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August 6, 1992

Docket Nos. 50-277
50-278

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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 Station Blackout Response to NRC Questions Concerning the Use of the Conowingo Hydroelectric Power Station as the Alternate AC Power Source

REFERENCES:

(1) Letter from D. R. Helwig (PECo) to NRC dated April 24, 1991

(2) Letter from J. W. Shea (NRC) to G. J. Beck (PECo) dated January 28, 1992

(3) Letter from G. J. Beck (PECo) to NRC dated April 1, 1992

(4) Letter from C. L. Miller (NRC) to D. M. Smith (PECo) dated June 23, 1992

(5) Letter from G. J. Beck (PECo) to NRC dated July 17, 1992

Dear Sir:

In Reference (1), Philadelphia Electric Company (PECo) submitted a revised complete Station Blackout (SBO) analysis for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. In Reference (2), the NRC requested additional information regarding this analysis. PECo response to this request was provided in Reference (3).

On May 15, 1992, we met with NRC representatives and presented, among other issues, a proposal to install a dedicated line from the Conowingo Hydroelectric Power Station to the PBAPS onsite distribution system. Following this meeting, additional telephone discussions between PECo and the NRC were held to discuss the possibility of crediting the Conowingo Hydroelectric Power Station as the Alternate AC (AAC) power source to meet the requirements of the SBO rule. As a result of these

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discussions, we agreed to identifying the Conowingo Hydroelectric Power Station as the AAC power source. Accordingly, in Reference (4), the NRC transmitted 13 questions regarding the Conowingo Hydroelectric Power Station line and its use as the AAC power source. The NRC requested that responses be provided by July 24, 1992. In Reference (5), we requested that the response date be extended to August 7, 1992, due to personnel resource constraints. The purpose of this letter is to provide responses to the NRC questions. In the Enclosure to this letter, each NRC question is restated followed by our response.

If you require additional information, please do not hesitate to contact us.

Sincerely,

cc: T. T. Martin, Administrator, Region I, USNRC
J. J. Lyash, USNRC Senior Resident Inspector, PBAPS

Peach Bottom Atomic Power Station, Units 2 and 3
Response to Questions Regarding Use of
Conowingo Line in Station Blackout Analysis

1. Provide a complete description of the proposed circuit from the Conowingo Station to the Peach Bottom safety busses. One-line diagrams showing the hydro units, buses, transformers, breakers, protected transmission line, associated voltage levels and capacities, and extent of protection against weather related events would be acceptable.

Response:

The proposed line from Conowingo Hydroelectric Power Station (Conowingo) to Peach Bottom Atomic Power Station (PBAPS) is designed to support the necessary loads (i.e., safe shutdown of both units from full power operation) during a Station Blackout (SBO). A SBO is defined as loss of the preferred offsite power supplies and loss of the four station emergency diesel generators (EDGs). The proposed line will function as the alternate AC (AAC) power supply as defined in Regulatory Guide (RG) 1.155, "Station Blackout" and NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors." The line is designed to support a continuous load of 15MVA. The line is located to take advantage of the highly reliable and available Conowingo generating units. Attachment 1 provides a simplified single line of the proposed design.

There are 11 generating units at Conowingo. Seven units (Units 1 through 7) are rated at 36MW. The remaining four units (Units 8 through 11) are rated at 65MW. Units 3, 4, 5, 6, 10 and 11 provide power directly to the 33kV transmission system via either the Susquehanna Substation No. 10 or No. 12 transformers, each of which is rated at 25MVA. Units 1, 2, 7, 8 and 9 can also provide power to the 33kV system via the 220kV switchyard. A minimum Conowingo startup configuration (i.e., assuming loss of offsite power) will consist of one 36MW unit and one 65MW unit. This is different from the configuration presented at the May 15, 1992 meeting between representatives of Philadelphia Electric Company (PECo) and the NRC. At that meeting, we stated that any one of the 11 Conowingo units was sufficient to provide the needed AC power to PBAPS, Units 2 and 3. Further analysis determined that a combination of one small unit and one large unit was needed to provide transient stability during the start of the Residual Heat Removal (RHR) and High Pressure Service Water (HPSW) pump motors.

The proposed 33kV line will initiate at the 33kV Susquehanna Substation located at Conowingo, and will terminate at a 33/13kV-15MVA transformer to be located at PBAPS. The transformer load side (13kV) will be connected to the PBAPS No. 2 13kV startup bus which provides power to the 4kV emergency buses via the 2EA transformer (13/4kV).

The line will include 33kV circuit breakers at both the 33kV Susquehanna Substation and the 33/13kV transformer at PBAPS.

The proposed line will provide a feed to PBAPS Unit 1 and will carry a normal load of approximately 1MVA. A partially loaded line will provide greater reliability than an energized line with no load. PBAPS Unit 1 will be the only normal load on this line. No other distribution customers will be fed from this line. Provisions will be made to disconnect PBAPS Unit 1, as necessary, to provide PBAPS Units 2 and 3 the full 15MVA.

The proposed line will be designed to withstand severe weather conditions and will be routed either underground or under the Conowingo Dam reservoir.

2. **Confirm that the 33kV line from Conowingo and the associated 33kV/13kV transformer and 13kV bus at Peach Bottom would be continuously energized, and that any unavailability or fault on this circuit would be immediately alarmed in the Peach Bottom control room.**

Response:

The proposed line will be normally energized and provide power to PBAPS Unit 1 for building light and power. The line may be taken out of service for periodic testing and/or maintenance.

Any planned or unplanned de-energization of this line will result in an undervoltage/loss of power annunciation in the PBAPS Units 2 and 3 Control Room. Priority would be given to placing the line back in service expeditiously in order to maintain a high availability.

We propose that a loss of this line for greater than 15 days will result in notification to the NRC providing restoration plans and compensatory actions or precautions to be taken. This notification requirement will be formalized in a Technical Specifications Change Request that we will submit to the NRC.

3. **Describe the procedures for assuring restoration of power to Peach Bottom from the Conowingo station given (1) a general system failure including trip of the Conowingo units, and (2) a system failure which did not trip the Conowingo units. In each case, provide the time required for restoration.**

Response:

We plan for and would perform a system restoration following a system blackout in accordance with the PECo System Operations Division procedure titled "System Restoration Following Complete Shutdown."

At the onset of a system disturbance, all generating stations are to take appropriate action to prevent the loss of operating units.

Conowingo normally has five of its units (Units 3, 4, 7, 9, and 10) running as electrical condensers and are available for generation as spinning reserves. In this case, the time required for Conowingo to provide power to the 33kV system would be about 5 minutes. The existing governing procedure for restoration of power will be revised to also energize the proposed Conowingo 33kV line to PBAPS, Units 2 and 3.

If Conowingo has no units in service, the initial actions required by the Conowingo operators as part of the System Restoration Procedure would be to start several of the Conowingo units. Station power to facilitate starting these units is available from one of two "house" generators, one of which is normally running. Each house unit is rated at 1600kVA. These actions would take an additional 10 minutes so that Conowingo would provide power to the proposed Conowingo 33kV line within 15 minutes.

Once the line is energized, PBAPS personnel would close both a 33kV circuit breaker on the high side of the proposed 33/13kV transformer and a 13kV circuit breaker installed on the No. 2 13kV startup bus to energize the 2EA 13/4kV transformer, thus providing power to the safeguards 4kV buses. The actions required by Peach Bottom personnel will be incorporated into PBAPS procedure SE-11, "Station Blackout." These additional actions will take approximately 15 minutes to perform. Thus, the time required to energize the safeguards buses at PBAPS from Conowingo following a system blackout would be between 20 minutes to 30 minutes depending on the initial condition of the Conowingo units.

4. **Provide the expected overall availability (considering both reliability and availability aspects) of the power supply from the Conowingo hydro site at the Peach Bottom 13kV bus. Provide an estimated breakdown for the separate components (e.g., hydro power, transformers, 33kV cable) including the bases for these estimates to the extent that such information is available.**

Response:

The overall availability of the proposed line from Conowingo to PBAPS is expected to be in excess of the 95% target EDG availability goal. Attachment 2 provides the total line availability for the three cable routing options being evaluated. The availability analysis was based upon methodology presented in IEEE Standard 493, "Design of Reliable Industrial and Commercial Power Systems." As shown in Attachment 2, the contribution to total line unavailability due to Conowingo generation is approximately 1 hr/yr. This assumes the revised configuration of any one of the seven small units and any one of the four large units. Because of this small contribution due to generation, it is concluded that any decrease in generation availability resulting from the combination configuration is negligible.

5. Describe how Peach Bottom's priority for Conowingo's power will be implemented. For example, if the spinning reserve at the Conowingo hydro site were not sufficient to supply the SBO load on demand, what would the sequence of events be (communications required, shedding of 33kV load, adding hydro generation, etc.)?

Response:

Restoration of power to the 33kV system, which will include the Conowingo line, is one of the very first actions taken by Conowingo operators as part of the system restoration. The Conowingo line will be the initial line energized on the 33kV system. Any activities needed to support the Conowingo line such as load additions or shedding from the 33kV system will be coordinated and directed by the Power System Director as defined in the System Restoration Procedure. The Power System Director is the single point of contact for communications and direction following a system blackout. Communication between the Power System Director and PBAPS will occur via a dedicated load dispatching telephone system. Availability of this telephone system is already verified daily by PBAPS operators. The Power System Director will have responsibility and authority to ensure that need for power to PBAPS is met as the top priority.

6. In event of an SBO at Peach Bottom, provide your best and worst case estimates of the time required to energize the safety buses at Peach Bottom from the Conowingo power source. Also, state which of these estimated times is used in arriving at your answer to question 7.

Response:

The response to Question 3 provides the estimated time for emergency power restoration following a SBO at PBAPS. The analysis referred to in Question 7 is based upon 1 hour to energize the PBAPS Units 2 and 3 sageguards buses.

7. Your April 24, 1991, revised response to the SBO Rule provided a coping assessment for an 8-hour SBO assuming one of the existing EDGs would be available as an AAC source within 1 hour. Consider each section (i.e., condensate inventory, Class 1E battery capacity, compressed air, effects of loss of ventilation, containment isolation, reactor inventory, etc.) and state if any changes would be applicable to these sections if the Conowingo power source were the AAC power source rather than the EDG.

Response:

Since the time required to energize the safeguards buses at PBAPS, Units 2 and 3 via the proposed Conowingo line is less than 1 hour, the referenced coping assessment can be considered bounding. If the Conowingo line is substituted as the AAC power source in the referenced coping assessment, the following conclusions can be made.

The operator actions to control EDG loads, previously required to maintain the AAC EDG loading below 3000kW, will not be required. In addition, the containment analysis performed to demonstrate the ability of each unit to cope with the SBO event for the 8-hour period without containment cooling, bounds the expected results for a SBO with Conowingo as the AAC power source during the second through the eighth hour of the SBO since power for a RHR pump and HPSW pump for containment cooling will become available during this period. Each specific section of the referenced coping assessment is addressed below.

1. Condensate Inventory for Decay Heat Removal

   Our April 24, 1991 submittal stated that a minimum of approximately 100,000 gallons of the 166,713 gallons of makeup water required for each PBAPS unit would be available from the Condensate Storage Tank (CST). With an EDG as the AAC source, no containment cooling was postulated for either unit during the SBO duration. The High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) pump suctions were therefore transferred back to the CST upon reaching a suppression pool temperature of 180°F due to net positive suction head concerns. However, with Conowingo as the AAC source, sufficient power would be available to align a RHR and HPSW pump for containment cooling for each unit after the first hour. If necessary, in fact, sufficient power would be available to align two containment cooling loops per unit. Therefore, based on the heat generated at 1 hour into the SBO event relative to the existing heat removal capability with Conowingo as the AAC source, it is our engineering judgement that the suppression pool inventory will not increase in temperature to greater than 180°F during the SBO event, and transferring HPCI and RCIC pump suction back to the CST will not be required to supply reactor makeup water for safe shutdown. For this reason, with Conowingo as the AAC source, the CST inventory will not need to be credited as a makeup water source.

2. Class 1E Battery Capacity

   This section is unchanged. The batteries will still be capable of providing the required power during the first hour without recharging, and will be charged with power from the Conowingo AAC power source after the end of the first hour.

3. Compressed Air

   This section is unaffected by the Conowingo AAC power source.

4. <u>Effects of Loss of Ventilation</u>

The results of the analyses in this section are either unchanged with Conowingo as the proposed AAC source, or bounded by the results obtained when the previously proposed EDG was the AAC source. The analyzed temperatures in the HPCI and RCIC Room, Control Room, Cable Spreading Room, and other plant areas are unchanged by the difference between the previously and currently proposed AAC source. The containment analysis in our April 24, 1991 submittal will bound the conditions that will exist with the Conowingo AAC source since with an EDG as the AAC Source, no containment cooling was postulated for the entire 8-hour SBO event. With Conowingo as the AAC source, its greater capacity will allow establishing a RHR and HPSW pump for containment cooling on each unit during the second through eighth hour of the SBO duration. The conditions analyzed with no containment cooling will therefore bound the conditions which will exist when containment cooling is available.

Due to the available capacity of Conowingo as the AAC source, we may consider an analysis to demonstrate the effects of energizing a non-safeguard bus after the first hour of the SBO event to recover normal Control Room ventilation. Priority would be given to recovering this ventilation over opening cabinet doors or removing ceiling tiles to enhance control room cooling. Recovering normal control room ventilation would obviate the need for these operator actions.

5. <u>Containment Isolation</u>

The list of primary containment valves that do not qualify for exclusion as defined by NUMARC 87-00, Section 7.2.5 is not affected by the proposed Conowingo AAC power source.

6. <u>Reactor Coolant Inventory</u>

This section is unchanged. The source of the AAC power after the first hour of the SBO event does not affect the ability to maintain adequate reactor coolant system inventory.

7. <u>Equipment Quality Assurance</u>

In our April 24, 1991 submittal, we listed the CST and its associated level instrumentation as some of the few components credited in our SBO analysis, but not covered by our Quality Assurance Program as required by Appendix B of 10CFR50. Accordingly, we committed to maintain that equipment in accordance with Appendix A of RG 1.155. As stated previously, the CST is no longer credited in our SBO analysis and, therefore, will not be maintained in accordance with Appendix A of RG 1.155.

In our April 24, 1991 submittal we also stated that the 00A19 non-segregated phase 4kV bus would be maintained in accordance with Appendix A of RG 1.155 and that no part of the 13kV system was needed for response to a SBO event. The No. 2 startup bus, which is part of the 13kV system, will now be needed for response to a SBO event. As shown on Attachment 1, the No. 2 13kV startup bus is where the Conowingo line will be connected to PBAPS. We plan to maintain the Conowingo generating units, the proposed PBAPS connecting line, the 00A19 bus and the portion of the PBAPS distribution system up to but not including the Class 1E breaker, located between the 2EA transformer and the 4kV bus, as non-safety related equipment. The existing equipment of this list has been highly reliable and available. We plan to maintain both the existing and the proposed equipment of this list in accordance with our standard utility maintenance practices. We do not commit to maintaining this list of equipment in accordance with Appendix A of RG 1.155. This is consistent with the quality assurance practices currently applied to our preferred offsite sources.

8. **Address each item of NUMARC 87-00, Appendix B (i.e., B1 through B13) and describe to what extent the Conowingo hydro power source to Peach Bottom meets these criteria for AAC power sources.**

Response:

B.1 The Conowingo generating units and proposed PBAPS connecting line are not designed to meet Class 1E or safety system requirements.

B.2 The Conowingo generating units and proposed PBAPS connecting line will not be protected against the effects of failure or misoperation of mechanical equipment, including (i) fire (ii) pipe whip, (iii) jet impingement, (iv) water spray, (v) flooding from a pipe break, (vi) radiation, pressurization, elevated temperature or humidity caused by high or medium energy pipe break, and, (vii) missiles resulting from failure of rotating equipment or high energy systems. The Conowingo generating units and proposed PBAPS connecting line will not be seismically designed.

B.3 The Conowingo line will consist of the Conowingo Hydroelectric Power Station, the substation equipment at Conowingo and PBAPS and the distribution line. All of these components are capable of withstanding the effects of likely weather-related events. Each of the three cable routing options being evaluated for the line includes burying the cable.

B.4 The Conowingo line will be physically separated from the PBAPS, Units 2 and 3 Class 1E power lines and will meet the separation criteria as defined in the PBAPS UFSAR.

B.5 Failure of the Conowingo generating units and proposed PBAPS connecting line will not adversely affect any Class 1E AC power systems due to the isolation devices incorporated into the design.

B.6 The Conowingo line will be connected to the PBAPS No. 2 13kV startup buses which are non-safety related; therefore, isolation will be provided by the existing Class 1E safeguards 4kV bus breakers and the non-class 1E 13kV startup feeder breaker to the Unit 2 emergency auxiliary transformer. See Attachment 1 for a simplified single line diagram of this configuration.

B.7 The Conowingo line normally will not be connected to the preferred or on-site Emergency AC Power System for either PBAPS Unit 2 or Unit 3. Shutdown equipment will not be capable of automatically loading onto the Conowingo line.

B.8 Minimum potential exists for common cause failure of the Conowingo generating units and proposed PBAPS connecting line for the following reasons.

(a) Any required back-up power source for Conowingo will be independent from PBAPS preferred and Class 1E power system.

(b) An air start system is not applicable to the Conowingo generating units.

(c) A fuel oil supply is not applicable to the Conowingo generating units.

(d) The Conowingo line will rely upon hydro generator units, as compared to the PBAPS EDGs.

(e) The Conowingo generating units and proposed PBAPS connecting line will be designed to prevent vulnerability to failure from a weather-related event or single active failure that could simultaneously disable the onsite EAC sources and the preferred power source.

(f) The Conowingo generating units and proposed PBAPS connecting line will be capable of operating during and after a SBO event without any support systems powered from the PBAPS preferred power supply or the PBAPS Class 1E power source.

(g) Portions of the Conowingo line subjected to maintenance activities will be tested prior to returning the Conowingo line to service.

B.9 The Conowingo line will be sized at 15MVA nominal to carry the required shutdown loads for the required 8-hour coping duration for PBAPS, Units 2 and 3. It will be capable of maintaining voltage and frequency within limits consistent with established industry standards such that the performance of any components within shutdown systems will not be degraded.

B.10 The Conowingo line normally will be energized from the Susquehanna Substation to the No. 2 startup switchgear breaker. The loss of this source will be annunciated in the Control Room. The line will be tested approximately once every two years to verify that it can support the required loading.

B.11 The Conowingo generating units and proposed PBAPS connecting line will be maintained according to practices currently in place or as subsequently modified commensurate with a principal function of system restoration for system blackout.

B.12 Upon completion of the modification to permit the use of the Conowingo line as the AAC Source, it shall be demonstrated by test to be capable of carrying a load equivalent to the load of the required shutdown equipment within 1 hour of a station blackout event.

B.13 The Conowingo generating units and proposed PBAPS connecting line normally will be operated (i.e., powering PBAPS Unit 1) and will be monitored to an availability goal of 95% of the time the reactor is operating. This is the target availability goal for a normally on-line power system. There is no target for reliability for normally on-line systems.

9. Describe the testing that will be performed in accordance with 10 CFR 50.63(c)(2) to demonstrate the capability of Conowingo as the AAC source.

Response:

(1) Pre-Operational Testing

Prior to placing the Conowingo line in service, a pre-operational test will be performed to verify the following.

(a) The capability to establish power to the 4kV emergency buses from the Conowingo line within 1 hour of a SBO event. This includes simulating the start of the required number of Conowingo generators from a condition of no units running.

(b) The capability of the Conowingo line to carry approximately 7000kW in load. The 7000 kW represent the load required to bring both units to safe shutdown.

(2) Periodic Testing

Testing of the Conowingo line will be done approximately once every two years. The periodic test will verify the capability of the Conowingo line to start and carry approximatley 7000kW of load. The capability of the 4kV buses and the SBO required shutdown equipment to energize and start is already demonstrated by existing surveillance tests.

10. Provide an estimated implementation schedule for the proposed power feeder from the Conowingo Station.

Response:

The proposed Conowingo line will be installed and placed in service within two years of NRC issuance of the Safety Evaluation approving the SBO analysis for PBAPS, Units 2 and 3.

11. If the allowable outage time (AOT) for an inoperable EDG is increased from 1 week to 2 weeks, how would this affect the overall availability (considering both reliability and availability aspects) of the EDG? Same question if the AOT for an inoperable EDG is increased from 1 week to 30 days? Provide the bases for these answers.

Response:

The intent of the increased allowable outage time is to increase the flexibility should an unexpected condition occur associated with the EDGs. Actions would be taken to limit the time in any Limiting Condition for Operation Technical Specifications Action statement and therefore, limit the EDG unavailability. If all preventive maintenance activities are not completed during existing 7-day AOT, entry into another AOT at a later date would be necessary to complete the activities. These multiple entries into an AOT would cause an increase in EDG unavailability over that of one longer but continuous AOT due to the testing and post-maintenance checks that must be performed prior to each time the EDG is returned to service.

If an EDG were removed from service for a two week period, the unavailability would double from the one week value of 1.9% to 3.8% per year. The yearly availability would decrease by only 1.9%, from 98.1% to 96.2%. Similarly, an increase from one week to one month would result in a 8.3% unavailability, or a 91.7% availability.

However, availability averaged over several years would be expected to remain about the same or better as additional preventive maintenance activities would be expected to preclude work required at a later date, and thus limiting the duration of future outages.

The historical reliability of the EDGs has been e tremely high (e.g., 99.35%) and would be expected to remain high regardless of the unavailability experienced by the EDGs.

12. **Provide the results of PRA analyses that have been performed in support of the proposed power feeder from the Conowingo Station.**

Response:

The current Probabilistic Risk Assessment (PRA) for PBAPS, Units 2 and 3 core damage frequency (CDF) is 5.5E-06/Reactor (Rx)-yr. The contribution of SBO and Loss of Offsite Power (LOOP) sequences to the CDF is 8.7% and 24.8% respectively. A LOOP sequence is one in which multiple (but not all) EDGs have failed subsequent to a loss of offsite power. The Conowingo line would be capable of supplying power with a capacity greater than the combined output of the onsite EDGs to the safeguards 4kV buses. This substantially reduces the need to load manage the available EDG power to successfully mitigate an accident affecting one or both of the PBAPS units following a LOOP. The contribution of SBO and LOOP with the installed Conowingo line to the CDF calculated to be 0.4% and 0.1%, respectively. The total CDF would consequently decrease to 3.7E-06/rx-yr, which represents a 33% decrease.

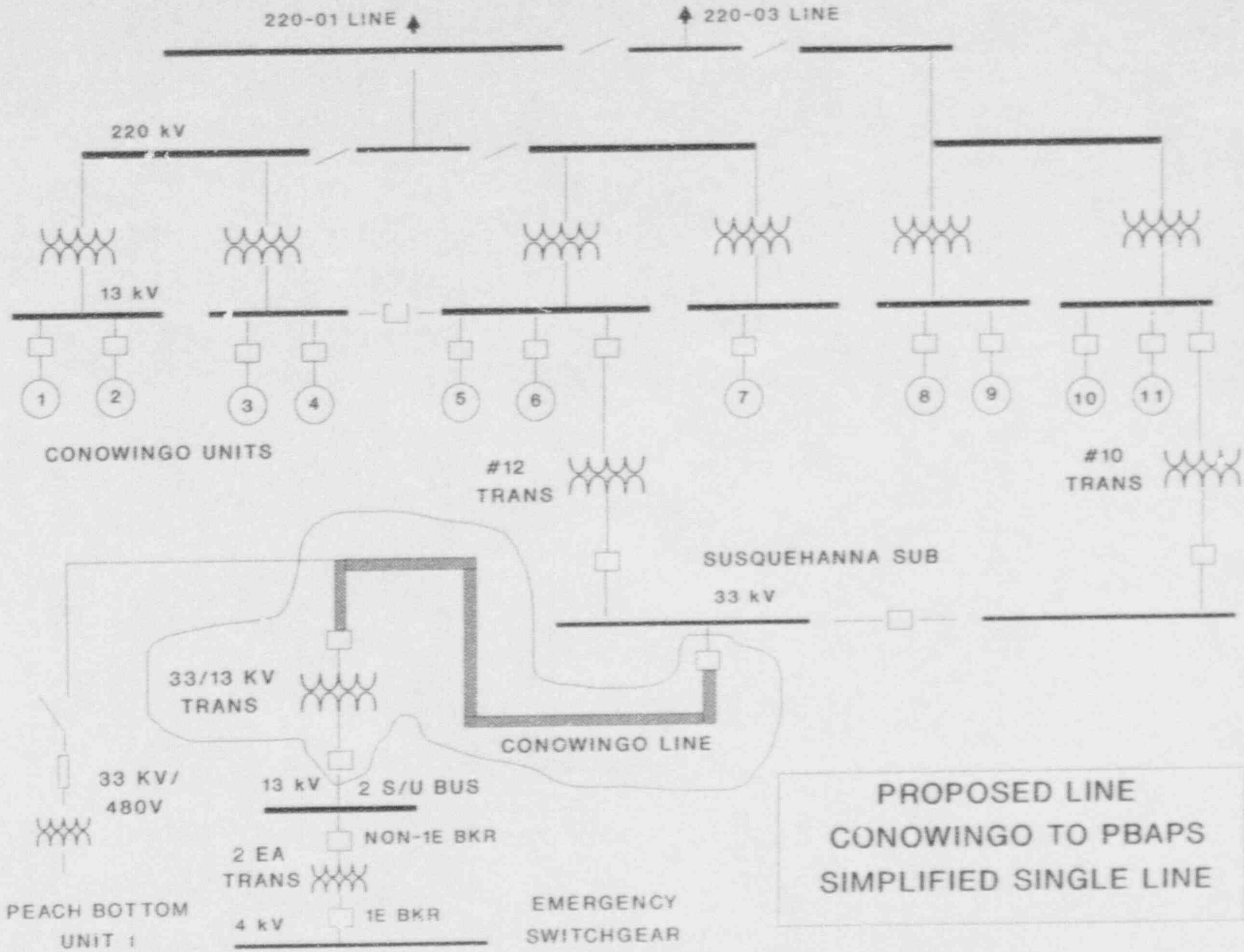
13. **Provide historical data on Peach Bottom's EDG unavailability (due to maintenance) during power operations and during shutdown of one or both units.**

Response:

Historical EDG unavailability recorded from 1986 to the present (i.e., May, 1992) represents the most recent, consistent, and applicable collection of data for the PBAPS EDGs and was used to determine the EDG unavailabilities below.

With one or both of the PBAPS units operating, the EDG unavailability recorded in the above time frame averaged 2.3% per EDG per year. The annual EDG inspection required by the Technical Specifications contributes 1.9% EDG unavailability for each EDG every year. This inspection interval was recently changed to once every 18 months and would result in a drop in EDG unavailability per year by approximately one-third. For the last three years, 90% of the unavailability was due to planned outages and 10% due to unplanned outages.

During the approximately 25 months when both PBAPS units were shut down (March 31, 1987 to April 26, 1989), the EDG unavailability averaged 6% per EDG per year. This unavailability was a result of modifications, tests, and lengthened inspection outages. Although the units were not operating, the annual EDG inspections were performed.



PROPOSED LINE
CONOWINGO TO PBAPS
SIMPLIFIED SINGLE LINE

Attachment 1

ATTACHMENT 2

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3
CONOWINGO LINE UNAVAILABILITY
BASED ON EQUIPMENT FAILURE RATES

	CABLE ROUTING OPTIONS		
	DUCT BANK	DIRECT BURIED	SUBMARINE
Generation (Including Generators and associated equipment)	1 hr/yr	1 hr/yr	1 hr/yr
Distribution (Including breakers, transformers, and cables)	131 hr/yr	143 hr/yr	333 hr/yr
TOTAL LINE UNAVAILABILITY (excluding maintenance)	132 hr/yr	144 hr/yr	334 hr/yr
TOTAL LINE AVAILABILITY	98%	98%	96%