



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

July 10, 2001

SDP/EA-00-238

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

**SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION - NRC SUPPLEMENTAL  
INSPECTION REPORT NO. 50-395/01-07**

Dear Mr. Byrne:

On May 24, 2001, the NRC completed a supplemental inspection at your Virgil C. Summer Nuclear Station. The enclosed report documents the inspection finding which was discussed on May 24, 2001, with you and other members of your staff.

This supplemental inspection was an examination of the root cause analysis, extent of condition determination, and corrective actions associated with a White Finding identified in the mitigating systems cornerstone. The White Finding involved the unavailability of the turbine driven emergency feedwater pump to supply emergency feedwater flow. This supplemental inspection also examined the corrective actions for Technical Specification violation identified by your staff that was associated with the White Finding. The violation involved South Carolina Electric & Gas Company's failure to identify the turbine driven emergency feedwater pump discharge isolation valve that was closed for 48 days, during August and September 2000. Additionally, the inspection included the issues and circumstances surrounding the reported White Performance Indicator in the mitigating systems cornerstone of safety system unavailability, heat removal system (Auxiliary Feedwater).

Based on this inspection, we have concluded that your root cause evaluation was thorough and effectively identified the primary cause and contributing causes. The completed and proposed corrective actions, including actions to prevent recurrence, appropriately addressed the results of your root cause evaluation and your implementation schedule was consistent with the overall safety significance of the problem.

No findings of significance were identified during the inspection.

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 Publicly Available Records (PARS) component of the 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/*

Kerry D. Landis, Chief  
Reactor Projects Branch 5  
Division of Reactor Projects

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

Enclosure: Inspection Report 50-395/01-07

Attachment: Supplemental Information

cc w/encl.:

R. J. White  
Nuclear Coordinator (Mail Code 802)  
S.C. Public Service Authority  
Virgil C. Summer Nuclear Station  
Electronic Mail Distribution

K. Sutton  
Winston and Strawn  
Electronic Mail Distribution

Henry J. Porter, Assistant Director  
Div. of Waste Mgmt.  
Dept. of Health and Environmental  
Control  
Electronic Mail Distribution

R. Mike Gandy  
Division of Radioactive Waste Mgmt.  
S. C. Department of Health and  
Environmental Control  
Electronic Mail Distribution

Greg H. Halnon, General Manager  
Nuclear Plant Operations (Mail Code 303)  
South Carolina Electric & Gas Company  
Virgil C. Summer Nuclear Station  
Electronic Mail Distribution

Melvin N. Browne, Manager  
Nuclear Licensing & Operating  
Experience (Mail Code 830)  
Virgil C. Summer Nuclear Station  
Electronic Mail Distribution

Distribution w/encl:  
 K. Cotton, NRR  
 RIDSNRRDIPMIIPB  
 OEMAIL  
 PUBLIC

PUBLIC DOCUMENT (circle one): YES NO

OFFICE	RII:DRS	RII:DRS	RII:EICS	RII:DRP		
SIGNATURE	/RA/	/RA/	/RA By O. DeMirande for/	/RA/		
NAME	RBaldwin:pmd	MErnstes	ABoland	LGarner		
DATE	7/9/2001	7/9/2001	7/10/2001	7/10/2001		
E-MAIL COPY?	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY

DOCUMENT NAME: C:\Program Files\Adobe\Acrobat 4.0\PDF Output\sum 01-1.wpd

U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket No. 50-395

License No. NPF-12

Report No.: 50-395/01-07

Licensee: South Carolina Electric & Gas Company

Facility: Virgil C. Summer Nuclear Plant

Location: P. O. Box 88  
Jenkinsville, SC 39065

Dates: May 21-24, 2001

Inspector: Richard S. Baldwin, Senior Operations Engineer

Approved by: K. D. Landis, Chief,  
Reactor Projects Branch 5  
Division of Reactor Projects

Enclosure

## SUMMARY OF FINDINGS

IR05000395-01-07, on 05/21-24/01, South Carolina Electric & Gas Company, Virgil C. Summer Nuclear Station. Supplemental inspection for a White Finding related to the inoperability of the turbine driven emergency feedwater pump due to the discharge isolation valve being closed and a Performance Indicator (PI) crossing from Green to White in the mitigating systems cornerstone of safety system unavailability, heat removal system (Auxiliary Feedwater).

This inspection was conducted by a regional senior operations engineer. No findings of significance were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described at its Reactor Oversight Process website at <http://www.nrc.gov/NRR/OVERSIGHT/index.html>.

### **Cornerstone: Mitigating Systems**

This supplemental inspection was performed to assess South Carolina Electric & Gas Company's activities associated with identification, root cause analysis, and corrective actions for the inoperability of the turbine driven emergency feedwater pump (TDEFWP) due to a closed discharge isolation valve. The White Finding was previously characterized in NRC Inspection Report 50-395/00-05 and in the NRC's Final Significance Determination for a White Finding and Notice of Violation (dated December 28, 2000).

Using Inspection Procedure (IP) 95001, "Inspection for One or Two White Inputs In a Strategic Performance Area," the inspector concluded that the licensee's problem identification and root cause analysis was acceptable. The licensee determined the root cause was due to human error, a failure to open the valve coupled with inadequate independent verification. Additionally, the licensee identified four causal factors associated with this event. The completed and proposed corrective actions, including actions to prevent recurrence, adequately addressed the results of the root cause evaluation.

Additionally, IP 95001 was used to assess the licensee's evaluation and corrective actions associated with a White Performance Indicator (PI) for safety system unavailability, heat removal system (Auxiliary Feedwater). The major contributor for the PI crossing from Green to White (unavailability threshold is greater than 2%) was due to the time the TDEFWP was inoperable due to the White Finding and the extended time to complete a refueling outage. The licensee reported the White PI to the NRC during the routine first quarter 2001 PI submittal. The corrective actions identified to correct the mis-positioning of the TDEFWP discharge isolation valve were considered sufficient to address the White PI.

## Report Details

### 01 Inspection Scope

This supplemental inspection was performed by the NRC in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." The inspector reviewed the licensee's root cause analysis and the corrective actions associated with a White Finding that involved the unavailability of the turbine driven emergency pump (TDEFWP) to supply emergency feedwater flow. The inspector also reviewed a threshold change from Green to White for safety system unavailability, heat removal system (Auxiliary Feedwater) Performance Indicator (PI). The PI changing from Green to White is a function of unavailable hours (planned, unplanned and fault exposure) and total hours required during the previous twelve quarters. The unavailability of the TDEFWP during this time was determined to be 1157 hours. This single event was the major contributor to the total number of hours the emergency feedwater system was unavailable during the past twelve quarters. Since the PI color change was directly related to the unavailability of the TDEFWP, the corrective actions associated with the TDEFWP unavailability bounded the issues associated with the PI color change. Therefore, the inspector assessed and addressed both issues simultaneously.

The inspector assessed the adequacy of the licensee's root cause analysis, determined if appropriate corrective actions were specified and scheduled commensurate with risk, and determined if the proposed actions were sufficient to prevent recurrence. The inspection was completed by review of documents, inspection of plant equipment, and discussions with licensee personnel. The root cause analysis and specified corrective actions were identified in Condition Evaluation Report (CER)-00-1235 and associated documents. The White Finding and PI is in the mitigating systems cornerstone of the Reactor Safety Strategic Performance Area.

### 02 Evaluation of Inspection Requirements

#### 02.01 Problem Identification

- a. Determine that the evaluation identifies who (i.e. licensee, self-revealing, or NRC), and under what condition the issue was identified.

The White Finding and the PI were identified by the licensee and were documented in CER-00-1235. The White Finding was identified in Licensee Event Report (LER) 050000395-2000-006-00, and documented in NRC Inspection Report (IR) 50-395/00-05. The licensee identified the White Finding on September 21, 2000, with the unit at 100 percent reactor power. During the performance of a scheduled surveillance test on the turbine driven emergency feedwater pump (TDEFWP), the licensee identified that manual discharge isolation valve, XVG-1036-EF, had been inappropriately locked in the closed position. XVG-1036-EF was not manipulated as part of this surveillance test; however, an operator observed that this valve stem was positioned different from other similar valves in the area. The duty shift supervisor (DSS) with the assistance of the shift engineer (SE) immediately opened and locked the valve in the correct position.

The inspector verified this information was correct through documentation reviews and discussions with operations personnel.

- b. Determine that the evaluation documents how long the issue existed and prior opportunities for identification.

Licensee review of plant surveillance test records revealed that the valve was last positioned on August 4, 2000, during the quarterly performance of Surveillance Test Procedure (STP)-120.004, "Emergency Feedwater Valve Operability Test." The licensee determined that valve XVG-1036-EF was closed for a period of approximately 48 days. The valve is located in a well-traveled area of the auxiliary building, however, the valve is approximately fifteen feet above the main floor. There was no identifiable reason why the valve position was not identified before the performance of STP-120.004. The valve position was questioned during another surveillance that did not change this particular valve's position.

The PI was reported during the first quarter submittal of 2001. The fault exposure hours based on the unavailability of the TDEFWP was documented during the third quarter of 2000. An extended outage due to a reactor coolant system pipe crack significantly reduced required hours for the fourth quarter of 2000 and the first quarter of 2001. The formula for the system unavailability was calculated using unavailability and required data for the previous 12 quarters. The excessive fault exposure hours coupled with the reduced amount of required hours caused the first quarter 2001 PI to increase above 2%, ie., cross the Green-White threshold.

The inspector reviewed the documentation and agreed with the licensee's evaluation.

- c. Determine that the evaluation documents the plant specific risk consequences (as applicable) and compliance concerns associated with the issue.

The risk consequences of the TDEFWP discharge isolation valve mis-positioning event rendering the TDEFWP inoperable for 48 days were evaluated and discussed with the NRC at an open regulatory conference held on December 7, 2000, at the Region II offices. The licensee's estimate of incremental core damage frequency (CDF) for the period of time the TDEFWP was inoperable was calculated using three different methods. The best estimate using Causal Based Decision Tree/Technique for Human Error Rate Prediction (CBDT/THERP) methodology resulted in an increase in CDF of  $4 \times 10^{-6}$ /year. In the NRC's Final Significance Determination for a White Finding and Notice of Violation letter dated December 28, 2000, the NRC agreed that the CBDT/THERP approach approximately evaluated the increase in risk.

## 02.02 Root Cause and Extent of Condition Evaluation

- a. Determine that the problem was evaluated using a systematic method(s) to identify root cause(s) and contributing cause(s).

The inspector confirmed that the root cause analysis (RCA)-00-1235, was performed in accordance with the guidance of Station Administration Procedure (SAP) - 900, "Root

Cause Analysis, Revision 4, and RCG-01, "V.C. Summer Nuclear Station Root Cause Guidelines," dated 1999. The evaluation was performed using the TapRoot® Incident Investigation System software program. Additionally, the RCA considered four causal factors. These involved auxiliary operator (AUO) #1 failing to correctly position the valve, placement of the locking device prior to independent verification by AUO #2, failure of AUO #2 to recognize the valve was closed, and program enhancements (procedure quality and human factor issues). A TDEFWP RCA self assessment was conducted to assure that the root cause and contributing causes (casual factors) were understood and to independently assess the extent of condition.

- b. Determine that the root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.

The licensee determined the root cause was due to human error to open the valve coupled with inadequate independent verification. The self assessment determined the root cause analysis lacked detail to identify contributing causes. CER-00-1235, incorporated corrective actions recommended in RCA-00-1235, (TapRoot®). The inspector determined that the level of detail described in RCA-00-1235 was commensurate with the significance of the problem.

- c. Determine that the root cause evaluation included a consideration of prior occurrences of the problem and knowledge of prior operating experience.

From review of CER-00-1235, RCA-00-1235, and the TDEFWP RCA self assessment, the inspector determined that the licensee considered prior station history and industry events in the evaluation. The inspector found that there were several events similar to this event which were properly referenced. TDEFWP RCA self assessment identified that RCA-00-1235 did not take into account a similar event concerning the mis-positioning of a danger tag. The licensee determined that similarities with this event were not explored and they possibly missed an opportunity to review what was addressed during the root cause analysis for the tagging event. The inspector reviewed the TDEFWP RCA self assessment and determined that the licensee appropriately addressed this concern.

- d. Determine that the root cause evaluation included consideration of potential common cause(s) and extent of condition of the problem.

As documented in CER-00-1235, the licensee considered the potential for common cause and conducted a broadness (extent of condition) review. The licensee determined that these issues could have effected other plant equipment. The licensee reviewed twenty-one locked valves in the emergency feedwater (EFW) system. In addition, the licensee verified thirty-one locked valves in other systems that were manipulated or verified by the AUO's associated with this event. The licensee identified no additional problem areas. The inspector agreed that the licensee's actions properly addressed common cause failures and extent of condition.

### 02.03 Corrective Actions

- a. Determine that appropriate corrective action(s) are specified for each root/contributing cause or that there is an evaluation that no actions are necessary.

The corrective actions were discussed during the December 7, 2000, regulatory conference. CER-00-1235 and LER 50-395/2000-006-00 identified corrective actions to prevent recurrence. LER 50-395/2000-006-00 also described immediate actions that were taken to prevent recurrence. CER-00-1235 described detailed actions that have been taken and those that are planned to be accomplished. The inspector verified each root/contributing cause (casual factors) was addressed and that appropriate corrective actions were implemented or scheduled.

The licensee identified station procedures needing revision based on corrective actions required by CER-00-1235. The following is a partial list of procedures that were determined to require revision. These included SAP-153, "Component/Condition Verification," Operations Administrative Procedure (OAP)-106.3, "Locked Valve Program," STP-120.004, "Emergency Feedwater Valve Operability Test," and Operations Management Standard, OS-005, "Pre-Job Briefing." During the inspection the inspector noted that a formalized method to elicit feedback for procedural changes was not used. The licensee, however, was able to address human factor issues with the procedure changes. Formal training on these procedural changes was in progress. The inspector reviewed the changed procedures listed above and determined they were adequate.

- b. Determine that corrective actions have been prioritized with consideration of the risk significance and regulatory compliance.

The inspector concluded that corrective actions associated with CER-00-1235 and associated documents were prioritized appropriately considering the risk significance of the TDEFWP system. Compliance with Technical Specification Limiting Condition for Operation 3.7.1.2, "Emergency Feedwater System," was restored on September 21, 2000, when XVG-1036-EF was opened. All accessible locked valves in the EFW system were verified to be in their correct position.

- c. Determine that a schedule has been established for implementing and completing the corrective actions.

The licensee assigned and scheduled corrective actions appropriately to ensure timely completion. The schedule for implementation of corrective actions was contained in the licensee's corrective action program and described in CER-00-1235. The inspector verified that all corrective actions specified were either completed or scheduled for completion in a timely manner. Most of the corrective actions were completed at the time of the inspection. There were approximately sixteen of the forty-one corrective actions that remained to be completed. The majority of these items will be closed when all training has been accomplished and new procedures issued.

- d. Determine that quantitative or qualitative measures of success have been developed to prevent recurrence.

The inspector reviewed the May 21, 2001, issue of CER-00-1235 and verified the corrective actions to prevent recurrence were specified including the performance of an effectiveness review scheduled to be performed by Quality Assurance (QA) during the week of September 3, 2001, and a self assessment audit scheduled to be accomplished during the week of November 5, 2001. The May 24, 2001, issue of CER-00-1235 added an Operations Management expectation regarding supervisor observation of the effectiveness of the program and its implementation. This short term monitoring is scheduled to be performed through November 2001 at which time the Operations Supervisor is tasked to review its effectiveness. Additionally, enhanced monitoring of the emergency feedwater system was initiated by plant support engineering. Planned outages for the emergency feedwater system trains will receive additional oversight. The inspector determined that the licensee had or will adequately address the issues to prevent recurrence.

### 03 Other Activities

- a. (Closed) VIO 50-395/00007-04: TDEFWP discharge isolation valve mis-positioning event rendering the TDEFWP inoperable for 48 days. This violation was associated with a White finding. Based on supplemental inspection as documented in this inspection report the licensee performed acceptable problem identification, root cause evaluation, and corrective actions for the TDEFWP inoperability due to the discharge isolation valve being closed.
- b. (Closed) LER 50-395/2000-006-00: Turbine Driven Emergency Feedwater Pump Discharge Valve found Isolated. This LER was associated with VIO 50-395/00007-04. Based on the supplemental inspection documented in this inspection report this LER is closed.

### 04 Management Meetings

#### Exit Meeting Summary

The inspector presented the inspection results to Mr. S. Byrne, Vice President, Nuclear Plant Operations, and other members of licensee management on May 24, 2000. The inspector asked the licensee whether any of the material examined during the inspection should be considered proprietary and no proprietary information was identified.

## **SUPPLEMENTAL INFORMATION**

### **PERSONS CONTACTED**

#### Licensee

J. Archie, General Manager, Engineering Services  
M. Browne, Manager, Nuclear Licensing and Operating Experience  
S. Byrne, Vice President, Nuclear Plant Operations  
L. Cunningham, Surveillance Specialist/QA  
B. Fenstermacher, Operations Procedures  
C. Fields, Manager, Quality System  
G. Gatlin, Manager, Operations  
D. Goldston, Supervisor, Operations  
G. Halnon, General Plant Manager  
K. Marsh, Nuclear Licensing and Operating Experience  
K. Nettles, General Manager, Nuclear Support Services  
A. Rice, Manager, Plant Support Engineering  
R. Sweet, Supervisor, Nuclear Licensing and Operating Experience  
A. Torres, Manager, Outage  
J. Turkett, Engineer, Nuclear Licensing and Operating Experience  
B. Waselus, General Manager, Strategic Planning  
G. Williams, Manager, Maintenance  
S. Zarandi, Engineer, Operations

#### NRC

M. King, Resident Inspector  
D. Rich, Acting Senior Resident Inspector  
M. Widmann, Senior Resident Inspector

**ITEMS OPENED AND CLOSED**

**Opened**

None

**Closed**

50-395/00007-04	VIO	Technical Specification Violation Due to TDEFWP discharge isolation valve mis-positioning event rendering the TDEFWP inoperable for 48 days (Section 03.a)
50-395/2000006-00	LER	Turbine Driven Emergency Feedwater Pump Discharge Valve Found Isolated (Section 03.b)

**DOCUMENTS REVIEWED**

Virgil C. Summer Nuclear Station - NRC Integrated Inspection Report No. 50-395/00-05

Virgil C. Summer Nuclear Station - NRC Integrated Inspection Report No. 50-395/00-07

LER 50 - 395/2000-006-00, Turbine Driven Emergency Feedwater Pump Discharge Valve Found Isolated

NRC letter dated December 28, 2000, Final Significance Determination for a White Finding and Notice of Violation (NRC Inspection Report No. 50-395/00-05, Virgil C. Summer Nuclear Station)

Handouts from May 21, 2000, entrance meeting at VCSNS

Condition Evaluation Report CER-00-1235, Revisions dated 03/05/2001, 05/21/2001 and 05/24/2001, Turbine Driven Emergency Feedwater Pump discharge isolation valve mis-positioning event.

SAP-153, Independent Verification, Revision 1, 07/17/1996

OS-005, Pre-Job Briefing, Revision 1, 06/30/1995

OAP-106.3, Locked Valve Program, Revision 3, 4/20/1999

SAP-201, Danger Tagging, Revision 8, 05/15/2000

SAP-900, Root Cause Analysis, Revision 4, 09/20/1999

STP-120.004, Emergency Feedwater Valve Operability Test, Revision 13, 11/25/1998

RCG-01, Root Cause Analysis Guidelines, 09/27/1999

Event Notification Work Sheet dated 09/21/2000

Incident Response Team Report for CER-00-1235

FSAR Figure 10.4-16, Emergency Feedwater (Nuclear)

MRB 2000-02, September 26, 2000 Meeting Notes

V. C. Summer Self Assessment Report

MRB TDEFW Self-Assessment, November 16, 2000 Meeting Notes

Corrective Action Review Board Meeting Notes # 2001-02, May 15, 2001