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SUBJECT: Provides info re deficiency in RETRAN computer program. Program used to perform transient analyses in support of core design & licensing.

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SUSQUEHANNA STEAM ELECTRIC STATION
INFORMATION ON RETRAN **Docket Nos. 50-387**
PLA-4412 FILE R41-2 **and 50-388**

The purpose of this letter is to provide the NRC with information regarding a deficiency in the RETRAN computer program, which PP&L uses to perform transient analyses in support of core design and licensing. A detailed summary of the deficiency is attached.

PP&L has notified EPRI of this deficiency through their Electric Power Software Center, which maintains RETRAN under a formal QA program. Subsequently, EPRI has notified RETRAN users of this information.

This deficiency has been found not to be safety significant for Susquehanna SES, and was not found to be reportable under any applicable regulations. Any questions on this submittal should be directed to Mr. R. Sgarro at 610-774-7552.

Very truly yours,

R. G. Byram

Attachment

copy: NRC Region I
Mr. C. Poslusny, Jr., NRC Sr. Project Manager - OWFN
Ms. M. Banerjee, NRC Sr. Resident Inspector - SSES

A001 1/1

PP&L EVALUATION OF RETRAN PROGRAMMING DEFICIENCY

Summary

During preliminary analysis of a licensing basis generator load rejection transient for a future core design, an anomalous transient power response was noticed in the generator load rejection analysis. Transient analyses are performed with the RETRAN02 MOD5.1 computer program. The transient power anomaly was a small step decrease in reactor power when scram rod motion was initiated. This led to the discovery of a programming deficiency in the RETRAN computer program. This deficiency involves the inconsistent application of logic which limits the value of certain neutronic parameters. The logic deficiency causes a problem when a scram occurs.

PP&L Evaluation

In order to determine the cause of the step decrease in reactor power, many parameters were analyzed. Transient power distributions were analyzed to determine the location of the power reduction in the reactor core model. Based on the analyzed distributions, the power at the top of the core decreased rapidly as soon as the scram rods moved into the bottom of the core. A review of detailed edits of the neutronic parameters (i.e., cross sections) used in the model identified that a step change in the fast group total removal cross section was occurring in the two top fueled nodes of the reactor core model. When the scram rods started to move it was evident that the radial buckling of the radial leakage component of the fast neutron group total removal cross section was being set to zero.

The values for radial buckling determined by the SIMTRAN computer program are negative for the top two fueled nodes. SIMTRAN is used to collapse three dimensional cross section sets from SIMULATE to one dimension for RETRAN. A negative buckling value is not physically possible since this would represent a source of neutrons instead of a loss. However, from a purely mathematical standpoint, a negative buckling value is required to satisfy the neutron balance equations in SIMTRAN.

RETRAN contains logic to ensure that the neutronic parameters remain within reasonable limits during a transient. The neutronic parameters that RETRAN requires for a transient are in the form of polynomials which represent the neutronic parameters as a function of the change in fluid density and fuel temperature during the transient. Each reactor control state uses a set of these polynomials; if they are not well behaved, the evaluation of the polynomials may result in a negative number. This is the reason for having logic to check limits on the neutronic parameters. However, the logic assumes that the initial values are positive for all neutronic parameters that are not density or temperature dependent. The only neutronic parameter that is not density or temperature dependent is radial buckling. Before a scram is called for in the event, a single "base" set of cross section polynomials is used. Because there is no rod motion, the base

set of polynomials is only checked against limits if the polynomial is density or temperature dependent.

The RETRAN computer code allowed the radial buckling values to be negative until the scram rods were moved. When the logic in RETRAN detects scram rod motion, all neutronic parameters are checked to make sure they are bounded between zero and 1×10^{10} to assure that the calculated cross sections remain bounded during the scram in the transient, regardless of density or temperature dependence. The net effect of applying this limit logic at the time of scram rod motion is a step increase in the fast neutron group removal cross sections for any node with a negative value of radial buckling. This step change in the removal of neutrons has the effect of erroneously reducing peak power for any transient that relies on the scram to limit peak power.

PP&L has reviewed the impact of the above findings on our analysis of limiting licensing events and on non-licensing best estimate applications. No safety significant impacts were identified.

Generic Implications

The RETRAN computer program is used throughout the industry to perform licensing and best estimate analyses. PP&L has notified the Electric Power Research Institute (EPRI) of the program deficiency through the Electric Power Software Center (EPSC). EPSC maintains RETRAN under a formal quality assurance program and is responsible for distribution of the RETRAN program and error reports.