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SCE&G®
A SCANA COMPANY

January 26, 2012

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

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS) UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
LICENSE AMENDMENT REQUEST – LAR-06-00055
LICENSE AMENDMENT REQUEST TO ADOPT NFPA 805
RESPONSE TO REQUEST FOR SUPPLEMENTAL INFORMATION

Reference: Letter from Thomas D. Gatlin to NRC Document Control Desk, dated November 15, 2011, License Amendment Request – LAR-06-00055, "License Amendment Request to Adopt NFPA 805 Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants (2001 Edition)"

South Carolina Electric & Gas Company (SCE&G), acting for itself and as agent for South Carolina Public Service Authority, submitted a License Amendment Request per the referenced letter to adopt NFPA 805 as a basis for the VCSNS Fire Protection Program. During the acceptance review, the NRC identified the need for supplemental information to complete its review. The supplemental information request is related to describing the process used for fire modeling and changing the license condition to identify when the implementation items, other than the modifications, will be completed following approval of the safety evaluation. The attachment to this letter provides the supplemental information request and SCE&G's response.

If you have any questions or require additional information, please contact Bruce Thompson at (803) 931-5042.

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

1-26-2012
Executed on

Thomas D. Gatlin

GAR/TDG/jg
Attachment

A006
NRR

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RTS (CR-06-00055)
File (813.20)
PRSF (RC-12-0015)

Attachment
Response to Request for Supplemental Information for
License Amendment Request to Transition
Fire Protection Program to NFPA 805

During their review, the staff identified two areas where insufficient information was provided in the LAR to conduct the detailed review of the LAR. These areas are as follows:

NRC Area 1-

- Fire Modeling Performance-Based Approach

  SRP Section III Element 3.2.2, Performance-Based Compliance with NFPA 805, Section 4.2.4. Although the LAR provides a high level discussion of the use of the fire modeling performance-based approach in Section 4.5.2.1, there is insufficient information related to the process used (the parameters calculated to compare the maximum expected fire scenario (MEFS) to the limiting fire scenario (LFS)), the determination of uncertainties, the results obtained and how all these factors contributed to the decision making process. In addition, the information provided on a fire area basis in Attachment C is insufficient to document the results of the fire modeling evaluation.

  Please provide:

  1. A summary of the process used to perform the Fire Modeling Performance-Based Approach including:
     a. A description of the calculations performed to establish MEFS and LFS
     b. A description of the process used to establish the uncertainties
     c. Guidelines used in the decision process to conclude that sufficient margin exists between MEFS and LFS.
  2. On a fire area basis, a summary of the calculational results for that fire area indicating how you concluded that the MEFS is sufficiently less than the LFS in accordance with NFPA 805.

SCE&G Response to NRC Area 1-

The following provides a complete revision of Section 4.5.2.1 of Enclosure 1, "Transition Report" in the License Amendment Request, LAR-06-00055. This revision provides a summary of the process used to perform fire modeling and the calculational results for MEFS and LFS. Since a new table 4-5 is being added, the table currently listed as Table 4-5 in Section 4.5.2.2 will require renumbering which will be done in a subsequent revision of the Transition Report.

4.5.2.1 Fire Modeling Approach

Overview of Evaluation Process

Fire Modeling Evaluations were completed as part of the VCSNS NFPA 805 transition for key areas as alternatives to compliance with deterministic criteria. These Fire Modeling Evaluations

were developed using the process described in NFPA 805, Section 4.2.4.1 and documented in VCSNS Design Calculations (See Table 4-5). This methodology is based upon the industry guidance in NEI 04-02, and RG 1.205.

Fire Modeling Process

NFPA 805 Section 4.2.4.1 identifies the specific use of fire modeling as a performance-based method to evaluate compliance for specific areas. In these cases, a performance based solution was selected to resolve the VFDR (Variance from Deterministic Requirements) in the identified fire area. The following discussion represents a summary of the Fire Modeling Process steps at VCSNS to document the adequacy of this approach for the selected areas, as follows:

A. Identify Targets. (NFPA 805, section 4.2.4.1.1)

VFDRs are identified against the deterministic requirements of nuclear safety performance criteria during the Nuclear Safety Capability Assessment (NSCA). The VFDRs identify a specific set of cables within the fire area such that fire-induced damage to the functionality of these cables will prevent deterministic compliance. These cables are considered targets in performance-based fire modeling.

For each target cable in the fire area, a listing was prepared that identifies:

- Equipment and the corresponding failure mode that led to the deterministic non-compliant condition
- Cable(s) associated with that equipment and failure mode of concern, and
- Physical location of the equipment and cable(s) within the fire area (e.g., specific locations of raceways/conduits containing the cables of interest).

B. Established Damage Thresholds. (NFPA 805, section 4.2.4.1.2)

This step establishes the damage thresholds for the equipment and cables needed to achieve the nuclear safety performance criteria. Damage thresholds are established in accordance with Sections 2.5 and 4.2.4.1.2 of NFPA 805. For example, the damage criteria for cables exposed to fire is expressed in most cases in the form of an incident heat flux on the cables or the cable's surface temperature. NUREG/CR-6850 Appendix H was used as a reference for determination of the cable damage threshold.

C. Determine Limiting Condition(s). (NFPA 805, section 4.2.4.1.3)

This step performs an evaluation to identify the limiting condition and defines the combinations of equipment or required cables with the highest susceptibility in the fire area. This determination is needed since multiple targets (or cables) may appear in the same VFDR or multiple VFDRs may have been identified in the fire area. These targets (or cables) may be located in various locations within the fire area and thus exposed to various fire sources and fire-generated conditions.

The outcome of this step are target-set(s), (combination of equipment and cables) and fire-generated condition affecting the target-set(s). Each target set is characterized by a damage threshold as described in the previous step. The following fire-generated conditions account for most of the adverse environments in which targets may be exposed to:

- Flame impingement- Targets are in close proximity to the ignition sources and subjected to flame temperatures.
- Plume- Targets are vertically aligned (i.e. directly above) the fuel package, with an ignition source, that are subjected to hot gases in the plume.
- Flame radiation- Targets are horizontally aligned with the ignition source and may not be subjected to other fire-generated conditions such as plume or hot gas layer temperatures.
- Ceiling Jet Targets- Where targets are located at ceiling level and subjected to unobstructed flow of hot gases generated when the plume impinges in the ceiling and spreads in a radial direction
- Hot-gas-layer- Targets outside the plume or ceiling jet region and immersed in the hot gases accumulated in the fire area.
- Smoke deposition- Targets susceptible to short term damage generated by smoke deposition, or other non-thermal adverse effects generated by smoke (i.e. obscuration, etc).

The following considerations contribute to the selection of the limiting condition:

- The least combination of targets (or cables) that lead to the non-compliant state in the fire area.
- The combination of targets (or cables) exposed to the fire scenario that are most challenging to the target-set [i.e. single ignition source with lowest time to damage].

D. Describe Fire Area and Fire Protection Features

In order to develop a representative model, the physical attributes of the fire area under consideration are described. This information is collected and used in the model for **Calculating Fire Effects**, where the fire generated conditions are estimated. Depending on the model and desired assessment of impacts on the target, the following information may be gathered:

- Fire Zone Boundaries: Describe physical dimensions of the fire area including materials of construction for boundary walls (include fire barrier rating), discussion of doors and penetrations, and properties of materials for fire modeling calculations.
- Ventilation Effects: Describe the ventilation effects in the fire area, including mechanical and natural ventilation, and normal positioning of doors and vents.
- Fire Protection Systems and Features: Describe fire detection and suppression equipment in the fire area, including automatic actuation, manual capabilities, etc.
- Personnel: Evaluate the potential for personnel to be in the fire area during normal operating conditions, including whether the fire area has equipment that may require manual operation.

E. Fire Model Selection/ Limitation

Consistent with Section 4.2.4.1 of NFPA 805, the fire modeling process is used for examining the impact of the fire conditions against the performance criteria under consideration. The fire modeling calculation described in this section follows the requirements of Section 2.4.1 of NFPA 805.

NFPA 805 Section 2.4.1.2 prescribes requirements for the use of fire models. The requirements include:

- The use of fire models that are acceptable to the authority having jurisdiction
- The application of fire models is within its limitations
- The fire models shall be verified and validated

The range of applicability, uncertainties, verification and validation (V&V) are addressed in Appendix J following primarily the guidance documented in NUREG 1824.

F. Established Fire Scenarios. (NFPA 805, section 4.2.4.1.4)

Fire scenarios are developed to determine the overall area bounding conditions to assess the effect of these changes on the identified targets. NFPA 805 section 2.4.1.3 requires selection and evaluation of the identified fire scenarios for each assessment when fire modeling is used for performance-based compliance, to support an assessment that there is reasonable margin between the Maximum Expected Fire Scenario and the point of failure (NFPA 805, section 1.6.37).

- **Maximum Expected Fire Scenario:** The maximum expected fire scenario (MEFS) is defined in NFPA 805 (2001 Ed) as the scenario that "represents the most challenging fire that could be reasonably anticipated in the occupancy type and conditions in the space". The definition indicates that the scenarios "can be established based on electric power industry experience with consideration for plant specific conditions and fire experience." Establishing the MEFS involves defining the problem in sufficient detail to perform calculations and to ensure that the input parameter set represents conditions that are reasonable and conservative.
- **Limiting Fire Scenario:** The limiting fire scenario (LFS) is defined in NFPA 805 (2001 Ed) as the scenario in which "one or more of the inputs to the fire modeling calculation are varied to the point that the performance criteria is not met". Development of the LFS is essentially a sensitivity analysis performed to identify those combinations of input parameters or variables which are critical to the analysis, to create a damaged state. The intent of LFS development is to determine if there is reasonable margin between the MEFS and the point of failure (exceeding the established performance criteria).

The process of selecting fire scenarios requires identification of fire hazards with potential impact on the target-set(s) which challenge deterministic performance criteria as defined in Section C, "**Determine Limiting Condition(s)**".

Table C.3.4 in Appendix C of NFPA 805 suggests a number of fuels and ignition sources to consider when identifying fire hazards. Although not limited to these recommendations, the postulated scenarios in this step reasonably consider and disposition them accordingly.

The MEFS is expected to capture the variables that are relevant to or important to the fire modeling analysis for the fire area under consideration. In some cases this requires evaluation of several fire scenarios before an MEFS can be determined. The MEFS should address the following input parameters, as described in NFPA 805:

- Combustible Materials (type, quantity, etc.) and Ignition Sources – Defines the fire sources associated with the MEFS.
- Plant Area Configuration – Establishes the geometry of the problem, including the compartment size, relative positions of fire sources and targets, and possible smoke/fire spread paths.
- Fire Protection System and Features – Specifies the details of fire protection system in the fire area.
- Ventilation – Defines the ventilation effects in the fire area, including mechanical and natural ventilation.
- Personnel – Identifies the number of persons and their relative positions to the fire if personnel exposure to combustion products is a consideration (e.g., if personnel actions are necessary in the fire area).
- Administrative Controls – Identify any limitations or station practices which are necessary to support analysis results.

The following steps are followed for defining the MEFS:

- Review the fire scenarios developed for risk quantification in the Fire PRA (if any).
- Conduct a review to identify and realistically characterize the fire hazards in a particular area (e.g. Material, Heat Release).
- Review fire protection administrative controls and preventive and corrective maintenance activities. In most cases these controls will define the characteristics of the fuel package for the assumed fire in the MEFS.
- Select fire scenarios considering:
    a. Identified Fire ignition sources,
    b. Intervening combustibles, and
    c. Target-set(s) with limiting conditions defined in section C, "Determine Limiting Condition(s)".
- Describe the selected MEFSs for calculation of their fire generated conditions.

The following steps are followed for defining the LFS:

- Identify the fire modeling parameters (one or more) that are candidates for sensitivity analysis excluding those that are considered fixed (e.g. Room size, Wall materials). Examples of these parameters include:
  a. Heat release rate
  b. Fire growth rate
  c. Flame spread rate where appropriate, e.g., cable fires
  d. Location of the fuel package with respect to the target-set, if variable
  e. Ventilation conditions
- Identify parameter combinations to conduct a sensitivity analysis for determining LFSs
- Calculate the impact of the LFSs
- Describe the identified LFSs for calculation of their effects.

G. Assess Adequacy of Fire Scenario Effects (NFPA 805, Section 4.2.4.1.5.)

In this step, the identified MEFSs and LFSs are analyzed to determine the fire-generated limiting condition against the target-set(s) of concern defined using the selected fire model(s).

For each fire scenario, the environmental conditions resulting from each MEFS are compared to the damage thresholds for the targets in the fire area. If damage thresholds are not exceeded, the targets associated with the VFDR in the fire area can be considered free of fire damage under the conditions of the postulated MEFS.

By definition, the effects of the LFS include damage to the targets in the fire area under consideration. Fire modeling parameters that are varied to establish the LFS conditions are identified and described. The final combination of input values for these parameters that define the LFS will form the basis for safety margin assessment.

Once the conditions associated with MEFS and LFS have been established, a qualitative evaluation is performed to determine that sufficient margin exists between the LFS and MEFS to account for modeling uncertainties, field conditions or other factors associated with the analysis for the area under review. If sufficient margin is determined to exist (e.g. Large Heat Release Rates to achieve damage states, low area temperatures after a reasonable area burn), it is used as one of a number of considerations evaluated for the impact of the change on the overall safety margin.

H. Describe Operations Guidance/ Controls (NFPA 805, Section 2.6/ 4.2.4.1.6)

This section describes any operational guidance, administrative controls or actions for plant personnel. This includes the performance of recovery actions, based on the fire modeling analysis assumptions inputs and results in the corresponding fire area.

Fire Model Use/ Validation

RG 1.205, Regulatory Position 4.2 and Section 5.1.2 of NEI 04-02, provide guidance on documenting and justifying acceptable fire models for use in performance-based analyses.

The following fire models were used at VCSNS:

- NUREG-1805, Fire Dynamic Tools (FDT^s)
- Consolidated Fire and Smoke Transport Model (CFAST)

The acceptability of the use of these fire models has been summarized in Attachment J of the license amendment request.

Fire Modeling Acceptance Criteria Determination

The acceptance criteria for the Fire Modeling Evaluation consist of two parts, and are summarized below:

A. **Target Damage** – The fire modeling analysis defines and evaluates a postulated scenario involving the Maximum Expected Fire Scenario (MEFS). If target set damage does not occur then first acceptance criterion is met.

B. **MEFS<<LFS** – The fire modeling analysis involves a degree of uncertainty. This uncertainty is addressed through sensitivity analysis by the determination of the Limiting Fire Scenario (LFS). This includes the development of conditions required to create this scenario. A comparison of MEFS and LFS is used to determine if a sufficient fire modeling margin exists for the assumed conditions used in the analysis. If sufficient fire modeling margin exists, then the fire modeling approach is acceptable. (MEFS does not generate damage, and MEFS - LFS margin is sufficiently large to address uncertainties in modeling.)

In order to determine that Performance Based Fire Modeling provides an acceptable solution to the VFDR, the analysis must conclude that both conditions described above are satisfied, considering a reasonable margin exists based on the assumed area and fire scenario conditions.

Results of Evaluation Process

Disposition of VFDRs

Each VFDR dispositioned using performance-based fire modeling was assessed against the Fire Model Evaluation acceptance criteria described NFPA 805, Section 2.4.1. The detailed fire modeling calculations for each analyzed fire area include the documentation of these results; with variations to Fire Size have been summarized in Table 4-5.

Table 4-5: Results of Performance-Based Fire Modeling Calculations [1]

Fire Area	Calculation Number	MEFS (HRR)	Peak Temp (HGL)	LFS (HRR)	Peak Temp (HGL)
CB10	DC0780F-096	500 kW	141°C	900 kW	192°C [2]
CB12	DC0780F-097	758 kW	125°C	1500 kW	184°C [3]
CB18	DC0780F-103	500 kW	151°C	900 kW	206°C
IB11	DC0780F-173	93 kW	74°C	600 kW	220°C

Notes:

1. Temperature damage thresholds for Kerite FR cable assumed to be 205°C (similar to thermoplastic cables). [Reference: NUREG-1805, Appendix A, NUREG/ CR-6850]
2. Damage thresholds not achieved for this size fire due to ventilation effects/ oxygen depletion within the first 20 minutes of the simulation (CFAST).
3. Damage thresholds not achieved for this size fire due to ventilation effects/ oxygen depletion within the first 25 minutes of the simulation (CFAST).

NRC Area 2-

License Condition Items

a. RG 1.205, Revision 1 states,

"Paragraph (c) in 10 CFR 50.48 does not mandate a specific schedule for implementing an FPP that meets the provisions of NFPA 805. However, the statement of considerations for 10 CFR 50.48(c) states that the NFPA 805 license amendment will include a license condition imposing the use of NFPA 805, together with an implementation schedule. Licensees should include an implementation schedule with their request to adopt an FPP based on NFPA 805."

Please provide a license condition that defines when full compliance will be achieved.

b. Attachment M currently states

"The licensee shall implement the following modifications to its facility to complete the transition to full compliance with 10 CFR 50.48(c) by December 31, 2015:

* ECR50577: NFPA 805 Instrument Air Recovery
* ECR50780: Alternate Seal Injection (MSPI)
* ECR50784: NFPA 805 Circuit/Tubing Protection
* ECR50799: NFPA 805 RCP Seal Replacement
* ECR50800: NFPA 805 1DA 115kV Supply Reroute
* ECR50810: NFPA 805 Hazard Protection
* ECR50811: NFPA 805 Incipient Detection
* ECR50812: NFPA 805 Disconnect Switch Rework
* ECR70588: NFPA 805 Penetration Seal Documentation
* ECR71553: NFPA 805 Communication"

Does this include all modifications that are necessary to achieve the "going-forward" compliant plant and, if not, why are the additional items not needed?

SCE&G Response to NRC Area 2-

The list in Attachment M provides all of the modifications necessary to achieve full compliance with 10 CFR 50.48(c). Other items (procedure changes, process updates, and training to affected plant personnel) required for implementation of the requirements in NFPA 805 are listed in Attachment S, Table S-2 of the License Amendment Request (LAR-06-00055). SCE&G proposes that the License Condition in Attachment M to the LAR under "Transition License Conditions" be revised to include these other items as follows:

(4) The licensee shall implement the other items listed in Attachment S, Table S-2 of the License Amendment Request within 180 days of issuance of the Safety Evaluation Report.