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John L. Skolds
Vice President
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June 12, 1992

Mr. S. D. Ebneter
Regional Administrator
U. S. Nuclear Regulatory Commission
Region II, Suite 2900
101 Marietta Street, NW
Atlanta, GA 30323

Dear Mr. Ebneter:

Subject: VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
SPECIAL REPORT (SPR 920003) (ONO 920041)

This Special Report is being submitted by South Carolina Electric & Gas Company pursuant to the requirements of the Virgil C. Summer Nuclear Station (VCSNS) Station Administrative Procedure (SAP) 131A, Fire Service Equipment/ Systems Operability Requirements.

At 1230 hours on May 16, 1992, the smoke detectors in Zone PPP of the Reactor Building (RB) spuriously alarmed and failed to reset. Because of a previous failure of a smoke detector in the RB, hourly temperature readings required by the Action Statement of SAP-131A had previously been implemented.

During the Plant Safety Review Committee (PSRC) meeting of September 26, 1991, the failure of smoke detectors in the RB was discussed. The PSRC directed that a Root Cause investigation be initiated to determine a common denominator for the high failure rates of the RB smoke detectors. The task group identified two primary causes for the failures: high temperature and high humidity. In addition, secondary failure modes were identified which result in permanent detector and/or base damage. Attached to this report is a copy of the Executive Summary from the investigation.

A modification has been initiated and approved for the replacement of the RB Smoke Detector System. This modification is currently scheduled for implementation in March 1993 during Refuel 7.

Should you have any questions, call at your convenience.

Very truly yours,

John L. Skolds

RJB:lcd

c: See Page 2

IE22

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EXECUTIVE SUMMARY

This Root Cause Investigation was initiated in response to a PSRC Committee request to determine a common denominator for the high failure rates of the Reactor Building Smoke Detectors. During this investigation, the task group identified two primary causes for the Reactor Building Smoke Detector failures. In addition, secondary failure modes were identified which result in permanent detector and/or base damage.

The first primary failure contributor is high temperatures in the Reactor Building. A direct correlation can be made between smoke detectors experiencing high failure rates and plant locations with high ambient temperatures. In several failed detectors, the task group noted a general softening of a resin used in the assembly of the detector head. This softened resin allowed the internal detector components to shift or change configuration tolerances. Eventually, this changed internal configuration of the detector head will result in a false alarm signal. This softening of the resin is believed to be caused by extended exposure to the high area temperatures.

Another primary failure contributor is high humidity. Humidity levels experienced by the detectors located in the Reactor Building exceed those specified by the manufacturer. The high humidity caused the normally energized trouble relay contacts to oxidize, eventually causing excessive line resistance and spurious trouble alarms. The detection strings with multiple detectors were especially vulnerable to this condition. The combination of high temperature and humidity is suspected to have a synergistic effect for the primary failure contributors. Radiation was considered as a possible contributing factor. However, no conclusive failure trend could be identified from the empirical data reviewed.

Detectors which fail in a locked trouble or alarm condition are susceptible to secondary failure modes. Design of the detectors and/or bases allows for operation in alarm or trouble condition for short durations only. Per the manufacturer, operator response and system reset would be expected to occur expeditiously. The detectors located in the Reactor Building are not readily accessible during normal plant operations, therefore detectors which lock into alarm or trouble may operate in these conditions for extended periods or until the next unit outage.

Several failed detector bases were inspected and tested by the task group. Those bases which had operated continuously or over extended periods in alarm or trouble condition experienced wiring damage associated with the base's integral local buzzer. In addition, the detectors which had operated for extended periods in an alarm state experienced changes in the detector head's sensitivity. This sensitivity drift was found to be attributable to the cathode tube internal to the head. Once the detector's cathode tube fires, the tube remains in an energized/excited state. Extended continuous operation of the head in this state will result in changes in the required firing potential of the tube, hence causing the detector sensitivity to drift outside of the allowable range.

Prior to this investigation Design Engineering was aware of the Reactor Building Smoke Detector reliability problem. Based on the poor system performance and vendor inability to support the existing system, modification MRF-20951 had been initiated and approved to repair or replace the plant smoke detector system. Implementation of the Reactor Building portion of this MRF is scheduled for Refuel 7.

The Reactor Building Smoke Detector failure Root Cause Investigation team concurs with the replacement of Reactor Building Smoke Detector System under MRF-20951. The new system components will be tested for operation in high radiation, temperature, and humidity environments. This modification should resolve the high failure rate problem currently being experienced by the Reactor Building Smoke Detectors.