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DENTON, H. R. Office of Nuclear Reactor Regulation, Director (post 851125

SUBJECT: Advises that commitment to reroute electrical conduit serving Ex-core Neutron Detector NM-44 per SER Open Item 99 unnecessary. Safety evaluation encl.

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NOTES: Application for permit renewal filed. 05000400

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CP&L
Carolina Power & Light Company

SERIAL: NLS-86-226

JUL 16 1986

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
UNIT NO. 1 - DOCKET NO. 50-400
EXCORE NEUTRON DETECTOR INSTRUMENTATION

REFERENCE: Letter dated November 14, 1983 from
Mr. M. A. McDuffie (CP&L) to Mr. H. R. Denton (NRC)
CP&L Response for Additional Information to Draft
Safety Evaluation Report Open Item 99
(Instrumentation and Control Systems Branch)

Dear Mr. Denton:

In the referenced letter, Carolina Power & Light Company (CP&L) committed to reroute electrical conduit serving the excore neutron detector NM-44. In lieu of this commitment, CP&L is submitting a safety evaluation report of potential consequences for the Shearon Harris Nuclear Power Plant (SHNPP) in the event of instrument damage causing D-Bank Rod Control Cluster Assembly (RCCA) withdrawal prior to reactor trip at the onset of a small break LOCA. The results of the attached evaluation demonstrate that the small break LOCA analysis performed with NOTRUMP bounds the case in which RCCAs withdraw prior to reactor trip. Therefore, CP&L considers rerouting electrical conduit serving the excore neutron detector unnecessary and considers the previous commitment closed.

If you have any question, please contact me at (919) 836-6242.

Yours very truly,

S. R. Zimmerman
Manager
Nuclear Licensing Section

GB/vaw (3978JDK)

Attachment

cc: Mr. B. C. Buckley (NRC)
Mr. G. F. Maxwell (NRC-SHNPP)
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ATTACHMENT TO NLS-86-226

(0813NEL/pgp)

SAFETY EVALUATION FOR

D-BANK ROD CONTROL ASSEMBLY WITHDRAWL

FOLLOWING A POSTULATED LOCA IN

THE SHEARON HARRIS NUCLEAR POWER PLANT

Rupture of a six-inch diameter line or larger on the cold leg of the Shearon Harris Nuclear Power Plant could hypothetically result in jet impingment and damage to the instrumentation system. Damage to the excore neutron detector instrumentation could result in the withdrawl of the D-Bank rod cluster control assemblies prior to a reactor trip during the postulated accident. The purpose of this safety evaluation check list is to evaluate the consequences of such an accident.

BACKGROUND

The D-Bank rod cluster control assemblies (RCCAs) consist of cylindrical neutron absorbing rods. These provide operational reactivity control and can shut down the core at all times. During normal full power steady state operation D-Bank RCCAs are partially inserted at the Bite position, typically five percent of full insertion. The maximum speed at which D-Bank RCCAs could be withdrawn from the core is 72 steps per minute with a maximum change in reactivity of 2 pcm per step. Withdrawl of the D-Bank RCCAs would provide positive reactivity insertion which would increase the core power.

Loss of coolant accidents (LOCAs) result when ruptures of the primary coolant boundary exceed the makeup capability of the plant. Breaks of an equivalent diameter larger than 1-ft^2 are considered large break LOCAs. The Westinghouse large break LOCA emergency core cooling system (ECCS) evaluation models do not take credit for the insertion of the rod control cluster assemblies following a reactor trip signal. Reactivity insertion effects due to control rod motion following a large break LOCA are inconsequential when compared to the magnitude of the reactivity insertion due to moderator density change in the reactor core. The reactor core is typically shutdown by void formation within 0.1 seconds following a large break LOCA.

Breaks of an equivalent diameter smaller than 1-ft^2 are considerd small break LOCAs. Reactivity insertion effects result from control rod motion and void formation following a small break LOCA. The RCCAs fall into the core when the RCCA drive mechanisms are deenergized following the generation of a reactor trip signal plus an appropriate signal processing delay time. The RCCAs are fully inserted approximately 2.0 to 2.4 seconds after the drive mechanisms are deenergized.

The Westinghouse small break LOCA ECS evaluation model typically assumes that a reactor trip signal is generated by a low pressurizer pressure signal. The core heat generation rate is conservatively assumed to remain at full power until after the generation of a reactor trip signal, plus an appropriate time for the RCCAs to be fully inserted. At this time the core heat generation rate is based upon the 1971 ANS decay heat plus 20 percent and residual fissions heat contribution is calculated based upon an appropriate core shutdown margin. The Westinghouse small break LOCA evaluation model results in a conservative upper bound for the heat generation rate following a small break LOCA.

Reactivity insertion effects due to control rod motion and void formation following a small break LOCA are typically not modeled in the Westinghouse small break LOCA ECCS evaluation model analyses. These effects, however, would be contributors to the early shutdown of the reactor core. The effect of D-Bank RCCA withdrawl prior to reactor trip may be evaluated for a small break LOCA by examining the reactivity effects.

SMALL BREAK LOCA EVALUATION

The Shearon Harris Small Break LOCA analyses were performed using the NOTRUMP small break LOCA ECCS evaluation model. In the Shearon Harris smallbreak LOCA analysis, the core heat generation rate was conservatively assumed to remain at full power until after reactor trip plus delay times for signal processing and control rod insertion. Reactivity effects due to void formation were not explicitly modeled in the analyses. The Shearon Harris analyses of a six-inch equivalent diameter cold leg break resulted in the generation of the reactor trip signal on low pressurizer pressure 1.977 seconds after the initiation of the break.

If the D-Bank RCCAs begin to withdraw as a result of jet impingment damage to the control instrumentation system from a six-inch break in the RCS, positive reactivity will be added to the core prior to the time of reactor trip. After the generation of the reactor trip signal (1.977 seconds) and signal processing delay time (2.0 seconds) D-Bank RCCAs will begin to fall into the core. Conservatively assuming that the RCCAs begin to withdraw coincident with the break opening, a maximum positive reactivity insertion of 9.93 pcm could be added prior to reactor trip.

The negative reactivity insertion caused by moderator density changes may be calculated for the Shearon Harris six-inch small break LOCA analyses at the time the RCCAs would begin to fall into the core. The analysis indicates that the core average moderator density decreases by approximately 2.0 lbm/ft^3 prior to the time that the RCCAs would begin to fall into the core. This density decrease is equivalent to a negative reactivity insertion of 55.2 pcm.

Clearly, the positive reactivity insertion due to the hypothetical withdrawl of D-Bank RCCAs following a postulated six-inch break in the Shearon Harris Nuclear Power Plant is offset by the negative reactivity insertion due to the decrease in core average moderator density resulting from void formation in the core. However, it should be understood that extremely short durations at different power level, whether it is a net power increase or decrease, will not affect equilibrium fission product concentration and consequently the transient decay heat. Therefore, explicit modeling of reactivity phenomena prior to reactor trip would show a negligible effect on the overall transient response of the reactor coolant system and the calculated Peak Clad Temperature (PCT).

CONCLUSION

Explicit modeling of the reactivity effects due to rod cluster control assembly withdrawl prior to reactor trip following a small break LOCA indicate that a small amount of positive reactivity would be added to the core. Further modeling of reactivity controlling phenomena within the core illustrates that a significantly larger amount of negative reactivity would be inserted as a result of void formation prior to reactor trip, thereby negating any increase due to rod withdrawl. Therefore, it is concluded that the small break LOCA analysis performed for Shearon Harris with NOTRUMP bounds the case in which D-Bank RCCAs withdraw prior to reactor trip.