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SCE&G®
A SCANA COMPANY

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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

ATTN: Document Control Desk

Subject: Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3 Combined License Application (COLA) - Docket Numbers 52-027 and 52-028
Response to NRC Request for Additional Information (RAI) Letter No.072 Related to Radiation Protection Design Features

Reference: Letter from Donald C. Habib (NRC) to Alfred M. Paglia (SCE&G), Request for Additional Information Letter No. 072 Related to SRP Section 12.03-12.04 for the Virgil C. Summer Nuclear Station Units 2 and 3 Combined License Application, dated November 23, 2009.

The enclosure to this letter provides the South Carolina Electric & Gas Company (SCE&G) response to the RAI items included in the above referenced letter. The enclosure also identifies any associated changes that will be incorporated in a future revision of the VCSNS Units 2 and 3 COLA.

Should you have any questions, please contact Mr. Al Paglia by telephone at (803) 345-4191, or by email at apaglia@scana.com.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on this 6th day of January, 2010.

Sincerely,

Ronald B Clary

Ronald B. Clary
Vice President
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JMG/RBC/jg

Enclosure

D083
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NRC RAI Letter No. 072 Dated November 23, 2009

SRP Section: 12.03-12.04 - Radiation Protection Design Features

QUESTIONS for Health Physics Branch (CHPB)

NRC RAI Number: 12.03-12.04-3

V C Summer COL FSAR section 12.4.1.9 provides a description of the potential sources of exposure to construction workers. The dose limits to the workers are reviewed by the staff against the standards of 10 CFR 20.1301.

10 CFR 20.1301 (a)(1) states "The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year".

The Staff will review related V C Summer SCOL documents to support an independent assessment of compliance with the regulations, but the staff needs additional information to make a determination of reasonable assurance.

1) FSAR 12.4.1.9.2 discussed the exposures to Units 2 and 3 to direct and gaseous radioactive effluents from Unit 1. The FSAR does not provide sufficient details on the use of TLD data, and the assumed 1 mrem/y dose contribution from Unit 1 for the Units 2 and 3 construction workers. During the ER Site Audit conducted March 9 thru 12, 2009, the details of this assessment were discussed, where the applicant indicated that that for this evaluation 5 years of TLD data, including baseline background radiation measurements prior to Unit 1 operations, were compared with measurements collected during recent years of Unit 1 operation. With the construction site for Units 2 and 3 being approximately 1 mile from Unit 1 containment and buildings, any direct dose component would be negligible considering Unit 1 building the shielding and air attenuation. However, no details are provided for the evaluation of Unit 1 gaseous effluents for the Units 2 and 3 construction workers. No basis has been provided to justify what appears to be the use of recent Unit 1 data as representative of design basis conditions as should be used for a bounding assessment. Please provide the following additional information:

    a. Actual location (along with basis) and dispersion parameters assumed for the maximum exposed Units 2 and 3 construction workers relative to the Unit 1 release points.
    b. Justification for the use of what appears to be a single year of Unit 1 effluent data for this construction worker dose assessment. Consideration should be given to how the Unit 1 operating conditions compare with design basis conditions (e.g., failed fuel level and operating capacity). Alternatively, potential dose from gaseous effluents to construction workers from Unit 1

operations should consider a design basis source term (i.e., as assumed for Unit 1 licensing 10 CFR 50, Appendix I compliance).

2) FSAR 12.4.1.9.3 addresses the dose to Unit 3 construction workers following completion and operation of Unit 2. The details provided are not sufficient to substantiate the doses and conclusions. Please provide the following additional information:

   a. Actual location (along with basis) and dispersion parameters assumed for the maximum exposed Unit 3 construction worker relative to the Unit 2 release points;
   b. Rationale why 2000 hours per year exposure represents the maximum exposure time, considering likely overtime during major construction activities.

VCSNS RESPONSE:

1) A review of TLD data in the Unit 1 Radiological Environmental Operating Reports for five years showed direct radiation dose rates comparable to pre-operational levels, indicating direct radiation dose from Unit 1 is negligible. For conservatism, however, it is assumed that the direct dose rate from Unit 1 to the construction site for Units 2 and 3 is 1 mrem/yr, resulting in an annual worker dose of 0.23 mrem when multiplied by 2000/8766 to account for the 2000 hours per year that the worker spends at the construction site out of an average of 365.25 days or 8766 hours. The requested information on the evaluation approach used to assess the effect of Unit 1 gaseous effluents on the Units 2 and 3 construction workers is provided below.

   a. The doses to Units 2 and 3 construction workers from Unit 1 gaseous effluents are not explicitly calculated based on the locations of the release point and the receptors and the associated dispersion. Instead, the doses are taken from the Virgil C. Summer Nuclear Station - Annual Effluent Radioactive Release Reports for Unit 1 from 2003 through 2007 (see References 1 to 5). Table 6 of each effluent report shows gamma, beta, and organ doses to the hypothetical maximally exposed individual (MEI) in an unrestricted area. From the effluent reports for 2003 through 2007, the maximum MEI organ dose is selected; the maximum total body dose is estimated by dividing the organ dose by the thyroid weighting factor of 0.03 from the International Commission on Radiological Protection (ICRP) Publication 30 (ICRP 30). This, the smallest weighting factor specified in ICRP 30, is used because the organ receiving the maximum dose is not identified in the annual reports and dividing by the smallest weighting factor maximizes the corresponding total body dose. Since the construction area for Units 2

and 3 is farther away than the nearest unrestricted area of Unit 1, this approach is considered conservative.

b. The annual construction worker dose in FSAR Table 12.4-201 includes a gaseous effluent contribution from Unit 1 of 0.27 mrem TEDE, adjusted for worker time of 2000 hr/yr. As explained in the previous paragraph, the dose from Unit 1 is based on the annual effluent reports for 2003 through 2007. Operational data is representative of the actual plant conditions and selecting the maximum dose based on a review of five years of operational data conservatively compensates for variations in annual data.

2) The calculation of doses to Unit 3 construction workers from Unit 2 operation provided in FSAR 12.4.1.9.3 has been updated to incorporate 2 years of meteorological data (2007-2008). The associated changes to FSAR Section 12.4 are attached as Draft Revision 2 to the VCSNS FSAR. The information requested in the RAI on the calculation of doses to Unit 3 construction workers from Unit 2 operation is provided below based on the updated calculations.

a. For calculating the dose to Unit 3 construction workers from Unit 2 gaseous effluents, the undecayed and undepleted atmospheric dispersion factor (χ/Q) and the 2.26-day decayed and undepleted χ/Q are both 1.7E-5 sec/m3. The 8-day decayed and depleted χ/Q is 1.6E-5 sec/m3. The ground deposition factor (D/Q) is 6.5E-8 m-2. These values reflect 2007-2008 meteorological data and are based on the reactor center-to-center distance of 0.17 mile in the southwest direction from Unit 2 to Unit 3. The center-to-center distance between the reactors of Units 2 and 3 is used for the annual dose because it represents the average location of a worker moving about the construction area over the course of a year. The resulting annual dose from Unit 2 gaseous effluents to the Unit 3 construction worker is 0.48 mrem TEDE.

b. As discussed in FSAR 12.4.1.9.3, a peak construction workforce of 3600 is assumed based on working 2000 hours per year. To be consistent with the workforce calculation, the dose to the individual construction worker is also based on 2000 hours per year. If overtime had been planned, the assumed workforce estimate would have been smaller. As shown in FSAR Table 12.4-201, the construction worker doses are orders of magnitude below the limits of 10 CFR 20.1301. However, an evaluation was performed to determine the number of hours a construction worker would have to be exposed in order to exceed the regulatory limits defined in 10 CFR 20.1301. The case of Unit 3 construction workers was evaluated considering the contributions from Units 1 and 2. The amount of hours that can be spent at the Unit 3

construction site without exceeding the 10 CFR 20.1301 limit of 100 mrem TEDE is 150,000 hours. Therefore since there are only 8,766 hours in one year, even if overtime is worked, construction worker exposures would be well within regulatory limits for members of the public.

This response is PLANT SPECIFIC

ASSOCIATED VCSNS COLA REVISIONS:

Draft Revision 2 to the VCSNS FSAR Section 12.4 "DOSE ASSESSMENT" is attached (5 total pages). Changes are shown in red strikeout for deleted text and green underline for new text. Note that Draft Revision 2 to FSAR Section 12.4 also includes the incorporation of an AP1000 STANDARD supplemental item (STD SUP 12.4-1) as FSAR Subsection 12.4.1.9.6, "Operating Unit Radiological Surveys."

ASSOCIATED ATTACHMENTS:

VCSNS FSAR Section 12.4 "DOSE ASSESSMENT", Draft Revision 2.

REFERENCES:

1. SCE&G Virgil C. Summer Nuclear Station - Annual Effluent and Waste Disposal Report for the operating period January 1, 2003 through December 31, 2003, April 2004 (ML041250040).

2. SCE&G Virgil C. Summer Nuclear Station - Annual Effluent and Waste Disposal Report for the operating period January 1, 2004 through December 31, 2004, April 2005 (ML061360185).

3. SCE&G Virgil C. Summer Nuclear Station - Annual Effluent and Waste Disposal Report for the operating period January 1, 2005 through December 31, 2005, April 2006 (ML061220346).

4. SCE&G Virgil C. Summer Nuclear Station - Annual Effluent Radioactive Release Report for the operating period January 1, 2006 through December 31, 2006, April 2007 (ML071100292).

5. SCE&G Virgil C. Summer Nuclear Station - Annual Effluent Radioactive Release Report for the operating period January 1, 2007 through December 31, 2007, April 2008 (ML081280581).

Attachment 1

Draft Revision 2 of VCSNS FSAR 12.4

5 Total Pages

12.4 DOSE ASSESSMENT

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following new subsections after DCD Subsection 12.4.1.8:

VCS SUP 12.4-1

12.4.1.9 Dose to Construction Workers

This section evaluates the potential radiological dose impacts to construction workers at VCSNS resulting from the operating unit(s). Construction workers at Units 2 and 3 may be exposed to direct radiation and gaseous radioactive effluents from Unit 1. Since a portion of the Unit 3 construction period overlaps operation of Unit 2, construction workers at Unit 3 may be exposed to direct radiation and gaseous radioactive effluents from Unit 2.

12.4.1.9.1 Site Layout

The VCSNS power block areas are shown on FSAR Figure 2.1-203. Separation will be provided such that construction activity for Unit 3 is outside the protected area for Units1 and 2 but inside the owner controlled area.

12.4.1.9.2 Radiation Sources

Workers constructing Units 2 and 3 may be exposed to direct radiation and gaseous radioactive effluents emanating from the routine operation of Unit 1. Construction workers at Unit 3 are not exposed to any radiation sources from Unit 2 until it becomes operational. Workers constructing Unit 3 may be exposed to direct radiation and gaseous radioactive effluents emanating from the routine operation of Unit 2. Radiation doses to construction workers are from direct radiation and from airborne effluents from Unit 2 and from background radiation.

Direct radiation from the Unit 1 containment and other plant buildings is negligible. Routine operational thermo-luminescent dosimeter (TLD) measurements at the site boundary for Unit 1 show that the annual doses are comparable to the preoperational annual dose rates. For conservatism, the annual direct dose to a construction worker at Unit 2 or 3 is assumed to be 1 mrem per year. Small quantities of monitored airborne effluents are normally released from the Unit 1 from the waste gas decay tank, reactor building purges, and oil incineration. The construction workers are assumed to be exposed to the gaseous and liquid doses from routine operation of Unit 1.

Routine operational TLD measurements at the old steam generator recycling facility show that the annual doses are comparable to the preoperational annual dose rates. Therefore, the direct dose from this facility is negligible.

For Unit 2, the radiation exposure at the site boundary is considered in DCD Section 12.4.2. As stated in that section, direct radiation from the containment and other plant buildings is negligible. Additionally, there is no contribution from refueling water since the refueling water is stored inside the containment instead of in an outside storage tank. For conservatism, the annual dose to a construction worker at Unit 3 is assumed to be 1 mrem per year.

For Unit 2, small quantities of monitored airborne effluents are normally released through the plant vent or the turbine building vent. The plant vent provides the release path for containment venting releases, auxiliary building ventilation releases, annex building releases, radwaste building releases, and gaseous radwaste system discharge. The turbine building vents provide the release path for the condenser air removal system, gland seal condenser exhaust and the turbine building ventilation releases. The ventilation system is described in DCD Section 9.4. The expected radiation sources (nuclides and activities) in the gaseous effluents are listed in DCD Table 11.3-3.

Exposure of Unit 3 construction workers to radioactive liquid effluents is evaluated for conservatism. Although the construction workers would not be exposed to the liquid exposure pathways at the Unit 3 construction site, it is conservatively assumed that the workers receive the same doses as the maximally exposed member of the public offsite.

While Unit 2 is operating and Unit 3 is under construction, workers may be exposed to liquid effluents from Unit 2 while performing Unit 3 liquid waste effluent discharge piping connections. However, this work will be performed by trained radiation workers, not general site construction workers. Hence, this activity is not considered a contributor to construction worker doses.

12.4.1.9.3 Construction Worker Dose Estimates

For liquid effluent doses from Unit 1, the determination of construction worker dose due to Unit 1 operation is assumed to be equal to the calculated liquid effluent dose for routine operation per the Unit 1 Off-Site Dose Calculation Manual (ODCM). For liquid effluent doses from Unit 2, the determination of construction worker dose due to Unit 2 operation depends on the liquid effluent release and the transport to worker location. The liquid dilution and transport to the maximally exposed person used the guidance in Regulatory Guide 1.113 for the average flow rate for the Broad River.

The construction worker doses are conservatively estimated using the following information:

- The workers receive the same doses as the maximally exposed member of the public offsite in accordance with Section 11.2.3.5
- A construction worker exposure time of 2000 hours per year

- A peak loading of 3600 construction workers per year for Unit 3 construction

The use of 2000 hours assumes that the worker works 40 hours per week for 50 weeks per year.

The methodology used to calculate the doses to construction workers from normal effluent releases complies with the guidance provided in Regulatory Guide 1.109. Construction worker doses were estimated by use of LADTAP II computer code (NUREG/CR-4013). The total effective dose equivalent (TEDE), which is the sum of the deep dose equivalent (DDE) and the committed effective dose equivalent (CEDE), was determined from the LAPTAP II results. The annual TEDE dose was corrected for the actual time the construction workers are onsite by multiplying by the ratio of hours worked per year to hours in a year.

For airborne doses, the determination of construction worker dose due to Unit 2 operation depends on the airborne effluent release and the atmospheric transport to the worker location. The atmospheric dispersion calculation used the guidance provided in Regulatory Guide 1.111, meteorological data for the years 20072003 ~~and~~to 20082006, and downwind distances to the construction worker locations. The XOQDOQ computer code (NUREG/CR-2919) was used to determine the χ/Q and D/Q values for the nearest location along the Unit 2 protected area fence in each direction as well as the nearest point of the Unit 3 construction area.

Construction worker doses are conservatively estimated using the following information:

- The estimated maximum dose rate for each pathway.
  - External exposure to contaminated ground.
  - External exposure to noble gas radionuclides in the airborne plume.
  - Inhalation of air.
- A construction worker exposure time of 2000 hours per year.
- A peak loading of 3600 construction workers per year for Unit 3 construction.

The use of 2000 hours assumes the worker works 40 hours per week for 50 weeks per year.

The methodology used to calculate the doses to construction workers from normal effluent releases complies with the guidance provided in Regulatory Guide 1.109. Construction worker doses were estimated by use of GASPAR computer code (NUREG/CR-4653). The TEDE, which is the sum of the DDE and the CEDE, was determined based on the GASPAR results. The annual TEDE dose was corrected

for the actual time the construction workers are onsite by multiplying by a ratio of hours worked per year to hours in a year.

12.4.1.9.4 Compliance with Dose Regulations

VCSNS Units 2 and 3 construction workers are, for the purposes of radiation protection, members of the general public. This means that the dose to the individual does not exceed 100 mrem per year, the limit for a member of the public. The construction workers do not deal with radiation sources.

Dose limits to the public are provided in 10 CFR 20.1301 and 10 CFR 20.1302. Because the construction workers are considered members of the public, the requirements of 10 CFR 20.1201 through 20.1204 do not apply.

The 10 CFR 20.1301 limits annual doses from licensed operations to individual members of the public to 100 mrem TEDE. In addition, the dose from external sources to unrestricted areas must be less than 2 mrem in any one hour. This applies to the public both outside and inside access controlled areas. The maximum dose rates are given in Table 12.4-201. For an occupational year, dose at the Unit 3 construction area is 1.3~~1.2~~ mrem TEDE. This value is less than the limits specified for members of the public. Therefore, construction workers can be considered to be members of the general public and do not require radiation monitoring.

12.4.1.9.5 Collective Doses to VCSNS Units 2 and 3 Workers

The collective dose is the sum of all doses received by all workers. It is a measure of population risk. The total worker collective maximum annual dose is 4.6~~4.3~~ person-rem. This estimate is based upon the construction workforce of 3600 and assumes 2000 hours per year for each worker.

12.4.1.9.6 Operating Unit Radiological Surveys

STD SUP 12.4-1 The operating unit conducts radiological surveys in the unrestricted and controlled area and radiological surveys for radioactive materials in effluents discharged to unrestricted and controlled areas in implementing 10 CFR 20.1302. These surveys demonstrate compliance with the dose limits of 10 CFR 20.1301 for construction workers.

VCS SUP 12.4-1

Table 12.4-201
Construction Worker Dose Comparison to 10 CFR 20.1301 Criteria

Type of Dose	Dose Limits(1) (TEDE)	Estimated Dose(2)
Annual total effective dose equivalent	100 mrem	1.3~~1.2~~ mrem
Maximum dose in any hour	2 mrem	6.5~~6.0~~ E-04 mrem

Notes:

1. 10 CFR 20.1301 criteria.

2. Estimated dose is at Unit 3 construction area. Total body dose calculated using the methodology in Regulatory Guide 1.109.