From: <Steve_Hale@fpl.com>
To: <rca@nrc.gov>, <ssk2@nrc.gov>
Date: 3/8/01 9:29AM
Subject: Draft Responses to RAIs Transmitted by letter dated 1/17/01 RegardingSubsection 3.7, Section 4.4, and Subsection 3.2.6 of Appendix B Related toElectrical/I&C Equipment

Raj/Steve,

Please review the attached draft responses to see if they address the reviewers' questions. Please arrange a telecon to discuss comments/questions on these responses when the reviewers are ready. We can also cover any RAI responses on the "Scoping and Screening" letter that are not covered tomorrow (3/2/01) at that time.

Thanks

(See attached file: L-2001-34 Response to RAIs dated 1-17-01 E&IC.doc)

CC: <Liz_Thompson@fpl.com>, <Tony_Menocal@fpl.com>, <Howard_Onorato@fpl.com>

A084

ATTACHMENT 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION DATED JANUARY 17, 2001 FOR THE REVIEW OF THE TURKEY POINT UNITS 3 AND 4, LICENSE RENEWAL APPLICATION

SECTION 4.4 ENVIRONMENTAL QUALIFICATION

RAI 4.4.1-1:
In the LRA Section 4.4.1, you have stated that the wear cycle aging effect is only applicable to ASCO solenoid valves for Turkey Point. Provide justification why wear cycle aging effect is not applicable to motors (i.e., Joy motors, Westinghouse motors, MOV actuators, etc.), limit switches, and electric connectors.

FPL RESPONSE:
Wear cycling is addressed in the test reports in the Turkey Point Environmental Qualification (EQ) Documentation Packages for motors, limit switches, and electrical connectors when appropriate and is reviewed as part of the aging affects. Typically, the cycling done during testing is significantly more than the application in the plant requires as shown in the discussions below. Therefore, it is normally not the limiting factor in the qualified life of the equipment and may or may not be specifically discussed in the qualification package. Experience has shown that in certain applications, solenoid valve cycling can approach and even exceed the tested values over the design life of the plant. Thus, it can become the limiting factor in the qualified life of the solenoid valve and therefore was specifically addressed in the License Renewal Application (LRA). Other wear cycle aging evaluations are discussed below.

The wear cycle for a motor is a start/stop cycle. The Joy and Westinghouse motors in the Turkey Point EQ Program are only used in applications where the component is idle (in standby) for a significant portion of its operating life. Of these motors, the motors that experience the most start/stop cycles are the Residual Heat Removal (RHR) pump motors. For these motors, motor operation consists of monthly performance testing, maintenance testing, and operation during plant outages for decay heat removal. Allowing for a conservative number of motor start/stop cycles for maintenance testing and refueling outages, in addition to monthly performance tests, the number of start/stop cycles would not exceed 1000 for these motors over a 60-year plant life. The EPRI Power Plant Electrical Reference Series Volume 6 on Motors, page 6-46, states that a motor should be able to withstand 35,000 to 50,000 starts. Thus, the wear cycle aging effect is considered insignificant for Westinghouse and Joy motors.

For the motors in Limitorque actuators in the Turkey Point EQ Program, the actuators that would be subjected to the most cycles are those associated with valves in the RHR System. Considering that there are two actuator motor start/stop cycles for every open/close cycle of its associated valve, and conservatively assuming the valves are subjected to an open/close cycle each time the RHR pumps are operated, motor start/stop cycles associated with Limitorque actuators would not exceed 2000 over a 60-year plant life. Therefore, for the same reasons stated in the EPRI report discussed above, wear aging on these motors is also considered insignificant.

There are no Time Limited Aging Analyses (TLAAs) associated with limit switches in the EQ Program at Turkey Point. The limit switches have a qualified life of less than 40 years based on thermal aging.

The wear cycle for a connector is a mate-demate cycle and the EQ consideration is the effect on the sealing surfaces of the connector. The seal on a Patel/EGS Grayboot connector is created between the outside rubber surface of the plug and the inside rubber surface of the receptacle making inspection of the receptacle sealing surface difficult. Thus, cycling as part of qualification testing is relied upon to demonstrate wear resistance. The Patel/EGS Grayboot electrical connectors that would be cycled most frequently in EQ applications at Turkey Point are the ones associated with normally energized ASCO solenoid valves that are replaced every third refueling cycle. Since Grayboot electrical connectors were not used at Turkey Point until late 1991, this would result in an expected cycling frequency of 10 cycles through the end of the extended period of operation. In the EQ testing done by EGS, the connectors were cycled at least 140 times prior to being subjected to postulated Design Basis Accident test conditions. Therefore, the cycling is bounding for the expected license renewal period at Turkey Point. It should also be noted that half of the connector would be replaced each time the solenoids are replaced. Therefore, wear cycle aging on the Grayboot connectors is considered insignificant.

The only other connectors in the EQ Program at Turkey Point are those associated with the heated-junction and core exit thermocouples. Two different connector designs are used and cycling as part of qualification testing ranged from 5 to 50 mate-demate cycles depending on whether they would be taken apart only for trouble-shooting or for disassembly of the reactor each refueling outage. However, unlike the Grayboot connectors, these connectors have grafoil gaskets, which are easily inspected for flaws each mate-demate cycle, or copper crush rings that are replaced every mate-demate cycle. Thus, seal qualification is based on inspection or seal ring replacement rather than the mate-demate cycles and wear cycle aging is considered insignificant.

There are no other TLAAs for EQ equipment that consider wear cycling aging effect, therefore this aging effect is only significant for ASCO solenoid valves as described in the LRA Subsection 4.4.1 (page 4.4-3).

RAI 4.4.1-2:
The LRA does not address whether there have been any major plant modifications or events at Turkey Point, Units 3 and 4 of sufficient duration to have changed the temperature and radiation values that were used in the underlying assumptions in the EQ calculations, and whether the conservatism in the EQ equipment qualification analyses are sufficient to absorb environmental changes occurring due to plant modification and events. Also, the LRA does not address the controls used to monitor changes in plant environmental conditions to periodically validate the environmental data used in analyses.

Please provide additional information on the following:

a) whether there have been any major plant modifications or events at Turkey Point of sufficient duration to have changed the temperature and radiation values that were used in the underlying assumptions in the EQ calculations,

b) whether the conservatism in the EQ equipment qualification analyses are sufficient to absorb environmental changes occurring due to plant modification and events, and

c) the specific controls used to monitor changes in plant environmental conditions to periodically validate the environmental data used in analyses.

FPL RESPONSE:
a) There have not been any major plant modifications or events at Turkey Point of sufficient duration to change the temperature and radiation values that were used in the underlying assumptions in the EQ calculations due to the conservative profile of the temperature and radiation values used. In 1992, FPL chose to increase the EQ temperature profile for conservatism to provide the maximum design margin between the actual calculated profile and the EQ profile. The EQ equipment in Containment was shown to meet the new profile.

For radiation values, the postulated normal operating dose rates are based on the assumption of 1% failed fuel which is ten times the amount of fuel leakage than has ever been recorded at Turkey Point. The postulated accident doses are based on the conservative assumptions and methodologies in NUREG-0578, TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations, NUREG-0737, Clarification of TMI Action Plant Requirements, and NUREG-0588, Interim Staff Position on Environmental Qualification of Safety Related Electrical Equipment.

b) LRA Section 4.4 (page 4.4-2), states that the Turkey Point EQ Program includes three main elements. The third element includes preventive maintenance processes (for replacing parts and components at specified intervals), design control processes (ensuring changes to the plant are evaluated for impact to the EQ Program), procurement processes (ensuring new and replacement components are purchased to applicable environmental qualification requirements), and corrective action processes in accordance with the FPL Quality Assurance Program. As part of the design control aspect of the EQ Program, any plant modification that could affect the qualification of a component in the program is addressed and resolved in the modification package. Similarly for events, the effect on the qualification is addressed and resolved by the corrective action process. These controls assure any environmental changes occurring due to plant modifications and events are properly dispositioned for the remainder of the current license and throughout the renewal period.

LRA Subsection 4.4.1 (page 4.4-3) also identifies the equipment that had enough conservatism in the EQ equipment qualification analyses to absorb the environmental changes that occur due to the decision to apply for a renewed license. However, as indicated in the LRA Section 4.4 (page 4.4-2), 10 CFR 50.49 requires EQ components to be refurbished, replaced, or have their qualification extended, prior to reaching their aging limits established in the Turkey Point EQ Program aging evaluations. Therefore, although the preferred method is to demonstrate that there is enough conservatism in the EQ analyses to absorb environmental changes occurring due to plant modifications and events, there are other options available (e.g., replacement). As described in LRA Appendix B, Subsection 3.2.6 (page B-52), the EQ program will be maintained through the extended period of operation.

c) LRA Subsection 4.4.1 (page 4.4-3), states that the temperature and radiation values used for service conditions in the EQ analyses are the maximum design operating values for Turkey Point. With regard to radiation, equipment qualification is based on area radiation dose rate values for continuous operation with 1% failed fuel. This is conservative because Turkey Point has never operated with more than 0.1% fuel clad leaks, and has had a number of fuel cycles with no fuel clad leaks. The maximum, continuous containment temperature of 120ºF is a Technical Specification limit. Containment temperature is continuously monitored by three temperature monitors at the 58 foot elevation of containment. Adverse changes to the containment temperature would be detected by plant personnel and corrected under FPL's Corrective Action program. Since the qualified life calculations take into account increases in temperature due to self-heating and are done at a continuous temperature 2ºF higher than the maximum continuous temperature allowed by the Technical Specifications, these temperature monitors ensure that the qualified life of EQ equipment inside containment will not be exceeded.

For the balance of the plant, operator walkdowns as part of their rounds, Health Physics radiation monitoring, and maintenance and system engineering personnel provide feedback to engineering through FPL's Corrective Action program when changes to the plant environment or EQ equipment are encountered. Since maximum design temperatures were used as normal continuous temperatures in the Arrhenius aging calculations, changes to temperature, which would affect the qualified life of the equipment, will be significant enough to be readily identified. The same is true for the normal 40-year radiation doses. The total integrated radiation doses for EQ equipment are primarily due to doses following a postulated design basis accident. Therefore, changes to normal operating dose rates that would affect the qualification of EQ equipment would have to be so significant that they would be readily identified. An example of this was the inside containment radiation dose. After multiplying the 40-year normal dose by 1.5 to obtain the 60-year normal dose and adding it to the design basis accident dose, the original 40-year, rounded off, total integrated dose was not exceeded.

RAI 4.4.1-3:
In Section 4.4.1 of the LRA, the applicant stated that for conservatism, a temperature rise of 10ºC was added to maximum operating temperature for continuous duty power cables to account for ohmic heating. Provide basis for a temperature rise of 10ºC.

FPL RESPONSE:
As indicated in the summary of the October 31, 2000 meeting between the NRC and FPL to discuss TLAAs related to EQ equipment, there are no continuously energized power cables in the EQ Program at Turkey Point. However, the 10°C rise is applied to all power cables continuously for the 60-year life to account for the affects of ohmic heating.

The 10ºC rise is conservative based on the maximum cable temperature rise of 3.2ºC for the 4160 VAC EQ motors (Safety Injection and Residual Heat Removal pumps). Additional screenings of cable temperature rise for the 480 VAC EQ motors inside and outside containment (Emergency Containment Filters, Emergency Containment Coolers, and Containment Spray pumps) were performed. For the Emergency Containment Cooler and Filter Motor cable inside containment, the temperature rises are 13.31ºC and 9.72ºC respectively over the 50ºC ambient. For the Emergency Containment Cooler, Filter, and Containment Spray Pump Motor cable outside containment, the temperature rises are 22.89ºC, 9.39ºC and 18.63ºC respectively over a 40ºC ambient. Although the actual temperature rises are greater than the 10ºC continuous temperature rise assumption, when actual operating times of the Emergency Containment Cooler and Containment Spray Pump Motors are considered (0.25 and 0.3 years respectively over a 60 year period), the 10ºC continuous temperature rise assumption is over three times as harsh for both inside and outside containment. Therefore, the 10ºC rise applied continuously for 60 years is a conservative value to use for ohmic heating.

APPENDIX B, SUBSECTION 3.2.6 ENVIRONMENTAL QUALIFICATION PROGRAM

RAI APPENDIX B-3.2.6-1:
In Section 3.2.6 of Appendix B, under Operating Experience and Demonstration, the applicant stated that the program provides assurance that the environments to which installed devices are exposed will not exceed the qualified lives associated with the devices. This is accomplished through effective monitoring of key parameters (temperature, radiation) at established frequencies with well-defined acceptance criteria.

Please provide a summary description of how the key parameters (temperature and radiation) were monitored, including the instrumentation and procedures used to obtain the temperature and radiation data, measurement locations, the frequency of the measurements and the plant status during measurements. In the discussion, please address the measures taken to ensure that the temperature and radiation data obtained are representative of the service environment in which the equipment being evaluated are installed.

FPL RESPONSE:
Section 4.4 (pages 4.4-1 and 4.4-2), states that the EQ Program established a qualified life for the equipment within the scope as defined by 10 CFR 50.49. Once the equipment reaches the end of its qualified life the only acceptable corrective actions are replacement, refurbishment, or requalification. The Turkey Point EQ Program and the procedures and administrative controls related to the Turkey Point EQ Program are implemented in accordance with the requirements of Appendix B to 10 CFR 50 and will continue to be adequate for the period of extended operation. Replacement and refurbishment of EQ components is a part of the EQ Program and its procedures.

The EQ Program relies on specific equipment configurations, operational limitations, and bounding environmental limits. This program requires specific preventive or corrective actions to address the effects of aging (e.g., periodic part replacement) and restoration of configurations and conditions. This program also requires appropriate verification of these actions (e.g., documented completion of required maintenance activities). The documentation required by the EQ Program, including the TLAAs, for each qualified component is maintained in an auditable form in accordance with the FPL Quality Assurance Program.

Turkey Point maintenance and administrative procedures provide specific directions to maintenance personnel on what to replace, when the equipment needs replacing, how to replace such equipment and what post maintenance testing needs to be performed to demonstrate that the item has been replaced correctly. Such procedures also provide the forms required to document that the required maintenance actions have been completed.

SECTION 3.7 ELECTRICAL AND INSTRUMENTATION AND CONTROLS

RAI 3.7.1-1:
In Sections 3.7.1.1.3, 3.7.1.1.4, and 3.7.1.1.5 of the LRA evaluate the aging effects applicable for electrical components that can be expected to occur due to: (1) moisture-produced water trees, (2) radiation, and (3) heat, depending on environmental conditions. Further, the LRA states that water trees occur when the insulating materials are exposed to long term continuous electrical stress and moisture. These trees eventually result in breakdown of the dielectric materials and ultimate failure. However, the LRA concludes that because Turkey Point uses lead sheath cable to prevent effects of moisture on the cables, there are no requirement for aging management program for medium voltage cable and connections. The LRA also concludes that because the maximum operating doses to insulation material will not exceed the moderate damage dose and because the maximum operating temperature of insulation material will not exceed the maximum temperature for 60-year life, no aging management are required for heat or radiation effects.

Most electrical cables in nuclear power plant are located in dry environments. However, some cables may be exposed to condensation and wetting in inaccessible locations, such as conduits, cables trenches, cable troughs, duct banks, underground vaults or direct buried installations. When energized cable not specifically designed for submergence is exposed to these conditions, water treeing or a decrease in dielectric strength of the conductor insulation can occur. This can potentially lead to electrical failure. The radiation levels most equipment experience during normal service have little degrading effect on most insulation materials. Design-basis calculations or evaluation determine or bound the expected radiation doses for all plant areas. These evaluations usually account for additional doses seen in these areas during to infrequent operations. However, some localized areas may experience higher than expected radiation condition. Typical areas prone to elevated radiation levels include areas near primary reactor-coolant system piping or the reactor-pressure vessel, areas near waste processing systems and equipment, and areas subject to radiation streaming. The most common adverse localized equipment environments are those created by elevated temperature. Elevated temperature can cause equipment to age prematurely, particularly equipment containing organic materials and lubricants. The effects of elevated temperature can be quite dramatic.

Therefore, for non-EQ cables, connections (connectors, splices, and terminal blocks), and electrical/I&C penetration insulation within the scope of license renewal located in the turbine building, intake structure, main steam and feedwater platforms, yard structures, containment, the diesel generator building, and the auxiliary building, provide a description of the following:

- An aging management program for accessible and inaccessible electrical cables, connections, and electrical/I&C penetration insulation exposed to an adverse localized environmental caused by heat or radiation.

- An aging management program for accessible and inaccessible electrical cables used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance exposed to an adverse localized environment caused by heat or radiation.

- An aging management program for accessible and inaccessible medium-voltage (2kV to 15kV) cables (e.g., installed in conduit or directly buried) exposed to an adverse localized environmental caused by moisture-produced water trees and voltage stress.

FPL RESPONSE:

BULLET POINTS 1 & 2
As indicated in LRA Subsection 3.7.2.2 (page 3.7-8), FPL performed an extensive review of Turkey Point Plant operating experience associated with cables, connections (connectors, splices, and terminal blocks), and electrical/I&C penetrations, in part to determine the existence of adverse localized environments. This review did not identify any adverse localized environments caused by heat or radiation that might be detrimental to cables, connections, and penetrations. Occurrences of degraded cable are identified and dispositioned routinely through the Corrective Actions and maintenance programs.

In addition, FPL license renewal personnel performed walkdowns of accessible non-EQ cables, connections, and penetrations within the scope of license renewal and found no adverse localized environments caused by heat or radiation.

Also, the subject Turkey Point areas are not likely to have adverse localized environments, because of the following:

1. The only buildings with any appreciable radiation levels are the Containments and the Auxiliary Building.

2. The Intake Structure, Main Steam and Feedwater Platforms, and Yard Structures are outdoor areas where cable, connections, and penetrations are not subject to adverse localized temperature and radiation effects.

3. The Turbine Building is essentially an outdoor area with no external walls or roof.

As stated in Subsections 3.7.1.1.4 and 3.7.1.1.5 (page 3.7-5) and summarized in Tables 3.7-3 (page 3.7-13) and 3.7-4 (page 3.7.14) of the Turkey Point LRA, the evaluation of non-EQ cables, connections, and penetrations determined that each cable/ connection/penetration type was capable of performing its function for the entire plant life, including the renewal term. The evaluation was based on the assumption that non-EQ cables, connections, and penetrations were subjected to continuous maximum design plant temperature and radiation levels. These temperature and radiation levels have been compared to the temperature and radiation levels each cable/connection/ penetration type is capable of withstanding for a 60-year life. All in scope cable/connection/penetration types are capable of withstanding the design temperature and radiation levels to which they will be exposed in the plant for the full 60-year period.

Using design values for temperature and radiation for a 60-year life is very conservative.

Inside containment, as indicated in the response to RAI 4.4.1-2 c), the containment temperature is monitored continuously by three temperature monitors at the 58 foot elevation of the containment to meet Technical Specification 3/4.6.1.5 (120ºF). These values are recorded under all plant conditions in the control room. To ensure that the temperatures are bounding for the service environment, the monitors are located at the highest level of in scope license renewal electrical equipment inside containment. Note that all cable, connection, and penetration insulation materials that are located within the Containment Buildings are the same as cable, connection, and penetration insulation materials already included in the EQ Program at Turkey Point.

As indicated in the response to RAI 4.4.1-2 c), operator walkdowns as part of their rounds, Health Physics radiation monitoring, and maintenance and system engineering personnel provide feedback to engineering through FPL's Corrective Action program when changes to the plant environment are encountered. Any change in temperature that could adversely affect non-EQ cables, connections, and penetrations would readily be noticed. The same situation would apply for radiation. The normal 40-year radiation doses are based on the assumption of operation with 1%

failed fuel. In actuality, Turkey Point has never operated with more than 0.1% fuel clad leaks, and has had a number of fuel cycles with no fuel clad leaks. Therefore, changes to the normal operation dose that would affect the life of equipment would have to be so significant that they would be readily identified. Turkey Point plant procedures govern the frequency of surveillances, radiation surveys, and plant walkdowns. The frequencies range from shiftly to annual surveys, and these activities are performed during all modes of plant operation.

In addition, the 60-year life maximum temperature and radiation values for non-EQ cables, connections, and penetration insulation materials are also conservative. The typical "endpoint" for cable thermal aging data is 40% to 60% retention-of-elongation. Research funded by the NRC and published in NUREG/CR-6384, Literature Review of Environmental Qualification of Safety-Related Electric Cables, determined that the retention-of-elongation of most cable insulation materials can be reduced to 0% and the insulation will still be capable of withstanding a loss-of-coolant accident (LOCA) and remain functional. As the insulated cables, connections, and penetrations subject to an AMR will either not be subjected to an accident environment or are not required to function after being subjected to an accident environment, the endpoints chosen for this review are extremely conservative. The insulated cable, connection, and penetration materials could be aged a great deal more, possibly to the point where retention-of-elongation reaches 0%, without loss of intended function.

Preliminary results of the environmental qualification research on low-voltage electrical cables were presented by Brookhaven National Laboratories at an NRC public meeting on March 19, 1999. As added indication that there is margin in the thermal aging, preliminary conclusions from LOCA tests 1, 2, and 3 of the NRC research program indicate that, "Electric cables with insulation EAB (elongation-at-break) values as low as 5% performed acceptably under accident conditions."

Therefore, the useable 60-year life temperature for a typical cable insulation is significantly higher than the values shown in Table 3.7-4 (page 3.7-14) of the Turkey Point LRA.

Table 3.7-3 (page 3.7-13) of the Turkey Point LRA shows that the radiation values that non-EQ cable, connection, and penetration insulation material can withstand is much greater than the actual design value for 60-year life of the plant.

Turkey Point operating experience and inspections are consistent with the observations made in the preceding paragraphs. Based on the absence of adverse localized environment caused by heat or radiation in areas where, non-EQ cables, connections, and penetrations are present, inspection of these non-EQ cables, connections, and penetrations would be of little value, since temperature and radiation levels are not high enough to be of concern. Based on the factors presented above, FPL concludes that no aging management program is required for non-EQ cables, connections, and penetrations.

BULLET POINT 3

Subsection 3.7.1.1.3 (page 3.7-4)of the Turkey Point LRA states that the Turkey Point medium voltage applications (4.16kV) uses lead sheath cable, with a jacket over the lead, to prevent effects of moisture on the cables. The Turkey Point medium voltage cable is designed with a thick layer of lead over the cable insulation with an overall jacket over the lead and insulation. This differs from the typical medium voltage cable design of insulation with an overall jacket. FPL uses lead sheath cables as a standard for medium voltage applications because of its good characteristics in moisture environments.

FPL performed an extensive review of Turkey Point plant operating experience and found no adverse localized environment caused by moisture produced water trees and voltage stress that might be detrimental to medium voltage cables.

The effects of moisture-produced water treeing on medium-voltage cable were examined in Section 4.1.2.5 of the DOE Cable AMG. Water trees occur when the insulating materials are exposed to long-term, continuous electrical stress and moisture; these trees eventually result in breakdown of the dielectric and ultimate failure. The growth and propagation of water trees is somewhat unpredictable and few occurrences have been noted for cables operated below 15kV. Water treeing is a degradation and long-term failure phenomenon that is documented for medium-voltage electrical cable with XLPE or high molecular weight polyethylene (HMWPE) insulation. In addition, Section 4.1.2.5 of the DOE Cable AMG states: "Jackets and semiconductor shields may substantially reduce the ingress of moisture and ion migration, thereby, reducing the rate of tree formation and propagation".

Industry experience shows no failures of the medium voltage lead sheath cable under various environments including moisture. Turkey Point does not use XLPE or HMWPE insulated cables in medium-voltage applications (4.16kV). Therefore, aging effects related to cable exposed to moisture-produced water trees and voltage stress are not applicable for Turkey Point insulated cables.