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A SCANA COMPANY

October 13, 2005
RC-05-0168

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

ATTN: Mr. R. E. Martin

Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS)
DOCKET NO. 50/395
OPERATING LICENSE NO. NPF-12
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING INSPECTION REPORT UNRESOLVED ISSUE
URI 2004009-02, TAC No. MC6951, (C-05-0032)

Reference:

1. SCE&G Letter to NRC (Document Control Desk), RC-05-0008, dated February 9, 2005, Response to Preliminary White Finding NRC Inspection Report 2005006, ADAMS ML050420249
2. SCE&G Letter to NRC (Document Control Desk), RC-05-0034, dated February 23, 2005, Response to Preliminary White Finding NRC Inspection Report 2005006 Apparent Violation AV 05000395/2005006-02
3. NRC (R. E. Martin) Letter to VCSNS, September 12, 2005, Request for Additional Information Regarding Inspection Report Unresolved Issue (TAC No. MC6951), ADAMS ML052520445

On December 22, 2004, the U.S. Nuclear Regulatory Commission (NRC) issued NRC Inspection Report 05000395/2004009 to South Carolina Electric and Gas Company (SCE&G) announcing an assessment of Unresolved Item (URI) 0500395/2004009-02. This URI addressed a perceived inadequacy in the method of calculation used by SCE&G to determine the probability of tornado missile vulnerability for VCSNS and is documented in section 2.1.12.b of the report.

A February 17, 2005, Regulatory Conference was held between SCE&G and the NRC to discuss issues related to this Inspection Report and the Preliminary Finding issued through NRC Inspection Report 0500395/2005006.

Subsequently, a Request for Additional Information (RAI) was issued on September 12, 2005, (Reference 3).

SCE&G hereby submits the attached response to the referenced RAI regarding URI 2004-009-02.

IE01

If you have any questions or require additional information, please contact Mr. Robert G. Sweet at (803) 345-4080.

Very truly yours,

Jeffrey B. Archie

JT/JBA/mb
Attachment

c: N. O. Lorick
S. A. Byrne
N. S. Carns
G. Champion (w/o Attachment)
R. J. White
W. D. Travers
R. E. Martin
NRC Resident Inspector
K. M. Sutton
NSRC
RTS (C-05-0032)
File (815.01)
DMS (RC-05-0168)

South Carolina Electric & Gas Company (SCE&G)
Virgil C. Summer Nuclear Station (VCSNS)
Response to NRC Request for Additional Information (RAI)
Regarding
INSPECTION REPORT UNRESOLVED ISSUE 05000395/2004009-02
RELATED TO TORNADO MISSILES

TAC MC6951 - submittal dated September 12, 2005

BACKGROUND:

VCSNS Final Safety Analysis Report (FSAR) Section 3.5.1.4 (Missiles Generated by Natural Phenomena) describes the original licensing basis used at VCSNS for evaluating specific missile types generated by the design basis tornado. In the mid 1970's, there was no NRC approved methodology for calculating total probability of tornado missile impact. Rather, only RG 1.76 (April 1974) was in place to define parameters for the Design Basis Tornado, along with Standard Review Plan (SRP) 3.5.1.4 to define missile types. RG 1.117 (June 1976) is not applicable due to its implementation date; however, its guidance for minimum structures, systems, and components (SSCs) to be protected against tornados was taken into consideration as part of the VCSNS evaluation.

Therefore, the VCSNS FSAR describes the methodology used to evaluate individual missile types (with the missile spectrum as defined by SRP 3.5.1.4), generated by the Design Basis Tornado (RG 1.76), in order to ensure structural protection of those SSCs important to safety. This methodology determined that as long as the total impact probability for each individual missile type remained less than 10^{-7}, then no additional protection was required for structure openings. [This methodology is also conservative by assuming a reactor site strike of the design basis tornado of 10^{-3}, while focusing only on missile impact rather than component loss-of-function.] Specific safety-related components located outdoors (outside protection structures) are identified in FSAR Table 3.5-6.

Based on initial review of the original FSAR, NRC issued additional requests for information (0.10.1, 0.10.7, 040.44, 040.82, 040.83, 311.3, and 311.13) relative to structural protection, demonstration of functional requirements for safety-related components located outdoors, and probability analysis for tornado protection.

SCE&G provided responses to the RAIs (along with a FSAR update in August 1978), including discussion that the Table 3.5-6 components were in general not considered to affect the capability of safe shutdown.

In Section 3.5.1 of NUREG-0717, February 1981, the NRC concluded that the design of the facility is in accordance with the requirements of 10CFR50, Appendix A, General Design Criterion (GDC) 4 with regard to the protection of SSCs from externally generated missiles and is therefore acceptable.

RAI 1 – Section 3.5.1.4 of the Final Safety Analysis Report (FSAR) for the V. C. Summer Nuclear Station (VCSNS) states that the total probability of a missile impacting exposed length of the emergency diesel generator exhaust pipe is less than 10^{-7} per year. Therefore, no missile protection is provided. However, the FSAR does not indicate how that probability was calculated. Available records do not indicate that the Nuclear Regulatory Commission (NRC) staff had evaluated the VCSNS methodology for these calculations. Please provide information describing the methodology for the calculation of this probability that supports the conclusions of the VCSNS FSAR.

RAI 1 - RESPONSE:

The methodology as described in FSAR Section 3.5.1.4 (as accepted by SER) was also used to evaluate the probability of a missile impacting the exposed length of the EDG exhaust pipe. This review was conducted in 1978 as part of Design Calculation DC03780-009, which is only one of several calculations developed by the Architect-Engineer (AE) as part of the original tornado missile strike analyses.

This evaluation treated each exhaust stack target area as an opening for impact, with a profile area equivalent to 5' x 4.25' (21.25 ft^2). Values used in the calculation were: P1 = 10^{-3}, P2 = 1.0, P3 = 0.1, and P4 = 21.25/196,350 = 1.08 x 10^{-4}. P5 to P8 values were set to 1.0. This equates to a Probability (P) = 1.08 x 10^{-8} for impact, which is less than 10^{-7} as identified in the FSAR.

Note that using this methodology neglects a significant reduction in probability (to virtually $10^{-\infty}$) due to loss-of-function of the exhaust pipes given a missile impact. At the target location on the Diesel Generator Building roof, all of the credible tornado missile types are of smaller dimension and mass; therefore, any potential impact or perforation of the target would not result in the loss of function for allowing transfer of exhaust gas.

RAI 2 – The equation located in section 3.5.1.4 of the FSAR calculates the total probability per year of a tornado-generated missile reaching and passing through a Seismic Category I (Category I) structure opening, and impacting any critical components located inside. In its application of the total probability equation to components located outdoors (see 1993 Calc. No. DC03380-001, Adequacy of Control Room Intake Missile Shields to Protect Chilled Water Expansion Tanks)[1], the VCSNS analysis concluded that the acceptance criteria were met because the missile inlet area of the expansion tank barrier was smaller than the maximum allowable target area (~196 ft^2). It is not clear to the NRC staff how the acceptance criterion accounts for the cumulative probability of damage to the critical components that are located outside of Category I structures since the equation calls for a summation of impact probabilities for all openings in Category I structures, and by extension, all externally located critical components.

[1] A copy of this calculation may be found at ADAMS ML052130469.

RAI 2 - RESPONSE:

Based on further review of referenced Calculation DC03380-001 and other VCSNS calculations, it appears that DC03380-001 used a simplified backwards approach to show that a total target area opening (of less than 196.35 ft^2) would not result in missile strike probability greater than 10^{-7}; however, this calculation apparently did not account for the cumulative probability of impact for a specific missile type for openings in Category I structures. [Note that the chilled water expansion tanks are located on the roof of the Control Building and are enclosed by reinforced concrete structures that have openings on the south and north sides of 3' x 9'-10" each, which equates to a combined surface area opening of 59 ft^2. Additionally, the chilled water expansion tanks occupy an area within the reinforced concrete enclosure which is much smaller than the actual opening size of the structure.]

Since DC03380-001 overestimated the reinforced concrete protective structure opening size (59 ft^2 actual versus 98.4 ft^2 used in the calculation), the corrected probability would be less than 59/196.35 ($\times 10^{-7}$) = 3×10^{-8}. This conservative value, when added to the P_T (as shown in other calculations), would not result in total probability of greater than 10^{-7} for any of the individual missile types evaluated for Category I structure openings.

RAI 3 – In VCSNS's application of the total probability equation to the chilled water expansion tanks, the probability of an object maintaining an orientation inside the tornado which exposes its maximum cross-sectional area to the full force of the wind (P3) is assumed to be 0.1. However, the probability that a missile impacts a target located outside of a structure is not a function of its orientation. Please, provide an explanation that justified the assumption for P3.

RAI 3 - RESPONSE:

Even though the chilled water expansion tanks are listed as outside components, they are actually enclosed by reinforced concrete structures with two openings. Therefore, missiles would have to enter and pass through the openings before any potential impact with the target is postulated. Thus the assumption used for P3 is considered applicable for this case, as was done for all openings in Category I structures.

A conservative estimate for P3 of 10^{-1} was selected from FSAR Section 3.5.4 - Reference 15 ["Tornado Protection for the Spent Fuel Storage Pool", General Electric Company, November 1968]. Although we have been unable to locate this reference (including additional research by the AE), industry consensus reflects a position that missiles tend to tumble rather than maintaining a continuous orientation which exposes the maximum cross-sectional area of the missile to the full force of the wind. The tumbling motion results in missiles not being accelerated to maximum velocity. The realistic probability of a heavy object missile being continuously accelerated without tumbling would actually approach zero; therefore, the conservative value of P3 = 10^{-1} was used.

Additionally, missile orientation as described for P3 should not be confused with orientation of missiles relative to striking targets (which is considered as part of P5). The evaluation of the chilled water expansion tanks used a P5 impact factor of 1.0, which neglects orientation of impact.

RAI 4 – The equation described in Section 3.5.1.4 of the FSAR calculates the total probability for impact to critical components per year per missile. This in itself does not take into account the impact probability based on multiple potential missiles generated by the design basis tornado. Please provide your rationale in assessing the adequacy of the acceptance criteria for providing missile protection to critical safety-related components either inside or outside Category I structures.

RAI 4 - RESPONSE:

As discussed in the background comments, FSAR Section 3.5.1.4 (Missiles Generated by Natural Phenomena) describes the licensing basis used at VCSNS for evaluating specific missile types generated by the design basis tornado. The FSAR describes the methodology used to evaluate individual missile types (as defined by SRP 3.5.1.4) in order to ensure structural protection of those SSCs important to safety. Thus, as long as the total probability for each individual missile type remained less than 10^{-7}, then no additional protection was required for structure openings.

More recent tornado probability evaluations have been conducted at other nuclear plants. Such evaluations have incorporated multiple potential missiles for each tornado event, while using historical data to develop Tornado Point Strike Probability. These results are then input to calculate Mean Annual Impact Probability for specific targets.

SCE&G believes that the equation described in FSAR Section 3.5.1.4 is acceptable for assessing the original licensing basis at VCSNS, based on the then state-of-the-art methodology. Incorporation of multiple potential missiles into the FSAR equation is not considered appropriate for the FSAR methodology since its derivation was focused on determining protection requirements for important to safety SSCs when subjected to individual missile types (in accordance with SRP 3.5.1.4) postulated under the design basis tornado conditions (RG 1.76).

Since there are no new regulations or requirements for a new methodology (using multiple missiles per tornado), such effort would require extensive re-evaluation at VCSNS, and would also result in re-evaluation of numerous inputs relative to the current licensing basis of VCSNS. Since the original methodology met all of the existing regulations and guidance (as approved by NRC), the basis for re-evaluation using more recent methodologies does not appear justified.