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

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

Subject: Peach Bottom Atomic Power Station, Units 2 and 3
Limerick Generating Station, Units 1 and 2
Response to Request for Additional Information Concerning NRC Bulletin 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Strainer While Operating in the Suppression Pool Cooling Mode"

Gentlemen:

This letter is being submitted in response to an NRC Request for Additional Information (RAI) issued by letter May 9, 1996, concerning PECO Energy Company's response to NRC Bulletin (NRCB) 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Strainer While Operating in the Suppression Pool Cooling Mode," for Peach Bottom Atomic Station (PBAPS), Units 2 and 3, and Limerick Generating Station (LGS), Units 1 and 2.

NRCB 95-02 was issued on October 17, 1995, and requested that licensees evaluate the operability of their Emergency Core Cooling System (ECCS) pumps, and other pumps, that draw suction from the suppression pool. The NRC requested that this evaluation be based on suppression pool cleanliness, suction strainer cleanliness, and the effectiveness of the licensees foreign material exclusion (FME) practices. NRCB 95-02 also requested that licensees implement appropriate procedural modifications and other actions (e.g., suppression pool cleaning), as necessary, to minimize foreign material in the suppression pool, drywell, and containment. In addition, NRCB 95-02 required that affected licensees provide a written response within 30 days of the date of the Bulletin. PECO Energy responded to NRCB 95-02 for PBAPS, Units 2 and 3, and LGS, Units 1 and 2, by letter dated November 16, 1995.

However, as a result of the NRC's review of PECO Energy's response to NRCB 95-02 for PBAPS and LGS, several issues were identified in which additional information was necessary in order for the NRC to complete its review of our response to NRCB 95-02. Specifically, the NRC identified eight (8) questions pertaining to our response, and requested that we respond to these questions within 30 days.



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Accordingly, the attachment to this letter provides PECO Energy's response to the eight (8) questions identified by the NRC regarding our response to NRCB 95-02 for PBAPS, Units 2 and 3, and LGS, Units 1 and 2. Each question is restated in the attachment to this letter followed by our response.

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

Very truly yours,

G. A. Hunger, Jr.

G. A. Hunger, Jr.
Director - Licensing

cc: T. T. Martin, Administrator, Region I, USNRC (w/ attachment)
N. S. Perry, USNRC Senior Resident Inspector, LGS (w/ attachment)
W. L. Schmidt, USNRC Senior Resident Inspector, PBAPS (w/ attachment & enclosure)

# ATTACHMENT

**Response to Request for Additional Information**
**Concerning NRC Bulletin 95-02**
**for**
**Peach Bottom Atomic Power Station, Units 2 and 3**
**Limerick Generating Station, Units 1 and 2**

# RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION CONCERNING NRC BULLETIN 95-02 FOR PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 LIMERICK GENERATING STATION, UNITS 1 AND 2

## Question 1

It is not clear that sampling of suppression pool water or sludge will be 100% effective in determining the presence of all debris that could potentially clog a strainer. In particular, the staff is concerned that fibrous material could be localized and may not be detected in random samples taken in the pool. For instance, if a large clump of insulation or other fibrous material is on the pool floor, and the water samples are taken from elsewhere in the pool, its presence will not be detected. In addition, other non-fibrous materials (e.g., plastic bags), that could clog strainers would not be detectable with this sampling method. The ISTs may be of insufficient duration to create sufficient turbulence in the suppression pool to assure that all of the debris will be part of the sample. Debris which may go undetected during an IST could still be present in the suppression pool, and it could clog the strainer during more turbulent events. Note that Perry had a second strainer clogging event after having cleaned their pool. Justify why you do not consider necessary performing a test to demonstrate the operability of the pumps for Limerick Generating Station, Unit 2, and Peach Bottom Atomic Power Station, Units 2 and 3.

## Response

PECO Energy's program to demonstrate adequate pool cleanliness consists of several parts which are designed to function together. These parts are described below.

1) Sampling of water and sludge for the presence of fiber by itself is not intended to be a definitive test for the absence of fiber, but one indicator of the presence of foreign material. Also, sampling is considered an ongoing program, not a one-time indicator. Since the individual fibers in the quantities found at LGS were highly dispersed, random sampling conducted at any single given time may not detect the presence of fiber. Samples collected over a long period of time are likely to detect the presence of fibrous material. During outages, when diver activities are planned, water samples are taken at various locations and elevations. During operating cycles, samples are taken from the suppression chamber cleanup lines at Peach Bottom Atomic Power Station (PBAPS) and Limerick Generating Station (LGS) which sample from the bottom of the pools.

2) Inspection of pump strainers detects any foreign material which accumulated over the previous period of operation and provides further indication of the presence of foreign material in the suppression chamber.

3) Inspection of the suppression chamber floor detects the presence of heavier material which would tend to settle to the bottom of the pool. This inspection is also intended to detect excessive accumulations of corrosion products (i.e., sludge).

   Any inspections that are performed can be conducted using either camera or divers, depending on water quality and sludge accumulation.

4) Trending of pump suction strainer dp data from Inservice Inspection Testing (IST) is intended to detect any accumulation of foreign material on pump suction strainers over a period of operation, not just the period of the test. Our observations of the suppression chambers at PBAPS and LGS with an Residual Heat Removal (RHR) system pump aligned to the suppression chamber indicates that sufficient turbulence is created with only a single pump in operation to suspend fiber in the pool water volume. Since the pumps operate for suppression chamber cooling as well as IST testing, it is likely that debris will accumulate on the strainers and be detected over time. Our review of pump suction pressure data from the LGS, Unit 1, "B" RHR pump following the suction strainer fouling event, which showed appreciable accumulations of fiber but no effect on pump performance, verified that noticeable dp losses could be detected prior to the fiber accumulation affecting pump performance. This is also supported by data from suction strainer testing conducted by the Boiling Water Reactor Owners' Group (BWROG). This data showed varying head losses from varying accumulations of fiber and sludge. Since the accumulation of fiber on the suction strainers at LGS was determined to result from chronic exposure to foreign material, trending of dp data will detect fiber accumulation prior to pump operability being affected.

PECO Energy considers that the combination of all of the above listed elements represents an effective program to demonstrate both short and long term operability of the Emergency Core Cooling System (ECCS) and other pumps taking suction from the suppression chambers at PBAPS and LGS. We also consider that the second strainer plugging event that occurred at Perry does not call into question the effectiveness of pool cleaning and inspection into question, but highlights the need to perform complete cleanings and inspections. Our review of the Perry event and interviews with Centerior Energy personnel indicates that the source of debris which clogged the strainer the second time came from the annulus between the drywell and weir wall. This area had not been cleaned or adequately inspected. If the area had been adequately cleaned, the debris would have been removed. In contrast, the suppression chambers at both PBAPS and LGS have been thoroughly cleaned and/or inspected within the last refueling cycle for each unit and determined to be clean. Therefore, a source of foreign material as found at Perry is not present in the suppression chambers at PBAPS and LGS.

Therefore, we consider that taken together, the above listed program elements provide equivalent or better assurance of ECCS pump operability than a single multiple pump test.

**Question 2**

The staff believes that a single pump IST is also not representative of potential operating conditions during a transient for the Limerick Generating Station. A multiple pump test would be appropriate, as demonstrated during the September 1995 event at Limerick Unit 1, when the stuck open safety relief valve led to the operation of two pumps in the suppression pool cooling mode for an extended period of time. The "A" pump that clogged 20 minutes into the event, had been running for an hour. The second pump and the safety relief valve discharge were also considered contributors to the strainer clogging. State and discuss the potential for this situation at the Peach Bottom units.

**Response**

Based on PECO Energy's investigation of the safety relief valve (SRV) discharge event at LGS and subsequent report, we have characterized the fouling of the Unit 1 "A" RHR pump suction strainer as chronic exposure to fibrous material present in the suppression pool since initial operation, not as a result of the SRV discharge and subsequent operation of two (2) RHR pumps. The LGS, Unit 1, suppression pool had never been cleaned.

The SRV discharge and operation of two (2) RHR pumps contributed to the pump cavitation by elevating the suppression pool temperature and depositing additional corrosion products on the already fouled strainer. If the plugging resulted from fibrous material transported by turbulence from the SRV discharge and subsequent pump operation, it is highly likely that the "B" RHR pump suction strainer would have clogged also, since this pump operated longer following the event than the "A" RHR pump. While the "B" RHR pump strainer showed some accumulation of fibrous material, the amount was significantly less than that on the "A" RHR pump suction strainer. Since the "B" RHR pump was operated significantly less than the "A" RHR pump prior to the SRV discharge, this data tends to support that the degradation was the result of chronic exposure to foreign material.

While the level of pool turbulence with a single pump in operation may not be as severe as with two (2) pumps operating and an SRV discharging, we consider the turbulence to be sufficient to entrain foreign material that may have settled on the torus floors at PBAPS. Also, since the results of our diver inspections showed no significant foreign material or sludge accumulation, no potential for plugging similar to that which occurred at LGS exists, regardless of the number of pumps operating. Thus, we believe a single pump IST is a satisfactory test for the reasons cited in Item 4 of our above response to Question 1.

**Question 3**

Discuss your operational data of the RHR system (cooling mode) for the torus/suppression pool at both sites over the last operating cycle. Has a unit at either station operated two trains of the torus/suppression pool cooling at the same time for any period of time during the last operating cycle? If so, identify the events and the duration.

**Response**

PBAPS

Operational data for the RHR containment cooling mode for the last operating cycle shows no signs of accumulated debris on the suction strainers. The differential pressure between static and dynamic suction pressure for each RHR pump on both units at PBAPS has been constant.

Normal testing and operation of the RHR system does not include running both RHR subsystems simultaneously in the Containment Cooling mode. However, PBAPS High Pressure Coolant Injection (HPCI) system testing procedures allow the operation of two (2) loops of RHR Containment Cooling if desired to ensure that containment water temperature remains below allowable limits. Two (2) loops of Unit 3 RHR Containment Cooling were placed in operation on May 30, 1996, for approximately four (4) hours to support planned HPCI system testing. There were no anomalies identified with any RHR system parameters.

LGS

Operational data from LGS operating two (2) loops of RHR in suppression pool cooling simultaneously indicates that Unit 1 was in this configuration approximately 25 hours during HPCI testing. This includes approximately seven (7) hours where one (1) loop of RHR was in suppression pool cooling with the other loop in an IST test mode. Unit 2 had a total of approximately two (2) hours of simultaneous operation, during HPCI testing. No RHR system operational anomalies were noted. During the SRV event, identified in NRC Bulletin 95-02, both loops of RHR were operating in suppression pool cooling for a total of approximately 11 hours.

**Question 4**

We acknowledge that you performed an operability test in response to the event in September, 1995, at Limerick Unit 1. However, this unit has undergone another refueling outage. Discuss the types of activities that have taken place in the suppression pool chamber during the most recent outages. Specifically, address how your foreign material exclusion (FME) practices have ensured that there has been no further introduction of debris into the pool during these outages.

**Response**

The following activities were performed in the LGS, Unit 1, suppression pool during the Sixth Refueling Outage (1R06) conducted in February, 1996.

1) Liner inspection (vapor phase and immersion phase)

2) Strainer inspections (all strainers)

3) Inspection of all downcomers (inside and outside)

4) Desludging was performed on all surfaces below the waterline (vertical and horizontal), SRV piping and tee-quencher, pool floor, wall liner, downcomers, and all pump suction strainers. Vertical surfaces were vacuumed at least once and the pool floor at least 2 times during the cleaning period. Divers initially concentrated efforts on cleaning the pool floor to remove most of the accumulated sludge and to minimize its resuspension caused by the divers' activities. Vertical surfaces were then vacuumed, and material not picked up by this effort either settled to the pool floor or was filtered by the filter rack assemblies.

5) Suppression pool water was continually filtered by the installation of temporary filter rack assemblies, which were suspended into the water approximately 4-5 feet below the waterline. The inside of the reactor pedestal was filtered for 2-days by inserting a vacuum hose into it. Divers did not enter the pedestal because of the complications it presented (i.e., unable to safely monitor the diver or respond to a diver emergency as well as not being able to adequately survey the area prior to entry). The possibility of migration of foreign material from inside the pedestal to the suppression pool is remote due to the small size of the access port and elevation above the suppression pool floor. Water visibility at the start of the cleaning was a few inches. Visibility at the end of the cleaning was approximately 20-25 feet (as reported by the divers). All strainers were clearly visible from the catwalk and the pool floor could almost be seen in well lighted areas at the end of the cleaning.

6) Light vacuuming was performed on accessible areas on and around the catwalk. This included all vacuum breaker platforms. The area inside the pedestal was not vacuumed because of the high dose rates.

7) All vacuum breakers had preventive maintenance performed on them which included removal of the outer breakers. Prior to the start of this work, tarps were placed to contain tools and to catch any materials which could fall.

8) Divers made many passes along the pool floor during the course of the cleaning and various inspections. Debriefs occurred following each dive to determine the status of the cleaning and other activities. Any materials which were found on the pool floor were promptly picked up, bagged, and stored at one (1) location on the pool floor in preparation for removal. Divers reported that the quantity and type of material was small, heavier than water and minimal. The divers made a final dive and swim-through of the pool after cleaning and disassembly of the filter racks. This dive was completed just prior to suppression pool closeout and concentrated on looking for dropped items in the pool. It also occurred after the spent filters were removed.

Foreign Material Exclusion (FME) Practices and Controls

FME practices have been proceduralized in a common plant procedure for PBAPS and LGS. This procedure (i.e., A-C-131-8) provides specific housekeeping requirements for the torus at PBAPS and the suppression pool at LGS. The objective of this procedure is to maintain cleanliness controls within the suppression chambers at PBAPS and LGS. FME controls for the drywells at PBAPS and LGS are also controlled by a common plant procedure (i.e., A-C-30). Personnel working in the drywell see signs that identify the downcomers as areas that communicate with the suppression chambers. These signs also indicate that items are prohibited from being placed into the downcomers. The only exception to this practice would be during the performance of different local leak rate tests (LLRTs) taking place inside the drywell. An LLRT hose can be temporarily placed in the downcomer tube to provide a vent path for the system being tested. The work group performing the LLRT removes the hose after testing is complete. For the work in the suppression chambers at PBAPS and LGS, an individual must read and provide a signature that attests the reading of the applicable procedure prior to entry into the suppression chamber for the first time. The procedure requires that all unnecessary items be left outside the control point. A storage location is provided to make it easy for people to leave unnecessary items at a designated area. Items that are required to be taken in to the suppression chamber are either attached by lanyard or secured in some way (i.e., placed in the pocket which is subsequently taped over). A visual inspection is performed by the control point personnel to ensure there are no loose items. The control point personnel will challenge individuals if they feel unnecessary items are being taken into the pool areas. The pool entrance is posted as an FME area. Dust producing evolutions (e.g., cutting, grinding, welding, etc.) shall be performed in an enclosed shelter or a post cleanup plan must be developed. Wood materials will only be cut outside the pool areas. Tarps shall be placed on grating in the vicinity of the work taking place to catch any fallen objects or debris. Clear plastic materials, tape, rags, rope or other materials, that could potentially clog a strainer, are not authorized unless specific approval is obtained from the Maintenance Manager. Periodic inspections are made by management and work group supervision to verify job site cleanliness is being maintained. Items of concern are immediately addressed and resolved. Should an item be dropped into the water during work, an entry is made in a log. This log is maintained at the control point. During the LGS, Unit 1, refueling outage 1R06, nine (9) entries were made in the log, and all items were recovered by the divers. In summary, positive controls do exist for maintaining suppression chamber cleanliness at PBAPS and LGS. Procedural controls assist people in performing their tasks, and periodic checks during the work process ensure the standards are being maintained.

**Question 5**

Discuss for both sites, how you will monitor suction differential pressure (dp) on the strainers. State if you provide a dp gage on each suction strainer, and discuss the relationship between the differential pressure and the buildup of debris on the surface of the strainers. For instance, if a strainer is designed to withstand 50% fouling, does this mean that the strainer could accumulate a substantial amount of debris before an indication would be seen on the gage?

**Response**

At both PBAPS and LGS, strainer differential pressure will be measured by comparison of static and dynamic pressures measured by a gauge installed in the pump suction lines for the RHR and Core Spray (CS) systems. The acceptance criteria takes into account calculated piping friction losses and velocity head. In order to establish meaningful trend data, data is initially taken from a clean strainer and trended for changes over time. A review of the dp data from the "B" RHR pump suction strainer following the event at LGS has demonstrated that dp changes can be detected even when the whole strainer is not significantly blocked, and well before the accumulation of debris would affect pump operability.

**Question 6**

We have noted differences between your approaches for the Peach Bottom and the Limerick sites. For instance, at Limerick you will monitor and trend a strainer's dp. Also, your response indicates that you will modify the procedures to measure a strainer's dp at Peach Bottom. However, the response only acknowledges trending this data for the Limerick site. In addition, you state that you will perform pool/strainer inspections during each Limerick unit next refueling outage, while you state that you will assess the need to inspect based on tests and sampling for the Peach Bottom units. The staff supports activities such as inspections and pump parameter trending as measures which may help to identify potential strainer clogging situations. Discuss the basis for the difference in responses for the two sites. If you do not plan to have different approaches for the two sites, please provide clarification.

**Response**

PBAPS has already revised plant procedures to monitor and trend the pump suction strainer differential pressures for the affected associated systems similar to LGS.

The only difference between the two (2) sites, is that PBAPS does not plan to perform inspections of the torus or suction strainers during the next refueling outages. The basis for this is the excellent cleanliness conditions discovered during the previous inspections of the suppression chambers at PBAPS, Units 2 and 3. The Unit 2 inspection results revealed that, after period of approximately three (3) years since the last cleaning, the amount of debris retrieved consisted of only two (2) handfuls of material. During the Unit 3 inspections, which were conducted after a period of approximately four (4) years, three (3) fibrous strands and one (1) small piece of tape was retrieved. Additionally, the PBAPS plants are Mark I designs and provide an inherent "debris trap" by virtue of the ring header which collects any items from the drywell. The ring header is inspected at the beginning and end of each outage. Based on the cleanliness results, the PBAPS FME Program, and housekeeping controls, additional inspections are not warranted at this time.

**Question 7**

Your water sampling program seems to be focused on "neutrally buoyant fibrous type material." Discuss denser fibers or other materials (e.g., shrinkwrap) that may clog strainers that may not be suspended in the water until turbulence is created by a transient or pump operation. Specifically, how do you account for the possible presence of these materials at all units at both sites. Also, provide a description of how the station will take samples of the torus/suppression pool water. Specifically, how will the samples be taken, how many samples will be taken and from what locations in the torus/suppression pool, what is the frequency of sampling, and if the sampling procedure will make any attempt to mix up the pool water prior to taking the sample.

**Response**

Water sampling was partially discussed in our response to Question 1 above. Water sampling during outages is performed at various locations and elevations when divers are available. During operating cycles, samples are taken from the suppression chamber cleanup lines at PBAPS and LGS which sample from the bottom of the pools. This is one part of our monitoring program and is supplemented by properly timed diver inspections. While denser material and insulation clumps may not be detected during water sampling, they would be detected during the diver inspections. The efficacy of the diver inspections were demonstrated during the last inspection at PBAPS when a single isolated piece of duct tape approximately 3/4" by 3/4" was found on the torus floor, as well as three (3) single strands of fibrous material. If sludge material is identified, samples of sludge will also be taken. Since both water and sludge are sampled in addition to periodic diver inspections, mixing of the pool volume is not required to detect foreign material.

**Question 8**

You have made statements regarding the "excellent cleanliness results" for the Peach Bottom's torus. What criteria were used by Peach Bottom, Unit 3 to determine the adequacy of the cleanliness of the torus and what is the basis for the criteria? Will these criteria be used as the success criteria for the station's torus cleaning program? The staff recognizes that the licensee will not finalize a suppression pool cleaning schedule until it completes its analysis of the Loss of Coolant Accident (LOCA) generated debris issue. Also, state if the same criteria is being used for the evaluation of Limerick's suppression pools. In addition, discuss the visibility in each torus/suppression pool for both sites, and the potential for divers to have missed debris (both small and large) in the pools.

**Response**

No specific criteria was used to judge the level of cleanliness of the PBAPS suppression chambers. PECO Energy's judgement that the level of torus cleanliness is acceptable is based on the results of previous diver inspections which indicated that the silt accumulation in the torus was not sufficient to be measured. We estimate a total accumulation of silt of approximately 1/64" or less. Additionally, the total foreign material accumulation detected consisted of approximately 3 single isolated fibers of less than 1 inch in length and one (1) piece of duct tape approximately 3/4" by 3/4". The criteria used to judge the acceptability of the cleaning of the LGS suppression pool, was no measurable remaining silt accumulations and no detectable foreign material present. Visibility at both PBAPS and LGS was sufficient to assure that these criteria were met. Visibility at PBAPS was 10 to 12 feet, and visibility at LGS at the end of the latest work was 20 to 25 feet. Given the ability of the divers to detect even minute pieces of debris, we feel confident that the cleanings were complete.

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