

March 22, 2006

MEMORANDUM TO: Chuck Casto, Director
Division of Reactor Projects
Region II

FROM: Edwin M. Hackett, Deputy Director /RA/
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

SUBJECT: FINAL RESPONSE TO TASK INTERFACE AGREEMENT 2005-04
RELATING TO LICENSING BASIS FOR TORNADO MISSILE
VULNERABILITY OF OUTDOOR COMPONENTS THAT ARE RELIED
ON FOR SAFE SHUTDOWN AT THE V. C. SUMMER NUCLEAR
STATION (INSPECTION REPORT NO. 05000395/2004009)
(TAC No. MC6951)

By letter dated April 28, 2005, Region II submitted Task Interface Agreement (TIA) 2005-04, requesting assistance from the Office of Nuclear Reactor Regulation (NRR) in assessing the V.C. Summer Nuclear Station (V. C. Summer) licensing basis for tornado missile protection for outdoor components that are relied on for safe shutdown. Specifically, the following questions were posed:

1. What is the V. C. Summer licensing basis for tornado missile vulnerabilities of outdoor components that are relied on for safe shutdown?
2. Are the licensee's equations in UFSAR [Updated Final Safety Analysis Report] Section 3.5.1.4 and the licensee's application of that equation acceptable?
3. Is the licensee's position, that anything smaller than about 196 square feet in size is not required to be physically protected from tornado missiles, acceptable?

We provided our draft response to this TIA on January 9, 2006, and Region II has provided its comments on the draft. We have incorporated the comments and the NRC staff's final evaluation of the TIA is enclosed.

Principal Contributors: J. Hernandez
S. Jones

Docket No. 50-395

Enclosure: NRC Staff Assessment

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Enclosure

STAFF ASSESSMENT
BY THE BALANCE-OF-PLANT BRANCH,
DIVISION OF SAFETY SYSTEMS, IN RESPONSE TO
TIA 2005-04: LICENSING BASIS FOR TORNADO MISSILE VULNERABILITY
OF OUTDOOR COMPONENTS THAT ARE RELIED ON FOR SAFE SHUTDOWN
AT THE V.C. SUMMER NUCLEAR STATION
(INSPECTION REPORT NO. 05000395/2004009)
(TAC NO. MC6951)

1.0 INTRODUCTION

During a special engineering team inspection at the V.C. Summer Nuclear Station (V.C. Summer, VCSNS), performed using Temporary Instruction 2525/158, the team identified several outdoor components that were relied on for safe shutdown but were not physically protected from tornado missiles. The team also identified related apparent inaccuracies in the Updated Final Safety Analysis Report (UFSAR) and related apparent inconsistencies in the licensing basis. Consequently, the team opened an unresolved item (URI) for further NRC review of the licensing basis for tornado missile vulnerability of outdoor components that are relied on for safe shutdown of the plant.

By letter dated April 28, 2005, Region II submitted Task Interface Agreement (TIA) 2005-04, requesting assistance from the Office of Nuclear Reactor Regulation (NRR) in assessing the VCSNS licensing basis for outdoor components that are relied on for safe shutdown. Specifically, the following questions were posed:

1. What is the V. C. Summer licensing basis for tornado missile vulnerabilities of outdoor components that are relied on for safe shutdown?
2. Are the licensee's equation in UFSAR [Updated Final Safety Analysis Report] Section 3.5.1.4 and the licensee's application of that equation acceptable?
3. Is the licensee's position, that anything smaller than about 196 square feet in size is not required to be physically protected from tornado missiles, acceptable?

The NRC staff requested additional information (RAI) on these issues in a letter dated September 12, 2005, and SCE&G responded to those RAIs by letter dated October 13, 2005.

2.0 BALANCE-OF-PLANT BRANCH (SBPB) RESPONSE TO REGION II REQUEST

Region II requested NRR's review of three issues. The SBPB review of each issue is summarized below.

Request 1:

What is the VCSNS licensing basis for tornado missile vulnerabilities of outdoor components that are relied on for safe shutdown?

SBPB Response:

The VCSNS FSAR, Section 3.5.1.4, describes the original licensing basis used at VCSNS for evaluating specific missile types generated by the design tornado. Attachment 2 to the TIA provides RAI 311.13 and SCE&G's response to it, as included in amendment number 7 to the FSAR in August 1978. In RAI 311.13, the NRC staff requested the applicant to provide sufficient information to demonstrate that the loss of function of the safety related components located outdoors, as listed in Table 3.5-6, will not affect the capability to shutdown the reactor and maintain it in a safe shutdown condition. The SBPB staff reviewed licensing documents related to Section 3.5.1.4 generated prior to the issuance of the 1981 Safety Evaluation Report (SER). The NRC staff identified subsequent amendments to the FSAR where supplemental information had been included to address tornado missile protection for the diesel generator exhaust pipes. The applicant stated in such amendments (see TIA Attachment 3), and also in its FSAR, that the total probability of a missile impacting the exposed length of the exhaust pipe is less than 10^{-7} . The review did not identify the methodology used to calculate this probability. In a letter dated October 13, 2005, South Carolina Electric & Gas (SCE&G) described the methodology used to derive the tornado missile strike probability for the diesel generator exhaust pipes. This probability was calculated using the equation described in the UFSAR Section 3.5.1.4, by treating the exhaust stacks as openings, each having a profile area equivalent to 21.25 square feet (ft^2). The calculated probability is 1.08×10^{-8} , which is less than 10^{-7} , as stated in the UFSAR. However, this methodology neglects a reduction in probability due to the loss-of-function of the exhaust pipes given a missile impact. All of the credible missile types at the target location (high above the ground) are of such small size, that potential impact or perforation would not result in the loss of function. Because the applicant had already responded to RAI's and updated its FSAR by the time the SER was issued, the NRC staff found that the applicant's justification for not providing missile protection for diesel generator exhaust pipes is acceptable.

Nevertheless, this does not imply that the general use of the equation described in the UFSAR to calculate tornado missile strike probabilities for any components that are located outdoors is adequate. The equation requires summing the tornado missile strike probabilities for all safe shutdown components that are vulnerable to tornado missile damage. The overall sum of the missile strike probabilities is to be less than $1.0 \text{ E-}7$ for each missile in FSAR Table 3.5-5. The licensee has a calculation that sums the missile strike probabilities for all safe shutdown components that are located indoors. Consequently, application of the equation to various outdoor components as well as indoor components would involve summing the tornado missile strike probabilities for all outdoor and indoor components.

Request 2:

Are the licensee's equation in the UFSAR Section 3.5.1.4 and the licensee's application of that equation acceptable?

SBPB Response:

The equation described in the UFSAR, Section 3.5.1.4, calculates the total probability per year for each missile in FSAR Table 3.5-5 of potential tornado missiles generated by the design basis tornado, penetrating a critical opening and striking critical components inside Category I structures. The equation describes the methodology used to evaluate individual missile types in order to ensure structural protection of those structures, systems and components (SSCs) important to safety. Standard Review Plan (SRP) Section 3.5.1.4 guidance is that all plants be

designed to protect safety related equipment against damage from missiles, which might be generated by the design basis tornado for that plant. The SRP does not specify whether the analysis should be performed for either individual or multiple potential missiles for each tornado event. More recent tornado probability evaluations have been conducted at other nuclear plants, which incorporate multiple potential missiles. These methodologies include the use of TORMIS, which has already been approved and its use is encouraged by the NRC staff. However, at the time that VCSNS was licensed, there was no approved methodology for calculating the total probability of tornado missiles impact. Considering the state-of-the-art methodologies available during the VCSNS licensing period, the NRC staff found that the proposed approach was acceptable and consistent with industry practice during such time.

However, the licensee's application of the equation to the outdoor chilled water expansion tanks was not acceptable because it did not verify that the cumulative probability (i.e., for both indoor and outdoor safe shutdown components) for each of the missiles in Table 3.5-5 remains less than 10^{-7} , as is described in the FSAR (see the response to Request 3 below).

Request 3:

Is the licensee's position, that anything smaller than about 196 square feet in size is not required to be physically protected from tornado missiles, acceptable?

SBPB Response:

SCE&G's letter dated October 13, 2005, states that SCE&G had conducted a review of Calculation No. DC03380-001, "Adequacy of Control Room Intake Missile Shields to Protect Chilled Water Expansion Tanks." SCE&G stated that it used a simplified backwards approach to show that a total area opening of less than 196.35 ft² would not result in a missile strike probability of more than 10^{-7} . However, SCE&G agreed with the NRC staff position, that this calculation does not account for the cumulative probability of impact for openings in Category I structures. With regards to the chilled water expansion tank, it should be noted that because the tanks are enclosed by reinforced concrete structures with two openings having an actual combined surface area of 59 ft², which is less than the 98.4 ft² used in DC03380-001, the probability of impact to the tank is less than originally calculated.

Nevertheless, since the licensee's calculation for the outdoor chilled water expansion tanks did not account for cumulative probabilities of impact to components relied on for safe shutdown, it is not acceptable. Similarly, the SBPB staff finds that the licensee's position with regards to evaluating physical protection for an individual component, based on an area of less than 196 ft², is not acceptable, because it represents a departure from the methodology described in the FSAR. Such practice is also not consistent with regulatory guidance in Regulatory Guide 1.117, "Tornado Design Classification," or Standard Review Plan section 3.5.3.4, "Missiles Generated by Natural Phenomena."

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