10 CFR 50.54(f)
GL 92-01

PHILADELPHIA ELECTRIC COMPANY
NUCLEAR GROUP HEADQUARTERS
955-65 CHESTERBROOK BLVD.
WAYNE, PA 19087-5691
(215) 640-6000

NUCLEAR ENGINEERING & SERVICES DEPARTMENT

July 10, 1992

Docket Nos. 50-277
50-278
50-352
50-353
License Nos. DPR-44
DPR-56
NPF-39
NPF-85

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 Generic Letter 92-01, Revision 1,
"Reactor Vessel Structural Integrity, 50.54(f)"

REFERENCES: 1) Letter from J. W. Gallagher (PECo) to T. E. Murley (NRC), dated May 13, 1988

2) Letter from R. D. Binz, IV (BWROG) to B. J. Elliot (NPC), K. R. Wichman (NRC), and D. G. McDonald (NRC), dated April 10, 1992

3) Internal NRC Memorandum from J. E. Richardson (NRR) to D. G. McDonald (NRR), dated May 5, 1992

Dear Sir:

Attached are our responses to the information requested by the subject Generic Letter 92-01, dated March 6, 1992. Generic Letter 92-01 concerns licensee's compliance with requirements and commitments regarding reactor vessel integrity. Attachment A provides the responses for Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3. Attachment B provides the responses for Limerick Generating Station (LGS), Units 1 and 2.

The attached responses generally follow the example responses developed by the Boiling Water Reactor Owners' Group (BWROG) (Reference 2). In addition, the comments of the Nuclear Regulatory Commission (NRC) as described in the Reference 3 letter are addressed at the end of each attachment for PBAPS, Units 2 and 3, and LGS, Units 1 and 2.

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In addition to the response to Generic Letter 92-01, the Enclosure to Attachment A provides the "Peach Bottom Atomic Power Station Unit 2 Vessel Surveillance Materials Testing and Fracture Toughness Analysis," Revision 1, dated December 1991. The original report was submitted in the Reference 1 letter in accordance with the requirements of 10 CFR 50, Appendix H, "Reactor Vessel Material Surveillance Program Requirements," Section III.A. This Revision being submitted includes an analysis of unirradiated plate and weld Charpy specimens.

As noted in Attachment B responses 2b (2), 2b (5), and 3a, a supplemental response to this Generic Letter will be submitted no later than November 20, 1992.

This response was due to the NRC on July 4, 1992. In a conversation with J. Shea (NRC) on July 1, 1992, an extension was granted to July 13, 1992.

If you have any questions, please contact us.

Very truly yours,

G. J. Beck, Manager
Licensing Section

Attachments and Enclosure

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

COMMONWEALTH OF PENNSYLVANIA :

: ss.

COUNTY OF CHESTER :

D. R. Helwig, being first duly sworn, deposes and says:

That he is Vice President of Philadelphia Electric Company; that he has read the response to Generic Letter No. 92-01, 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.

D. R. Helwig

Vice President

Subscribed and sworn to
before me this 10th day
of July 1992.

Notary Public

Notarial Seal
Erica A. Santori, Notary Public
Tredyffrin Twp., Chester County
My Commission Expires July 10, 1995

ATTACHMENT A

PEACH BOTTOM ATOMIC POWER STATION

UNITS 2 AND 3

RESPONSE TO GENERIC LETTER 92-01

Request 1:

"1. Certain addressees are requested to provide the following information regarding Appendix H to CFR Part 50:

Addressees who do not have a surveillance program meeting ASTM E185-73, -79, or -82 and who do not have an integrated surveillance program approved by the NRC (see Enclosure 2), are requested to describe actions taken or to be taken to ensure compliance with Appendix H to 10 CFR Part 50. Addresses who plan to revise the surveillance program to meet Appendix H to 10 CFR Part 50 are requested to indicate when the revised program will be submitted to the NRC staff for review. If the surveillance program is not to be revised to meet Appendix H to 10 CFR Part 50, addressees are requested to indicate when they plan to request an exemption from Appendix H to 10 CFR Part 50 under 10 CFR 50.60(b)."

Response:

10 CFR Part 50, Appendix H, Paragraph II.B.1 requires, "That part of the surveillance program conducted prior to the first capsule withdrawal must meet the requirements of the edition of ASTM E 185 that is current on the issue date of the ASME Code to which the reactor vessel was purchased." The Peach Bottom Atomic Power Station (PBAPS), Units 2 and 3 vessels were designed to the Winter 1965 Addenda to the 1965 Edition of Section III of the ASME Boiler and Pressure Vessel Code. Since the design of the surveillance program is "part of the surveillance program conducted prior to the first capsule withdrawal", the edition of the standard applicable to the PBAPS programs design is E185-61.

The PBAPS, Units 2 and 3 surveillance programs meet the intent of E185-82 with the following clarifications and alternate positions:

1. ASTM E185-82 in paragraph 5.1.1 requires, "...The base metal, weld metal and HAZ materials included in the program shall be those predicted to be the most limiting, with regard to setting pressure-temperature limits, for operation of the reactor to compensate for radiation effects during its lifetime."

   The plate material used in making the base metal, weld metal and heat affected zone (HAZ) surveillance specimens for Unit 2 is not the most limiting. The difference is not significant since chemistry factors provided in Regulatory Guide 1.99, Revision 2 are used to account for this deviation. Utilizing a chemistry factor of 131 for the most limiting plate and 121 for the surveillance sample results in a 3.5° difference in the Adjusted Reference Temperature (ART) at 32 EFPY.

2. ASTM E185-82 in paragraph 6.2 requires, "...so that the major axis of the specimen is parallel to the surface and normal to the principal rolling direction for plates,..."

   All the Charpy and Tensile specimens for the Units 2 and 3 capsules were made parallel to the principal direction of rolling. However, the data from these longitudinal Charpy specimens has been utilized by incorporation of a correction factor of .65. This correction

factor is discussed in Branch Technical Position MTEB 5-2 ("Fracture Toughness Requirements"), Revision 1.

3. ASTM E185-82 in paragraph 7.5.2 requires, "One set of temperature monitors shall be located within the capsule...".

   The capsules in both Unit 2 and Unit 3 do not contain temperature monitors. This lack of temperature monitors is not a serious concern for the PBAPS, Units 2 and 3 pressure vessel surveillance programs because the capsules in both vessels are located at mid-core height on the vessel wall in the annulus regions where high water flow to the recirculation suction piping keeps the capsules the same temperature as the vessel wall. Therefore, varying radiation effects due to temperature differences are negligable.

Based on the above discussion, and the responses to requests 2 and 3 below, it can be concluded the PBAPS, Units 2 and 3 surveillance programs effectively meet the objective of Appendix H to "...monitor changes in the fracture toughness properties of ferritic materials in the reactor vessel beltline region of light water nuclear power reactors resulting from exposure of these materials to neutron irradiation and the thermal environment."

The PBAPS, Unit 2 and 3 surveillance programs' designs were approved during the FSAR approval process. Additionally, the Units 2 and 3 surveillance programs satisfy the requirements of paragraph II.B.1 of Appendix H. Therefore, an exemption is not considered necessary.

Request 2a:

"2. Certain addressees are requested to provide the following information regarding Appendix G to 10 CFR Part 50:

   a. Addressees of plants for which the Charpy upper shelf energy is predicted to be less than 50 foot-pounds at the end of their licenses using the guidance in Paragraphs C.1.2 or C.2.2 in Regulatory Guide 1.99, Revision 2, are requested to provide to the NRC the Charpy upper shelf energy predicted for December 16, 1991, and for the end of their current license for the limiting beltline weld and the plate or forging and are requested to describe the actions taken pursuant to Paragraphs IV.A.1 or V.C of Appendix G to 10 CFR Part 50."

Response:

The upper shelf energies (USE) of the beltline materials at PBAPS, Units 2 and 3 are not expected to be less than 50 ft-lb by the end of 32 Effective Full Power Years (EFPY). Therefore, Request 2a does not apply to PBAPS, Units 2 and 3. A description of the USE evaluation supporting this conclusion follows.

USE data were not developed during fabrication of the plates or welds used in the beltlines of either PBAPS, Units 2 and 3. However, in connection with the testing and evaluation of the first surveillance capsules removed from both units, archive specimens from the same plates and similar

electroslag welds were tested. The significant results of the irradiated and unirradiated Charpy V-notch data are depicted in Table 5-5 of the respective reports ("Peach Bottom Atomic Power Station Unit 2 Vessel Surveillance Materials Testing and Fracture Toughness Analysis", dated December 1991 (Enclosure 1), and, "Peach Bottom Atomic Power Station Unit 3 Vessel Surveillance Materials Testing and Fracture Toughness Analysis," dated June 1990 and submitted in a letter from G. A. Hunger (PECo) to USNRC, dated June 27, 1990 (Enclosure 2)). Figure 2 of Regulatory Guide 1.99, Revision 2, was used to calculate an USE of 132 ft-lb longitudinal/86 ft-lb transverse for Unit 2 and 122 ft-lb longitudinal/79 ft-lb transverse for Unit 3 for the surveillance plates and an USE of 80 ft-lb for Unit 2 and 82 ft-lb for Unit 3 for vertical electroslag welds at 32 EFPY.

In the case of those materials not covered by the surveillance program, the BWROG report "BWR Beltline Material Upper Shelf Energy Estimation Methods", submitted to the NRC in a letter dated June 12, 1992, was used to calculate the USEs. The lowest upper shelf energy at 32 EFPY calculated for PBAPS, Unit 2 was 61.2 ft-lbs and for PBAPS, Unit 3 was 60.6 ft-lbs as documented in the June 12, 1992 letter.

Request 2b:

"b. Addressees whose reactor vessels were constructed to an ASME Code earlier than the Summer 1972 Addenda of the 1971 Edition are requested to describe the consideration given to the following material properties in their evaluations performed pursuant to 10 CFR 50.61 and Paragraph III.A of 10 CFR Part 50, Appendix G:

(1) the results from all Charpy and drop weight tests for all unirradiated beltline materials, the unirradiated reference temperature for each beltline material, and the method of determining the unirradiated reference temperature from the Charpy and drop weight test;"

Response:

For the beltline plate materials, Charpy and dropweight tests were performed. The Charpy specimen orientation was longitudinal and the test requirement was to meet 30 ft-lb at 10°F. In order to demonstrate fracture toughness equivalent to Appendix G requirements, a General Electric procedure, described in Section 3.2.4 of the "Vessel Surveillance Materials Testing and Fracture Toughness Analysis" reports for PBAPS, Units 2 and 3 (Enclosures 1 and 2, respectively), was used to adjust the 30 ft-lb longitudinal Charpy data to determine the temperature T_{50T} at which an equivalent 50 ft-lb transverse Charpy energy could be expected. The unirradiated RT_{NDT} was then selected as the higher of (T_{50T} - 60°F) or the dropweight nil-ductility temperature (NDT).

For the beltline weld materials, only Charpy tests were performed. The specimens were cut transverse to the weld length and the test requirement was 30 ft-lb at 10°F. As with the plate, the GE procedure was used to adjust the 30 ft-lb Charpy data to determine (T_{50T} - 60°F) or -50°F.

Table 3-2 in Enclosures 1 and 2 depict the requested information for PBAPS, Units 2 and 3, respectively.

Request 2b (2):

"(2) The heat treatment received by all beltline and surveillance materials;"

Response:

The fabrication process for the plate material (ASME SA302, Grade B modified) for both Units 2 and 3 vessels employed double quench and temper heat treatment immediately after hot forming, then electroslag or submerged arc welding and post-weld heat treatment. The post-weld heat treatment was typically for 30 hours at temperatures of 1125 ± 25°F.

The base metal specimens were cut from beltline plates. The test plates were double quenched and tempered and then given a stress relief heat treatment for 30 hours at 1125 ± 25°F to simulate the post-weld heat treatment of the vessels.

The weld metal and HAZ specimens were fabricated from trim-off pieces from beltline plates and were welded together by electroslag welding, using the same process for the longitudinal seam welds in the beltline, and post-weld heat treated for 30 hours at 1125 ± 25°F to simulate the post-weld heat treatment of the vessels.

Request 2b (3):

"(3) the heat number for each beltline plate or forging and the heat number of wire and flux lot number used to fabricate each beltline weld;"

Response:

The beltline consists of portions of the lower shell and lower-intermediate shell. Each shell is formed from three plates, so the beltline includes portions of six plates, six vertical welds and one circumferential welds. All beltline plate and weld material were considered in the Appendix G evaluation. The requested information is depicted in Figure 3-2 and Tables 3-1 and 3-2 of the Enclosures 1 and 2 for PBAPS, Units 2 and 3, respectively.

Request 2b (4):

"(4) the heat number for each surveillance plate or forging and the heat number of wire and flux lot number used to fabricate the surveillance weld;"

Response:

The heat numbers for the surveillance plates are C2761-2 for Unit 2 and C3103-1 for Unit 3. Only one weld wire heat was used for the vessels' electroslag welds, and the usual Babcock and Wilcox practice was to use

the same heat in the surveillance welds. However, the chemical analyses of the irradiated surveillance welds do not appear to support the assumption that the surveillance and beltline welds are the same heat. This matter is discussed in detail in Sections 3.2.3 of Enclosures 1 and 2 for PBAPS, Units 2 and 3, respectively.

Request 2b (5):

"(5) the chemical composition, in particular the weight in percent of copper, nickel, phosphorous, and sulfur for each beltline and surveillance material; and"

Response:

Chemical composition weight percent data for beltline materials are shown in Tables 3-1 of the Enclosures 1 and 2 for PBAPS, Units 2 and 3, respectively. Beltline material chemistries, or upper bound assumptions, were used in accordance with Regulatory Guide 1.99, Revision 2, to determine the limiting beltline material, the adjusted reference temperature versus EFPY for that material, and the predicted USE at 32 EFPY.

Verification chemical composition weight percent data for the irradiated surveillance plate and weld are shown in Tables 3-3 of the Enclosures 1 and 2 for PBAPS, Units 2 and 3, respectively. These analyses compare favorably with the fabrication analyses for the plates but not favorably for the welds as discussed above in response to Request 2b (4).

Request 2b (6):

"(6) the heat number of the wire used for determining the weld metal chemical composition if different than Item (3) above."

Response:

As discussed above in responses to Request 2b (4) and 2b (5), there is an apparent dissimilarity between the weld wire used for the surveillance specimens and that used for the electroslag longitudinal welds of the vessels. This dissimilarity does not pose a problem because it is bounded by using the highest chemical factors for the welds. The Adjusted Reference Temperatures (ART) at 32 EFPY, based on Regulatory Guide 1.99, Revision 2 calculations, are acceptable.

Request 3a:

"3. Addressees are requested to provide the following information regarding commitments made to respond to GL 88-11:

a "how the embrittlement effects of operating at an irradiation temperature (cold leg or recirculation suction temperature) below 525°F were considered. In particular licensees are requested to describe consideration given to determining the effect of lower irradiation temperature on the reference temperature and on the Charpy upper shelf energy."

Response:

Since surveillance specimens are exposed to the same temperature conditions as the beltline materials, temperature effects, if any, will be reflected in the surveillance results. When the surveillance results are factored into the Appendix G analysis per Regulatory Guide 1.99, Revision 2, temperature effects, if any, will be accounted for inherently.

Operation with PBAPS, Units 2 and 3 beltline regions below 525°F was not considered in the Appendix G analyses for response to Generic Letter 88-11 because the steady-state operating temperature of the coolant in the beltline region is slightly greater. Based on the temperature in the recirculation suction piping, which draws water directly from the beltline region, the steady-state temperature in the beltline is greater than 527°F.

Only during startup and operation without feedwater heating, which occurs when feedwater heaters are out of service or when the turbine is off line and the reactor steam is routed through the turbine bypass, does the beltline experience coolant temperatures less than 525°F when the reactor is critical. The time of operation in these conditions has been estimated to be less than 1%, and the associated temperatures for most of that time are 515°F or higher. The Peach Bottom, Unit 2 32 EFPY fluence with the 1/4T lead factor is estimated to be 5.5 X 10^{17} n/cm^2 with an upper bound of 6.9 X 10^{17} n/cm^2, and the Peach Bottom, Unit 3 32 EFPY fluence with the 1/4T lead factor is estimated to be 5.0 X 10^{17} n/cm^2 with an upper bound of 6.3 X 10^{17} n/cm^2. Using the upper bound, the fluence accumulated below 525°F would be about 6.9 X 10^{15} n/cm^2 for Unit 2 and 6.3 X 10^{15} n/cm^2 for Unit 3. This combination of low fluence and small deviation from the 525°F level will not significantly affect beltline RT_{NDT} or USE predictions.

Request 3b:

"b. How their surveillance results on the predicted amount of embrittlement were considered."

Response:

Regulatory Guide 1.99, Revision 2, Paragraph C.2 requires credible data from two surveillance capsules before adjustments to the prediction methods are made, and only one capsule from Unit 2 and one capsule from Unit 3 have been tested. Therefore, the beltline predictions are based on Revision 2 methods without consideration of surveillance results.

Request 3c:

"c. If a measured increase in reference temperature exceeds the mean-plus-two standard deviations predicted by Regulatory Guide 1.99, Revision 2, or if a measured decrease in Charpy upper shelf energy exceeds the value predicted using the guidance in Paragraph C.1.2 in Regulatory Guide 1.99, Revision 2, the licensee is requested to report the information and describe the effect of the surveillance results on the adjusted reference temperature and Charpy upper shelf energy for each beltline material as predicted for December 16, 1991, and for the end of its current license."

Response:

Measured increases in the reference temperatures for PBAPS, Units 2 and 3 based on surveillance tests of the first capsules were less than the mean-plus-two standard deviations predicted by Regulatory Guide 1.99, Revision 2. Since only one set of surveillance results are available, the effects of the measured changes on the beltline predictions have not been considered for either unit, per Paragraph C.2 of the Regulatory Guide.

Measured decreases in USE from the first surveillance capsules for PBAPS, Units 2 and 3 were within the predictions for both plates and welds. Since only one set of surveillance results are available, the effects of the measured changes on the beltline predictions have not been considered for either unit, per Paragraph C.2 of the Regulatory Guide.

Response to Additional Items Identified in May 5, 1992 NRC Internal Memorandum

Request 1:

"For cases where an ASTM E185 standard earlier than the 1973 revision is involved for a licensee's 10 CFR 50, Appendix H, surveillance program, the licensee should include a discussion of the effectiveness of its program in assessing radiation embrittlement."

Response:

This information is contained in our reply to Request 1 of Generic Letter 92-01.

Request 2:

"A detailed description should be provided to clearly show how initial upper shelf energy data were estimated for those vessels where the initial upper shelf energy was not available from existing data."

Response:

This information is contained in our reply to Request 2a of Generic Letter 92-01.

Request 3:

"The staff believes that every effort should be made to retrieve records and data relating to each licensee's reactor vessel and surveillance sample material chemistry and heat number identification. The extent of this effort should be described in the submittal."

Response:

This information is contained in our reply to Request 2b (1) through 2b (6) of Generic Letter 92-01.

Request 4:

"The details of the BWROG's SSP and its topical report on fracture toughness should be provided to the NRC staff, for information, prior to licensee submittals which reference them."

Response:

The BWROG report "BWR Beltline Material upper Shelf Energy Estimation Methods" was submitted to the NRC on June 12, 1992.

Request 5:

"Basis and justification should be provided or referenced to demonstrate that the General Electric procedure used to estimate unirradiated reference temperatures is equivalent to current requirements."

Response:

This information is contained in Section 3.2.4 of Enclosures 1 and 2, respectively.

Request 6:

"If a reactor vessel operated at a constant temperature less than 525°F, the licensee should report an estimate of the neutron fluence accumulated at that temperature."

Response:

This information is contained in our reply to Request 3a of Generic Letter 92-01.

Request 7:

"Details should be provided by each licensee for actions being taken when the measured increases in reference temperature or measured decreases in USE exceed, by more than 2-sigma, those predicted by RG 1.99, Revision 2, for the first surveillance capsule. The BWROG was encouraged to have licensees not wait for the results of the second surveillance capsule before actions are taken to determine the validity of the measured data."

Response:

The results depicted in Enclosures 1 and 2, respectively, indicated that the increase in reference temperature and the decrease in USE are within 2-sigma.

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Enclosure 1

to

Attachment A