Station Support Department

NRC GL 96-06

PECO NUCLEAR
A Unit of PECO Energy

PECO Energy Company
965 Chesterbrook Boulevard
Wayne, PA 19087-5691

September 11, 1998

Docket Nos. 50-277
50-278

License Nos. DPR-44
DPR-56

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Peach Bottom Atomic Power Station, Units 2 and 3
Response to NRC Request For Additional Information (RAI)
Regarding Generic Letter 96-06.

Dear Sir/Madam:

By letter dated May 28, 1998 the NRC requested additional information related to PECO Energy Company's response to Generic Letter (GL) 96-06 "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," for Peach Bottom Atomic Power Station, Units 2 and 3.

Contained in Attachment 1 of this letter is PECO Energy Company's response to the Peach Bottom Atomic Power Station RAI. This information is being submitted under affirmation, and the required affidavit is enclosed.

If you have any questions regarding this submittal, please contact us.

Very truly yours,

Garrett D Edwards

G. D. Edwards
Director - Licensing

cc: H. J. Miller, Administrator, Region I, USNRC
A. C. McMurtray, USNRC Senior Resident Inspector, PBAPS

A072 1/1

COMMONWEALTH OF PENNSYLVANIA :

: ss

COUNTY OF CHESTER :

J. B. Cotton, being first duly sworn, deposes and says: that he is Vice President of PECO Energy Company, the Applicant herein; that he has read the enclosed response to NRC RAI regarding Generic Letter 96-06 "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," for Peach Bottom Atomic Power Station, Units 2 and 3, Facility Operating License Nos. DPR-44 and DPR-56, and knows the contents thereof; and that the statements and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

John B Cotton

Subscribed and sworn to

before me this 11th day

of Sept 1998.

Carol A. Walton

Notary Public

NOTARIAL SEAL
CAROL A. WALTON, Notary Public
City of Philadelphia, Phila. County
My Commission Expires May 28, 2001

ATTACHMENT 1

PEACH BOTTOM ATOMIC POWER STATION
UNITS 2 and 3
Docket Nos.
50-277
50-278
License Nos.
DPR-44
DPR-56

Response to RAI
"PECO Energy Response to the
NRC's Request for Additional Information
Dated 05/28/98 (PBAPS)
Regarding Generic Letter 96-06"

Response - 9 pages

The following is a complete response to your request for additional information (RAI) dated May 28, 1998 regarding our response to Generic Letter 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Basis Accident Conditions," dated February 10, 1997 for Peach Bottom Atomic Power Station, Units 2 and 3. The NRC staff's questions, taken from the PBAPS RAI, are reprinted below for convenience and to facilitate complete response for PBAPS.

The following contains a discussion regarding the PBAPS design as a source of background information (Section I.) and our response to the staff's questions (Section II.) Please refer to Figure 1 for a simplified diagram of the PBAPS drywell cooling system. For more details on system design, please refer to the referenced Updated Final Safety Analysis Report (UFSAR) figures.

I. SYSTEM INFORMATION

<u>BACKGROUND</u>

The Unit 2 and Unit 3 normal drywell cooling function is provided by the drywell chilled water system (DCWS). This system provides chilled water to the drywell coolers via two loops inside containment. Chilled water is supplied through a supply penetration and returned through a return penetration (one penetration pair per loop). There is one containment penetration isolation valve (PCIV) on each supply penetration and one PCIV on each return penetration. The isolation function for these PCIVs is a remote manual action. Current emergency procedures direct closure of the drywell cooling line PCIVs when drywell pressure exceeds cooling line header pressure.

The reactor building closed cooling water (RBCCW) system provides a backup means of containment cooling via two mechanically linked three-way valves (per loop of DCWS), one on the supply and the other on the return. In the event of a loss of electrical power to the DCWS, emergency power is provided to the three-way valves, which automatically align to the RBCCW system. Cooling water for the RBCCW system is provided by the non-safety related service water system.

The drywell cooling function of DCWS and RBCCW is non-safety related and not required for mitigation of any design basis accident. The safety related function of containment cooling is provided by the torus (i.e., suppression pool) cooling mode of the residual heat removal (RHR) system. The torus spray and drywell spray are also used for containment cooling. The DCWS and the RBCCW have a pressurized head tank and an elevated head tank respectively and both are non-safety related and non-seismic. The instrumentation and switches on the tanks are non-safety related.

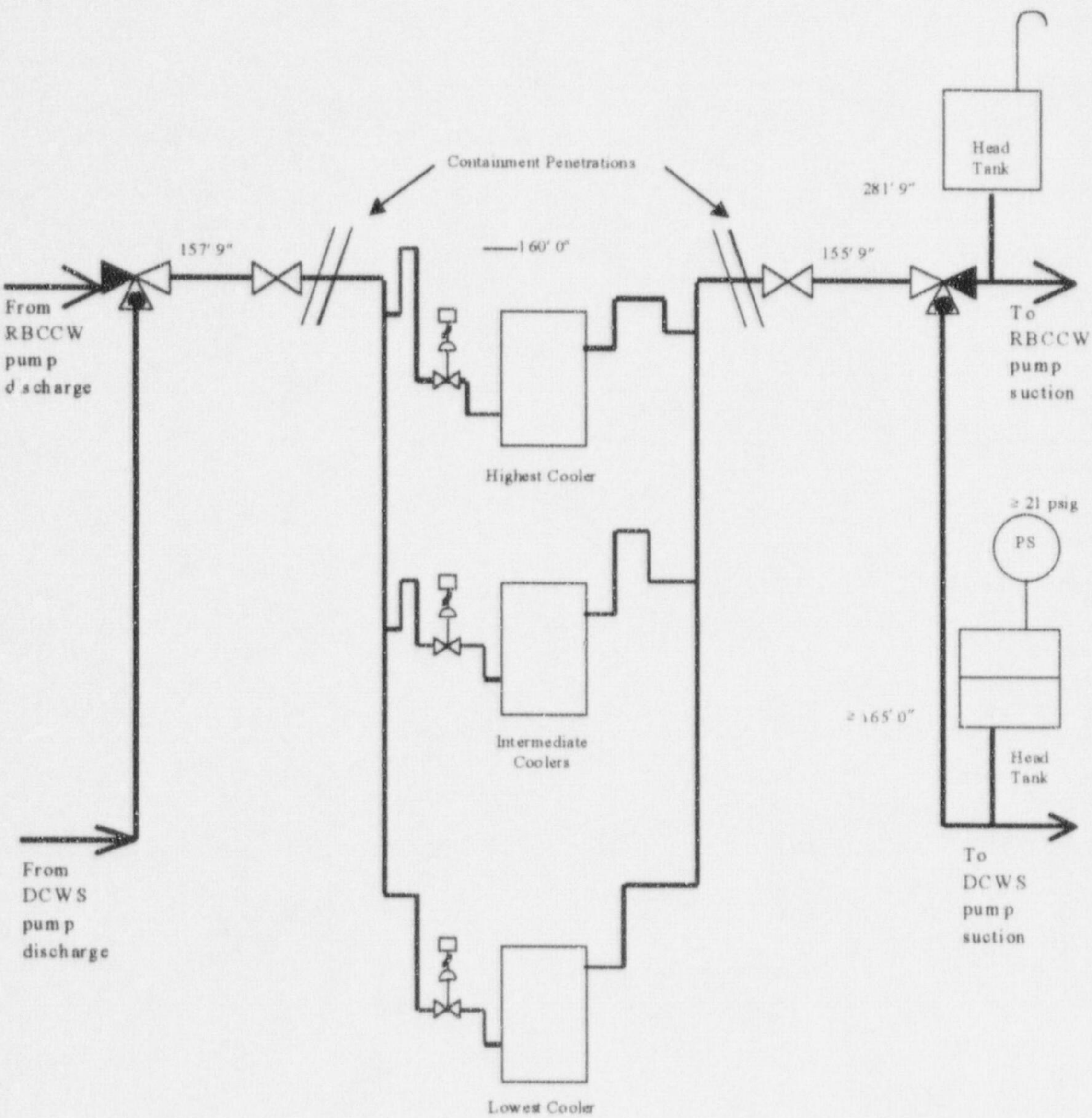

Figure 1 – PBAPS Drywell Cooling System (typical of 2 loops)

Ref: UFSAR Figures 10.8.1 & 10.11.1

II. RESPONSE TO NRC's REQUEST FOR ADDITIONAL INFORMATION

QUESTION:

1. *Discuss specific system parameter requirements that must be maintained to assure that waterhammer will not occur (e.g., RBCCW head tank and DCWS expansion tank level, temperature, pressure), and state the minimum margin to boiling that exists, including consideration of measurement and analytical uncertainties. Describe and justify reliance on any non-safety related instrumentation and controls for assuring that waterhammer will not occur, and explain why it would not be appropriate to establish Technical Specification requirements for maintaining these parameters.*

RESPONSE:

There are no system parameter requirements that must be maintained to assure waterhammer will not occur during the immediate (automatic) system response. The PBAPS design and operation is not susceptible to an immediate response waterhammer because for the worst-case design basis loss-of-coolant accident (LOCA) concurrent with a loss-of-offsite power (LOOP), flow is re-established within two (2) minutes following initiation of the event, and a conservative assessment for the temperature at the end of this time is about 124°F. The two (2) minute time is a conservative estimate based on electrical bus loading sequence and valve stroke times. This temperature is not great enough to develop steam at atmospheric pressure, and thus an immediate response waterhammer is not credible. The minimum margin to boiling is 212 – 124 = 88°F. No non-safety related instrumentation or controls are relied upon for this assessment.

In the case of the long-term system response (i.e., greater than 2 min.), the PBAPS design and operation is not susceptible to waterhammer. For any design basis LOCA (with or without off-site power available), Emergency Operating Procedures (EOP)-directed, manual attempts are made to re-establish unit cooler flow until the EOPs direct isolation of the drywell cooling water penetrations when drywell pressure exceeds cooling water return header pressure or until drywell sprays are initiated. Remote-manual isolation of the DCWS and RBCCW penetration isolation valves is described in the PBAPS Updated Final Safety Analysis Report (Table 7.3.1, note 16). The configuration is allowed per 10CFR50, Appendix A, GDC57, since they are neither part of the reactor coolant pressure boundary nor connected directly to containment atmosphere, and plant operating procedures ensure appropriate closure of these valves following the onset of an accident.

Based on DCWS and RBCCW system parameters, it was determined that DCWS pressure parameters are more limiting. Therefore, DCWS is used in the analysis. The DCWS return header pressure indicator used during procedures to compare the system pressure against the drywell pressure is located at an elevation at least ten (10) feet higher than the high point of the cooling water lines inside containment, therefore, the pressure inside the drywell cooling water lines in containment is greater than the monitored return header pressure by about 4 psi. Thus, prior to conditions conducive to steam formation in the drywell cooling water lines inside containment, direction is provided to isolate the drywell cooling water line penetrations in accordance with current EOPs. The EOPs direct the drywell to be sprayed prior to drywell pressure and temperature exceeding the drywell spray initiation limit (DWSIL). For a design basis LOCA, this will occur at a drywell temperature of no greater than 250° F. At a drywell temperature of 250 °F, the elevation head of ten feet gives a margin to boiling of about 7° F. Any non-condensable gases in the drywell at this time increases this margin.

The system (DCWS and RBCCW) instruments used for this assessment are non-safety related, however, they provide positive measures which are considered acceptable to support EOP-directed actions. Although these instruments perform support functions for equipment already contained in PBAPS Technical Specifications (i.e., containment), they do not meet the criteria for inclusion into Technical Specifications. Instruments monitoring diverse parameters (i.e., system temperature and level) also provide assurances that changes within the drywell cooling system are detected and appropriate actions are taken.

QUESTION:

2. *The GL 96-06 response indicated that for small break LOCAs, operators will re-establish drywell cooling using existing emergency procedures before containment temperatures reach a point where steam generation could occur. Describe in detail the actions required by the EOPs for this situation, operator response and the timing involved, and the minimum margin to boiling that will exist, including consideration of inherent uncertainties.*

RESPONSE:

EOPs direct containment cooling be maximized if drywell temperature cannot be maintained below 145°F, to establish torus sprays if containment temperature cannot be maintained below 200°F and establish drywell sprays if drywell temperature and pressure satisfy the containment spray initiation curve. Emergency depressurization of the reactor vessel is required if drywell temperatures cannot be maintained below 281°F. EOPs also direct isolation of the drywell cooling water penetrations if drywell pressure exceeds the drywell cooling water return header pressure. Direction to spray the drywell includes the shutdown of the drywell cooling fans (this results in closure of unit cooler inlet valves).

As discussed above, a waterhammer in the drywell cooling piping is not credible at PBAPS. For any design basis LOCA (with or without off-site power available), EOP-directed manual attempts are made to re-establish unit cooler flow until the EOPs direct isolation of the drywell cooling water penetrations or until the drywell sprays are initiated. For this event, the drywell atmosphere is saturated steam (conservatively assuming all non-condensable gases are purged to the torus airspace). Since the pressure indicator used to monitor the drywell cooling water return header is located at least ten (10) feet higher than the high point of the cooling water lines inside containment, and the current EOPs direct isolation of the DCWS penetrations if drywell pressure exceeds DCWS return header pressure, steam voids cannot form in the cooling water lines inside containment anytime while the penetration is open. Current EOPs direct the spraying of the drywell prior to the drywell temperature and pressure exceeding the drywell spray initiation limit (DWSIL). For a design basis LOCA, this will occur at a drywell temperature of no greater than 250°F. The minimum margin to boiling at 250°F is 7°F. If any non-condensable gases remain in the drywell the margin to boiling is larger. Finally, if drywell cooling is re-established during a design basis LOCA, it is most likely to occur at drywell temperatures much less than 250°F. This also increases the margin to boiling.

The timing involved and consideration of inherent uncertainties was not evaluated, and evaluation of these factors is not considered necessary to assure that waterhammer does not occur, because; re-establishment of unit cooler flow is most likely to occur well before containment temperatures of 250°F, operators are directed to isolate the system penetrations before steam can form in the system, and adequate margin to boiling exists.

QUESTION:

3. *In order to more fully address the two-phase flow concern, provide the following information:*

   a. *Provide a detailed description of the "worst case" scenario for two-phase flow, taking into consideration the complete range of event possibilities, system configurations, and parameters. For example, temperatures, pressures, flow rates, load combinations, and potential component failures should be considered. Additional examples include:*

      - *the consequences of steam formation, transport, and accumulation;*
      - *cavitation, resonance, and fatigue effects; and*
      - *erosion considerations.*

      Licensees may find NUREG/CR-6031, "Cavitation Guide for Control Valves," helpful in addressing some aspects of the two-phase flow analyses. (Note: it is important for licensees to realize that in addition to heat transfer considerations, two-phase flow also involves structural and system integrity concerns that must be addressed.)

RESPONSE:

The "worst case" scenario for two-phase flow is a large break LOCA concurrent with a LOOP. In this situation, the RBCCW system restarts with no operator intervention, aligns to the drywell cooling lines, cooling penetrations remain open, and system heat removal capability is not available (i.e., service water cooling).

The containment response to a design basis large break LOCA is discussed in the PBAPS UFSAR Section 14.6. The drywell temperature profile for this event, as described in the UFSAR, rises from an initial drywell temperature of 145°F to a peak drywell temperature of 294°F at 9 seconds, drops below 274° F at 20 seconds, below 267°F at 430 seconds, and to 214°F at 600 seconds.

The RBCCW system has an elevated head tank on the pump suction header (outside containment), connected directly to the return line from the containment. The bottom of this vented tank is at an elevation no lower than 281 feet 9 inches. Assuming a conservative water temperature of 135°F, this tank ensures a pressure at the high point of at least 51 psig. The saturation temperature at this pressure is 298°F. Therefore, steam formation in the drywell cooling lines will not occur.

Since the PBAPS review for two-phase flow is conservative, consideration for the consequences of steam formation, transport, accumulation, cavitation, resonance, fatigue effects, and erosion, is not relevant to PBAPS.

QUESTION:

3b. *Identify any computer codes that were used in the two-phase flow analysis and describe the methods used to benchmark the codes for the specific loading conditions involved (see Standard Review Plan Section 3.9.1).*

RESPONSE:

No computer codes were used in the two-phase flow analysis.

QUESTION:

3c. *Describe and justify all assumptions and input parameters (including those used in any computer codes), and explain why the values selected give conservative results. Also, provide justification for omitting any effects that may be relevant to the analysis (e.g., flow-induced vibration, erosion).*

RESPONSE:

It is conservatively assumed that the water level in the RBCCW head tank is at the bottom of the tank. An alarm in the control room alerts the operator on low head tank level. Existing procedures direct appropriate actions if head tank level cannot be maintained above the alarm setpoint.

It is also conservatively assumed that the water temperature in the RBCCW head tank connection line is 135°F. The 135°F temperature is greater than the maximum post-LOCA reactor building temperature where the RBCCW tank is located. This temperature is used to determine the minimum system head provided by the head tank during the event.

The two-phase flow analysis does rely on the premise that the system is operating normally prior to a LOCA. The worst case two-phase flow analysis described above does not rely on system components since there are no credible failures (i.e., drywell cooling system boundary breach) that will result in a two phase flow condition post LOCA. If the drywell cooling system boundary were to fail as a result of the LOCA the system penetrations are isolated.

QUESTION:

3d. *Determine the uncertainty in the two-phase flow analysis, explain how the uncertainty was determined, and how it was accounted for in the analysis to assure conservative results.*

RESPONSE:

An evaluation of uncertainty is not considered necessary, because the "worst case" analysis for two-phase flow is conservative, and the resulting margin to two-phase flow is sufficient.

QUESTION:

3e. *Confirm that the two-phase flow loading conditions do not exceed any design specifications or recommended service conditions for the piping system and components, including those stated by equipment vendors; and confirm that the system will continue to perform its design-basis functions as assumed in the safety analysis report for the facility, and that the containment isolations valves will remain operable.*

RESPONSE:

The PBAPS review demonstrates that adequate margin to saturation conditions exists such that two-phase flow in the drywell cooling lines cannot occur for any design basis LOCA. Therefore, containment integrity is not challenged by the operation of the RBCCW system during a design basis LOCA at PBAPS.

QUESTION:

4. *Confirm that the waterhammer and two-phase flow analyses included a complete failure modes and effects analysis (FMEA) for all components (including electrical and pneumatic failures) that could impact performance of the cooling water system and confirm that the FMEA is documented and available for review, or explain why a complete and fully documented FMEA was not performed.*

RESPONSE:

A FMEA was not performed for the evaluation of the PBAPS design for either the waterhammer or two-phase flow concerns. The immediate waterhammer analysis relies strictly on physical properties following a DBA. The long term waterhammer analysis relies on system parameters and the use of EOPs. The EOP actions rely on diverse system indications to assess/reassess system conditions.

The two-phase flow analysis does rely on the premise that the system is operating normally prior to a DBA LOCA. The worst case two-phase flow analysis described above does not rely on system components since there are no credible failures that will result in a two phase flow condition post DBA LOCA.

QUESTION:

5. *Explain and justify all uses of "engineering judgement."*

RESPONSE:

The PBAPS review for GL 96-06 waterhammer and two-phase flow makes no use of "engineering judgment."

QUESTION:

6. *Provide a simplified diagram of the affected systems, showing major components, active components, relative elevations, lengths of piping runs, and the location of any orifices and flow restrictions.*

RESPONSE:

See Figure 1 above for a simplified diagram of the affected systems at PBAPS. Lengths of pipe runs are not indicated, since the lengths of runs are not significant in cases where waterhammer and two-phase flow are not credible.

QUESTION:

7. *Describe in detail any modifications that have been made (or will be made) to system design or operating requirements to resolve the waterhammer and two-phase flow issues.*

RESPONSE:

No modifications have been made, nor are any planned to be made, to the system design or operating requirements to resolve the waterhammer and two-phase flow issues. Review of the PBAPS design and operating procedures has adequately shown that GL 96-06 waterhammer and two-phase flow is not a concern at PBAPS.

Although PECO Energy does not consider this a commitment in regard to GL 96-06, we have decided to enhance our EOPs to identify the concern for waterhammer in the drywell cooling water lines. This additional guidance is intended to sensitize our operators of this concern. These enhancements are to be incorporated with previously planned revisions being performed during the upcoming Unit 2 refueling outage scheduled for October, 1998.