



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 30, 2012

Mr. Thomas D. Gatlin
Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
Jenkinsville, SC 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1 - ISSUANCE OF
AMENDMENT ON BEACON CORE MONITORING AND OPERATIONS
SUPPORT SYSTEM (TAC NO. ME6878)

Dear Mr. Gatlin:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 190 to Renewed Facility Operating License No. NPF-12 for the Virgil C. Summer Nuclear Station (VCSNS), Unit 1 in response to your application dated August 11, 2011. This amendment allows an updating of the applicable topical report in TS 6.9.1.11, "Core Operating Limits Report" to use the three-dimensional Advanced Nodal Code neutronic model.

A copy of the related Safety Evaluation is enclosed. A Notice of Issuance will be included in the Commission's Biweekly *Federal Register* notice.

Sincerely,

A handwritten signature in black ink that reads "Robert E. Martin".

Robert E. Martin, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosures:

1. Amendment No. 190 to NPF-12
2. Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

DOCKET NO. 50-395

VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 190
Renewed License No. NPF-12

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by South Carolina Electric & Gas Company (the licensee), dated August 11, 2011, 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.

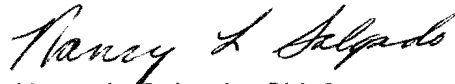
2. Accordingly, the license is amended by changes to the Technical Specifications, as indicated in the attachment to this license amendment; and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-12 is hereby amended to read as follows:

- (2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 190 , 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 90 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Nancy L. Salgado, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to Renewed Facility
Operating License No. NPF-12
and the Technical Specifications

Date of Issuance: May 30, 2012

ATTACHMENT TO LICENSE AMENDMENT NO. 190
TO RENEWED FACILITY OPERATING LICENSE NO. NPF-12
DOCKET NO. 50-395

Replace the following pages of the License and Appendix "A" Technical Specifications with the enclosed pages as indicated. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove Pages

License
License No. NPF-12, page 3

TS
6-16a

Insert Pages

License
License No. NPF-12, page 3

TS
6-16a

- (3) SCE&G, pursuant to the Act and 10 CFR Part 70, to receive, possess and use at any time special nuclear material as reactor fuel, in accordance with the limitations for storage and amounts required for reactor operation, as described in the Final Safety Analysis Report, as amended through Amendment No. 33;
- (4) SCE&G, pursuant to the Act and 10 CFR Parts 30, 40 and 70 to receive, possess and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed neutron sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;
- (5) SCE&G, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to receive, possess and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus of components; and
- (6) SCE&G, pursuant to the Act and 10 CFR Parts 30, 40, and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This renewed license shall be deemed to contain, and is subject to, the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

SCE&G is authorized to operate the facility at reactor core power levels not in excess of 2900 megawatts thermal in accordance with the conditions specified herein and in Attachment 1 to this renewed license. The preoccupation tests, startup tests and other items identified in Attachment 1 to this renewed license shall be completed as specified. Attachment 1 is hereby incorporated into this renewed license.

(2) Technical Specifications and Environmental Protection Plan

The technical Specifications contained in Appendix A, as revised through Amendment No 190 and the Environmental Protection Plan contained in Appendix B, are hereby incorporated in the renewed license. South Carolina Electric & Gas Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

ADMINISTRATIVE CONTROLS

CORE OPERATING LIMITS REPORT (Continued)

- c. WCAP-12945-P-A, Volume 1 (Revision 2) through Volumes 2 through 5 (Revision 1) "Code Qualification Document for Best Estimate LOCA Analysis," March 1998 (Westinghouse Proprietary).
- Liparulo, N. (W) to NRC Document Control Desk, NSD-NRC-96-4746, "Re-Analysis Work Plans Using Final Best Estimate Methodology" dated 6/13/1996.
- (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor.)
- d. WCAP-12472-P-A, "BEACON CORE MONITORING AND OPERATIONS SUPPORT SYSTEM," August 1994, (W Proprietary).
- WCAP-12472-P-A, Addendum 1-A, "BEACON CORE MONITORING AND OPERATIONS SUPPORT SYSTEM," January 2000, (W Proprietary)
- (Methodology for Specifications 3.2.2 - Heat Flux Hot Channel Factor, 3.2.3 - RCS Flow Rate and Nuclear Enthalpy Rise Hot Channel Factor, and 3.2.4 - Quadrant Power Tilt Ratio.)
- e. WCAP-13749-P-A, "Safety Evaluation Supporting the Conditional Exemption of the Most Negative EOL Moderator Temperature Coefficient Measurement," March 1997, (Westinghouse Proprietary).
- (Methodology for Specification 3.1.1.3 - Moderator Temperature Coefficient.)
- f. WCAP-12610-P-A, "VANTAGE + Fuel Assembly Reference Core Report," April 1995 (W Proprietary). WCAP-12610-P-A & CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™," July 2006 (W Proprietary).
- (Methodology for Specification 3.2.2 - Heat Flux Hot Channel Factor.)

The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

The CORE OPERATING LIMITS REPORT, including any mid-cycle revisions or supplements there to shall be provided upon issuance, for each reload cycle, to the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.



UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 190 TO RENEWED FACILITY OPERATING LICENSE NO. NPF-12

SOUTH CAROLINA ELECTRIC & GAS COMPANY

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY

VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1

DOCKET NO. 50-395

1.0 INTRODUCTION

By letter dated August 11, 2011, (Reference 1) South Carolina Electric & Gas Company (SCE&G, the licensee), submitted a license amendment request (LAR) for changes to the Virgil C. Summer Nuclear Station (VCSNS), Unit 1, Technical Specification (TS) 6.9.1.11, "Core Operating Limits Report (COLR)" to reference and use Westinghouse topical report, WCAP-12472-P-A, Addendum 1-A (Reference 3). This is an update to the existing reference to WCAP-12472-P-A, "BEACON Core Monitoring and Operations Support System," August 1994, (Reference 2) which was approved for use at VCSNS by License Amendment No. 142. Reference 3 reflects NRC approval of Addendum 1-A to WCAP-12472-P-A, which allows the use of the three-dimensional Advanced Nodal Code (ANC) neutronic model (Reference 4) in BEACON in place of the previously approved SPNOVA model.

The purpose of the reactor core monitoring system is discussed in the NRC staff's safety evaluation for the issuance of License Amendment No. 142 (Reference 6) as follows:

[The changes to the VCSNS TS] incorporate a new reactor core power distribution monitoring system (PDMS). The new system uses an NRC-approved Westinghouse proprietary computer system, the best estimate analyzer for core operation-nuclear (BEACON), to augment the flux mapping system when performing a core power distribution surveillance. The proposed TS changes allow the use of the PDMS at power ranges greater than 25% rated thermal power (RTP). At ranges less than or equal to 25% RTP, the licensee must declare the PDMS inoperable. The existing TS will continue to require the licensee to perform a surveillance using the present movable incore detector system when the PDMS is declared inoperable.

The NRC-approved BEACON Topical Report WCAP-12472-P-A...is acceptable for use at VCSNS, and it describes a greatly improved on-line power distribution monitoring system. This system provides direct, continuous core power distribution determination and directly relates power distribution to fuel safety limits for Westinghouse plants. At VCSNS, the licensee will use the BEACON system for measuring power distribution instead of using the moveable in-core flux mapping

system when power is greater than 25% RTP. All existing power distribution limits remain unchanged. SCE&G will continue to perform power distribution surveillances at the current frequency (every 31 effective full power days). The NRC staff has confirmed that the licensee has referenced and adhered to any restrictions and/or conditions the NRC imposed on WCAP-12472-P-A approval. SCE&G will use the BEACON system only with moveable in-core detectors, as the Westinghouse Topical Report does not apply to fixed in-core detectors.

The proposed TS 6.9.1.11 revision to add WCAP-12472-P-A, "BEACON Core Monitoring and Operations Support System," August 1994, will ensure the values for cycle-specific parameters are maintained within the applicable limits of the plant safety analysis, thus ensuring conformance to 10 CFR 50.36.]

2.0 REGULATORY EVALUATION

The BEACON core monitoring system methodology was approved for use at VCSNS in license amendment number 142 for monitoring and determining the three-dimensional core power distribution (Reference 6). This calculation was performed with the NRC approved Westinghouse SPNOVA nodal method (Reference 5). SPNOVA employs a single effective neutron fast group calculation to determine the global neutron flux solution, and then uses a local correlation to determine thermal flux and power distribution (Reference 2). SPNOVA is a simplified neutron diffusion equation code which was used due to limited computational power of early vintage work stations. The licensee, as a result of enhanced capability workstations and improvements in numerical solution technique of the nodal expansion method, proposes to upgrade the BEACON core monitoring system to use the three-dimensional ANC neutronic model (Reference 4), as referenced in WCAP-12472-P-A, Addendum 1-A.

Title 10 of the *Code of Federal Regulations*, Section 50.36(b) states, in part, that the TS will be derived from the analyses and evaluations included in the safety analysis report, and amendments thereto, submitted pursuant to Section 50.34. Section 50.36(c)(5) states that TS shall contain Administrative Controls "relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner."

VCSNS TS 6.9.1.11 requires that the core operating limits be established and documented in the COLR prior to each reload cycle using NRC approved analytical methods. WCAP-12472-P-A, Addendum 1-A for the BEACON core monitoring system (Reference 3) was reviewed and approved by the NRC staff. The license amendment is proposed by the licensee under 10 CFR 50.90 to incorporate the Addendum 1-A into the VCSNS TS.

The NRC staff reviewed the LAR to evaluate compliance of the proposed methodology with the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, General Design Criterion 13:

GDC-13, "*Instrumentation and Control*" Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment

and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

3.0 TECHNICAL EVALUATION

3.1 Background and Methodology

The BEACON system was originally developed by Westinghouse to monitor core power distribution in Westinghouse reactors. The monitoring operation was based largely on, and tied together by, the use of the NRC staff-approved three-dimensional neutronics analysis code SPNOVA (Reference 5). SPNOVA's primary role in BEACON was to generate detailed power distributions and compare them to core limits (e.g., departure from nucleate boiling (DNB) ratio limits, on a nearly continuous basis and supply that information to the operator. SPNOVA was calibrated periodically using the incore neutron flux measurement system to provide details of the power distribution, and calibrated frequently using the exit thermocouples for the updating of radial power distributions and the excore neutron detectors for updating axial power distributions.

The BEACON monitoring system that used the SPNOVA neutronic methodology employed one-node-per-assembly (radial) representation to achieve the rapid running times required by hardware platforms available in the late 1980s. The limited computational capabilities at the time of the initial approval with SPNOVA precluded extension of the BEACON monitoring capability to use the NRC-approved PHONIX/ANC methodology. However, recent workstation advancements, coupled with improvements in numerical solution techniques of the nodal expansion method, have permitted the optional use of the ANC neutronic code in the BEACON system while maintaining BEACON functionality. The NRC staff reviewed the Addendum 1-A to WCAP-12472-P-A and approved the use of PHOENIX-P/ANC code for the prediction of the incore detector currents and power distribution calculated from these currents.

Addendum 1-A to WCAP-12472-P-A incorporates additional features into the BEACON system, such as, (1) the use of self-powered detectors (SPD) and (2) the use of the three-dimensional advanced nodal (ANC) neutronic model code. The PHOENIX/ANC code is a licensed methodology that is supported by many critical experiments and plant data. The method is based on neutron physics and avoids the use of empirical correlations and data. Another advantage is that this method can be applied to a wider range of design and operating conditions.

The proposed BEACON-ANC methodology determines the measured power distribution by monitoring the predicted power distribution and multiplying it by the ratio of measured-to-predicted currents. The current ratio is indicative of the flux distribution. The best estimate measured power distribution is obtained by adjusting the predicted power distribution by the current ratio. The ratio of the measured-to-predicted power in each node is defined as the incore calibration constant for that node. This constant is then multiplied by the node fluxes and the node peak powers to generate the adjusted values of these parameters.

Since the BEACON monitoring system is statistical in nature, the determination of the measured peaking factor is affected by such things as the detector measurement variability, the number and layout of detectors, interpolation techniques, and any differences between predicted and true power distribution. Westinghouse implemented the BEACON system uncertainty using a statistical method in which the detector behavior is simulated on the basis of measurement variability statistics (Reference 2). Details of the calculations for the bounding 95/95 upper

tolerance limit in the fuel assembly power and peak node power, the total uncertainty in the assembly power, the total uncertainty in the peak node power, the total hot channel $F_{\Delta H}$ measurement uncertainty, and the total hot channel F_Q measurement uncertainty are detailed in References 2 and 3.

Implementation of the upgrade of BEACON requires that the plant-cycle-specific components shall be determined on a plant-specific basis and confirmed each cycle. The staff has determined that in order to ensure that the assumptions made in BEACON uncertainty analyses remain valid; the generic uncertainty components will require reevaluation when BEACON is applied to plant or core designs each cycle of operation.

3.2 Summary

The NRC staff has reviewed the LAR (Reference 1) to evaluate the upgrade of the BEACON core monitoring and operations support system to use the three-dimensional Advanced Nodal Code (ANC) in place of SPNOVA code. The staff finds that the licensee will comply with the processes and procedures set forth in the BEACON topical reports (References 2 and 3) in implementing the update of BEACON at VCSNS, Unit 1. Accordingly, the NRC staff concludes that based on the review as discussed above, the licensee provided sufficient information to support the proposed TS changes and those changes are acceptable.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the South Carolina State official was notified of the proposed issuance of the amendments. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATIONS

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (October 11, 2011, 76 FR 62864). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission 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) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

1. License amendment request from T. D. Gatlin (SCE&G) to US NRC, proposing change to TS Administrative Controls section to allow use of Westinghouse WCAP-12472-P-A, Addendum 1-A, August 11, 2011, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11228A009).
2. WCAP-12472-P-A, "BEACON Core Monitoring and Operations Support System, "Westinghouse Electric Company, August 1994.
3. WCAP-12472-P-A, Addendum 1-A, BEACON Core Monitoring and Operations Support System," Westinghouse Electric Company, January 2000, ADAMS Accession No.ML003678346.
4. WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores," Westinghouse Electric Corporation, June 1998.
5. WCAP-12394 (Proprietary), "SPNOVA- A Multidimensional Static and Transient Computer Program for PWR Analysis," Westinghouse Electric, September 1989.
6. License amendment no. 142 for VCSNS, Unit 1, April 9, 1999, ADAMS Accession No. ML012260068.

Principal Contributor: M. Panicker, NRR

Date: May 30, 2012

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Mr. Thomas D. Gatlin
Vice President, Nuclear Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
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Sincerely,

/RA/

Robert E. Martin, Senior Project Manager
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Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosures:

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* By memo dated

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