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

Peach Bottom Atomic Power Station, Units 2 and 3
Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: Information to Resolve Electrical Issues on the License Renewal Application

Reference: Summary of September 24-25, 2001 NRC Staff Visit dated October 26, 2001

Dear Sir/Madam:

Exelon Generation Company, LLC (Exelon) hereby submits the enclosed information as previously agreed upon in the reference summary.

Attachment 1 provides information on electrical systems and components that responds to those questions related to electrical issues. For your convenience, attachment 1 restates the question from the reference summary and provides our response.

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

Very truly yours,

Michael P. Gallagher
Director, Licensing and Regulatory Affairs
Mid-Atlantic Regional Operating Group

Enclosures: Affidavit, Attachment 1

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

A087

Affidavit of Joseph J. Hagan

I, Joseph J. Hagan, Senior Vice President, do hereby affirm and state:

1. I am authorized to execute this affidavit on behalf of Exelon Generation Company, LLC ("EGC").

2. EGC is providing this information is support of its Application for License Renewal for the Peach Bottom Atomic Power Station Units 2 and 3 (NRC Facility Operating License Nos. DPR-44 and DPR-56; Docket Nos. 50-277 and 50-278.)

3. I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

Joseph J. Hagan
Senior Vice President

Commonwealth of Pennsylvania
County of Chester

Subscribed and sworn to before me, a Notary Public, in and for the County and Commonwealth above named, this 20th day of December, 2001.

Notary Public

My Commission Expires:

10-6-03

Notarial Seal
Vivia V. Gallimore, Notary Public
Kennett Square Boro, Chester County
My Commission Expires Oct. 6, 2003
Member, Pennsylvania Association of Notaries

ATTACHMENT 1

<u>NRC question 8</u>: The results of the environmental qualification of electrical equipment in Section 4.4 indicate that the aging effects of the environmental qualification (EQ) of electrical equipment identified in the Time Limited Aging Analysis (TLAA) will be managed during the extended period of operation under 10CFR 54.21(c)(1)(iii). However, no information is provided in the submittal on the attributes of a reanalysis of an aging evaluation to extend the qualificated life of electrical equipment identified in the TLAA. The important attributes of a reanalysis are the analytical methods, the data collection and reduction methods, the underlying assumptions, the acceptance criteria, and corrective actions. Provide information on the important attributes of reanalysis of an aging evaluation of electrical equipment identified in the TLAA to extend the qualification under 10CFR 50.49(e).

<u>Answer to NRC question 8</u>:

PBAPS EQ Component Reanalysis Attributes

The reanalysis of an aging evaluation is normally performed to extend the qualification by reducing excess conservatism incorporated in the prior evaluation. Reanalysis of an aging evaluation to extend the qualification of a component is performed on a routine basis pursuant to 10 CFR 50.49(e) as part of the PBAPS Environmental Qualification Program. While a component life limiting condition may be due to thermal, radiation, or cyclical aging, the vast majority of component aging limits are based on thermal conditions. Conservatism may exist in aging evaluation parameters, such as the assumed ambient temperature of the component, an unrealistically low activation energy, or in the application of a component (de-energized versus energized). The reanalysis of an aging evaluation is documented according to PBAPS quality assurance program requirements, which requires the verification of assumptions and conclusions. As already noted, important attributes of a reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met). These attributes are discussed below.

Analytical Methods: The PBAPS Environmental Qualification Program analytical models used in the reanalysis of an aging evaluation are the same as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable thermal model for performing a thermal aging evaluation. The analytical method used for a radiation aging evaluation is to demonstrate qualification for the total integrated dose (that is, normal radiation dose for the projected installed life plus accident radiation dose). For license renewal, one acceptable method of establishing the 60-year normal radiation dose is to multiply the 40-year normal radiation dose by 1.5 (that is, 60 years/40 years). The result is added to the accident radiation dose to obtain the total integrated dose for the component. For cyclical aging, a similar approach may be used. Other models may be justified on a case-by-case basis.

Data Collection and Reduction Methods: Reducing excess conservatism in the component service conditions (for example, temperature, radiation, cycles) used in the prior aging evaluation is the chief method used for a reanalysis per the PBAPS Environmental Qualification Program. Temperature data used in an aging evaluation is to be conservative and based on plant design temperatures or on actual plant temperature data. When used, plant temperature data can be obtained in several ways, including monitors used for technical specification compliance, other installed monitors, measurements made by plant operators during rounds, and temperature sensors on large motors (while the motor is not running). A representative number of temperature measurements are conservatively evaluated to establish the temperatures used in an aging evaluation. Plant temperature data may be used in an aging evaluation in different ways, such as (a) directly applying the plant temperature data in the evaluation, or (b) using the plant temperature data to demonstrate conservatism when using plant design temperatures for an evaluation. Any changes to material activation energy values as part of a reanalysis are to be justified on a plant-specific basis. Similar methods of reducing excess conservatism in the component service conditions used in prior aging evaluations can be used for radiation and cyclical aging.

Underlying Assumptions: The PBAPS Environmental Qualification Program EQ component aging evaluations contain sufficient conservatism to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

Acceptance Criteria and Corrective Actions: Under the PBAPS Environmental Qualification Program, the reanalysis of an aging evaluation could extend the qualification of the component. If the qualification cannot be extended by reanalysis, the component is to be refurbished, replaced, or requalified prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner (that is, sufficient time is available to refurbish, replace, or requalify the component if the reanalysis is unsuccessful).

These attributes are consistent with the attributes described in NUREG-1801, Generic Aging Lessons Learned (GALL) Report, Program X.E1, "Environmental Qualification (EQ) of Electrical Components".

NRC question 9: Section 2.5 is "Scoping and Screening Results". The staff does not understand the relevance of Section 2.5.1. The staff believes that this section belongs in Section 3.6.

Answer to NRC question 9:

The NRC stated that they would adjust the SER to accommodate the present LRA format. The NRC's staff safety evaluation report will discuss the content of Section 2.5.1.

NRC question 10: Did the licensee use any aging management guide (AMG) (e.g., DOE AMG, Sandia Report SAND96-0344, etc.) to evaluate the aging effect of cables and connections?

Answer to NRC question 10:

Yes. SAND96-0344, "Aging Management Guideline for Commercial Nuclear Power Plants – Electrical Cable and Terminations", dated September 1996 was used.

NRC question 11: The aging effects for cables and connections are due to a) corrosion of conductor, b) electrical stresses, c) water and humidity, d) temperature, e) radiation, f) mechanical stress (insulation damage during installation and vibration, g) chemical attacks, and h) cables subject to frequent manipulation (connectors and terminal blocks). All the mechanisms are not discussed. Provide justification.

<u>Answer to NRC question 11</u>:

The License Renewal Application (LRA) in Section 3.6 discusses three stressors (i.e., aging mechanisms) applicable to cables and connections at PBAPS; temperature, radiation, and moisture (i.e., water and humidity). The other stressors listed in the question are identified in SAND96-0344 as "significant". SAND96-0344 categorizes aging mechanisms as being either "significant" or "significant and observed."

Section 4.2 of SAND96-0344 emphasized that "the applicability of some aging mechanisms to actual cable systems may be very limited or the frequency of their occurrence may be extremely low". After a consideration of all the stressors and the reported incidence of their effects in the industry, SAND96-0344 concluded "the likelihood of substantially increased effects or failure rate resulting from aging mechanisms currently categorized only as 'significant' is considered low." This assessment, which is based on industry wide observations, provides reasonable assurance that these aging mechanisms will not cause a loss of intended function if left unmanaged during the extended period of operation.

Based on SAND96-0344 information, the additional "significant" aging mechanisms that were not addressed in the PBAPS license renewal application (conductor corrosion, electrical stresses, mechanical stress, chemical attacks, and cables subject to frequent manipulation) are not applicable.

Additionally, degradation due to the above effects are considered to be either event driven, caused by to a design deficiency, or are a result of human error. PBAPS operational history was reviewed. No age-related degradation at PBAPS for cables and connections has occurred due to the above stressors not specifically addressed in the LRA.

Note: NRC letter from Grimes to Walters, dated 6/5/1998, "License Renewal Issue No. 98-0013, "Degradation Induced Human Activities", states that "the staff concludes that the issue of degradation induced by human activities need not be considered as a separate aging effect and should be excluded from aging management review."

<u>NRC question 12</u>: Provide details about the cable replacement program to replace "suspected" cables subject to water treeing. It is not clear why moisture is not an aging effect requiring management at Peach Bottom.

<u>Answer to NRC question 12</u>:

Certain electrical cable insulations can experience a phenomenon known as "water treeing", that could lead to failure of some identified types of cable insulation, under a collective series of conditions. One of those conditions involves an installed environment exposed to long-term wetting or high moisture. This phenomenon does induce a *"Loss of Material Properties"* to specific cable insulation materials.

The water-treeing phenomenon is a slow process by which a breakdown of the cable insulation properties may, or may not, lead to a cable failure. The cable must be exposed to the combination of <u>all</u> of the following conditions for water treeing to occur:

1. A cable insulation material void or impurity (inclusion, flaw) must be present in the cable insulation.
2. The phenomenon predominantly affects only "medium voltage" (5kV-15kV) cables.

3. The presence of an electrical field on "lightly" loaded, but continuously energized cables.
4. The presence of continuous (long term) moisture.

Water treeing affects cable insulation materials having an ethylene polymer base. Water treeing has been shown to occur predominately in cables with Cross-linked Polyethylene (XLPE) insulation. Since the recognition and understanding of the water treeing phenomenon by the cable manufacturers and the utility industry in the late 1970s, improved formulations (resistant to water treeing) of XLPE cable insulations for use in underground applications have been made available and used since 1980.

PBAPS experienced a series of non-safety related cable failures between 1984 and 1991, when XLPE insulated 5kV and 15kV cables failed with no cause initially identified. Analyses identified that one failure, occurring in 1991, was attributable to water treeing. Further analyses on other cable samples were conducted, and evidence of water trees were found in six cases. The "trees" were found to be extensive in some cases.

A cable replacement program was initiated at PBAPS in 1995, and completed in 1999 on "suspect" cables subjected to the collective conditions listed above.

The replacement cable was ethylene propylene copolymer (EPR) insulated cable, pink in color, which has a low level of crystallinity with a poly-vinyl-chloride (PVC) jacket, suitable for use in wet or dry locations in conduit, underground duct systems, or direct buried, or aerial installations. The cables are rated for a minimum of 90° C for normal operation, 130° C for emergency loading operation, and 250° C for short circuit conditions.

The basic construction of the cable is either single conductor class B strand bare copper or aluminum, with extruded semi-conducting strand screen, EPR insulation, extruded semi-conducting insulation screen, bare copper shielding tape, and PVC jacket.

The components at PBAPS which had their original cables replaced with the above cable were:

2A Condensate Pump (5KV and 15KV)
2B Condensate Pump (5KV and 15KV)
2 Unit Aux Transformer (15KV side)
2A Recirc Pump (15KV)
3A Condensate Pump (5KV)
3B Condensate Pump (5KV)
3C Condensate Pump (5KV)
3 Unit Aux Transformer (15KV side)
3A Recirc Pump (15KV)
3B Recirc Pump (15KV)
3A Circ Pump (5KV and 15KV)
3B Circ Pump (5KV and 15KV)
3C Circ Pump (5KV and 15KV)
3A Service Water Pump (5kv and 15KV)
3B Service Water Pump (5KV and 15KV)
3C Service Water Pump (5KV and 15KV)
3B M-G Set (5KV)

Note: The Unit 2/3 Unit Aux Transformers and the 2A, 3A, and 3B Recirc Pumps are in the scope of license renewal. No other cables to components within the scope of license renewal met <u>all</u> conditions which may induce water treeing, and, therefore, did not require cable replacement.
The remaining components listed above are not in the scope of license renewal.

Review of the PBAPS operating history has determined that no additional cable failures, caused by the effects of the "water treeing" phenomena, have occurred at PBAPS since the cable replacement program was completed.

Review of a paper entitled "An Assessment of Field Aged 15KV and 35KV Ethylene Propylene Rubber Insulated Cables" published in the 1994 T&D Conference Proceedings, Pages 652-658, provided the following information and conclusions:

1. Laboratory evaluations were performed on 10-15KV and 5-35KV EPR feeder cables.
2. The evaluations consisted of visual examinations of the cables, including the presence of water trees in the insulation, and physical and electrical tests to establish changes, which may have occurred in service.
3. 12 of the 15 cables were made from a proprietary ethylene propylene copolymer (EPR), pink in color, which has a low level of crystallinity.
4. Changes have been introduced in the process of preparing the compound. During the past 10-12 years, it has incorporated a peroxide absorption system and continuous improvements have been made in screening the compound to remove contaminants and hard particles.
5. The 10-15KV cables ranged from 2-years to 22-years in service.
6. The cables were installed in PVC concrete encased conduits. The conduit system was filled with water the majority of the time, with the load on the cables being about 50% of their capacity, and operating consistently at that level.
7. Evaluations were performed using procedures as outlined in AEICCS6-87. These evaluations included: (a) visual examination for corrosion of the metallic components, (b) microscopic examination of the surface of radially cut slices of the insulation for voids, contaminants, protrusions, and water trees, (c) moisture content, (d) tensile strength and elongation, (e) force required to remove strips of the insulation shield from the insulation, (f) volume resistivity of the shield, (g) dielectric constant, (h) dissipation factor, (i) ac voltage strength, and (j) impulse voltage strength.
8. Resulting data was also compared to new EPR (pink) cable.
9. Using a staining process, trees were observed.
10. The criteria for establishing the end of life for a cable in the field is to relate voltage breakdown levels obtained during testing with operating voltage.

The conclusions of this study indicated that:

1. "As evidenced by numerous data, including ac and impulse voltage breakdown strength, a newer (< 15 years old) EPR cable performs significantly better than an older EPR (containing carbon black in its compound) made by the same manufacturer."
2. "Based on extrapolation of the voltage-time curves (obtained from cables in service) it is estimated that the newer EPR (EP) cable in this study will have a useful service life in excess of 30 years."

In addition, a review of the draft Root Cause Analysis Report - #2 CCW Pump Trip – Revision 1, 6/30/2000 from Davis-Besse identified that laboratory analysis of the failed EPR cable found that "there was also no evidence of "treeing" on the EPR material but this is not unusual since "treeing" is more common with cross-linked polyethylene (XLPE) insulation". The cable had been in service since the mid-70s, and failed 10/2/1999.

For the reasons stated above, we believe that moisture is not an aging effect requiring management at PBAPS.

NRC question 13: Provide details of radiation aging effects (total radiation dose for different areas, different cable specifications for radiation dose).

Answer to NRC question 13:

The insulation 60-year dose value for cables installed at PBAPS is listed below.

PBAPS Cable, Connector, and Splice Insulation Material/Dose

Material Name (Common Abbreviation)	60-Year Service Limiting Environment – Radiation Dose-(Rads)
Polyvinyl Chloride (PVC)	2 x E+07
Polyethylene (PE)	2 x E+07
Ethylene Propylene Rubber (EP, EPR)	5 X E+07
Cross-linked Polyethylene (XLPE, XLPO))	1 X E+08
Chlorosulfonated Polyethylene (CSPE-Hypalon)	2 X E+06
Teflon-based (Tefzel, FEP, ETFE, ETTC)	3 X E+07
Polypropylene (PO)	5 X E+06

Per PBAPS Specification NE-164, Rev. 3, "NSR Spec. for PBAPS Units 2 & 3 Environmental Service Conditions" the bounding (maximum) normal 40-year radiation doses at PBAPS were multiplied by 1.5 (that is, 60 years/40 years) to result in the following doses (in Rads):

Unit 2 Room #	Unit 3 Room #	Room Name	60Year Dose
210	255	Neutron Monitoring Room	1.11E+08
430	453	Backwash Receiving Tank	3.24E+08
509	516	Filter Demin/Pre-HEPA Filter	2.99E+08
208	254	Steam Tunnel Room	2.16E+06
410	452	Backwash Transfer Pump Room	2.02E+06

N/A	N/A	All Other Areas	<2.00E+06

Per the Integrated Nuclear Data Management System (cable routing database) search, and layout drawing reviews, non-EQ cables and electrical equipment in the above rooms (having radiation levels of 2.00E+06 Rads and above) were identified and reviewed. We did not identify any non-EQ electrical cables, connectors or splices located in these rooms that were in the scope of License Renewal.

In summary, in-scope License Renewal non-EQ cables, splices, and connectors are located in PBAPS areas where the 60-year radiation doses are below the radiation levels required to incur significant aging effects on their insulation materials.

NRC question 14: Provide the basis for the temperature rise due to ohmic heating.

Answer to NRC question 14:

The operating temperature of any installed power cable can be calculated by using the formula shown on page III of ICEA (formerly IPCEA) P-46-426. Use of ICEA P-46-426 is normal practice throughout the industry. However, if an upper bounding temperature increase is desired to apply to a thermal life analysis for all power cables regardless of actual load, then a value of 32°C can be applied to all cables in a room ambient of 40°C, provided that the circuit was properly designed and that the correct cable size was properly selected. That is, the maximum temperature increase caused by ohmic heating in any power cable application (in a 40°C ambient) will be 32°C; consequently, the maximum cable insulation temperature will be 72°C (162°F). In addition, when compensating for a higher ambient temperature (such as 50°C ambient), factors in the calculations and tables, which is brought about by standard derating practices such as using larger cables or limiting tray fill, counter-act each other resulting in the same maximum cable insulation temperature of 72°C (162°F).

Non-power cables in direct proximity to continuously loaded power cables may also be affected by the ohmic heating of the loaded circuit. According to ICEA P-46-426, this situation can be analyzed for the non-power cable by adding a bounding temperature increase of 12.5°C to the 40°C room temperature.

Instrumentation cables at PBAPS have dedicated routing with other instrumentation cables, and are not subjected to appreciable ohmic heating effects due to their low amperage applications.

Control cables are routed with power and are subjected to the ohmic heating effects of the adjacent energized power cables. Since the power cable ohmic heating temperatures elevate the actual control cable "ambient" temperature, the control cable material groups are combined with the power cable material groups for conservative bounding purposes.

Additionally, a field measurement was made for a large continuous load supplied by Polyethylene (PE) power cable, which has a 131° F 60-year limiting service temperature. The PE power and control cables at PBAPS are used in underground ducts and are not exposed to high ambient temperatures when underground (buried environment). A 500 MCM, 225 ampere continuous load was chosen for review as the "weakest link" to review in determining a bounding condition for other PE loads. At the point the cable entered the Turbine Building ("stub up"), and would see a sheltered environment (< 105° F), a temperature measurement of the cable was taken, and found to be 88° F, which bounds all other PE cables. This is discussed in the LRA, Section 2.5.1, and figure 2.5-1, page 2-137.

NRC question 15: Provide the basis for 60-year limiting service temperature and area temperatures. How the hot spot is considered.

Answer to NRC question 15:

Per PBAPS Specification NE-164, Rev. 3, "NSR Spec. for PBAPS Units 2 & 3 Environmental Service Conditions" the bounding normal ambient temperatures are as shown below:

Location	Service Temperature
All other locations (buried, outside, etc.)	< 105° F (< 40.5° C)
Outside Primary Containment (all buildings)	105º F (40.5° C)
Drywell	145º F (62.8° C)
Steam Tunnel	150º F (65.6° C)

The following table contains the 60-year service limiting temperatures for insulation materials used at PBAPS and their application.

Material Name (Common Abbreviation)	60-Year Service Limiting Environment– Temperature	Application P – Power C – Control I - Instrumentation
Polyvinyl Chloride (PVC)	112.8°F (44.5°C)	I
Polyethylene (PE)	131°F (55.0°C)	P, C, I
Ethylene Propylene Rubber (EP, EPR)	188°F (86.6°C)	P, C
Cross-linked Polyethylene (XLPE, XLPO))	194°F (90°C)	P, C, I
Chlorosulfonated Polyethylene (CSPE-Hypalon)	154ºF (67.8°C)	I
Teflon based (ETFE, ETTC, TFE)	199°F (92.8°C)	I
Polypropylene (PO)	176°F (80.0°C)	I
"Modified Polyolefin" (similar to XLPE/XLPO)	194° F (90° C)	Raychem Splices

Note: The values for the 60-Year Service Limiting Environment Temperatures for EP/EPR and XLPE/XLPO were taken from actual test reports as follows:

1. "Okonite FMR (EP/XLPE) Control Cable", dated May 18, 2000
2. "Okonite Okoguard EP/XLPE) 5KV Power Cable", dated May 18, 2000
3. "Rockbestos Firewall III (XLPE) 600V Cable", dated May 18, 2000
4. "Rockbestos Pyrotrol (XLPE) 600V Control and Power Cable", dated May 18, 2000
5. "Okonite Report No. NQRN-2, "Qualification of Okonite FMR Insulated Cables for Nuclear Plant Service"
6. "Okonite Report No. NQRN-3, "Nuclear Environmental Qualification Report for Okoguard Insulated Cables for Nuclear Plant Services"
7. Rockbestos Co. Report "Qualification of Firewall III Class 1E Cables", dated July 7, 1977

Based on the guidance in EPRI TR-109619, "Guideline for the Management of Adverse Localized Equipment Environments", it has been found that plant operating experience (i.e., a study of plant problem reports) and visual inspections are two of the best methods of identifying adverse localized equipment environments (or hot spots).

A plant walk down was performed outside containment (i.e., not in the drywell or steam tunnel). The purpose of the walk down was to take local temperature data and look for adverse environments. The equipment used was a digital thermometer, and an infrared camera. No adverse environments as described in EPRI document TR-109619 "Guideline for the Management of Adverse Localized Environments" were identified outside the PBAPS containment (i.e., not drywell or steam tunnel).

Non-EQ cables in the Steam Tunnel were reviewed to identify if they supported any in-scope License Renewal loads. None were identified. Therefore, no License Renewal cables in the Steam Tunnel require an aging management activity.

An "adverse localized equipment environment" was identified for PVC cables installed in the Drywell, and through cable aging management review, the Drywell was found to be the only "adverse localized equipment environment" at PBAPS for in- scope, non-EQ cables.

NRC question 16: How did you determine that thirty cables for fire safe shutdown (FSSD) require aging management?

Answer to NRC question 16:

The Integrated Nuclear Data Management System (INDMS) was used as the primary tool to identify cable insulation groups, and for screening electrical cables for aging management review. INDMS references a cable code that depicts a unique cable size, application (power, control, or instrumentation) and insulation/jacket material. Most cable codes are associated with a cable specification from which the cable was purchased. These cable specifications identify the cable insulation material used for that cable.

Through the process of reviewing cable codes, insulation material, environment, and whether or not a specific component was in the scope of license renewal, the majority of the installed cables (via cable codes) were eliminated from requiring an aging management activity.

(This process is described in the License Renewal Application in Section 2.5.1, pages 2-133 through 2-137).

There are 33 PVC insulated instrumentation cable codes in INDMS. PVC insulation has a 60-year ambient temperature threshold value of 112.8° F (no ohmic heating for instrumentation cable codes). Thirty-one (31) of the 33 PVC insulated instrumentation control cable codes were excluded from review because they were either in service areas less than 112.8° F, or not connected to in-scope components. The remaining 2 PVC cable codes had a total population of 70 cables. Of these 70 PVC cables, 40 cables did not support an in-scope license renewal system function. The remaining 30 cables are relied upon for FSSD, some of which are located in the drywell (145° F), and do require an aging management activity.

Note: The 30 FSSD cables requiring aging management are actually 15 cables per unit. However, only 28 cables (14 per unit) are in containment; 2 cables (1 per unit) are external to containment and are used to transmit the thermocouple data to the temperature indicators in the control room. These 2 cables will be excluded from the FSSD cable aging management activity.

NRC question 17: Low voltage instrument circuits that are sensitive to small variations in impedance were determined to be potentially affected by oxidation of connectors or termination contacts. Based on the above, an aging management program is required at PBAPS.

Answer to NRC question 17:

The connector materials subject to aging are metal and insulation. The metals used for low voltage electrical connectors are copper, tinned copper, and aluminum. The connector insulation materials used are various elastomers and thermoplastics. Properly fitted and tight connections on un-insulated connectors protect the metallic contact surface area connection from environmental aging effects.

Low voltage (impedance sensitive) instrumentation electrical connectors may experience failures when the exposure to a wet environment induces corrosion or tarnishing of the metallic surface contact. The absence of a wet environment, with a proper fit connection, precludes failure of an impedance-sensitive instrumentation connection through corrosion or tarnishing.

Electrical connector failures, resulting from connectors not designed for wet environments but installed in a wet environment, are not age-related failures. Electrical connector failures, resulting from water unexpectedly introduced into a normally dry area of the plant, are event-driven or due to human error and are not age-related. This is confirmed in NRC letter from Grimes to Walters, dated 6/5/1998, "License Renewal Issue No. 98-0013, "Degradation Induced Human Activities", and states that "the staff concludes that the issue of degradation induced by human activities need not be considered as a separate aging effect and should be excluded from aging management review."

Review of PBAPS operational history concluded that no age related degradation due to oxidation of connectors has occurred at PBAPS. Therefore, no aging management activity is required.

NRC question 18: How is the EPR submarine cable shielded? What is the industry experience with the life of this cable? SBO equipment should be covered under a QA program. Is there an inspection program for this cable to meet the QA requirements as required by Section50.63?

Answer to NRC question 18:

The words " EPR shielding and insulation" in the License Renewal Application, Section 2.5.3, Page 2-141 is incorrect, and should read "EPR insulation" only. The "Submarine cable" has metallic shielding as stated in the same paragraph that describes the construction of the cable. Additionally, rather than the description "a layer of steel armor", it should read "a layer of steel armor wires".

A letter has been received from the manufacturer (Okonite) stating that they "are not aware of any age-related failures" of Okonite's Okoguard insulated submarine cables.

The Submarine cable does not have an inspection program because it is submerged, and cannot be visually inspected. The cable is operated in an energized state with a load of approximately 1KVA. This was done to be able to monitor the availability of the line as defined in the requirements of NUMARC 87-00. The cable is load tested along with its other PBAPS SBO components every two years, to assure it can support the required SBO loads.

The PBAPS components of the SBO Alternate AC source are maintained using procedures under the PBAPS QA program.

NRC question 19: An aging management program for non-EQ cables and connections is required in order to provide a reasonable assurance that the intended functions of non-EQ cables and connections exposed to postulated adverse localized equipment environments caused by heat or radiation will be maintained consistent with the current licensing basis through the period of extended operation. This is consistent with GALL and seven previous LRAs.

Answer to NRC question 19:

As discussed in the answer to NRC question 15, a plant walk down was conducted outside containment (i.e., excluding the drywell and steam tunnel) to identify any adverse localized equipment environments. The adverse environments for PBAPS consist of the drywell and main steam tunnel. Review and analysis of those cable and connections in the scope of license renewal within those environments found that only the PVC cables in the drywell credited for fire safe shutdown (FSSD) required an aging management activity.

Additionally, 6 of the 7 previous LRAs were of PWR design. The BWR (Plant Hatch) LRA reached the same conclusion PBAPS did in that the temperature and radiation reviews did not discover any non-EQ cables requiring aging management. Plant Hatch stated this conclusion in their response to their RAI on the matter, then later agreed to have the GALL program for non-EQ accessible cables, even though there was no evidence it was required.

Because of the above analysis, PBAPS does not need a generic aging management activity for non-EQ accessible cables other than the specific aging management activity for the FSSD cables in the Drywell, as described in Section B.3.2 of Appendix B of the License Renewal Application.

NRC question 20: Explain why the cable connections (terminations) are not included in this program described in Section B.3.2 of Appendix B.

Answer to NRC question 20:

The connections of the Copper/Constantine metallic conductors to the SRV thermocouples are made directly without the use of an interfacing connector. Therefore, there are no connectors to inspect in the program as described in Section B.3.2 of Appendix B of the License Renewal Application.

NRC question 21: In Appendix B, Section B.3.2, do items 7 (Corrective Action), 8 (Confirmation Process), and 9(Administrative Controls) meet the requirements of Appendix B of 10 CFR Part 50 Appendix B "Quality Assurance Program"?

Answer to NRC question 21:

This question is applicable to all PBAPS LRA programs. The following information is provided to clarify the information contained in the introduction to Appendix B on page B-1:

The Exelon corrective action program, which includes the confirmation process to assure that the cause of the condition is determined and corrective action taken to preclude repetition was credited for license renewal. Exelon procedure AD-AA-101, "Processing of Procedures and T&RMs," (administrative controls) governs creation and revision of site procedures and was the basis for attribute (9) in all PBAPS LRA Appendix B programs. The Exelon corrective action program and Exelon procedure AD-AA-101 are in accordance with the PBAPS Quality Assurance Program, which complies with 10CFR50, Appendix B. The Exelon corrective action program and Exelon procedure AD-AA-101 apply to all of the PBAPS programs credited for license renewal.

<u>NRC question 22</u>: Is the FSSD cable inspection activity for instrumentation circuits?

<u>Answer to NRC question 22</u>:

No. The cable inspection activity for the fire safe shutdown (FSSD) cables is not for instrumentation circuits. The FSSD cables are connected to thermocouples on the discharge of the Steam Relief Valves (SRVs) in the drywell, and provide temperature information to a recorder in the control room. The recorder provides both annunciation and input to the plant computer should an input signal go outside a preset allowable range. Although this may be considered a type of instrument circuit, it is not really "loop checked" as in the true meaning of an instrument circuit, but provides direct readings into the recorder. The primary concern is with the PVC insulation surrounding the thermocouple metallic conductors, not with the metallic conductors themselves. With that in mind, it was considered that the most appropriate inspection activity would be a visual inspection of PVC insulation consistent with the GALL Program XI.E1, "Electrical Cables and Connections Not Subject To 10CFR 50.49 Environmental Qualification Requirements". The GALL Program XI.E2, "Electrical Cables Not Subject To 10CFR 50.49 Environmental Requirements Used In Instrument Circuits" uses a combination of routine calibration and surveillance tests to identify the potential existence of aging degradation. This was considered to be an inappropriate activity to identify the potential aging degradation of the PVC insulation for FSSD cables.

<u>NRC question 23</u>: If the FSSD cable inspection activity is for instrumentation circuits, it does not meet the requirements of NUREG-1801 in the areas of parameter monitored/inspected, detection of aging effects, monitoring and trending, and acceptance criteria.

<u>Answer to question 23</u>:

The cable inspection activity is not for an instrument circuit. Refer to the answer to NRC question 22.

<u>NRC question 24</u>: Provide the technical basis for the FSSD sample size.

<u>Answer to NRC question 24</u>:

There are 13-two conductor thermocouple cables (Copper/Constantine) per unit connected to 13 thermocouples in both PBAPS, Units 2 and 3. These thermocouples measure the SRV discharge temperature. The sample size is 3 per unit. This is approximately 23% of the population per unit, which is an adequate sample size for the population. Since the visual inspection of the cable insulation will be conducted at the location closest to the thermocouple, which is the most adverse environment the cable insulation will see, the results of the inspection will be adequate to bound and assess the remaining length of cables in the Drywell.

NRC question 25: Why is aging management not required for bus bar insulators and the submarine cable?

Answer to NRC question 25:

The bus bar insulators associated with the Station Blackout line were reviewed and the results are as follows:

Porcelain insulators on the Susquehanna Substation bus bar and insulator on the wooden pole were assessed for aging effects due to cracking, loss of material due to wear, and surface contamination. Cracking (known as cement growth) is caused by improper manufacturing and is not an applicable aging effect. Loss of material due to mechanical wear is an aging effect due to movement of the insulators by wind blowing on the conductor and causing the insulator to move. Although this mechanism is possible, experience has shown that transmission conductors do not swing for very long once the wind has subsided. Therefore, this is not an applicable "significant and observable" aging effect. Surface contamination can be a problem in areas where there are great concentrations of airborne particles, such as near facilities that discharge soot, or near the sea where salt spray is prevalent. Susquehanna Substation and the wooden pole are in an area where airborne particle concentrations are comparatively low. Consequently, the contamination buildup on the insulators is insignificant, and therefore surface contamination is not an applicable aging effect. Therefore, no aging management activity is required for the bus bar and wooden pole insulators.

The submarine cable is designed for the environment it operates in (raw water). There are no aging effects from temperature and radiation. A letter has been received from the manufacturer (Okonite) stating that they "are not aware of any age-related failures" of Okonite's Okoguard insulated submarine cables. Therefore, no aging management activity is required.

NRC additional scope: The scope of the Station Blackout System was also discussed. The working group agreed that all cables from the generators at Conowingo to the to the PBAPS Unit 2 Startup Bus 00A03C is in scope. The applicant agreed to a revised Station Blackout System description that will include this cables, and their aging effects.

Answer to NRC additional scope:

The original boundary for the cable (transmission line) and SBO components began at the output breaker in the Susquehanna Substation and went to the PBAPS Unit 2 Startup Bus 00A03C. The discussion in LRA Section 2.5.3 of the SBO Alternate AC source did not specifically mention the cables spliced to the submarine cable, which occurs on land in the manholes both at Conowingo and PBAPS, nor did it specifically mention the cables from the Conowingo generator output breakers to the Susquehanna Substation. These cables were considered to be bounded by the results of the Aging Management Review Technical Report for Electrical Cables, and were not specifically included in LRA Tables 2.5-1,3.6-1, or 3.6-3 as a separate line item.

The Cable Aging Management Review Technical Report for Electrical Cables used the "spaces" approach for assessing electrical cables based on insulation material and environment.

The environments for the cable from the wooden pole to the manhole at Conowingo is combination of “buried”, and “outside”; the environment for the cable from the manhole at PBAPS to the SBO switchgear and Unit 2 Startup Bus 00A03C is “buried”, and the environment for the cables from the Conowingo generators to the Susquehanna Substation is a combination of “outdoor” and “sheltered”. These environments are as defined in the LRA, Section 3.0.

Table 3.6.3 of the LRA will be modified, due to the above, to include the environment “buried” for these cables.

The radiation these cables see is considered to be normal background radiation, well below the radiation levels, as discussed in the answer to NRC question 13 above, which would cause cable aging effects.

Moisture is not considered to be an applicable stressor for these cables since the requiring aging management since these cables do not meet all the criteria for “water-treeing” as defined in the answer to NRC question 12. The cables from the Conowingo generators to the Susquehanna Substation, which is a distribution substation, are not lightly loaded. The cables spliced to the Submarine Cable are 35KV cables, not medium voltage cables. The cable from the PBAPS SBO Substation to the PBAPS Unit 2 Startup Bus 00A03C is 15KV cable, but energized only during the SBO event or during testing.

As stated in the answer to NRC question 11, other stressors such as mechanical stresses, chemical stressors, etc. are not considered to be applicable to these cables.

Therefore, the cables as defined above do not require an aging management activity.

NRC question 26: Section B.1.13, "Standby Liquid Control System Surveillance Activities" covers SBLC components including solution tank, piping, valves on the suction side of the SBLC pumps. Explain why the electrical components (Cables, Connectors, Terminations) are not included in this program in order to manage the aging effects of electrical components located in borated water environments.

Answer to NRC question 26:

As a Boiling Water Reactor (BWR), PBAPS has a standby liquid control (SBLC) system that NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” describes in section VII.E2. GALL describes components of SBLC in contact with a sodium pentaborate solution. The sodium pentaborate solution provides a relatively mild environment whose pH is slightly basic. PBAPS does not have a borated water environment; therefore, “Generic Aging Lessons Learned (GALL) Report,” aging management program XI.M10, “Boric Acid Corrosion,” does not apply to PBAPS. As such, there is no boric acid corrosion of any external surfaces including cables, connectors and terminations. Additionally, the connectors and cables in the SBLC system are within protected enclosures such that sodium pentaborate leakage cannot degrade conductivity.