10 CFR 50.46(a)(3)(ii)

Progress Energy

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United States Nuclear Regulatory Commission
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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING ANNUAL REPORT OF CHANGES TO OR ERRORS DISCOVERED IN AN ACCEPTABLE LOSS-OF-COOLANT ACCIDENT EVALUATION MODEL APPLICATION FOR THE EMERGENCY CORE COOLING SYSTEM (TAC NO. ME2833)

Ladies and Gentlemen:

By letter dated May 11, 2010, the NRC requested that Carolina Power and Light Company, also known as Progress Energy Carolinas, Inc. (PEC), respond by June 25, 2010 to a request for additional information (RAI) regarding the annual report of changes to or errors discovered in an acceptable loss-of-coolant accident evaluation model application for the emergency core cooling system that was submitted on November 24, 2009. The attachment to this letter provides the RAI response for the H. B. Robinson Steam Electric Plant, Unit No. 2.

If you have any questions concerning this matter, please contact me at (843) 857-1626.

Sincerely,

Curtis A. Castell

Curtis A. Castell
Supervisor – Licensing/Regulatory Programs

RAC/rac

Attachment

c: Mr. L. A. Reyes, NRC, Region II
Mr. T. J. Orf, NRC, NRR
NRC Resident Inspector

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A002
NRR

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING ANNUAL REPORT OF CHANGES TO OR ERRORS DISCOVERED IN AN ACCEPTABLE LOSS-OF-COOLANT ACCIDENT EVALUATION MODEL APPLICATION FOR THE EMERGENCY CORE COOLING SYSTEM

NRC Question 1

With respect to the annual report covering the period of March 24, 2009 through November 5, 2009, a summary table provides results from large break loss-of-coolant accident (LBLOCA) evaluation model and small break loss-of-coolant accident (SBLOCA) evaluation model, however, no specific identification of the exact errors is given.

Please identify: (1) the specific errors and their impact on the results shown in the table of the submittal; (2) which specific model is used for the radiation heat transfer and heat conduction; (3) which new data on pellet thermal conductivity as burnup is used for the RODEX computer code; (4) which approved methodologies are used for LBLOCA and SBLOCA evaluation; and (5) the reason why the results due to the errors show there are -29 degrees Fahrenheit peak cladding temperature (PCT) change for LBLOCA evaluation and 8 degrees Fahrenheit PCT change for SBLOCA evaluation.

Response:

Item 1

Two error notices were received during the reporting period as follows: 1) evaluation of the coding of the point kinetics model and heat conduction solution, and 2) evaluation of the fuel thermal conductivity degradation issue with legacy fuel codes. These errors and their impacts are described below.

1) Evaluation of the coding of the point kinetics model and heat conduction solution

In 2007, Idaho National Laboratory (INL) announced an error in the coding of the point kinetics model. The corrections were provided by INL and then installed into S-RELAP5. Recently, INL announced that the previous error corrections were incorrect and that the recommended convergence criteria supplied with those corrections should be retained. This was corrected in a new version of S-RELAP5 for the Realistic Large Break LOCA (RLBLOCA). ANF-RELAP was not modified because it used the same strict convergence criteria as used in S-RELAP5 and, as noted by INL, the index corrections were of secondary importance.

Close to the timing of the above, INL announced that the heat conduction solution was incorrectly programmed. The error was associated with using the incorrect heat capacity when evaluating the right boundary mesh point. Instead of using the last (adjacent) mesh interval heat capacity, the code incorrectly used the next to last mesh interval heat capacity. The effect of the error is maximized in cylindrical and spherical geometries with few mesh points, and can be minimized with an increased number of mesh points. The effect is further minimized by the

S-RELAP5 RLBLOCA, SBLOCA and Non-LOCA modeling guidelines requiring close mesh spacing at the left and right boundaries. This error exists exclusively in the RELAP5 series of codes.

The corrections for these two errors were installed into a new code version of S-RELAP5 and 10 CFR 50.46 evaluations for large breaks were performed.

The PCT impacts are - 29°F (LBLOCA) and + 8°F (SBLOCA) for the point kinetics and heat conduction solution issues. Both of these results are small in comparison to the degree of cladding temperature rise evaluated. The impact is expected to be primarily due to the revised kinetics solution as the mis-assignment of the heat capacity in the pellet is small for the mesh spacing used in these analyses. The kinetics model interfaces with a substantial number of core parameters leading to differing impact for large and small breaks. For the LBLOCA evaluated, the net effect is a slightly quicker core shutdown on voids and a slight lowering of the core stored energy approaching the achievement of effective core cooling in reflood. For the SBLOCA the core is shutdown by rods, not voids, and a slightly different kinetics prediction ensued, probably causing a slight increase in vaporization during the early portion of the transient.

2) Evaluation of the fuel thermal conductivity degradation issue with legacy fuel codes

The RODEX3A code has been benchmarked against an increased database (i.e., the database used for the RODEX4 approval) that extends to higher burnup. This benchmarking lead to an alteration of the code bias applied in realistic LOCA calculations. The bias increases the fuel stored energy at the LOCA initiation for burnup greater than about 20 GWd/MTU and lowers the stored energy for burnup less than 20 GWd/MTU. The HBRSEP, Unit No. 2, limiting RLBLOCA case was sampled at 11.3 GWd/MTU and thus the RODEX3A output used in the analysis is over predicted in this burnup range. The LBLOCA PCT impact is 0°F for the revised code bias.

A SBLOCA evolves through a pump coast down and natural circulation phase to a loop draining phase followed by a boil-down and refill phase. During the pump coast-down phase a single or two-phase forced circulation exists within the RCS which prevents a cladding temperature excursion and acts to remove the initial energy of the fuel and deposit it in the steam generators or the containment. In either case, the energy content of the fuel has been reduced to that required to transport decay heat out of the fuel by the end of the coast-down phase. Thus, the peak cladding temperatures, which occur later in the transient depend on decay heat versus heat transfer and have no relationship to the initial stored energy within the fuel. For SBLOCA, the PCT impact is 0°F for the thermal conductivity degradation issue.

Item 2

The models for radiation and heat conduction are those published in the S-RELAP5 models and correlations code manual, EMF-2100(P), which was submitted with EMF-2103(P)(A) Rev. 0 as supporting material during the NRC review of RLBLOCA Rev. 0 methodology and have not been altered for or by these changes. Also, the ANF-RELAP models and correlations code manual was not altered.

Item 3

See discussion above for Item 1.

Item 4

The approved methodologies used are:

a. EMF-2103(P), Rev. 0, Realistic Large Break LOCA Methodology for Pressurized Water Reactors
b. XN-NF-82-49(P)(A), Rev. 1, Exxon Nuclear Company Evaluation Model EXEM PWR Small Break Model, April 1989
c. XN-NF-82-49(P)(A), Rev. 1, Supplement 1, Exxon Nuclear Company Evaluation Model Revised EXEM PWR Small Break Model, December 1994

Item 5

See discussion above for Item 1.

NRC Question 2

Please provide a detailed analysis of the errors including the initial conditions, assumptions, discussion of error and its corrective action, and sensitivity study of the impact from those error identified.

Response:

A discussion of each error and the estimated impact from each error is discussed in the response to Question 1. A detailed reanalysis is not required and has not been performed because the impact of the errors is not significant.