UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30323

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Report No.: 50-395/89-05

Licensee: South Carolina Electric & Gas Company
Columbia, SC 29218

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

Facility Name: V. C. Summer

Inspection Conducted: February 27-March 3, 1989

Inspectors: Eldon D. Testa 4/17/89
E. Testa, Team Leader Date Signed

William B. Gloersen 4/17/89
W. Gloersen Date Signed

Susan S. Adamovitz 4/17/89
S. Adamovitz Date Signed

Roger B. Shortridge 4/17/89
R. Shortridge Date Signed

Approved by: John Potter 4/18/89
J. P. Potter, Chief Date Signed
Facilities Radiation Protection Section
Emergency Preparedness and Radiological
Protection Section
Division of Radiation Safety and Safeguards

SUMMARY

Scope

This was a special, announced assessment in the areas of the licensee's program to maintain occupational radiation exposures as low as reasonably achievable (ALARA).

Results

The licensee has a high level of plant and corporate management awareness of and support for the dose reduction program. Fuel defects have caused increases in out-of-core reduction levels which can contribute to increased collective dose. Program strengths were noted in completion of specific inspection and maintenance tasks with low collective dose, general worker and management knowledge of ALARA concepts, excellent plant-wide radiological contamination control, continuing training of Health Physics personnel and effective use of Radiation Safety Bulletins and Safety Meetings to keep all plant personnel

aware of ALARA activities and dose information. Additionally, several weaknesses were identified in the ALARA program. These weaknesses were:

- Slowness in completion of review of dose reduction initiatives (Paragraph 11.d).
- Minimal use of the ALARA suggestion program (Paragraphs 4 and 8.a.(3)).
- Infrequent use of still photographs, video tape and mockups for valve and pump maintenance training (Paragraph 6).
- Less than full implementation of adopted Electric Power Research Institute chemistry guidelines for Secondary Water Chemistry for Sulfate and Cation conductivity (Paragraph 11.c).
- Lack of followup on ALARA action items by the ALARA Review Committee (Paragraphs 4 and 11.d).

Within the areas inspected, no violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

T. Allsep, Nuclear Technical Instructor
F. Bacon, Associate Manager, Chemistry
*W. Baehr, Manager, Chemistry & Health Physics
*L. Blue, Manager, Corporate Health Physics & Environment Programs
*O. Bradham, Vice President, Nuclear Operations
*M. Browne, Manager, Systems & Performance Engineering
*R. Clary, Manager, Design Engineering
J. Cox, Associate Manager, Health Physics
A. Cribb, Plant Chemist
*H. Donnelly, Senior Engineer, Regulatory Compliance
*S. Hunt, Manager, Quality Systems
*A. Koon, Manager, Nuclear Licensing
*G. Moffatt, Manager, Maintenance Services
*D. Moore, General Manager, Engineering Services
*K. Nettles, General Manager, Nuclear Safety
*J. Nolting, QA Specialist
*M. Quinton, General Manager, Station Support
E. Robinson, Health Physics Supervisor
*J. Schafer, HP Supervisor
R. Schwartz, Supervisor - Nuclear Technical Training
*J. Skolds, General Manager
R. Sweet, Supervisor, Operations
G. Taylor, Manager, Operations
*R. Tripp, General Training Supervisor
D. Warner, Manager, Core Engineering and Nuclear Computer Services
*V. Williams, Jr, Spec. Asst. Nuclear Operations - Santee Cooper
*F. Zander, Manager, Nuclear Technical Education and Training

Other licensee employees contacted during this inspection included engineers, maintenance mechanics, technicians, and administrative personnel.

Nuclear Regulatory Commission

*T. Decker, Acting Chief, Emergency Preparedness and Radiological Protection Branch, Division of Radiation Safety and Safeguards
*R. Prevatte, Senior Resident Inspector

*Attended exit interview

2. Background (83528/83728)

The licensee began the development of the program to maintain occupation radiation dose to workers as low as reasonably achievable (ALARA) in 1981. Job codes were established and special instructions on ALARA techniques were developed for specific jobs expected to be major contributors to annual collective dose. The corporate ALARA plan was approved in 1982, documenting the licensee's policy to maintain occupaticnal dose ALARA. The ALARA Committee was formed and the program formally implemented. Fuel was loaded in 1982 and the plant began commercial operation in 1983.

For the years 1984 through 1986, the licensee averaged 232 person-rem which was below the national average of 453 person-rem (3 yrs) for pressurized water reactors (PWRs). It is common, though, for plants to have relatively low collective occupational dose during early years of operation. In 1987 and 1988, the plant annual collective dose average increased to 535 person-rem while the national average for PWR's decreased to 359 person-rem (2 yrs). The licensee stated that the increase in annual collective dose during this period was attributed to increased reactor coolant activity due to fission and activation product buildup in piping and increased steam generator maintenance. As an example of the increase in the out of core source term, dose rates have increased by a factor of 20.

Table 1 shows a comparison of the V. C. Summer collective annual dose with that of the average PWR collective annual dose.

Table 1

Comparison of V. C. Summer Annual Collective Dose with Average Collective Dose from Commercial Pressurized Water Reactor

Year	PWR Average Dose Per Reactor (Rem)	Summer Dose (Rem)
1983	592	111
1984	552	295
1985	416	379
1986	390	23
1987	371	562
1988	346	511

3. Program to Maintain Radiation Doses ALARA (83528/83728)

The licensee's ALARA organization consisted of an ALARA Committee, a permanent staff of a radiation protection supervisor with collateral ALARA duties, and three health physics (HP) specialists with collateral ALARA duties. The licensee established an HP planner position that interfaces with production departments and HP. The HP planner reviews jobs to be performed relative to reducing exposure and assists in the planning and scheduling of the work. During outages the number of HP planners was increased to five people to facilitate the increased work load.

The ALARA Committee, comprised of station managers from 10 departments, was responsible for reviewing and evaluating the effectiveness of the implementation of the ALARA program; review of jobs that are expected to exceed specific person-rem estimates; determining the effectiveness of station dose goals and the cause for exceeding those goals, and for reviewing ALARA suggestions and recommending pensation for those suggestions that are cost effective.

4. ALARA Committee (83528/83728)

Station Administrative Procedure, SAP-121, ALARA Committee, Rev. 4, dated December 7, 1988, described the organization and responsibilities of the ALARA Committee. The inspectors reviewed thre minutes of the ALARA Committee meeting held each quarter for the years 1983 through 1988. The members of the ALARA committee were as follows:

Chairman: Associate Manager, HP
Members: General Manager, Operations, and Maintenance; General Manager, Station Support, Manager Operations; Manager, Scheduling and Modifications; Manager, Maintenance Services; Manager, Chemistry and HP; Manager Systems and Performance Engineering; Manager; Corporate HP and Environmental Programs; Manager, Facilities and Administration

The ALARA Committee met once per quarter or whenever a significant exposure concern required a meeting. The ALARA Committee was tasked with reviewing and evaluating: (1) the effectiveness of the implementation of the ALARA Committee; (2) the activities for which reported personnel dose was greater than five person-rem and exceeded the pre-job estimated collective dose by 50%; and (3) the ALARA suggestions for practicality and implementation. It should be pointed out that approximately 12 suggestions had been submitted since initial operation (January 1984). The lack of ALARA suggestions was an apparent weakness in the licensee's program and is discussed below.

The meeting minutes indicated that ALARA Action Items (items approved by the committee to reduce dose) were not always discussed, nor the current status for completion reviewed at the meetings.

In discussions with licensee representatives, the inspectors learned that for the life of the plant, 12 ALARA suggestions had been submitted. Of the 12 suggestions, five were considered valid and the ALARA Committee approved four of them. In 1988, there were no ALARA suggestions submitted; however, the licensee stated that some employee suggestions to reduce dose were put on the ALARA Action Items list. The inspectors noted that ALARA suggestion 87-2, was a suggestion to use extended life light bulbs throughout the plant. Maintenance personnel would not have to enter radiation areas as frequently to replace burned out light bulbs. The suggestion was approved and showed a postulated savings of over 25,000 dollars. The licensee stated that another means for employees to make ALARA suggestions was through plant employee suggestion program established in 1987, but were not able to attribute receiving any dose reducing suggestions to this program.

The inspectors discussed with licensee management the need to improve the effectiveness of the ALARA Committee, to formalize the ALARA suggestion program and open it for contractor participation, and to increase management's support for the program. Licensee management representatives acknowledged the inspectors concerns and stated that they would review the need to improve in these areas.

5. Management of Collective Dose (83528, 83728)

The inspectors discussed the methods used by the licensee in managing collective dose and achieving their annual collective dose goal. The licensee stated that each department formulated the annual estimate for their personnel and the estimate was submitted to the ALARA Committee for review and approval. From the estimates submitted by departments, the ALARA Committee established the station's annual collective dose goal. To achieve the annual goal, including individual outage goals, the station managers are provided a printout daily of dose by man-hours and person-rem with the amount of person-rem used versus the amount alloted for each department. Based on a review of ALARA Committee meeting minutes, exposure data and interviews with station managers, supervisors and technical staff personnel, the inspectors determined that collective dose appeared to be effectively managed and dose goals were frequently met.

Performance

In discussions with the inspectors, licensee representatives stated that the operating dose budget for the plant was approximately 20 to 23 person-rem per year, and that during recent outages collective dose had increased over past outages due to maintenance problems with the steam generators, and activation and fission product buildup in primary piping systems, and in valves requiring maintenance.

The inspectors reviewed NUREG/CR-4254, Occupational Dose Reduction and ALARA at Nuclear Power Plants: Study on High-Dose Jobs, Radwaste Handling, and ALARA Incentives, dated April 1985, with licensee personnel. The NUREG contains data on doses experienced throughout the industry for typical high dose jobs. The inspectors compared the licensee's exposure history for several jobs in the NUREG as indicated in Table 2.

Table 2

V. C. Summer Dose Summary for High Dose Jobs (person-rem)

Job	1985	1987	1988	NUREG/CR-4254 Avg.
Snubber, hanger, anchor bolt inspection/ repair	8	19	14	110
Steam generator eddy current testing	23	49	19	50
Reactor assembly/ disassembly	32	35	41	48
Steam generator tube plugging	98	28	33	47
In-service inspection	6	9	29	46
Primary valve maintenance and repair	7	21	74	30
Plant decontamination	7	9	18	45
RCP seal replacement	4	9	6	17
Steam generator manway removal/replacement	5	13	6	16
Instrument calibration and repair	7	12	13	12
Chemical, volume, and control system repair and maintenance	--	5	6	11
Fuel shuffle/sipping and inspections	2	2	3	10
Operations, surveillance, routines, and valve lineups	2	5	4	7
Cavity decontamination	3	7	10	6
Pressurizer valve testing and repair	3	22	10	6

Radwaste system operation, repair, and maintenance	2	6	2	5
Residual heat removal system repair and maintenance	2	4	19	3

The inspectors determined that for most jobs reviewed the licensee's dose performance was lower than the industry average indicated in NUREG/CR-4254 (1974-1984 data).

6. Training (83528/83728)

The inspectors reviewed the licensee's training program to determine which groups of employees received training in ALARA beyond that given in basic General Employee Training (GET). Both the HP and training groups were involved in providing the various types of ALARA training.

The licensee provided specific ALARA training to individuals involved with steam generator maintenance and non-destructive testing activities. The inspector reviewed lesson plan HPT-LP-J1 (PHPEX001) - Steam Generator Mock-up, dated September 1, 1988, and discussed various portions of the lesson plan with licensee representatives. It was noted that HPs were involved with discussions of pre-job review check sheets during the training sessions. The inspectors toured the facility used for steam generator mock-up training. This facility was equipped with a full-scale model of the steam generator lower head which had been purchased before the previous refueling outage. The licensee has recognized the importance of steam generator mock-up training, especially since steam generator work during the last three refueling outages, has been the largest single contributor to the station's annual collective dose. Although the licensee had also incorporated some ALARA concepts in the craft training programs for electrical and valve maintenance students, the inspector observed that the licensee's training program would be enhanced with the addition of mock-up training, still photographs, and video tapes for various pumps and valves. The licensee acknowledged the inspectors comments and stated that there were plans to provide additional mock-up training for pumps and valves. The licensee also stated that the increased use of still photographs and video tapes for craft training would be assessed.

With regard to the specific ALARA training provided to other work groups, the inspector noted that the engineering group was not provided with specific ALARA training other than what was provided in GET. Additionally, the Operations group received only minimal ALARA training which was covered in the lesson entitled "Nuclear Operations Education and Training, Chemistry and Radcon Protection against Radiation," CR-6, AHLPY Topic 6, Revision (Rev.) 0, dated July 14, 1988.

The inspectors also reviewed the licensee's advanced radworker training program, including the "Radiation Worker Program Manual," Rev. 1, dated

June 2, 1988. The manual included topics on ALARA and the radiation work permit (RWP) process.

The annual advanced radworker training program consisted of 40 hours of classroom training and 16 hours of on-the-job (OJT) (field) training. OJT was limited to three students per instructor. At the time of this inspection, the licensee had 201 individuals qualified to be radiation workers. With regard to advanced HP training, the inspectors recognized the licensee's commitment in the HP specialist training program by providing 160 hours per year of continuing training. Some of the tasks related to specific ALARA training for the HP specialist included:

- Conduct ALARA evaluations for active RWP/Standard RWP work
- Participate in mock-up training for radiological control
- Perform pre-job and post-job review
- Initiate, track, and complete ALARA projects
- Interface with scheduling and outage management groups for processing work documents
- Modify and/or terminate RWPs on ALARA Computer Programs
- Coordinate and implement Station ALARA Committee Meetings
- Perform an ALARA design room review
- Perform a shielding review
- Process an ALARA suggestion
- Create and maintain an RWP on the computer system

Lastly, the inspectors reviewed the GET Program and noted that the licensee had adopted INPO guide 87-004, Guidelines for General Employee Training, July 1987. During June 1988, the licensee formed a new GET group and transferred the GET responsibilities from the HP group to the GET group.

7. ALARA/Procedure Implementation (83528/83728)

The inspectors reviewed both station HP procedures and corporate health physics procedures. Station procedures were designated either as Health Physics Procedures (HPPs) or Station Administrative Procedures (SAPs), while corporate HPPs were designated as Corporate Health Physics (CHP). The following procedures were reviewed:

- SAP-121, ALARA Committee, Rev. 4, December 7, 1988.

- SAP-500, HP Manual, Rev. 5, January 21, 1988.
- HPP-151, Use RWP and SRWP, Rev. 4, April 1, 1988.
- HPP-401, Issue, Termination, and Use of RWPs and SRWPs, Rev. 8, April 1, 1988.
- HPP-819, Temporary Shielding ALARA Evaluation/HP Responsibilities, Rev. 4, September 8, 1988.
- CHP-201, Interfacing Procedure for CHP and the Station and ALARA Committees, Rev. 4, January 18, 1988.
- CHP-304, Review of Project Procedures and Program Implementation for ALARA, Rev. 5, January 18, 1988.
- Corporate ALARA Plan, Rev. 3, January 25, 1988.
- RWP and ALARA Training Manual, April 6, 1988.

The inspectors reviewed the licensee's criteria for post-job ALARA reviews, and noted that SAP-500, Section V.F. did not provide specific guidance as to when a post-job review should be performed. The inspectors observed, however, that the RWP and ALARA Training Manual, Table 1.0, Job Review Requirements, specified the conditions as to when a pre-job and post-job ALARA review would be required. The licensee agreed that the procedure would be enhanced by incorporating a job review requirement matrix similar to Table 1 of the Training Manual. In general, the licensee conducts pre-job reviews and pre-job briefings, whenever the estimated collective dose is greater than or equal to one rem. Additionally, pre-job reviews and briefings are conducted whenever respiratory protection is required. Post-job reviews are conducted when one of the following conditions apply: (1) estimated dose less than one rem and the actual dose is greater than one person-rem and 150 percent (%) greater than the estimate; (2) estimated dose is greater than or equal to one person-rem and the actual dose is 150% greater than the estimate; and (3) estimated dose is greater than or equal to five person-rem and the actual dose is greater than ± 25% of the estimate. The licensee requires an ALARA committee post-job review when the estimated dose is greater than or equal to five person-rem and the actual dose is greater than 150% of the estimate. Additionally, the licensee reviews SRWPs whenever the dose to an individual is greater than 25 mrem or the collective dose is greater than 50 mrem. The purpose of this review is to determine whether the dose should be tracked on a RWPs.

Licensee representatives also demonstrated the operation of the Health Physics Information System (HIS) which was primarily used for the following (1) generating RWPs and RWP reporting, including work group dose listings, dose by work group listings, and worker dose listings; (2) work group man-rem goals; (3) component and job code dose history; and (4) daily reports.

After review of HPP-401, "Issue, Termination, and Use of RWPs and SRWPs," the inspectors observed that a reference was not made to the HIS in either Section 2, References, or in the details of the procedure. The HIS has been used by the licensee for generating RWPs since approximately June 1988. The licensee agreed to revise HPP-401 to include reference to the HIS.

The inspectors noted that the licensee records all pocket ion chamber (PIC) readings entered into the HIS. This includes entries made by individuals who attempt to make a PIC reading that is beyond the resolution of the PIC scale. All RWP and SRWP doses were based on PIC measurements. During the past year, the licensee has had good correlation between thermoluminscent dosimeters (TLDs) and PICs with a percent difference between PIC readings and TLD measurement of less than 10%.

8. Discussions with Plant Staff (83528/83728)

a. Employee Discussions

Discussions were held with licensee employees to assess their knowledge, involvement, and perspective of the utility's ALARA program, including the employees' knowledge of ALARA goals, concepts, policies and procedure documents; individual responsibilities, personnel doses and personal dose limits; the employees' involvement in special ALARA training, communication with co-workers and supervision, and participation in the ALARA suggestion program; and the employees perspective on how to improve the ALARA program, what events or condition have caused increased personnel doses, and on what events or conditions had helped reduce personnel doses.

(1) Employees

All employees interviewed entered the radiological controlled areas (RCAs) on a daily to weekly basis depending on plant conditions.

(2) Knowledge of ALARA Program

Each of the employees interviewed was familiar with the basic ALARA concepts taught in the GET program and knew that they had a basic responsibility for implementing the utility's ALARA program by performing tasks in a manner consistent with the utility's ALARA policy. All of the employees knew their current radiation exposure and their exposure limit. The employees were aware of where the ALARA requirements originated and what documents described the ALARA program objectives. All of the employees interviewed knew that each of their sections had an ALARA goal, and generally were aware of the goal that was established.

(3) ALARA Program Involvement

The majority of employees interviewed had not received any formal ALARA training other than that given in the GET course. A large number of those interviewed had received some informal ALARA training on jobs requiring ALARA pre-job planning and OJT. Employees reported frequent discussions of ALARA objectives on major jobs during outages with co-workers and supervisors. The employees also reported good communication with the ALARA and HP staffs. Only a small fraction of employees interviewed had participated in the formal ALARA suggestion program. Other employees reported that they had made suggestions to supervisors informally and had not used the formal ALARA suggestion program believing it was only for "significant ALARA suggestions."

(4) Perspective

Several of the employees had suggestions on how the ALARA program could be improved. The suggestions included better planning and scheduling of work to ensure that appropriate equipment and tools were readily available to perform tasks expeditiously. The majority of employees had an opinion on what had contributed to decrease and increases in personnel exposures. Employees believed that the following actions had contributed to exposure reductions: use of temporary shielding, special tools, decontamination of contaminated areas within the RCA, Contents and Criteria meetings, Radiation Safety Bulletins and Safety Meetings. Employees believed that the following actions had contributed to increases in personnel exposures: poor maintenance planning and scheduling, recent past and present fuel failures and valve maintenance.

b. Management Discussions

Discussions were held with licensee managers and supervisors to assess their knowledge of the utility's ALARA program including the managers' or supervisors' knowledge of ALARA goals, concepts, policies and procedure documents, individual responsibilities, personnel exposure, and personal exposure limits; the manager/supervisor's involvement in special ALARA training, communications with co-workers and supervision, and participant in the ALARA suggestion program; and the manager or supervisor's perspective on how to improve the ALARA program, what events or conditions have caused increased personnel exposures and what events or conditions have helped reduce personnel radiation exposures.

(1) Managers and Supervisors

Most of the individuals interviewed entered the RCAs on a weekly to monthly basis depending on plant conditions.

(2) Knowledge of ALARA Program

Each of the individuals interviewed was familiar with the basic ALARA concepts taught in the GET program and knew that they had a basic responsibility for implementing the utility's ALARA program by performing a task in a manner consistent with the utility's ALARA policy. In general, the managers and supervisors interviewed were knowledgeable of the current radiation exposure and exposure goals for their departments. The managers and supervisors understood where the ALARA requirements originated and what corporate and plant documents described the ALARA program objectives. Managers and supervisors interviewed knew their departments' ALARA goals.

(3) ALARA Program Involvement

The managers and supervisors interviewed had not received any formal ALARA training other than that given in the GET course.

(4) Perspective

All managers and supervisors interviewed had suggestions on how the ALARA program could be improved. The suggestions included recommendations for better scheduling and planning of work, ensuring that appropriate equipment and tools were readily available, and continuing to increase the awareness of the ALARA concept to all levels of plant personnel. These methods could be implemented through GET retraining, departmental training, and non-licensed training.

The majority of managers and supervisors had opinions on what had contributed to the decreases and increases in personnel exposures. Individual managers and supervisors interviewed believed that the following actions had contributed to exposure reductions: use of temporary shielding; reduced work activities in high radiation areas; and reduction of contaminated areas within the RCA. Individual managers and supervisors interviewed believed that the following actions had contributed to increases in personnel exposures: poor planning and scheduling of maintenance work; valve maintenance; reactor head work and steam generator work.

9. Audit Program (83728/83528)

The licensee's onsite operations quality assurance (QA) program included formal audits and surveillances. Formal audits were conducted per technical specification requirements on a biannual basis while surveillances were less structured, conducted more frequently and were activity oriented to observe work processes. Surveillances generally required 8 to 12 hours to complete while audits, on the average, required two to four weeks. Staffing for the QA program totaled 13 personnel including the Associate Manager, the Operations Supervisor and 11 auditors. The inspector reviewed resumes for the QA staff and noted that the staff had a variety of experience in nuclear power totalling 184 years. The licensee maintained procedures which defined and implemented the onsite QA program. QSP-11, "Conduct of Quality Assurance Audit," Rev. 0, dated May 13, 1988, provided instructions for the planning and preparation of audits. QSP-12 "Conduct of Surveillance," Rev. 0, dated May 13, 1988, provided similar instruction for conducting surveillances. Both procedures required tracking and followup of identified deficiencies.

The licensee also maintained a corporate audit function under Corporate Health Physics and Environmental Programs which was staffed by a manager and five health physicists. Nuclear experience for the five health physicists who conducted ALARA audits totalled 85 years. The organizational structure and responsibilities of the audit group were defined in the procedures CHP-105 "Schedule of Corporate Health Physics Activities," Rev. 5, dated January 18, 1988, and CHP-106, "Organizational Structure, Responsibilities, and Duties," Rev. 3, dated January 18, 1988. Responsibilities included a review of the station's HP programs; implementation of the facility's ALARA program; inplant and effluent radiation data; and proposed design changes for radiological impact.

The inspector reviewed a series of onsite and corporate audits and surveillances conducted during 1988 and 1989. The audits appeared thorough and identified problems were tracked. Several audits were performed in order to ensure closeout actions had been completed for identified nonconformance items. Work practices and program implementation were reviewed not only for adherence to procedural and program requirements but also for technical adequacy.

10. Corporate Support for the ALARA Program (83728/83528)

Corporate support for the ALARA program was evidenced by Corporate Health Physics and Environmental Program group. This group was responsible for implementation and review of the facility's ALARA program. Additionally the group provided technical support for review of proposed design changes which may have an associated radiological hazard. The group was also required to review periodically all the facility's radiation data which included inplant surveys and exposures, effluents, environmental monitoring, plant chemistry, and radioactive waste data. It appeared that the Corporate Health Physics and Environmental Program group was providing adequate ALARA support for the plant.

11. Dose Reduction Initiatives (83728/83525)

The inspectors reviewed records and data for the licensee's program of dose reduction initiatives.

a. High Radiation and Contaminated Areas

The licensee had a program to reduce high radiation and contaminated areas of the plant. A Plant Radiological Status Report was provided to managers and supervisors of key departments monthly. The status report for January 1989 reflected that four areas were locked high radiation areas (greater than 1,000 millirem/hour general area), 30 were high radiation areas (greater than 100 millirem/hour general area), and that 1,291 square feet (ft^2) of the RCA of the plant was contaminated (excluding containment).

The status report also updates the number of radioactive material areas, the number and location of temporary containments used to control contamination at the source, and provides information needed to resolve any problems associated with the areas regarding decontamination for subsequent release. The inspectors noted that the licensee's program for control of RCAs was very aggressive and one of the best in Region II.

b. Chemistry Controls

In order to minimize secondary system corrosion problems, the licensee had adopted the Electric Power Research Institute's secondary water chemistry guidelines for control parameters. These guidelines were reflected in the station's administrative procedure SAP-401, "Secondary Water Chemistry Program," Rev. 4, dated December 22, 1988. During the current inspection, the licensee was not able to maintain the recommended levels for sulfates and cation conductivity due to resin intrusion in the secondary system.

The licensee's commitment to ALARA objectives was evidenced in station procedures and worker training. The inspector reviewed several procedures concerning inplant sampling and operation of the post-accident sampling system (PASS). Radiological hazards and ALARA concepts were identified in the "Precautions" section of the procedures. Additionally, the licensee's "Chemistry Specialist Training Manual" covered the concepts of minimizing exposure to radiation and contamination control.

Chemistry personnel had initiated several sampling modifications in order to reduce worker exposure. Approximately four years ago, Chemistry had identified that the current sampling methods for the Waste Evaporators would possibly cause an exposure and/or contamination problem. As a result, a sampling station consisting of a sink and hood was installed near the evaporators. The PASS system was originally installed with welded joints. Chemistry personnel noted that as radioactive materials would accumulate in the system over time, working with welded joints would raise ALARA concerns by prolonging close contact and spreading contamination. As the system was modified and new components added, quick disconnect fittings were installed to replace the welded joints. Also, pressure detectors for the system were replaced with removable detectors that required less maintenance and calibration time.

c. Fuel Integrity

° Iodine trends and effect on outages

The inspector reviewed a "Refuel 4 Exposure Summary" report dated December 21, 1988, and discussed past outage experiences with licensee representatives. The licensee's first experience with failed fuel occurred during Cycle 3 (January 1986 to March 1987) when one or two tight defects were identified in the fuel. The licensee utilized the main containment purge to lower iodine activity in work areas and required workers to wear respirators as further protection. Failed fuel was also identified in Cycle 4 (June 1987 - September 1988), and attributed to one or more open rod defects. This caused greater radiological problems than the tight defects in Cycle 3 fuel; however, the licensee had acquired experience from the previous outage. The licensee used additional work planning, respirators, and containment purge to minimize airborne exposure.

° Failed Fuel - Action Plan and Clean-Up Methods

The inspector discussed the status of the failed fuel and plans for clean-up with cognizant licensee representatives. The licensee had identified failed fuel in the current Cycle 5 core. This was indicated during early February 1989, when I-131 concentrations increased from approximately E-4 uCi/ml to E-2 uCi/ml during steady state operations. Based on visual inspections and initial iodine activity levels in the core, the Cycle 5 fuel was considered to be defect free when loaded. The current defects were thought to be caused by debris within the core. Tapes from the metal impact monitor indicated that no debris was currently circulating in the primary or secondary side. The metal impact monitor tapes were to be sent to a vendor for additional analysis. The licensee planned to record additional noise tapes for confirmatory analysis but the monitors required several days of steady-state operation to be effective.

During the previous several weeks, the licensee had not been able to maintain steady-state power due to resin intrusion in the secondary side. Based on reactor coolant iodine ratios, the failed fuel was attributed to tight defects. Vendor analysis of reactor coolant isotopic activity supplied preliminary information that the fuel failures were located in more than one region. Failures were thought to include the new fuel, Vantage 5, and once-burned fuel. The vendor estimated that the failures included five fuel rods. The licensee planned to provide additional information on the isotopic distributions of the reactor coolant during steady-state power operations to the vendor to determine if the additional information supported the preliminary findings.

The inspector reviewed the licensee's "Failed Fuel Action Plan," Rev. 0. The plan identified various action levels based upon I-131 activity in the reactor coolant. As I-131 activity increased, HP personnel would determine the impact on plant personnel and facility effluents by increasing surveys, evaluating effluent releases and investigating other possible vent paths. Nuclear Operations would review processing systems to ensure that the systems were operational, process liquid and gaseous waste in the most efficient manner to maintain tank availability, and minimize cross-contamination of segregated systems. Core Engineering was responsible for identifying the contributing factors for increased coolant activity whether it be failed fuel or plant transients. If failed fuel was identified, Core Engineering was also responsible for quantifying the number and size of the defects. ALARA considerations were evident throughout the plan as indicated by increased surveys, reassessment of release rates and alerting personnel to the possibility of higher than normal dose rates. The licensee was in Action Level 1, the lowest level, of the Failed Fuel Plan at the time of the inspection, based on I-131 levels.

The licensee, with vendor assistance, was working on a recovery plan for the failed fuel. A demineralizer system was available for activity reduction. Future plans included installation of a combination reverse osmosis (RO)/demineralizer system with the demineralizer package installed upstream of the RO system. This system would be connected to a manifold to allow demineralizer processing of the Boric Acid Tanks, the Refueling Water Storage Tank, and the Spent Fuel Pool (SFP). The RO system would remove silica from the liquid streams. Proposed benefits from this combination system included prevention of crud deposits on fuel elements and reduction in radiation exposure levels for the SFP by removal of reactor coolant impurities. The licensee tentatively planned to have this system installed by the next refueling outage during March 1990.

- Resin Intrusion

The licensee had experienced problems with two resin intrusion events since the first of this year. During January 1989, approximately 10 to 12 cubic feet (ft^3) of powdered resin from the condensate polishers had been introduced into the condensate and feedwater systems. The licensee's evaluation of this incident identified two possible mechanisms by which resin intrusion could take place. These were failure of the filter retention elements to prevent leakage and reverse flow of resin into the inlet header caused by kidney loop pump trips. Corrective actions included replacement of the washers in the end caps of the vertical filter tubes with foam rubber gaskets to prevent resin leakage and inspection of the end springs to remove any burrs which could prevent a tight fit with the stub tube. The licensee was able to remove the resin using steam generator blowdown since powdered resin remained suspended in liquid for a sufficient time to be swept out of the system.

A second resin intrusion occurred on February 14, 1989. The licensee's investigation identified the root cause of the event to be a bypass valve for the nuclear blowdown demineralizers left in the open position after completion of maintenance. When liquid was transferred from the Nuclear Blowdown Hold-Up Tank to the condenser, the open valve allowed resin to bypass the filter and be transported into the condenser Hotwell. The driving force for the reverse flow through the demineralizers was considered to be either the condenser vacuum or a siphoning effect when the system was drained for the valve maintenance. The licensee considered the condenser vacuum to be the most likely cause of the resin transfer. Sulfate and cation conductivity levels briefly peaked on February 14, 1989, at 10.7 ppm and 118 umho/cm respectively in steam generator A. Steam generator B showed levels of 6.7 ppm sulfate and approximately 91 umho/cm cation conductivity. Steam generator C peaked at 7.2 ppm sulfate and 120 umho/cm cation conductivity on that date. The EPRI chemistry guides for secondary water chemistry for sulfate and cation conductivity during operations are $\leq$ 0.02 ppm sulfate and $\leq$ 0.8 umho/cm conductivity at 25°C. The licensee reduced power and attempted to clean the secondary side by use of the condensate polishers and steam generator blowdown. The condensate polishers were designed to be used for cleanup of the secondary system during startup and could not be utilized at greater than 50% reactor power. Accordingly the licensee maintained power at less than 50% in order to periodically use the polishers. The licensee chose not to use the "kidney loop" installed between the hotwell and the condensate polishers for secondary system cleanup. The licensee had experienced operational difficulties with the loop and the kidney loop could also not be back flushed. At the time of this inspection, the condensate polishers were not in service and the licensee was attempting to clean the system by blowdown and rotating the condensate booster and feedwater pumps in order to flush any trapped resin. This resulted in sulfate and cation conductivity spikes when trapped resin was flushed into the secondary system liquid. Unlike the January incident with powdered resin, this event involved whole bead resin. The whole bead resin was heavier and would therefore not stay suspended in liquid as long as the powdered resin. The bead resin tended to sink and be caught in low places or crevices. This resulted in sulfate and cation conductivity spikes when the pumps were rotated since resin was flushed from low points. The licensee had contacted Westinghouse to get information concerning the effect of high sulfate concentrations on secondary systems. At the time of this inspection, the licensee did not know how much resin had been transported into the secondary system but had calculated that approximately 250 pounds or 5.6 ft^3 had been removed by blowdown thus far. The licensee acknowledged the inspectors concern that the plant was operating outside the adopted EPRI chemistry guidelines for Secondary Water Chemistry for Sulfate and Cation Conductivity. The operation of the plant outside the guidelines was identified as a weakness.

d. Permanent Reactor Head Shield

A permanent reactor head shield was proposed in November of 1983, to reduce dose rates for work on the reactor vessel head during refueling and maintenance outages. The proposed head shield was placed on the ALARA Committee Action Item List in March of 1984, and an evaluation was initiated to provide cost and postulated collective dose saving. Economic evaluations were performed in 1985, 1986, 1988, and 1989. The evaluation in 1989 revealed that since 1984, 200 person-rem had been expended for reactor cavity/head work over four outages. Also, that the installation of a similar head shield at a plant with a similar reactor design had reduced dose rates by 40%. During the inspection, the licensee approved purchase of a permanent head shield and targeted installation for their next refueling outage.

Other dose reduction initiatives were noted by the inspectors that have been carried for up to six years with little progress being made. Examples include quick blind flange closures for the transfer tube and a plan for chemical flushes (excluding steam generators). The licensee stated that a significant amount of dose had been expended on work on the resistance thermocouple detectors (RTDs) and plans were to replace the RTDs during the fifth refueling cycle. The licensee is in the process of performing a study on cobalt reduction in the primary system piping by reducing filter sizes in the letdown and seal injection filters. The intent is to remove micron sized activated particles of cobalt from reactor coolant thereby reducing the out-of-core source term. The licensee stated that during the last refueling/maintenance outage that over 900 primary system valves were repacked with live load packing at a cost of 60 person-rem. The dose expended was considered acceptable based on improved material condition of the plant and reduced future maintenance.

12. Confirmatory Measures (84725)

As part of the NRC Confirmatory Measurements Program, spiked liquid samples were sent on June 2, 1988, to the plant for selected radiochemical analyses. The NRC received the analytical results from SCE&G in a letter dated August 4, 1988. The comparison of the licensee's results to the known values are presented in Attachment 1. The acceptance criteria for the comparison are listed in Attachment 2. A review of these data showed that all comparative results were in agreement. A member of the plant staff was notified of these results by telephone on August 25, 1988.

13. Conclusions (83528/83728)

Fuel defects have caused increases in out-of-core radiation levels which can contribute to increased collective dose. Increased innovative dose management techniques for steam generator maintenance and valve maintenance and repair are being considered by the licensee to reverse the recent trend in collective dose. The following significant issues were identified during the inspection:

- Slowness in completion of evaluation of review of dose reduction initiatives, Paragraph 11.d (50-395/89-05-04).

- Minimal use of the ALARA suggestion program, Paragraphs 4 and 8.a.(3) (50-395/89-05-03).

- Infrequent use of still photographs, video tape and mockups for valve and pump maintenance training, Paragraph 6 (50-395/89-05).

- Incomplete implementation of adopted Electric Power Research Institute chemistry guidelines for Secondary Water Chemistry for Sulfate and Cation conductivity, Paragraph 11.c (50-395/89-01).

- Lack of followup on ALARA action items by the ALARA Review Committee Paragraphs 4 and 11.c (50-395/89-05-02).

The following ALARA features were identified during the inspection as program assets indicative of significant licensee accomplishment:

- Completion of many inspection and maintenance tasks with lower than industry average collective dose for each task.

- General worker and management knowledge of ALARA concepts and awareness of their responsibility to keep doses ALARA.

- Inclusion of dose goal performance as part of each persons' annual performance review.

- Excellent plant-wide contamination control.

- Annual continuing training of Health Physics personnel.

- Use of Radiation Safety Bulletings, Summer Report, Program and Content Criteria, and Safety Meetings to keep personnel aware of ALARA activities and plant dose information.

14. Exit Interview

The inspection scope and findings were summarized on March 3, 1989, with those persons indicated in Paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection findings (Paragraph 13). The licensee acknowledged the inspection findings and took no exceptions. The licensee did not identify as proprietary any of the material provided to or reviewed by the inspectors during the inspection.

ATTACHMENT 1

CONFIRMATORY MEASUREMENT COMPARISION OF H-3 FE-55, SR-89, AND SR-90 ANALYSES
FOR SUMMER NUCLEAR PLANT ON AUGUST 4, 1988

Isotope	Licensee (uCi/ml)	NRC (uCi/ml)	Resolution	Ratio (Licensee/NRC	Comparison
H-3	1.71 E-05	(1.79 ± 0.04) E-05	45	0.96	Agreement
Fe-55	2.08 E-05	(1.76 ± 0.04) E-05	44	1.18	Agreement
Sr-89	1.33 E-04	(1.35 ± 0.04) E-04	34	0.99	Agreement
Sr-90	7.89 E-06	(8.12 ± 0.32) E-06	25	0.97	Agreement

ATTACHMENT 2

Criteria for Comparing Analytical Measurements

This enclosure provides criteria for comparing results of capability tests and verification measurements. The criteria are based on an empirical relationship which combines prior experience and the accuracy needs of this program.

In these criteria, the comparisons denoting agreement or disagreement between licensee and NRC results are variable. This variability is a function of the NRC's value relative to its associated uncertainty, referred to in this program as "Resolution"[1]. As resolution increases, the range of acceptable differences between the NRC and licensee values should be more restrictive. Conversely, poorer agreement between NRC and licensee values must be considered acceptable as the resolution decreases.

For comparison purposes, a ratio[2] of the licensee value to the NRC value for each individual nuclide is computed. This ratio is then evaluated for agreement based on the calculated resolution. The corresponding resolution and calculated ratios which denote agreement are listed in Table 1 below. Values outside of the agreement ratios for a selected nuclide are considered in disagreement.

[1]Resolution = $\frac{\text{NRC Reference Value for a Particular Nuclide}}{\text{Associated Uncertainty for the Value}}$

[2]Comparison Ratio = $\frac{\text{Licensee Value}}{\text{NRC Reference Value}}$

TABLE 1

Confirmatory Measurements Acceptance Criteria
Resolutions vs. Comparison Ratio

Resolution	Comparison Ratio for Agreement
<4	0.4 - 2.5
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

NRC FORM 766
(11-84)
IE MC 0535

U.S. NUCLEAR REGULATORY COMMISSION

INSPECTOR'S REPORT
Office of Inspection and Enforcement

PRINCIPAL INSPECTOR (Name, last, first, and middle initial): E.D. Testa

Reviewer: J. Potter

INSPECTORS: W. Gloersen, R.B. Shortridge, S. Adamovitz

LICENSEE/VENDOR: South Carolina Electric & Gas Co. Summer

TRANSACTION TYPE: [X] I – INSERT; [ ] M – MODIFY; [ ] D – DELETE; [ ] R – REPLACE

DOCKET NO. (8 digits) OR LICENSE NO. (BY PRODUCT) (13 digits): 05000395

REPORT NO.: 8905 SEQ. A

NEXT INSPEC. DATE: MO. ___ YR. ___

PERIOD OF INVESTIGATION/INSPECTION

FROM MO	FROM DAY	FROM YR	TO MO	TO DAY	TO YR
02	27	89	03	03	89

INSPECTION PERFORMED BY: [X] 1 – REGIONAL OFFICE STAFF; [ ] 2 – RESIDENT INSPECTOR; [ ] 3 – PERFORMANCE APPRAISAL TEAM; [ ] OTHER

ORGANIZATION CODE OF REGION/HQ CONDUCTING ACTIVITY (See IEMC 0530 "Manpower Reporting—Weekly Manpower Reporting," for code.)

REGION	DIVISION	BRANCH
2	4	1

REGIONAL ACTION (Check one box only): [ ] 1 – NRC FORM 591; [X] 2 – REGIONAL OFFICE LETTER

TYPE OF ACTIVITY CONDUCTED (Check one box only): [X] 02 – SAFETY; [ ] 03 – INCIDENT; [ ] 04 – ENFORCEMENT; [ ] 05 – MGMT AUDIT; [ ] 06 – MGMT VISIT; [ ] 07 – SPECIAL; [ ] 08 – VENDOR; [ ] 09 – MAT ACCT; [ ] 10 – PLANT SEC.; [ ] 11 – INVENT. VER.; [ ] 12 – SHIPMENT/EXPORT; [ ] 13 – IMPORT; [ ] 14 – INQUIRY; [ ] 15 – INVESTIGATION

INSPECTION/INVESTIGATION FINDINGS (Check one box only): A: [X] 1 – CLEAR; 2 – VIOLATION; 3 – DEVIATION; 4 – VIOLATION & DEVIATION

TOTAL NUMBER OF VIOLATIONS AND DEVIATIONS: A: 00; B: ; C: ; D:

ENFORCEMENT CONFERENCE HELD: A B C D — 1 – YES

REPORT CONTAINS 2.790 INFORMATION: A B C D — 1 – YES

LETTER OR REPORT TRANSMITTAL DATE

NRC FORM 591 OR REG. LETTER ISSUED MO	DAY	YR	REPORT SENT TO HQ. FOR ACTION MO	DAY	YR
04	19	89			

MODULE INFORMATION

REC ORD TYPE	NUMBER	PHASE	MANUAL CHAPTER	PROCEDURE NUMBER	LEVEL	SEQ	PRIORITY	DIRECT INSPECTION EFFORT IN STAFF HOURS EXPENDED THIS INSPECTION	PERCENTAGE COMPLETED TO DATE	STATUS
8		5	30	703		A		004	100	C
EXIT						B, C, D				
8		5	84	750		A		23	25	C
Rad Waste Systems & Water Chemistry						B, C, D				
8		5	83	528		A		128	100	C
Maintaining Occupational Exposures ALARA						B, C, D				
8		5	83	750		A		29	45	C
Occ Exp & Trans						B, C, D				

* CIRCLE SEQUENCE # VIOLATION OR DEVIATION

DOCKET NO. (S) See Reverse side for Example. OUTSTANDING ITEMS LIST (OIL) - FOR NEW ITEMS ONLY Form T-5A

50-395 UNIT 1
UNIT 2
UNIT 3
UNIT 4

FACILITY NAME: V. C. Summer

RESPONSIBLE INDIVIDUAL: E. D. TESTA

UNIT	ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1	89-05-04	IFI	83528	FRP	FRP	-- --
UNIT 2						
UNIT 3						
UNIT 4						

DESCRIPTIVE TITLE: Reticence To ImplEment CurRANT IndusTRY dose Reduction INITIATIVES

UNIT	ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1	89-06-05	IFI	83528	FRP	FRP	-- --
UNIT 2						
UNIT 3						
UNIT 4						

DESCRIPTIVE TITLE: InAdequATe use of STILL phoTogRAphs/VIDEO TAPES AND MUCKUPS FoR VAIVE AND PuMP MAINTENANCE TRAINING

UNIT	ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1						-- --
UNIT 2						
UNIT 3						
UNIT 4						

DESCRIPTIVE TITLE:

DOCKET NO.(S) See Reverse side for Example. OUTSTANDING ITEMS LIST (OIL) - FOR NEW ITEMS ONLY

Form T-5A

Docket No.	Unit
50-395	UNIT 1
	UNIT 2
	UNIT 3
	UNIT 4

FACILITY NAME: V. C. Summer

RESPONSIBLE INDIVIDUAL: E. D. TESTA

ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1: 89-05-04	IFI	83528	FRP	FRP	-- --
UNIT 2:					
UNIT 3:					
UNIT 4:					

DESCRIPTIVE TITLE

Reticence To ImplemenT CurranT IndusTRY dose Reduction INITIATIVES

ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1: 89-06-05	IFI	83558	FRP	FRP	-- --
UNIT 2:					
UNIT 3:					
UNIT 4:					

DESCRIPTIVE TITLE

INadequATe usc of sTILL phoTogRAphs/VIDEO TAPES AND MUCKUPS FoR VLIVE AND PuMP MAINTENANCE TRAINING

ITEM NUMBER	TYPE	MODULE #	AREA	RESP	ACTION DUE DATE
UNIT 1:					-- --
UNIT 2:					
UNIT 3:					
UNIT 4:					

DESCRIPTIVE TITLE

DOCKET NO.(S) See Reverse side for Example. OUTSTANDING ITEMS LIST (OIL) - FOR NEW ITEMS ONLY Form T-5A

DOCKET NO.: 50-395 UNIT 1

UNIT 2

UNIT 3

UNIT 4

FACILITY NAME: V.C. Summer

RESPONSIBLE INDIVIDUAL: E.D.TESTA

UNIT 1 — ITEM NUMBER: 89-05-01

UNIT 2

UNIT 3

UNIT 4

TYPE: IFI MODULE #: 83528 AREA: FRP RESP: FRP ACTION DUE DATE: -- --

DESCRIPTIVE TITLE: Inadequate implementation of EPRI chemistry guidelines for secondary water chemistry for sulfate and cation conductivity

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UNIT 1 — ITEM NUMBER: 89-05-02

UNIT 2

UNIT 3

UNIT 4

TYPE: IFI MODULE #: 83528 AREA: FRP RESP: FRP ACTION DUE DATE: -- --

DESCRIPTIVE TITLE: Ineffective performance of the ALARA review committee

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UNIT 1 — ITEM NUMBER: 89-05-03

UNIT 2

UNIT 3

UNIT 4

TYPE: IFI MODULE #: 83528 AREA: FRP RESP: FRP ACTION DUE DATE: -- --

DESCRIPTIVE TITLE: Inactive ALARA suggestion program