



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

REGION II  
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ATLANTA, GEORGIA 30303-8931

ATTACHMENT 2 CONTAINS PROPRIETARY INFORMATION

October 17, 2005

South Carolina Electric & Gas Company  
ATTN: Mr. Jeffrey B. Archie  
Vice President, Nuclear Operations  
Virgil C. Summer Nuclear Station  
P. O. Box 88  
Jenkinsville, SC 29065

SUBJECT: V. C. SUMMER NUCLEAR STATION - SIGNIFICANCE REVIEW OF THREE  
OPEN FIRE PROTECTION ISSUES - INSPECTION REPORT  
05000395/2005009

Dear Mr. Byrne:

During July 18-22, 2005, the U.S. Nuclear Regulatory Commission (NRC) personnel visited your Virgil C. Summer Nuclear Station to evaluate the significance of three unresolved fire protection issues. The enclosed inspection report documents the results of that evaluation, which were discussed on July 21, 2005, with Mr. D. Gatlin and other members of your staff.

The evaluation reviewed 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, inspected in-plant conditions, and interviewed personnel.

This report documents three NRC-identified findings of very low safety significance (Green) involving violations of NRC requirements. However, because of the very low safety significance and because they are entered into your corrective action program, the NRC is treating the findings as non-cited violations (NCVs) consistent with Section VI.A of the NRC Enforcement Policy. If you contest any NCV in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN.: Document Control Desk, Washington, D.C. 20555-0001; with copies to the Regional Administrator Region 2; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, D.C. 20555-0001; and the NRC Resident Inspector at Virgil C. Summer Nuclear Station.

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Sincerely,

**/RA/**

D. Charles Payne, Chief  
Engineering Branch 2  
Division of Reactor Safety

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

Enclosure: NRC Inspection Report 05000395/2005009  
w/Attachments: 1. Supplemental Information  
2. Phase 3 SDP Evaluation

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**U. S. NUCLEAR REGULATORY COMMISSION**

**REGION II**

Docket No.: 50-395

License No.: NPF-12

Report No.: 05000395/2004007

Licensee: South Carolina Electric & Gas Company

Facility: Virgil C. Summer Nuclear Station

Location: 576 Stairway Road  
Jenkinsville, SC 29065

Dates: July 18-22, 2005

Inspectors: W. Rogers, Senior Reactor Analyst, RII  
R. Schin, Senior Reactor Inspector, RII

Accompanied by: D. Frumkin, Fire Protection Engineer, NRR  
S. M. Wong, Senior Reactor Analyst, NRR  
S. Nowlan, Fire Protection Contractor, Sandia National  
Laboratories

Approved by: D. Charles Payne, Chief  
Engineering Branch 2  
Division of Reactor Safety

Enclosure

## SUMMARY OF FINDINGS

IR 05000395/2005009; 07/07 - 11/2005; Virgil C. Summer Nuclear Station; Significance of Open Fire Protection Issues.

This report covers an announced one-week period of onsite review and several weeks of in-office review involving one regional inspector, two senior risk analysts, one fire protection engineer, and one fire protection contractor. Three open unresolved issues were evaluated to be three Green findings, all of which were non-cited violations (NCVs), were identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter 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. NRC-Identified and Self-Revealing Findings

#### Cornerstone: Mitigating Systems

- Green. A non-cited violation of V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Section III.G.2, was identified for failure to protect the control circuits for level control valves (LCV) LCV-115C and LCV-115E, (charging pump suction valves from the Volume Control Tank), to prevent spurious operation during a severe fire.

The finding adversely impacted the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding is greater than minor because it is associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone objective. The finding degraded the defense-in-depth for fire protection. The safety significance of this finding was not more than very low because of the installed spare charging pump, redundancy in reactor coolant pump seal cooling, limited ignition sources, and current protection transformers. (Section 4OA5.1)

- Green. A non-cited violation of V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Sections III.G and III.L. was identified for failure to establish timely performance of key steps in the fire emergency procedures to ensure that pressurizer level would be maintained in the indicating range during plant fires that involved evacuation of the control room and use of alternative shutdown methods.

The finding adversely impacted the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding is greater than minor because it is associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone objective. The finding degraded the defense-in-

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depth for fire protection. The safety significance of this finding was not more than very low because of the operator action timelines and thermo-dynamic analysis. (Section 4OA5.2)

- Green. A non-cited violation of V.C. Summer Technical Specification 6.8.1 regarding written procedures was identified for failure to ensure that vendor recommendations related to operation of reactor coolant pump seals would be followed during a severe fire.

The finding adversely impacted the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding is greater than minor because it is associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone objective. The finding degraded the defense-in-depth for fire protection. The safety significance of this finding was not more than very low because of the redundancy in reactor coolant pump seal cooling, limited amounts of ignition sources, and current protection transformers. (Section 4OA5.3)

B. Licensee-Identified Violations

None

## REPORT DETAILS

### 4. OTHER ACTIVITIES

#### Cornerstone: Mitigating Systems

##### 4OA5 Other

.1 (Closed) Unresolved Item (URI) 05000395/2004007-003: Failure to Prevent Spurious Operation of Charging Pump Suction From Volume Control Tank (VCT), Valves LCV-115C and LCV-115E

Introduction. A Green non-cited violation (NCV) of V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Section III.G.2, was identified for failure to protect the control circuits for level control valves (LCV) LCV-115C and LCV-115E, charging pump suction valves from the VCT, to prevent spurious operation during a severe fire.

Description. During the last triennial fire protection inspection (NRC Inspection Report 05000395/2004007, dated July 30, 2004), the inspectors identified a finding having more than minor safety significance and potentially greater than very low significance. This finding involved failure to protect the control circuits for LCV-115C and LCV-115E, charging pump suction valves from the VCT, to prevent spurious operation during a severe fire. Spurious closing of either of these valves would isolate the suction source for the operating charging pump and cause immediate damage to the pump. The damaged pump could well be the one that the licensee relied upon to shut down the plant during the fire. The significance of this finding had not been determined at the end of the inspection; consequently, the finding was identified as a URI.

Analysis. The inspectors had determined during the triennial fire protection inspection that the finding adversely affected the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding was more than minor because it was associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone. The finding was also more than minor because it degraded the defense in depth for fire protection.

During a recent significance review of this finding, the inspectors determined that the finding was of very low safety significance (Green). That determination is described in detail in the Phase 3 Significance Determination Process (SDP) Evaluation (Attachment 2). The SDP is described in NRC Inspection Manual Chapter (IMC) 0609, Appendix F. Some of the factors (assumptions used in the SDP evaluation) causing the finding to be of very low safety significance were:

- Operators could align the installed spare charging pump in sufficient time to support the reactor coolant makeup function of the charging system and in some cases in sufficient time to support the reactor coolant pump (RCP) seal cooling function of the charging system.

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- Due to redundancy in the RCP seal cooling function, two cables would have to be damaged in a particular manner to cause loss of function [LCV-115C or LCV-115E and one of eight motor-operated valves (MOVs) in the component cooling water (CCW) system flowpath for RCP seal cooling].
- There were a limited number of ignition sources in the plant that could credibly create a fire that could damage control cables for LCV-115C or LCV-115E and also damage control cables for one of eight MOVs in the CCW system flowpath for RCP seal cooling.
- The control circuits for the MOVs included current protection transformers, which reduced the likelihood of hot shorts causing spurious operation of the MOVs.

Enforcement. Because this failure to comply with V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Section III.G.2 is of very low safety significance and has been entered into the corrective action program (CAP) as Condition Evaluation Report (CER) 04-1756, this violation is being treated as an NCV, consistent with Section VI.A of the NRC Enforcement Policy: NCV 05000395/2005009-001, Failure to Prevent Spurious Operation of Charging Pump Suction From VCT Valves LCV-115C and LCV-115E.

.2 (Closed) URI 05000395/2004007-004: Fire Emergency Procedure Implementation Not Timely To Maintain Pressurizer Level In Indicating Range

Introduction. A Green NCV of V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Sections III.G and III.L, was identified for failure to establish timely performance of key steps of the fire emergency procedures to ensure that pressurizer level would be maintained in the indicating range during plant fires that involved evacuation of the control room and use of alternative shutdown methods.

Description. During the last triennial fire protection inspection, the inspectors identified a finding having more than minor safety significance and potentially greater than very low significance. The finding involved failure to establish timely performance of key steps of the fire emergency procedures to ensure that pressurizer level would be maintained in the indicating range during plant fires that involved evacuation of the control room and use of alternative shutdown methods. The significance of this finding had not been determined at the end of the inspection; consequently, the finding was identified as a URI.

Analysis. The inspectors had determined during the triennial fire protection inspection that the finding adversely affected the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding was more than minor because it was associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone. The finding was also more than minor because it degraded the defense in depth for fire protection.



During the recent significance review of this finding, the inspectors determined that the finding was of very low safety significance (Green). Some of the factors causing the finding to be of very low safety significance were:

- Licensee operator action timelines showed that operators could potentially perform the key procedure steps in time to maintain pressurizer level in the indicating range.
- Licensee thermo-dynamic analysis showed that pressurizer level could temporarily go below the indicating range, but then could be recovered to within the indicating range without causing core damage.

Enforcement. Because this failure to comply with V.C. Summer Facility Operating License No. NFP-12, Condition 2.C.(18) and 10 CFR 50, Appendix R, Sections III.G and III.L is of very low safety significance and has been entered into the CAP as CER 04-0472, this violation is being treated as an NCV, consistent with Section VI.A of the NRC Enforcement Policy: NCV 05000395/2005009-002, Fire Emergency Procedure Implementation Not Timely To Maintain Pressurizer Level In Indicating Range.

.3 (Closed) URI 05000395/2004007-001: Local Manual Actions To Align RCP Seal Injection May Not Be Timely

Introduction. A Green NCV of V.C. Summer Technical Specification (TS) 6.8.1 regarding written procedures, was identified for failure to ensure that vendor recommendations related to operation of RCP seals would be followed during post-fire safe shutdown.

Description. During the last triennial fire protection inspection, the inspectors identified a URI involving operator actions to align RCP seal injection during some severe fires that may not be performed in sufficient time to ensure that RCP seal integrity is maintained. In addition, existing procedural actions to reestablish seal injection after an extended loss may aggravate any degradation in RCP seal integrity that occurs. The issue was identified as a URI pending NRC review of RCP seal package performance during a complete loss of seal cooling caused by a severe fire.

Since the last triennial fire protection inspection, NRC review of RCP seal package performance during a complete loss of seal cooling caused by a severe fire was documented in NRC Information Notice 2005-14, "Fire Protection Findings on Loss of Seal Cooling to Westinghouse Reactor Coolant Pumps." In IN 2005-004, the NRC stated that deviations from the vendors' recommendations without a documented basis, and related inadequate procedures, could be considered to be performance deficiencies and violations of regulatory requirements. During the recent review of this URI, the inspectors identified certain procedural actions related to RCP seal cooling during a severe fire that would not ensure that vendor recommendations would be followed. Also, the licensee had no documented basis for deviating from the vendors' recommendations. Consequently, plant damage could occur that could adversely affect post-fire safe shutdown.

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The vendors' analyses and recommendations are contained in Westinghouse Direct Work No. DW-94-011, "Response Letter ERG-96-019," dated November 15, 1996; Westinghouse WCAP-10541, "Reactor Coolant Pump Seal Performance Following a Loss of All AC Power," Rev. 2, dated November 1996; and Westinghouse WCAP-15603, "WOG 2000 Reactor Coolant Pump Seal Leakage Model for Westinghouse PWRs," Rev. 1-A, dated June 2003; and are summarized in Westinghouse Technical Bulletin TB-04-22, dated November 17, 2004.

The procedural actions of concern included:

- FEP 2.0, "Train A Plant Shutdown to Hot Standby Due to a Fire," Rev. 3, Enclosure E, Step 6 directed the auxiliary building operator to align seal injection within 90 minutes. The licensee's time line anticipated this action could be completed about 37 minutes after the FEP 2.0 was entered. The step included local manual opening or closing of 20 different valves. Six of the valves were normally open valves in the RCP seal injection flowpath and were vulnerable to being spuriously closed by fire damage to control cables. If one or more of these six valves were spuriously closed by fire damage, then the operator would local manually open it (per Step 6), to restore seal injection flow to the RCPs. This would occur after the seal injection flow had been stopped for approximately 30 minutes or longer. If the same fire also caused spurious closing of one of the eight MOVs in the CCW system flowpath for RCP seal cooling, then all cooling to the RCP seals could have been stopped for approximately 30 minutes or longer before the seal injection flow was restored. Vendor recommendations were to not restore CCW flow or seal injection to the RCP seals after all cooling to the seals had been lost for more than 13 minutes. Restoration of seal injection after the seals heated up to RCS temperature (in about 13 minutes) could cause cold thermal shock damage to the seals and unacceptable leakage of water from the reactor coolant system. The inspectors determined that there were multiple locations in the plant where a fire could damage cables and cause spurious closure of one or more of the seal injection MOVs and one or more of the CCW MOVs in the flowpath for RCP seal cooling, resulting in a loss of all RCP seal cooling. Consequently, the inspectors concluded that this operator action was contrary to vendor guidance and could credibly result in thermal shock and unacceptable damage to the RCP seals.
- FEP 4.0, "Control Room Evacuation Due To Fire," Rev. 3, Step 3.13, directed operators to start a component cooling water pump. A note before step 3.13 stated that Steps 3.13 through 3.16 must be completed within 90 minutes of implementation of this procedure. However, the procedure also directed operators to stop all charging and component cooling water pumps at about 7 minutes into the procedure (by de-energizing the safety-related busses). Also, a charging pump would not be restarted until about 30 minutes into the procedure, after local valve alignments have been completed. Vendor recommendations included not restoring CCW to the RCP seals if all seal cooling had been lost for more than 13 minutes. By restarting component cooling after all RCP seal cooling has been stopped for potentially more than 13 minutes, the procedure

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did not ensure that vendor recommendations would be followed. Consequently, the component cooling water system could experience water hammer and become damaged, which would adversely affect safe shutdown.

- FEP 4.0, Enclosure E, Step 8, directed the auxiliary building operator (upper) to slowly throttle open the seal injection header flow bypass valve to restore seal injection to the RCP seals without thermal shock. Licensee time lines indicated that the operator could be performing this action about 32 minutes after FEP 4.0 was started and about 25 minutes after operators stopped all RCP seal cooling. This step did not include instructions to limit seal cooldown rate to no more than 1 degree per minute, as recommended by the vendor. Restoring RCP seal injection after all cooling had been lost to the RCP seals for potentially more than 13 minutes, and without limiting seal cooldown rate to no more than 1 degree per minute, did not ensure that vendor recommendations would be followed. Consequently, the inspectors concluded that this operator action was contrary to vendor recommendations and could credibly result in cold thermal shock, damage to the RCP seals, and unacceptable leakage of water from the reactor coolant system, that could adversely affect safe shutdown.

Because the procedural actions would not ensure that vendor recommendations related to operation of the RCP seals would be followed, and consequent plant damage may occur that could adversely affect post-fire safe shutdown, the inspectors concluded that this issue was a finding.

Analysis. The inspectors determined that the finding adversely affected the reliability and capability of equipment required to achieve and maintain a safe shutdown condition following a severe fire. The finding was more than minor because it was associated with the protection against external factors attribute and degraded the reactor safety mitigating systems cornerstone. The finding was also more than minor because it degraded the defense in depth for fire protection.

During the significance review of this finding, the inspectors determined that the finding was of very low safety significance (Green). That determination is described in detail in the Phase 3 SDP Evaluation (Attachment 2). Some of the factors causing the finding to be of very low safety significance were:

- For fires that did not involve evacuation of the main control room, due to redundancy in the RCP seal cooling function, two cables would have to be damaged in a particular manner to cause a loss of function (e.g., one of four seal injection MOVs and one of eight CCW system MOVs).
- There were a limited number of ignition sources in the plant that could create a fire that could damage control cables for one of four seal injection MOVs and also damage control cables for one of eight CCW system MOVs.
- The control circuits for the MOVs included current protection transformers which reduced the likelihood of hot shorts causing spurious operation of the MOVs.

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- There were a limited number of ignition sources in the main control room that could create a fire that would cause an evacuation of the control room.

Enforcement. V.C. Summer Technical Specification (TS) 6.8.1 requires that written procedures shall be established, implemented, and maintained covering activities recommended in Appendix A of Regulatory Guide 1.33, Revision 2, February 1978. Appendix A recommends procedures for combating emergencies and other significant events, including plant fires, control room fires, and forced evacuation of the control room.

Contrary to the above, licensee procedures FEP 2.0, "Train A Plant Shutdown to Hot Standby Due to a Fire," Rev. 3, and FEP 4.0, "Control Room Evacuation Due To Fire", Rev. 3, were not adequate to mitigate the effects of plant fires and main control room fires. The procedures were not adequate because they did not ensure that vendor recommendations related to operation of the RCP seals would be followed. Consequently, plant damage could occur that could adversely affect post-fire safe shutdown.

Because this failure to comply with V.C. Summer TS 6.8.1 is of very low safety significance and has been entered into the CAP as CER 04-1527, this violation is being treated as an NCV, consistent with Section VI.A of the NRC Enforcement Policy: NCV 05000395/2005009-003, Post-Fire Operator Actions For RCP Seal Cooling Were Not Adequate.

#### 4OA6 Meetings, Including Exit

On July 21, 2005, the lead inspector presented the inspection results to Mr. D. Gatlin and other members of the licensee's staff, who acknowledged the findings. Proprietary information was reviewed during the inspection, but is not contained in this report.

## **SUPPLEMENTAL INFORMATION**

### **KEY POINTS OF CONTACT**

#### **Licensee personnel:**

R. Clary, Manager, Nuclear Licensing and Operating Experience  
S. Furstenberg, Manager, Nuclear Training  
D. Gatlin, General Manager, Nuclear Plant Operations  
G. Lippard, Manager, Operations  
A. Monroe, Engineer, Nuclear Licensing and Operating Experience  
K. Nettles, General Manager, Nuclear Support Services  
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B. Stokes, Manager, Design Engineering  
R. Sweet, Supervisor, Nuclear Licensing and Operating Experience  
R. Williamson, Supervisor, Engineering Services

#### **NRC personnel:**

J. Zeiler, Senior Resident Inspector

### **LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED**

#### **Opened**

None

#### **Opened and Closed**

05000395/2005009-001	NCV	Failure to Prevent Spurious Operation of Charging Pump Suction From VCT Valves LCV-115C and LCV-115E (Section 4OA5.1)
05000395/2005009-002	NCV	Fire Emergency Procedure Implementation Not Timely To Maintain Pressurizer Level In Indicating Range (Section 4OA5.2)
05000395/2005009-003	NCV	Post-Fire Operator Actions For RCP Seal Cooling Were Not Adequate (Section 4OA5.3)

#### **Closed**

05000395/2004007-001	URI	Local Manual Operator Actions To Align RCP Seal Injection May Not Be Timely (Section 4OA5.3)
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05000395/2004007-003	URI	Failure to Prevent Spurious Operation of Charging Pump Suction From VCT Valves LCV-115C and LCV-115E (Section 4OA5.1)
05000395/2004007-004	URI	Fire Emergency Procedure Implementation Not Timely To Maintain Pressurizer Level In Indicating Range (Section 4OA5.2)