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June 15, 2009
RC-09-0072

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

ATTN: R. E. Martin

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
SUPPLEMENT TO LICENSE AMENDMENT REQUEST - LAR 04-02911
LICENSE AMENDMENT AND RELATED TECHNICAL SPECIFICATION CHANGES TO IMPLEMENT FULL-SCOPE ALTERNATIVE SOURCE TERM IN ACCORDANCE WITH 10 CFR 50.67

Pursuant to our telephone conversation on March 12, 2009, South Carolina Electric and Gas Co. submits the requested supplemental information for Virgil C. Summer Nuclear Station Unit No. 1 to support your review of License Amendment Request – LAR 04-02911, License Amendment And Related Technical Specification Changes To Implement Full Scope Alternative Source Term In Accordance With 10 CFR 50.67, dated February 17, 2009.

This letter replaces the previous letter dated April 8, 2009. The previous submittal was rejected by the Document Control Desk, because attachment 2 contained proprietary information. Attachment 2 has been revised and no longer contains proprietary information.

Enclosed are the responses to the questions discussed and a copy of the requested calculation.

There are no regulatory commitments made in this supplement.

If you should have any questions regarding this submittal, please contact Mr. Bruce L. Thompson at (803) 931-5042.

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

6/15/09
Executed on

Jeffrey B. Archie

JHW/JBA/gar

Attachments: (2)
Attachment 1 - AST Submittal Questions
Attachment 2 - Calculation DC00040-066, Rev 2

A001
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PRSF (RC-09-0072)

# Attachment 1- AST Submittal Questions

1. **Provide time dependant values of strong acid concentrations in the sump for a period of 30 days post-LOCA.**

   The VCS AST submittal states that the post-LOCA sump pH remains above 7 throughout the event. This conclusion was based on the current VCS licensing basis discussed in FSAR section 3.11.5.1.2 and original project calculations. The calculations did not include consideration of acid generation (nitric acid produced by the irradiation of water and air or hydrochloric acid produced by the radiolysis of chlorine bearing materials) as they were considered secondary effects.

   Recently the staff summarized the effects of acid generation for a Westinghouse PWR in the Byron SER (ML062340420). The conclusion reached therein was that the effect of these phenomena on sump pH would be to decrease the pH value less than 0.1 pH unit, a negligible effect. It is expected that a similar result would be the case for VCS by comparison of the parameters listed in the Byron SER with the VCS parameters used for the conservatively calculated minimum pH case:

| Component | Byron | VCS |
|---|---|---|
| RWST: | 457,904 gallons at 2500 ppmB | 457,620 gallons at 2500 ppmB |
| RCS: | 620,800 pounds mass at 2300 ppmB | 427,606 pounds at 2000 ppmB |
| Accumulators: | 28,868 gallons (total) at 2400 ppmB | 23,050 gallons (total) at 2500 ppmB |
| NaOH | 2500 gallons 30 wt% | 1836 gallons 20 wt% |

   Furthermore, back leakage of sump fluid through the RWST is not considered in the post-LOCA analysis based on plant procedures (EOPs) that require closure of the 20" Refueling Water Storage Tank (RWST) outlet valve following the transition to cold leg recirculation. This results in three valve isolation and a minimum of two valve isolation in the long term with a single failure. Therefore, there is no need to address the potential issue of reduced pH in the RWST, which could lead to a potential radioactive iodine release from the RWST to the environment.

2. **Describe the analysis methodology used to determine the pH in the sump water during a period of 30 days post-LOCA. Include detailed calculations of time dependant pH values in the sump during a 30 day period, post-LOCA, to demonstrate that the pH remains greater than 7 throughout this time period.**

   The Current Licensing Basis (CLB) is described in Sections 3.11.5.1.2 and 6.2.2.3.1.4 of the FSAR for the four significant operating combinations of Reactor Building (RB) spray and Emergency Core Cooling System (ECCS) pumps (described in Section 6.2.2.2.1.2 of the FSAR). The pH values of the spray solution, as a function of the injection and recirculation phases for the four RB spray and ECCS pump operating combinations, are shown in Figures 6.2-51m through 6.2-51bb of the FSAR. As described in the FSAR, supplemental analyses of the CLB have been performed in VCS calculation DC00040-066 for Steam Generator (SG) replacement to calculate both the minimum and maximum spray and sump pH values during the injection and long-term recirculation phases of the accident.

Section 6.0 of VCS calculation DC00040-066 describes the detailed methodology to determine the spray header pH during the injection phase, and the spray header pH and sump pH during the long-term recirculation phase. As shown in the summary of results (Section 8) of DC00040-066, the minimum calculated sump pH at the end of the injection phase is 7.5, and increases slightly to 7.61 for the long-term equilibrium value during recirculation.

**3. If a computer program was used, describe the code and provide the input and output data of the program.**

No computer code was used. To solve for pH, NaOH and $H_3BO_3$ molarities were first calculated using a spreadsheet (spreadsheet formulas are included in VCS calculation DC00040-066) and then used with ORNL data to determine the spray and sump pH's during injection and recirculation phases.

**4. The FSAR states that "During post recirculation operations, the Reactor Building recirculation sump water can be sampled with the normal and Post-Accident Sampling System to monitor the pH. If additional sodium hydroxide is required, the sodium hydroxide feed line valve(s) from the sodium hydroxide storage tank is (are) opened and the sodium hydroxide solution is gravity fed into the Reactor Building spray pump suction line(s)" Please describe the sampling technique and time interval sampling occurs, starting with the time of first sample.**

Following the transition to cold leg recirculation, the VCS Emergency Operating Procedures (i.e., EOP-2.0, Step 22) direct the operating staff to sample the RB Sump from the operating RHR train. Information from the sample analysis may be used by the operating staff, in concert with the Technical Support Center personnel, to evaluate the long term plant status including sump pH. The initial sample will be taken and analyzed in accordance with plant procedures taking into account plant equipment availability and existing environmental conditions, including ALARA concerns. Although the time needed will be event-specific, it is reasonable to conclude that this activity could be initially accomplished within the first 24 hours of the accident. Subsequent samples would be taken as directed by Technical Support Center personnel.

The post-accident, highly radioactive sump sample would be collected using the Nuclear Sampling System, which is described and illustrated in Section 9.3.2 and Figures 9.3-4 and 9.3-20 of the VCS FSAR. The system extracts fluid for sampling and analysis from two points on Residual Heat Removal Loops A & B within the Auxiliary Building. Tubing from each of these sample points is routed to the Nuclear Sampling Room within the Control Building. Shielding is provided for these lines along areas where personnel exposure can occur. All equipment is located in the Nuclear Sampling Room except for the sample coolers and some valving. The sump sample from the RHR loop is cooled by exchangers which utilize Component Cooling Water for cooling; and, if necessary, the samples can be further cooled by an auxiliary sample cooler in the nuclear sampling area.

The pressure of the sample is reduced to safe levels by the use of globe type throttling valves located downstream of the heat exchangers. Upon completion of purging the sample lines, the liquid sample may be routed to the sample sinks for pH analysis.

**5. Please describe and justify the sampling locations.**

Samples would be taken from two points on the Residual Heat Removal Loops A & B within the Auxiliary Building following the transition to cold leg recirculation. With suction off the RB sump(s) and a fully mixed sump solution (see item 7 below), these sampling points will provide a good indication of equilibrium conditions that exists within the sump solution.

**6. Please justify, that the sodium hydroxide storage tank has a volume sufficient to maintain a pH greater than 7.0 in the sump during a 30 day period, post-LOCA?**

The minimum equilibrium sump pH is calculated in Section 7.2.7 of VCS calculation DC00040-066. The most conservative, worst-case scenario evaluated in section 7.2.7 assumed the following:

- Conservatively high boron initial concentration of 2500 ppm in the RWST and Safety Injection (SI) accumulators (RCS was at nominal 2000 ppm).
- The Sodium Hydroxide Storage Tank (SHST) contained the minimum 20 w/o NaOH solution at the minimum tank level. Furthermore, only one spray pump is conservatively used to drawdown the SHST.
- NaOH from the SHST is only added to the RB during the injection phase of the accident (i.e. it does not continue to gravity-drain if the RB is pressurized).
- The RWST continues to drawdown and add boric acid past the low-low level setpoint at 18% (where injection switches to recirculation), and instead continues to drain until the 6% empty alarm.

Results from this analysis determined a minimum pH of 7.4, which increases to over 7.6 when normal RCS pH control is credited.

**7. Describe the assumptions that have been used to account for the degree of mixing that occurs when the sodium hydroxide is sprayed and interacts with the water from the ECCS and the Reactor Coolant System.**

It is assumed that the NaOH solution is fully mixed with the ECCS and RCS fluids in the sumps. During the short injection phase of the accident, one or more RB spray pumps will spray boric acid and NaOH into the RB as described in Section 6.2.2.2.1.2 of the FSAR. However, the RB sprays will continue to operate for a minimum period of four hours, into the long-term recirculation phase of the accident. The spray discharge will collect in the two RB recirculation sumps, and continue to be recirculated with at least one train of spray (for a minimum of four hours) or at least one train of ECCS pumps. While the sumps themselves have been designed to prevent flow irregularities, besides diffusion there will be mixing from the sumps, pumps, break flow spillage, and RB spray dispersal when it is operating. Therefore, it is assumed that the turbulent mixing due to pumps and break flow spillage (and occasional operation of the spray system if long-term environmental conditions require) are sufficient to ensure a long-term, fully-mixed sump solution.

**8. In the FSAR, four significant operating combinations of reactor building spray pumps and emergency core cooling system (ECCS) pumps have been listed. Have calculations been performed to ensure that each operating combination (especially the limiting case) will have a sufficient amount of sodium hydroxide to keep the pH greater than 7.0 in the sump during a 30 day period, post-LOCA? What is your expected range of pH values for each operating condition?**

Section 4 of VCS calculation DC00040-066 provides a brief description of the operating conditions for the four cases described in Section 6.2.2.2.1.2 of the FSAR. In all cases, the pH is ≥ 7.5. Furthermore, from Section 8 of DC00040-066, the limiting case pH ranges from a low of 7.5 in the sump at the end of the injection phase to the sump equilibrium pH of 7.61.