# PHILADELPHIA ELECTRIC COMPANY

2301 MARKET STREET

P.O. BOX 8699

PHILADELPHIA, PA 19101

(215) 841-5001

JOSEPH W. GALLAGHER
VICE PRESIDENT
NUCLEAR SERVICES


June 6, 1988

Docket Nos. 50-277
50-278

Mr. W. R. Butler, Director
Project Directorate I-2
Division of Reactor Projects I/II
U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

SUBJECT: In-House Reload Licensing for Peach Bottom Atomic Power Station

REFERENCE: Letter from R. E. Martin, NRC, to E. G. Bauer, Jr., PECo, dated March 4, 1988, Request for Additional Information

Dear Mr. Butler:

This letter responds to the referenced NRC letter requesting additional information regarding Philadelphia Electric Company's topical report PECO-FMS-0004, "Methods for Performing BWR Systems Transient Analysis". In particular, information was requested concerning the application of the methods to reload licensing. Attachment 1 of this letter provides PECo's response to the requests of the referenced letter.

Philadelphia Electric Company is presenting its transient analysis methods in two topical reports: 1) PECO-FMS-0006, "Methods for Performing Reload Safety Evaluation Analysis", which has not yet been submitted for NRC review, and 2) PECO-FMS-0004 (submitted September 28, 1987). The purpose of PECO-FMS-0004 is to describe the structure of the transient analysis model, to demonstrate that the model accurately represents the plant by comparison of model predictions to plant measured data, and to demonstrate Philadelphia Electric Company's proficiency in the use of the transient analysis code including interpretation of the output. The application of Philadelphia Electric Company's transient analysis methods for analysis of specific reload licensing events will be described in detail in PECO-FMS-0006. Philadelphia Electric Company requests that the NRC review PECO-FMS-0004 and issue a Safety Evaluation Report based on its limited purpose, as stated above. It is expected that upon complete review of both PECO-FMS-0004 and PECO-FMS-0006, the NRC will find Philadelphia Electric Company's transient analysis methods for specific reload licensing applications to be acceptable.

IE26
1/1

The sixth and final topical report, PECO-FMS-0006, was scheduled for submittal by February 1, 1989. However, due to the extension of the current outage schedules for both Peach Bottom Units and small delays in preparation of PECO-FMS-0006, Philadelphia Electric Company has revised its schedule for submittal of PECO-FMS-0006 and the first in-house reload licensing application. Attachment 2 of this letter provides the new schedule. The new schedule projects submittal of PECO-FMS-0006 by May, 1989 and NRC approval by February, 1990. PECO-FMS-0003, "Steady-State Fuel Performance Methods Report", and PECO-FMS-0005, "Methods for Performing BWR Steady-State Reactor Physics Analyses" were submitted for NRC review on July 13, 1987 and February 1, 1988, respectively. Philadelphia Electric Company requests that the NRC complete its review of these topical reports by July 1988 and February 1989, respectively. Philadelphia Electric Company's first reload licensing application remains planned for Peach Bottom Unit 3 Cycle 9, now scheduled to commence in November 1990. The reload licensing safety analysis to support this reload is planned to be submitted in June 1990.

If you have any questions or require additional information, please do not hesitate to contact us.

Very truly yours,

JW Gallagher

Attachments

cc: Addressee
W. T. Russell, Administrator, Region I, USNRC
T. P. Johnson, USNRC Senior Resident Inspector
T. E. Magette, State of Maryland

Peach Bottom Atomic Power Station
In-House Reload Licensing

Request No. 1:

Model qualification means a thorough demonstration that the RETRAN model (nodalization and selection of built-in models) accurately represents the plant, that the computer code is being used within its range of applicability, and that the user can correctly interpret the output from the code analysis. In addition, use of the RETRAN computer code is subject to certain limitations which are delineated in the staff SER applicable to the code. Therefore, to qualify the RETRAN models for use in Peach Bottom reload applications, provide the following for the intended use:

(a) justify the nodalization on a transient-by-transient basis by parametric studies and by comparison to available test data;

RESPONSE:

The adequacy of the Philadelphia Electric Company RETRAN model nodalization is demonstrated in Section 3 of PECO-FMS-0004 by comparison of the model predictions to measured plant data for rapid pressurization events (e.g., turbine trips), core flow reduction events (e.g., recirculation pump trips), and slow pressurization events (e.g., S/RV lift test). The accuracy of the turbine electro-hydraulic controller (EHC) model, the feedwater controller and turbine-pump dynamics model, and the reactor water level calculation have also been demonstrated by comparison of model predictions to measured plant data. In addition, the limiting transient in each of the FSAR abnormal operational transient event categories will be evaluated and presented in topical report PECO-FMS-0006. Table I lists the transients that will be evaluated as part of Philadelphia Electric Company's overall transient analysis methods (PECO-FMS-0004 and PECO-FMS-0006). Table I also indicates the limiting transient events for which parametric studies will be performed. Further information regarding the parametric studies is provided in the response to NRC Request No. 2.

Request No. 1 (continued):

(b) justify the selection of RETRAN built-in models on a transient-by-transient basis by parametric studies and by comparison to available data, and by demonstrating that all such models are used within their ranges of validity;

RESPONSE:

The Philadelphia Electric Company RETRAN model utilizes the following RETRAN built-in models.

1) Centrifugal Pump Model for Recirculation Pumps

2) Jet Pump (Momentum Mixing) Model for Jet Pumps

3) Nonmechanistic Separator Model

4) Nonequilibrium Pressurizer Model for Upper Downcomer Steam-Water Interface Region

5) Algebraic Slip Model and Subcooled Void Model for Reactor Core Region

The accuracy of Philadelphia Electric Company's use of the models in items 1 and 2 has been demonstrated in Section 3.1.3 of PECO-FMS-0004 by comparison of model predictions to measured plant data for both single and double recirculation pump trips (M-G set trips). The centrifugal pump model uses homologous pump curves based on pump measured data and is used in the single phase, normal quadrant (forward flow, forward rotation, positive head) only. This is within the range of model validity as specified in the RETRAN SER. The jet pump model M-N characteristics (defined by the appropriate selection of jet pump junction areas and loss coefficients) are based on plant measured data. The jet pump model is generally applied in the normal quadrant (forward flows) only, which is the range of model validity specified in the RETRAN SER, although off normal (reverse flow) conditions were predicted in the single M-G set trip analysis. One of the FSAR abnormal operational transients listed in Table I, the recirculation flow controller failure, results in asymmetrical recirculation loop behavior and reverse jet pump flow. However, for this particular event, the predicted transient MCPR is insensitive to the reverse jet pump flow due to the timing and small magnitude of the flow reversal. Thus, this restricted use of the jet pump model outside of its normal range of validity should have no significant impact on the determination of conservative plant operating limits.

The accuracy of Philadelphia Electric Company's use of the models in items 3, 4, and 5 has been demonstrated in Section 3.3 of PECO-FMS-0004 by comparison of model predictions to measured plant data for the three Peach Bottom Unit 2 turbine trip tests conducted during Cycle 2. The nonmechanistic separator model is typically used at near nominal separator inlet quality (13.2%) conditions. The results of the analysis of the first turbine trip test (separator inlet quality of 6.0%) indicate that the separator model does not simulate the attenuation of pressure waves well at low inlet quality conditions and thus analyses of pressurization events at these conditions are avoided. Carryunder and carryover fractions are based on manufacturer data and are held constant. These conditions satisfy the limitations specified in the RETRAN SER which define the range of validity of the model. The nonequilibrium pressurizer model is used to predict the nonequilibrium effects (different temperatures) between the vapor and liquid in the steam-water interface region of the reactor downcomer. This is particularly important during rapid pressurization events when the vapor region superheats. The use of the nonequilibrium pressurizer model is restricted to the range of validity of the model as described in the response to NRC Request 1c. The algebraic slip model is used to determine the reactor core phase velocity differences for all applications. The dependence of the dynamic slip model on flow regime maps has led to inconsistent results when applied to the Philadelphia Electric Company RETRAN model and it is not used. The use of the HEM (zero slip) model in the core region is nonphysical and its application is limited by the RETRAN SER. The subcolled void model is qualified for application to the analysis of rapid pressurization events (see response to NRC Request No. 1c). The range of qualification defines the range of model validity as specified in the RETRAN SER. As indicated in the RETRAN SER and in Section 3.3 of PECO-FMS-0004, the combination of the algebraic slip model and the subcooled void model (with one-dimensional kinetics) leads to the prediction of the peak power of rapid pressurization events to within a few percent of the data.

Additional analysis demonstrating the validity of the application of these models on a transient-by-transient basis will be presented in the topical report PECO-FMS-0006 with appropriate parametric studies (see response to NRC Request No. 1a).

Request No. 1 (continued):

c) demonstrate that all limitations on code use specified in the RETRAN SER are satisfied for each analysis submitted.

RESPONSE:

The NRC's RETRAN SER specifies a number of general limitations (Section C of the Technical Evaluation Report) on the RETRAN computer code. Philadelphia Electric Company's use of the RETRAN code complies with these restrictions where applicable. In addition, the SER emphasizes five limitations, two of which apply to the Philadelphia Electric Company RETRAN model. The applicable limitations are 1) the use of the Subcooled Void Model and 2) the use of the Nonequilibrium Pressurizer Model.

The Subcooled Void Model is used to determine the void feedback in the lower region of the core when utilizing the RETRAN 1-D Kinetics option. Qualification of the use of this model is demonstrated in Section 3.3 of PECO-FMS-0004 by the accurate prediction of the local LPRM neutron flux response (in particular, LPRM B) for the three Peach Bottom Unit 2 turbine trip tests. Additional analysis utilizing this model, as well as parametric studies, will be presented in PECO-FMS-0006.

The Nonequilibrium Pressurizer Model is used to represent the steam-water interface region in the upper downcomer of the reactor vessel. Particular attention has been focused on the nodalization in this region in an attempt to prevent the steam-water interface from crossing either boundary (top or bottom) of the nonequilibrium volume during a transient calculation. Since the applicability of this model has not been demonstrated under the above mentioned conditions, any transient calculation which results in either condition will be considered invalid thereafter.

Request No. 2:

In conjunction with the basic model qualification in Question 1, in order to ensure that no unexpected anomalies occur in the use of Philadelphia Electric Company's version of RETRAN-02, provide a listing of the important sources of uncertainty in the code for the intended reload analyses. Consideration should be given to the reactor core model, recirculation system model, and steam line model. The key parameters which should be varied through the range of potential BWR transient conditions are scram time, void reactivity coefficient, void distribution, jet pump losses, flow rate and distribution, core pressure drop, stop valve closure time, separator model, bubble rise (or slip model), MSIV closure time (for pressurization transients), core exit pressure, specific heat ratio, etc. Estimate the 95% probability limits for these uncertainties and determine the corresponding delta-CPR/ICPR for each uncertainty for turbine trip without bypass transient. Determine the corresponding delta-pressure (%) for each of these uncertainties for the MSIV closure event with position switch scram failure. Also provide an estimate of the corresponding thermal-hydraulic stability decay ratio.

RESPONSE:

The development of an appropriate statistical basis for evaluation of limiting transients will be described in PECO-FMS-0006. However, the following responses are appropriate at this time:

(a) The current NRC-approved licensing basis for Peach Bottom identifies the most limiting CPR pressurization events to be the Generator Load Rejection Without Bypass (GLRWOB), and the Feedwater Controller Failure (FWCF). The referenced letter documents parametric studies used by General Electric to generically justify the use of ODYN/GEMINI statistical methods for evaluation of these limiting pressurization events. To develop statistical methods for specific application to Peach Bottom, Philadelphia Electric Company plans to describe the results of parametric studies for both the GLRWOB and FWCF events in PECO-FMS-0006. The parameters Philadelphia Electric Company plans to evaluate in the parametric studies are listed in Table II. These parameters, which include all applicable parameters evaluated in the referenced letter, have been identified as the most sensitive with regard to licensing application.

(b) The MSIV closure with assumed failure of the position switch scram is currently evaluated by General Electric using a deterministic (i.e., non-statistical) approach. Thus, no uncertainty or statistical evaluations of the peak vessel pressures have been made by General Electric to demonstrate compliance to the ASME vessel code limit. In a similar manner, Philadelphia Electric Company plans to conservatively evaluate the peak pressures occurring in the MSIV closure event each cycle. Consequently, in this case it is not necessary to quantify sensitivities in the results of the MSIV closure event versus assumed changes for each of the initial conditions and input parameters used. This deterministic method will be further described and qualified in PECO-FMS-0006.

(c) General Electric SIL-380 recommendations have been incorporated into the operating procedures and Technical Specifications for Philadelphia Electric Company BWRs; therefore, stability analysis is not required. NRC approval for deletion of a cycle specific stability analysis is documented in Amendment 8 to NEDE-24011-P-A-8-US, "General Electric Standard Application for Reactor Fuel."

Reference: Letter (and attachments) from J. S. Charnley, General Electric, to H. N. Berkow, NRC, dated January 16, 1986, Subject: Revised Supplementary Information Regarding Amendment 11 to General Electric Licensing Topical Report NEDE-24011-P-A.

TABLE I

PHILADELPHIA ELECTRIC COMPANY TRANSIENT EVENT EVALUATIONS

| TRANSIENT | EVENT CATEGORY | EVENT EVALUATION/ DATA COMPARISON | PARAMETRICS |
|---|---|---|---|
| Turbine Trip Tests | Rapid Pressurization | Sect. 3.3 of PECO-FMS-0004 | (a) |
| Generator Load Rejection Without Bypass | Rapid Pressurization | Sect. 5.1 of PECO-FMS-0006 | 5.1 of PECO-FMS-0006 |
| SRV Lift Test | Slow Pressurization | Sect. 3.2 of PECO-FMS-0004 | (a) |
| Feedwater Controller Failure | Core Coolant Temp. Decrease | Sect. 5.2 of PECO-FMS-0006 | 5.2 of PECO-FMS-0006 |
| Loss of Feedwater Heating | Core Coolant Temp. Decrease | Sect. 5.2 of PECO-FMS-0006 | (c) |
| Loss of Feedwater Flow | Core Coolant Inventory Decrease | Sect. 5.4 of PECO-FMS-006 | (b) |
| Two M-G Set Trip | Core Coolant Flow Decrease | Sect. 5.5 of PECO-FMS-0006 | (b) |
| M-G Trip Tests | Core Coolant Flow Decrease | Sect. 3.1 of PECo-FMS-0004 | (a) |
| Recirculation Flow Controller Failure | Core Coolant Flow Increase | Sect. 5.6 of PECO-FMS-0006 | (b) |
| MSIV Closure With Position Switch Failure | ASME Over Pressure Protection Check | Sect. 5.7 of PECO-FMS-0006 | (b) |
| Control Rod Withdrawal Error | Reactivity/Power Anomaly | Sect. 5.3 of PECO-FMS-0006 | (c) |
| Fuel Loading Error | Reactivity/Power Anomaly | Sect. 5.3 of PECO-FMS-0006 | (c) |

a - Comparisons to actual plant test data, no parametrics performed
b - Deterministic approach followed, no parametrics performed.
c - Planned to be analyzed with steady-state methods.

Docket Nos. 50-277
50-278

TABLE II

AN Input Parameters Planned

luation in Parametric Studies

I. Nuclear Model

*1. Void Reactivity Coefficient
*2. Doppler Reactivity Coefficient
*3. Scram Reactivity
*4. Prompt Moderator Heating

II. Core Thermal-Hydraulic Model

*1. Core Pressure Drop
2. Core Bypass Flow
3. Core Average Gap Conductivity
*4. Hot Channel Gap Conductivity
*5. Core Void Distribution (Thermal-Hydraulic Slip)
*6. Core Void Distribution (Subcooled Void)

III. Recirculation Model

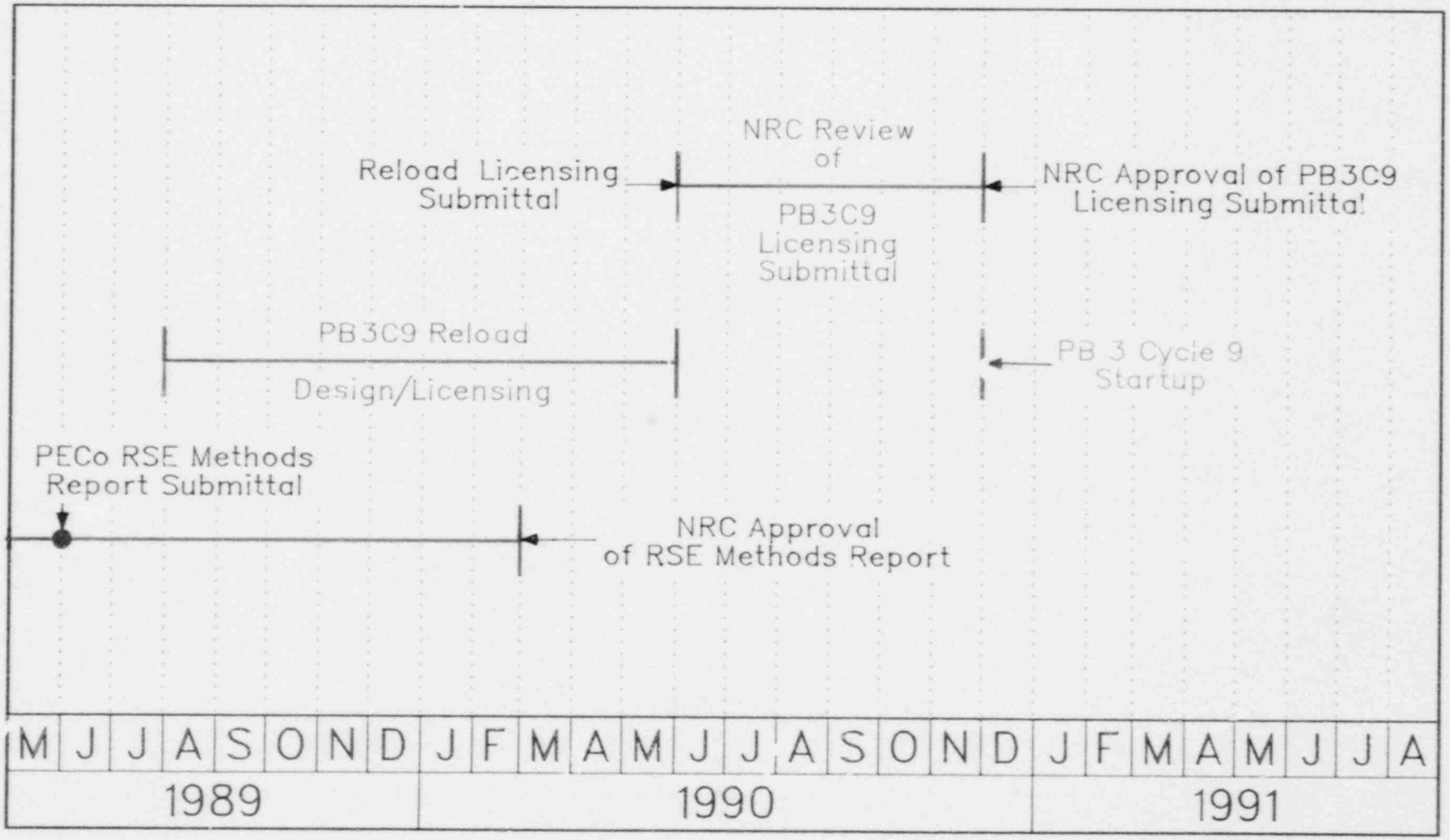
*1. Jet Pump Losses (M-N Efficiency)
2. Jet Pump Inertia
*3. Recirculation Loop Inertia
*4. Separator Inertia
*5. Separator Pressure Drop

IV. Steam Line Model

1. Steam Dome Volume
*2. Steam Line Pressure Drop
3. Steam Line Inertia

* - Parameters Evaluated In Referenced Letter.

# REVISED LICENSING SCHEDULE




Attachment 2
Docket Nos.: 50-277
50-278