified in the PO. The team's interviews with the licensee indicated that the licensee did not review the application of the design processes specified in NEI 01-01, RGs, and IEEE standards for suitability or evaluate them for the criteria addressed in the Updated Final Safety Analysis Report. In addition to the requirements in Appendix B, Criterion III, the licensee's Updated Final Safety Analysis Report, Section 3.1.2.1, specified the identification and evaluation of codes and standards to assure their applicability, adequacy, and sufficiency. The team determined that the licensee failed to apply these qualitative assessments to the design processes used in the as-built design and did not control deviations from these quality standards. The team's review of the corrective action program determined that the licensee did not identify the deviations from the PO requirements.

The following examples illustrate some of the design practices identified in the as-built design that did not meet the quality requirements in the PO. The team determined that:

- Management activities did not ensure the implementation of the specified design quality and practices addressed in the applicable quality standards.
- The design failed to implement the full scope of specified applicable life cycle activities.
- The chiller functional and software requirements specifications (SRS) were not well defined and complete, thus the SRS did not contain specific requirements necessary to address fast power transfer as identified in the LER.
- The SRS did not address applicable functional requirements from 10 CFR 50.55a, Codes and Standards, for newly designed digital SSCs (i.e. IEEE 603-1991).
- The verification and validation (V&V) activities did not meet performance and V&V independence specifications.
- V&V did not ensure that the functional requirements were well defined and complete.
- The as-built design did not provide a diverse means of operating the chillers as required by the PO.

Analysis: The licensee's failure to review the application of design processes prescribed for the HVAC system chillers for suitability, to assure that appropriate quality standards were specified and included in design documents, and to ensure that deviations from such standards were controlled was a performance deficiency and a violation of 10 CFR 50, Appendix B, Criterion III. The performance deficiency was more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective of ensuring availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Specifically, the failure to establish adequate design control measures that required the review of applicable design processes for suitability resulted in a failure to meet specified quality objectives, which decreased the availability and reliability of the 'A' chiller. The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued June 19, 2012, for Mitigating Systems Cornerstone, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined that the finding was of very low safety significance (Green) because although the finding was a deficiency affecting the design of a mitigating SSC and the SSC failed to maintain its operability, it did not represent a loss of the system function or a single train for greater than its TS allowed outage time. The HVAC system remains operable with the two remaining chillers, 'B' and 'C', in operation. The team determined the finding involved the cross-cutting aspect of supervisory and management oversight, within the Work Practices component of Human Performance area which states that, "the licensee ensures supervisory and management oversight of work activities, including contractors, such that nuclear safety is supported." Specifically, V. C. Summer management did not ensure management oversight of work activities that provided for the administration of quality assurance necessary to support nuclear safety. [H.4(c)].

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," states, in part, to review for suitability the application of processes that are essential to safety-related functions of the structures, systems and components and to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Contrary to the above, since May 25, 2006, the licensee failed to review for suitability the application of processes that were essential to the safety-related functions of the HVAC system chillers when they were automated and failed to control deviations from such standards. As a result, on June 25, 2013, the 'A' chiller malfunctioned during a fast bus transfer to an alternate power source. The licensee performed an operability evaluation and determined the 'A' chiller was inoperable; however, the 'B' and 'C' chillers remained operable to meet the requirements of TS LCO. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as CRs 13-04803, 13-04804, and 13-04665. (NCV 05000395/2013008-01, Failure to Design the Safety-related Chiller Modification to Appropriate Quality Standards)

ii Failure to Prevent a Water Hammer Event in the SW RBCU Discharge Piping

Introduction: The team identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of design to prevent water hammer on the reactor building cooling unit (RBCU) service water (SW) return lines following a potential design basis accident and a delayed closure of SW valves 3107A/B. This was a performance deficiency.

Description: The RBCUs are containment air coolers that provide reactor building cooling by recirculating the containment atmosphere across air-to-water heat exchangers. There are two system alignments for the cooling of the RBCUs: via the non-safety-related Industrial Cooling (IC) system, or the safety-related SW system. The IC alignment is the normal plant operating alignment and it is automatically transferred to the SW system after a safeguards actuation signal. In the SW cooling alignment, the SW booster pumps (SWBPs) feed the RBCU header via opened 3106A/B (RBCU SW supply) and 3107A/B (RBCU SW return) valves. The system is typically in the SW alignment during SW system testing and IC system maintenance; however, there are no restrictions to limit the SW cooling alignment during normal plant operation.

Generic Letter (GL) 96-06, "Assurance of Equipment Operability and Containment Integrity during Design Bases Accident Conditions," dated September 30, 1996, requested that licensees evaluate cooling water systems that serve containment air coolers to ensure, in part, that they were not vulnerable to water hammer conditions. These cooling water systems were not designed to withstand the effects of water hammer and corrective actions may have been needed to satisfy system design and operability requirements. The licensee evaluated their as-built system and identified that the RBCU SW cooling alignment at the onset of a design basis loss of offsite power (LOOP) event would result in the most severe water hammer conditions. In this alignment, the LOOP event will de-energize the SWBPs and the 3107A/B motor operated valves (MOVs) would fail open. Because the RBCU is at a higher elevation than the 3107A/B valves, the column of water in the piping downstream of the RBCUs would gravity drain down to the SW pond and form a large void in the piping. Upon restart of the SWBPs, sequenced approximately 41 seconds after the LOOP, the void would rapidly collapse creating a water hammer that could challenge SW piping and/or valve integrity inside containment. A failure of the SW piping inside containment would compromise containment isolation and could invalidate containment analytical assumptions.

In order to mitigate a water hammer event in this alignment, the licensee made several plant modifications. One of the modifications was the replacement of the 3107A/B MOVs with fast-closing air operated valves required to close in seven seconds upon de-energizing of the SWBPs. The fast valve closure is designed to trap water in the high points above the valve and prevent void formation and water hammer upon re-energizing the SWBPs. To address single failure design requirements with respect to containment integrity, the licensee installed interlocks within the control circuits of 3107A/B and their associated SWBP to prevent the pump from starting if the valve had not reached the full closed position. Additionally, a delayed closure of 3107A/B was evaluated. Should 3107A/B close at a later time, the SWBP may start and cause a water hammer event. To mitigate a delayed closure of 3107A/B, in January 2008, the licensee made procedural changes (per engineering change request No. 50567B) to require the operators to immediately place the SWBP in 'pull-to-lock' such that the pump doesn't start following a slow closure of 3107A/B.

The team reviewed procedure EOP-1.0, "Reactor Trip/Safety Injection Actuation," Rev. 26, which contained the procedural changes to mitigate a delayed closure of 3107A/B, and determined that the applicable procedural steps did not ensure that a delayed closure of 3107A/B would be mitigated. Specifically, Step 7, which would be reached approximately two minutes into the event, directed the operators to verify both SWBPs were running. If a pump was not running, operators then validated if the failure to run

was due to 3107A/B not being fully closed. If the valve was verified closed, the procedure directed the manual start of the pump. The team determined that if the valve closed sometime after the required seven seconds and before the operators reached Step 7, the operator would be unaware of the delayed closure of the valve and would take manual action to start the pump, causing a water hammer condition. Additionally, the team identified that in the event of a LOOP coincident with a loss of coolant accident, while in the SW alignment, the safeguards actuation signal would seal-in the start signal that energizes the SWBPs after it is sequenced to start. Because the pump start signal would seal-in, it would automatically start once 3107A/B finally closes and would cause a water hammer event.

The licensee entered the issue into the corrective action program as CR-13-04877 and CR-13-05139 and restricted the alignment of SW to the RBCUs during normal plant operation until changes to procedures or additional control circuit interlocks between 3107A/B and the SWBP could be implemented to mitigate the consequences of a delayed closure of the valves. Additionally, the team reviewed 3107A/B closing stroke time test results for the last three years, and verified the valves had always stroked within the required time, showing no adverse trend and thus, prior to the team's identification of the performance deficiency, this issue would not have resulted in a water hammer event that would have challenged containment integrity.

Analysis: The licensee's failure to verify the adequacy of design to prevent water hammer on the RBCU SW return lines following a design basis accident and a delayed closure of SW valves 3107A/B was a performance deficiency and was contrary to Criterion III, "Design Control," of Appendix B to 10 CFR Part 50. The performance deficiency was more than minor because it was associated with the SSC and Barrier Performance attribute of the Barrier Integrity cornerstone and affected the cornerstone objective to provide reasonable assurance that physical design barriers (i.e. containment) protect the public from radionuclide releases caused by accident or events. Specifically, startup of the SWBP following a delayed closure of 3107A/B would cause a water hammer event on the RBCU SW return lines inside containment. The water hammer loads would challenge SW piping and/or valve integrity and could compromise containment isolation. The team used IMC 0609, Att. 4, "Initial Characterization of Findings," issued June 19, 2012, for Barrier Integrity Cornerstone, and IMC 0609, App. A, "The Significance Determination Process (SDP) for Findings At-Power," issued June 19, 2012, and determined the finding to be of very low safety significance (Green) because the finding did not represent an actual open pathway in the physical integrity of reactor containment, containment isolation system, or heat removal components, and it did not involve a reduction in function of hydrogen igniters in the reactor containment. No cross-cutting aspect was assigned to this finding because the team determined that the cause of the finding was not indicative of current licensee performance.

Enforcement: Title 10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires, in part, that design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Contrary to the above, since January 7, 2008, the licensee failed to verify the adequacy of design to prevent water hammer on the RBCU SW return lines following design bases accidents involving a LOOP and a delayed closure of SW valves 3107A/B. Failure of the RBCU SW return lines would compromise containment isolation and provide a direct leakage path to the outside environment. The licensee restricted the alignment of SW to

the RBCUs during normal plant operation until changes to procedures or additional control circuit interlocks between 3107A/B and the SWBP could be implemented to mitigate the consequences of a delayed closure of the valves. This violation is being treated as an NCV, consistent with Section 2.3.2 of the Enforcement Policy. The violation was entered into the licensee's corrective action program as CRs 13-04877 and 13-05139. (NCV 05000395/2013008-02, Failure to Prevent a Water Hammer Event in the RBCU SW Discharge Piping)

4OA3 Followup of Events and Notices of Enforcement Discretion

(Closed) Licensee Event Report (LER) 05000395/2013-003-00: Trip Setpoint Renders Chiller and Control Room Emergency Filtration Inoperable

On June 25, 2013, with the plant in Mode 1, the 'A' Chiller shut down during a fast bus transfer of its 7.2kV bus power supply, from the normal to the alternate power source, due to the tripping of two compressor motor molded case circuit breakers. The licensee entered this problem into their corrective action program as CR-13-02694 and revised the breaker settings using their nonconformance program. The inspectors reviewed the aspects relating to design concerns and the licensee's corrective actions. The enforcement aspects of this LER are discussed in Section 1R17.b.i of this report. This LER is closed.

4OA6 Meetings, Including Exit

On November 22, 2013, the team presented preliminary inspection results to Mr. Thomas Gatlin and other members of the licensee's staff. On December 17, 2013, the team presented the final inspection results to Mr. Robin Haselden and other members of the licensee's staff. The team verified that no proprietary information was retained by the inspectors or documented in this report.

ATTACHMENT: SUPPLEMENTARY INFORMATION

SUPPLEMENTARY INFORMATION

KEY POINTS OF CONTACT

Licensee personnel
T. Gatlin, Vice President
D. Bryson, Nuclear Engineering
C. Calvert, Design Engineering Manager
T. Fanguy, Electrical Engineer
J. Garza, Licensing Supervisor
R. Haselden, Organization Effectiveness General Manager
W. Martin, Licensing
M. Moore, Licensing Supervisor
M. Morgan, Engineering
S. Shealy, Design Engineering Supervisor
W. Taylor, Licensing
B. Thompson, Licensing Manager

NRC personnel
R. Nease, Chief, Engineering Branch 1, Division of Reactor Safety
J. Reece, Senior Resident Inspector, Summer
E. Coffman, Resident Inspector, Summer

LIST OF ITEMS OPENED AND CLOSED

Opened and Closed

05000395/2013008-01	NCV	Failure to Design the Safety-related Chiller Modification to Appropriate Quality Standards (Section 1R17.b.i)
05000395/2013008-02	NCV	Failure to Prevent a Water Hammer Event in the RBCU SW Discharge Piping (Section 1R17.b.ii)

Closed

05000395/2013-003-00	LER	Trip Setpoint Renders Chiller and Control Room Emergency Filtration Inoperable (Section 4OA3)

LIST OF DOCUMENTS REVIEWED

10 CFR 50.59 Evaluations

CR-11-03227, Action 6, Eval No. 2011-0003, Accumulator Pressure Monitoring for XVG01611A/B/C, Rev. 0, dated 8/8/11
CR-13-01463, Westinghouse Notification to VCS of nonconforming condition with Zirlo coil material for grid straps, dated 4/29/13
ECR 50567L, Eval No. 2006-0001, Major Revision - Vacuum Relief Vlvs to SW Discharge Piping from RBCUs, dated 1/9/10
ECR 50585K/50585M, Eval No. 2010-0001, Major Revision - Chiller Replacement, dated 3/10/11
ECR 50613, Eval No. 2009-0001, XFL-8A/8B Vent and Drain Valves Replacement, Rev. 0
ECR 50846, Eval No. 2012-0003, Weld Repair Contingency for RV Head Examination (RF20), Rev. 0, dated 10/29/12
MRS-SSP-2651-CGE-LTA, Eval No. 2010-002, Cask Loading Procedure, dated 10/21/10
STD-OP-1992-6105 (Rev 6), RTN Insert Flexible Clipping Tool Operating Procedure, dated 1/11/10

10 CFR 50.59 Screenings

ECR 50539, Replacement of Obsolete Exide 15kVA UPSs (Ref. CER# 03-1196) Replace XIT 5909 & 5910 - dated 3/6/10ECR 50592E, Major Revision - New Cable Tray and Penetrations - Turbine and Control Building, dated 7/7/10
ECR 50700, Alternate AC Line Relocation, dated 3/24/08
ECR 50723, Generic Letter 08-01 Vent Line Additions, Rev. 0
ECR 50851, Determ Circuit ESM361X & Recalibrate OC Relay of XSW1B-12, dated 10/16/12
ECR 70830/70830A, Replace Electric Fire Pump Controller, dated 2/13/06
ECR 70926, Reactor Vessel Head Effective Degradation Year Calculation, Cycle 16, dated 10/23/06
ECR 71346, XCX5201 & 5202 Diesel Control Panel Correction for FO Xfer Pump A&B Switch Label to Include Pump Equip ID Number, dated 2/11/10
ECR 71565, Jamesbury 8" Butterfly Model 8926PA Valves with ST-400 Actuators are Obsolete and Require Replacement, dated 9/6/12
ECR 71704, Replacement of Firezone 101C High Temperature Cable with HW059 High Temperature Cable, dated 3/16/12
ECR 71733, Replacement of Obsolete Rotork Model 14NA1 and Model 14NA2, Electric Actuator, dated 3/20/13
ECR 71784, Replace Obsolete Telemecanique Contactor P/N A123E-MC-1L-32428, dated 10/17/12
ETBT 70484, Replacement Copes-Vulcan D100 Actuator with new design improvement for XVT-08880-SI, Rev. 0
ETBT 70545, Upgrade of Copes-Vulcan D100 Series Actuator w/ 1000 Series Actuators, Rev. 0
ETBT 71508, EF Turbine Jet Plug Replacement, dated 3/21/11
ETBT 71736, Replacement of Lonergan Co. Model D-32N, Relief Valve, dated 5/10/13
ETBT 71737, Replacement of Lonergan Co. Model D-20P, Relief Valve, dated 5/10/13
ETBT 71755, Replacement of Obsolete Atwood & Morrill Mod.13645-01 Check Valve, Rev. 0

Calculations

CN-TA-10-43, V. C. Summer Inadvertent ECCS Actuation at Power Analysis for PORV Qualification, Rev. 0
DC00020·221, Thermal-Hydraulic Design of ECCS Air Trap Vents, Rev. 3
DC00020-222, Hydraulic Design of XPS0063A and XPS0063B, Rev. 0

DC00120-009, Seismic Qualification of ECCS Air-Trap Floats, Rev. 0
DC0396H-031, Seismic Qualification of Flowserve Size 16 Class 150 Carbon Steel Butterfly Valve - Assembly Drawing 09-53475-01, Rev. A, Rev. 2
DC04330-073, Air Accumulator Sizing for XVB03107A/B-SW, Rev. 3
DC05600-044, SW piping from RBCU-A: Determination of water hammer forces for GL 96-06, Rev. 0
DC05600-050, SW to RBCU 'A' with LOOP Hydrodynamic Load Analysis, Revs. 2 and 3
DC06510-005, Sizing and Design Information for XTK0192A and XTK0192B, Revs. 0/1
SW008, SW008 Piping Analysis, Rev. 5.2
WCAP-11677, Pressurizer Safety Relief Valve Operation For Water Discharge During A Feedwater Line Break, January 1988

Condition Reports (CRs)
02-03291, The station's response to NSAL-93-013, "Inadvertent ECCS Actuation at Power" is incomplete, dated 10/17/02
03-02402, If LOOP were to occur with SW aligned to RBCUs, a water hammer would result, dated 7/29/03
06-00753, NRC Regulatory Issue Summary RIS 2005-29, Anticipated Transients That Could Develop into More Serious Events. Regulatory Issue that requires review for potential impact to VCSNS, dated 3/1/06
07-02961, Receiving MCB alarm "VCT Press Lo" several times per shift due XVC08411-CS sticking closed, dated 10/12/07
08-00162, Station tracking CR for NRC GL 2008-01 response, dated 1/15/08
11-03227, Air leak coming from control block. Leak is from top exhaust (A1), dated 6/7/11
11-03505, Compressor cycling every 3.5 min to re-pressurize the cylinder for XVG01611A-FW, dated 6/27/11
13-02490, After securing the RCS leak rate lineup, numerous Waste Panel alarms were received for hydrogen supply header pressure low (XPN00077-3), dated 11/4/13
13-02620, During performance of STP-223.002A, XVB-3107B closed stroke time of 10.3 seconds was greater than the Maximum Allowed stroke time of 9.0 seconds, dated 6/19/13
13-03909, Periodic H2 supply header low pressure alarms on XPN0007, dated 9/22/13

Drawings
1-MS-25-0362, 20-inch – 900-lb W.E. Feedpump Check Valve with 6-inch diameter Air Cylinder Bonnet, Rev. 2
1-MS-25-037, Model D1000-160 Operator 3-in 1500# ANSI Standard, Rev. 12
1-MS-25-041, Model D1000-100 Operator 1-in 1500# ANSI Std. Valve Assembly, Rev. 5
1-MS-25-042, Model D1000-100 Operator 1-in 1500# ANSI Std. Valve Assembly, Rev. 5
1-MS-25-1012, ¾-inch Ball Valve, Sch. 160 Socket weld ends – ANSI Class 1500, Sheet 1, Rev. 0 and Sheet 2, Rev. 0
1-MS-25-1013, Reach rod Assembly, Sheet 1, Rev. 0
1-MS-25-1013, Valve Control Rod Shield, Sheet 2, Rev. 0
1-MS-25-1016, Size 16 Class: 150 Butterfly Valve, Wafer Carbon Steel w/Limit Switches, Solenoid Valve Automax R316S031260V Actuator, Sheet 1, Rev. 4
1-MS-25-579, 1-inch Fig, No. 80 Diaphragm Type Valve Assembly, Rev. 4
1-MS-25-884, Rockwell Edwards Forged Steel Univalve, Rev. 0
1-MS-50-036, Model D1000-60 Operator 2-in 150# ANSI Std. Valve Assembly, Rev. 5
1-MS-50-043, Model D1000-60 Operator 2-in 150# ANSI Std. Valve Assembly, Rev. 7
B-208-101, Reactor Building Inlet A Isolation Valve XVB3106A, Sheet 25, Rev. 9
B-208-101, Reactor Building Outlet A Isolation Valve XVB3107A, Sheet 27, Rev. 10
B-208-101, Service Water Booster Pump A XPP45A, Sheet 6, Rev. 9

C-317-271, Piping Installation Isometric SW Supply IA to Valve 3107A-SW, Rev. 1
D-203-203, ESF Loading Sequence System – I&C Functional Diagram, Rev. 1
D-302-081, Feedwater (non-nuclear) Piping System Flow Diagram, Rev. 30
D-302-083, Feedwater Piping System Flow Diagram, Rev. 54
D-302-112, High Pressure Heater – Drips, Vents, and Reliefs, Rev. 34
D-302-222, Piping System Flow Diagram – Service Water Cooling – B Train Cooling to RBCU LOOP, Sheet 4, Rev. 0
E-302-641, Piping System Flow Diagram – Residual Heat Removal, Rev. 20
E-302-675, Piping System Flow Diagram – Chemical and Volume Control, Rev. 33
E-302-693, Piping System Flow Diagram – Safety Injection, Rev. 22
E-304-679, Chemical Volume Control System – Auxiliay Building – Plan and Sections above Elevation 463', Rev. 15
D-101-011, Auxiliary Building Floor Plan Elevation 374'-0" and 385'-0", Rev. 18
D-101-025, Turban Building Floor Plan Elevation 436'-0", Rev. 14
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 1, Rev. 5
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 2, Rev. 11
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 3, Rev. 7
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 4, Rev. 10
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 5, Rev. 6
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 6, Rev. 2
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 7, Rev. 0
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 8, Rev. 1
D-201-240, Fire Pressure and Radiation Barrier Details Wall & Floor Openings, Sheet 13, Rev. 0

Miscellaneous Documents

Updated Final Safety Analysis, Current
Technical Specifications, Current
Technical Requirements Manual, Current
1MS-94B-112, Instruction Manual for Boiler Feed Pump Check Valve, Rev. 0
1MS-94B-1568, Copes-Vulcan D-1000 Actuators, Rev. 0
DSP-588A(2), ASME Design Specification for Small Nuclear Power Plant Valves 0 ASME Class 2, Rev. 8
ECR 50567, Addition of SW Vacuum Relief Valves and Replacement of XVG03107A/B-SW, Revs. 0/A/B/F/L/O
ECR 50613, XFL-8A/8B Vent and Drain Valves Replacement, Revs. 0/B/C/D
ECR 50846, Weld Repair Contingency for Reactor Vessel Head Examination, dated 10/29/12
Engineering Information Request No. 81465, Define the design requirements for the stroke times of valves XVB03107A/B-SW, dated 9/19/08
Engineering Information Request No. 81636, CR-09-04990-001, STP-223.002A- XVB03107A-SW AND XVB03107B-SW Reference Values, dated 12/29/09
Engineering Information Request No. 81889, Provide justification for the discontinuation of locally stroke timing XVB03107A/B-SW, dated 7/9/12
Engineering Information Request No. 82034, After a LOOP, does the SWBP ESF Start Signal seal in?, dated 12/5/13
ETBT 54B, Replace 1"-1500# Rockwell Edwards Check Valve Fig. #3674F3165 with Rockwell Edwards Check Valve Fig. #B36274F316FT2, dated 10/16/97
ETBT 71704, HW059 High Temperature Cable, Rev. 0
ETBT 71733, Rotork Model 14NA2 Electric Actuator, Rev. 0

ETBT 71784, Fairbanks Morse Part#11916198 Contactor, Rev. 0
ETBT-70830, Firetrol model FTA-1000-AM300B Controller, Rev. 0
FAT-P-0798582-1, Factory Acceptance Test Plan, Rev. 2
In-service Testing Performance Trend Data for XVB03107A/B-SW per STP-223.002A, Oct/10 through Sep/13
ISE-5, Third Interval In-service Inspection Program Plan for V.C. Summer Nuclear Station, Rev.5
Letter from Gary J. Taylor (VCSNS), “Response to Generic Letter 96-06,” to Document Control Desk (USNRC), January 28, 1997
Letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing- Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC NO. MB8997)," dated July 3, 2003
Letter from J. B. Archie (SCE&G), “Response to NRC Questions Regarding Response to GL 96-06,” October 25, 2007
Letter from J. B. Archie (SCE&G), “Response to NRC Request for Additional Information Regarding SCE&G Response to GL 96-06,” to Document Control Desk (USNRC), December 12, 2005
Letter from Robert E. Martin (USNRC), “VCSNS- Request for Additional Information Regarding GL 96-06," to J. B. Archie (SCE&G), August 1, 2007
Letter from J. B. Archie (SCE&G), “SCE&G Action Commitments Regarding Response to NRC Questions Regarding Response to GL 96-06,” to Document Control Desk (USNRC), December 21, 2007
Letter from J. B. Archie, VCSNS, “Nine-Month Response to NRC Generic Letter 2008-01,” to USNRC, October 13, 2008
Letter from J. C. Snelson (WEC - V. C. Summer Project) to M. N. Browne, (VCSNS Systems and Performance Engineering Manager), “Reactor Coolant/Volume Control Tank Hydrogen Requirements,” dated August 25, 1989 (CGE-89-1101)
Letter from Robert E. Martin (USNRC), “VCSNS - Response to GL 96-06, “Quality Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions,” to J. B. Archie (SCE&G), September 22, 2008 (GL 96-06 Closure Letter)
Letter from Robert E. Martin, USNRC Project Manager, “VCSNS, Unit No. 1 – Closeout of Ganeric Letter 2008-01, “Managing Gas Accumulation in Emergency Core Cooling, Decay Heat Removal, and Containment Spray systems, to VCSNS, April 7, 2011
Letter from Robert E. Martin (USNRC), “VCSNS- Review of Response to GL 96-06 Concerning Water hammer and Two Phase Flow,” to J. B. Archie (SCE&G), August 22, 2006
Letter from Robert J. Pascarelli (U.S. NRC) to Thomas D. Gatlin (Virgil C. Summer Nuclear Station, Vice President for Nuclear Operations), Virgil C. Summer Nuclear Station, Unit 1 , Alternative RR-III-09-Alternate Weld Repair for Reactor Vessel Head Penetration (TAC NO. ME9851)(RC-12-0165), April 19, 2013
Letter from T. D. Gatlin (VCSNS) to Document Control Desk (NRC), "Relief Request RR-III-09 Alternative Weld Repair For Reactor Vessel Head Penetration," dated October 30, 2012
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RC-13-0116, LER, Chiller A Trip
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RN-09-003, Added information regarding air-traps and vented orifices installed in the ECCS in RF-18. IAW GLOB-01 commitments, 8/4/10
RN-10-025, Replaced existing air accumulator tanks (XTK0152A1B) with larger tanks (XTK0192A1B), 11/8/11
SDD-0798582-1, Software Development Document, Rev. 0
SDP-0798582-1, Software Development Process, Rev. 0
SRS-0798582-1, Software Requirements Specification, Rev. 0
South Carolina Electric & Gas Purchase Oder # NU-02SR736901, SPX Valves & Controls, 7/15/09
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SP-0951, Engineering Services Specification for Replacement Water Chillers, Rev. 1A
US Nuclear Regulatory Commission Standard Review Plan, 15.5.1 - 15.5.2 Inadvertent Operation of ECCS and Chemical and Volume Control System Malfunction that Increases Reactor Coolant Inventory, Rev. 2 (March 2007)
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White paper related to ECR 50585 and CR-13-04665

Modifications
ECR 50466/50466A/50466B, Diesel Generator Governor Replacement, dated 3/03/04, 8/08/07, and 1/28/2008
ECR 50567O, Addition of SW Vacuum Relief Valves and Replacement of XVG03107A/B-SW, dated 9/23/2010
ECR 50577, Diesel Air Compressor Auto-Start Addition, dated 6/21/12
ECR 50585K/50585M/50585Q, Major Revision - Chiller Replacement, dated 1/18/11, 3/10/11, and 9/01/11
ECR 50592D, Major Revision - Main Control Board/Simulator, dated 9/30/10
ECR 50677, RCS Leak Detection Improvements, dated 12/6/10
ECR 50725, XVC08411-CS Volume Control Tank Inlet Header Check Valve, dated 8/12/10
ECR 50746, VCS Switchyard - Upgrade 230kV Breaker Monitoring Main Control Board, dated 9/27/11
ECR 50747, Bus 1 Upgrades, dated 3/31/11
ECR 50768/50768B, PORV Qualification for Inadvertent SI, dated 1/12/12
ECR 50772A, Upgrades to Bus 2 (Electrical), dated 1/18/12

Procedures
EOP-1.0, Reactor Trip/Safety Injection Actuation, Rev. 26
EOP-6.0, Loss of all ESF Power, Rev. 27
ES-321, Procurement of Material and Services, Rev. 10
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MMP-445.026, Conversion of Copes Vulcan Valve Actuators from D-100 TO D-1000, Rev. 8C
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PR-09, Receiving Inspection Guide, Rev. 0
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SAP 1286, Procurement of Materials, Rev. 7
SAP-1351, Operating Experience Program, Rev. 10
SOP-117, Service Water System, Rev. 22
STP-112.005, ECCS Void Removal Verification, Rev. 1
STP-112.010, Charging Pump Suction Piping Void Removal Verification, Rev. 0
STP-112.011, Spray Pump Suction Piping Void Removal Verification, Rev. 0
STP-125.017, Diesel Generator A Loss of Offsite Power Test, Rev. 6
STP-125.018, Diesel Generator B Loss of Offsite Power Test, Rev. 7
STP-223.002A, Service Water Pump Test, Rev. 9
STP-223.004, XVB03107A(B)-SW Air Supply Check Valve Test, Rev. 1
STP-223.005, Reactor Building Cooling Unit Flow Test, Rev. 1
STP-250.002, Safety Injection/Chemical and Volume Control System Leat Test, Rev. 5
STP-250.004A, Residual Heat Removal System Plant Cooldown Piping Leakage Test, Rev. 5
STP-271.002, 30 Day Water Seal Test of XVG08701A-RH & XVG08701B-RH, Rev. 7

Work Orders (WOs)
WO1002011-001, STP0130.003C, Pressurizer PORV Operability Testing, dated 5/24/11
WO1102790, EHC Penetration Work, Rev. 2
WO1107072-008, Provide Indication of XVG01611B and XVG01611C Accumulator Pressure to IPCS, dated 3/27/13
WO121003, Replace K1 Contactor in Diesel Generator B Exciter Regulator Cubical XEX4202, dated 11/02/12

Condition Reports generated as a result of the inspection
13-04665, Digital Control System for 'A' HVAC Chiller, dated 11/07/13
13-04668, 50.59 Screen Documentation for ECR 50677, dated 11/07/13
13-04669, Applicability Determinations and Screens Not Documented in 50.59 Log, dated 11/07/13
13-04672, High Power Cable Short Circuit Performance Characteristics, dated 11/07/13
13-04803, Quality Standards for Digital Modifications, dated 11/15/13
13-04804, V&V Performance Adequacy Questioned for A Chiller Modification, dated 11/15/13
13-04877, Slow closure of SW 3107A/B not mitigated, dated 11/20/13
13-04906, Timeliness of corrective actions associated with CR-06-00753, dated 11/21/13
13-04907, Timeliness of corrective actions associated with CR-06-00753, dated 11/21/13
13-04928, Documentation of 7.2kV Walkdown with NRC, dated 11/22/13
13-05139, Loading Sequencer Safety Injection (SI) start signal to the SWBP would stay sealed in until the SI signal was reset, dated 12/6/13