

Philadelphia Electric Company

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of)
Philadelphia Electric Company) Docket No. 50-277
Peach Bottom Atomic Power Station)
Unit No. 2)

ORDER FOR MODIFICATION OF LICENSE AND EXEMPTION

I.

The Philadelphia Electric Company (the licensee), is the holder of Facility Operating License No. DPR-44 which authorizes the operation of the nuclear power reactor known as Peach Bottom Atomic Power Station Unit No. 2 (the facility) at steady state reactor power levels not in excess of 3253 megawatts thermal (rated power). The facility consists of a boiling water reactor (BWR) located at the licensee's site in Peach Bottom, York County, Pennsylvania.

II.

In conformance with evaluations of the performance of the Emergency Core Cooling System (ECCS) of the facility submitted by the licensee on July 9, 1975, and a supplements thereto dated September 10, 1975, October 1, 24 and 30, 1975, and November 7, 18 and 20, 1975, the Technical Specifications issued for the facility on June 11, 1976, limit the Average Planar Linear Heat Generation Rates to the values shown on Technical Specification Figures 3.5.1.A, B, F and G. The ECCS performance evaluation submitted by the licensee was based upon a previously approved ECCS evaluation model developed by General Electric Company (General Electric), the designer of the facility. This model has been found to conform to

the requirements of the Commission's ECCS Acceptance Criteria, 10 CFR Part 50 § 50.46 and Appendix K. The evaluation indicated that with the average planar linear heat generation rate limited as set forth above, and with the other limits set forth in the facility's Technical Specifications, the ECCS cooling performance for the facility would conform with the criteria contained in 10 CFR § 50.46(b) which govern calculated peak clad temperature, maximum cladding oxidation, maximum hydrogen generation, coolable geometry and long term cooling.

Recently, the NRC staff was informed by General Electric that several errors had been discovered in the computer codes used to calculate peak clad temperature and the clad oxidation percentage in the General Electric evaluation model. These errors have been discovered by General Electric during a continuing internal Quality Assurance (QA) audit of their LOCA evaluation model codes. This audit is still under way and the errors reported reflect those found to date. The additional effort expended by the vendor to enhance the assurance of the quality of its evaluation model, the staff believes, was prudent and desirable. Identification of additional errors of a minor nature may still develop during the ongoing QA checks. Nonetheless, the staff believes it appropriate to order the correction of those uncovered thus far. While some of these errors discussed herein have either no significant effect or a conservative effect on the evaluation results, one or more of the errors included in the Peach Bottom Unit No. 2 ECCS evaluation leads to non-conservative values. Based on a preliminary assessment, including information and supportive calculations by General Electric, the NRC staff has determined that the

combined effect of the following code errors would, when corrected, result in an ECCS evaluation requiring no reduction in operating limits for Peach Bottom Unit No. 2.

(1) Pressure Rule

The LAMB code is used to calculate system pressure during the LOCA. This calculated pressure is then used as an input to the REFLOOD code which calculates the water level vs time relationship in the core. General Electric used an approximation of the pressure response of the LAMB code that was thought, at the time of approval, to be an acceptable representation of the physical phenomena involved. Later application of this approximation to certain cases showed it to be nonconservative. General Electric proposes to correct this nonconservatism by utilizing a conservative approximation to the pressure rule for input into REFLOOD. This correction increases reflood time by 0 to 50 seconds and decreases MAPLHGR by 0 to 5%.

(2) Bundle Vaporization

General Electric has used incorrect coefficients in the calculation of the amount of vaporization occurring during core spray. The vapor formation in the bundle is a prime determinant of the amount of spray water that can get through the upper tie plate and reflood the core. The vapor formation was under-calculated by approximately 4% resulting in a 20-second increase in reflooding time and about a 2% decrease in the MAPLHGR.

(3) Discharge Break Modeling

General Electric proposes to take credit for an approved model for suction line friction (from the vessel nozzle to the discharge side of the

recirculation pump) that improves reflooding time for the discharge break by approximately 15 seconds. This increases the MAPLHGR for discharge break limited plants by about 1.5%.

(4) Structural Absorption of Gamma Heat

General Electric has erroneously taken double credit for power generation in non-fuel structural material. Correction of this error results in approximately a 4% decrease in the MAPLHGR for certain plants. This error does not apply to Peach Bottom Unit No. 2.

(5) Increased Counter Current Flow Limiting (CCFL) Differential Pressure

Some experimental evidence exists that the differential pressure in a fuel assembly during periods of CCFL may be higher than previously assumed. This could cause a delay in reflood time. Correction of this error reduces the Peach Bottom Unit No. 2 MAPLHGR by 1%.

(6) Others

Several small changes of inputs to the evaluation codes were identified as being necessary to correct errors. They included:

- (a) The use of actual plant specific break areas for the LOCA;
- (b) A reduced core plate weight;
- (c) An increase in the peripheral bypass area used in the counter current flooding calculations;
- (d) The correction of a decimal point error in the assumed guide tube thickness; and
- (e) Credit is no longer assumed for recirculation loop discharge valve closure during blowdown.

Due to the errors in the ECCS analysis currently approved by NRC for Peach Bottom Unit No. 2, the staff requested the licensee to submit an estimate of the impact of these errors on the peak clad temperature that would result from the worst break, if the errors were corrected. The revised ECCS calculations indicated that the MAPLHGR should be reduced by approximately 6% to accommodate the cumulative effect of these errors. On the other hand, the NRC staff is currently reviewing General Electric's most recent ECCS model revisions some of which have effects offsetting such a reduction. These revisions included:

(1) CHASTE 04 Computer Code Change

The CHASTE code has been modified to incorporate an improved conduction solution for the calculation of fuel rod temperatures and more detailed evaluation of view factors for calculation of rod to rod radiation of heat.

(2) Reflood 05 Computer Code Revision

The REFLOOD code was modified to correct a logic error in the evaluation of the flow split between the core and the jet pumps. This logic error only occurred for certain plant calculations and determined the fraction of steam used to evaluate the counter current flow limiting phenomenon which limits the penetration of spray cooling water into the lower plenum and therefore increase the reflood time for the core.

(3) Partially Drilled Core Credit

The partial drilling correction gives credit for additional flow paths provided by drilling holes in the bottom nozzle of the fuel assemblies. This additional flow area enhances the refill of the lower plenum by spray cooling water following the postulated Loss-of-Coolant Accident and results in a faster core reflood which reduces peak clad temperatures.

Although the entire group of model changes is still under review, the staff has completed its review of the CHASTE and REFLOOD changes and has concluded that they may be used in GE's ECCS performance evaluation model. While revised computer runs incorporating these changes in the model as a whole have not yet been run for a spectrum of break for all plants, the parametric studies performed by GE to determine the effect of these changes demonstrate that they will in turn result in changes of at least a 6% MAPLHGR increase for 7 x 7 fuel assemblies up to 10,500 MWD/t, a 8% increase for 7 x 7 fuel assemblies at fuel burnups greater than 10,500 MWD/t, and a 6% MAPLHGR increase for 8 x 8 fuel assemblies at all burnups. These values may be used to offset the reductions discussed above, and the cumulative effect of the error corrections and model changes verifies that the Peach Bottom Unit No. 2 current MAPLHGR's are adequately conservative.

The staff expects that when final revised calculations for the facility are submitted using the revised and corrected model, they will demonstrate that operation with the linear heat generation rates currently authorized will conform to the Criteria of 10 CFR §50.46(b). Such revised calculations fully conforming to the requirements of 10 CFR § 50.46 are to be provided for the facility as soon as possible.

As discussed herein, the present MAPLHGR limits for this facility are such that they assure that the ECCS will conform to the performance requirements of 10 CFR § 50.46. Accordingly, such limits provide reasonable assurance that the public health and safety will not be endangered.

Upon notification by the NRC staff on February 14, 1977, the licensee committed to submit a re-evaluation of the ECCS performance of Peach Bottom Unit No. 2 on a timely basis. The staff believes that the licensee's action, under the circumstances, is appropriate and that this action should be confirmed by NRC Order.

The facility is scheduled to be reloaded in April and May 1977, which may precede the completion of the required calculations. In the absence of safety significance in the period until the computer computations are completed, there appears no public interest in restricting the operation of the captioned facility. Accordingly, the Commission has determined that an exemption in accordance with 10 CFR § 50.12 authorizing operation with such reload is appropriate. Such Exemption shall be limited to the period of time necessary to complete computer calculations.

Copies of the following documents are available for inspection at the Commission's Public Document Room at 1717 H Street, Washington, D. C. 20555 and are being placed in the Commission's local public document

room at the Martin Memorial Library, 159 E. Market Street, York,
Pennsylvania 17401:

- (1) Letters from General Electric to NRC dated February 14, 1977, and January 26, 1977;
- (2) Letters from Philadelphia Electric Company to George Lear, Chief, Operating Reactors Branch #3, dated January 28, 1977, February 18, 1977;
- (3) Letter dated July 9, 1975 from Philadelphia Electric Company to NRC and supplements thereto dated September 10, 1975, October 1, 24 and 30, 1975, and November 7, 18 and 20, 1975.
- (4) This Order and Exemption in the matter of Philadelphia Electric Company (Peach Bottom Atomic Power Station Unit No. 2).

Accordingly, pursuant to the Atomic Energy Act of 1954, as amended, and the Commission's Rules and Regulations in 10 CFR Parts 2 and 50, IT IS ORDERED THAT Facility Operating License No. DPR-44 is hereby amended by adding the following new provision:

- (1) As soon as possible, the licensee shall submit a re-evaluation of ECCS cooling performance calculated in accordance with General Electric Company's Evaluation Model approved by the NRC staff

and corrected for the errors described herein and any other corrections in the Model of which the licensee is aware at the time the calculations are performed.

FOR THE NUCLEAR REGULATORY COMMISSION


Ben C. Rusche, Director
Office of Nuclear Reactor Regulation

Dated in Bethesda, Maryland
this 11th day of March 1977