April 3, 1991

Docket No. 50-395

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Mr. John L. Skolds
Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
P.O. Box 88
Jenkinsville, South Carolina 29065

Dear Mr. Skolds:

SUBJECT: ISSUANCE OF AMENDMENT NO. 96 TO FACILITY OPERATING LICENSE NO. NPF-12 REGARDING ALTERNATIVE TO TUBE SLEEVING OR PLUGGING - VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1 (TAC NO. 69066)

The Nuclear Regulatory Commission has issued the enclosed Amendment No. 96 to Facility Operating License No. NPF-12 for the Virgil C. Summer Nuclear Station, Unit No. 1. The amendment consists of changes to the Technical Specifications in response to your application dated August 1, 1988, as revised August 30, 1990.

The amendment changes the Technical Specifications to revise Surveillance Requirement 3/4.4.5, Steam Generators, to allow for an alternative to plugging or sleeving of tubes with degradation in the tubesheet area. This alternative method is designated the L^* criteria.

A copy of the related Safety Evaluation is enclosed. Also enclosed is a copy of the Notice of Issuance that has been forwarded to the Office of Federal Register for publication.

Sincerely,

George F. Wunder, Project Manager
Project Directorate II-1
Division of Reactor Projects I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Amendment No. 96 to NPF-12
2. Safety Evaluation
3. Notice of Issuance

cc w/enclosures:
See next page

OFC	:LA:PD21:DRPE	:PM:PD21:DRPE	:D:PD21:DRPE	:	:	:
NAME	:PAnderson:	: GWunder:sw	: EAdensam	:	:	:
DATE	: 4/3 /91	: 04/04/91	: 4/3 /91	:	:	:

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AMENDMENT NO. 96 TO FACILITY OPERATING LICENSE NO. NPF-12 - SUMMER, UNIT NO. 1

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

DOCKET NO. 50-395

VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 96
License No. NPF-12

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by South Carolina Electric & Gas Company (the licensee), dated August 1, 1988, as revised August 30, 1990, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications, as indicated in the attachment to this license amendment; and paragraph 2.C.(2) of Facility Operating License No. NPF-12 is hereby amended to read as follows:

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 96 , and the Environmental Protection Plan contained in Appendix B, are hereby incorporated in the license. South Carolina Electric & Gas Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This amendment is effective as of its date of issuance and shall be implemented within 30 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Original Signed By:

Elinor G. Adensam, Director
Project Directorate II-1
Division of Reactor Projects I/II
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: April 3, 1991

OFC	:LA:PD21:DRPE	:PM:PD21:DRPE	: OGC	:D:PD21:DRPE	:	:	:
NAME	:PAnderson:	:GWunder:sw	:	: EAdensam	:	:	:
DATE	:3/6/91	:03/06/91	: 3/11/91	:3/25/91	:	:	:

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ATTACHMENT TO LICENSE AMENDMENT NO. 96

TO FACILITY OPERATING LICENSE NO. NPF-12

DOCKET NO. 50-395

Replace the following pages of the Appendix A Technical Specifications with the enclosed pages. The revised pages are indicated by marginal lines.

Remove Pages	Insert Pages
3/4 4-12	3/4 4-12
3/4 4-14	3/4 4-14
3/4 4-15	3/4 4-15
B 3/4 4-3	B 3/4 4-3

SURVEILLANCE REQUIREMENTS (Continued)

1. All nonplugged tubes that previously had detectable wall penetrations greater than 20% that were not repaired.

2. Tubes in those areas where experience has indicated potential problems.

3. A tube inspection (pursuant to Specification 4.4.5.4.a.8) shall be performed on each selected tube. If any selected tube does not permit the passage of the eddy current probe for a tube inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection.

c. In addition to the sample required in 4.4.5.2 b.1 through 3, all tubes which have had the F* or L* criteria applied will be inspected in the tubesheet region. These tubes may be excluded from 4.4.5.2 b.1 provided the only previous wall penetration of >20% was located below the F* distance or the required L* inspection area (3.5 inches).

d. The tubes selected as the second and third samples (if required by Table 4.4-2) during each inservice inspection may be subjected to a partial tube inspection provided:

1. The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found.

2. The inspections include those portions of the tubes where imperfections were previously found.

The results of each sample inspection shall be classified into one of the following three categories:

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

Note: In all inspections, previously degraded tubes must exhibit significant (greater than 10%) further wall penetrations to be included in the above percentage calculations.

4.4.5.4 Acceptance Criteria

a. As used in this Specification:

1. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections.

2. Degradation means a service-induced cracking, wastage, wear or general corrosion occurring on either inside or outside of a tube.

3. Degraded Tube means a tube containing imperfections greater than or equal to 20% of the nominal wall thickness caused by degradation.

4. % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

5. Defect means an imperfection of such severity that it exceeds the plugging or repair limit. A tube containing a defect is defective.

6. Tube Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be repaired (i.e. sleeving) or removed from service by plugging and is equal to 40% of the nominal tube wall thickness. This definition does not apply to the portion of the tube in the tubesheet below the F* or L* distance provided the tube is not degraded (i.e., no indications of cracks) within the F* distance for F* tubes and within the L* distance for L* tubes.

7. Sleeve Plugging or Repair Limit

a. For the area in the upper weld joint, any degradation shall be plugged unless it can be clearly demonstrated by a qualified NDE technique that the degradation is less than 40% of the nominal wall thickness of the sleeve for ID imperfections or less than 40% nominal wall thickness of the tube for O.D. imperfections.

b. For the area of the tube behind the sleeve and above the upper weld joint, tubes with any degradation shall be plugged unless it can be clearly demonstrated by a qualified NDE technique, that the degradation is less than 40% of the nominal wall thickness.

c. For the area below the upper weld joint, any defect greater than 40% of the nominal sleeve wall thickness shall be plugged.

SURVEILLANCE REQUIREMENTS (Continued)

12. Preservice Inspection means an inspection of the full length of each tube in each steam generator performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection shall be performed after the field hydrostatic test and prior to initial POWER OPERATION using the equipment and techniques expected to be used during subsequent inservice inspections.

13. F* Distance is the distance into the tubesheet from the face of the tubesheet or the top of the last hardroll, whichever is lower (further into the tubesheet) that has been conservatively chosen to be 1.6 inches.

14. F* TUBE is the tube with degradation, below the F* distance, equal to or greater than 40%, and not degraded (i.e., no indications of cracking) within the F* distance.

15. L* Distance is the distance into the tubesheet from the face of the tubesheet or the top of the last hardroll, whichever is lower (further into the tubesheet), that has been conservatively chosen to be 0.7 inches.

16. L* Tube is a tube with short (less than 0.5 inches) axially oriented (20 degrees or less from axial) degradation occurring below the undegraded L* distance. An additional minimum of 1.0 inches of sound expanded tube (below the L* distance) separated by no more than 2 areas of axially oriented degradations must be contained in the top 3.5 inches of tube (within the tubesheet). Each area of degradation is limited to a maximum of 5 distinct indications. A maximum of 2500 tube ends per steam generator may utilize L*. Tubes qualifying as F* tubes ends per steam generator may utilize L*. Tubes qualifying as F* tubes are not classified as L* tubes.

b. The steam generator shall be determined OPERABLE after completing the corresponding actions (plug or repair all tubes exceeding the plugging limit) required by Table 4.4-2.

4.4.5.5 Reports

a. Within 15 days following the completion of each inservice inspection of steam generator tubes, the number of tubes plugged or repaired in each steam generator shall be reported to the Commission in a Special Report pursuant to Specification 6.9.2.

b. The complete results of the steam generator tube inservice inspection shall be submitted to the Commission in a Special Report pursuant to Specification 6.9.2 within 12 months following the completion of the inspection. This Special Report shall include:

SURVEILLANCE REQUIREMENTS (Continued)

1. Number and extent of tubes inspected.

2. Location and percent of wall-thickness penetration for each indication of an imperfection.

3. Identification of tubes plugged or repaired.

c. Results of steam generator tube inspections which fall into Category C-3 and require prompt notification of the Commission shall be reported pursuant to 10 CFR 50.72(b)2(i) prior to resumption of plant operation. A report pursuant to 10 CFR 50.73(a)2(ii) shall be submitted to provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

d. The results of inspections of F* and L* tubes shall be reported to the Commission in a report to the Director, ONRR, prior to the restart of the unit following the inspection. This report shall include:

1. Identification of F* and L* tubes, and

2. Location and size of the degradation

NRC approval of this report is not required prior to restart.

3/4.4.5 STEAM GENERATORS

The Surveillance Requirements for inspection of the steam generator tubes ensure that the structural integrity of this portion of the RCS will be maintained. The program for inservice inspection of steam generator tubes is based on a modification of Regulatory Guide 1.83, Revision 1. Inservice inspection of steam generator tubing is essential in order to maintain surveillance of the conditions of the tubes in the event that there is evidence of mechanical damage or progressive degradation due to design, manufacturing errors, or inservice conditions that lead to corrosion. Inservice inspection of steam generator tubing also provides a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken.

The plant is expected to be operated in a manner such that the secondary coolant will be maintained within those chemistry limits found to result in negligible corrosion of the steam generator tubes. If the secondary coolant chemistry is not maintained within these limits, localized corrosion may likely result in stress corrosion cracking. The extent of cracking during plant operation would be limited by the limitation of steam generator tube leakage between the primary coolant system and the secondary coolant system (primary-to-secondary leakage = 500 gallons per day per steam generator). Cracks having a primary-to-secondary leakage less than this limit during operation will have an adequate margin of safety to withstand the loads imposed during normal operation and by postulated accidents. Operating plants have demonstrated that primary-to-secondary leakage of 500 gallons per day per steam generator can readily be detected by radiation monitors of steam generator blowdown. Leakage in excess of this limit will require plant shutdown and an unscheduled inspection, during which the leaking tubes will be located and plugged or repaired.

Wastage-type defects are unlikely with proper chemistry treatment of the secondary coolant. However, even if a defect should develop in service, it will be found during scheduled inservice steam generator tube examinations. Plugging or repairing will be required for all tubes with imperfections exceeding 40% of the tube nominal wall thickness. Steam generator tube inspections of operating plants have demonstrated the capability to reliably detect wastage-type degradation that has penetrated 20% of the original tube wall thickness.

Plugging is not required for tubes meeting either the F* or L* criteria.

Whenever the results of any steam generator tubing inservice inspection fall into Category C-3, these results will be promptly reported to the Commission pursuant to 10 CFR 50.72(b)2(i) prior to resumption of plant operation. Such cases will be considered by the Commission on a case-by-case basis and may result in a requirement for analysis, laboratory examinations, tests, additional eddy-current inspection, and revision of the Technical Specifications, if necessary.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 96 TO FACILITY OPERATING LICENSE NO. NPF-12

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

VIRGIL C. SUMMER NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-395

1.0 INTRODUCTION

By letter dated August 1, 1988, as revised August 30, 1990, South Carolina Electric & Gas Company (SCE&G) requested a revision to the Technical Specifications (TS) for the Virgil C. Summer Nuclear Station, Unit No. 1 (VCSNS). The August 30, 1990, letter provided clarifying information that did not change the scope of the requested revisions. The proposed change would revise the surveillance requirements of TS 3/4.4.5, Steam Generators, to allow for an alternative to plugging or sleeving of tubes with degradation in the tubesheet area. This alternate method is designated the L* criterion.

The TS change request has been amended to provide additional conservatism over the Westinghouse L* criterion to allow for demonstrable implementation. The licensee has provided the basis for the L* criterion in WCAP-11857, "Tubesheet Region Tube Alternate Plugging (L*) Criteria for Steam Generators in the V.C. Summer Nuclear Station." The TS change was proposed by the licensee due to the history of eddy current indications of tube degradation in the mechanical roll expanded portion of the tubes within the tubesheet in the steam generators. It has been determined through interpretation of eddy current examinations that the tube degradation occurring in the steam generators is of the type associated with primary water stress corrosion cracking (PWSCC). Degradation appears to occur at sites where the residual stresses are the greatest (i.e., at the roll expansion transition and at the heel of each roll step within the depth of the tubesheet). Experience to date is that typically the indications are short (less than 1/2 inch), axially oriented and intergranular in nature (i.e., very little volumetric loss occurs). The indications primarily form rapidly and as they grow through the high stress field the stress is relieved and the crack is arrested. Some circumferential linking up of small axials may be found in some of the more susceptible/significantly degraded tubes (e.g., tubes that were poorly rolled or with poor metallurgy). In such cases, no more than five cracks in a band are allowed.

Using existing TS tube plugging criteria, many tubes experiencing only minor PWSCC degradation would have to be repaired or removed from service. However, with the analyses described in WCAP-11857, it can been shown that tube plugging or repair is not required to maintain tube bundle integrity in many cases. The proposed L* criterion was evaluated for the four tube modes recommended by Regulatory Guide 1.121 for three steam generator conditions (normal operations, feedline break and loss of coolant).

The Model D-3 steam generators at VCSNS were fabricated with a full depth roll expansion in the lower end of the tube above the tube-to-tubesheet weld. The presence of the tubesheet acts to constrain the tube and complement its integrity in that region by essentially precluding tube deformation beyond its expanded outside diameter. In addition, the proximity of the tubesheet significantly affects the leak behavior of through-wall tube cracks in this region. The elastic preload and interference fit between the tube and the tubesheet due to the roll expansion provides an effective barrier to significant leakage from cracks and other tube degradation in the expanded tube.

The proposed tube plugging criteria have been developed for indications of tube degradation in the tube expansion region below the transition of the mechanically expanded/unexpanded portions of the tube. Over the past three outages, SCE&G has utilized the F* criterion which allows tubes with degradation occurring greater than 1.6 inches into the tubesheet to remain in service. The F* criterion represents a length (designated F*) of continuous roll expansion in the tubesheet such that tube pullout would not occur during either normal operation or postulated accident condition loadings. The implicit assumption of a circumferential severance of a tube in the development of the F* criterion permitted the conclusion that degradation of any extent or orientation within the tubesheet below the F* distance is acceptable during normal and postulated accident conditions. This assumption results in a distance that is longer than necessary to provide a limit to significant leakage in excess of the TS allowance and safety analysis assumptions. Existing F* steam generator tube plugging and repair criteria do not take into account the reinforcing effect of the tubesheet on the external surface of the tube in the portion of the tube expansion above the F* location.

To address some of the indications occurring at an elevation too high in the tube to meet the F* criterion, an additional alternative plugging criterion, designated the L* criterion, was proposed. The L* criterion defines a length, L*, of undegraded expanded tube which, even in a worst case scenario, is sufficient to maintain leakage well below the TS limit. The L* criterion requires that the condition of the degradation below the L* distance be fully assessed. For those tubes in which the degradation below L* is determined to be axial or near axial (not greater than 20°) cracking, the degraded tube provides sufficient structural strength to preclude pullout of the tube and it may remain in service without repair or plugging. The approach taken in developing the L* criterion was to build on the fundamental basis of the F* criterion.

The minimum required engagement length, L*, of roll expansion to preclude significant leakage under normal operation and postulated accident loading conditions was determined to be 0.50 inch. This value does not include an allowance for eddy current elevation measurement uncertainty. The L* distance is measured from the bottom of the transition between the expanded and unexpanded portions of the tube. In the case of a transition located above the top of the tubesheet, the L* distance is measured from the top of the tubesheet.

In order to evaluate the L* criterion concept for indications within the top portion of the tubesheet, an evaluation of the strength of degraded tubes was made. Based on plant operation and laboratory experience the configuration of any new cracks should initially be axial. For axial or nearly axial cracks in the tubesheet region, the tube-end remains structurally intact minimizing any potential for tube pullout. The strength of tubes with axial or near axial cracks has been evaluated using analysis and testing. In order to implement the L* criterion, SCE&G has chosen to conservatively round off the bounding values established in WCAP-11857. A minimum of 3.5 inches of the tube, beginning at the top of the tubesheet and extending down into the tubesheet, must be inspected using a rotating pancake coil (RPC) eddy current technique (or equivalent) to determine the condition of the tube. A minimum of 1.0 inches of sound expanded tube (below the L* distance), separated by no more than two areas of tube degradation (cracks less than 1/2 inch and not greater than 20° from axial), must be found in the inspected portion of tube to ensure tube strength and prevent tube pullout.

The L* engagement length determination was derived from preload, tube pullout, hydraulic proof (pressure), and leak testing done to develop the F* criterion. An evaluation consisting of analysis and testing programs was conducted to verify that the strength of tubes with axial or near axial cracks in the roll expansion region is greater than that required to resist pullout forces during normal operation and postulated accident loading conditions. An additional program of testing was done to verify that a roll expansion with the length of L* is sufficient to significantly restrict leakage during normal operating and postulated accident condition loadings. The leak testing done to validate the L* distance used holes drilled through the tube to simulate the ends of axial cracks. The F* leak testing had used a less sophisticated method for simulating tube degradation using a circumferential cut through the tube. The acceptance criteria for leak testing was based on maintaining the total leakage through the L* distance to less than the primary to secondary leakage limit in the TS. To provide operational flexibility, the acceptance criteria was determined using a fraction of the TS limit (.117 gpm). This value was divided by a number larger than the number of tubes expected to use the L* criterion (note that the WCAP allows L* to be applied to 2648 tube-ends per steam generator; however, SCE&G has chosen a limit of 2500) to get a final acceptance criteria for average test specimen leakage. The results of the L* leak testing compared favorably with the acceptance criteria. For normal operating pressure differential, primary-to-secondary leakage for an L* value of 0.5 inch was negligible.

The leak testing included tests of lengths shorter than 0.5 inch to demonstrate that the function of leak rate versus length of sound expansion is not near a threshold value in the region of the L* length chosen.

The total L* distance value to be contained in the TS includes 0.2 inch as an allowance for eddy current measurement uncertainties. This value envelopes the present day capabilities of state-of-the-art eddy current technology. Below is a discussion of eddy current capabilities for L* implementation.

2.0 EVALUATION

Axial cracking has been shown to be self-limiting and not to rapidly grow into a length which could lead to an increased probability of a tube rupture. Existing tube rupture analyses bound the effects of any hypothetical failure of the tube due to the use of the L* criterion. The margin of safety is not reduced and is provided by the safety factors implicit in the use of the ASME Code to analyze the structural integrity of the tubes, the safety factors included in the recommendations of Regulatory Guide 1.121, and the margin represented by the difference in the size of a crack sufficient to exceed TS leak limits/safety analysis assumptions and the minimum size of crack required to result in tube rupture or exceed analysis assumptions in the steamline break analysis.

On the basis of the evaluation above and as detailed in WCAP-11857, it is determined that tubes with tube degradation which can be categorized as axial or near axial cracking (not greater than 20°) within the tubesheet region below the L* distance (defined as 0.7 inches, including eddy current uncertainty) can be left in service. Tubes with tube degradation which is located a distance of less than L* below the bottom of the transition between the expanded and unexpanded tubes or the top of the tubesheet, whichever is lower, will be removed from service by plugging or repairing in accordance with TS requirements.

The staff has previously approved the F* criterion and there is acceptable industry service experience with its use. The F* and L* criteria are based on a pullout load reaction length of tube such that the existence of sufficient friction is developed between the tube and tubesheet to prevent tube pullout under normal and design basis accident conditions. The same assumptions and calculational inputs for determining F* were also used for the evolution of L*. While the same F* friction methodology was used by L*, the L* criterion allows the frictional forces to be accumulated over bands of sound roll expanded tube that are separated by bands of defective tubing as opposed to one full, unbroken length at the very top of the tubesheet as in the F* criterion.

The unique aspects of L* which differ from F* are relative to leak rate and crack orientation. The assumption and calculational inputs in these two areas were derived to support L* solely and were not necessary for the utilization of F*. WCAP-11857 details these L* specific parameters and contains the test results and calculations necessary to support the L* criterion. L* is fundamentally based on the principles of F* and differs technically only in the areas of leak rate and crack orientation.

The staff had questioned the effect of possible crack growth on the adequacy of the L* approach. Until the recent acceptance of the F* criterion for primary water stress corrosion cracking, all tubes exhibiting greater than 40% thru-wall indications were plugged. For this reason, growth rate data from cycle-to-cycle is essentially nonexistent for domestic utilities. However, several foreign utilities have used a "critical crack length" approach to steam generator plugging for several years, therefore, some data exists on cracks in service tubes.

The licensee obtained information from a foreign plant which has roll transitions similar to those at the VCSNS. Because the rolls at the plant are deep within the tubesheet and cannot burst due to the restraining effect of the tubesheet, cycle-to-cycle growth rates were not tracked and are not available. However, subsequent to ten years of operation, tubes were removed from these generators and metallographic examinations of the tubes were performed. The results of these examinations indicated that the maximum length of cracks after 10 years of operation was 14 mm (or 0.55 inch).

The F* criterion has been utilized at two refueling outages at the VCSNS. The eddy current data on tubes left in service utilizing the F* criterion shows the character of the signal to be virtually unchanged from cycle-to-cycle. Therefore, data indicate that the crack has not changed measurably over the cycle. To date, all tubes left in service utilizing the F* criterion continued to meet the criterion after one cycle of operation (approximately 19 months).

Currently, it is hypothesized by the licensee that cracking itself relieves residual stresses. In addition, as a crack appears and propagates into an area of reduced tensile stress, continued propagation is prevented. The data available to date, both foreign and domestic, appears to support this hypothesis.

The experimental and calculational basis to support the proposed L* distance of 0.56 inch, combined with the foreign data on crack length not exceeding 0.55 inch, provides the assurance that unacceptable crack growth will not occur between inspections. Experimental evidence completed to date will actually support a much smaller L* distance; however, since the conservative 0.7 inch distance has been chosen, no additional allowance for crack growth was required.

On November 12, 1990, a member of the NRC staff and the staff's expert consultant on eddy current testing from Oak Ridge National Laboratory traveled to Lynchburg, Virginia, to review the proposed L* criterion for inspection of the VCSNS steam generators. The meeting was held at the Babcock & Wilcox (B&W) facilities in Lynchburg, since they are presently doing the work for the utility, and all the equipment was present at their facility. The object of the visit was to determine if the proposed eddy-current inspection technique was adequate to meet the L* criterion.

A presentation was given by B&W and SCE&G on the L* criterion and the eddy-current inspection that has been designed to test the candidate tubes. Three different types of rotating pancake coils were described in the presentation with two being from Zetec and one being from B&W. The B&W probe (Eddy-360) has transducers that will measure the angle of rotation and the axial distance along the tube.

The eddy-current probe was demonstrated to have an accuracy of within ±0.06 inches in measuring the length of a defect. A set of measurements was performed on an electro-discharge machined (EDM) standard. All the errors were less than the 0.2 in. eddy-current measurement uncertainty that was incorporated into the L* crack length determination margin.

Accurate measurement of the crack length and the angle of the crack with respect to the tube axis is critical to the successful use of the L* criterion. A demonstration of how the eddy-current testing system would be used was made using data that was recorded at a previous plant outage. The particular tube that was used in the demonstration had been pulled and examined metallographically, but information on these particular defects was not available. One section of another tube containing a short crack had been examined with metallography. The angle of this short crack was measured at 25.5 degrees with eddy current and at 60 degrees with metallography. However, only a limited number of data points were read around the tube and the pitch of the scan was coarser than that to be used for L*. In addition, this crack was in the expansion region, where the signal-to-noise ratio is generally worse than in the L* region. The proposed inspection appears to be adequate if the scan of 100 points around circumference are taken with a pitch of 0.050 in., as stated in the licensee's letter of December 7, 1990. The staff recommended that a standard with different crack lengths, and with different orientations be prepared and that the data analyst should train and be tested on the standard prior to the evaluation of the L* data from the plant. The licensee committed to such a program.

3.0 SUMMARY

Based on favorable inservice experience with the use of the F* approach and the eddy current testing demonstration and commitments made in the Licensee's letter of December 7, 1990, with respect to qualification of the eddy current testing system and data analysts, the staff finds the use of the L* criterion acceptable.

4.0 ENVIRONMENTAL CONSIDERATION

Pursuant to 10 CFR 51.21, 51.32 and 51.35, an environmental assessment and finding of no significant impact has been prepared and published in the Federal Register on April 2, 1991 (56 FR 13504). Accordingly, based upon the environmental assessment, we have determined that the issuance of the amendment will not have a significant effect on the quality of the human environment.

5.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: April 3, 1991

Principal Contributor: H. Conrad