UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
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ATLANTA, GEORGIA 30303-8931

March 18, 2002

EA-00-022
EA-01-310

Carolina Power & Light Company
ATTN: Mr. James Scarola
Vice President - Harris Plant
Shearon Harris Nuclear Power Plant
P. O. Box 165, Mail Code: Zone 1
New Hill, NC 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT - NRC INSPECTION REPORT NO. 50-400/00-09; REVISED RISK ASSESSMENT

Dear Mr. Scarola:

Following the regulatory conference held with you and your staff on January 31, 2002, the NRC revised its risk assessment associated with the degraded Thermolag barrier between the Auxiliary Control Panel Room and the A Train Cable Spreading Room at your Harris facility. This revised risk assessment is provided as an enclosure to this letter. In developing this revised assessment, the NRC considered the information you provided at the regulatory conference. However, as you will note in the attached assessment, the NRC also changed the failure probability factor for the Thermolag barrier in question. Since this factor was not discussed at the regulatory conference, we feel it appropriate that you have the opportunity to comment on this change.

In light of the previous discussions, correspondence, and meetings that have occurred on this Thermolag issue, we do not believe it is necessary to conduct another regulatory conference. Hence, we request that you provide your perspectives on our revised barrier failure probability in writing. We would appreciate your perspectives within two weeks of the date of this letter. If this schedule is not acceptable or you decline the opportunity to provide us your perspective, please contact Mr. Charles Ogle at (404) 562-4605.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's Document system (ADAMS). ADAMS is accessible from the NRC web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this letter, please contact us.

Sincerely,

/RA/

Charles A. Casto, Director
Division of Reactor Safety

Docket No. 50-400
License No. NPF-63

Enclosure: Revised Harris Thermolag Fire Protection SDP Assessment

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HARRIS THERMO-LAG FIRE PROTECTION SDP ASSESSMENT FOR SERP REVIEW
(final version completed on 3/13/02)

Non-Conforming Case

Ignition Frequency * Severity Factor * Manual Suppression * Barrier Degradation * Conditional Core Damage Probability = Core Damage Frequency

IF_{ec} *SF_{ec} * MS * BD * CCDP + IF_t * SF_t * MS * BD * CCDP = CDF

{7.3E-3 (electrical cabinets) * 0.214 * 0.5 * 0.5 * 1.5E-2} + {3.29E-3 (transformers) * 0.24 * 0.5 * 0.5 * 1.5E-2} = 5.86E-6 + 2.96E-6 = 8.82E-6

IF derivations: Ignition Source Data Sheet from IPEEE

SF_t derivation: The initial SDP Phase III evaluation provided to the licensee in the letter from Region II dated December 18, 2001, used a severity factor for transformer fires of (.1). Appendix F to IMC 0609 does not provide guidance on the use of severity factors when assessing the significance of fire protection inspection findings. During the regulatory conference held in Region II on January 31, 2002, the licensee challenged the (.1) value and stated that, based on a qualitative study by Alber, Altmann and Phieffer conducted in 1984 and referenced in the EPRI Fire PRA Implementation Guide which was published in 1995, the appropriate severity factor for the dry type transformers installed in the Train B Switchgear Room is zero (0).

In order to more accurately and fully assess the potential for a severe transformer fire in the Train B Switchgear Room at Harris, the SPLB staff at the request of SPSB reviewed the commercial nuclear industry fire experience data from 1965 through 1994 provided in Appendix A, Tables 1 and 2 of AEOD/S97-03 Special Study Fire Events of U.S. Operating Experience dated June 1997, prepared by James Houghton. This database includes an update to the Sandia fire events database, including fire event data from LERS, the proprietary EPRI fire events database, and fire related component failure histories from the Nuclear Plant Reliability Data System (NPRDS). This database, at its time of publication, provided the most comprehensive and up-to-date compilation of information on fire events, their calculated frequencies, and severity available. The data contained in this report indicates that there were a total of 21[1] transformer fires during this time period that did not involve: (1) smoke events, (2) transformers located outside of a building, or (3) where oil was identified as the initial combustible. The information

[1]Note: The EPRI Fire PRA Implementation Guide states that the Fire Events Database includes only 10 indoor transformer fires.

provided in both the EPRI and AEOD databases does not state the type of transformer (dry or oil filled) involved for each fire event. Once the oil fires are removed from consideration, the type of combustibles present and the ignition sources available for the different types of transformers are similar. Of these 21 fire events four had a reported duration exceeding 10 minutes[2] and one was reported as an explosion. The SPLB fire protection staff concludes that these 5 events, or 24% of the total reported transformer fires, had the potential to become severe such that the integrity of the Thermo-Lag barrier installed in the B Train Switchgear Room would be challenged without intervention by plant personnel. Therefore, the NRC is not endorsing the licensee's position presented during the regulatory conference, or that presented in the EPRI Fire PRA Implementation Guide concerning transformer fire severity.

SF_{ec} derivation: The initial SDP Phase III evaluation provided to the licensee in the letter from Region II dated December 18, 2001, used a severity factor for electrical cabinet fires of (.12). Appendix F to IMC 0609 does not provide guidance on the use of severity factors when assessing the significance of fire protection inspection findings. During the regulatory conference held in Region II on January 31, 2002, the licensee stated that of the 21 electrical cabinet fire events in the EPRI Fire Events Database, its analysis concluded that 4 ½ of these events were severe. Therefore the proper severity factor to be used is (.214).

At the SERP held on February 27, 2002, RII requested the DSSA staff to revisit the severity factor used for electrical cabinet fires in the Phase 3 SDP for Harris. To accomplish this the staff reviewed an update to the June 1997 AEOD report noted above. This report "Fire Events - Update of U.S. Operating Experience, 1986- 1999," RES/OERAB/SO2-01 dated January 2002, added the following information to the database: (1) LERs from 1996 -1999, (2) fire event-related component failures from the Equipment Performance and Information Exchange (EPIX) system, including Nuclear Plant Reliability Data System (NPRDS) fire event archival data for 1995-1996, EPIX fire event data for 1997-1999, previously excluded short duration fires events from the EPRI database for 1986 -1988 survey data, and new survey reported fire event data from the NEIL database for 1993 -1999. The RES database indicates that there were 62 fires involving electrical cabinets (Note: smoke events have been excluded). Based on the same criteria used for transformer fire severity, the staff identified 18 fires events with the potential for becoming severe which equates to a severity factor of (.29). This would result in increased CDFs for the conforming case to 2.18E-6 from 1.8E-6,

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[2]The EPRI Fire PRA Implementation Guide also uses a duration or suppression time greater than or equal to 10 minutes for its severity screening criteria.

and for the non-conforming case to 1.09E-5 from 8.82E-6, for a change to a ΔCDF of 8.72E-6 from 7.0E-6 in the previous calculations, still consistent with a WHITE finding. Based on the preliminary nature of the DSSA review of the recent RES report, and the relatively small increase in the severity factor based on the revised data, (which results in a potential increase in ΔCDF of approximately 1.7E-6 from the previous calculation, and no change to the classification of the finding), the DSSA staff concludes that there is no significant risk insight benefit to be gained from revising the severity factor used by the licensee and previously adopted by the DSSA staff for electrical cabinet fires based on the most recent data.

MS derivations: Based upon discussion of the type of severe fires produced, actual examples of fire brigade response and suppression time of fire brigades. Time available for brigade response following ignition is the sum of the time for hot gas layer development and time to failure of the barrier, adjusted for fire detection time and brigade notification. As a result, it is estimated that 20 to 30 minutes is available for the fire brigade to suppress the fire. According to the "Fire Risk Scoping Study: Investigation of Nuclear Power Plant Fire Risk, Including Previously Unaddressed Issues," NUREG/CR-5088, Figure 4.1-1, the failure probability of manual suppression is 0.5 to 0.4. The value 0.5 is taken since it is the more conservative of the two values. This curve to some extent underestimates the failure of the fire brigade team in its efforts to suppress the fire as the overall success probability of the fire brigade is comprised of successes prior to deployment of a hose stream. This underestimation can be used to qualitatively offset potential licensee's contentions that the curve fit in NUREG/CR-5088 is inappropriate or there may be other ways to compile the data. The failure probability associated with the fire brigade rating of normal operating state is used to evaluate the degraded barrier consistent with the Reactor Oversight Program guidance (since root cause of degradation of fire brigade and barrier are different).

In the preliminary Phase III SDP no credit for manual suppression, beyond use of the severity factor, was given.

BD derivations: In a TIA response to Region II dated February 26, 2001, NRR advised the Region that the licensee's 3-hour wall and ceiling assembly fire tests did not satisfy the appropriate fire testing criteria and that these tests should not be used as the basis for determining the adequacy of the assembly for satisfying NRC fire protection requirements. In its letter to the licensee dated December 18, 2001, RII stated that the Thermo-Lag barrier had an indeterminate rating but was assumed at one hour and forty-eight minutes based on the licensee's test data and was assigned a moderate degradation (.056) in the SDP. A moderate degradation, in accordance with Attachment 2 of Appendix F to IMC 0609, should be

assigned to a fire barrier assembly only when a portion of the fire barrier assembly is found to be deficient such as a fire damper, fire door or penetration seal. The deficiency at Harris applies to the entire barrier assembly. Attachment 2 of Appendix F to IMC 0609 also states that a fire barrier system design which is mis-applied or with an indeterminate fire resistive rating should be assigned a high degradation. Therefore, strictly applying the SDP guidance the Thermo-Lag barrier installed at Harris should have been assigned a high degradation (0). The licensing basis for this plant required that a 3-hour rated barrier be installed between the ACP and the Train B Switchgear Room.

The SPLB staff recognizes that the as installed Thermo-Lag barrier between the ACP and the Train B Switchgear Room at Harris will provide some level of fire resistance to allow for manual suppression activities to succeed, albeit an indeterminate level of fire resistance due to the inadequate testing procedure, and substantially less than a fully qualified 3-hour barrier of reinforced concrete or masonry. Therefore, the use of the high degradation value (0) specified in the SDP guidance is inappropriate. The SPLB staff upon further consideration of the barrier assembly degradation, subsequent to the January 31, 2002, regulatory conference, and in consideration of the use of severity factors (not used during Phase 2 to reduce the estimated fire frequency), concluded and DSSA management has concurred, that given a severe fire in the Train B Switchgear Room at Harris that is not promptly suppressed by the plant fire brigade, the probability of a failure of the as installed Thermo-Lag barrier to prevent propagation into the ACP is approximately (.5). This qualitative determination of the revised barrier degradation value (between moderate and highly) is principally due to: (1) the lack of valid fire test data to properly assess the performance of this unique barrier configuration as the licensee did not conduct its fire testing program in accordance with industry accepted practice, (2) the high combustible loading present in the switchgear room that has the potential for the development of a hot gas layer in the switchgear room within approximately 30 minutes, (3) the types of combustible materials present in the switchgear room, (4) the presence of numerous high voltage ignition sources (i.e cabinets and transformers) in the room that can result in an energetic electrical fault; also heat release rate of 65 Btu/s is too low for electrical cabinet fires for cabinets in this room in general, (5) the combustible nature of the Thermo-Lag fire barrier material unlike that of typical structural barriers which are classified as non-combustible in accordance with the requirements specified in GDC 3, (6) the less robust construction of the subject barrier (i.e. Thermo-lag panels bolted to angle iron) in comparison to the typical separation between these types of fire areas in the industry by a reinforced concrete or masonry wall, (7) the mis-application of the Thermo-Lag material as a structural fire barrier separating fire areas in this configuration versus its use as an electrical raceway barrier within a fire area, which is the typical application in the

industry as Thermo-lag is a more friable material than concrete or masonry, (8) that the identified fire barrier degradation applies to the entire barrier assembly and is not restricted to a portion as would be the case with a fire damper, fire door or penetration seal, and (9) that the potential for a failure of the barrier increases significantly and non-linearly as the fire severity increases with time.

Fire barriers in the nuclear and general industry are tested in accordance with the provisions specified in ASTM E-119/NFPA 251, including a hose stream test. The results of this testing protocol provides a relative barrier rating in time (Hours and Minutes) in relation to a standard time-temperature fire endurance curve developed in 1917 which is based on room fires containing normal cellulosic materials located at the floor level such as wood and paper. Actual fire exposures in rooms such as switchgear rooms that contain plastic fuels such as cable insulation located above the floor level, and high voltage electrical components located in cabinets often develop faster and can exceed the severity of the standard curve. Therefore, a time rating obtained from a standard fire exposure may not be representative of the actual time available prior to barrier failure in an actual fire scenario. The NRC staff provided this conclusion in NUREG-1547 in 1996.

CCDP derivations: Based upon work originally performed to support the preliminary Phase III SDP. The licensee provided no additional information regarding this portion of the analysis.

<u>Conforming Case</u>

(7.3E-3 * .214 * .5 * .1 * 1.5E-2) + (3.29E-3 * .24 * .5 * .1 * 1.5E-2) = 1.2E-6 + 5.9E-7 = 1.8E-6

Differences from the non-conforming case:

MS derivations: In the conforming case the MS term should be the value for the normal operating state, as in the non-conforming case, as directed by the Reactor Oversight Program, and explained above.

The value used for the failure of the barrier in the conforming case implicitly includes the additional time available for fire brigade intervention due to the additional time the barrier will remain intact prior to failure.

In the preliminary Phase III SDP MS was excluded when the severity factor was applied.

BD derivations: The initial Phase III analysis utilized a failure probability for the fire barrier in the conforming case of (.001). This value is considered reasonable for a barrier, although somewhat optimistic when assessing the failure of a fire barrier assembly (barrier including all its active and passive components) for all reported fire events. However, this value was not

adjusted to account for the fire severity factor that reduced the effective fire frequency during the initial Phase III analysis. A review was performed which concluded that when considering only severe fires a more appropriate estimation of the likelihood of a failure of a fully qualified barrier is (.1). The basis for this quantitative assessment is that the (.1) value, given a severe fire, accounts for: (1) active barrier components that penetrate the barrier assembly, such as fire doors and dampers, that have many failure modes that are not shared with passive components such as a reinforced concrete slab, (2) differences and uncertainties associated with the construction of the actual plant installed barrier configuration and the tested configuration, (3) fire exposure scenarios that are more severe than that of the standard fire exposure to which the assembly was qualified against (see discussion about non-conforming barrier), and (4) the revised value is consistent with the relative credit provided in typical fire risk assessments for the effectiveness of other fire protection systems and features.

As indicated, a failure probability of 10 exp(-3) = 0.001 was used in original phase III analysis.

Delta CDF

Nonconforming case CDF - Conforming case CDF = 8.82E-6 - 1.8E-6 = 7.0E-6

Consistent with a **WHITE** significance for the Thermo-Lag barrier finding.